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Working to protect and restore Western Watersheds and Wildlife

Western Watersheds Project

February 1, 2024

Regional Forester
U.S. Forest Service,
1220 SW 3rd Avenue
Portland, OR 97204

Re: NWFP Amendment | Beavers

Submitted via web portal: https://cara.fs2c.usda.gov/Public/CommentInput?Project=64745

Dear Region 6,

Please accept these timely filed scoping comments for the Northwest Forest Plan Amendment on behalf of Western Watersheds Project (WWP), … The comment deadline was extended to February 2nd from the original deadline of January 29th. WWP already submitted general comments on the amendment process. The purpose of these additional comments is to specifically focus on beavers.

The positive impact of beavers to both human communities and natural ecosystems is well-documented in the scientific literature. The science surrounding beaver-benefits is well established. The focus must now shift to protecting and expanding beavers on the landscape. The only component of beaver mortality that we can directly control is the regulation of hunting and trapping.

Through this plan amendment, the Forest Service should develop and adopt an alternative that closes all national forests to the hunting and trapping of beaver with the following exceptions:

1. **Native American Sovereignty:** Members of a federally recognized Indian nation, tribe or pueblo. They maintain their right to hunt or trap beavers within their traditional territories, ceded or unceded, as

designated by Treaty, past Executive Orders, Federal judicial rulings, or other federal administrative rules.

2. **Bona Fide Scientific Research:** "*Bona fide scientific research*" conducted by employees or contractors of the state wildlife department or authorized by a scientific collection permit from the department;

"*Bona fide scientific research*" is defined here as a research project that is not being conducted for commercial gain from the sale of animal parts and that is conducted by employees or contractors of the state wildlife department or authorized by a scientific collection permit from the state wildlife department.

3. **Relocation Trapping for Ecosystem Management**:** Relocation trapping conducted by employees or contractors of the state wildlife department or authorized trained individuals, with the proper permits from the state wildlife department and land management agencies, for the purposes of increasing the long-term sustainability and integrity of an entire system of living fish and wildlife and their environments that are dependent on wetlands and healthy stream and riparian ecosystems.

"Relocation Trapping for Ecosystem management" is defined here as using traps which capture or subdue without killing or injuring a beaver and then relocating the live beaver to suitable locations**.** Relocation is to take place in those areas and at those times where there is the greatest likelihood for the beavers to successfully re-establish themselves. This includes selecting areas with sufficient food resources and building material and water availability, moving complete family units, moving beavers at appropriate times to allow for winter preparations, and other features that are determined by the best available science to improve relocation success. Relocation success is to be monitored and results reported.

**** NOTE: Relocation trapping has limited success. It should be used sparingly. An excellent discussion of the challenges with relocation and its success rates can be found here.**

Key Documents

The following key documents/studies have been submitted along with these comments and we incorporate them for your reference in the Appendix:

1. Letter to President Biden Requesting Protection of Beaver on Federally Managed Public Lands

   This document is a letter to President Biden from the Western Watersheds Project, signed by 250 organizations and scientists, urging the issuance of an Executive Order to protect beavers on public lands in the United States. This measure is proposed as a response to climate change and biodiversity loss. The letter emphasizes beavers' role in creating wetlands, which are effective carbon sinks and provide various ecological benefits. It outlines the environmental, economic, and societal advantages of beaver-driven ecosystem restoration and criticizes state wildlife

agencies for failing to protect beavers, thereby hindering ecological and climate resilience efforts. The letter seeks decisive action to leverage nature-based solutions for environmental challenges.

2. Rewilding the American West

This paper proposes a strategy for ecological restoration, particularly focusing on the rewilding of gray wolves and North American beavers on federal lands in the American West. It aligns with President Biden's "America the Beautiful" plan, which targets conserving 30% of US land and water by 2030. The rewilding efforts emphasize restoring key native species to foster ecological processes, benefit biodiversity, and counteract the adverse effects of livestock grazing and other resource extraction activities. The plan recommends creating a network of large reserves for habitat connectivity and protection of threatened species, retiring livestock grazing allotments within these reserves, and managing potential conflicts that may arise due to the presence of wolves and beavers. The paper advocates for this approach as a means to enhance ecosystem services, promote climate resilience, and conserve the natural heritage for future generations.

3. Beaver - Nature’s Ecosystem Engineers

This paper reviews the extensive role beavers play in water management and ecosystem engineering, with an emphasis on their profound impact on hydrology, geomorphology, ecology, and society. It discusses how beavers alter ecosystem structure, contribute to water resource management, improve water quality, and enhance freshwater ecology. The review also examines the historical context of beavers in European landscapes, their population recovery, and the need for a deeper understanding of their role in modern, human-shaped environments. The paper concludes by considering the future of expanding beaver populations and the necessary management of ecosystem services to maximize benefits and minimize conflicts.

4. BEAVER TRAPPING CLOSURES PUBLISHED STUDIES AND STUDY RESULTS

The study by Suzanne Fouty, Ph.D., analyzes the impact of beaver activity on habitats after trapping closures. The research spans from 1942 to 2018 across various U.S. states and England. It found that beaver dams and active colonies increased in closed areas, improving riparian and water-related habitats. These changes brought about cooler stream temperatures, better water quality, and more complex, diverse habitats. The study provides important insights into beaver management and the ecological benefits of trapping restrictions.

5. Restoring Beavers to Enhance Ecological Integrity in National Forest Planning

This paper discusses the importance of beaver restoration in achieving ecological integrity in National Forests. It highlights the beaver's role as an ecosystem engineer and how their activity can improve riparian areas and water systems, contributing to biodiversity and climate change mitigation. The paper addresses how beaver restoration aligns with federal policies such as the

2012 Planning Rule and recommends integrating beaver habitat restoration into forest planning to enhance water quality, supply, and ecosystem health.

6. The Importance of Beaver Ponds to Coho Salmon Production in the Stillaguamish River Basin, Washington, USA

The document by Pollock et al. (2004) outlines the significant influence of beaver ponds on the survival and growth of juvenile coho salmon in the Stillaguamish River Basin in Washington, USA. It points out a critical decline in the habitat's capacity to produce coho salmon smolts due to the reduction of beaver ponds, suggesting that historic levels of smolt production were higher when beaver ponds were abundant. The study underscores the benefits of habitat restoration, particularly through reestablishing beaver populations to recreate ponds and slow-water habitats, which could substantially enhance coho salmon numbers. It also implies that conservation and recovery plans for coho salmon should integrate beaver habitat restoration as a key component for effective watershed management.

7. FISH AND WILDLIFE MANAGEMENT ON FEDERAL LANDS: DEBUNKING STATE SUPREMACY

Nie et al., examines the complex interplay between federal and state authority over wildlife management on federal lands. It challenges the notion that states have supreme authority over wildlife, emphasizing the federal government's significant role and obligation in conservation efforts. The paper argues against the common misconception that only states manage wildlife, highlighting how federal laws, policies, and constitutional powers also play a crucial role. It stresses the importance of intergovernmental cooperation and criticizes the counterproductive conflicts arising from misunderstandings of jurisdictional boundaries. Furthermore, it calls for a more integrated approach to wildlife management that respects both federal mandates and the conservation responsibilities states hold.

8. 303(d) List Map for Oregon/Washington
9. A Thermal Map for all Oregon Streams
10. Surface Water Supplies that Originate on USFS Lands

The document provides an analysis of the percentage of the total mean annual surface water supply from 2001 to 2015 that originated on National Forest System lands by sub-watershed. It highlights how surface water supply at the outlet of each sub-watershed, including flow from upstream sub-watersheds and accounting for inter-basin transfers, is significantly contributed by National Forest System lands. Additionally, it discusses the role of these lands in providing public surface drinking water, indicating the percentage of water from forested lands and how it serves the population, emphasizing the critical contribution of USFS and other forested lands to the United States' public water supplies. For purposes of these comments; beavers play a critical role in water filtration and storage on National Forest lands where they are present. Where they are absent, these eco-services are not being realized.

11. Smokey the Beaver: beaver-dammed riparian corridors stay green during wildfire throughout the western United States

This study reveals that beaver-dammed areas maintain significantly higher vegetation greenness during wildfires compared to undammed areas. This increased resistance to wildfire in beaver-dammed regions is attributed to the water storage and distribution capabilities of beaver dams, which keep adjacent vegetation more hydrated and less susceptible to fire.

National Forest Management Act (NFMA) & 2012 Planning Rule

Enacted in 1976, the National Forest Management Act (NFMA) serves as the principal statute for the administration and management of national forest lands. This act mandates the creation of forest plans, stipulating that the Forest Service must follow the core planning principles outlined in the law during the development or revision of these plans, as specified in 16 U.S.C. § 1604(a). The NFMA directs the Forest Service to adopt a "systematic interdisciplinary approach" that integrates various scientific disciplines—including physical, biological, and economic sciences—in the formulation of forest plans, as stated in 16 U.S.C. § 1604(b). Furthermore, the act emphasizes public engagement in the development, review, and revision of land management plans, as required by 16 U.S.C. § 1604(d)(1). It also obligates the Forest Service to update these plans at minimum every fifteen years, according to 16 U.S.C. § 1604(f)(5).

The NFMA includes a consistency provision, found in 16 U.S.C. § 1604(i), which ensures that all actions and projects in a forest align with the respective forest's plan. This highlights the significance of having clear and substantial plan language, particularly concerning climate change in forest restoration. The Forest Service enforces these requirements through administrative regulations, with the most current being the 2012 Planning Rule, codified at 36 CFR Part 2

The implementation guidelines for the National Forest Management Act's (NFMA) planning requirements were initially established in 1982 and subsequently revised in 2012. This revision, known as the 2012 Planning Rule, is outlined in 36 CFR Part 219 and represents the current regulatory framework for NFMA's planning directives. The 2012 update was notably influenced by growing concerns about climate change, aiming to enable the Forest Service to adapt to environmental shifts, including those related to climate change (36 CFR § 219.5(a)). The regulations include several provisions that facilitate the integration of climate change considerations into forest restoration efforts. Key aspects of these regulations include:

- The regulation's introduction, which prioritizes the restoration of natural resources to enhance resilience to climate change, safeguard water resources, and bolster forest health (77 FR 21162, 21164).
- A purpose statement outlining that plans should lead to ecologically sustainable management of National Forest System lands, contributing to both social and economic sustainability, and supporting ecosystems with diverse flora and fauna (36 CFR § 219.1(c)).
- A requirement for planners to utilize the best available scientific information in the planning process (36 CFR § 219.3).

- Assessments that evaluate information relevant to ecological drivers and stressors, including climate change, as well as the capacity of ecosystems to adapt to these changes (36 CFR § 219.6(b)).
- Mandates focusing on the sustainability of ecosystems and species diversity (36 CFR § 219.8 & 219.9).

In this context, and given what we know about beavers, beaver protections and restoration must be a core focus of the Forest Service's strategy to meet its regulatory objectives of maintaining ecological integrity and enhancing climate change resilience. The 2012 Planning Rule, by emphasizing ecological integrity and the importance of riparian areas, highlights the role of beavers as a keystone species in improving ecosystem function and health.

Additionally, other statutes, regulations, and executive orders supplement and elaborate on the NFMA and the 2012 Planning Rule. These include the Forest Service Manual, Chapter 1920 (FSM 1920), and the Forest Service Handbook, Section 1909.12 (FSH 1909.12). Nonetheless, the provisions in the NFMA and the 2012 Planning Rule are generally sufficient to support arguments in favor of beaver restoration and protection from human hunting/trapping.

Beavers as Ecosystem Engineers

Beavers are recognized as ecosystem engineers due to their ability to transform landscapes through their dam-building activities. Their dams create wetlands, which serve as habitats for a variety of species, increase biodiversity, and improve water quality (Brazier et al., 2021[1]). These wetlands also act as carbon sinks, playing a crucial role in mitigating climate change (Kivinen et al., 2020[2]). Additionally, the presence of beavers has been linked to enhanced insect biodiversity, indicating their significant impact on ecosystem complexity (Andersen et al., 2023[3]).

Beaver activities can lead to changes in hydrological dynamics, which affect sediment transport and nutrient cycling. This can result in the creation of new habitats and changes in species composition, as observed in their impact on riverine aquatic macroinvertebrates (Washko et al., 2022[4]). The landscape alterations by beavers also results in more mammalian usage of riparian habitat, demonstrating their influence across trophic levels (Gauvin et al., 2020[5]). Moreover, beavers can influence environmental heterogeneity, creating a mosaic of habitats that support diverse plant and animal communities (Kivinen et al., 2020).

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[1] Brazier, R. E., Puttock, A., Graham, H. A., Auster, R. E., Davies, K. H., & Brown, C. M. L. (2021). Beaver: Nature's ecosystem engineers. *Wiley Interdisciplinary Reviews: Water, 10*(1), 1494. Link

[2] Kivinen, S., Nummi, P., & Kumpula, T. (2020). Beaver-induced spatiotemporal patch dynamics affect landscape-level environmental heterogeneity. *Environmental Research Letters, 15*(6), 9924. Link

[3] Andersen, L. H., Ransborg, C., Pertoldi, C., Pagh, S., & Bahrndorff, S. (2023). Can reintroduction of beavers improve insect biodiversity? *Social Science Research Network. Link

[4] Washko, S. E., Willby, N., & Law, A. (2022). How beavers affect riverine aquatic macroinvertebrates: a review. *PeerJ, 10*, 13180. Link

[5] Gauvin, L. Y., Gallant, D., Tremblay, É., Berteaux, D., & Lecomte, N. (2020). Spatiotemporal changes in biodiversity by ecosystem engineers: how beavers structure the richness of large mammals. *bioRxiv*. Link

Beavers naturally contribute to environmental sustainability and ecological integrity by constructing dams in waterways, which leads to the creation and maintenance of wetlands. These activities significantly enrich local biodiversity by providing habitats for a wide range of species, from fish to birds and mammals. The slow-moving or standing water behind beaver dams aids in filtering pollutants, thus improving water quality. Moreover, these water bodies help to recharge groundwater supplies, acting as natural reservoirs that release water slowly, reducing the impact of droughts. Beaver-engineered landscapes are more resilient to climate change, buffering against extreme weather events by storing excess water during floods and releasing it during dry periods, maintaining ecological balance and supporting a diverse array of life forms.

Forest Service Focal Species

The criteria for designating a focal species within the U.S. Forest Service encompasses several key ecological and conservation-related factors; all of which pertains to the beaver. These criteria are typically centered around:

> **Area Requirements:** Species that necessitate large or specific areas for their habitat are often considered as focal species. This criterion is pivotal as it ensures that the chosen species will necessitate the conservation of extensive and diverse habitats, which, in turn, supports a broad spectrum of other species (Coppolillo, P., Gómez, H., Maisels, F., & Wallace, R. (2004)[6]
>
> **Heterogeneity:** Species thriving in a variety of habitats are indicative of the health of different ecosystem types. Selecting such species as focal species ensures the conservation of a range of habitat types.
>
> **Ecological Function:** Species that hold significant roles in their ecosystems, such as keystone species, ecosystem engineers, or indicator species, are frequently chosen as focal species. Their presence or absence can significantly impact the ecosystem (Coppolillo, P. et al., 2004). Vulnerability: Species that are vulnerable or sensitive to environmental changes, including human activities, can be focal species. Their status often reflects the overall health of the ecosystem.
>
> **Socioeconomic Significance:** Species with cultural, economic, or recreational importance are also considered. This aligns the focal species approach with human interests and fosters community support for conservation (Coppolillo, P. et al., 2004).

These criteria collectively ensure that the selected focal species represent a broad spectrum of ecological functions, habitat requirements, and conservation challenges. This approach is designed to create a protective umbrella for a wider array of species and functional landscapes, contributing to the overarching aim of sustaining biodiversity and ecosystem health.

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[6] Coppolillo, P., Gómez, H., Maisels, F., & Wallace, R. (2004). Selection criteria for suites of landscape species as a basis for site-based conservation. *Biological Conservation*, 115(1-2), 419-430. https://doi.org/10.1016/S0006-3207(03)00159-9

FSH 1909.12 - Land Management Planning Handbook - Species of Conservation Concern

The Planning Rule defines species of conservation concern as follows:

> **(c) Species of conservation concern. A species of conservation concern is a species, other than federally recognized threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area.**
> (36 CFR 219.9).

Chapter 10 § 12.5 and Chapter 20 §§ 21.2, 23.1 - Included below

10.2 – Objectives

1. Identify and assess a solid base of available information relevant to the plan development or plan revision, by:

   a. Identifying available, relevant information by reviewing a range of sources and information provided by the public and other governmental entities, including potential information sources in 36 CFR 219.6(a);

   b. Assessing available information with the public and other interested parties relevant to the assessment requirements of 36 CFR 219.6(b); and

   c. Developing an understanding of the conditions and trends of the assessment topics that is useful to making decisions about plan components and other content of the plan (36 CFR 219.5(a)(1)).

2. Build an understanding of relevant information with the public and other interested parties before starting plan development or plan revision.

3. Develop relationships with interested parties to facilitate public and government participation among government entities, Indian Tribes, private landowners, and other partners and interested parties.

4. Develop readiness of both the Agency and the public to focus on topics appropriate to a plan or plan revision.

10.4 – Responsibilities

It is the responsibility of the Responsible Official to organize and manage the assessment process as follows:

1. Set the scale, scope, and timing of the assessment early in the process based on what has been learned from monitoring and implementation of projects.

2. Assign an Interdisciplinary Team Leader and Interdisciplinary Team to carry out the assessment process.

3. Identify a systematic, interdisciplinary approach, with the Team and Team Leader to complete the assessment within one year.

4. Identify, throughout the assessment process, the topics to be analyzed in depth.

5. Supervise the process so that the assessment is an analysis and synthesis of the most important relevant information.

6. Engage the public and governmental entities early to encourage participation in the gathering of information for the assessment process (36 CFR 219.4; FSH 1909.12, ch. 40).

7. Manage the assessment process so that the assessment report is promptly available to the public.

8. Ensure the report is written in plain language so that people readily understand it.

9. Ensure the report has concise findings useful to identify the need to change the plan.

10. Ensure that the assessment is within Forest Service authority, the inherent capability of the plan area, and the fiscal capability of the unit.

11. Ensure that the assessment is complete before starting the planning phase.

10.5 – Definitions

See the zero code chapter of this Handbook for definitions.

10.6 – References

1. Cleland, D.T.; Avers, P.E.; McNab, W.H.; Jensen, M.E.; Bailey, R.G., King, T.; Russell, W.E. 1997. National hierarchical framework of ecological units. In, Boyce, M.S.; Haney, A., eds. Ecosystem management applications for sustainable forest and wildlife resources. Yale University Press, New Haven, CT. pp. 181-200.

2. U.S. Department of Agriculture Forest Service. 2011a. Watershed condition classification technical guide. FS-978. Washington, DC: U.S. Department of Agriculture, Forest Service. 49 p. Available at http://www.fs.fed.us/publications/watershed/watershed_classification_guide.pdf

3. U.S. Department of Agriculture, Forest Service. 2011b. Watershed condition framework. FS-977. Washington, DC: U.S. Department of Agriculture, Forest Service. 34 p. Available at http://www.fs.fed.us/publications/watershed/Watershed_Condition_Framework.pdf

4. U.S. Department of Agriculture, Forest Service. 2012. Climate projections FAQ. Gen. Tech. Rep. RMRS-GTR-277WWW. Rocky Mountain Research Station. Fort Collins, CO. 32 p. Available online at http://www.treesearch.fs.fed.us/pubs/40614.

5. Weins, J.A., G.D. Hayward, H.D. Safford, and C.M. Giffen. 2012. Historical environmental variation in conservation and natural resource management. Wiley-Blackwell. Chichester, West Sussex, UK. 337 p.

12.5 – Identifying and Assessing At-risk Species

The Interdisciplinary Team shall identify and assess available information relevant to the plan area for threatened, endangered, proposed, and candidate species and potential species of conservation concern present in the plan area (36 CFR 219.6(b)).

Based on the information, the Interdisciplinary Team shall identify and document the set of at-risk species and assess plan area ecological conditions for these species in the assessment. The set of at-risk species for assessment purposes are:

1. Federally recognized threatened, endangered, proposed, and candidate species (sec. 12.51 of this Handbook).

2. Potential species of conservation concern (sec. 12.52 of this Handbook).

12.51 – Identifying Federally Recognized Species

As a part of the assessment and planning process, the Responsible Official shall coordinate with the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration NMFS, as appropriate, to identify federally listed threatened and endangered species, species proposed for Federal listing, and candidate species in the plan area.

12.52 – Identifying Species of Conservation Concern

The Planning Rule defines species of conservation concern as follows:

> **(c) Species of conservation concern. A species of conservation concern is a species, other than federally recognized threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area.**
> (36 CFR 219.9).

The rule requires the Responsible Official to identify potential species of conservation concern and assess existing information for them in the assessment (36 CFR 219.6 (b)(5)). Direction about potential species of conservation concern and species of conservation concern is found in two chapters of this Handbook as follows:

1. Responsibilities of Responsible Official for potential species of conservation concern during the assessment are found in section 12.52a of this Handbook.

2. Requirements for developing the list of potential species of conservation concern are found in section 12.52b of this Handbook.

3. Criteria for identifying a species of conservation concern are found in section 12.52c of this Handbook.

4. Species to consider when identifying potential species of conservation concern are found in section 12.52d of this Handbook.

5. Guidance regarding the Regional Forester's identification of the species of conservation concern is found in FSH 1909.13, chapter 20, section 21.22a.

6. Guidance on evaluating new information on species of conservation concern is found in FSH 1909.12, section 21.22b.

12.52a – Responsibilities for Species of Conservation Concern During the Assessment

The Responsible Official has the authority and responsibility to:

1. Identify potential species of conservation concern (36 CFR 219.9(c)).

2. Identify and assess information relevant to species that occur in the plan area and when the best available scientific information raises a substantial concern about a species' capability to persist over the long term in the plan area. This information serves as a filter during the assessment process to aid in the efficiency and efficacy of the process used to identify potential species of conservation concern.

3. Leverage expertise of the public, including local, State, Tribal, and other Federal natural resource agencies, for identifying species of conservation concern.

4. Engage the public and consider public input on the assessment including the identified potential species of conservation concern (see FSH 1909.12, ch. 40, sec. 42 for guidance on public participation).

FSH 1909.12, chapter 20, section 21.22a describes the responsibilities of the Regional Forester for species of conservation concern.

12.52b – Developing the List of Potential Species of Conservation Concern

Unless the Regional Forester has identified the species of conservation concern before the assessment process, during the assessment phase the Responsible Official shall:

1. Coordinate with the Regional Forester when identifying the potential species of conservation concern. This coordination may be conducted in several ways including:

a. The Regional Forester and Responsible Official may jointly identify the potential species of conservation concern for the plan area.

b. The Responsible Official may provide an initial list of potential species of conservation concern for review by the Regional Forester, who may concur or request modifications.

c. The Responsible Official and Regional Forester may review and adjust a previously developed list of potential species of conservation concern derived from plan area or multi-plan area studies or broad-scale assessments.

d. The Regional Forester may develop an initial list of potential species of conservation concern for each plan area within the Region and the Responsible Official may analyze the species on this list and any additional species, as appropriate.

2. Use the criteria in section 12.52d of this Handbook to select the species to consider, and the criteria in section 12.52c of this Handbook to identify the potential species of conservation concern.

3. Document the best available scientific information supporting the identification of a species as a potential species of conservation concern.

4. Document the best available scientific information that supports not identifying a species that was considered but not identified as a potential species of conservation concern. Such rationale may include:

a. Knowledge of the species abundance, distribution, lack of threats to persistence, trends in habitat, and responses to management, or

b. Lack of sufficient scientific information available about the species' status.

12.52c – Criteria for Identifying a Species of Conservation Concern

The criteria for identifying species of conservation concern are also the criteria for identifying potential species of conservation concern.

1. The species is native to, and known to occur in, the plan area.

A species is known to occur in a plan area if, at the time of plan development, the best available scientific information indicates that a species is established or is becoming established in the plan area. A species with an individual occurrences in a plan area that are merely "accidental" or "transient," or are well outside the species' existing range at the time of plan development, is

not established or becoming established in the plan area. If the range of a species is changing so that what is becoming its "normal" range includes the plan area, an individual occurrence should not be considered transient or accidental.

2. The best available scientific information about the species indicates substantial concern about the species' capability to persist over the long term in the plan area. See FSH 1909.12, zero code, section 07, for guidance on best available scientific information.

If there is insufficient scientific information available to conclude there is a substantial concern about a species' capability to persist in the plan area over the long-term that species cannot be identified as a species of conservation concern.

If the species is secure and its continued long-term persistence in the plan area is not at risk based on knowledge of its abundance, distribution, lack of threats to persistence, trends in habitat, or responses to management that species cannot be identified as a species of conservation concern.

12.52d – Species to Consider when Identifying Potential Species of Conservation Concern

1. When identifying potential species of conservation concern, the Responsible Official shall consider only species native to, and known to occur in, the plan area.

2. Species in the following categories must be considered:

a. Species with status ranks of G/T1 or G/T2 on the NatureServe ranking system. See exhibit 01 for description of NatureServe Conservation Status Ranks.
Note: Species with NatureServe G/T1 or G/T2 status ranks are expected to be included unless it can be demonstrated and documented that known threats for these species, such as those threats listed for the species by NatureServe, are not currently present or relevant in the plan area.

b. Species that were removed within the past 5 years from the Federal list of threatened or endangered species, and other delisted species that the regulatory agency still monitors.

12.52d - Exhibit 01

NatureServe Conservation Status Ranks

NatureServe conservation status ranks are based on a scale of one to five, ranging from critically imperiled (G1) to demonstrably secure (G5). Status is assessed and documented at three distinct geographic scales: global (G), national (N), and State/province (S). The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by a letter reflecting the appropriate geographic scale of the assessment. (*http://www.natureserve.org/explorer/ranking.htm*)

Status Rank	Status Rank Definition
1	*Species is Critically Imperiled* At very high risk of extinction or elimination due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors.
2	*Species is Imperiled* At high risk of extinction or elimination due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
3	*Species is Vulnerable* At moderate risk of extinction or elimination due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
4	*Species is Apparently Secure* At fairly low risk of extinction or elimination due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
5	*Species is Secure* At very low risk or extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats.
Infraspecific taxa refer to subspecies, varieties, and other designations below the level of the species. The status of infraspecific taxa (subspecies or varieties) are indicated by a T-rank following the species' global rank. Rules for assigning T-ranks follow the same principles outlined above. For example, the global rank of a critically imperiled subspecies of an otherwise widespread and common species would be G5T1.	

3. Species in the following categories should be considered:

   a. Species with status ranks of G/T3 or S1 or S2 on the NatureServe ranking system. See exhibit 01 for description of NatureServe Conservation Status Ranks.

   b. Species listed as threatened or endangered by relevant States, federally recognized Tribes, or Alaska Native Corporations.

   c. Species identified by Federal, State, federally recognized Tribes, or Alaska Native Corporations as a high priority for conservation.

d. Species identified as species of conservation concern in adjoining National Forest System plan areas (including plan areas across regional boundaries).

e. Species that have been petitioned for Federal listing and for which a positive "90-day finding" has been made.

f. Species for which the best available scientific information indicates there is local conservation concern about the species' capability to persist over the long-term in the plan area due to:

(1) Significant threats, caused by stressors on and off the plan area, to populations or the ecological conditions they depend upon (habitat). These threats include climate change.

(2) Declining trends in populations or habitat in the plan area.

(3) Restricted ranges (with corresponding narrow endemics, disjunct populations, or species at the edge of their range).

(4) Low population numbers or restricted ecological conditions (habitat) within the plan area.

12.53 – Evaluating Relevant Information for At-risk Species

The Interdisciplinary Team shall consider available information on the set of at-risk species to understand the ecological conditions necessary to sustain them. The assessment phase focuses on rapidly evaluating available information, not on developing new information, about ecological conditions or about individual species. The assessment report should document information gaps relevant to at-risk species that may be filled in through inventories, plan monitoring program, or research.

Information may come from a variety of sources, including Federal and State agencies, literature, local information on occurrence and population status, subbasin analyses, broad-scale assessments, and information available from local species experts and other organizations.

The Interdisciplinary Team should consider information about at risk species such as the following, when available:

1. Current taxonomy.

2. Distribution (including historical and current trends), especially species known from only a relatively few, discrete locations, and the status of those locations.

3. Abundance (including historical and current trends).

4. Demographics and population trends, including population effects resulting from hunting, fishing, trapping, and natural population fluctuations if available.

5. Diversity (phenotypic, genetic, and ecological).

6. Ecological condition (habitat) requirements at appropriate spatial scales (fine-scale, home range, geographic range).

7. Ecological condition (habitat) amount, quality, distribution, connectivity, status, and trends in the plan area.

8. Ecological function of at-risk species.

9. Important biological interactions and ecological processes, such as periodic fire, flooding, groundwater discharge, and so on.

10. Ecological conditions that are threats or limiting factors to persistence.

11. Influence and occurrence of uncharacteristic natural events like severe wildfire or insect epidemics.

12. Effects of climate change and susceptibility to stressors caused by human disturbances or activities like air and water pollution, invasive species, trails, roads, and dams.

13. Endangered Species Act information, such as reasons for listing and species status, set out in recovery plans and biological opinions, and critical habitat designations.

12.54 – Optional Grouping of Species

In some cases, it may be practical or efficient to group at-risk species for identifying and evaluating relevant information about them because they have similar ecological conditions and habitat needs. If used, groupings should be made based on the ecological conditions necessary to maintain or, in the case of federally listed threatened or endangered species, recover each group member. As a basic approach, groupings may be based on species' needs, for example, with respect to vegetation, successional stage of vegetation, stream size, valley bottom configuration, lake size, proximity, or access to groundwater, or wetland type. Such groupings should consider other key ecosystem conditions used by each species such as vegetation types, structural stages, and hydrogeomorphic factors. Grouping at-risk species in the assessment phase is strictly an analysis and evaluation tool that may be used to improve planning efficiency. When species are grouped in an assessment, the assessment must provide the rationale for doing so. The rationale must:

1. Identify the critical assumption(s) made for the grouping, or for including a species in the group, and explain why the assumption(s) is (or are) reasonable, and

2. Identify any uncertainties associated with including a species in the group and why the grouping is nonetheless reasonable.

Once groups are identified, ecological conditions for individual species in each group may be further described using attributes such as those set out in section 12.53 of this Handbook.

12.55 – Determining the Status of At-risk Species

The Interdisciplinary Team shall determine the status of at-risk species, by considering the existing plan direction, ecological conditions needed to support the species (sec. 12.53 of this Handbook), status of ecological conditions in the plan area (sec. 12.14c of this Handbook), and other relevant information. The assessment should identify influences on ecological conditions needed to support the species, key risk factors to those ecological conditions, and limiting factors both on and off the plan area.

The following is a suggested approach to determining the status of each at-risk species:

1. Describe current distribution of each at-risk species in the plan area.

2. Identify ecological conditions in the plan area necessary to meet the requirements of 36 CFR 219.9(b) for each at-risk species (sec. 12.53 of this Handbook) and at-risk species grouping (sec. 12.54 of this Handbook). These are the ecological conditions to be considered for at-risk species in the assessment.

3. Identify those ecological conditions assessed by the assessment of key ecosystem characteristics. Refer to sections 12.1 and 12.2 of this Handbook for their evaluation.

4. Identify ecological conditions in the plan area necessary to meet the requirements of 36 CFR 219.9(b) for each at-risk species that were not addressed by the assessment of key ecosystem characteristics as follows:

   a. Describe the current and likely future status of the ecological conditions necessary to meet the requirements of 36 CFR 219.9(b) for each at-risk species, assuming management continues under the current plan.

   b. Compare the species' current and likely future status described in paragraph 4a for each at-risk species to the ecological conditions of the natural range of variation, or an alternative ecological reference model (sec. 12.14b of this Handbook).

   c. Assess human-related stressors (for example, roads, human disturbance and displacement, dams) and whether they can be managed under Forest Service authorities.

   d. Identify other threats or limiting factors (for example, naturally small and isolated populations, climate change) and whether they can be managed under Forest Service authority.

5. Describe the current and projected overall status of the ecological conditions necessary to meet the requirements of 36 CFR 219.9(b) for at-risk species considering the combined ecological conditions addressed through the assessment of key ecosystem characteristics and, if needed, for specific at-risk species or groupings.

6. For those ecological conditions not currently meeting or expected to meet the requirements of 36 CFR 219.9(b) for at-risk species, describe the potential outcome of the at-risk species status

and identify the key risk factors, taking into account factors such as time (for example, short-term, long-term, planning period, generations of species), affected life history requirement (for example, loss of part of foraging habitat, loss of all spawning habitat), or affected population dynamic (for example, loss of recolonization routes).

7. Identify those key risk factors influencing the ecological conditions not expected to meet the requirements of 36 CFR 219.9(b) for at-risk species that are or can be influenced by Forest Service management of the plan area.

8. Describe any differences in likely future status of groups of individuals in the plan area that are known to be or highly suspected to be reproductively isolated and separate from the rest of the individuals of at-risk species.

9. Summarize the overall status of each at-risk species or species group (sec. 12.54 of this Handbook) with explanations of which key risk factors weighed most heavily in determining status. Describe the effect of key risk factors on species in simple terms such as the level of resulting vulnerability and the trend in that vulnerability. State the conclusions of the vulnerability status process for each species in a way that is helpful in identifying the need for change and in developing plan components that provide the ecological conditions necessary to sustain the species. The Interdisciplinary Team may support conclusions using the "Issue-Rule-Analysis/Application-Conclusion" model (IRAC) as described in FSH 1909.12, chapter 20, section 21.42. Document the resulting information and status evaluation in the planning record.

This chapter describes the planning requirements of 36 CFR 219 ("2012 Planning Rule") and the procedures for developing, amending, and revising land management plans during the planning phase. FSH 1909.12, chapter 10 describes the requirements for the assessment phase for developing, amending, and revising land management plans.

20.5 – Definitions

See the Zero Code chapter of this Handbook for definitions.

20.6 – Cited References

U.S. Department of Agriculture, Forest Service. 2011a. Watershed Condition Classification Technical Guide. FS-978. Washington, DC: U.S. Department of Agriculture, Forest Service. 49 p. Available at *http://www.fs.fed.us/publications/watershed/watershed_classification_guide.pdf* .

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U.S. Department of Agriculture. Forest Service. 2012a. National Best Management Practices for Water Quality Management on National Forest System Lands. Volume 1: National Core BMP Technical Guide. FS-990a. Washington, DC: U.S. Department of Agriculture, Forest Service. 177 p. Available online at *http://www.fs.fed.us/biology/resources/pubs/watershed/index.html*.

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U.S. Department of Agriculture. Forest Service 2014. National Riparian Vegetation Monitoring Technical Guide: Conterminous United States. General Technical Report. Rocky Mountain Research Station-GTR-XXX. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. (Draft). Available at *http://www.fs.fed.us/biology/watershed/riparian/USFS_National_Riparian_Protocol.pdf*.

Weins, J.A., G.D. Hayward, H.D. Safford, and C.M. Giffen. 2012. Historical Environmental Variation in Conservation and Natural Resource Management. Wiley-Blackwell. Chichester, West Sussex, UK. 337 p.

21.2 – Information Basis for Plan Development, Plan Amendment, and Plan Revision

New plans, plan amendments, and plan revisions are based on a need to change the plan. Usually the Responsible Official begins a plan revision because it is time to do so; that is, NFMA requires plan revision "at least every 15 years." 16 USC 1604 (f)(5). In that case, how much of the content of the plan must change in the revision process is the “need to change the plan” inquiry.

Otherwise, if a need to change the plan is identified that cannot be made through administrative changes (36 CFR 219.13) or by changing management practices rather than plan components, an amendment or revision should be started, as appropriate. A well-supported and effective rationale determining a need to change the plan must be based on a good source of information. Assessments (ch. 10), along with the planning record, are an important source of information for a new plan or plan revision.

For plan amendments, an assessment is not required (see FSH 1909.12, ch. 10, sec. 15). The Responsible Official may rely on a monitoring report or other documentation of new information, changed conditions, or changed circumstances to identify a need to change the plan (36 CFR 219.13(b)).

The Responsible Official shall focus on evaluating available, relevant information. The terms “available” and “relevant” are defined in FSH 1909.12, chapter 10, section 11.

21.21 – Need to Change the Plan

The Responsible Official for plan development, plan amendment, and plan revisions shall identify a need to change the plan to give focus to the planning process. If a need to change the plan is identified that cannot be made through administrative changes (36 CFR 219.13), an amendment or revision should be started, as appropriate.

The need to change the plan helps define the proposed action, purpose and need, and decision framework for the environmental analysis related to the planning process (See FSH 1909.12, ch. 40 and FSH 1909.15, ch. 10, sec. 11.2). The Responsible Official should involve the public in the development of the need to change the plan by giving the public the opportunity to comment on a preliminary need to change before documenting the need to change the plan as part of the purpose and need in the environmental analysis documents for the plan development, plan revision, or plan amendment.

1. The need to change the plan should be written so that it is clear to the public which plan components are proposed to be changed and which are not.

2. Numerous sources of information are available to the Responsible Official to help determine a need to change the plan including:

a. Biennial evaluations of monitoring information (36 CFR 219.12(d); FSH 1909.12, ch. 30, sec. 34)

b. An assessment for plan development or plan revision (36 CFR 219.6(a) and (b); FSH 1909.12, ch. 10, secs. 12, 13 and 14)

c. A focused assessment for plan amendments, if needed (36 CFR 219.6; FSH 1909.12, ch. 10, sec. 15)

d. Other documentation of new information, changed conditions, or changed circumstances on the plan area, from any source, that supports a need for a revision, amendment or administrative change to the plan (36 CFR 219.6(c)).

e. Changes in laws, regulations, or policy.

3. When developing or revising a plan, the Responsible Official should invite public input on a preliminary need to change the plan (36 CFR 219.7(c)(2)(i)) so that:

a. Public comments are used to improve the need to change the plan.

b. The topics and concerns considered can be broadened or reduced as needed.

c. The need to change the plan may support retaining existing plan direction as plan components as well as developing new plan components as appropriate.

4. For documentation, the Responsible Official should document the need to change as part of the purpose and need in the environmental analysis documents for the plan development, plan revision, or plan amendment.

21.22 – Species of Conservation Concern

21.22a – Identifying Species of Conservation Concern

The Regional Forester is the Responsible Official for identifying any species of conservation concern in a plan area. Identifying the SCCs usually occurs during the planning phase, but may occur at any time.

1. The Regional Forester has the authority and responsibility to:

   a. Review the rationale and documentation for potential species of conservation concern provided by the Responsible Official (FSH 1909.12, ch. 10, sec. 12.52), and determining whether the best available scientific information indicates:

   (1) That the species is native and known to occur in the plan area, and

   (2) There is a substantial concern about the species' capability to persist over the long term in the plan area based on the guidance of FSH 1909.12, chapter 10, section 12.52c.

   b. Based on the review of the potential species of conservation concern, identify the species of conservation concern in coordination with the Responsible Official for the plan area. This authority to identify species of conservation concern may not be delegated.

   c. Identify species of conservation concern early enough to expedite the planning process.

   d. Leverage expertise of the public and local, State, Tribal, and other Federal natural resource agencies, for identifying species of conservation concern.

   e. Engage the public and invite public input when identifying species of conservation concern, as part of the public participation strategy (FSH 1909.12, ch. 40, sec. 42).

   f. Document the rationale for the selection of species of conservation concern.

   g. Inform the Responsible Official and the public of the identified species of conservation concern.

   h. Identify any species of conservation concern at times outside the planning process as appropriate.

2. The Responsible Official has the authority to:

   a. Leverage expertise of the public and local, State, Tribal, and other Federal natural resource agencies in determining whether plan components need to be added, removed, or

changed based on any new species of conservation concern being identified by the Regional Forester.

b. Recommend additional changes to the list of species of conservation concern to the Regional Forester, if appropriate. See section 21.22b of this Handbook for guidance on new information and species of conservation concern.

21.22b – Evaluating New Information on Species of Conservation Concern

After the Regional Forester has identified the species of conservation concern, new scientific information may indicate some species should be added or removed from the list.

If any employee receives such new scientific information before or after a new plan or plan revision is approved, the employee should send the information to the Forest Supervisor for the plan area.

1. When there is new scientific information indicating a potential change to the list of species of conservation concern, the Forest Supervisor should:

a. Evaluate the new information using the guidance of FSH 1909.12, chapter 10, section 12.52 to develop a recommendation whether to change the list of species of conservation concern.

b. Leverage expertise of the public and local, State, Tribal, and other Federal natural resource agencies.

c. Document the rationale for including or not including the species as a species of conservation concern for the plan area using the guidance of FSH 1909.12, chapter 10, section 12.52.

d. Send documentation and recommendation to the Regional Forester.

2. When the Regional Forester receives a recommendation from a Forest Supervisor to change the species of conservation concern for a plan area, the Regional Forester should:

a. Consider the recommendation using the guidance of FSH 1909.12, chapter 10, section 12.52.

b. Leverage expertise of the public, including local, State, Tribal, and other Federal natural resource agencies, for identifying species of conservation concern.

c. Document a response and rationale.

d. Notify the public and the Responsible Official of any changes to the list of species of conservation concern for the plan area.

3. If the Regional Forester identifies an additional species of conservation concern, the Forest Supervisor should:

a. Review the information relevant to the threats, stressors, and other risks to the species persistence within the plan area using the guidance of FSH 1909.12, chapter 10, section 12.

b. Evaluate whether existing plan components would provide the ecological conditions necessary to maintain the long-term persistence of the species within the planning area using the guidance of section 23.13 of this Handbook.

c. Determine if the plan must include additional species-specific plan components to maintain the species' long-term persistence.

d. Document the determination, and amend the plan accordingly, if appropriate.

4. If the Regional Forester removes a species from the list of species of conservation concern, the Forest Supervisor should review the plan and amend the plan, if appropriate (sec. 21.3 of this Handbook).

21.23 – Outreach during Development or Revision of Plans

Guidance on a public and governmental outreach strategy, including tribal consultation, and on methods for giving notice is provided in FSH 1909.12, chapter 40. The 2012 Planning Rule requirements include 36 CFR 219.4, "Requirements for Public Participation," and 36 CFR 291.16, "Public Notifications."

If the approval of a plan, or plan revision, or plan amendment may affect listed species or critical habitat, or may adversely affect essential fish habitat of managed fisheries, the Responsible Official shall follow procedures in FSM 2670 for working with the NMFS or the USFWS or both (FSM 1920.3). See FSM 2670 for requirements for consultation on land management plans.

For plan development or plan revision that may adversely affect historic properties or sites of religious or cultural importance to Indian Tribes, the Responsible Official shall follow procedures in FSM 2360 for consulting with State Historic Preservation Offices (SHPOs), Indian Tribes, and the Advisory Council for Historic Preservation (Title 16, United States Code 470 et seq.; 36 CFR 800; Executive Order 13007 – Indian Sacred Sites).

21.24 – Consultation with Federally Recognized Indian Tribes and Alaska Native Corporations

Under the Federal Land Policy and Management Act of 1976, the Responsible Official shall coordinate with planning programs of Indian Tribes and for Indian Tribes (such as those developed by the Bureau of Indian Affairs):

> In the development and revision of land use plans, the Secretary of Agriculture shall coordinate land use plans for lands in the National Forest System with the land use planning and management programs of and for Indian tribes by, among other things, considering the policies of approved tribal land resource management programs. (43 U.S.C. 1712(b)).

The Responsible Official shall engage in formal, meaningful consultation and collaboration with Tribal Officials on new plans or plan revisions as part of the Federal government-to-government relationship and Executive Order 13175, Consultation and Coordination with Indian Tribal Governments. See FSH 1509.13, chapter 10, and FSH 1909.12 and Chapter 40 – Public Participation, for guidance regarding consultation and coordination with Indian Tribes and Alaska Native Corporations. (See 36 CFR 219.4(a)(2); FSH 1909.12, ch. 40, sec. 44.3;
FSH 1509.13, ch. 10)

23.1 – Ecological Sustainability and Diversity of Plant and Animal Communities

To develop the land management plan consistent with maintaining ecological sustainability, the plan must include plan components, including standards or guidelines, designed to maintain, restore, or promote the ecological integrity of terrestrial, riparian, and aquatic ecosystems; maintain the diversity of plant and animal communities; and support the persistence of native species within the plan area, subject to the extent of Forest Service authority and the inherent capability of the plan area.

This section (sec. 23.1 of this Handbook) gives direction for developing plan components for ecological sustainability and diversity of plant and animal communities. It consists of three subsections.

The first two subsections, "Plan Components for Ecosystem Integrity and Ecosystem Diversity" (sec. 23.11-23.11d of this Handbook) and "Plan Components for Air, Soil, and Water" (sec. 23.12-23.12c of this Handbook), provide direction for design of plan components for the ecosystem and watershed level within the plan area.

The third subsection, "Additional Species-Specific Plan Components" (sec. 23.13-23.13c of this Handbook), gives direction for the design of plan components when those developed for the ecosystem and watershed level under sections 23.11 and 23.12 of this Handbook would not provide for the ecological conditions necessary to meet the requirements of 36 CFR 219.9(b).

The plan development process for ecological sustainability and diversity of plant and animal communities should primarily focus on the ecosystem and watershed level plan components, especially those that support ecological conditions for at-risk species.

When developing integrated plan components the Interdisciplinary Team should consider the following:

1. Major vegetation types and their successional stages, patch sizes, spatial arrangement, and connectivity;

2. Dominant ecological processes and disturbance regimes for the plan area;

3. Ecosystems and unique habitat types including those that are rare or at risk;

4. Stressors, such as changes in human impacts within the plan area, disruptors of a key ecosystem characteristic by catastrophic fire, effects of a changing climate, invasive species, or water obstructions;

5. Soil resources and soil productivity;

6. Geologic resources and hazards;

7. Air resources;

8. Water quality and quantity, stream and other natural water flows, stream and lake morphology, wetlands, riparian areas, floodplains, and other groundwater-dependent ecosystems;

9. Management strategies that mitigate the effects of stressors, restores ecological integrity, or adaptation strategies to reduce vulnerability; and

10. Access, recreational settings, and scenic character.

11. Maintenance or restoration of key ecosystem characteristics identified in the assessment including those that are rare or at risk (FSH 1909.12, ch. 10, secs. 12.14c and 12.55) in the plan area.

12. Range of ecological conditions established within the limits of natural landforms, vegetation, and disturbance processes that existed before extensive human alteration (FSH 1909.12, ch. 10, sec. 12.14a).

13. Variation in physical and biological conditions exhibited by ecosystems because of system drivers, stressors, climatic fluctuations, and disturbance regimes, including those that are beyond the control of the Agency (FSH 1909.12, ch. 10, sec. 12.3).

14. The concept that the environmental conditions that sustained species and other ecosystem components in the past are likely to sustain them (at least over the short term) in the future (Weins et al. 2012; and sec. 23.11a of this Handbook).

23.11 – Plan Components for Ecosystem Integrity and Diversity

The Agency's vision is for ecosystems in the plan area to have ecological integrity and adaptive capacity. (See FSH 1909.12, zero code, sec. 05 for definition of ecological integrity and adaptive capacity). Ecosystems have integrity when their composition, structure, function, and connectivity are operating normally over multiple spatial and temporal scales. However, not every desired condition or acre has to meet the definition of ecological integrity, because some specific areas may not have the capability or because another concern such as public safety is more important in a specific area.

In light of possible changes in species composition under the effects of climate change and with a focus on restoration, the Agency designs plan components to provide ecological conditions to sustain functional ecosystems based on a future viewpoint. Functional ecosystems are those that sustain critical ecological functions over time to provide ecosystem services.

Functional restoration may be necessary to restore the abiotic and biotic processes in degraded ecosystems. Functional restoration focuses on the underlying processes that may be degraded, regardless

of the structural condition of the ecosystem. As such, a functionally restored ecosystem may have different structure and composition than the past reference condition.

1. The Responsible Official should coordinate with Research and Development to develop plan components to adapt to the effects of climate change.

2. The Responsible Official should direct the Interdisciplinary Team to design plan components that are within Forest Service authority, the inherent capability of the plan area, and the fiscal capability of the unit (36 CFR 219.1(g)):

a. Provide ecological conditions to restore, establish, and maintain functioning ecosystems on National Forest System lands that can sustainably support multiple uses and provide a broad range of goods and services.

b. Restore, establish, and maintain functioning ecosystems that will have greater adaptive capacity to withstand stressors and recover from disturbances, especially changing and uncertain environmental conditions and extreme weather events.

c. Provide ecological conditions to sustain ecosystems that maintain the diversity of plant and animal communities and the persistence of native species in the plan area (36 CFR 219.9).

d. Take into account the effects of a changing climate (36 CFR 219.8(a)(1)(iv)).

e. Provide for ecological integrity, ecosystem services, and multiple uses within the plan area in an integrated manner (36 CFR 219.10).

23.11a – Natural Range of Variation

An understanding of the natural range of variation related to key ecosystem characteristics provides context and insights to the design of plan components. Agency intent is to promote ecosystem integrity in the plan area. However, it may not be possible or appropriate to strive for returning key characteristics to past conditions throughout the plan area.

Understanding the natural range of variation is fundamental in strategic thinking and planning, even if restoration to historical conditions is not the management goal or possible on parts of the plan area. Understanding the natural range of variation of an ecosystem provides an understanding of how ecosystems are dynamic and change over time. The natural range of variation is useful for understanding each specific ecosystem, for understanding its existing ecological conditions, and for understanding its likely future character, based on projections of climate regimes. The natural range of variation is a guide to understanding how to restore a resilient ecosystem with structural and functional properties that will enable it to persist into the future.

The goal of understanding natural range of variation is to help design plan components to maintain or restore the integrity of the diversity of terrestrial, riparian, and aquatic ecosystems and habitat types

throughout the plan area provide an ecosystem (coarse-filter) approach to maintaining the persistence of native species.

When developing plan components, the Interdisciplinary Team shall consider the role of the natural range of variation as follows:

1. In general, where appropriate, the Interdisciplinary Team should design plan components aimed at maintaining or restoring the natural range of variation of specific key ecosystem characteristics needed to promote ecosystem integrity in the plan area.

2. For specific areas within an ecosystem, the Responsible Official may determine that it is not appropriate, practical, possible, or desirable to contribute to restoring conditions to the natural range of variation. Natural range of variation includes a wide range of characteristics, some more common than other characteristics. To achieve social, economic, cultural, or ecological objectives it may be desirable to manage for uncommon conditions in specific areas in the plan area. For an ecosystem to withstand or recover from disturbance events caused under unique circumstances, it may be necessary to manage for characteristics that were rare or never occurred in the past. The following are examples of situations where it is NOT appropriate, practical, possible, or desirable to design plan components to restore past conditions for specific areas within an ecosystem:

a. The system is so degraded that restoration is not possible.

b. The ability to restore the desired ecological conditions or key ecosystem characteristics is beyond the authority of the Forest Service, the fiscal capability of the unit, or the inherent capability of the plan area.

c. The system is no longer capable of sustaining key ecosystem characteristics identified as common in the past based upon likely future environmental conditions.

d. Conditions that rarely or never occurred in the past, but that can be managed for in the future, will better contribute to long-term ecosystem sustainability and adaption to the effects of a changing climate.

e. Conditions that rarely or never occurred in the past, but that can be managed for in the future, will better address public health and safety concerns.

f. Conditions common in the past are directly opposed to integrated desired conditions (desired conditions that represents a balance of social, economic, cultural and ecological needs).

3. If past conditions relative to the natural range of variation are not appropriate, practical, possible, or desirable approaches:

a. The Interdisciplinary Team should design plan components based on a general scientific and ecological understanding of the conditions that would sustain key ecosystem

characteristics and sustain at-risk species using factors such as: representativeness, redundancy, habitat associations of particular species, disturbance dynamics, or observed conditions in reference areas. (FSH 1909.12, ch. 10, sec. 12.14b); and

b. The Responsible Official should briefly explain in the plan decision document the rationale for NOT basing the design of the plan components on those conditions that were common in the past relative to the natural range of variation.

23.11b – Ecosystem Integrity

Plans must contain plan components, including standards or guidelines, that maintain or restore the composition, structure, ecological processes, and connectivity of plan area ecosystems in a manner that promotes their ecological integrity (36 CFR 219.8(a) and 219.9(a)(1)). Ecological integrity is defined in the Rule at 36 CFR 219.19 and at FSH 1909.12, zero code, section 05.

219.8 Sustainability

(a) Ecological sustainability. (1) Ecosystem Integrity. The plan must include plan components, including standards or guidelines, to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity, taking into account:

(i) Interdependence of terrestrial and aquatic ecosystems in the plan area.

(ii) Contributions of the plan area to ecological conditions within the broader landscape influenced by the plan area.

(iii) Conditions in the broader landscape that may influence the sustainability of resources and ecosystems within the plan area.

(iv) System drivers, including dominant ecological processes, disturbance regimes, and stressors, such as natural succession, wildland fire, invasive species, and climate change; and the ability of terrestrial and aquatic ecosystems on the plan area to adapt to change.)

(v) Wildland fire and opportunities to restore fire adapted ecosystems.

(vi) Opportunities for landscape scale restoration.

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§ 219.9 Diversity of plant and animal communities.

. . . (a) Ecosystem plan components. (1) Ecosystem integrity. As required by § 219.8(a), the plan must include plan components, including standards or guidelines, to maintain or restore the ecological integrity of terrestrial and

aquatic ecosystems and watersheds in the plan area, including plan components to maintain or restore their structure, function, composition, and connectivity.

The Interdisciplinary Team shall take into account the following items, set out in the Rule at 36 CFR 219.8(a)(1)(i) –(iv) and (vi) when developing plan components:

1. Interdependence of terrestrial and aquatic ecosystems in the plan area. The Interdisciplinary Team should develop plan components in an integrated manner reflecting the interaction and interdependence of terrestrial, aquatic, and riparian ecosystems in the plan area.

2. Contributions of the plan area to ecological conditions within the broader landscape influenced by the plan area. When developing plan components the Interdisciplinary Team should consider:

a. Ecological conditions within the broader landscape and how those conditions may be influenced by resources or management within the plan area (FSH 1909.12, ch. 10, sec. 12.14c, paragraph 3).

b. Ecological connectivity at multiple temporal and spatial scales that would provide landscape linkages facilitating the exchange of resources and the movements of species across the broader landscape (FSH 1909.12, ch. 10, sec. 12.14c, paragraph 1).

c. Ecological conditions, habitats, or key ecosystem characteristics in the plan area that are unique, under-represented, or rare across the broader landscape (FSH 1909.12, ch. 10, sec. 12.14c, paragraph 3).

d. Opportunities to maintain or restore ecological conditions for pollinators and improve pollinator health.

3. Conditions in the broader landscape that may influence the sustainability of resources and ecosystems within the plan area. When developing plan components the Interdisciplinary Team should consider the ecological conditions in the broader landscape that may influence the sustainability of the plan area and should consider the following:

a. Existing conditions of the broader landscape outside National Forest System boundaries that may influence the plan area's ability to maintain or restore ecological integrity of plan area ecosystems. Such conditions may include habitat fragmentation, land use patterns, resource management, or urbanization (FSH 1909.12, ch. 10, sec. 12.14c, paragraph 3).

b. Facilitating or mimicking dominant ecological processes and system drivers of the broader landscape, especially those related to fire-adapted ecosystems (FSH 1909.12, ch. 10, sec. 12.3).

c. Collaborating with other land managers across the broader landscape when developing an all-lands approach to planning for ecological resources in a manner that promotes the

ecological integrity of terrestrial, riparian, and aquatic ecosystems in the plan area (FSH 1909.12, ch. 40).

4. System drivers, including dominant ecological processes, disturbance regimes, and stressors. When developing plan components, the Interdisciplinary Team should consider dominant ecological processes, disturbance regimes, and stressors (FSH 1909.12, ch. 10, sec. 12.3), and should:

a. Consider plan components designed to facilitate ecosystem adaptation to the effects of stressors.

b. Consider developing plan components designed to limit the ability of stressors to impact ecosystem integrity. In doing so, consider:

(1) Providing protection from stressors for areas of high ecosystem integrity, or areas of social, cultural, or economic importance.

(2) Mitigating stressors associated with forest and rangeland management, such as equipment impacts on soils and water, or movement of invasive species via vehicles and foot travel.

(3) Mitigating, if feasible, the effects of widespread environmental stressors such as air pollution and influence of changing climate.

(4) Coordinating with Agency staff from Research and Development to develop plan components to adapt to the effects of climate change.

5. Opportunities for landscape scale restoration. When developing plan components regarding opportunities for landscape-scale restoration of ecological integrity the ID team should consider the following:

a. Multiple spatial and temporal scales. The arrangement of ecological conditions, key ecosystem characteristics, and management goals at multiple spatial and temporal scales are important.

(1) The ecological role of the plan area within the broader landscape, including capability and condition of terrestrial, aquatic, and riparian systems.

(2) Complementary restoration goals of other land managers adjacent to or within the relevant ecosystems of the plan area, if available.

(3) Opportunities to compensate for degraded conditions in the broader landscape.

(4) The broad-scale context of scarcity and abundance, and Agency ability to restore and maintain desired features or conditions that are scarce in the broader landscape (FSH 1909.12, ch. 10, sec. 12.14c, paragraph 3).

(5) Opportunities to align desired ecological conditions with landscape-scale ecological units (such as the land-type association level of the National Hierarchical Framework of Ecological Units (FSM 2060.3)), if feasible, to simplify analysis and management by reducing the variability of ecological classifications across units of the National Forest System.

(6) Opportunities for partnerships to support restoring ecological conditions at the appropriate geographic scale.

b. At-risk species. The Interdisciplinary Team should consider the key ecosystem characteristics, ecosystems, and ecological conditions necessary to sustain the at-risk species.

c. Landscape patterns that promote long-term ecological integrity and ecosystem diversity. The ID team should consider plan components for landscape patterns that promote long-term ecological integrity and ecosystem diversity. Landscape pattern is defined as the arrangement, connectivity, composition, size, and relative abundance of ecosystem patches that occur within an area of land at a given time. Patches can be characterized by vegetation type, seral stage, habitat type, or other features relevant to a forest or rangeland management question. Examples of ways to provide plan components for such patterns include:

(1) Designing ecosystem (coarse-filter) connectivity based on landscape patterns of forests, grasslands, rangelands, streams, and wetlands that were created under ecological processes and landscape disturbance regimes that occurred before extensive human alteration.

(2) Designing spatial configuration of desired ecological conditions relative to the natural range of variation conditions, including the scale, frequency, and intensity of system drivers of ecosystem change over time (or other ecological reference model if the natural range of variation is not an appropriate approach) (FSH 1909.12, ch. 10, sec. 12.14a; Weins et al. 2012).

(3) Maintaining a representative range of successional states for all ecosystems and in patch configurations similar to those that occurred under historical conditions, at a scale resilient to natural disturbances.

(4) Designing for ecosystem integrity based on a general scientific and ecological understanding of the conditions that would sustain key ecosystem characteristics and at-risk species using factors such as representativeness, redundancy, habitat associations of particular species, or other factors (FSH 1909.12, ch. 10, sec. 12.14b; and sec. 23 of this Handbook).

(5) Maintaining the integrity of scarce or unique smaller areas through plan components for desired conditions and standards or guidelines to constrain the levels of disturbance for areas around them.

23.11d – Ecosystem Diversity

The Planning Rule requirements for ecosystem diversity from 36 CFR 219.9(a)(2) are:

> The plan must include plan components, including standards or guidelines, to maintain or restore the diversity of ecosystems and habitat types throughout the plan area. In doing so, the plan must include plan components to maintain or restore:
>
> (i) Key characteristics associated with terrestrial and aquatic ecosystem types;
>
> (ii) Rare aquatic and terrestrial plant and animal communities; and
>
> (iii) The diversity of native tree species similar to that existing in the plan area.

To develop the land management plan consistent with maintaining ecosystem diversity, the plan must include plan components, including standards or guidelines, designed to maintain, restore, or promote ecosystem diversity and habitat types.

The diversity of terrestrial, riparian, and aquatic ecosystems and habitats is fundamental to providing ecological conditions that support the abundance, distribution, and long-term persistence of native species and diversity of plant and animal communities. In addition, diversity of ecosystems and habitat types within the unit is an important aspect of the coarse-filter approach. The terms ecosystem diversity and habitat type are defined in FSH 1909.12, zero code, section 05. Terrestrial, riparian, and aquatic ecosystems to be addressed in the planning process are identified in the need to change the plan based on the assessment phase or identified based on information brought forward during the public and governmental participation process. See sections 23.1–23.12c of this Handbook for direction about plan components related to maintaining or restoring terrestrial, riparian, and aquatic ecosystems.

When developing plan components for maintaining and restoring the diversity of ecosystems and habitat types, the Interdisciplinary Team should consider the following:

1. The spatial extent and distribution of ecosystems and habitat types and spatial relationships to the natural range of variation (or other reference conditions if the use of natural range of variation is inappropriate).

2. The importance of ecosystems and habitats type to providing ecological conditions that contribute to the recovery of threatened and endangered species, conserve proposed and candidate species, and maintain viable populations of species of conservation concern (sec. 23.13 of this Handbook).

3. How plan components under consideration for large-scale ecosystems (like longleaf pine forests) would maintain or restore rare or unique embedded communities (like hillside bogs and longleaf savannahs) (FSH 1909.12, ch. 10, sec. 12.14c).

4. How plan components under consideration for ecosystems would contribute to maintaining the persistence of native tree species within the plan area.

5. How plan components for key characteristics of the ecosystem and habitat types contribute to the broader biodiversity of ecosystems across the plan area.

23.11e – Riparian Areas

The rule requirements for riparian areas from 36 CFR 219.8(a)(3) are:

> (i) The plan must include plan components, including standards or guidelines, to maintain or restore the ecological integrity of riparian areas in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity, taking into account:
>
> (A) Water temperature and chemical composition;
>
> (B) Blockages (uncharacteristic and characteristic) of water courses;
>
> (C) Deposits of sediment;
>
> (D) Aquatic and terrestrial habitats;
>
> (E) Ecological connectivity;
>
> (F) Restoration needs; and
>
> (G) Floodplain values and risk of flood loss.
>
> (ii) Plans must establish width(s) for riparian management zones around all lakes, perennial and intermittent streams, and open water wetlands, within which the plan components required by paragraph (a)(3)(i) of this section will apply, giving special attention to land and vegetation for approximately 100 feet from the edges of all perennial streams and lakes.
>
> (A) Riparian management zone width(s) may vary based on ecological or geomorphic factors or type of water body; and will apply unless replaced by a site-specific delineation of the riparian area.
>
> (B) Plan components must ensure that no management practices causing detrimental changes in water temperature or chemical composition, blockages of water courses, or deposits of sediment that seriously and adversely affect water conditions or fish habitat shall be permitted within the riparian management zones or the site-specific delineated riparian areas.

To maintain the ecological integrity of riparian areas, the plan must include plan components, including standards or guidelines, designed to maintain, restore, or promote riparian areas. This provision does not prohibit projects that may have short-term adverse effects to water conditions and fish habitat, but that will maintain or restore structure, function, composition, and connectivity of riparian areas over the long term.

Riparian areas are important elements of watersheds that provide critical transition zones linking terrestrial and aquatic ecosystems. Restoration of riparian areas may be accomplished through passive management or may require active management particularly in areas where natural disturbances such as fire or flooding have been prevented from occurring.

The terms ephemeral stream, intermittent stream, perennial stream, riparian area, and riparian management zone are defined in FSH 1909.12, zero code, section 05.

The National Core Best Management Practices (BMP) Technical Guide (USDA Forest Service 2012a) refers to riparian management zones as aquatic management zones. The technical guide discusses designation of the riparian management zone under the national core best management practice "Plan-3 Aquatic Management Zone Planning." The Agency uses the technical guide to carry out the requirements for the national best management practices for water quality (FSM 2526). As discussed in section 23.12c of this Handbook, plan components must ensure implementation of the best management practices.

Sections 23.1–23.12c of this Handbook give direction on plan components related to maintaining or restoring the ecological integrity of all ecosystems including riparian ecosystems (riparian areas).

The plan must establish widths for riparian management zones for all lakes, perennial and intermittent streams, and open water wetlands (36 CFR 219.8(a)(3)(ii)) so employees know where the plan components for ecological integrity of riparian areas apply.

Riparian management zones must include the riparian area.

1. When establishing riparian management zones, the Interdisciplinary Team should consider:

    a. Available information on the location and extent of surface waterbodies, springs, wetlands, vegetation, soils, geomorphology, topography, and other relevant information.

    b. Soil and vegetation indicators of riparian areas that include regionally distinctive riparian soils and vegetation, or the soil potential to support regionally distinctive vegetation.

    c. Fluvial geomorphic indicators of riparian areas such as break in slope or evidence of fluvial deposition.

    d. The 100-year recurrence interval flood stage. The water surface elevation corresponding to the 100-year recurrence interval flood may be preferable to some standard distance from the stream channel (for example, a 100-foot buffer) because a set distance may overestimate actual riparian widths along small streams and underestimate the extent of riparian vegetation along larger rivers.

    e. Existing site-specific riparian area delineations, if available (FSH 1909.12, ch. 10, section 12.14d).

f. The effects of climate change on stream flows that may affect the size of riparian management zones.

2. When establishing widths for riparian management zones as require by the Rule, and in areas where available information on the distribution of riparian dependent resources within the plan area is too limited to determine appropriate riparian management zone dimensions, the Interdisciplinary Team should consider the following when establishing widths:

a. Establishing a default distance from the edge of all lakes, perennial streams, intermittent streams, and open water wetlands, such as the ordinary high water mark or bankfull flow, for the riparian management zone.

b. Giving special attention to the first 100 feet from the edges of all perennial streams, lakes, and other bodies of permanent surface water containing aquatic flora and fauna or supporting substantial riparian vegetation. In other words, plan components for riparian management zones should be developed to maintain, improve, or restore the condition of the land around and next to waterbodies in the context of the environment in which they are located, recognizing their unique values and importance to watersheds while providing for multiple uses on National Forest System lands.

c. Giving attention to dry washes or channels with minimal or no riparian vegetation that support riparian vegetation downstream due to subsurface flow through the stream channel or adjacent alluvial sediments.

3. When developing plan components for ecological integrity of riparian areas, the Interdisciplinary Team should:

a. Design plan components that constrain projects and activities to comply with requirements of the Planning Rule not to cause detrimental changes to water resources that "seriously and adversely affect water conditions or fish habitat"

(36 CFR 219.8(a)(3)(ii)(B)). This provision does not prohibit projects that may have short-term adverse effects to water conditions and fish habitat, but that will maintain or restore structure, function, composition, and connectivity of riparian areas over the long term.

b. Consider designing plan components for restoring processes that support desirable riparian integrity including allowing roots of plants access to groundwater.

c. Consider designing plan components that provide for passive management or active management. An example of passive management is restoring elements of flow regimes, such as environmental flows and levels, by restricting a destructive activity. Examples of active management include recontouring roads or mechanically removing structures or vegetation. Active management may be appropriate in areas if past management has prevented natural disturbances (such as fire or flooding), or if past projects and activities have altered riparian functions (such as where roads are located within riparian areas).

For guidance on delineating site-specific riparian areas associated with streams and rivers, see the guidelines in the National Riparian Vegetation Monitoring Technical Guide (Forest Service 2012b) or other Agency supported guidance. For guidance on delineating site-specific riparian areas for non-fluvial or palustrine areas (associated with wetlands, lakes and other standing bodies of water), see the U.S. Army Corps of Engineers wetland delineation manuals for the region of interest, available at *http://el.erdc.usace.army.mil/wetlands/wlpubs.html*.

23.12 – Plan Components for Air, Soil, and Water

The rule requirements for air, soil and water from 36 CFR 219.8(a)(2) are:

> The plan must include plan components, including standards or guidelines, to maintain or restore:
>
> (i) Air quality.
>
> (ii) Soils and soil productivity, including guidance to reduce soil erosion and sedimentation.
>
> (iii) Water quality.
>
> (iv) Water resources in the plan area, including lakes, streams, and wetlands; ground water; public water supplies; sole source aquifers; source water protection areas; and other sources of drinking water (including guidance to prevent or mitigate detrimental changes in quantity, quality, and availability).

Plan components, including standards or guidelines, designed to maintain or restore these ecosystem elements provide the basis for maintaining or restoring the ecological integrity of the plan area. In addition to the resources listed in 36 CFR 219.8(a)(2), clean air, clean and abundant water supplies, geologic resources, and riparian areas should be considered when developing plan components.

When developing plan components for maintaining air quality, soil productivity, water quality, and water resources within the plan area, the Interdisciplinary Team should consider:

1. The range of ecological conditions established within the limits of the natural landforms, vegetation, and disturbance processes that existed before extensive human alteration.

2. The variation in physical and biological conditions exhibited by ecosystems because of climatic fluctuations and disturbance regimes.

3. The concept that the environmental conditions that sustained ecosystem components in the past are likely to sustain them, at least over the short term, in the future.

4. The potential influences of threats and stressors that are within and beyond the influence of management actions on the plan area that are likely to affect ecological conditions on the plan area during the life of the proposed plan (15 years).

23.12b – Soils and Soil Productivity

The rule requirements for soils and soil productivity are listed in 36 CFR 219.8(a)(2)(ii). The development of plan components for soils and soil productivity, including standards or guidelines, should be based on the need to change the plan identified from the assessment (FSH 1909.12, ch. 10, sec. 12.22) or information brought forward during the public and governmental participation process.

1. In addition to considering information identified in the assessment, the Interdisciplinary Team may consider existing recommendations in Forest Service national best management practices guidance documents (USDA Forest Service 2012a). Additional information is found in FSM 2551.3.

2. When designing plan components for soils and soil productivity to sustain the productive capability of the land, its ecological resources, and watershed functions, the Interdisciplinary Team should consider whether it would be appropriate for plan components to give direction regarding :

a. Restoring degraded areas.

b. Maintaining the ecological integrity and functions of soils by managing vegetation communities and the type, degree, and amount of disturbance to soils. (See FSM 2550.5 and FSM 2551.5 for definition of soil function).

c. Maintaining biological properties of soils, such as an appropriate level of organic matter to sustain biological cycling.

d. Maintaining organic matter inputs and avoiding losses, to help maintain or increase net soil carbon storage.

e. Mitigating impacts for those soils that have been identified as vulnerable to stressors.

f. Mitigating potential impacts of changing climate, such as changes in occurrence of extreme storm events (in other words, do potential impacts affect appropriate uses of soils?).

g. Limiting potential impacts on soil physical properties, for example, compaction, rutting, puddling, displacement of the soil surface, and erosion.

h. Limiting potential effects on soil chemical properties, such as potential for nutrient depletion, acidification or both.

23.12c – Water Quality and Water Resources

The Planning Rule requires the plan to have plan components, including standards or guidelines, to maintain or restore:

(iii) Water quality.

> (iv) Water resources in the plan area, including lakes, streams, and wetlands; ground water; public water supplies; sole source aquifers; source water protection areas; and other sources of drinking water (including guidance to prevent or mitigate detrimental changes in quantity, quality, and availability). (36 CFR 219.8(a)(2)(iii) and (iv)).

The rule requires the establishment of BMPs in the Forest Service Directive System 36 CFR 219.8(a)(4).

> (4) *Best management practices for water quality*. The Chief shall establish requirements for national best management practices for water quality in the Forest Service Directive System. Plan components must ensure implementation of these practices.

The development of plan components, including standards or guidelines, designed to maintain or restore water resources in the plan area, including lakes, streams, wetlands, and groundwater, should be based on a need to change the plan identified from the assessment (FSH 1909.12, ch. 10, secs. 12.23 and 13.34) or on information brought forward during the public and governmental participation process.

The Interdisciplinary Team should consider surface and subsurface water quality and public water supplies associated with the plan area watersheds. The Team should also coordinate with State, local and tribal water managers, water users, and others about appropriate resource protection, consistent with applicable law.

The Interdisciplinary Team should develop desired conditions for water quality and quantity in the plan area and consider developing plan components to:

1. Maintain or restore the water quality, quantity, timing, and distribution necessary to sustain ecosystems and downstream ecosystem services into the future by:

   a. Including guidance designed to prevent or mitigate detrimental changes in quantity, quality, and availability, including temperature changes and inputs of sediment and other pollutants.

   b. Ensuring implementation of the national best management practices (BMPs) program for water quality (FSM 2532; USDA Forest Service 2012).

   c. Quantifying the water necessary to maintain and restore terrestrial, riparian, and aquatic ecosystems and associated dependent species, including aquatic species and groundwater-dependent ecosystems in the plan area, when appropriate and practical.

   d. Specifying the appropriate environmental flows and water levels, when appropriate and practical.

2. Support the restoration of designated impaired waters within or adjacent to National Forest System lands with primary or secondary impairments that have the potential to be influenced by Forest Service forest and rangeland management activities in the plan area.

3. Maintain or restore the integrity of public water supplies, sole source aquifers, source water protection areas, and other sources of drinking water in the plan area.

4. Maintain or restore the integrity of lakes, streams, wetlands, and groundwater in the plan area.

5. Address the concerns identified for priority watersheds (sec. 22.31 of this Handbook).

23.13 –Species-specific Plan Components for At-risk Species

Plan components developed for ecosystem integrity and ecosystem diversity (sec. 23.11 of this Handbook) are expected to provide for ecological conditions necessary to maintain the persistence or contribute to the recovery of native species within the plan area, including at-risk species identified in assessment.

At-risk species for planning are federally recognized threatened, endangered, proposed, and candidate species; and species of conservation concern. The term "ecological conditions" is defined in FSH 1909.12, zero code, section 05. Ecological conditions include habitat and the effects of human uses (for example, recreation, grazing, and mining).

The Planning Rule, at 36 CFR 219.9(b)(1), requires the Responsible Official to determine whether plan components, including standards or guidelines, to maintain or restore ecosystem integrity and ecosystem diversity provide sufficient ecological conditions for at-risk species, or if plan components specifically directed toward providing specific conditions required by such species must be developed:

> (b) Additional, species-specific plan components. (1) The responsible official shall determine whether or not the plan components required by paragraph (a) of this section provide the ecological conditions necessary to: contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area. If the responsible official determines that the plan components required in paragraph (a) are insufficient to provide such ecological conditions, then additional, species-specific plan components, including standards or guidelines, must be included in the plan to provide such ecological conditions in the plan area.

To make the determination required by 36 CFR 219.9(b)(1), the Responsible Official should evaluate if emerging plan components that would provide for ecosystem integrity and ecosystem diversity (coarse-filter approach) would also provide the ecological conditions necessary to meet the Rule's requirements for all the at-risk species in the plan area. If the evaluation indicates such plan components would not provide sufficient conditions required by the Rule for one or more at-risk species, the

Responsible Official shall develop additional, species-specific plan components, including standards or guidelines, for each of those species (fine-filter approach).

Examples of such plan components include a standard for protecting red-cockaded woodpecker nest cavity trees during prescribed burning activities, an objective to establish a food storage order designed to minimize grizzly bear/human conflicts occupied grizzly bear habitat, or a standard for size and placement of culverts on cutthroat trout streams.

The Responsible Official should design an evaluation process for the emerging set of plan components for each at-risk species to determine the degree to which the set of emerging plan components meet the requirements of the Planning Rule for at-risk species. The Responsible Official should take into account the need to change the plan based on the status for each at-risk species (as outlined in FSH 1909.12, ch.10, sec. 12.55).

Plan components that provide for ecological conditions for ecosystem integrity and ecosystem diversity (sec. 23.11 of this Handbook) are the primary context for the evaluation of at-risk species. For most species, the only practical quantitative evaluation of their required ecological conditions is an assessment of habitat conditions (ecological conditions). Plan components developed for multiple uses may contribute to, or detract from, ecological conditions needed for at-risk species. For example, on some forests or grasslands, a portion of the plan area may have a desired condition for undeveloped remote recreation. Such a desired condition should be taken into account when evaluating the ecological conditions for at-risk species, because it may mitigate some stressors, contribute to ecological conditions, or provide refugia.

1. Process for evaluating emerging plan components. Evaluating the emerging plan components and their likely contribution to meeting requirements for at-risk species is an iterative process as the plan is being developed, amended, or revised. The process includes:

a. Developing emerging plan components that provide for ecosystem integrity and ecosystem diversity.

b. Evaluating whether those emerging plan components would sustain the ecological conditions that the Rule requires for at-risk species.

c. Refining emerging plan components that do not adequately handle species risk factors from the evaluation of status of at-risk species (FSH 1909.12, ch. 10, sec. 12.55) or do not sustain the ecological conditions that support at-risk species by:

(1) Making adjustments to the emerging plan components for ecosystem integrity and ecosystem diversity necessary to sustain the ecological conditions that support at-risk species;

(2) Adding additional species-specific plan components necessary to sustain the ecological conditions required by the Rule for at-risk species; or

(3) Combining paragraphs (1) and (2).

d. Repeating the steps of paragraphs 1b and 1c if other social, economic, or ecological considerations are added that alter plan components in a way that would affect an at-risk species.

2. Considerations when evaluating the potential emerging plan components. When evaluating whether emerging plan components that provide for ecosystem integrity and diversity would adequately provide conditions for at-risk species, the Interdisciplinary Team should consider the following:

a. Relevant information derived from the status of at-risk species (FSH 1909.12, ch. 10, sec. 12.55), as well as limiting factors, threats, and stressors to each at-risk species.

b. The key habitat relationships of the species, by:

(1) Evaluating the connection between habitat conditions and population consequences.

(2) Using general ecological principles when there is a lack of knowledge of relationships between species, populations, and habitats.

(3) Using existing spatially explicit habitat models, demographic models, or other relevant models.

(4) Using qualitative methods such as expert opinion or simple habitat assessments in the absence of adequate information or models.

(5) Framing the evaluation in the context of risk and uncertainty, no matter what evaluation method is used.

c. Conducting the evaluations of the emerging plan components at the scale in which biological populations of the species operate. Analysis at the scale of distinct population segments or evolutionary significant units may be appropriate.

d. Effects, influences, and contributions from other land ownerships and actions outside of the plan area in addition to those within the plan area.

23.13a – Threatened and Endangered Species

The development of or changes to plan components to provide for ecological conditions for threatened and endangered species should be based on a need to change the plan identified from the assessment of the ecological conditions necessary to contribute to their recovery and maintaining or restoring critical habitats (FSH 1909.12, ch. 10, sec. 12.55), or from information brought forward during the public and governmental participation process.

When designing plan components (ecosystem and species-specific) to provide for ecological conditions that contribute to the recovery of threatened and endangered species that occur within the plan area, the Interdisciplinary Team should:

1. Consider conservation measures and actions identified in the recovery plan for each threatened and endangered species.

2. Consider limiting factors (for example, naturally small and isolated populations, climate change) and key threats to each threatened and endangered species.

3. Engage with the U.S. Fish and Wildlife Service and National Marine Fisheries Service (NMFS), as appropriate, in the evaluation of existing conditions for threatened and endangered species and in the development of plan components that contribute to their recovery.

4. Work beyond the plan area boundary to collaborate and cooperate with U.S. Fish and Wildlife Service, National Marine Fisheries Service, States, Tribes, other partners, landowners, and land managers to support an all-lands approach to species recovery.

5. Support the reintroduction of listed species into historical habitat on National Forest System lands where appropriate, consistent with recovery plan objectives.

6. Engage with the U.S. Fish and Wildlife Service or National Marine Fisheries Service, as appropriate, in the evaluation of any effects to aquatic threatened and endangered species downstream of the plan area that could be affected by actions within the plan area.

23.13b – Proposed and Candidate Species

Development of plan components for proposed and candidate species should be based on the ecological conditions necessary to conserve proposed and candidate species that were identified in the assessment phase or information brought forward during the public and governmental participation process and maintain or restore their habitats in the plan area to contribute to preventing them from being federally listed (FSH 1909.12, ch. 10, sec. 12.55).

When developing plan components (ecosystem and species-specific) to conserve proposed and candidate species, the Interdisciplinary Team should:

1. Consider conservation measures identified in existing conservation strategies and agreements relevant to proposed and candidate species in the plan area.

2. Consider limiting factors and key threats to species identified in proposed rules from U.S. Fish and Wildlife Service or National Marine Fisheries Service for listing or candidate species assessments.

3. Engage with U.S. Fish and Wildlife Service and National Marine Fisheries Service in the evaluation of existing conditions for proposed and candidate species and in the development of plan components designed to conserve these species.

4. Work beyond the plan area boundary to collaborate and cooperate with U.S. Fish and Wildlife Service, National Marine Fisheries Service, States, Tribes, other partners, landowners, and land managers to support an all-lands approach to conserve proposed and candidate species.

23.13c – Species of Conservation Concern

Species of conservation concern are defined in the Planning Rule (36 CFR 219.9(c)) and in FSH 1909.12, zero code, section 05. The rule requirements for species-specific plan components for species of conservation concern are:

> (2) If the responsible official determines that it is beyond the authority of the Forest Service or not within the inherent capability of the plan area to maintain or restore the ecological conditions to maintain a viable population of a species of conservation concern in the plan area, then the responsible official shall:
>
> (i) Document the basis for that determination (§ 219.14(a)); and
>
> (ii) Include plan components, including standards or guidelines, to maintain or restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range. In providing such plan components, the responsible official shall coordinate to the extent practicable with other Federal, State, Tribal, and private land managers having management authority over lands relevant to that population. (36 CFR 219.9(b)(2)).

See section 21.22a of this Handbook for guidance on selecting species of conservation concern.

The Rule requires, as a general matter, that the plan have plan components to provide ecological conditions necessary to maintain a viable population of each species of conservation concern in the plan area. The ecological conditions may be those provided for through a coarse filter approach or through a fine filter (species-specific) approach. The Rule also provides that when the Forest Service's authority or the inherent capability of the plan area is insufficient to provide ecological conditions to maintain a viable population of species of conservation concern in the plan area, the Agency's obligation becomes one of contributing to maintaining a viable population of the species of conservation concern in its range.

When evaluating whether plan components (ecosystem and species-specific) would provide for the ecological conditions to maintain a viable population of each species of conservation concern in the plan area, the Interdisciplinary Team shall determine whether the plan components would provide the ecological conditions necessary to maintain or restore a viable population of a species of conservation concern in the planning area (36 CFR 219.9(b)(1)).

Five aspects of the evaluation process are explained in the following paragraphs: (1) viable population, (2) three possible outcomes of evaluating plan components, (3) examples of circumstances not within the authority of the Forest Service, (4) examples of circumstances not within the inherent capability of the plan area, and (5) duties of the Responsible Official when maintenance of a viable population of species of conservation concern within the plan area is beyond the authority of the Forest Service or not within the inherent capability of the plan area.

1. Viable population. The Planning Rule defines viable population as follows:

Viable population. A population of a species that continues to persist over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments.
(36 CFR 219.19)

The following principles must be kept in mind when developing plan components to provide for ecological conditions necessary to maintain a viable population of species of conservation concern in the plan area:

a. The rule only requires ecological conditions to maintain a viable population.

b. The meaning of the word "population" for planning purposes is explained in the preamble to the proposed rule: "it is the Department's expectation that for the purposes of this subpart, the individuals of a species of conservation concern that exist in the plan area will be considered to be members of one population of that species." (77 FR 21217, April 9, 2012). In some situations, individuals or groups of individuals in the plan area may be known to be or highly suspected to be reproductively isolated and separate from the rest of the individuals. These individuals or groups may need to be considered when considering "sufficient distribution" as described in paragraph 1d of this section.

c. The words "persist over the long-term" means the species continues to exist in the plan area over a sufficiently long period that encompasses multiple generations of the species, the time interval between major disturbance events, the time interval to develop all successional stages of major habitat types, or the time interval needed for the overall ecosystem to respond to management. Understand that confidence in the evaluations of persistence decreases rapidly as the timeframe of projections increases and that the Responsible Official will change plan components using plan amendments and plan revisions when the Responsible Official decides plan components need to be changed because of changed conditions.

d. Whether there is "sufficient distribution" of a species should be considered in the context of the species' natural history and historical distribution and on the potential distribution of the habitat within the plan area. Recognize that habitat and population distribution are dynamic over time. Sufficient distribution also implies a distribution that permits individuals to interact within the plan area within the constraints of the species' natural history. Sufficient distribution implies that ecological conditions are provided to support redundancy in numbers such that losing one or some without replacement will still support a viable population. It should not be expected that management of National Forest System lands would provide broadly or evenly distributed habitat throughout a plan area for all species. Furthermore, as long as there is enough habitat in the plan area to maintain a viable population, there is no requirement that habitat to maintain all known individuals or the maximum possible number of individuals of a species must be available in the plan area.

e. The word “resilient” suggests that when disturbance events or stressors result in the local disappearance of individuals or extirpation from an area, recolonization of suitable habitat may occur in the future to facilitate long-term persistence in the plan area.

f. The word “adaptable” means that the species is able to adjust to new conditions. Ecological conditions to support the species are distributed in a way that the species may be represented in a variety of locally adapted ecotypes for increased likelihood of persistence in unknown future environments.

g. Species distribution should also be provided for by the requirement that plan components must maintain or restore the diversity of ecosystems and habitat types throughout the plan area (36 CFR 219.9(a)(2), and by the requirement to maintain or restore connectivity (36 CFR 219.9(a)(1)).

2. Three possible outcomes of evaluating plan components. There are a variety of methods for conducting this evaluation, such as expert opinion, expert panels, Bayesian-belief models, habitat suitability models, and so on. The evaluation of the ecosystem and species-specific plan components may result in three outcomes:

a. The emerging plan components, when carried out, would provide the necessary ecological conditions to maintain a viable population of the species of conservation concern in the plan area.

b. Adjustments to emerging ecosystem plan components, additional species-specific plan components, or both, when carried out, would provide the necessary ecological conditions to maintain a viable population of the species of conservation concern in the plan area.

c. Due to circumstances that are neither within the authority of the Forest Service nor consistent within the inherent capability of the land, the plan area is unable to provide the ecological conditions necessary to maintain a viable population of a particular species of conservation concern within the plan area. When this occurs, the Responsible Official shall document the basis for this determination in the planning record.

3. Examples of circumstances not within the authority of the Forest Service. The following are species-specific examples of when ecological conditions necessary for the long-term persistence of a species are outside the National Forest System lands and, therefore, outside Forest Service control for providing ecological conditions to maintain viable populations of each species of conservation concern within a plan area:

a. Forest clearing in South America. These South American forests provide important wintering areas for many Neotropical birds that nest in North America. The clearing of these forests for agricultural purposes adversely affects the wintering habitat and ecological conditions necessary for the continued survival of viable populations of the Cerulean warbler. Thus, impacts to habitat outside the National Forest System may adversely affect populations of species that migrate to and from a National Forest.

b. Hydropower and flood control facilities in the Pacific Northwest and recreational and commercial fish harvest practices. These facilities and practices are primary downstream threats to anadromous fish populations whose spawning beds may occur on stream reaches within National Forests. These facilities and practices occur outside of National Forest System lands and are outside of Forest Service control, but nonetheless may adversely affect anadromous fish populations found on National Forest System lands.

c. Land use patterns on private lands intermixed with or adjacent to National Forest System lands. The continuing agricultural uses and urbanization that is occurring east of the Rocky Mountains is causing habitat fragmentation, which reduces available habitat and ecological conditions necessary for the viability of swift fox populations. Therefore, a reduction in viable populations of this species can occur as a result of land use development and patterns outside of National Forest System lands.

d. Domestic sheep grazing on private lands intermixed with or adjacent to National Forest System lands in the west. The contact of bighorn sheep with domestic sheep can transmit diseases to bighorn sheep and can cause die-offs of the affected bighorn sheep herds. Therefore, a reduction in viable populations of bighorn sheep can occur because of land use outside National Forest System lands.

4. Examples of circumstances not within the inherent capability of the plan area. The inherent capability of the land is defined in FSH 1909.12, zero code, section 05. Examples of circumstances that are not within the inherent capability of the plan area to provide the ecological conditions needed to maintain or restore a viable population of a species within the plan area include:

a. A species that is inherently rare because its individuals naturally occur at low numbers and are wide-ranging. For example, the wolverine occurs at relatively low densities in the northern Rocky Mountains and the number of breeding individuals in a single National Forest may be presumably too small to be considered a viable population.

b. A plan area that lacks sufficient ecological capacity to produce the habitat or ecological conditions necessary to maintain a viable population. An example is the Kisatchie National Forest, which has very limited amounts of land capable of producing the broad bottomland hardwood and cypress swamp habitat necessary to maintain a viable population of swallow-tailed kite. This National Forest is only capable of providing habitat for some individuals of this species.

c. Current and projected changes in climate that may affect a National Forest or grassland's ability to maintain or even contribute to the ecological conditions necessary to maintain viable populations of some species. An example is the warming trends at higher elevations in the West, which are altering the capability of some National Forests in California and other areas of the West to provide ecological conditions needed to maintain viable populations of American pika.

d. Where water quality conditions in Appalachian Mountain streams that provide habitat for eastern brook trout have been altered through acid deposition. The acid deposition is due to past and current acid rain, rendering many streams unsuitable for brook trout and compromising the ability of some Appalachian National Forests to provide the ecological conditions needed to maintain viable populations of this species.

5. Duties of the Responsible Official. If the Responsible Official determines it is beyond the authority of the Forest Service or not within the inherent capability of the plan area to maintain or restore the ecological conditions to maintain a viable population of a species of conservation concern in the plan area, then the Responsible Official shall:

a. Document the basis for the determination.

b. Include plan components, including standards or guidelines, to maintain or restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range. For additional guidance see the principles about viable populations at paragraph 1 of this section.

c. Coordinate, to the extent practicable, with Federal, State, Tribal, and private land managers relevant to the species population. In doing so, consider:

(1) The range of the species beyond the plan area, and the ecological role of the plan area to contribute to a viable population across the broader landscape.

(2) Working towards an all-lands approach to species conservation with other land managers across the range of the species, including efforts to mitigate threats or stressors and to provide ecological conditions that would support the species.

Sincerely,
/s/ Adam Bronstein

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Working to protect and restore Western Watersheds and Wildlife

February 27, 2023

President Joseph R. Biden
The White House
1600 Pennsylvania Ave NW
Washington, DC 20500

Dear President Biden:

We, the undersigned, appreciate your recognition of the urgency of the climate crisis and the existential threat it poses to human civilization, to native wildlife and fish, and to ecosystems by signing into law our country's greatest climate legislation to date, the *Inflation Reduction Act*. Building on the momentum this legislation has ignited, **we urge you to issue an Executive Order that closes all federally-managed public lands (public lands) in the United States to beaver trapping and hunting** as an emergency climate change and biodiversity loss response measure (maps)**.**

Protecting beavers from this human-caused mortality would immediately implement a nature-based climate solution identified in the November 2022 report to The National Climate Task Force titled, *Opportunities To Accelerate Nature-Based Solutions: A Roadmap For Climate Progress, Thriving Nature, Equity, & Prosperity*. In response to protection, beavers and their dams would begin expanding in numbers, setting in motion processes that would help restore hundreds of thousands of miles of degraded streams and create millions of hectares of new, nature-based **carbon capture and storage** (CCS) zones in the form of stream-corridor wetlands. These changes would in turn support the goals found in existing Executive Orders such as: 13990, *Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis* (January 25, 2021); 14008, *Tackling the Climate Crisis at Home and Abroad* (January 27, 2021); and 14072, *Executive Order on Strengthening the Nation's Forests, Communities, and Local Economies* (April 22, 2022). These new CCS zones would also add to the CCS contributions currently being made from existing coastal wetlands and mature and old growth forests.

The value of new wetlands cannot be overstated.[1] The Intergovernmental Panel on Climate Change and the International Energy Agency identified carbon capture and storage (CCS) as likely to play a vital role in efforts to address climate change.[2] In response, the Inflation Reduction Act provided critical updates to the 45Q tax credit for industries to incentivize the use of CCS technologies. Protecting beavers, therefore, directly compliments the Act because the newly-created wetlands become net carbon sinks once a minimum of 55% vegetation cover is achieved as above and below ground biomass expands, a change that usually occurs within two to five years.[3] The effectiveness of wetland soils in carbon sequestration is reflected in the values listed below:

[1]Zhu et al (2022). Conservation of carbon resources and values on public lands: A case study from the National Wildlife Refuge System. PLoS One 17 (1). 17 p.; Nahlik and Fennessy (2016). Carbon Storage in US wetlands. Nature Communications, 9p.
[2]Clean Air Task Force (2022). https://www.catf.us/resource/carbon-capture-provisions-in-the-inflation-reduction-act-of-2022/
[3]Valach et al (2021). Productive wetlands restored for carbon sequestration quickly become net CO2 sinks with site-level factors driving uptake variability. *PLoS ONE* 16(3)

- Store 3-10 times more carbon than the same volume of soil in a virgin forest, 6-14 times more than a secondary forest, and 7-35 times more than a grassland due to deep and extensive root networks.[4] The amount of stored carbon varies depending on the site conditions.

- Store carbon for longer residence times (> 1,000 years) than upland forest soils (100s of years).[5] This is an important contribution given the long-term challenge of climate change.

- Store 195 to 478 metric tons of carbon per hectare-meter of soil depending on their type and location.[6]

In addition to new nature-based CCS, widespread, cost-effective, and rapid beaver-driven restoration of wetlands and stream ecosystems would provide additional valuable benefits such as those listed below and captured in this presentation (video). These benefits directly address other national challenges highlighted in the November 2022 *Opportunities to Accelerate Nature-Based Solutions* (p. 13, Table 1).

- **Temporarily store large volumes of surface and groundwater.** This storage would help 1) maintain stream base flows once supplied by deep but now dwindling and less predictable snowpacks, 2) reduce flood magnitudes downstream by altering the volume and timing of floodwaters, and 3) increase water security for municipal and agricultural users by dampening extremes in flows (video).

- **Improve water quality.** Improvement would be the result of wetlands and ponds 1) trapping sediment and nutrients eroding from uplands, and 2) decreasing stream temperatures through increased groundwater inputs and deeper water depths. Reductions in temperatures and nutrient inputs would help decrease potential for algae blooms.

- **Increase the size and abundance of natural firebreaks**. These firebreaks 1) become refuges for wildlife and livestock during wildfire events, 2) provide post-fire habitat, 3) trap post-fire sediment eroding from hillslopes, helping to protect water quality and fisheries, and 4) alter fire patterns and severity in the surrounding area (video).

- **Improve and expand wildlife habitat.** Protecting beavers leads to greater diversity, abundance, and distribution of wetlands and riparian woody and herbaceous vegetation such as willows, dogwood, sedges, and rushes needed by beavers and other riparian-dependent species.

- **Improve and expand fish habitat.** Beavers and their natural infrastructure create colder stream temperatures, clearer waters, greater channel complexity, beaver ponds, greater vegetation and insect life – all of which are critical for salmon and other cold-water dependent species (video).

[4]Wohl (2013). Landscape-scale carbon storage associated with beaver dams. *Geophysical Research Letters,* Vol. 40, 1-6; Buringh (1984). Organic Carbon in Soils of the World (chapter 3) in *The Role of Terrestrial Vegetation in the Global Carbon Cycle: Measurement by Remote Sensing*. pp. 91-109.

[5]Valach et al (2021).

[6]Nahlik and Fennessy (2016).;https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#:

The value of these benefits, also known as "ecosystem services", is in the billions of dollars.[7] This value is generated by the combination of benefits gained and costs no longer incurred as damaged streams and riparian ecosystems recover. As pointed out in numerous studies of ecosystem responses to beaver activity (references) and on the front page of The New York Times, these benefits are experienced directly by a wide variety of individuals and communities. However, to receive these benefits and eliminate costs, beaver populations, their dams, and their distributions need to rapidly expand. Expansion requires increased survival rates. Protecting beavers by closing public lands to beaver trapping and hunting will improve their survival rates and is, in fact, the only mortality factor we can control.

SUMMARY OF KEY POINTS

The climate and biodiversity crises require actions that lead to rapid and large-scale tangible results. Protecting beavers on public lands will provide such results because it does the following:

- **Complements** the *Inflation Reduction Act* and numerous Executive Orders by implementing a known nature-based climate solution (protecting beavers) that provides a host of benefits including bringing rapidly online another nature-based climate solution in the form of millions of hectares of new carbon capturing and storing wetlands.

- **Delivers** visual and measurable results rapidly (video) and provides cost-effective and widespread stream ecosystem restoration at the regional scale. The benefits gained will be in the billions of dollars.

- **Builds** on the hope generated by the recent passage of the *Inflation Reduction Act* for the millions of Americans struggling to cope with "eco-anxiety." It does this by working with a charismatic species that is family-oriented, playful and hard-working (video), and capable of rapidly restoring health and diversity to degraded stream systems as they go about their daily lives. This kind of energy is infectious and a powerful antidote to despair and depression.

- **Inspires** public engagement in restoration. The ability to participate in restoring stream ecosystems will increase creativity and energy to find other opportunities to help solve our most pressing challenge – how to not only survive, but thrive during this time of great change.

WHY AN EXECUTIVE ORDER IS REQUIRED TO IMPLEMENT THIS NATURE-BASED CLIMATE SOLUTION

Our request for an executive order is the result of the following issues:

1. The accelerating, intertwined climate change and biodiversity loss crises, which beavers can help address.

[7]Zhu et al (2022); ECONorthwest (2011). The economic value of beaver ecosystems services: Escalante River Basin, Utah. 64p. (report); Thompson et al. (2021). Ecosystem services provided by beavers Castor spp. *Mammal Review,* 51(1), 25–39; The Conservation Fund (2013). Houston-Galveston – Green Infrastructure and Ecosystem Services Assessment, 16 p.; Industrial Economics Inc. (2011). Economic valuation of wetland ecosystem services in Delaware: Final report. Delaware Department of Natural Resources and Environmental Control, Diversion of Water Resources, Dover, DE. 133p.; Niemi et al (2020). Economic Benefits of Beaver-Created and Maintained Habitat and Resulting Ecosystem Services. Appendix F in "*Petition to Initiate Rulemaking to Amend OAR 635-050-0070 to Permanently Close Commercial and Recreational Beaver Trapping and Hunting on Federally-Managed Public Lands and the Waters that Flows Through These Lands*", brought before the Oregon Fish and Wildlife Commission on September 24, 2020.

2. The futility of spending money and time on public lands creating beaver habitat, restoring stream-floodplain connectivity, and relocating beavers into these areas to further restoration and habitat building only to allow beavers to be killed via trapping and hunting.

3. The impact that historic and current trapping had, and continues to have, on beaver populations, the habitat they create and maintain, and the biodiversity that the habitat sustains.

4. The unwillingness of state wildlife agencies to protect beavers and allow them to help address climate change impacts and biodiversity loss as they modify their environments.

Only issues 3 and 4 are discussed below given the awareness of the crises, and the obvious contradiction between building habitat and relocating beavers only to allow them to be killed.

Impact of Historic and Current Beaver Trapping on Stream Ecosystems

Prior to the arrival of Europeans in North America, beavers, scientifically known as *Castor canadensis*, were found in nearly all aquatic habitats and estimated at 60-400 million individuals.[8] They created and maintained vast networks of rich wetland habitat and complex rivers that generated much of the early wealth of what would become the United States.

Beginning in the 1600s, beavers began to be systematically trapped out of streams in response to demands of the international fur trade. If not for the fact that the beaver hat went out of style in the mid-1800s[9] beavers may have gone extinct. As for the vast wetlands and complex river systems they created and maintained, and the abundant biodiversity their habitat sustained, these decreased as dams failed and were not repaired, channels incised, widened and were simplified, and water tables dropped. Riparian vegetation shifted to dryland species as other land uses took hold and gigatons of greenhouse gases, such as carbon dioxide, were emitted into the atmosphere.

The result of these historic changes is that stream ecosystems, and the human and wild communities that depend on them, are more vulnerable to climate variability.[10] This vulnerability is rapidly increasing as climate change accelerates and the risk of system failure grows. Current beaver trapping and hunting contributes to this increased vulnerability by removing beavers during their breeding and pregnancy season when they are most secure from wild predators (winter). Removal of beavers means dams are no longer maintained, leading to dam failure and loss of habitat. It also means that populations remain suppressed, preventing the dispersal needed to build new dams and create new complex habitat such as wetlands. While some degraded streams will need a human assist because of specific site conditions, many streams simply lack beavers.

Inability of State Wildlife Agencies to be Proactive in Climate Change Preparations

Beavers are key to rapid and landscape-scale restoration of stream ecosystems and wetland development. Yet state wildlife agencies refuse to provide protections. Currently, only California and New Mexico have trapping bans that protect beavers, and these are recent. California closed its entire state to

[8]Naiman et al. (1988). Alteration of North American Streams by Beaver. *BioSciences*, Vol. 38, No. 11, pp. 753- 762, *citing Seton (1929).*
[9]Backhouse, F. (2015). Once They Were Hats: In Search of the Mighty Beaver**.**
[10]Fouty (2018). Euro-American beaver trapping and its long-term impact on drainage network form and function, water abundance, delivery, and system stability [Chapter 7] In: *Johnson et al (tech. eds.), Riparian research and management: Past, present, future: Volume 1. Gen. Tech. Rep. RMRS-GTR-377. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station*. p. 102-133

all trapping in 2019 and New Mexico closed its public lands to all trapping in 2022. These closures took 15 to 20 years to accomplish, and eventually required legislative action.

In Oregon, known as the "the beaver state," efforts to protect beavers have been underway for the last 14 years without success. The most recent efforts to close public lands to beaver trapping and hunting involved proposals brought before the Oregon Fish and Wildlife Commission (2020, 2022) and the Oregon state legislature (2021). These efforts failed even as Oregon experienced severe droughts and wildfires that left towns burned to the ground, charred remains of livestock and wildlife, and fish belly up as sediment and ash filled the streams. The efforts failed even though Oregon has had two prior state-wide beaver trapping closures (1899-1917 and 1932-1952),[11] and less than 200 people in the state currently trap and hunt beavers on Oregon's public lands.[12]

Oregon's two prior state-wide legislative closures were enacted in response to water and soil resource concerns. The first closure (1899-1917) followed on the heels of the 1893 closures in drought-prone Baker and Malheur Counties to improve stream flows.[13] Beaver-generated benefits were considered so important that Oregon kept its national forests closed even when other parts of the state were reopened to trapping. In contrast to this prior proactive approach, beaver trapping and hunting is currently allowed on public lands even though 50% or more of the state has experienced moderate to exceptional drought in eight of the last ten years (2013-2022).[14]

State regulations vary. Beaver trapping and hunting seasons range from a couple of months to year-round. Most states have no limits to the number of beavers that can be killed, and reporting requirements are minimal. The failure of the state wildlife agencies to protect beavers is puzzling until one realizes that their goal is to meet the desires of hunters and trappers who contribute to their funding via licenses and equipment purchases. As a result, state wildlife agencies ignore the wealth of information about the societal, economic, and environmental benefits derived from beaver-created and maintained habitat. They ignore the serious consequences of climate change and biodiversity loss to communities and the essential contributions beavers can make towards improving conditions. And they ignore studies showing that the cessation of trapping, or its absence after beaver reintroductions, result in increased beaver numbers, distribution, habitat, and benefits (references).

The narrow focus of the state wildlife agencies has serious consequences. Failure to protect beavers is helping keep hundreds of thousands of miles of streams locked into degraded conditions. It is also contributing to the billions of dollars in lost benefits and in the emotional and financial costs incurred as floods, droughts, and wildfires destroy towns, livelihoods, and fish and wildlife, and as distinct salmon populations become listed as threatened, endangered, or go extinct (video). On the West Coast alone, NOAA has listed 28 population groups of salmon and steelhead as threatened or endangered under the Endangered Species Act.[15] Clearly, the broader human and wild community can no longer afford the luxury of this narrow state wildlife focus. A new national approach to this ecosystem engineer is needed.

[11]Kebbe, C.E. (1960). Oregon's beaver story. *Oregon State Game Commission Bulletin*. February 1960. No. 2, Vol. 15: pp. 3-6.
[12]Oregon Department of Fish and Wildlife (2022). Oregon Furbearer Information Summary and Regulation Proposals: 2022–2023 and 2023–2024. Table 1 (p.10) and Appendix 11 (p. 26)
[13]Kebbe, C.E. (1960); Gilliam, L.L. (1942). History of beaver planting in Oregon with recommendations for planting in the future. Bachelor of Science thesis. School of Forestry, Oregon State University. 31p.
[14]https://droughtmonitor.unl.edu/Maps/MapArchive.aspx
[15] https://www.fisheries.noaa.gov/species/pacific-salmon-and-steelhead#esa-protected-species

THE RESTORATIVE POWER OF THIS EXECUTIVE ORDER

An executive order is unique in its ability to create a uniform policy and provide clear and decisive leadership. Using the federal government's constitutional and statutory authority to manage the land, fish, and wildlife under its care, as granted by Congress and upheld in various Supreme Court decisions (authority),[16] an executive order protecting beavers would achieve the following:

- Send a clear message that our nation is serious about implementing nature-based climate solutions to address climate change and biodiversity loss.

- Allow benefits to be maximized and made rapidly available to broad and diverse human and wild communities.

- Initiate stream restoration processes that will bring CCS zones and other benefits online in some locations in as little as two to five years, such as improved water quality, quantity, and channel complexity needed by salmon, steelhead, and a host of other human and wild communities.

- Demonstrate that this administration will take bold action that directly addresses community priorities, and rising anxiety levels felt especially by our youth, related to the climate change crisis[17] as they watch their future become increasingly untenable.

- Create opportunities for private landowners to learn about the water and habitat benefits related to beaver activity and the effectiveness of coexistence strategies *without risk.* This opportunity allows them to decide if they will welcome beavers in the streams that flow through their lands in order to gain the benefits and, in turn, contribute to the well-being of their community.

Actively promoting nature-based solutions on public lands creates hope. It allows Americans and agencies to participate in and accelerate recovery of water-rich ecosystems and carbon capture and storage zones at the landscape scale. Opportunities include improving habitat and installing low-tech, process-based restoration structures such as beaver dam analogs. These structures are valuable when streams are so degraded that dams frequently fail[18] as they alter a stream's hydrology and power such that beaver dams can persist and benefits expand (video).[19] However, artificial structures are supporting players in promoting landscape-scale recovery. These structures need maintenance, are inflexible, and costly if done at the scale required to help reduce climate change impacts. In contrast, robust beaver populations maintain and expand the natural infrastructure and habitat they create at little to no cost, adapt their dams to changing conditions, and repair them when needed.

MAXIMIZING BENEFITS FOR AND MINIMIZING IMPACTS ON COMMUNITIES

An effective executive order designed to develop abundant and widely-distributed nature-based carbon capture and storage zones (wetlands), capture other valuable benefits, and capitalize on interconnected

[16]Nie, et al. (2017). Fish and Wildlife Management on Federal Lands: Debunking State Supremacy. *Environmental Law*, 47, no. 4.
[17]Hickman et al. (2021). Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *Lancet Planet Health*, Vol. 5, Issue 12; Responsive Management (2016). Oregon Residents' opinions on and values related to Oregon Department of Fish and Wildlife. See pages 8, 66-67, and 70-71 of 200; The Conservation Fund (2013). Houston-Galveston – Green Infrastructure and Ecosystem Services Assessment. See pages 8-11 of 16.
[18]Demmer and Beschta (2008). Recent History (1988-2004) of Beaver Dams along Bridge Creek in Central Oregon. *NW Science,* Vol. 82. No. 4
[19]Bouwes et al (2016). Ecosystem experiment reveals benefits of natural and simulated beaver dams to a threatened population of steelhead (*Oncorhynchus mykiss). Scientific Reports:* 6:28581

nature-based climate solutions (beavers, wetlands, healthy stream ecosystems) must include the following elements:

- **Stop** the hunting and trapping of beavers on public lands with a few exceptions. The exceptions identified are Native American sovereignty, bona fide scientific research, and relocation trapping for ecosystem management (exceptions).

- **Direct** federal land management agencies to prioritize beaver-wetland creation and maintenance in all land-management decisions, and to employ and maintain coexistence strategies on public lands to address any beaver-human infrastructure conflicts.[20] These strategies are more durable and cost-effective than repeated killing of beavers,[21] and leave the benefits they provide intact.

- **Allocate** funds to the following federal agencies to undertake activities related to expanding beaver numbers and dams on public lands.

    - Federal Land Management Agencies (Bureau of Land Management, Forest Service, Department of Defense, National Park Service, Fish and Wildlife Service)

        - Restore stream ecosystems in ways that facilitate the expansion and persistence of beavers, their dams, and the habitat they create.
        - Employ and maintain appropriate coexistence strategies on public lands to address any beaver-infrastructure conflicts.
        - Monitor and report on changing conditions in habitat diversity, distribution and area, and if appropriate, wildlife such as migratory birds.
        - Create and post educational signage notifying the public of the moratorium on beaver trapping and hunting on federal public land and benefits gained.
        - Partner with local nonprofits such as watershed councils and conservation groups and help fund their beaver-related stream restoration and co-existence efforts.

    - Natural Resources Conservation Service (NRCS):

        - Share with interested landowners the benefits beavers could bring to their property.
        - Help with costs and expertise of implementing and maintaining coexistence strategies.
        - Partner with local nonprofits such as watershed councils and conservation groups and help fund their beaver-related stream restoration and coexistence efforts.

    - US Geological Survey:

        - Create and maintain a national database to track hectares of beaver-created wetlands coming online and changes in mean carbon stock and rates of carbon sequestration.
        - Install stream gauges to track changes in flood peaks and baseflows in response to improved stream conditions related to beaver-created wetlands and ponds and increased channel complexity and floodplain connectivity.

[20]Coexistence strategies websites: 1, 2, 3, 4, 5

[21]Boyles and Savitzky (2008). An Analysis of the Efficacy and Comparative Costs of Using Flow Devices to Resolve Conflicts with North American Beavers Along Roadways in the Coastal Plain of Virginia. *Proceedings – Vertebrate Pest Conference*; Hood et al. (2017). Mitigating infrastructure loss from beaver flooding: A cost-benefit analysis. *Human Dimensions of Wildlife*; Callahan et al. (2019). Billerica Municipal Beaver Management Program 2000 - 2019 Analysis. *Assoc. of MA Wetland Scientists*, 7 p.

- Install and monitor groundwater wells in the areas of beaver-created wetlands to assess changes in groundwater storage and water table rises.

- NOAA Fisheries:

  - Fund research into beaver expansion and distributions as it relates to salmon recovery.
  - Monitor and report on conditions of distinct populations of salmon, their numbers, and their geographic distributions and connection to beaver habitat.

- Civilian Climate Corps:

  - Provide youth and young adults with paid professional opportunities that:

    - Restore stream ecosystems in ways that facilitate the expansion and persistence of beavers, their dams, and the habitat they create.
    - Assist federal agencies in collecting and analyzing monitoring data.
    - Implement and help maintain beaver-human coexistence strategies.

CONCLUSION

Mr. President, our window to minimize the worsening effects of climate change and biodiversity loss is closing. As our life support systems continue to degrade, restoration becomes more difficult and costly, and likelihood of success diminishes. Water and water-rich habitats are and will remain essential resources, and we need the assistance of beavers to restore their quality and availability if we are to help maintain the health and well-being of our human and wild communities.

We urge you to take this step and issue an Executive Order protecting this vital ecosystem engineer. Nature-based climate solutions make good societal, economic and environmental sense. As Americans work with beavers, we will begin seeing changes in a couple of years if not sooner. These changes will come at little to no cost, and bring enormous benefits to all of us.

Thank you for your consideration. Western Watersheds Project looks forward to answering any questions or concerns that members of your administration might have.

Sincerely,

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Director for Oregon & Nevada
Western Watersheds Project
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Suzanne Fouty

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Charles F. Sams, Director, National Park Service
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Ali Zaidi, Assistant to the President and National Climate Advisor to lead the Climate Policy Office
John Podesta, Senior Advisor to the President for Clean Energy Innovation and Implementation
Dr. Jane Lubchenco, Deputy Director for Climate and Environment, White House Office of Science and Technology Policy
Stephenne Harding, Senior Director for Lands, Council for Environmental Quality
Rep. Raúl M. Grijalva, Chair, House Natural Resources Committee
Sen. Tom Carper, Chair, Senate Environment and Public Works Committee
Sen. Joe Manchin, Chair, Senate Energy and Natural Resources Committee
Rep. Suzan DelBene, Sponsor of the *Dams (Developing Alternative Mitigation Systems) for Beavers Act*

Sign-on Disclaimer: *University and agency affiliations provided for informational purposes only to indicate the credentials of the cosigners and do not necessarily reflect the official policy or position of the agency or university.*

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Rewilding the American West

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After taking office, President Biden signed an executive order announcing his America the Beautiful plan to conserve 30% of US land and water by 2030. He challenged Americans to collaboratively "conserve, connect, and restore the lands, waters, and wildlife upon which we all depend" at a national scale (US Departments 2021, p. 9). Here, we take a major step in advancing President Biden's plan by envisioning a bold and science-based rewilding of publicly owned federal lands (hereafter, *federal lands*) in the American West. Beyond concerns for human survival and flourishing, a principled commitment to the natural world and a sense of moral urgency underpins the motivation for our proposal.

In general, rewilding aims to reestablish vital ecological processes that can involve removing troublesome nonnative species and restoring key native species. Our rewilding call is grounded in ecological science and is necessary regardless of changing political winds. Our objective is to follow up on President Biden's vision to conserve, connect, and restore by identifying a large reserve network in the American West suitable for rewilding two keystone species, the gray wolf (*Canis lupus*) and the North American beaver (*Castor canadensis*).

We focus first on the gray wolf, a wide-ranging species requiring extensive areas of habitat. Gray wolves were largely eradicated from the American West following Euro-American colonization and manifest conquest of the West. Through measures afforded by the US Endangered Species Act, in the mid- to late 1990s, gray wolves were reintroduced to portions of the northern Rocky Mountains and Mexican gray wolves (*Canis lupus baileyi*) to portions of New Mexico and Arizona. Nevertheless, the wolf's current range in the 11 Western states is approximately 14% of its historical range (figure 1a). Once likely numbering in the tens of thousands, there may be as few as approximately 3500 wolves in the American West today (supplemental table S1). As an apex predator, wolves can trigger strong ecological effects on prey and plants across a variety of landscapes of western North America (Beschta and Ripple 2009).

Beaver restoration forms a second key feature of our rewilding proposal. Beaver populations had once been robust across the American West but were decimated by an estimated 90% to 98% in the wake of settler colonialism and are now extirpated from many streams (Butler and Malanson 2005). By felling trees and shrubs and building dams, beavers enrich fish habitat, increase water and sediment retention, maintain water flows during drought, provide wet fire breaks, improve water quality, initiate recovery of incised channels, increase carbon sequestration, and generally enhance habitat for many riparian plant and animal species (Castro et al. 2015). Beaver restoration is a cost-effective means of repairing degraded riparian areas. Although riparian areas occupy less than 2% of the landscape, they provide habitat for up to 70% of wildlife species (Poff et al. 2012).

The Western Rewilding Network

To identify prospective habitat for rewilding, we considered potential gray wolf core habitat on federal lands in 11 Western states (see the supplemental material). We began with wolves, because their recovery and persistence require large areas. We then identified areas of contiguous federally managed lands within core wolf habitat that were at least 5000 square kilometers [km^2].

That analysis revealed a potential network of 11 large reserves spanning the American West, which we term the Western Rewilding Network (figure 1b, supplemental figure S1, supplemental table S2). We mapped the spatial links between certain pairs of these 11 reserves using connectivity modeling (figures 1c, supplemental figures S2, S3, and S4).

Finally, we cataloged the threatened and endangered plant and animal species, including subspecies and distinct population segments, that had at least 10% of their ranges within the Western Rewilding Network. For each of these species, we determined threats, at least in part, associated with resource extraction industries, including livestock grazing, logging, mining, and oil and gas drilling (see the supplemental material).

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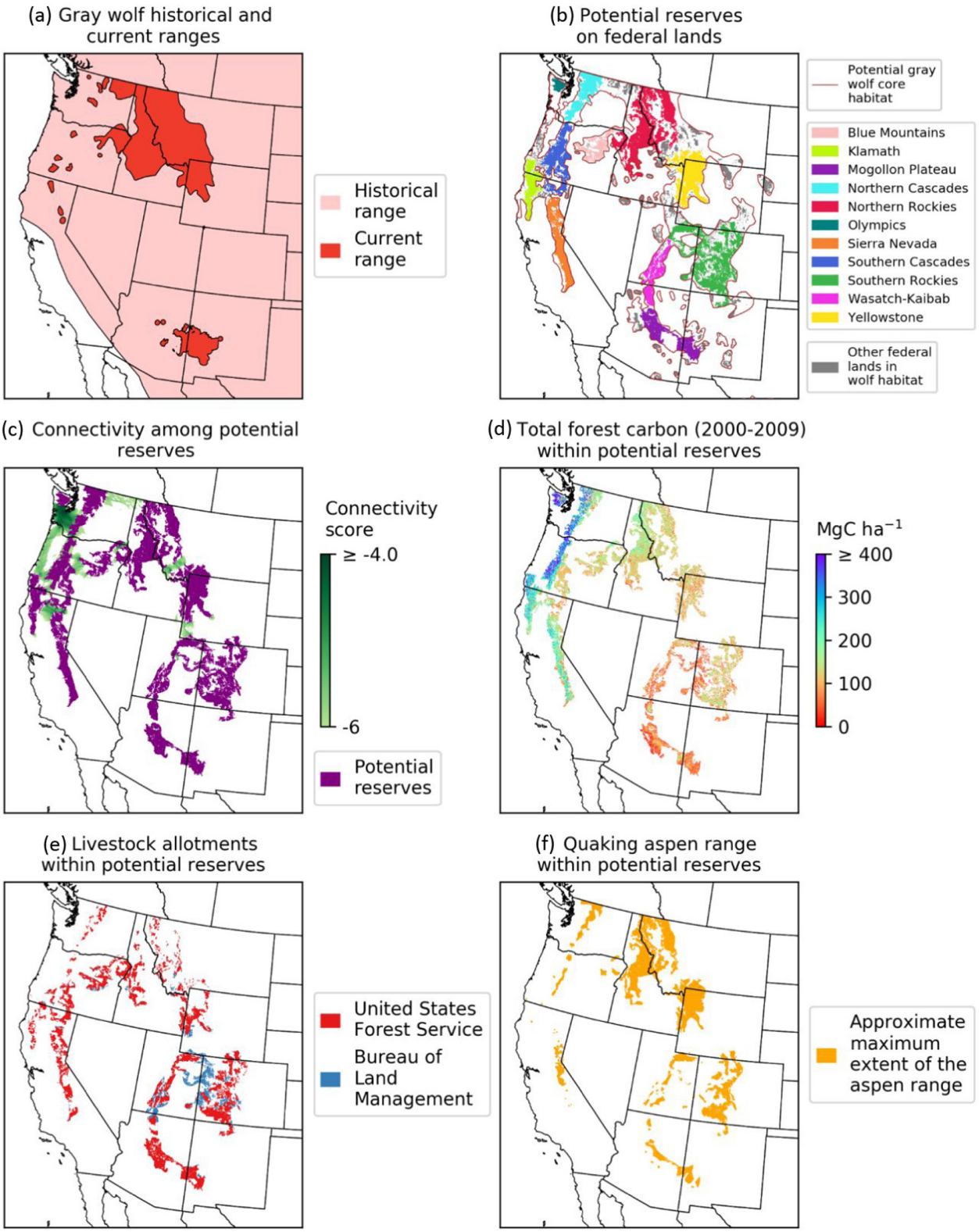

Figure 1. Proposed reserve network for the American West. The gray wolf range (a) could be expanded significantly through the establishment of large reserves corresponding to patches of potential core habitat on federally managed lands that cover at least 5000 square kilometers (b). Most reserves are closely connected to nearby reserves as shown in green (c). The proposed reserves harbor large amounts of forest carbon (d) and successful rewilding will depend on retirement of grazing allotments within potential reserves (e), thus offering great benefits for biodiversity, including aspen (f) and other species. See the supplemental material for data sources.

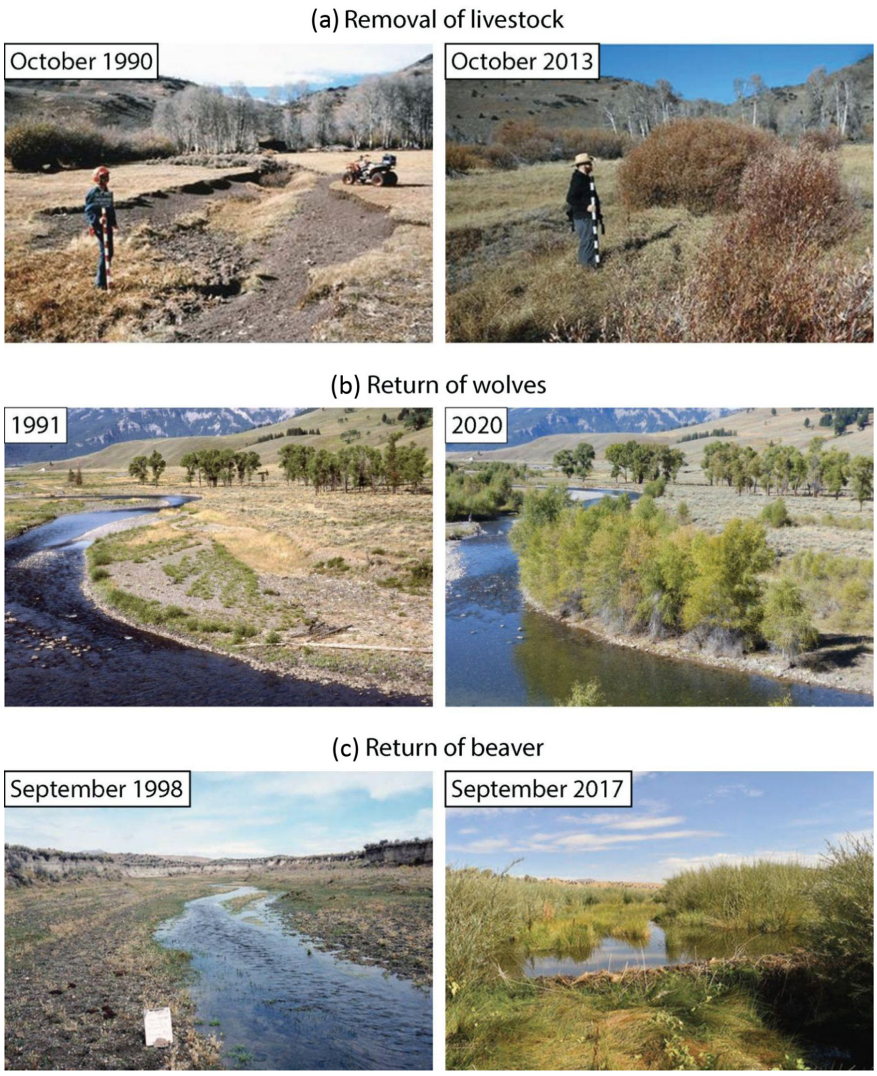

Figure 2. Paired photo examples of recovering riparian or aquatic habitats. The removal of livestock in 1991, Hart Mountain National Antelope Refuge, south-central Oregon (a). The reintroduction of wolves in 1995–1996, northern range of Yellowstone National Park, north-western Wyoming (b). Altered livestock grazing management that allowed sufficient riparian plant community recovery for beavers to return, north-central Nevada (c). Photographs: (a) Removal of Livestock, left photo from US Fish and Wildlife Service, right from photo Jonathan Batchelor; (b) Return of Wolves, left photo from National Park Service, right photo from Robert L. Beschta; (c) Return of Beaver, left and right photos from US Bureau of Land Management.

The Western Rewilding Network currently includes 92 threatened and endangered species across nine taxonomic groups: five amphibians, five birds, two crustaceans, 22 fishes, 39 flowering plants, five insects, 11 mammals, one reptile, and two snail species (supplemental table S3). The reserves with the greatest numbers of threatened and endangered species were the Mogollon Plateau (n = 24) and the Southern Rockies (n = 23). Overall, livestock grazing poses by far the most common threat (48% of species; n = 44), followed by mining (22%; n = 20), logging (18%; n = 17) and oil and gas drilling (11%; n = 10; supplemental figure S5). In 7 of the 11 potential reserves, at least half of the listed species are threatened by livestock grazing (supplemental figure S6). In all of the 11 potential reserves, average stream densities (stream orders 2–7) exceed 50 meters per km^2, suggesting significant opportunities for high density beaver restoration (supplemental figure S7).

Livestock grazing is ubiquitous on federal lands in the American West (figure 1e, supplemental figure S8) and, astoundingly, even occurs within some protected areas, such as wilderness areas, wildlife refuges, and national monuments (supplemental figure S9, table S2). Federal lands with managed livestock allotments often have various ecological impacts because of the multiple direct and indirect effects of these introduced large herbivores. For example, in many areas, livestock grazing causes stream and wetland degradation, affects fire regimes, and inhibits the regeneration of woody species, especially willow (*Salix* sp.; Beschta et al. 2013, Kauffman et al. 2022).

Although the effects of livestock grazing management on riparian areas are well known, there are also possible multitrophic effects on a host of wild animals such as herbivores, pollinators, and predators (Filazzola et al. 2020), as evidenced by the 23 animal species within the proposed reserves at risk from livestock grazing (table S3). Ruminant livestock are also a significant source of greenhouse gas emissions, especially methane, and their ecosystem impacts can exacerbate warmer and drier conditions, potentially shifting landscapes from carbon sinks to carbon sources (Kauffman et al. 2022). Moreover, limiting grazing and logging within strategic areas of federal lands can play an important role in mitigating climate change by protecting existing carbon stocks (figure 1d, supplemental figure S10; Law et al. 2021).

Based on our analysis, we suggest a rewilding plan for the proposed reserve network that includes: (1) retiring livestock grazing allotments on federal land within the proposed reserve network; (2) protecting, reestablishing, or recovering gray wolves,

especially within the network; and (3) reintroducing beaver in suitable habitat within the network. These three rewilding steps could greatly improve ecosystem structure and function, especially in riparian areas (figure 2). It is important to consider the order of the rewilding steps. For example, it generally makes sense to reintroduce beaver after livestock grazing on federal lands has been halted, allowing for a period of initial restoration of riparian woody vegetation on which beaver depend (Small et al. 2016).

Rewilding benefits

The ecological benefits of our rewilding plan would accrue over time, becoming greatest when wolves and beaver are allowed to reach ecologically effective densities (Soulé et al. 2003). In addition to eliminating the adverse effects of livestock grazing within the identified reserve network, it would be important to limit resource extraction industries and off-road vehicles. Because our plan prioritizes potential core areas of wolf habitat that occur mostly in forested areas, it spatially complements the proposed Sagebrush Sea Reserve Network, which is focused on protecting the greater sage grouse (*Centrocercus urophasianus*) and a host of other species in the sagebrush steppe (supplemental figure S11).

Considering our plan suggests reducing grazing allotments on federal lands by 29% (285,000 km^2 out of a total of 985,000 km^2 in the 11 western states), an economically and socially just federal compensation program for those who relinquish their government grazing permits would be appropriate provided these allotments are permanently retired. However, the net economic benefits would be substantial given the social carbon cost of livestock grazing on federal lands (Kauffman et al. 2022). For all allotments, receipts from grazing fees were $125 million less than federal appropriations in 2014 (Glaser et al. 2015). There would also need to be an action plan for managing potential conflict associated with wolves and beavers in cases where they move out of the reserve network.

Our proposed network across the West offers substantial connectivity between pairs of identified reserves, supporting gene flow, climate-related range shifts, and population viability of wide-ranging native species (figure 1c). The Western Rewilding Network would help protect and restore the 44 threatened and endangered species at risk because of livestock grazing (supplemental figure S12). And, over time, it would restore riparian systems, streams, and biodiversity; ameliorate altered fire regimes; and provide climate change mitigation through increased carbon storage. Restoration efforts could also be focused on the high connectivity areas between reserve pairs with land acquisitions or easements, which would form important wildlife corridors benefitting a variety of species (figures 1c and S3, supplemental table S4). In general, rewilding will be most effective when participation concerns for all stakeholders are considered, including livestock ranchers, local communities, hunters and fishers, recreationists, state and local governments, nonprofit organizations, and other private landowners (Fleischner 2010). Indigenous people and their governments would become the key partners.

Retiring allotments on some federal lands would also decrease livestock-related conflicts between humans and large predators. Moreover, adding and preserving wolves could assist in the natural control of overabundant native ungulates. This would allow for native vegetation regrowth of important species such as aspen (*Populus tremuloides*; figure 1f), which supports highly diverse plant and animal assemblages and is in major decline in the West, often because of browsing by livestock and wild ungulates in the absence of wolves (Seager et al. 2013). Restoring another keystone species, the beaver, to streams within the network would bolster and widen the ecological benefits to riparian areas. Currently, wolf management by some of the western state governments is geared toward reducing their numbers, and it is essential that these policies be reversed and federal protected status be fully restored (see the supplement for an overview of the policies).

Although our proposal may at first blush appear controversial or even quixotic, we believe that ultra ambitious action is required (Fleischner 2010). We are in an unprecedented period of converging crises in the American West, including extended drought and water scarcity, extreme heat waves, massive fires triggered at least partly by climate change (Ripple et al. 2021), and biodiversity loss with many threatened and endangered species (table S3). Furthermore, we note that the lands in the proposed network are already owned by the public and meat produced from all federal lands forage accounts for only approximately 2% of national meat production (Leshy and McUsic 2008).

President Biden's America the Beautiful plan needs a bold, scientifically grounded organizing principle like that provided by the Western Rewilding Network and the three steps proposed for rewilding these federal lands. If implemented alongside fine-scale conservation planning, it would restore critical ecological processes with minimal human interference, protect many endangered and at-risk species, increase resilience to climate change, and sustain an array of ecosystem services. Therefore, our plan represents a historic opportunity to rewild significant portions of the American West that could serve as an inspiring model for other regions and would ensure our natural heritage remains intact for future generations.

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Supplemental material

Supplemental data are available at *BIOSCI* online

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Beaver: Nature's ecosystem engineers

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Abstract

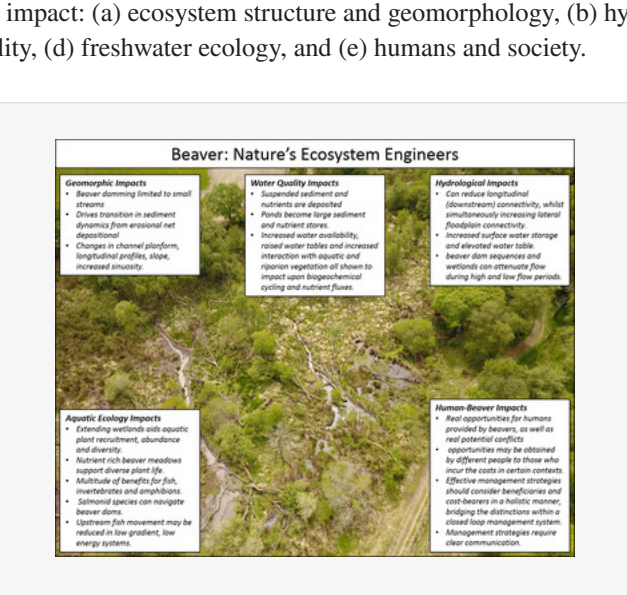
Beavers have the ability to modify ecosystems profoundly to meet their ecological needs, with significant associated hydrological, geomorphological, ecological, and societal impacts. To bring together understanding of the role that beavers may play in the management of water resources, freshwater, and terrestrial ecosystems, this article reviews the state-of-the-art scientific understanding of the beaver as the quintessential ecosystem engineer. This review has a European focus but examines key research considering both *Castor fiber*—the Eurasian beaver and *Castor canadensis*—its North American counterpart. In recent decades species reintroductions across Europe, concurrent with natural expansion of refugia populations has led to the return of *C. fiber* to much of its European range with recent reviews estimating that the *C. fiber* population in Europe numbers over 1.5 million individuals. As such, there is an increasing need for understanding of the impacts of beaver in intensively populated and managed, contemporary European landscapes. This review summarizes how beaver impact: (a) ecosystem structure and geomorphology, (b) hydrology and water resources, (c) water quality, (d) freshwater ecology, and (e) humans and society. It concludes by examining future considerations that may need to be resolved as beavers further expand in the northern hemisphere with an emphasis upon the ecosystem services that they can provide and the associated management that will be necessary to maximize the benefits and minimize conflicts.

This article is categorized under:

- Water and Life > Nature of Freshwater Ecosystems

Keywords: beaver, catchment management, ecological restoration, ecosystem engineers, hydrology

This article reviews the state-of-the-art scientific understanding of the beaver as an ecosystem engineer. It summarizes how beaver impact: (a) ecosystem structure and geomorphology, (b) hydrology and water resources, (c) water quality, (d) freshwater ecology, and (e) humans and society.



1. INTRODUCTION

Over millions of years, beavers (*Castoridae*) have developed the ability to modify ecosystems profoundly to meet their ecological needs. In doing so, they also provide valuable habitats for many other species that thrive in wetlands. They engineer ecosystems by building dams, which retain ponds, full of sediment, nutrients, plants, and wildlife. These dams slow the flow of water, reducing peak flows downstream (Puttock, Graham, Cunliffe, Elliott, & Brazier, 2017), storing and gently releasing water in times of drought (Hood & Bayley, 2008). Beavers excavate canals, laterally across floodplains, to access and transport food and building resources, enhancing floodplain connectivity and geomorphic dynamism (Gorczyca, Krzemień, Sobucki, & Jarzyna, 2018; Pollock et al., 2014). They coppice trees, providing deadwood habitat and allowing sunlight to reach understory vegetation which in turn responds in abundance and diversity (Law, Gaywood, Jones, Ramsay, & Willby, 2017), providing rich habitat for insects, birds, bats, and amphibians (Dalbeck, Hachtel, & Campbell-Palmer, 2020; Stringer & Gaywood, 2016; Willby, Law, Levanoni, Foster, & Ecke, 2018). Beavers were once present throughout Europe, Asia, and North America in large numbers, managing water resources, working with natural processes, supporting the healthy functioning of freshwaters—the very definition of a keystone species.

Consider the potential implications of removing such an animal from our ecosystems. Large areas of stored surface water are lost, rivers flow faster, becoming flashy in times of flood and with lower baseflows in times of drought. Woody debris, carbon in water—an essential building block of life in ponds, streams, rivers, estuaries, and marine environments is reduced, undermining the food-chains that it supported. Wetlands dry up, wildlife move on, or are possibly lost from ecosystems entirely. During the Anthropocene, our catchments have largely become a product of human activity that realizes all of these implications, with associated additional pressures including; hydrological extremes, diffuse pollution, and soil erosion (Hewett, Wilkinson, Jonczyk, & Quinn, 2020). The natural disturbance and dynamic equilibrium maintained by beaver activity drives geomorphic and ecological complexity, in their absence, riparian ecosystems have taken on a simpler form both in terms of their structure and their function (Brown et al., 2018).

In the Northern hemisphere, beavers were hunted to near extinction and extirpated entirely in countries such as Great Britain (GB) about 400 years ago (Conroy & Kitchener, 1996). Thus, our living memory of what beaver-lands were like, is limited, in landscapes where natural recolonizations or reintroductions are now taking place. Our understanding of how *other* species co-existed with beavers, many of them dependent upon wetlands such as beaver ponds, is similarly limited. There is thus a requirement to understand the impact of beaver in contemporary ecosystems, particularly in landscapes that, since their extirpation, have been over-exploited, degraded, and altered by intensive farming and urban development.

To bring together understanding of the role that beavers may play in the management of water resources, freshwater, and terrestrial ecosystems, this paper reviews the state-of-the-art scientific understanding of the beaver as the quintessential ecosystem engineer. We focus upon research considering both *Castor fiber*—the Eurasian beaver and *Castor canadensis*—its North American counterpart, as they re-establish in ecosystems within which their numbers were decimated and are reintroduced or return to ecosystems from where they were extirpated, due to their high-value fur (for hats), castoreum (as a painkiller and perfume)—Nolet and Rosell (1998), and their scaly tail, which led the Catholic church to classify beavers as a fish—fit for consumption on Fridays and Saints days (Coles, 2006; Kitchener & Conroy, 1997; Manning et al., 2014).

The remaining two species of beaver are related to pre-historic *Castoridae* which included as many as 40 species, for example, the giant beaver (*C. Castorides spp*; Martin, 1969) and the terrestrial *C. Paleocastor spp*, famed for its spiralized burrows (Martin & Bennett, 1977). Today, the two extant species of beaver are genetically distinct with differing numbers of chromosomes (Kuehn, Schwab, Schroeder, & Rottmann, 2000). Despite their genetic and minor physiological differences, there are many similarities between the species. For example, they are visually similar and difficult to differentiate by sight alone (Kuehn et al., 2000). Until relatively recently, it was considered that the North American beaver had a tendency to build dams and lodges more frequently and of a greater size than the Eurasian beaver, but it has now been shown by Danilov and Fyodorov (2015) that, under the same environmental conditions, the building behavior of the two species does not differ.

In recent decades species reintroductions across Europe, followed by natural expansion has led to the return of *C. fiber* to much of its Eurasian range (Halley, Rosell, & Saveljev, 2012) with a recent review of national population studies, estimating that the *C. fiber* population in Europe numbers over 1.5 million individuals (Halley et al., 2012). As such, there is an increasing need for understanding of the impacts of beaver in intensively populated and managed modern European landscapes. This review focuses on Europe and *C. fiber* but draws on relevant research into *C. canadensis* in North America. The review summarizes how beaver impact: (a) ecosystem structure and geomorphology, (b) hydrology and water resources, (c) water quality, (d) freshwater ecology, and (e) humans and society. It concludes by examining future scenarios that may need to be considered as beavers expand in the northern hemisphere with an emphasis upon the ecosystem services that they can provide and the associated management that will be necessary to maximize the benefits and minimize conflicts.

2. BEAVER IMPACT UPON THE ENVIRONMENT—CONTEMPORARY UNDERSTANDING

2.1. Impacts of beaver upon geomorphology

2.1.1. Overview We take this opportunity to revisit Gurnell's (1998) review on the hydrogeomorphological effects of beaver, which provides an excellent foundation for our understanding. Beavers, as ecosystem engineers, have a marked influence upon the terrestrial and riverine environments that they occupy (Westbrook, Cooper, & Baker, 2011). Beavers are primary agents of zoogeomorphic processes; here we acknowledge their influence upon river form and process (Johnson et al., 2020) and discuss recent literature on the impacts of beaver on hydrogeomorphology.

2.1.2. Canal and burrow excavation Beavers are well known for their construction of impressive lodges, sometimes as tall as 3 m (Danilov & Fyodorov, 2015), but beavers, especially in river systems, typically excavate bank burrows in which to establish dwellings (Collen & Gibson, 2000; Rosell, Bozer, Collen, & Parker, 2005). Beavers often excavate multiple burrows in a single territory, which can contribute significant volumes of sediment to a watercourse (de Visscher, Nyssen, Pontzeele, Billi, & Frankl, 2014; Lamsodis & Ulevičius, 2012) and also create areas of weakness which can lead to localized erosion and, in some instances, the collapse of earthen flood embankments (Harvey, Henshaw, Brasington, & England, 2019).

Beavers commonly dig shallow channels, often referred to as canals, which extend laterally from beaver ponds. These structures enable beavers to access food and building resources more easily (Butler, 1991; Gurnell, 1998). Often developing into dense networks, these canals contribute significantly to the local hydrogeomorphology of floodplains, creating hydraulic roughness, tortuous flow paths, and complex topography in otherwise planar landscapes (Hood & Larson, 2015). Like burrows, these canals may act as a source of fine sediment (Lamsodis & Ulevičius, 2012; Puttock, Graham, Carless, & Brazier, 2018) or, in the event of significant overbank flows and floodplain inundation, sites of deposition. It is interesting to consider that early humans might have moved over (crossing channels on beaver dams) and through beaver landscapes crisscrossed by canals, observing beaver transporting woody building materials by water with ease, and subsequently learning to do so themselves (Coles, 2006).

2.1.3. Woody debris contribution Woody debris is a key driver of geomorphic complexity, has been shown to be a fundamental aspect of "natural" stream geomorphology and a critical habitat for aquatic life (Collen & Gibson, 2000; Gurnell, Piégay, Swanson, & Gregory, 2002; Harvey, Henshaw, Parker, & Sayer, 2018; Thompson et al., 2018; Wohl, 2014, 2015). Beaver increase the rate of both large and small woody material contribution to river systems (Gurnell et al., 2002). In small streams, the large woody material (for example felled trees) is less mobile and often remains in place, exerting a strong influence on geomorphic processes, increasing bed heterogeneity through promoting localized scour and deposition (Gurnell et al., 2002). The contribution of smaller woody fragments or cuttings has been shown to significantly increase willow (*Salix spp*) recruitment due to the provision of propagules, which can establish on gravel/sand bars (Levine & Meyer, 2019). This increases the stability of depositional features and promotes rates of aggradation and bed/bank stability.

2.1.4. Dam building Beavers have a preference for habitats with deep, slow-flowing water, to feel safe from predators (Collen & Gibson, 2000; Hartman & Tornlov, 2006; Swinnen, Rutten, Nyssen, & Leirs, 2019). Therefore, their dam-building activity is typically restricted to lower-order streams where stream power is limited (Graham et al., 2020; Gurnell, 1998; Macfarlane et al., 2015; Rosell et al., 2005) and water depths may not be sufficient (normally <0.7 m depth) for beaver movement and security. When dam building does occur, it increases the area of lentic (still freshwater) habitats in systems that are typically dominated by lotic (free-flowing freshwater) habitats (Hering, Gerhard, Kiel, Ehlert, & Pottgiesser, 2001). Damming typically reduces downstream connectivity, and conversely increase lateral connectivity, forcing water sideways into neighboring riparian land, inundating floodplains, and creating diverse wetland environments (Hood & Larson, 2015) as well as contributing to soil and groundwater recharge (Westbrook, Cooper, & Baker, 2006). Dams vary significantly in their size and structure depending on physical factors such as hydrology, topography, and building materials but also ecological factors (Graham et al., 2020). Hafen, Wheaton, Roper, Bailey, and Bouwes (2020) found that primary dams, that maintained a lodge pond, were significantly larger than secondary dams, which are used to improve mobility and the transport of woody material, concluding that beaver ecology, in addition to channel characteristics, exerts a primary control on dam size.

2.1.5. Agents of erosion Erosion often occurs at the base of dams, due to a localized increase in gradient and stream power (Gurnell, 1998; Lamsodis & Ulevičius, 2012). Woo and Waddington (1990) observed that flow across the dam crest may be concentrated in gaps, enhancing erosion of the stream bed and banks downstream of the dam, forming plunge pools, and widening the channel, respectively. Lamsodis and Ulevičius (2012) observed the geomorphic impacts of 242 dams in lowland agricultural streams in Lithuania; of which, 13 (5.4%) experienced scour around the periphery of the dam.

Beaver dams are also key sites for channel avulsion (Giriat, Gorczyca, & Sobucki, 2016; John & Klein, 2004), as shown in Figure 1. John and Klein's (2004) study investigated the geomorphic impacts of beaver dams on the upland valley floor of the third-order River Jossa (Spessart/Germany). Due to the creation of valley-wide dams, which extended beyond the confines of the bank, multi-thread channel networks developed across the floodplain. Newly created channels would deviate from the main stream channel, re-entering the river some way downstream. At the point where the newly created channel enters the stream, a difference in elevation results in the development of a knickpoint. This knickpoint then propagates upstream through head-cut erosion, eventually relocating the main stem of the channel.

FIGURE 1

Examples of dam construction and channel avulsion resulting from beaver dam construction from the River Otter catchment, England. Panel (a) shows an example where a divergent flow path has re-entered the main channel resulting in head-cut erosion. Panel (b) shows the type of multi-thread channel form that occurs downstream of dams in wide, low gradient floodplains. Panel (c) shows a beaver dam on a 4th order stretch of river. (Reproduced with permission from Photos © Hugh Graham and Alan Puttock)

2.1.6. Agents of aggradation Hydrogeomorphic changes, due to beaver engineering, are likely to have implications for stores and downstream fluxes of sediment and associated nutrients (Butler & Malanson, 1994; Lizarralde, Deferrari, Alvarez, & Escobar, 1996a). Sediments mobilized and transported from upstream are deposited in beaver ponds, due to a decrease in velocity associated with a reduction in water surface gradient (Giriat et al., 2016) and consequently stream power (Butler & Malanson, 1994).

Pollock, Lewallen, Woodruff, Jordan, and Castro (2017) showed lower concentrations and loads of suspended sediment leaving a beaver site in contrast to those entering the site, while Puttock et al. (2018) showed that within the same site the beaver pond sequence was storing 100 t of sediment combined with an associated 16 t of carbon and 1 t of nitrogen. It is therefore suggested that beaver dams and ponds can create landscapes with depositional sediment regimes exerting a significant influence over channel sediment budgets, akin to the pre-anthropocene dam and woody debris that once played a vital role in the evolution of river networks and floodplains, through the storage of sediment and nutrients and creation of riparian wetland and woodland (Brown et al., 2018).

The large mass of sediment (over 70 kg per m^2 of ponded extent) being stored in a relatively small area (1.8 ha) reported by Puttock et al. (2018) represents similar levels of aggradation to those reported in studies, primarily from North America. Beaver dam sequences on lower order streams have previously been shown to account for up to 87% of sediment storage at reach scales, while the removal of a sequence of beaver dams in Sandon Creek, British Columbia, leads to the mobilization of 648 m^3 of stored sediment (Butler & Malanson, 1994, 1995; Page et al., 2005). Butler and Malanson (1994, 1995), also reported sediment accumulation rates of 2–28 and 4–39 cm $year^{-1}$ for different beaver pond sequences in Glacier National Park, Montana. Values of sediment accumulation from North American beaver systems indicate the estimated average accumulation value of 5.4 cm $year^{-1}$ presented by Puttock et al. (2018) in Great Britain may be at the lower end of what is possible in bigger dam–pond complexes or systems with a more plentiful sediment supply. In one of the few other studies in European landscapes, de Visscher et al. (2014) studied sediment accumulation in two beaver pond sequences in the Chevral River, Belgium. de Visscher et al. (2014) estimated that the total sediment mass deposited in the dam sequences at 495.9 t. From the two pond sequences, average pond area was 200.4 m^2, average sediment depth 25.1 cm, and average sediment mass of 14.6 t, equating to a normalized mass of 72.65 kg of sediment deposited per m^2 of the pond. These values are very similar to the mean sediment depth of 27 cm and mean normalized mass of 71.40 kg m^2 reported from the intensively managed grassland catchment in the UK (Puttock et al., 2018).

The sediment data published also demonstrate that beaver ponds can exhibit high sediment accumulation rates in comparison with other wetland systems. As an example, in a review of sediment accumulation rates in freshwater wetlands (Johnston, 1991) a mean annual accumulation rate of 0.69 cm $year^{-1}$ was reported across 37 different wetland types, ranging from riparian forest to wet meadows. As with the biodiversity benefits of beaver ponds (see Willby et al., 2018 and Section 2 below) the high sediment accumulation rate of beaver ponds in relation to other freshwater wetlands, may reflect the highly dynamic nature of beaver systems, their constant evolution, and sustained maintenance (i.e., continuous dam-building).

The long-term fate of sediment will depend on the availability and composition of deposited sediment, the flow regime, and the preservation of dam structures (Butler & Malanson, 2005; de Visscher et al., 2014). Over many years, sediment may continue to accumulate until each pond fills completely and sediments are colonized by plants forming beaver meadows (Polvi & Wohl, 2012). However, beavers can also contribute to downstream sediment budgets; through the excavation of canal networks and bank burrows (de Visscher et al., 2014; Lamsodis & Ulevičius, 2012), in addition to the release of sediment following dam outburst floods (Curran & Cannatelli, 2014; Levine & Meyer, 2014). Beaver dam failure can result in releases of sediment (Polvi & Wohl, 2012) meaning that sediment storage in ponds can be transient (de Visscher et al., 2014). However, differential retention dynamics have been reported following dam collapse. For example, Giriat et al. (2016) found that there were very minimal losses of sediment from beaver ponds studied in Poland, following a dam collapse. Similarly, the majority of sediments were retained in ponds and subsequently stabilized following dam reconstruction (Curran & Cannatelli, 2014; Levine & Meyer, 2014) most likely reducing the downstream release of sediment from any single dam failure within the complex (Butler & Malanson, 2005; Puttock et al., 2018). While recent studies in North America involving extensive survey work have expanded knowledge of beaver dam persistence significantly (Hafen et al., 2020), including persistence during large rainstorm events (Westbrook, Ronnquist, & Bedard-Haughn, 2020), resilience, failure, and associated sediment dynamics are likely to be highly spatially and temporally variable. As identified in Section 2.2 for both hydrological, geomorphic, and associated sediment/water quality impacts a greater mechanistic understanding of dam failure is therefore still required.

Finally, high levels of nutrient-rich sediment have also been shown to result in further biogeomorphic alterations, that is, colonization by homogenous patches of herbaceous or shrubby species, adding roughness to topography, reduced water velocities, and encouraging further deposition of sediments. Additionally, partial felling and submergence of woody debris disrupts flows and when felled in-channel, creates enforcement for existing dam structures (Curran & Cannatelli, 2014).

2.1.7. Impacts of dams on river profile Beaver dams have two main effects on river profile; (a) long-profile is altered such that a stepped profile develops with sections of reduced gradient, that promote aggradation, upstream of dams separated by hydraulic jumps, created by flow over the dams, which initiates erosion. (b) Channel planform typically increases in complexity with many studies reporting; greater sinuosity, channel width, and the development of a multi-thread planform (Ives, 1942; John & Klein, 2004; Pollock et al., 2014; Wegener, Covino & Wohl, 2017). These increases in cross-profile complexity are driven by an increase in the heterogeneity of flow direction, which drives lateral flow, increasing bank erosion, channel widening, and subsequent localized deposition (Gorczyca et al., 2018).

2.1.8. Agents of river restoration In an undisturbed or near-pristine riverine system, the engineering behavior of beaver may simply maintain an evolving geomorphic structure, sustaining a state of dynamic equilibrium in river function. In degraded landscapes (which are much more common), where river planforms are incised, single thread, straightened, even dredged, and lacking in geomorphic diversity, beaver have a dramatic impact on channel planform at multiple scales. In North America, beaver dams and their human-constructed counterparts, known as beaver dam analogs, have been shown to restore degraded river systems (Pollock, Beechie, & Jordan, 2007), primarily through the aggradation of channel beds, leading to greater channel-floodplain connectivity (Macfarlane et al., 2015; Pollock et al., 2014).

Dams, however, are not rigid structures—they influence and are influenced by flow regimes (Johnston & Naiman, 1987) as is evidenced in Figure 2 (after Pollock et al., 2014). In narrow, incised channels, typical of degraded landscapes, beaver dams will capture some sediment but predominantly provide a foci for erosion. In these confined channels, unit stream power is high and therefore dams will frequently blow-out and erode laterally. The resultant effect is a widening of the channel, which leads to a concomitant decline in stream power, thus allowing for greater aggradation rates and less frequent blow-outs altering the sediment regime from net erosional to net depositional (Butler, 1995; Butler & Malanson, 2005). Over time, incised, straightened streams can be restored to complex multi-threaded channel systems that represent a return to the pre-anthropocene streams and rivers that were once common across north-west Europe (Brown et al., 2018). In Poland, beaver initiated geomorphic processes were shown to have artificially homogenized river reaches and thus it has been suggested that they may have a substantial role to play in the renaturalization of river systems (Gorczyca et al., 2018).

FIGURE 2

The influence of beaver activity on the geomorphology of incised streams: (a) low-flow damming of confined channels with high-flow blowouts causes overtopping, bank widening, and excavation of the channel bed; (b) sediment becomes more mobile and the channel reconfigures with vegetation establishment; (c) channel widening reduces high-flow peak stream power and this provides suitable conditions for wider, more stable dams; (d) sediment accumulates in ponds and raises the height of the channel with dams overtopped and small blow-outs occurring where dams are abandoned; (e) process repeats until dams are rebuilt, channel widens and the water table rises sufficiently to reconnect river channel to the floodplain; and (f) high heterogeneity occurs with vegetation and sediment communities establishing themselves, multi-threaded channels and ponds increase reserves of surface water and dams and dead wood reduce flows and provide wetland habitats. (Reproduced with permission from Pollock et al., 2014)

2.1.9. Summary of geomorphic impacts

- Beaver damming activity is mostly limited to ≤fifth-order streams as low stream power is favorable for dam-building and persistence, with a reduction in the frequency of blowouts.
- Beavers drive a transition in sediment dynamics from dominantly erosional to net depositional, while increasing the spatial variability of both erosional and depositional features.
- Geomorphic change due to beaver is often characterized by changes in channel planform, longitudinal profiles, water surface and channel bed slope, increased sinuosity, and enhanced floodplain connectivity and surface roughness.

2.1.10. Gaps in geomorphic understanding

- At present, the majority of geomorphology-facing beaver research is from North America. Several studies from Europe indicate strong parallels between the geomorphic impacts between continents. However, geomorphic impacts are strongly influenced by local geography and therefore further monitoring is necessary to complement these findings.
- Research on the impacts of beaver on geomorphic processes is required at larger spatial extents and longer temporal scales. At present, most research focuses on site/reach scale observations, which must be continued in dialogue with long-term, catchment scale monitoring and modeling to build understanding at landscape scales.
- The effects of beaver activity on short-term sediment storage/mobilization due to bank-burrowing and canal excavation, has not yet been substantially investigated.

2.2. Impacts of beaver upon hydrology

2.2.1. Overview There is an increased need to recognize the influence of biology upon river form and process (Johnson et al., 2020) and beavers as recognized ecosystem engineers are a key example of the ability of an animal to influence hydrological functioning. While other beaver engineered structures discussed in Section 2.1, such as burrows and canals, have a measurable impact (Grudzinski, Cummins, & Vang, 2019), the biggest (and most studied) hydrological impact of beavers results from their dam-building ability and the consequent impoundment of large volumes of water in ponds (Butler & Malanson, 1995; Hood & Bayley, 2008). Dam and pond features can alter hydrological regimes, both locally and downstream (Burchsted & Daniels, 2014; Polvi & Wohl, 2012). Beaver activity can reduce downstream hydrological connectivity, and conversely increase lateral connectivity, forcing water sideways into neighboring riparian land, inundating floodplains, and creating diverse wetland environments (Macfarlane et al., 2015), while also contributing to soil and groundwater recharge (Westbrook et al., 2006).

Multiple studies have identified beaver dam sequences and wetlands as a cause of flow attenuation—so-called "slowing the flow" (Green & Westbrook, 2009; Gurnell, 1998; Pollock et al., 2007). This impact has been attributed to the increase in water storage in beaver pond sequences, relative to undammed reaches (Westbrook et al., 2020), and increased hydrological roughness from the creation of dams and complex wetlands (Puttock et al., 2017), resulting in water being trapped or slowed as it moves through, over and around beaver dams. For example, Green and Westbrook (2009) found the removal of a sequence of beaver dams resulted in an 81% increase in flow velocity. The slow movement of water in beaver impacted sites is attributed to two main mechanisms: (a) increased water storage and (b) stream discontinuity and reduced longitudinal hydrological connectivity (Puttock et al., 2017). The increase in storage provided by beaver ponds and wetlands (Grygoruk & Nowak, 2014; Gurnell, 1998; Woo & Waddington, 1990) lengthens water retention times and reduces the velocity of the water. This in turn can increase the duration of the rising limb of the flood hydrograph which can reduce the peak discharge of floods (Burns & McDonnell, 1998; Green & Westbrook, 2009; Nyssen, Pontzeele, & Billi, 2011). Additionally, water stored in beaver ponds is released slowly as the porous dams gently leak both during and following rainfall, elevating stream base flows even during prolonged dry periods (Majerova, Neilson, Schmadel, Wheaton, & Snow, 2015; Puttock et al., 2017; Woo & Waddington, 1990), increasing environmental resilience to risks including drought and fire (Fairfax & Whittle, 2020).

Water levels in ponds vary significantly as a result of meteorological conditions both over long (i.e., seasonal) and short (i.e., inter-event) timeframes (Puttock et al., 2017; Westbrook et al., 2020). Consequently, seasonal variations in water storage have been observed (see Majerova et al., 2015 for example). It might be expected that the attenuating impact of flow due to storage will be less during wet periods. However, it has been proven that beaver activity still attenuates flow during large events. For example, see Nyssen et al. (2011) who conducted one of the few in-channel hydrological studies of Eurasian beaver; finding that flow attenuation was in fact greatest during largest events. In 2013, Westbrook et al. (2020) monitored the largest recorded flood in the Canadian Rocky Mountains west of Calgary, Alberta, challenging the commonly held assumption that dams fail during large floods (the majority fully or partially persisted) and showing that water storage offered by beaver dams (even failed ones) delayed downstream flood peaks. Therefore, it has been argued that the observed discontinuity or reduced downstream hydrological connectivity resulting from beaver dam-building activity—also shown by Butler and Malanson (2005), is a key reason for the flow attenuation impact persisting even for larger events during wetter periods (Puttock et al., 2017).

Of course, beaver dam construction is highly variable and depends on the existing habitat, building material availability, and channel characteristics (Collen & Gibson, 2000; Woo & Waddington, 1990). Woo and Waddington (1990) identified multiple ways in which dam structure will influence flow pathways and that streamflow can overtop or funnel through gaps in the dams, leak from the bottom of the dams or seep through the entire structure. While the impact of dam structure upon connectivity and therefore, flow velocity will differ (Hering et al., 2001; Woo & Waddington, 1990), all dams will increase channel/hydraulic roughness and therefore, deliver some flow attenuation effect, which can be most significant when a suite of dams in close proximity are constructed (for example see Puttock et al., 2017 case study). Thus, in addition to dam structural variations, it is important to note that the number of dams and their density will strongly influence any observed differences in hydrological function. Existing work has also discussed the importance of the number of dams in a reach, with beaver dams having the greatest impact on hydrology when they occur in a series (Beedle, 1991; Gurnell, 1998). Similarly, sequences of (non-beaver) debris dams in third order, Northern Indiana (USA) streams were found to increase the retention time of water by a factor of 1.5–1.7 (Ehrman & Lamberti, 1992). Ponds located in series provide both greater storage and greater roughness, resulting in a greater reduction in flow velocities as shown by Green and Westbrook (2009). In another study, pond sequences have been shown to reduce the peak flows of 2-year return floods by 14% whereas individual dams reduced flood peaks of similar events by only 5.3% (Beedle, 1991).

There are very few hydrological modeling studies into the impacts of beaver dam sequences upon flow regimes. In European landscapes, this perhaps reflects the fact that until recently there has been both a dearth of beaver dams themselves and also a lack of empirical understanding of the impact on hydrological functioning. In a notable exception, Neumayer, Teschemacher, Schloemer, Zahner, and Rieger (2020) undertook hydraulic modeling of beaver dam sequences and evaluated their impacts during flood events. Utilizing surveys of beaver dam cascades in Bavaria and 2D hydraulic modeling, Neumayer et al. (2020) predicted that during small flood events, beaver dams can deliver significant impacts upon peak flows (up to 13% reductions) and lag/translation times (up to 2.75 hr). But, Neumayer et al. (2020) also predicted that during larger floods (return period ≥2 years), the impact upon peak flows of a single dam sequence may be smaller (ca. 2%) and perhaps negligible at the catchment outlet. However, Neumayer et al. (2020) modeled the impacts of beaver dams on channels larger than those that other research has shown might support the greatest densities of dams (i.e., Graham et al., 2020 show that dams rarely persist on >fifth-order streams) and thus it is suggested that further modeling work is required into the downstream hydrological impacts of small streams with high dam densities. In addition, further research is required to understand what the cumulative catchment outlet effects might be if beavers return to being widespread and catchments contain multiple dam sequences (i.e., hundreds of dams) in all headwater streams.

2.2.2. Summary of hydrological impacts

- Beavers can reduce longitudinal (downstream) connectivity, while simultaneously increasing lateral connectivity, pushing water sideways.
- Beavers can increase surface water storage within ponds and canals, while also elevating the water table and contributing to groundwater recharge.
- Beaver dam sequences and wetlands can attenuate flow during both high and low flow periods.

2.2.3. Gaps in understanding: Hydrology

- A greater mechanistic understanding of the hydrological impacts of beaver dams and also critically sequences of beaver dams across scales and land uses to inform hydrological modeling, management, and policy decision making.
- Conditions of dam failure and consequences.
- Greater understanding of beaver landscape engineering upon low flow conditions and wetland maintenance during drought.

2.3. Impacts of beaver upon water quality

The altered flow regimes and water storage capacity discussed in Section 2.2 can also modify sediment regimes and nutrient and chemical cycling in freshwater systems. As a consequence of reduced downstream connectivity and a change from lotic to lentic systems, beaver activity is believed to alter both local and downstream sediment dynamics, and water quality via both abiotic and biotic processes (Cirmo & Driscoll, 1996; Johnston, Pinay, Arens, & Naiman, 1995). It has been argued that two key mechanisms affect the difference in downstream dynamics of water quality observed in beaver systems: (a) slowing of flow resulting in the physical deposition of sediment (reviewed in Section 2.1) and associated nutrients/chemicals, (b) an increase in both ponded water and a local rise in water tables, results in an overall increase in wetness altering the biogeochemical cycling of nutrients (Puttock et al., 2017).

2.3.1. Impacts on nutrient cycling When beaver dams inhibit the transport of fine sediments, large volumes of organic and inorganic compounds become stored within beaver ponds (Rosell et al., 2005), including; nitrogen, phosphorus, and particulate (bound) carbon (Lizarralde et al., 1996; Naiman, Pinay, Johnston, & Pastor, 1994). This change increases the volume of anoxic sediments and provides organic material to aid microbial respiration. Nutrients are temporarily immobilized in pond sediments and taken up by aquatic plants, periphyton, and phytoplankton. Increases in plant-available nitrogen, phosphorus, carbon, and increased light availability (due to canopy reduction) favor the growth of instream and riparian vegetation, thus further immobilizing nutrients within plant biomass that re-establishes local nutrient cycles (Rosell et al., 2005). In addition to the impacts of large volumes of sediment, the reduction in free-flowing water and increased decomposition has been shown to increase anaerobic conditions in both pond surface water and saturated soils (Ecke et al., 2017; Rozhkova-Timina, Popkov, Mitchell, & Kirpotin, 2018).

Lazar et al. (2015) show that beaver ponds have a denitrification impact while results from Puttock et al. (2017) showed Total Oxidized Nitrogen (TON) and Phosphate (PO_4-P) to be significantly lower in waters leaving a beaver impacted site compared with water quality entering. These reductions manifest both in terms of concentrations and loads of nutrients, suggesting that beaver activity at the site created conditions for the removal of diffuse pollutants from farmland upstream. Correll, Jordan, and Weller (2000) found that prior to dam construction, TON concentrations were significantly correlated with river discharge but after dam construction, no significant relationship was observed, although there was a correlation between discharge and nitrate (NO_3-N). Similarly, Maret, Parker, and Fannin (1987) identified reductions in Total Kjeldahl Nitrogen (TKN) downstream of beaver dams during high flows. It has also been shown that beaver ponds are particularly effective at NO_3-N retention (K. J. Devito, Dillon, & Lazerte, 1989). It is suggested, therefore, that in agriculturally dominated catchments where diffuse pollution rates are high, beaver ponds may be effective tools to manage N-related diffuse pollution problems from intensive agriculture upstream (Lazar et al., 2015).

Puttock et al. (2017) show that beaver ponds can also act as sinks for phosphorus associated with sediments, while Maret et al. (1987) identified that suspended sediment was the primary source of phosphorus found leaving a beaver pond; therefore, during conditions when more sediment is retained behind the dam than is released, total phosphorus retention will increase. In a study of a beaver impacted and non-beaver impacted catchment (Dillon, Molot, & Scheider, 1991), found total phosphorus export was higher in the non-impacted catchment suggesting that phosphorus was being stored somewhere within the catchment—most probably in the beaver ponds. Lizarralde et al. (1996) also reported that while phosphorus concentrations were significantly higher in riffle sediments, due to extensive wetland creation, total storage was highest in Patagonian beaver ponds. Previous studies have focused primarily on the relationship between discharge and phosphorus concentrations and yields leaving ponds, with inconclusive results. Devito et al. (1989) reported a strong positive correlation between phosphorus loads and stream discharge, however, Maret et al. (1987) report a negative correlation between phosphorus concentrations and discharge and Correll et al. (2000) report no correlation between nutrient flushing and stream discharge following dam construction. Climatic and seasonal changes (Devito & Dillon, 1993; Klotz, 2007) and organic matter availability (Klotz, 2007, 2013) have been shown to also affect in-pond phosphorus-dynamics. With regard to downstream impact, the key consensus, that is supported by the correlation between suspended sediment and phosphate concentrations observed in Puttock et al. (2017) is that beaver ponds are effective at retaining phosphorus associated with high sediment loads (Devito et al., 1989; Maret et al., 1987).

Ecke et al. (2017) suggest age dependency as a factor in nitrogen and phosphorus dynamics, with older, more solid dams increasing retention compared to younger more leaky dams. In a review of beaver impacts upon nitrogen and phosphorus content in ponds and downstream, Rozhkova-Timina et al. (2018) cite contradictory information and study results as showing there is a strong contextual dependence and it is clear that further research into the controlling mechanisms of nutrient retention is required.

In contrast to the trends observed for nitrogen and phosphorus, multiple studies, that is, Puttock et al. (2017) and Cazzolla Gatti et al. (2018) found concentrations and loads of Dissolved Organic Carbon (DOC) increase due to beaver activity. This increase is attributed to enhanced sediment and nutrient storage in addition to the overall increase in wetland extent creating an environment rich in organic matter, as previously shown by Vecherskiy, Korotaeva, Kostina, Dobrovol'skaya, and Umarov (2011). Similarly, Law, McLean, and Willby (2016), using color as a proxy for DOC, observed increased concentrations below a series of beaver dams. Dams trap sediment-bound particulate carbon meaning that ponds can act as net stores of carbon (D. Correll et al., 2000; Lizarralde et al., 1996; Naiman, Melillo, & Hobbie, 1986). However, as a consequence of this overall increase in carbon availability, significant exports of DOC have been observed either downstream (D. Correll et al., 2000; Naiman et al., 1994) or in comparison with non-beaver impacted catchments (Błędzki, Bubier, Moulton, & Kyker-Snowman, 2011). Several authors have speculated that the cause of this DOC release relates to (a) incomplete decomposition processes making DOC more available for loss (Cirmo & Driscoll, 1996); (b) enhanced production during primary productivity; (c) a product of enhanced microbial respiration (D. Correll et al., 2000); and (d) retention of particulate organic carbon and litter entering the site and subsequent decomposition (Law et al., 2016). Based upon research in western Siberia, Cazzolla Gatti et al. (2018) argue that beaver activity simultaneously increases nutrient cycling and DOC availability at the same time as increasing carbon sequestration as carbon is accumulated in sediment and removed from the short-term carbon cycle.

pH has been shown to be a first-order control on DOC production and transport in other wetlands (Clark, Lane, Chapman, & Adamson, 2007; Grand-Clement et al., 2014). However, Cirmo and Driscoll (1996) found that a beaver impacted catchment contained higher levels of DOC both before and after $CaCO_3$ treatment (to reduce acidity) when compared with a non-impacted catchment, suggesting that pH plays a limited role in the production of DOC in beaver ponds. Puttock et al. (2017) showed pH to be marginally more alkaline in water leaving the site, which is in agreement with other studies showing more acidic waters in beaver ponds than immediately downstream (Cirmo & Driscoll, 1993; Cirmo & Driscoll, 1996; Margolis, Castro, & Raesly, 2001). However, whether these changes in pH were of a large enough magnitude to alter within site biogeochemical cycling is as yet unclear.

Increased water availability in beaver systems, in addition to a change in chemistry associated with a transformation from lotic to lentic waters, has also been ascribed by multiple studies to control increased leaching of heavy metals from soils and increased concentrations in waters downstream. Releases from pond or increases in downstream concentrations of calcium, iron, and magnesium (for example) were observed by Naiman et al. (1994) and C. A. Johnston et al. (1995), while Levanoni et al. (2015) and Margolis et al. (2001) also observed downstream increases in manganese and observed increasing methylmercury concentrations both downstream of beaver sites and in macroinvertebrates within beaver sites. In a meta-analysis review, Ecke et al. (2017) found young ponds to be a source for methylmercury in water, while old ponds were not, again highlighting that beaver systems are complex and dynamic with a high degree of context-dependence required to understand their impacts upon water quality.

2.3.2. Summary of water quality impacts

- Beaver wetlands and dam sequences can change parts of freshwater ecosystems from lotic to lentic systems impacting upon sediment regimes and biogeochemical cycling.
- By slowing the flow of water, suspended sediment and associated nutrients are deposited, with ponds shown to be large sediment and nutrient stores.
- Increased water availability, raised water tables, and increased interaction with aquatic and riparian vegetation have all been shown to impact positively upon biogeochemical cycling and nutrient fluxes.

2.3.3. Water quality gaps in understanding

- Sediment and nutrient dynamics within dam sequences as opposed to individual dams and ponds.
- A greater understanding is required of the contributing source of sediment and nutrients to beaver ponds.
- How long-term beaver dam sequences and wetland dynamics contribute to downstream water quality.
- How the impoundment of water, sediments, and associated nutrients in ponds affects biogeochemical cycling and resulting transfers of nutrients in both gaseous and dissolved forms to understand the contribution of beavers to overall nutrient budgets in both the carbon and nitrogen cycles.

3. BEAVER IMPACTS UPON LIFE—CONTEMPORARY UNDERSTANDING

Go to:

3.1. Impacts of beaver upon aquatic ecology

Enhancement of natural processes, floodplain inundation, lateral connectivity, and structural heterogeneity in beaver-impacted environments creates a diverse mosaic of habitats. Such habitats are underpinned by greater provision of food, refuge, and colonizable niches, which form the cornerstone of species-rich and more biodiverse freshwater wetland ecosystems (Brazier et al., 2020; Campbell-Palmer et al., 2016; Gaywood et al., 2015; Gurnell, 1998; Rosell et al., 2005; Stringer & Gaywood, 2016). Readers are directed to three reviews on this topic: Stringer and Gaywood (2016), which provides a comprehensive overview of the impacts of beaver on multiple species, Dalbeck et al. (2020) which considers the impacts of beavers on amphibians in temperate European environments and Kemp, Worthington, Langford, Tree, and Gaywood (2012) which provides a valuable meta-analysis of the impacts of beaver on fish. This section builds on these reviews to summarize the findings of research into the impacts of beaver activity on aquatic plants, invertebrates, and fish. We focus on these groups as they are widely considered to be strong indicator species of freshwater health and function (Herman & Nejadhashemi, 2015; Law et al., 2019; Turley et al., 2016).

3.1.1. Aquatic vegetation (macrophytes) Beavers affect aquatic vegetation through direct and indirect mechanisms over a range of spatial and temporal scales (Rosell et al., 2005). Natural disturbances, including; herbivory, food caching, tree-felling (Campbell-Palmer et al., 2016; Harrington, Feber, Raynor, & Macdonald, 2015), and/or dam-induced extension of wetland area (Gurnell, 1998; Puttock et al., 2017) can aid macrophyte recruitment (Levine & Meyer, 2019), regenerate riparian areas (Jones, Gilvear, Willby, & Gaywood, 2009), and enhance plant biodiversity from the local to the landscape scale (Law, Bunnefeld, & Willby, 2014; Law, Jones, & Willby, 2014; Law, Levanoni, Foster, Ecke, & Willby, 2019; Willby et al., 2018). Canopy-opening and floodplain inundation creates wetland areas with reduced shading (Donkor & Fryxell, 2000; Johnston & Naiman, 1990), providing opportunities for shade-intolerant, opportunistic, and wetland plant species (Law et al., 2016, 2017; Law, Levanoni, et al., 2019; Marshall, Hobbs, & Cooper, 2013). Early successional shifts in newly created wetted zones promote emergent vegetation (Ray, Rebertus, & Ray, 2001), while transitional edges form around pond margins, characterized by rich, diverse, and structurally complex plant communities (McMaster & McMaster, 2001).

Over time, beaver wetland creation, maturation, and abandonment, can result in the siltation of ponds, creating novel habitats in marshy beaver meadows characterized by spatial variability in moisture-regimes which drives higher plant species richness (Polvi & Wohl, 2012; Ray et al., 2001; Wright, Flecker, & Jones, 2003; Wright, Jones, & Flecker, 2002). As beaver meadows mature, terrestrial succession often occurs, leading to herbaceous encroachment, typically comprising grasses, shrubs, and sedges, with studies showing evidence of an eventual return to open, forested, stream environments (Johnston, 2017; Little, Guntenspergen, & Allen, 2012; McMaster & McMaster, 2001; Naiman, Johnston, & Kelley, 1988; Pollock et al., 1995; Ray et al., 2001).

3.1.2. Invertebrates and amphibians Beaver increase the heterogeneity of stream depth, flow velocity, and benthic habitats such as silty substrates, woody material (Clifford, Wiley, & Casey, 1993; France, 1997; Rolauffs, Hering, & Lohse, 2001), and both submerged and emergent vegetation, which separately support unique invertebrate species and assemblages (Benke, Ward, & Richardson, 1999; Bush & Wissinger, 2016; Law, Levanoni, et al., 2019; Wissinger & Gallagher, 1999). Beaver ponds support more lentic species (Collen & Gibson, 2000; Margolis et al., 2001; Rosell et al., 2005) and typically demonstrate increased invertebrate abundance (Czerniawski & Sługocki, 2018; Osipov, Bashinskiy, & Podshivalina, 2018; Strzelec, Białek, & Spyra, 2018; Willby et al., 2018), biomass (Osipov et al., 2018) and/or density (McDowell & Naiman, 1986). Beaver ponds may harbor unique assemblages, dominated by collector-gatherers, shredders, and/or predators (Law et al., 2016; McDowell & Naiman, 1986; Robinson, Schweizer, Larsen, Schubert, & Siebers, 2020; Strzelec et al., 2018). However, diversity may be reduced due to the typically homogenous benthic habitat within ponds resulting from increased fine sediment deposition (Descloux, Datry, & Usseglio-Polatera, 2014; Pulley, Goubet, Moser, Browning, & Collins, 2019). At broader scales, varying successional stages in beaver wetlands, as well as longitudinal variability in habitat type along with beaver dam-pond sequences (e.g., Margolis et al., 2001), increases the taxonomic, trophic, and/or β-diversity of aquatic invertebrate communities compared to environments lacking beaver modification. This is primarily due to the heterogeneity of habitat benefiting a range of both lotic and lentic species (Bush, Stenert, Maltchik, & Batzer, 2019; Law et al., 2016; Pollock et al., 2017; Willby et al., 2018). Furthermore, the storage of sediment and nutrients within beaver ponds improves water quality (Puttock et al., 2017) downstream and therefore enhances habitat for pollution-sensitive species (Rosell et al., 2005; Strzelec et al., 2018).

The gradual release of water from beaver ponds maintains flows during dry periods (Section 2.1), thereby increasing invertebrate resilience to drought by providing refuge pools and greater post-drought recolonization potential (Wild, 2011; Wissinger & Gallagher, 1999). High-head dams promote high velocity and turbulent water over, through, or around dams in side-channels, creating habitat suitable for lotic species, which can otherwise be rare in low-gradient stream reaches (Clifford et al., 1993; Law et al., 2016). In addition, cold hyporheic upwelling and lower stream temperatures downstream of high-head dams, and at depth in beaver ponds, has been shown to benefit the reproductive success of invertebrate species such as mayflies (Fuller & Peckarsky, 2011).

Beaver-engineered woody structures, such as dams and lodges, offer key invertebrate habitats resulting in greater abundance (France, 1997), biomass, density (McDowell & Naiman, 1986; Rolauffs et al., 2001), productivity, richness (France, 1997; Rolauffs et al., 2001), and diversity (Benke, Van Arsdall, Gillespie, & Parrish, 1984) compared to beaver ponds and free-flowing streams. Direct benefits for invertebrates arise from physical complexity, such as the interstices of dams, lodges, bank burrows, and canals, which offer spaces suitable for novel microhabitats (Hood & Larson, 2015; Willby et al., 2018), refuge from predators (Benke & Wallace, 2003), egg-laying (oviposition) sites (Gaywood et al., 2015), and emergent metamorphosis (Wallace, Grubaugh, & Whiles, 1993). These woody structures also provide attachment sites for filter-feeding organisms and foraging resources for species that feed on woody material (xylophagous) and those that feed on the epixylic biofilms which grow on woody surfaces (Godfrey, 2003; Hering et al., 2001; Strzelec et al., 2018). For example, deadwood-eating (saproxylic) beetles are known to occupy beaver-impacted habitats (Horák, Vávrová, & Chobot, 2010; Stringer & Gaywood, 2016). In addition, the retention of organic particulate matter in beaver ponds enhances foraging opportunities for aquatic invertebrates, particularly gatherers and shredders (Johnston, 2014; Law et al., 2016; Wohl, 2013). Organic drift can also bring wider benefits within catchments, increasing the abundance and/or richness of invertebrates in areas both downstream (Redin & Sjöberg, 2013) and upstream (Rolauffs et al., 2001) of beaver-modified sites.

Dalbeck et al. (2020) conclude that beavers and their habitat creating activities can be pivotal determinants of amphibian species richness, particularly in the headwater streams. The creation of lentic zones in beaver modified wetlands is cited as an essential breeding habitat for amphibian species, but can also be important for entire life history requirements (Cunningham, Calhoun, & Glanz, 2007), with beaver ponds offering sites where reliable spawning and early metamorphosis can take place, in instances comprising exclusive ovipositional sites within wider wetlands (Dalbeck, Janssen, & Luise Völsgen, 2014). Beaver modifications, which increase lentic-rich habitat heterogeneity and/or raise light levels and solar radiation, warming patches of water, in turn, support healthier amphibian assemblages. Such improvements manifest via greater species-richness (Cunningham et al., 2007), diversity (Bashinskiy, 2014; Cunningham et al., 2007; Dalbeck, Lüscher, & Ohlhoff, 2007), colonization rates and abundance (Anderson, Paszkowski, & Hood, 2015; Dalbeck et al., 2014; Stevens, Paszkowski, & Foote, 2007), older-pond density (Stevens et al., 2007), size and productivity compared to unmodified habitats, with connectivity between ponds and through beaver canals reducing distances between breeding and foraging sites (Anderson et al., 2015). Woody complexes which form lodges and dams may also provide valuable habitat which amphibians can use for larval food provision and development (Tockner, Klaus, Baumgartner, & Ward, 2006), potential overwintering hibernation sites (Stevens et al., 2007) or cover from predators (Tockner et al., 2006), with cover options offering predatorial and larval protection by areas of shallow emergent-vegetated pond margins (Dalbeck et al., 2007; Vehkaoja & Nummi, 2015). Conversely, lotic obligate species may be negatively affected by beaver activity (Stringer & Gaywood, 2016), although studies have demonstrated the persistence and high abundance of stream-dependent species on the unimpounded reaches of beaver modified streams (e.g., Cunningham et al., 2007).

3.1.3. Fish Beavers and fish have cohabited for millennia (Malison & Halley, 2020) and have previously been shown to coexist positively (Kemp et al., 2012). As such, it is no surprise that beaver-induced habitat changes, particularly increased heterogeneity, can benefit fish populations (Figure 3). Documented benefits include increased: growth rates (Malison, Eby, & Stanford, 2015; Pollock, Heim, & Werner, 2003; Rosell & Parker, 1996), survival (Bouwes et al., 2016), biomass (Bashinskiy & Osipov, 2016), density (Bouwes et al., 2016; Wathen et al., 2019), productivity (Osipov et al., 2018; Pollock et al., 2003; Pollock, Pess, Beechie, & Montgomery, 2004), species richness (Snodgrass & Meffe, 1998), and diversity (Smith & Mather, 2013). Additional benefits to fish include the creation of juvenile rearing habitat (Johnson & Weiss, 2006; Leidholt-Bruner, Hibbs, & McComb, 1992; Pollock et al., 2004), overwintering habitat (Chisholm, Hubert, & Wesche, 1987; Cunjak, 1996; Malison et al., 2015), migratory respite (Virbickas, Stakėnas, & Steponėnas, 2015), enhanced spawning habitat (Bylak, Kukuła, & Mitka, 2014), greater invertebrate food availability (Rolauffs et al., 2001), and refugia from low-flows (Hägglund & Sjöberg, 1999), high discharge (Bouwes et al., 2016), temperature extremes (Wathen et al., 2019), and predation (Bylak et al., 2014). It is for these reasons, that recent approaches in the US have used beaver reintroduction to enhance habitat in support of salmonid reintroduction and/or conservation (Bouwes et al., 2016).

FIGURE 3

Flow Diagram of expected change following beaver return. (Reproduced with permission from Bouwes et al., 2016)

Due to the wide range of changes that beavers bring about, the benefits listed above will likely manifest for a variety of freshwater fish species through a wider understanding of these impacts is required as most research has focused upon interactions between beaver and salmonid species. Salmonids, particularly anadromous species (migrating from the sea to spawn in rivers) hold significant financial, cultural, and recreational value from a fisheries perspective (Butler, Radford, Riddington, & Laughton, 2009). Unfortunately, for a variety of reasons, which have nothing to do with beavers, populations of salmonid populations in Europe are in decline, and the two most abundant native salmonids, the Atlantic salmon (*Salmo solar*) and the Brown/Sea trout (*S. trutta*) are under threat (Forseth et al., 2017). Research in the US has largely shown that beaver reintroduction aids the recovery of salmonid populations (e.g., Bouwes et al., 2016; Wathen et al., 2019); however, despite the long-term coexistence of these species, the expansion and reintroduction of beavers across European landscapes, now substantially altered due to anthropogenic activity, has raised concerns regarding the potential impact that beaver activity may have on salmonid species (Malison & Halley, 2020).

Two recent studies have investigated the impacts of beaver on salmonid habitat and populations in upland streams (Bylak & Kukuła, 2018; Malison & Halley, 2020). Both of these studies report increased habitat patchiness and heterogeneity in river systems that are typically dominated by fast-flowing habitat. Neither study found evidence to suggest that beaver dams prevented fish movement either upstream or downstream. However, Malison and Halley (2020) did find that the presence of beaver dams affected the frequency of movement between stream reaches, suggesting that either beaver dams may act to restrict daily home ranges of salmonids, or the increased local habitat complexity around beaver dams reduces the need for salmonids to travel greater distances. A conflicting finding of these studies is that of the use of ponds by salmonids. In agreement with numerous studies that found beaver ponds to provide valuable rearing habitat (Malison, Lorang, Whited, & Stanford, 2014; Weber et al., 2017) and habitat niches for different stages of salmonid life cycles (Bouwes et al., 2016; Wathen et al., 2019), Bylak and Kukuła (2018) observed that brown trout used different beaver-created habitats throughout their life stages. However, Malison and Halley (2020) reported that they did not observe beaver ponds being used as salmon rearing habitat. Both studies report either no significant effect of beaver on fish populations (Malison & Halley, 2020) or a positive impact on the community composition and patch dynamics (Bylak & Kukuła, 2018).

Virbickas et al. (2015) studied the impacts of beaver on two lowland Lithuanian streams. Unlike, the studies from upland streams, Virbickas et al. (2015) found evidence to suggest that beaver dam sequences do restrict upstream movement of salmonids with reaches below and between ponds being used but no salmonids or redds (spawning sites) being observed upstream of beaver dam complexes. While the presence of beavers did enhance community evenness upstream of dams, this effect was attributed to the exclusion of salmonids, which typically dominated fish communities downstream of dams.

The scale of such studies should be considered carefully in the context of mobile and dynamic species of fish. Bylak and Kukuła (2018) present data from the longest period of monitoring in Europe. They show that the response of fish to beaver activity enhances metacommunity resilience but consequently localized fish communities may alter for short periods of time. However, in these upland systems, high flows capable of "blowing out" dams are more frequent (Macfarlane et al., 2017) thus allowing unimpeded fish movement during these periods. In lowland systems, such as those investigated by Virbickas et al. (2015) the increased hydrological stability may result in a longer lasting separation of fish communities up and downstream of beaver dams. In low gradient systems, where spawning habitat is located solely in the upper reaches of a catchment, the presence of dams could potentially limit access to these reaches, affecting spawning success or resulting in the formation of new spawning habitat, such as the clean gravel bars which commonly form at the tail end of beaver ponds and immediately downstream of dams (Bouwes et al., 2016).

Further research on the impacts of fish across varied European landscapes is required. These studies should seek to understand the effect of beaver on fish communities at the catchment scale. It is well established that fish can navigate beaver dams (Bouwes et al., 2016; Bylak & Kukuła, 2018; Malison & Halley, 2020; Virbickas et al., 2015). However, a greater understanding is required to quantify the importance of any reduced longitudinal movement of fish alongside the known benefits including an increase in food availability and greater habitat diversity.

3.1.4. Aquatic ecology summary

- Beaver activity creating wetland areas aids aquatic plant recruitment, abundance, and species diversity.
- Nutrient-rich beaver meadows result in mature beaver managed landscapes, contributing diverse plant life, and increasing patchiness in otherwise homogeneous (especially intensively farmed) landscapes.
- Heterogeneity of beaver habitat leads to greater diversity of invertebrates, benefitting both lotic, and lentic species.
- Slow release of water from beaver ponds elevates baseflow downstream supporting greater aquatic life, improving resilience especially in times of drought.
- A multitude of benefits accrue for fish due to beaver activity such as increased habitat heterogeneity and food availability.
- It is established that salmonid species can navigate beaver dams, though there is evidence that the presence of dams does alter the way they move within river networks. The impact of dams on salmonid movement is highly dependent on location and upstream movement may be reduced in low gradient, low energy systems.

3.1.5. Aquatic ecology gaps in understanding

- Community level, catchment scale understanding of beaver interactions with fish of all species is required to determine whether the changes seen—returning freshwaters to something akin to pre-anthropocene conditions, are overall positive (as current literature suggests) or negative and thus requiring management interventions.
- The narrow, riparian landscapes of many European countries, wherein intensive agriculture encroaches on freshwaters, need further research into the impacts of beavers on both existing vegetation and that which may emerge if more space for water and beavers is made.
- Changes to the ecological status of freshwaters inhabited by beavers are inevitable and research to understand the impact on goals of the Water Framework Directive is needed, to contextualize what is meant by "good" ecological status now that beavers are present.

3.2. Human–beaver interactions

The potential benefits and impacts of beaver reintroduction (outlined above for the environment) can also manifest for humans. Notably, flow attenuation resulting from beaver damming will be likely to reduce potential for flooding of properties downstream. There is a further socioeconomic benefit not as yet explored in this article; as beavers bring more wildlife to ecosystems, beaver lands can become a focus of wildlife tourism, where humans interact with wild animals or with animals in enclosures (Higginbottom, 2004; Moorhouse, D'Cruze, & Macdonald, 2017). Wildlife tourism is a growing global trend which can engage people with nature, with their experiences often contributing toward local communities, providing benefits for mental health and well-being, and incentivizing nature conservation behaviors (Curtin, 2009; Curtin & Kragh, 2014; Higginbottom, 2004; Lackey et al., 2019; Newsome, Rodger, Pearce, & Chan, 2019; Skibins, Powell, & Hallo, 2013).

Much wildlife tourism is centered upon "charismatic species" (Curtin, 2010; Skibins et al., 2013), but some are motivated by the intention to support wider biodiversity rather than charismatic species alone (Hausmann, Slotow, Fraser, & Minin, 2017). Beavers are often considered charismatic and, as a keystone species, are associated with biodiverse landscapes, which they create and maintain. Thus, they exhibit both those traits that motivate wildlife tourism. Beaver tourism activities that currently exist in Europe include "beaver safaris", guided tours of beaver-modified landscapes, and information centers (Campbell, Dutton, & Hughes, 2007; Halley et al., 2012; Rosell & Pedersen, 1999). Beaver tourism and associated support for local communities is therefore often cited as one of the reasons for reintroduction where beavers are not yet present (Campbell et al., 2007; Gaywood, 2018; Gurnell et al., 2009; Jones, Halley, Gow, Branscombe, & Aykroyd, 2012; Moran & Lewis, 2014).

There are, however, a number of challenges experienced where beaver and humans interact. In Europe, these are observed mostly where beaver impacts interact with human interests within the riparian zone (Campbell-Palmer et al., 2016; Halley et al., 2012; Heidecke & Klenner-Fringes, 1992), particularly in upper and marginal reaches of watercourses where beaver will undertake the largest-scale habitat alteration (Graham et al., 2020; Halley et al., 2012). For example, where water is stored behind beaver dams, it may inundate land owned by humans which could lead to a financial cost, especially when associated with agriculture or forestry (Campbell-Palmer et al., 2016; Gaywood et al., 2015; Morzillo & Needham, 2015; Parker et al., 1999). Other notable impacts can include beaver burrow collapse and bank erosion in agricultural land (Campbell-Palmer et al., 2016; Gurnell, 1998), beaver grazing on arable crops (Campbell-Palmer et al., 2016, p.; McKinstry & Anderson, 1999), or the felling of particular trees of human importance (Campbell-Palmer et al., 2016; Campbell-Palmer, Schwab, & Girling, 2015). Perhaps not surprisingly, beaver are perceived more negatively by people where these conflicts occur (Enck et al., 1992; Jonker et al., 2010; McKinstry & Anderson, 1999; Payne & Peterson, 1986).

Practical management interventions exist that can be employed to address these factors, including dam removal, bank stability management, flow device installation (to lower water levels), tree protection, restoration of riparian zone as management, supported further by compensation or positive incentive payments (Campbell-Palmer et al., 2015; Campbell-Palmer et al., 2016; Morzillo & Needham, 2015; Pollock et al., 2017). To reduce the potential for further conflicts, however, particularly those that occur between people over species management (Marshall, White, & Fischer, 2007; Redpath, Bhatia, & Young, 2015), it is recognized that engaging with affected individuals and sharing in the decision-making processes for management of beaver is vital (Coz & Young, 2020; Decker et al., 2015, 2016; Redpath et al., 2015).

A recent study of local peoples' attitudes toward beaver in Romania and Hungary demonstrated that beaver was often viewed negatively when related to provisioning ecosystem services but positively regarding regulatory or cultural services. As such the study called for recognition of this complexity in perceptions to minimize conflicts, through "reciprocal learning" between conservationists and locals in adaptive management (Ulicsni, Babai, Juhász, Molnár, & Biró, 2020). For beaver, there are a number of management frameworks which seek to engage with affected parties across Europe in a variety of ways, for example: in Bavaria (Germany), regional authorities employ two beaver managers to oversee a network of volunteer beaver consultants throughout the region (Pillai & Heptinstall, 2013; Schwab & Schmidbauer, 2003); in the Netherlands, the government monitors the beaver population and provides management advice to landowners (Pillai & Heptinstall, 2013); in France, the state authorities provide an advisory service at a catchment scale (Campbell-Palmer et al., 2015; Campbell-Palmer et al., 2016; River Otter Beaver Trial, 2019). However, although engagement is a key component of management strategies, there are to date, few European studies describing attitudes towards beaver (Ulicsni et al., 2020).

The case is different in Great Britain where beaver is currently being reintroduced at a politically devolved level (with the reintroduction status at varying stages throughout the nations) as there have been a number of studies of attitudes towards the species. This may be because an understanding of social factors is a requirement of reintroduction according to the guidelines set by the International Union for the Conservation of Nature (IUCN & SSC, 2013); these guidelines were published in 2013 after many of the reintroduction projects in mainland Europe (Halley et al., 2012), and of course, these guidelines do not apply to established or naturally dispersing populations of beaver that were not therefore "reintroduced". Additionally, there is a recent increase in recognition in the literature that the human dimension of environmental projects is a key component of their success or failure (Bennett et al., 2017a, 2017b; Chan et al., 2007; IUCN & SSC, 2013; Redpath et al., 2015). For example, conflicts between humans and wildlife, or between humans about wildlife, may result in threats to species populations or the future success of any attempted species reintroduction (Dickman, 2017; Manfredo & Dayer, 2004; O'Rourke, 2014).

The British studies of attitudes may have limitations (most notably the ability to which they can be deemed representative of a wider population), but they have consistently demonstrated a majority in favor of beaver projects, ranging between 63 and 95.19% of respondents (Auster, Puttock, & Brazier, 2019). However, the intricacies of the social debate run deeper than a simple "for or against" question. A nationwide survey found an association between support for reintroduction and a positive view of potential impacts, and vice versa (Auster et al., 2019). The respondents from the occupational sectors of "Farming and Agriculture" or "Fisheries and Aquaculture" were less likely to have a favorable view of beaver impacts and were thus often (though not unanimously) opposed to beaver reintroduction, which is in line both with other studies conducted in Great Britain (Auster, Barr, & Brazier, 2020a; Crowley, Hinchcliffe, & McDonald, 2017; Gaywood, 2018; Lang, 2004; Scott Porter Research and Marketing Ltd, 1998) and the aforementioned conflict challenges which have been observed across mainland Europe.

Socially, when whomever gains or losses from beaver reintroduction is examined it is concluded that (in certain scenarios) those people who experience the benefits may differ from those who experience the costs (Brazier et al., 2020; Gaywood, 2018). Although it is often cited that the potential benefits of beavers will outweigh the costs (Brazier et al., 2020; Campbell et al., 2007; Gaywood, 2018; Gaywood et al., 2015; Gurnell et al., 2009; Jones et al., 2012; Tayside Beaver Study Group, 2015), the costs that do occur may be attributed to a small number of people who themselves derive little or no direct financial benefit. This distinction between potential beneficiaries and the negatively impacted parties is perhaps most easily demonstrated in the case of beaver damming, where a downstream community may benefit significantly from flood alleviation while the landowner upstream may experience flooding on their property. Thus, strategic management decisions will need to consider how to bridge this disconnect and address potential conflict issues while allowing for the potential opportunities for biodiversity, flow attenuation, water quality, and ecotourism to be maximized.

It is highlighted herein, that to enable maximization of the opportunities from beaver reintroduction that are reviewed above, these conflicts will need to be appropriately recognized; the best management strategies are those where issues are mutually addressed between wildlife management authorities and stakeholders (Auster, Barr, & Brazier, 2020b; Redpath et al., 2015; Rust, 2017; Treves, Wallace, & White, 2009). There are real opportunities resulting from beavers, as discussed above, but there are real conflict challenges to be addressed as well, and they should be considered as one within a holistic approach with a closed-loop between the beneficiaries and the negatively affected. Further, in the case of reintroduced beavers, such management considerations will need early attention if the potential for later conflicts is to be reduced, particularly as challenges may not yet exist but could occur post-introduction (Auster et al., 2019; Conover & Decker, 1991; Coz & Young, 2020).

Finally, holistic management strategies will need to incorporate effective communication to aid the reduction of potential conflict issues. In a case from Poland, beavers had been reported as of concern by fishery managers, who cited damage to pond levees. Some of the participants had received compensation for reported damage, but a number of fishery managers had undertaken both authorized and unauthorized beaver culls as the beavers were viewed as problematic. In this scenario, it was reported that "poor communication" by conservation bodies was a particular part of the problem, with a lack of information on management measures and unresponsiveness from government agencies being factors which were suggested to have exacerbated conflict (Kloskowski, 2011). However, the literature recognizes that, when stakeholders are appropriately engaged and communication is effective, trust can be fostered between stakeholders and the wildlife management authorities (Decker et al., 2015, 2016; Redpath et al., 2015; Rust, 2017; Treves et al., 2009). This in turn can enable an environment within which, as Redpath et al. remarked in 2013, wildlife management issues and decisions can be "shared as one" (Redpath et al., 2015).

3.2.1. Summary of human–beaver interactions

- There are real opportunities for humans provided by beavers, as well as real potential conflicts between humans and the activity of beavers. The opportunities may be realized by different people to those who incur the costs in certain contexts.
- Effective management strategies should consider the beneficiaries and cost-bearers in a holistic manner, bridging the distinctions within a closed-loop management system.
- Management strategies require clear communication to gain trust between stakeholders and the wildlife management authority, thus providing an environment that is conducive toward addressing issues as a collective and reducing the potential for conflict between parties.

3.2.2. Human–beaver gaps in understanding

- Where they are reintroduced, living with beavers (and associated management) will be a new concept. How do people learn and adapt to this change?
- In policy, what is the best approach for a closed-loop management framework that maximizes opportunities, for example, ecosystem service provision, while minimizing the potential for conflicts?
- What is the best way to disseminate information regarding approaches to management?

4. CONCLUSION: FUTURE SCENARIOS AND CONSIDERATIONS

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The beaver is clearly the very definition of a keystone species. The myriad ways in which it alters ecosystems to suit its own needs, which in turn supports other species around it, demonstrate its value in re-naturalizing the heavily degraded environments that we inhabit and have created. The impacts of beaver reintroduction reviewed herein; to deliver changes to ecosystem structure and geomorphology, hydrology and water resources, water quality, freshwater ecology and humans, and society are profound. Beaver impacts are not always positive, at least from a human perspective, thus it remains critical that the knowledge gaps identified above are addressed as beaver populations grow, to ensure that improved understanding coupled with clear communication of beaver management can prevail.

Where beavers do deliver positive change, on balance benefits are shown to outweigh the costs associated with beaver reintroduction or management. It is unlikely that any other species, including humans, will deliver these changes, thus it would seem rational to conclude that beaver population expansion should be supported, wherever habitat is suitable and the species naturally occurred historically. Indeed, it is suggested that reintroducing beavers, is a genuine example of "working with natural processes" or implementing "nature-based solutions", which are both low cost and multi-faceted. As such, beaver reintroduction can underpin approaches to reverse the decline of species extinctions while also delivering ecosystem services, which may increase resilience to climate change and mitigate associated risks such as flooding and drought.

Of course, such an environmentally progressive approach needs to be implemented hand-in-hand with an appropriate management regime, ideally funded by Government, to capitalize on the environmental goods and services that beavers provide, and established as part of a national (or even international) strategy for the reintroduction of the beaver. Such management approaches have been normalized in places such as the German state of Bavaria, where beavers now deliver the wide range of ecosystem services reviewed above, with a pragmatic and flexible approach towards beaver management to support people who experience negative impacts while supporting a favorable conservation status of the species (Pillai & Heptinstall, 2013; Schwab & Schmidbauer, 2003). Other countries, including GB where beaver populations are in their infancy, but expanding, would do well to adopt similar management strategies (e.g., see the River Otter Beaver Trial, 2019) to ensure that successful reintroduction of beavers maximizes the environmental opportunities and minimizes the social conflicts that may manifest (Box 1).

Case study: Hydrology and water quality—Devon Beaver project

Puttock et al. (2017) undertook research at an enclosed and therefore controlled beaver reintroduction site in Devon, South West England. The site is situated on a first-order stream. In March 2011, a pair of Eurasian beavers were released into a 3 ha enclosure, dominated by mature willow and birch woodland, in addition to gorse scrub. Upstream, the site was fed by a 20 ha catchment area dominated by intensively-managed grassland. As illustrated in Figure 4, beaver activity at the site created a complex wetland, dominated by 13 ponds, dams, and canal networks (Puttock, Cunliffe, Anderson, & Brazier, 2015). Flow was monitored upstream and downstream of the beaver ponds.

FIGURE 4

A summary figure for the Devon Beaver Project: (a) aerial photo showing the beaver wetland nestled amongst an agriculturally dominated landscape; (b) an example hydrograph showing the contrast in flow regime between water entering the site (blue) and water leaving the site (red); (b) summary water quality results from the site for each figure "Above Beaver" to the left is the concentration entering the site and "Below Beaver" to the right is concentration leaving the site. From left to right: suspended sediment, phosphate, total oxidized nitrogen, and dissolved organic carbon

Monitoring of the site between 2013 and 2016 showed that the 13 ponds covered >1,800 m^2 and stored >1 million liters of water. Across 59 rainfall-runoff storm events, the outflow below the beaver impacted site showed a more attenuated response relative to water entering the site. Events exhibited on average 34% lower total event discharges, 30% lower peak discharges, and 29% longer lag times below the beaver dam sequence, in contrast, to flow entering the site. Critically, Puttock et al. (2017) analyzed a sub-set of the largest flood events of greatest interest from a flood risk management perspective. Results showed the flow attenuation impact to persist. Additionally, while the inflow to the site was ephemeral, drying up during drought periods, the outflow from the site never dried up during the monitoring period, highlighting the ability of increased water storage in beaver wetland environments to maintain base flow in river systems.

Analysis was undertaken into sediment storage within the site and water quality entering and leaving the site. A site survey (Puttock et al., 2018) showed that ponds held over 100 t of sediment, 15 t of carbon, and 1 t of nitrogen. Pond size was shown to be the greatest control over storage, with larger ponds holding more sediment per unit area. Source estimates indicated that >70% of the sediment trapped in the ponds was from the upstream agriculturally dominated catchment. A summary of water quality results taken during rainfall-runoff events (see Puttock et al., 2017) showed that on average, compared to water entering the site, water downstream of the bottom of the beaver dam sequence contained 3 times less sediment, 0.7 times less nitrogen, 5 times less phosphate, but twice the dissolved organic carbon content. Associated flow attenuation was shown to result in further reductions in total loads.

Go to:

CONFLICT OF INTEREST

Go to:

The authors have declared no conflicts of interest for this article.

AUTHOR CONTRIBUTIONS

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Richard Brazier: Writing-original draft; writing-review and editing. **Alan Puttock:** Writing-original draft; writing-review and editing. **Hugh Graham:** Writing-original draft; writing-review and editing. **Roger Auster:** Writing-original draft; writing-review and editing. **Kye Davies:** Writing-original draft; writing-review and editing. **Chryssa Brown:** Writing-original draft; writing-review and editing.

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Notes

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BEAVER TRAPPING CLOSURES
PUBLISHED STUDIES AND STUDY RESULTS

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EXECUTIVE SUMMARY

Twelve peer-reviewed, published studies were obtained that evaluated how beaver activity, and, in many studies, habitat changed in response to a trapping closure. Eleven studies occurred in the United States and one in England. Two additional studies are included. One was a peer-reviewed published study in an area not closed but that captured the impact of beaver presence and then removal via trapping on a section of stream (Fouty 2018). The second was an unpublished 1942 Oregon State University Bachelor of Science thesis. This study gives insight into the information presented in the Kebbe (1960) publication on Oregon's trapping history from 1899-1952. Study locations are found in Figure 1 and references in Table 1.

A variety of features were examined in these studies and publication dates range from 1942 to 2018. Studies occurred in California, Maine, Massachusetts, Minnesota, Montana, Oregon, New York, Wyoming, and southwest England. The study time periods ranged from 4 to 89 years and covered ecosystems ranging from boreal forests to semi-arid regions. Closure size ranged from 56.8 acres (England exclosure study) to 63 million acres (state of Oregon).

In the closure studies, mortality from human-caused trapping and hunting was eliminated. All other mortality causes remained (e.g., carnivore predation, disease, changing habitat conditions, accidents).

Three closure studies occurred in Oregon. The first closure study was done by Chester Kebbe (chief biologist, fur resources) and published in the Oregon State Game Commission Bulletin (Kebbe 1960). Kebbe examined Oregon's trapping history and responses to trapping closures and reopening from 1899 to 1952. During this time Oregon was entirely closed to beaver trapping/hunting twice: 1899-1917 and 1932-1952 with large partial closures at other times involving entire counties. In general, only agricultural lands were opened in order to confine trapping to areas of damage and prevent over-trapping on mountain streams. National Forest lands were closed from 1899-1952 except for 6-7 years when Benton and Marion Counties were completely open in 1917 and 1918 to 1923. A 1942 unpublished Master's Thesis from Oregon State University explains the reasons for changes in the state's trapping policy. It also explains how the opening of the state from 1923 to 1931 affected national forests (Gilliam 1942). There were no BLM lands until 1946.

The two other Oregon studies examined changes on Bridge Creek in Wheeler County, a spatially complex closure due to multiple land management and ownerships (Demmer and Beschta

2008; Weber et al 2017). The watershed includes BLM managed lands, national forest lands, private lands, a national monument, and state lands. The portions of the watershed that occur on federally-managed public lands are closed under two different closures. The closure of the portion of the watershed on BLM land only closed Bridge Creek and its tributaries. The surrounding BLM land is open which is the foraging area for beaver. The closure of the portion of the watershed that resides on the Ochoco National Forest (headwaters) closed both water and the land foraging base. The remaining areas (national monument, private lands, state lands) are open to beaver trapping and hunting.

Features Measured or Tracked

Features studied fell into four general categories: beaver-related, habitat-related, wildlife (excluding beaver), and social (Table 2). The most common beaver-related feature measured was active colonies and/or beaver dams. Assessment of active colonies was based on one or more of the following: active dams, bank dens, lodges and food caches. Also examined were changes in density of active beaver colonies, beaver age classes, number of live beavers, number reported trapped, and number relocated. Habitat features examined were changes in riparian habitat and water-related habitat types, pond number and dimensions, water quality, stream flows, water levels, and sediment deposited or eroded. Wildlife features examined were changes in density of breed pairs of selected waterfowl species. Social features examined were number of complaints or relocations, trapping history, and land owner interest in beaver presence. Most studies evaluated more than one feature.

Methods

The studies examined how various features changed over time in response to a closure. Methods of determining change included ground-based measurements, aerial photos, aerial (fixed-wing plane) surveys, repeat photos, information from reports or records, live trapping, dead trapping, and mark and release (Table 3). Methods varied as a function of available technology, questions asked, and metrics being measured. A number of studies had a field and office component.

Closure Results

The closure studies found increases in the number of beaver dams, active colonies, and populations. The study that examined population in Sagehen Ck, CA and Prescott Peninsula, MA, over 47 and 42 years respectively, captured fluctuations in populations in response to changes in habitat availability and drought conditions (Busher and Lyons 1999). Studies that evaluated riparian and/or water-related habitat found these expanded in abundance and complexity with increased beaver activity. Changes observed were increased amounts of ponded water, riparian areas, willows, complex and diverse water-habitat types (i.e., bogs, marshes, wetlands) and sediment deposition. Studies that evaluated water quality found decreases in stream temperatures, suspended sediment, nitrogen, and phosphate. The one study that evaluated stream flows in response to rainfall events found lower flood peaks with

longer durations. Regardless of geographic area, all studies showed ecosystem improvements as a result of the increased presence and activities of beaver following closure driven by increased beaver dams.

Two studies tracked complaints. Complaints increased with increased beaver activity. In eastern Warren County, NY, the dominate complaints were related to plugged culverts, flooding land and plugging ponds (Parson 1975). The majority of the county is private land. The causes of the complaints in the 1960 Oregon publication were not specifically listed (Kebbe 1960) but appear to be related to private lands and agriculture (Kebbe 1960). This assumption was confirmed in Gilliam (1942).

Trapping Results

Five studies provide insight into the effect of beaver trapping in 1) an area previously closed and then reopened, 2) two areas both previously trapped and only one closed, and 3) where beaver had existed long enough to build and maintain multiple dams despite the area being opened, then trapped out. The studies occurred in Oregon, Maine, Montana, and New York.

Closed then reopened

Oregon was fully closed to beaver trapping from 1899 to 1917 and from 1932 to 1952. (Kebbe 1960). The decision to reclose most of the state in 1931 after only eight trapping seasons and the entire state in 1932 was due to the rapid reduction in beaver numbers as indicated by number of beaver reported trapped. While the national forests were officially closed during this time it was noted that "opening seasons adjacent to the national forests was equivalent to opening the forests themselves" (Gillman 1942). Kebbe also noted a change in beaver numbers after the 1952 season [first 3-month open season in 30 years]. He noted that while the number of complaints received were comparable to the previous year [1951], most complaints involved only a pair of animals where previously large colonies had to be remove (Kebbe 1960).

In New York, eastern Warren County was closed to beaver trapping from 1965 to 1968 then the area reopened in 1969 (Parson 1975). Active beaver colonies increased from 11 in 1964 (pre closure) to 56 by 1967. No census data was gathered in 1968 because the airplane was required for other uses. In 1969, after a single open season, the number of active colonies had decreased to 41.

Comparison of two areas

The Maine study compared two sites during 1988-1992, one recently closed to trapping and a similar site that remained open to trapping (McCall et al 1996). The study found distinct differences over time between the two areas. The density of beaver colonies increased in the untrapped area but changed little in the trapped area. Number of maintained dams increased in untrapped area but showed little change in the trapped area. Number of wetlands increased in both areas but more in the untrapped area. Beaver created all new wetlands on both sites.

Total surface area of water increased on the untrapped area but remained the same on the trapped area. Flooded vegetation lifeforms increased in untrapped area but showed minimal changed in the trapped area. Changes in the density of waterfowl breeding pairs varied depending on the species. Number of wetlands used by waterfowl breeding pairs increased the most in the untrapped area.

Open area that is trapped

In Montana, beaver moved into a cattle exclosure, built dams, and were then removed via trapping as the area was open. In less than three years post-trapping dams failed, ponds drained and sediment eroded and the stream was again disconnected from its valley floor. A downstream control area saw no changes in water levels, volume of channel filled with water, or channel form despite the erosion of upstream sediment from behind the dams and elimination of beaver ponds (Fouty 2018).

The results from the documents cited are found in Table 4. Also included are study years, closure area if known, closure information, study goal(s), features tracked, and methods used. This additional information provides context to the results. Figure 1 and Tables 1-4 are found below.

All documents cited are available upon request.

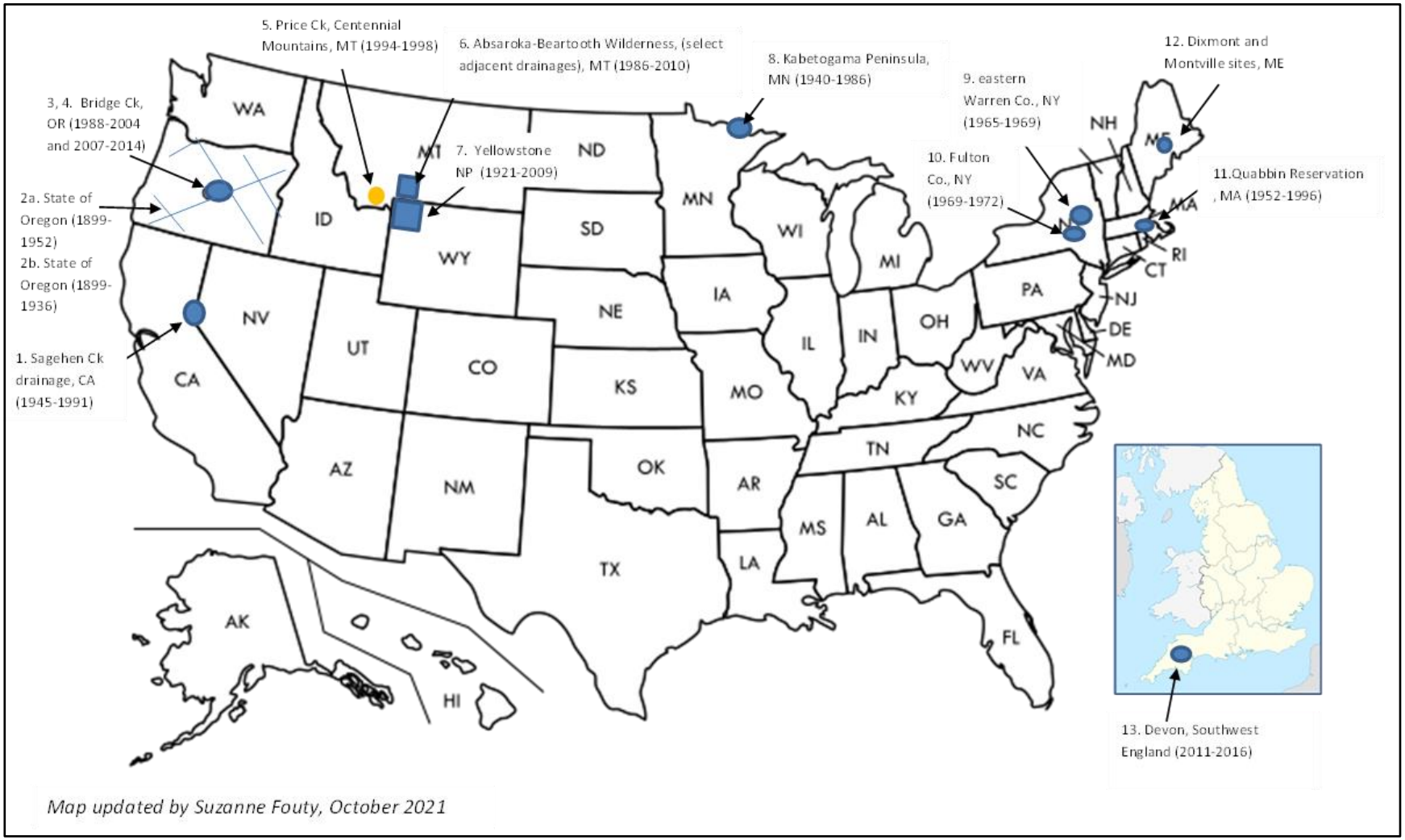

Figure 1. Generalized locations of published studies related to beaver trapping/hunting closures, changes in an open area related to arrival and subsequent trapping (#5, orange dot), and one unpublished Master's thesis (#2b). The years represents the period of study. The numbers correspond to the references found in Table 1.

Table 1. References and map number of beaver trapping closures studies, the unpublished Master's thesis (#2b), and one study of channel changes related to beaver arrival and subsequent removal via trapping in an open area (#5). All closures studies include land and water closures *except* ODFW's Bridge Creek Bureau of Land Management (BLM) closure (#3, 4). Only its creek and its tributaries are closed. The National Monument inside the BLM is open.

Map No.	Location	Reference
1	Sagehen Ck, California	Busher P.E., Lyons P.J. (1999) Long-Term Population Dynamics of The North American Beaver *Castor Canadensis* on Quabbin Reservation, Massachusetts, and Sagehen Creek, California. In: Busher P.E., Dzięciołowski R.M. (eds) Beaver Protection, Management, and Utilization in Europe and North America. Springer, Boston, MA. https://doi.org/10.1007/978-1-4615-4781-5_16
2a	State of Oregon	Kebbe, C.E. (1960). Oregon's beaver story. Oregon State Game Commission Bulletin. February 1960. No. 2, Vol. 15: pp. 3-6.
2b	State of Oregon	Gilliam, L. L (1942). History of beaver planting in Oregon with recommendations for planting in the future. Bachelor of Science thesis. School of Forestry, Oregon State University. 31p. (unpublished but available)
3	Bridge Creek, Oregon (study 1/2) ***Land base open***	Demmer, R. and Beschta, R. L. (2008). Recent History (1988 – 2004) of Beaver Dams along Bridge Creek in Central Oregon. Northwest Science, Vol. 82. No. 4, pp. 309 – 318.
4	Bridge Creek, Oregon (Study 2/2) ***Land base open***	Weber, N., Bouwes, N., Pollock, M.M., Volk, C., Wheaton, J.M., and Wathen, G. (2017). Alteration of stream temperature by natural and artificial beaver dams. PLoS ONE 12(5): e0176313. https://doi.org/ 10.1371/journal.pone.0176313
5	Price Creek, Centennial Mountains, Montana	Fouty, S. C. 2018. Euro-American beaver trapping and its long-term impact on drainage network form and function, water abundance, delivery, and system stability [Chapter 7] In: *Johnson, R. Roy; Carothers, Steven W.; Finch, Deborah M.; Kingsley, Kenneth J.; Stanley, John T., tech. eds. 2018. Riparian research and management: Past, present, future: Volume 1. Gen. Tech. Rep. RMRS-GTR-377. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station*. p. 102-133. doi: http://doi.org/10.2737/RMRS-GTR-377-CHAP7.
6	Hellroaring, Buffalo Fork, and Slough drainages in the Absaroka-Beartooth Wilderness, Montana	Scrafford, M. A. and d. B. Tyers, D. T. Patten, and B. F. Sowell. Beaver habitat selection for 24 yr since reintroduction north of Yellowstone National Park. (2018). Rangeland Ecology and Management 73, no. 2: 266-273. doi: 10.1016/j.rama.2017.12.
7	Yellowstone National Park, Wyoming	Smith, D. W. and D. B. Tyers. (2012). The history and current status and distribution of beavers in Yellowstone National Park. Northwest Science 86:276-288.

Map No.	Location	Reference
8	Kabetogama Peninsula, Minnesota	Naiman, R. J., Johnston, C. A. and Johnston. J.C. (1988). Alteration of North American Streams by Beaver. BioSciences, Vol. 38, No. 11, pp. 753- 762. URL: http://www.jstor.org/stable/1310784 and Dr. John Pastor, email correspondence, 2020)
9	eastern Warren County, New York	Parson, G. R. (1975). Effect of a 4-year closure of the trapping season for beaver in eastern Warren County, New York. New York Fish and Game Journal Vol. 22, No. 1
10	Fulton County, New York	Parson, G. and M. Brown (1978). Effect of a Four-year closure of trapping season for beaver in Fulton County. New York Fish and Game Journal, Vol. 25, No. 1.
11	Prescott Peninsula, Quabbin Reservation, Massachusetts	Busher P.E., Lyons P.J. (1999) Long-Term Population Dynamics of The North American Beaver *Castor Canadensis* on Quabbin Reservation, Massachusetts, and Sagehen Creek, California. In: Busher P.E., Dzięciołowski R.M. (eds) Beaver Protection, Management, and Utilization in Europe and North America. Springer, Boston, MA. https://doi.org/10.1007/978-1-4615-4781-5_16
12	Dixmont and Mountville sites, Maine	McCall, T.C., Hodgman, T. P., Diefenbach, D. R. and R. B. Owen, Jr (1996). Beaver populations and their relation to wetland habitat and breeding waterfowl in Maine. Wetlands. Vol. 16, No. 2, pp. 163-172.
13	Devon, SouthWest England	Puttock, A., Graham, H. A., Cunliffe, A. M., Elliott, M. and R. E. Brazier (2017). Eurasian beaver activity increases water storage, attenuates flow and mitigates diffuse pollution from intensively-managed grasslands. Science of the Total Environment 576, pp. 440-443.

Table 2. Features examined for change over time in response to beaver activity

Feature examined	Reference Number
Beaver feature	
Beaver dams	3, 4, 5, 6, 8, 12, 13
Active colonies (based on active dams, bank dens, lodges, food caches)	6, 7, 9, 10, 11,12
Density of active beaver colonies	12
Beaver populations	1
Beavers relocated	2a, 2b, 10
Beavers reported trapped	2a, 2b, 9
Beaver age classes	11
Habitat features	
Riparian vegetation and water-related habitat types	3, 6, 7, 8, 12
Water quality	4, 8, 13
Ponds (dimensions, volumes, surface area)	3, 8
Channel water depths	3, 5
Sediment deposited/eroded	5
Stream flows	13
Channel complexity	3
Wetted channel area	4
Surface water stored	13
Wildlife feature	
Density of breeding pairs of select waterfowl	12
Other	
Complaints	2a, 10
Trapping history	2a, 2b, 5, 9, 12
Landowner interest in beaver presence	2a

Table 3. General methods used to assess changes to a feature over time in response to beaver activity.

Methods Used	Reference Number
Field-based	
Ground-based measurements	1, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13
Aerial (fixed-wing plane) surveys	7, 9, 10, 12
Repeat field photos	3, 5
Mark and release	1, 11
Live trapping	1, 11, 12
Office-based	
Aerial photos	4, 8, 9, 10, 11, 12
Unpublished reports and/or records	2a, 2b, 7, 8, 9, 10, 11, 12
Published but not peer-reviewed reports	7
Published, peer-reviewed literature	2b, 7

Table 4. Descriptive information and results of beaver trapping closures studies, one study of channel changes related to beaver arrival and subsequent removal via trapping in an open area (#5), and one unpublished Thesis. The closures include land and water closures *except* ODFW's Bridge Creek Bureau of Land Management (BLM) closure (#3, 4). Only its creek and its tributaries are closed. The National Monument inside the BLM closure streams is open.

1. Sagehen Ck, California (Busher and Lyons 1999)
Study years: 1945 – 1991 (47 years) **Closure area:** Entire drainage closed but no size provided. Portion west of highway 89 presented in paper as the portion intensively studied. Total stream length = 13.5 km (8.4 miles) but only portion west of Hwy 89 presented in this study. **Closure information:** CA Department of Fish and Game introduce four adults into the area in 1945. No trapping/hunting permitted. **Study Goal:** Determine changes in numbers and dynamics of a local unexploited beaver population. **Features measured or tracked:** 1) Number of live beavers, not colonies **Methods used: L**ive trapping, mark and release, observation of colonies primarily during summer and autumn.
RESULTS: 1948 -1956: increase from 2 to 10 animals. (Phase 1 = slow growth) 1956 -1959: increase from 10 to 20 animals. (Phase 2 = more rapid increase) 1959 -1963: relatively stable, ranging between 18 and 22 animals. (Phase 3 = fluctuating populations at relatively high levels) 1963 -1969: decline from a high of 22 to 2 animals. (Phase 4 = steep decline) 1969 -1979: increase from 2 to 23 animals (Phase 5 = rapid increase) 1982 -1991: decline from 20 to 7 animals. (Phase 6 = steep decline) Second decline (Phase 6) due to two drought years and animal movement from west of Hwy 89 to the portion of the stream east of Hwy 89. "The second decline phase of the Sagehen Creek beaver population in the late 1980s supports this view of habitat saturation. It is possible that after two periods of high beaver numbers (early 1960s, 1970s) the vegetation in potentially marginal habitat may have been effectively depleted. (p. 157)"
2a. State of Oregon (Kebbe 1960)
Study years: 1899- 1952 (54 years) **Closure area:** Entire state of Oregon. 63 million acres (98,438 sq. miles). Covers open and closed periods. **Closure information:** State fully closed from 1899 -1917-1918 and 1932 to 1952. Partial closures other times involving entire counties. In general, only agricultural lands were opened in order to confine trapping to areas of damage and prevent over-trapping on mountain streams. National Forest lands closed from 1899-1952 except for 6-7 years when Benton and Marion Counties completely open (1917/1918-1923) **Study Goal:** Provide an overview of the history of beaver trapping and hunting closures in the state from 1899 to 1952 and results of various closures. **Features measured or tracked:** 1) trapping closure history in the state

2) number of beaver relocated to mountain streams
3) Damage complaints
4) Number of landowners interested in perpetuating beaver
5) Take of state trappers and then later private citizen trappers
Methods used: Number of dead beavers, relocation numbers, complaint number

RESULTS:

Closure History: State was completely closed twice to beaver trapping/hunting. The first was from 1899 to1917/1918 after which Benton and Marion Counties were opened. In 1923 entire state was opened except national forests and the five southwest counties. The entire state was again closed by the 1931 legislature from 1932 to 1952. The second statewide closure ended in 1952 when the legislature gave the Game Commission the authority to set trapping seasons and bag limits in 1951. States that "in general, only agricultural lands were opened in order to confine trapping to areas of damage and prevent over-trapping on mountain streams. (p.5)"

1938: Began relocating beavers from agricultural lands where their activities were seen as destructive and moved to places where their actions would bring benefits. Over 3000 beaver were relocated between 1938 and 1945 when dead trapping and pelting began. The change from relocation to dead trapping was due to the scarcity of suitable transplanting sites, increasing damage complaints, and a rapidly increasing beaver population over the entire state.

1942: 656 beaver were removed from complaint areas. By 1944 the number exceeded 2000.

1945: Landowners interested in perpetuating beaver were included in the management program. 590 landowners participated in 1945 and that increased to 1,500 in 1950 the last year the cooperative agreements were in effect.

1945 to 1950: Number of beaver removed by state trappers increased from 3,000 to 6,000/year. When state trappers under this program failed to remove a satisfactory number from complaint areas and had no effect on the large surpluses available elsewhere, legislation followed to set bag limits, open seasons and open streams and areas in 1951. In general, only agricultural lands were open.

[After 1952 season, 3-month open season first in 30 years] Complaints were received in numbers comparable to the previous year. One difference was noted, however, in that most complaints involved only a pair of animals where previously large colonies had to be removed.

"This [efforts post-1932 closure] restoration is a remarkable example of a fur species responding to protection and other management practices."

2b. State of Oregon (Gilliam 1942, unpublished OSU Bachelor of Science thesis)

Study years: 1899-1936 (38 years)
Closure area: Entire state of Oregon. 63 million acres (98,438 sq. miles). Covers open and closed periods.
Closure information: See Kebbe 1960 above**.**
Study Goal: Present a clear view of the beginning, progress, and present status of beaver planting in Oregon and 2) point out the advisability of planting beaver on public or private lands in Oregon.

Features measured or tracked:

1) Oregon's trapping and closure history
2) Numbers of licenses issued and beaver trapped during open trapping years (1923-1931)
3) History of beaver relocations/planting on national forests, numbers and locations and success
4) Relocation methods and factors considered

Methods used:

Review of existing studies and work carried on by the U.S. Forest Service, Oregon State Game Commission, and Pittman-Robertson Federal Aid Program in Oregon.

RESULTS:

Listed reasons for the initial state closure in 1899, the state reopening, and subsequent reclosure:

- Initial interest generated by ranchers who saw benefits of beaver related to stream flows and how that affected irrigation with focus in eastern Oregon. Baker and Malheur Counties are the first to be closed.

- Reopening in 1917 and 1918 in Benton and Marion Counties because beaver creating trouble in agricultural lands.

- Entire state reopened in 1923 in response to numerous complaints brought by ranchers against beaver damaging fruit trees and diverting irrigation water. Legislation ignored fact that the 1893 law allow landowners to control the animals doing damage. Two effects noted of opening: 1) Opening seasons adjacent to the national forests was equivalent to opening the forests themselves [National Forests had remained closed to trapping]. 2) Only part of the anticipated value of the fur crop would be realized due to wasteful methods of trapping and skinning by inexperienced persons.

In the first open season (1923-1924), 12,019 beavers were reported trapped. In the 1924-1925 season 3,669 were reported followed by 2,019 (1925-26), 1,336 (1926-27), 1,267 (1927-28), and 1,549 (1928-29). No beaver were reported for the 1929-1930 and the 1930-1931 seasons. The numbers reported are noted as low because 10 to 40% of the licenses failed to report on their catch.

- 1932 closure in response to rapid decline in number of beaver.

Relocating beaver in Oregon begins in 1932 after the state was closed to beaver trapping.

Between 1932 and 1936 beaver were relocated to eight national forests. Total number of beaver relocated were 637. Number of colonies = 131. Sources of beaver were lowlands were beaver were doing damage. Beaver relocated to the Deschutes, Fremont, Malheur, Ochoco, Rogue River, Umatilla, Wallowa, and Whitman NFs.

Examination of 53 plantings [relocations] on the Ochoco NF indicate that about 50% of the colonies settle in the vicinity of the planting site and the remainder disappear.

In 1936 state removed 264 beaver by dead-trapping, and co-operating agencies removed 370 by live-trapping [animals removed from private lands].

Presents information at the time on how to properly trap, handle, select, and transport live beavers for maximum success and site selection.

3. Bridge Creek, Oregon (study 1/2) (Demmer and Beschta 2008)

Study years: 1988- 2004 (17 years)
Closure area: Spatially complex closure. Bridge Ck and tributaries on BLM-managed lands are closed but waters only. Land base is open while those headwaters located on the Ochoco National Forest are closed (land and water). The National Monument and private land sit in the middle of the BLM area. The private, state, and National Monument are open. Estimated closure size = ¼ of watershed or 43,058 acres (67.3 sq. miles).
Closure information: ODFW closes Bridge Ck and all its tributaries on BLM-managed lands area to beaver trapping after 1991. Waters closed; land open. It remains an ODFW existing closure.
Study Goal: Determine impact of livestock grazing reduction (1988) and beaver trapping closure (post 1991) on the condition and characteristics of Bridge Creek and the riparian zone. Study examined a 31.7 km (19.7 miles) reach of Bridge Ck. Private lands excluded.
Features measured or tracked:

1) Beaver dams
2) riparian, channel complexity, secondary beaver-created channels
3) pond surface area, pond dimensions, pond volumes

Methods used: Ground surveys, photo points, field measurements, beaver dam surveys twice a year (early summer and late fall)

RESULTS:

1988: 36 beaver dams.
1989 – 1992: dams increase from 9 to 103 (low spring flows)
1992 – 1998: dams decrease from 103 to 9 (large spring high flows knock dams out). As water depths remained relatively high, beaver shifted to bank dens.
1998 – 2002: dams increase from 9 to about 60.
2002 – 2004: dams decrease from about 60 to 40.

Stability of dams related to magnitude of spring flows acting on dams in an incised channel. However, while dams failed during high flow years, the amount and complexity of the riparian zone and channel complexity increased. Dams remained in place from < 1 to 7 years. 75% lasting ≤ 2 years.

Vegetated riparian zones increased in width throughout much of the study reach as did the diversity of species (from coyote willow dominant to other species of willow, alder, water birch, red-osier dogwood and black cottonwood).

Channel complexity increased in the form of increased channel sinuosity, roughness via vegetation and woody material, secondary beaver-created channels, and ponds.

Pond dimensions: Max pond width = 8 m (± 5 m), pond lengths = 26 m (± 18 m), max pond depths = 0.8 m (± 0.3 m), pond surface areas = 120 m^2 (± 150 m^2), Pond volumes = 80 m^3 (± 130 m^3)

4. Bridge Creek, Oregon (Study 2/2) (Weber et al 2017)

Study years: 2007-2014 (8 years)
Closure area: Spatially complex closure. Bridge Ck and tributaries on BLM-managed lands are closed but waters only. Land base is open while those headwaters located on the Ochoco National Forest

are closed (land and water). The National Monument and private land sit in the middle of the BLM area. The private, state, and National Monument are open. Estimated closure size = ¼ of watershed or 43,058 acres (67.3 sq. miles).

Closure information: ODFW closes Bridge Ck and all its tributaries on BLM-managed lands area to beaver trapping after 1991. Waters closed; land open. It remains an ODFW existing closure. Study examined a 34 km (21.1 miles) reach of Bridge Ck. Private lands excluded.

Study Goals: Determine if and how natural beaver dams and/or BDA restoration structures

1) influence longitudinal surface water temperature regimes at the scale of stream segments, over seasons and at multiple scales
2) induce channel-scale temperature heterogeneity during periods of extreme surface water temperature during summer

Features measured or tracked:

1) Beaver dam numbers and distributions
2) Water quality (stream temperatures)
3) Changes in wetted channel area (includes ponded areas and flowing water)

Methods used: Aerial photos, ground surveys, 23 stream temperature loggers, BDA installation on 4 km of stream length and monitoring of effects

RESULTS: Beaver dams increased by an order of magnitude from 24 to 120 dams in reaches without beaver dam analogs (BDAs). Beaver also built and maintained dams on many of the BDAs in an additional 46 active beaver dams. The BDAs increased stream roughness and were more resistant to failure due to their design leading to decreased stream power during high flows. Their installation in a portion of the Bridge Creek allowed beaver dams to persist and increase in numbers and distributions beyond the BDA reach as a result of reduced stream power.

Average maximum daily stream temperatures decreased in the area with beaver by 2.6 *C when compared to the upstream control area pre and post BDA and beaver dams being built. Also, an increase in minimum stream temperatures by 1.76 *C compared to control site. The net result was a decrease in daily temperature variations.

In beaver-dominated areas the wetted channel area increased with values varying from 56% to 283% to 334% depending on location. In the control/no dam area, wetted area increased 16%.

5. Price Creek, Centennial Mountains, Montana (Fouty 2018)

Study years: 1995-1998

Closure area: Not a closure. Drainage area from 8.7 to 14.28 sq. km (3.4 to 5.5 sq. miles).

Closure information: While not a closure this publication is included because study captured channel changes related to beaver arrival and subsequent removal by trapping. Beaver moved into a cattle exclosure prior to 1994 and built multiple dams. Beaver trapped out post 1994 field season and prior to 1995 field season. Cross-sections inside the cattle exclosure were measured 1995, 1997, 1998. Cross-sections in the control area were measured 1994, 1995, 1997, 1998 (XS 17) and 1994, 1995, 1998 (XS 18)

Study Goals: Determine changes in channel cross-section areas and available channel capacity as a function of presence/absence of beaver dams, distance upstream of a dam, and dam integrity.

Features measured or tracked:

1) Beaver dam integrity (intact, failing, breached)
2) Changes on 14 channel cross-sections. Twelve were inside a cattle exclosure with multiple beaver dams. Exclosure cross-sections were distributed in several reaches. Two were located downstream of the exclosure and in a reach without dams.
3) Water depths, Available channel capacity, sediment deposited or eroded

4) Distance upstream of a beaver dam

Methods used: Repeat surveys of monumented cross-section sites in reaches with and without beaver dams, photos, field observations.

RESULTS:

In 1995 the available channel capacity (amount of channel not filled with water) at the 12 cross-sections inside the cattle exclosure ranged from 0% (channel full) to 69% (pond water level low) depending on integrity of the downstream dam. Distance from a beaver dam ranged from 3 to 35 m (10 to 115 ft).

Though dams appeared visually intact in 1995, the differences in water levels between sites revealed that some were in the early stages of disrepair. Clear breaching was visible in 5/12 sites by 1997. All 12 had breached by 1998 with 4/12 dams completely removed.

The available channel capacities (ACC) at the 12 sites increased from 0-69% in 1995 to 68 to 95% in 1998 as dams failed and were not repaired and ponds drained and sediment eroded. All 12 cross-sections in the cattle exclosure increased in ACC due to pond drainage but only cross-sections less than 15.2 m (50 ft) upstream of a dam (5/12) saw an increase in channel size as previously deposited sediment trapped behind the dams eroded.

The two cross-sections located downstream of the cattle exclosure and in reaches without beaver dams saw little to no change in their ACCs between 1995 and 1998 (87 to 89% and 94 to 94%). Water levels were similar and minimal to no sediment deposition or erosion occurred.

Area saw a net loss in sediment as the sediment previously trapped behind the beaver dams in the cattle exclosure moved through the system due to a lack of sediment trapping features downstream.

6. Hellroaring, Buffalo Fork, and Slough drainages in the Absaroka-Beartooth Wilderness portion of the Custer-Gallatin National Forest, Montana (Scrafford et al 2018)

Study years: 1986 – 2010 (24 years)

Closure area: 128,263 acres (200.4 sq. miles) (*Source: Scrafford 2011, M.S. Thesis and email comm. July 2020)*

Closure information: 46 beaver were reintroduced into area by US Forest Service between 1986 and 1999 after a 40-year absence. Montana Fish, Wildlife and Parks put a moratorium on trapping in Hellroaring, Buffalo Fork and Slough drainages.

Study Goal: Determine whether the desired outcomes of beaver reintroduction (restoring populations and riparian environments) were met

Features measured or tracked:

1) Active colonies (via beaver dams, food caches, bank dens, and lodges)
2) Density of active-beaver colonies and dams
3) Changes in willow cover
4) Habitats associated with beaver expansion since reintroduction

Methods used: Ground surveys

RESULTS:

Number of active beaver colonies increased with their density appearing to level in 2000. Colonies ranged from 1.23-1.44 active colonies/stream km from 2000-2010.

Number of active beaver dams increased. Range was 2.04-2.71 active dams/stream km from 2000-2010.

Beaver expanded from original meadows to 10 additional meadows within 9 years.

Meadows increased in willow cover from 1981 to 2011 by 16%.

Beaver reintroduction can be successful in riparian areas where willow stand condition is less than optimal.

7. Yellowstone National Park, Wyoming. (Smith and Tyers 2012)

Study years: 1921 to 2009 with focus on 1996 to 2009 (89 years)
Closure area: 2,221,440 acres 3471 sq. miles* *(from web*)
Closure information: Park established in 1872 but area was trapped. Sometime after establishment, beaver trapping and hunting ends.
Study Goals:

1) determine beaver abundance, distribution and population trend in YNP from 1996-2009
2) summarize early beaver censuses and compare to contemporary ones to reconstruct beaver abundance and areas of use over the last 90 years
3) review willow and aspen literature from the Northern Range to aid interpretation of beaver population fluctuations.

Features measured or tracked:

1) Active colonies. Early researchers not consistent on colony definition. Authors used a fresh lodge and/or recent beaver sign with a fall food cache as indication of active colony. Fall food cache was definitive measure as it included both lodge and bank dens.
2) changes in willow and aspen abundance and distribution

Methods used: Methodology changed as technology did. Early surveys were ground surveys. Later surveys (1988-1989 and 1994) augmented ground surveys with one fixed-wing fight to check on what was ground surveyed. Beginning in 1996, used aerial surveys to cover the park every other year.

Reviewed published but not peer-reviewed reports, unpublished reports and/or records, and published literature. Reviewed willow and aspen literature from NR and used to aid interpretation of beaver population fluctuations. Compared early censuses to contemporary ones to reconstruct beaver abundance and areas of use over the last 90 years.

RESULTS:

Changes in Active colonies:
1921 and 1923: 25 colonies found in limited area of NR. Using aspen and willow as building material and food.
1953: 6 colonies found in NR. Earlier sites from 1920s not active and no aspen reported. Some location reported from park interior.
1979-1980: limited ground survey. No results provided.
1988-1989 and 1994: two incomplete, mostly ground surveys. 71 and 44 colonies respectively in YNP.
1996, 1998, 1999, 2001, 2003, 2005, 2007, and 2009: complete, park-wide aerial surveys. Active colonies ranged from 44 (1996) to 127 (2007) with increasing trend.

"….in a period of about 90 years (1920s-2000s) the beaver population in the northern portion of the park appears to have declined in the NR and then increased probably because of a willow recovery. (p. 276)"

Aspen primary woody food and building material in the early 1900s. Willows were the primary woody food and building material in the 1996-2000s.

Limited aspen currently available to beavers in interior region. Willow, aspen, and cottonwood present on the NR.

Willow release has occurred since mid-1990s, coincident with mid-1990 wolf reintroduction. Some evidence that approximately 10 years after willow (mid-late 2000s), aspen also are releasing.

Most colonies from 1996 on associated with willows. A few showed minimal cottonwood use.

Based on 1996 -2009 and changes in beaver activity, beaver appeared to be rotating areas.
Speed of recent beaver expansion due in part to beaver being reintroduced north of YNP by the Gallatin National Forest from 1986-1999 which complimented beaver movement upstream from the Yellowstone River.

Population fluctuations in the interior of YNP less clear because limited work done especially during the early surveys. Appears beaver populations are stable and subsisting on willows.

Excellent discussion of various reasons/hypotheses as to why beaver and willow have increased. Discusses role of elevated water table in helping willow to grow and expand and inverse relationship found between elk numbers and beaver numbers, and evidence for/against a climate influence.

8. Kabetogama Peninsula, Minnesota (Naiman et al 1988)

Study years: 1940 to 1986
Closure area: 11,136 acres (17.4 sq. miles). More than 300 km [186 miles] of stream available for colonization.
Closure information: Timber operations on the Peninsula closed in the 1940s. Remoteness and cessation of logging road maintenance made access difficult creating a de facto closure. In 1975, the Peninsula became part of Voyageurs National Park which made it an official closure.
Study Goal: Quantify response of a boreal forest landscape to beaver activity
Features measured:

1) Beaver dams
2) Changes in hectares of ponds, wet and moist areas
3) % of peninsula impounded by beavers
4) upland changes in the riparian zone
5) Av. Redox potential and acidity in 1986 for soil and sediment in the different vegetative-hydrologic cover types
6) Available forms of soil/sediment nitrogen and total nitrogen for 1940 and 1986 for the different vegetative-hydrologic cover types.

Methods used: Eight sets of aerial photos (1940-1986), unpublished reports and/or records, information on number of active colonies since 1958

RESULTS:

1940: 71 beaver dams and 1% of the peninsula impounded by beavers.
1986: 835 beaver dams and 13% of the peninsula impounded by beavers.

1940-1986: An additional 12-15% of uplands in the riparian zone were altered during the same time due to beaver browsing.

Development of a mosaic of different vegetation types due to dynamic hydrology of beaver ponds, diversity of pre-impoundment vegetation and changes caused by beaver foraging in the riparian zone.

Some impoundment types were resistant to change while others changed rapidly as they were flooded and then abandoned.

Pond surface area increased from 16 ha (39.5 acres) in 1940 to 1371 ha (3388 acres) in 1986. Wet and Moist areas (indicative of near surface water table) increased from 243 ha (600.5 acres) in 1940 to 2396 ha (5921 acres) in 1986.

Shift from scattered individual impoundments to a mosaic of contiguous impoundments along entire valleys.

"In 1940s, beaver were primarily creating new impoundments rather than altering existing ones….During the 1970s, new impoundments constituted only 9% of the changes. (p. 759).

9. Eastern Warren County, New York (Parson, 1975)

Study years: 1965-1969 (5 years)
Closure area: Portion of county east of Hudson River. No size provided
Closure information: Closed from 1965 to 1968. Opened in 1969. No census survey in 1968 because airplane not available.
Study Goal: Effect of trapping closure on beaver abundance
Features measured or tracked:

1) Active colonies (parameters examined to determine activity not described)
2) Potential sites
3) Trapping pressure

Methods used: Aerial surveys to assess active sites during closure, infra-red aerial photographs to assess potential sites, aerial and ground surveys to assess trapping pressure, unpublished reports and/or record, reports of pelt tags trapping pressure surveys.

RESULTS:

Number of active colonies increased during the closure and decreased significantly after only one season. 1964 baseline year: 11 known active colonies. Post trapping closure: 1965 (39), 1966 (47), 1967 (56). No aerial census data in 1968 because airplane required for other uses. Opened for trapping in 1969 from March 1 - April 6 (37 days). 41 active colonies counted based on ground and aerial surveys.

1969: 75% of the colonies were being trapped. 131 beaver pelts were tagged in 1969 from towns studied. No information for years prior to 1965 because not required that pelts be tagged. Large variations between towns in increases and decreases in number of beaver colonies. Believed that these variations may, at least in part, be attributed to pattern of illegal trapping based on evidence found of beaver trapping occurring prior to season.

"….aerial censuses of beaver colonies are subject to some error….instances reported in which colonies had been missed, with bank colonies being missed most frequent. On occasion, colonies were counted as active that, when investigated on the ground, were found to be inactive. (p. 60)."

"….recognized that counts of active colonies do not necessarily provide a true measure of a beaver population. It is possible that, due to behavioral patterns and family structures among beaver, populations could double without any increase in colony count or colony counts could double with only a slight increase in population. (p.60)."

"…the reductions in colony count after 1969 trapping season may have reflected a much larger population reduction, since colonies which had some but not all beaver removed still remained active. (p. 60)."

Concluded "...the reduction in colony count must be interpretated to reflect a substantial decrease in the beaver population, presumably caused by trapping. (p.61).

10. Fulton County, New York (Parson and Brown, 1978)

Study years: 1969 – 1972 (4 years)
Closure area: 318,080 acres (497 sq. miles)
Closure information: County closed to beaver trapping from 1969 to 1972 because populations in northern zone were at very low level and trapping was identified as probably the principal cause.
Study Goal: Effect of trapping closure on beaver abundance.
Features measured or tracked:

1) Active colonies (defined by fresh food caches)
2) Number of complaints
3) Complaint type
4) Number of nuisance beaver relocated

Methods used: Aerial surveys to assess active colonies; aerial photos to assess potential sites in AF section; analysis of watershed, stream gradient and vegetation used to assess potential sites in Mohawk section; complaint reporting

RESULTS:

Active colonies in portion of the county surveyed all three years increased (mostly within the AF section). 1969 = 17 colonies, 1971 = 57 colonies, 1972 = 75 colonies. Full Mohawk and Adirondack Foothills (AF) sections surveyed in 1971 and 1972. AF section active colonies increased. In 1971 = 95 and 1972 = 115. Mohawk section active colonies increased. In 1971 = 55 and 1972 = 69.

Complaints rose. AF section complaints: 1967 (1), 1968-1971 (4 or less), 1972 (18). Mohawk section complaints: 1967 (3), 1968-1970 (5 or less), 1971 (11), 1972 (25). [NOTE: Mohawk section mostly private lands with 50% devoted to farming. AF section 36% state land and forest preserve with < 10% is farmed.]

Majority new complaints were plugging road culverts, flooding land, plugging ponds. Represented 87% of complaints in 1971 and 95% in 1972. Total complaints in 1971 = 15. In 1972 = 43.

AF section: 17 beaver relocated, 4 died. Mohawk section: 38 beaver relocated. 9 died.

With respect the question of % occupancy of potential sites and rising complaints the authors noted that "There is need for more information concerning the value of beaver colonies in relation to the cost of servicing damage complaints."

11. Prescott Peninsula, Quabbin Reservation, Massachusetts (Bushner and Lyons, 1999)

Study years: 1952-1996 (42 years)
Closure area: 5018 ha (12,400 acres, 19.4 sq. miles)
Closure information: The beavers returned to this area after being absent for more than 200 years. No trapping/hunting permitted
Study Goal: Identify changes in numbers and dynamics of a local unexploited beaver population.
Features measured or tracked:

1) Number of active colonies (identified by food cache, recent tree and shrub cuttings, evidence of lodge and dam maintenance)
2) Distribution of active colonies
3) Changes in age-class composition of the population

Methods used: Aerial photos and anecdotal reports from early researchers, watershed managers and game managers (1950s and 1960s), live trapping and mark and release (1960s and 1970s), autumn food cache/activity surveys and boat surveys along shorelines (1969 to 1996)

RESULTS:

1952-1968: Active colonies increase from 2 to 16. (Phase 1 = slow growth)
1968-1975: Active colonies increase from 16 to 46. Increase in number of shore colonies contributed to rapid increase. (Phase 2 = rapid growth)
1975-1983: Active colonies remain high but fluctuate between 42 and 54. (Phase 3 = fluctuating populations at high levels)

- 1969-1983 rapid colonization of new sites on peninsula and shore. By 1983 many marginal sites occupied.

1983-1988: Active colonies decline from 44 to 12 precipitated by a reduction in number of shore colonies. No shoreline colonies by 1988. (Phase 4 = steep decline)
1988 – 1996: Number of active colonies fluctuate between 10 and 15. (Phase 5 = relative stability at low levels).

Population changes from 104 (1969) to 257 (1978) to 40 (1988). Relative percent of the various age-class groups also change over time. In the 1969 and 1978 counts, adults were 35.6 and 37.4%, yearlings were 25 and 28.8%, and kits were 33.7 and 30.4% or roughly a third each. 2-year olds made up only 3.5-5.8% of the population. Between 1974 and 1988, percent of adults and 2-year olds increases (reproductive animals) while yearling and kit percent of the population decreases to less than 20% each (pre-reproductive).

Two factors suggested as influencing population numbers and age classes.

1) Dispersal of 2-year old beavers was high when there was still suitable (if marginal) areas available to disperse to. Decline during 1983-1988 suggests that shore sites are not optimal for beaver occupation because these areas are subject to water fluctuations during drought years when the reservoir is not full (p.156)

2) “A second factor that may have influenced the beaver population is the occurrence of whitetail deer, on the peninsula. The deer population was very dense through the 1980s. Deer reduce the

regeneration of trees by eating the saplings. There is evidence that deer activity on the peninsula was inhibiting forest regeneration. Thus, woody species that beaver would have used for food after they regenerated were being removed by deer. (p. 157)

12. Dixmont and Montville Sites, Maine (McCall et al 1996)

Study years: 1986- 1992 (7 years)
Closure area: Dixmont site (untrapped site) = (111 sq. km, 42.9 sq. miles.) Montville Site (trapped site) = (111 sq. km, 42.9 sq. miles)
Closure information: The two sites were 12 km apart in similar topography. Dixmont site was closed from March 1988-December 1992. At least 70% of new closure area had been open to trapping in the 10 years prior to the study. Pre-closure data available for closure area on beaver, wetlands, and waterfowl for 1986 and 1987. The Montville site (Open) only had beaver colonies density available from fall 1988.
Study Goals:

1) Determine yearly changes in density of beaver colonies
2) Monitor annual numbers and morphology of wetlands
3) Examine the annual change in area of lifeforms of wetland vegetation
4) Compare these data to changes in the density of breeding pairs of selected waterfowl species.

Features measured or tracked:

1) Evidence of beaver colonies in wetlands in the Dixmont Site (1986-1987)
2) Active lodges (1988-1992)
3) Beaver dam condition (3 categories: good, fair, poor with clear definitions)
4) Changes in numbers of wetland, total basin area, total surface water area, perimeter of surface water area.
5) Changes in vegetation lifeforms (6 categories)
6) Changes in number and distribution of breeding pairs of selected species of waterfowl.

Methods used:
Beaver Activity: Annual census of active beaver lodges using fixed-wing aircraft, ground inspections of each lodge to verify activity, live-trapping of beaver.
Wetland changes: Repeat photography using fixed-wing aircraft and ground surveys to verify flight observations.
Waterfowl changes: Two ground census of breeding pairs of selected species of waterfowl each year

RESULTS:

Active beaver colonies: In untrapped site, the density of active beaver colonies began the increasing first year following closure to trapping and continued to increase during the study period (17 to 36). In trapped site the number of colonies site changed slightly (12 to 22).

Beaver harvest in the trapped site (Montville) declined from 39 to 18 (54%) during 1989-1992 as did percent of colonies trapped. Positive correlation found between harvest and pelt price and between the proportion of colonies trapped and pelt price. Though beaver harvest and percent of colonies trapped per year declined, colony density did not change.

Maintained dams: In untrapped site, number increased from 33 to 54. In trapped site, number was stable (24 to 26),

Unmaintained dams but holding water: In untrapped site, number increased from 13 to 26. In trapped site number increased from 11 to 18.

Unmaintained dams and not holding water: In untrapped site, number declined from 27 to 13. In trapped site, number remained unchanged (22 to 32).

Number of wetlands: In untrapped site, number increased from 120 to 134. Trapped site increased from 103-110. Beaver created all new wetlands on both sites. Numerous wetlands were flooded and abandoned by beaver during the study, but all sites impounded in 1989 were still wetlands in 1992.

Wetland Basin area: In untrapped site wetland area increased from 456 to 475 ha (4% or 19 ha). In trapped site it increased from 294 to 298 (2% or 6 ha).

Surface water area: In untrapped site, increased from 115 to 158 ha (36% or 43 ha) with small decline in last year. In trapped site, value remained stable.

Surface water area perimeter: In the untrapped site, perimeter increased from 85,961 to 92,442 m (8% or 6,481 m). In trapped site increased from 65,693 to 67,093 m (2% or 1400 m).

Flooded vegetation lifeforms: In untrapped site, open water (27 to 30 ha), emergent herbaceous (24 to 31 ha), ericaceous (11 to 22 ha), alder and willow (7 to 18 ha) and timber (12 to 23 ha) increased. On trapped site, all flooded lifeforms changed < 1 ha.

Density of waterfowl breed pairs: Density of breeding pairs of black ducks remained relative stable on untrapped site (27 to 32 pairs/100 km^2) and on the trapped site (28 to 21 pairs/100 km^2). Pairs of Canada geese on untrapped site increased from 4 to 9/ 100 km^2 and mallards increased from 7 to 12/100 km^2. Pairs of Canada geese on trapped site increased from 8 to 10/100 km^2 and no change in density of mallard pairs. Densities of hooded mergansers were higher on the untrapped site (23 to 29 pairs/100 km^2) compared to their pre-closure values (14 to 14 pairs/100 km^2) surveyed in 1986-1987 prior to the 1988 closure. Trapped site showed yearly changes similar to that the untrapped site with density increasing from 7 to 11 pairs/100 km^2.

Number of wetland used by waterfowl: Though density of breeding black ducks changed little on untrapped site, number of wetlands used by pairs increased from 31 to 43 (39%) during 1989-1991 with a small decline in 1992. On trapped site, number of wetlands used was stable (22 to 23) from 1989 to 1992.

Number of wetlands used on the untrapped site increased for Canada geese (5 to 14), mallards (7 to 12), and hooded mergansers (16 to 27). On trapped site, less change in number of wetlands used: Canada geese (7 to 10), mallards (10 to 14), and hooded mergansers (5 to 12).

13. Devon, SouthWest England (Puttock et al 2017)

Study years: 2011-2016 (6 years)
Closure area: 3 ha (7.4 acres) with 20 ha (56.8 acres) of contributing area (first order stream). Stream length = 183 m (600 ft)
Closure information: Two Eurasian beaver introduced into an exclosure in wooded site in 2011.
Study Goals: Quantify impacts of reintroducing Eurasian beaver into a first order tributary which drains an intensively managed grassland on water storage, water quality and flow regimes
Features measured or tracked:

1) Beaver dams

2) surface water stored
3) total event discharge per rainfall event above and below exclosure
4) peak event discharge per rainfall event above and below exclosure
5) peak rainfall to peak discharge lag time
6) water quality (suspended sediment, nitrogen, phosphate, dissolved organic carbon)

Methods used: field observations, water quality sampling and testing, stream flow and rainfall monitoring.

RESULTS:

Dams increased from 0 to 13.

Surface water storage increased at the site via the pond storage by about 1000 m3 (264,172 gallons).

Total event average discharge for all events was 34 ± 9% lower when it left the site than when it entered. (59 rainfall events were measured.)

Peak event average discharge for all events was 30 ± 19% lower when it left the site than when it entered.

Peak rainfall to peak discharge lag time increased by 29 ±21% and the average event duration was 32% longer.

22% more water entered the site than left the site.

Water quality: Suspended sediment, total oxidized nitrogen, phosphate loads were lower leaving the exclosure then when they entered. pH of water samples were slightly more acidic above than below the site. Dissolved organic carbon were higher leaving the site than entering it.

Restoring Beavers to Enhance Ecological Integrity in National Forest Planning

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Beaver restoration is a critical component of "next generation" National Forest management. The 2012 Forest Planning Rule's requirements for sustainability, and more specifically ecological integrity, open a meaningful legal, political, and physical space for beavers as ecosystem engineers to occupy within the forest planning framework.

This article provides an overview of the laws governing wildlife conservation in the National Forest System, and demonstrates how beaver restoration advances the purposes, objectives, and statutory and regulatory requirements related to wildlife conservation and watershed management. It illustrates the need to support beavers in the landscape to restore and maintain ecological composition, structure, function, connectivity, and species diversity, and also to facilitate mitigation and adaptation to climate change in forested and aquatic ecosystems.

Wildlife and National Forests: An Evolving Regulatory Framework

Wildlife conservation was one of the central concerns animating enactment of the National Forest Management Act (NFMA) in 1976. The most comprehensive analysis of NFMA and its history, penned by Charles Wilkinson and Michael Anderson, explains that the bill's sponsors fully intended to "elevate wildlife and ecological values in relation to timber." *Land and Resource Planning in the National Forests,* 64 Or. L. Rev. 1, 171 (1985). Indeed, in contrast to earlier National Forest management statutes, NFMA "requires Forest Service Planners to treat the wildlife resource as a controlling, co-equal factor in forest management and, in particular, as a substantive limitation on timber production." *Id.* at 173 (citing 16 U.S.C. § 1604(g)(3)(B)). These objectives are accomplished through comprehensive planning and periodic plan revisions for all National Forest units, with full public participation.

In an expression of cooperative federalism, NFMA requires the Forest Service to coordinate with the land and resource management planning processes of state and local governments in developing forest plans. 16 U.S.C. § 1604(a). Forest Service regulations, adopted decades ago under the Forest Service Organic Act of 1897, 16 U.S.C. § 551, direct the agency to "determine the extent to which national forests or portions thereof may be devoted to wildlife protection in combination with other uses and services of the national forests, and, in cooperation with the Fish and Game Department or other constituted authority of the State concerned, . . . formulate plans for securing and maintaining desirable populations of wildlife species." 36 C.F.R. § 241.2. This provision also authorizes cooperative agreements with States for the management of wildlife species. Hunting, fishing, and trapping within the National Forest are subject to state fish and wildlife laws unless those laws conflict with federal law or would permit activities that conflict with forest plans or undermine the land and resource management responsibilities of the Forest Service. Martin Nie, et al., *Fish and Wildlife Management on Federal Lands: Debunking State Supremacy*, 47 Envtl. L. 797, 866 (2017). Introductions of species like beavers are authorized by the Forest Service Manual (FSM) in order "to restore resources following environmental changes," or to "restore locally extinct indigenous species. . . ." *Id.* at 867 (citing FSM 2643.3).

Under NFMA, forest planning is the key means of achieving wildlife conservation and other forest management objectives. Specifically, NFMA requires forest plans to "provide for

diversity of plant and animal communities in order to meet overall multiple-use objectives." 16 U.S.C. § 1604(b)(3)(b).

The initial set of forest planning regulations, issued in 1982, expressed the diversity provision as a stringent requirement: "fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area." 36 C.F.R. § 219.19 (1982). The viability requirement of section 219.19 became one of the most controversial and frequently litigated elements of the 1982 planning regulations. Courtney A. Schultz et al., *Wildlife Conservation Planning Under the United States Forest Service's 2012 Planning Rule*, 77 J. of Wildlife Mgmt. 428 (2013). One of the most well-publicized controversies was known as the "spotted owl wars," where Forest Service violations of section 219.19 resulted in a series of injunctions against timber harvesting throughout the Pacific Northwest. *See, e.g.*, *Seattle Audubon Society v. Evans*, 952 F.2d 297, 301 (9th Cir. 1991); *Seattle Audubon Society v. Moseley*, 798 F. Supp. 1484, 1489 (W.D. Wash. 1992), *aff'd*, 998 F.2d 699 (9th Cir. 1993). The *Moseley* case held that, in light of its "historical context and overall purposes," the NFMA's diversity provision "confirms the Forest Service's duty to protect wildlife . . . [which] requires planning for the entire biological community--not for one species alone." As for section 219.19, the court found that it was not enough to protect only the spotted owl and provide only a "medium probability" of continued viability to other vertebrate species; rather, the Forest Service had a duty to protect wildlife, which requires "planning for the entire biological community." *Id.* at 1488.

In part because of the controversy generated by section 219.19, National Forest regulations were updated substantially in 2012, in what is often referred to as the 2012 Planning Rule. 36 CFR Part 219. The revised regulations aim "to provide the ecological conditions (habitat) necessary to keep common native species common, contribute to the recovery of threatened and endangered species, conserve proposed and candidate species, and maintain a viable populations [sic] of each species of conservation concern within the plan area." USDA Forest Service, *FAQs on 2012 Planning Rule*, https://www.fs.usda.gov/detail/planningrule/faqs. The structure for doing this is through a "coarse filter/fine filter" approach, aimed at ensuring conditions that support wildlife and ecological processes.

In addition, the 2012 Rule requires forest plans to consider the "interdependence of terrestrial and aquatic ecosystems." 36 CFR § 219.8(a)(1)(i). This synthesis provision informs and strengthens other provisions of the 2012 Rule related to watershed, water quality, and riparian areas, including its requirements to maintain or restore the ecological integrity of watersheds and riparian areas, described in more detail below.

Ecological Integrity as a Foundational Forest Planning Goal

Under the 2012 Planning Rule, each Forest Plan must include components to maintain and restore ecosystem integrity and to maintain and restore the diversity of ecosystems and habitat types throughout the plan area. 36 CFR § 219.19 (2012). Applying the "coarse filter," planners are to ensure habitat and persistence for most native plant and animal species. Where these measures are not sufficient, the agency is to apply a "fine filter" by designating and determining necessary steps to protect species at risk of extinction, including those that are listed under the Endangered Species Act (ESA), and Species of Conservation Concern, which are species "that occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area." *Id.* § 219.9(c) (2012). Examples include the greater sage grouse, California

golden trout, and the black toad. *See* USDA Forest Service, *Species of Conservation Concern: Frequently Asked Questions* (June 2016), https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd507865.pdf (listing species and criteria for ranking their vulnerability).

These requirements fall within the 2012 Planning Rule's larger statement of purposes which focuses on "collaborative and science-based development, amendment, and revision of land management plans that promote the ecological integrity of national forests . . . with ecological integrity and diverse plant and animal communities; and have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the present and into the future." 36 C.F.R. § 219.1(c). Ecological integrity, as defined by the 2012 Planning Rule, encompasses structure, function, and connectivity "within the natural range of variation" that "can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence." *Id.* § 219.19.

The Forest Service Handbook defines the "natural range of variation" as "the variation of ecological characteristics and processes over scales of time and space." FSH 1909.12.05 (2015). It explains, "The pre-European influenced reference period considered should be sufficiently long, often several centuries, to include the full range of variation produced by dominant natural disturbance regimes such as fire and flooding and should also include short-term variation and cycles in climate." *Id.* Identifying and understanding this variation will help forests maintain or restore resilient ecological conditions. Donald A. Falk, *The Resilience Dilemma: Incorporating Global Change into Ecosystem Policy and Management*, 48 Ariz. St. L.J. 145, 147 (2016).

Riparian areas receive special attention in the 2012 Rule. In particular, plans must include "components, including standards or guidelines, to maintain or restore the ecological integrity of riparian areas in the plan area…." 36 C.F.R. § 219.8(a)(3). Here again, the emphasis is on maintaining or restoring structure, function, composition, and connectivity of riparian areas. Beaver activity fits well within the factors to be considered in maintaining or restoring riparian areas: "Blockages (uncharacteristic and characteristic) of water courses; Deposits of sediment; Aquatic and terrestrial habitats; Ecological connectivity; Restoration needs; and Floodplain values and risk of flood loss." *Id.*

Forest Service Handbook provisions and directives provide further details on developing forest plans consistent with maintaining ecological sustainability. For example, Forest Plan Directive 23.1 addresses "Plan Components for Ecosystem Integrity and Ecosystem Diversity" and "Additional Species-Specific Plan Components." FSH 1909.12 (2015). In addition, the Forest Service Manual seeks to promote ecological integrity and to improve the resilience of National Forests and Grasslands to climate change and other stressors through collaborative, science-informed development, revision, or amendment of land management plans. Forest Service Manual, FSM 1921.03(2).

In sum, the 2012 Planning Rule, the Handbook, and the Manual emphasize the role that species play as part of a larger functioning ecosystem, focusing on how the various components function together, with natural variation as a reference point. Perhaps no native wildlife species is as important in restoring the natural range of variation in western landscapes—and, in turn, achieving ecological integrity of watersheds and riparian habitats—as the beaver.

Restoring Ecological Integrity and Adapting to Climate Change in Partnership with Beavers

By creating and modifying habitat structure in riparian areas, beavers are nature's most notable ecosystem engineers. Justin P. Wright, Clive G. Jones, and Alexander S. Flecker, *An Ecosystem Engineer, the Beaver, Increases Species Richness at the Landscape Scale,* 132 Ecosystems Ecology 96 (2002). Beavers contribute to the complexity of riparian areas and create a diverse environment that is resilient to disturbance and better able to respond to impacts of climate change. Ben Goldfarb, *Beavers, Rebooted,* 6393 Science 360 (2018). Beavers and their impoundments make beneficial contributions to water quality and water supplies (baseflows and aquifer recharge) while mitigating detrimental impacts of high peak flows and flooding. Ultimately, beavers in the landscape lead to high levels of species diversity. U.S. Fish & Wildlife Service, *The Beaver Restoration Guidebook 2.0, Working with Beaver to Restore Streams, Wetlands, and Floodplains* 4-5 (2017); Wright, *supra,* at 99.

Historically, most of North America was inhabited by beavers, with estimated populations of 60-400 million stretching from Alaska to the Gulf of Mexico. B.W. Baker and E. P. Hill, *Beaver (Castor canadensis),* in Wild Mammals of North America: Biology, Management, and Conservation, 288-310 (2003). Native Americans relied on beavers for food, clothing, medicine and many other uses, and the abundant animal drove much of the expansion of non-Indian settlers. "More than timber, cod, or any other natural resource," wrote Ben Goldfarb, "beavers help explain just about every significant American geopolitical event between European arrival and the Civil War." Ben Goldfarb, *Eager: The Surprising Secret Life of Beavers and Why They Matter* 41 (2018).

Beaver trapping became so frenzied that the harvest eventually glutted the market and came close to extirpating the beaver by the 19th century. *Id*. at 43. Declining markets and availability, along with protective measures adopted in the 20th century, led to beaver recovery throughout much but not all of its range. Today, the best guess of total beaver population in North America is around 15 million—about a hundred times more than at the lowest point during the fur trade. *Id*. at 9. But, to an extent we are only beginning to recognize, the absence of beavers over much of their historic range has profoundly changed our watersheds.

Without beavers and beaver dams, the overall ecological integrity, including connectivity, structure, and function of the riparian zone, changes dramatically, and ecosystem services are deeply impoverished. For example, water runs off faster, streams become narrower and more channelized, and the water table drops—reducing the availability of water for fish, birds, amphibians and other wildlife. Author Ben Goldfarb characterized the impact as "an aquatic Dust Bowl." *Id*. at 10.

As early as the 1930s, the U.S. government began reintroducing beavers in the Pacific Northwest to stop soil erosion. In the mid-1900s state wildlife managers experimented with airdrops and other methods to relocate "problem" beavers into wilderness areas and improve high-elevation wetland and riparian habitat. Rob Rich, *Better with Beavers*, Earth Island J. (Spring 2017). Some federal and state land management agencies have taken steps to restore beavers to stream systems to improve fish habitat, repair lost watershed functions, and more recently to offset climate change related impacts. FWS, *Report of the Climate Change Adaptation and Beaver Management Team*, *supra*, at 4. In some cases, this involves capture and translocation of "problem" beavers to targeted watersheds. Rich, *id.* In other cases, existing populations of beavers can be encouraged to recolonize a nearby watershed through relatively simple habitat improvements.

As the Forest Service engages in cooperative efforts with states to plan for, restore, and maintain wildlife species, it faces a diverse array of management priorities and approaches. Policies allowing for expanded beaver populations vary a great deal among states, as many still view the beaver as a nuisance rather than an essential part of a dynamic aquatic ecosystem. Utah adopted a statewide beaver management plan in 2010 that calls for incremental restoration of beavers in priority watersheds. Utah Division of Wildlife Resources, *Utah Beaver Management Plan*, DWR Publication 17-20 (2010), *available at* https://wildlife.utah.gov/furbearer/pdf/beaver_plan_2010-2020.pdf. Washington adopted legislation in 2017 that enables live-trapping and relocation of beavers to reduce conflicts and improve watershed health. RCW § 77.32.585 (2017).

The involvement of federal agencies in beaver restoration has been somewhat sporadic and *ad hoc*, but forest planning offers an important tool around which to form a more comprehensive conservation strategy and achieve the "coarse filter" conditions that will ensure ecological integrity, species diversity, recovery of threatened and endangered species, and viability of Species of Conservation Concern.

In recent years, a number of National Forests have begun to incorporate beaver restoration in their planning processes. The Custer-Gallatin's Proposed Management Approaches and Possible Actions note that watershed quality and resiliency could be enhanced through beaver reintroduction or by installing beaver mimicry structures (sometimes called beaver dam analogues or BDAs) to increase aquatic habitat and restore watersheds. The Rio Grande National Forest has included the presence of beavers as an indicator for watershed health, water resources, and aquatic ecosystems in its proposed monitoring framework. Forest Service biologists have reintroduced beavers to forest streams in the Methow Valley Ranger District of the Okanogan-Wenatchee National Forest to improve water storage and habitat for salmon, trout, frogs, and many other species.

To promote more consistency, enhance institutional capacity, and evidence a greater commitment to beaver restoration, forest plan revisions should affirmatively adopt substantive plan components that prioritize and set specific goals for restoring beavers and beaver habitat. The beneficial and self-sustaining contributions of beavers should be an essential element of climate adaptation and watershed restoration and management in forest plans and should be a regular part of the "coarse filter" component to ensure ecological conditions within the plan area to recover and maintain viable populations of wildlife species.

Guidance and support from Forest Service leadership on beaver restoration would streamline the analysis and reduce potential burdens on individual national forests while enhancing opportunities for achieving landscape-scale benefits from beaver activity. This could be accomplished through updates to Forest Service Directives and/or the Forest Service Manual. Specific standards, along with other plan components, should be adopted. As Professor Oliver Houck notes, absent concrete standards, the "multiple use" objective that pervades public lands management is no more than a Rorschach blot. Oliver A. Houck, *Tales from A Troubled Marriage: Science and Law in Environmental Policy*, 17 Tul. Envtl. L.J. 163, 172 (2003). Even more to the point, absent measurable, binding, and enforceable standards, "managers who are committed to protecting biodiversity [are left] without a solid, legal framework to help them withstand internal and external pressures to prioritize other factors." Schultz, *supra*, at 435. Although some wildlife management experts fear that the 2012 Rule's biodiversity provisions "are too ambiguous, grant the Agency too much discretion, and will prove ineffective in the conservation of native wildlife,"

if carefully implemented through plan revisions and project-level decisions, the Rule could effectively constrain agency discretion and improve forest management. Gordon Steinhoff, *Biodiversity Conservation in the National Forests, and the 2012 Planning Rule*, 8 Wash. J. Envtl. L. & Pol'y 1, 4 (2018).

We agree with the interagency Climate Change Adaptation and Beaver Management Team that the Forest Service should give expanded recognition of beavers as "focal species" under the 2012 Rule. FWS, *Report of the Climate Change Adaptation and Beaver Management Team to the Joint Implementation Working Group Implementing the National Fish, Wildlife, and Plant Climate Change Adaptation Strategy*, at 6 (2014). The 2012 Rule requires the selection and monitoring of focal species, which are species "selected on the basis of their functional role in ecosystems," 36 C.F.R. § 219.19, in order to evaluate the status and trends of overall plant and animal diversity and to assess ecological conditions as required under section 219.9. *Id.* § 219.12(a)(5)(iii). The Second Committee of Scientists explained that focal species are those that serve keystone functions in that they play a role as engineers of ecological processes or in food web dynamics. Schultz, *supra,* at 430. Beavers, as ecological engineers, certainly qualify. According to Schultz and others, this is the most promising provision for promoting a meaningful fine-filter approach to conservation planning. *Id.* at 436-437.

In addition to beavers' value in monitoring watershed conditions, beaver restoration is an important strategy to achieve "fine filter" objectives by creating and maintaining habitat for imperiled species, such as salmon, amphibians, and other water-dependent species. As a case in point, the National Marine Fisheries Service recommends "encouraging the formation of beaver dams" in its recovery plans for coho salmon. A 1992 study found that two-thirds of Oregon's coastal coho spent their winters in ponds and slackwater created by beavers. In fact, beavers share Oregon's creeks with a number of threatened and endangered runs of chinook, chum, sockeye, and coho. Ben Goldfarb, *In Oregon, A Peculiar Case for Protecting the Beaver,* High Country News, Feb. 20, 2018.

Given beavers' important role in providing habitat essential for salmon recovery, the Center for Biological Diversity and others lodged a notice of intent to sue the U.S. Wildlife Services in 2017, alleging that consultation is required under Section 7 of the ESA to ensure that the Services' beaver removal activities are not jeopardizing coho and other listed fish species. Letter from Collette Adkins et al. to William H. Clay, Deputy Administrator USDA APHIS Wildlife Services, et al. (Nov. 2, 2017), *available at* https://www.biologicaldiversity.org/campaigns/wildlife_services/pdfs/Beaver_and_fish-consultation_NOI_11_1_2017.pdf. In response, Wildlife Services agreed to stop killing beavers in Oregon while it conducts a biological assessment to determine the impacts on endangered salmon and steelhead. *See* Andrew Theen, *Federal Government Suspends Beaver-Killing After Environmental Groups Threaten Lawsuit,* Oregonian, Jan. 10, 2018.

Of course, the Forest Service has ESA responsibilities, too, including ensuring against jeopardy and utilizing its authorities in furtherance of the ESA's conservation purposes. The nexus between the ESA and NFMA's diversity requirement is made clear in the 2012 Rule, which directs the Forest Service to include plan components that provide the ecological conditions necessary to contribute to the recovery of federally listed species. 36 C.F.R. § 219.9(b)(1). The added urgency of endangered species recovery reinforces the value of prioritizing beaver restoration to achieve ecological integrity through forest planning, accompanied by widespread on-the-ground

implementation actions linked to improving the conditions of National Forest watersheds. See USDA Forest Service, *Watershed Condition Framework* (FS-977, May 2011).

Despite the current Administration's hostility toward climate science, the Forest Service continues to plan and take management actions within a climate-informed framework. Under the direction of the Office of Sustainability and Climate, each National Forest and Grassland is required to report progress achieving climate adaptation and mitigation actions through a 10-point performance scorecard, and at least ten National Forests have completed formal assessments of their resources' vulnerability to climate change impacts. For example, the Lolo National Forest's Watershed Climate Change Vulnerability Assessment identified beaver restoration as a strategy to address impacts of climate change on water supply from affected national forest watersheds. Alisa Wade, Christine Brick, Scott Spaulding, Traci Sylte and Joan Louie, *Watershed Climate Change Vulnerability Assessment: Lolo National Forest, U.S. Dept. Agriculture, Forest Service, Northern Region and Lolo National Forest*, Pub. No. R1-16-05. Following up on that report, the Forest Service engaged in a forest-wide beaver habitat assessment and now is planning on-the-ground watershed restoration projects incorporating beaver habitat expansion. Despite widespread interest among Forest Service Staff, there is no national coordination of beaver restoration on National Forests lands.

Collaborative networks and partnerships between land and water resource managers, scientists, educators, conservation organizations, and private landowners can build appreciation for and acceptance of beaver expansion as a means of ensuring healthy, resilient riparian ecosystems that support thriving fish and wildlife populations and improve water storage and stream flows to benefit downstream species, water users, and communities. As a cutting edge yet "old school" management strategy, beaver restoration through National Forest planning and beyond can promote watershed health, climate resiliency, and ecosystem-wide adaptation strategies.

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The Importance of Beaver Ponds to Coho Salmon Production in the Stillaguamish River Basin, Washington, USA

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Abstract.—The use of beaver *Castor canadensis* ponds by juvenile coho salmon *Oncorhynchus kisutch* and other fishes has been well established. However, the population-level effects on coho salmon resulting from the widespread removal of millions of beaver and their dams from Pacific Coast watersheds have not been examined. We assessed the current and historic distributions of beaver ponds and other coho salmon rearing habitat in the Stillaguamish River, a 1,771-km^2 drainage basin in Washington and found that the greatest reduction in coho salmon smolt production capacity originated from the extensive loss of beaver ponds. We estimated the current summer smolt production potential (SPP) to be 965,000 smolts, compared with a historic summer SPP of 2.5 million smolts. Overall, current summer habitat capacity was reduced by 61% compared with historic levels, most of the reduction resulting from the loss of beaver ponds. Current summer SPP from beaver ponds and sloughs was reduced by 89% and 68%, respectively, compared with historic SPP. A more dramatic reduction in winter habitat capacity was found; the current winter SPP was estimated at 971,000 smolts, compared with a historic winter SPP of 7.1 million smolts. In terms of winter habitat capacity, we estimated a 94% reduction in beaver pond SPP, a 68% loss in SPP of sloughs, a 9% loss in SPP of tributary habitat, and an overall SPP reduction of 86%. Most of the overall reduction resulted from the loss of beaver ponds. Our analysis suggests that summer habitat historically limited smolt production capacity, whereas both summer and winter habitats currently exert equal limits on production. Watershed-scale restoration activities designed to increase coho salmon production should emphasize the creation of ponds and other slow-water environments; increasing beaver populations may be a simple and effective means of creating slow-water habitat.

North American river networks contain numerous reaches dammed by beaver *Castor canadensis*, and the spatial distribution of beaver dams controls fundamental geomorphological and ecological processes (Rudemann and Schoonmaker 1938; McDowell and Naiman 1986; Johnston and Naiman 1990; Pollock et al. 2003). Of particular interest on the Pacific Coast of North America is the rearing habitat that beaver ponds provide for juvenile salmonids, most notably coho salmon *Oncorhynchus kisutch*. Coho salmon populations in parts of California, Oregon, and Washington are listed as threatened under the U.S. Endangered Species Act.

When beaver impound streams by building dams, they substantially alter stream hydraulics in ways that benefit many fish species (Murphy et al. 1989; Snodgrass and Meffe 1998). However, early research suggested that beaver dams might be detrimental to fish, such as hindering fish passage for anadromous salmonids; therefore, until recently, it was common for fish managers to remove beaver dams (Salyer 1935; Reid 1952). It has also been demonstrated that beaver dams seasonally restrict movement of fishes (Rupp 1954; Gard 1961; Murphy et al. 1989; Schlosser 1995). However, more than 80 North American fishes have been documented in beaver ponds, including 48 species that commonly use these habitats, and the beaver ponds' overall benefit to numerous fishes has been well documented (Pollock et al. 2003). Beaver ponds usually have slow current velocities and large edge-to-surface-area ratios, and therefore contain extensive cover and a highly productive environment for both vegetation and aquatic invertebrates; these conditions provide fish with foraging opportunities not found in unimpounded stream habitat (Hanson and Campbell 1963; Keast and Fox 1990). The slow water also means that energy expenditures for foraging are less than

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would be required in higher-velocity streams. Thus, sections of streams impounded by beaver dams are often more productive than unimpounded reaches in terms of both the number and size of fish (Gard 1961; Hanson and Campbell 1963; Murphy et al. 1989; Leidholt-Bruner et al. 1992; Schlosser 1995). Fishes are not the only beneficiaries of beaver dams. Relative to unimpounded reaches, areas impounded by beaver dams have been associated with biomass or diversity increases in a wide range of taxa, including birds, mammals, plants, and insects (see reviews in Naiman et al. [1988] and Pollock et al. [1994]).

Comparisons of salmonid growth and survival between reaches upstream of beaver dams and unimpounded reaches demonstrate the importance of beaver ponds. During the winter, juvenile coho salmon residing in side channels impounded by beaver dams utilize such habitats at a higher density, are consistently larger, and have a greater overwinter survival rate than juveniles that use side channels without beaver dams (Bustard and Narver 1975a; Swales et al. 1986). Beaver ponds also serve as important rearing areas during the summer. Higher densities and larger sizes of juvenile coho salmon have been found upstream of beaver dams during the summer in main-stem and off-channel habitats (Murphy et al. 1989; Leidholt-Bruner et al. 1992). In some cases, these reaches accounted for less than 1% of the total available habitat, yet over a third of all juvenile coho salmon were found there (Murphy et al. 1989). Similarly, Leidholt-Bruner et al. (1992) found that summer densities of juvenile coho salmon in beaver ponds were higher than in pools formed by wood or other obstructions. For three small, coastal island streams in southeast Alaska, Bryant (1983) found that summer populations of coho salmon juveniles were significantly higher in impounded reaches than in reaches just upstream and downstream. However, the densities in the impounded reaches were lower because the beaver dams had greatly expanded the surface area of the streams. In Carnation Creek, British Columbia, Bustard and Narver (1975a) found that the survival rate of overwintering juvenile coho salmon in old beaver ponds was about twice as high as the average for the entire stream system.

Studies of juvenile coho salmon production from beaver ponds have been limited to single or several ponds, and generally compare fish growth rates or sizes in ponds relative to those in streams (e.g., Bustard and Narver 1975a, 1975b; Peterson 1982; McDowell and Naiman 1986; Swales et al. 1986; Murphy et al. 1989; Swales and Levings 1989; Leidholt-Bruner et al. 1992; Nickelson et al. 1992). Other studies of coho salmon habitat loss were unable to estimate historic areas of beaver ponds (Beechie et al. 1994). However, we know that organized commercial trapping throughout the Pacific Northwest was initially responsible for widespread declines in beaver populations (Mackie 1997). Later, once Anglo-American settlement in the Puget Sound basin began in earnest, beaver were routinely trapped for subsistence fur trade and to eliminate what was considered an impediment to settlement. This scenario was repeated throughout much of North America such that by the early 1900s, beaver were thought to be in danger of extinction (Naiman et al. 1988). Although we know that beaver ponds were historically much more abundant, no study has examined the potential population-level effect of the widespread removal of beaver ponds on coho salmon. Here we investigate the current and historic distribution of beaver ponds in a large (1,771-km^2) Pacific Northwest drainage basin, and demonstrate how the loss of beaver ponds has greatly reduced the potential coho salmon smolt production of an entire watershed.

Methods

Study area.—We examined the historic and current distributions of beaver ponds and other stream habitats utilized by coho salmon in the Stillaguamish River, Washington (Figure 1). The Stillaguamish River originates in the North Cascade Mountains, flows westward through a glacially carved valley, and empties into the Pacific Ocean through the Puget Sound estuary. Annual rainfall in the basin ranges from 760 to 3,800 mm and increases with elevation. Forest types in the study area vary depending on elevation and physical setting. Floodplain forests were historically populated with red alder *Alnus rubra*, Sitka spruce *Picea sitchensis*, western redcedar *Thuja plicata*, black cottonwood *Populus trichocarpa*, and willows *Salix* spp. (Ayres 1899). Upland forests to an elevation of about 600 m (the western hemlock *Tsuga heterophylla* zone of Franklin and Dyrness [1973]) were dominated by Douglas-fir *Pseudotsuga menziesii*, western redcedar, western hemlock, and Sitka spruce (Ayers 1899; Gannett 1899). Silver fir *Abies amabilis* and western hemlock dominate forests from about 600 to 1,200 m (the silver fir zone), and higher elevations are in the alpine fir *Abies lasiocarpa* zone (Ayers 1899; Franklin and Dyrness 1973).

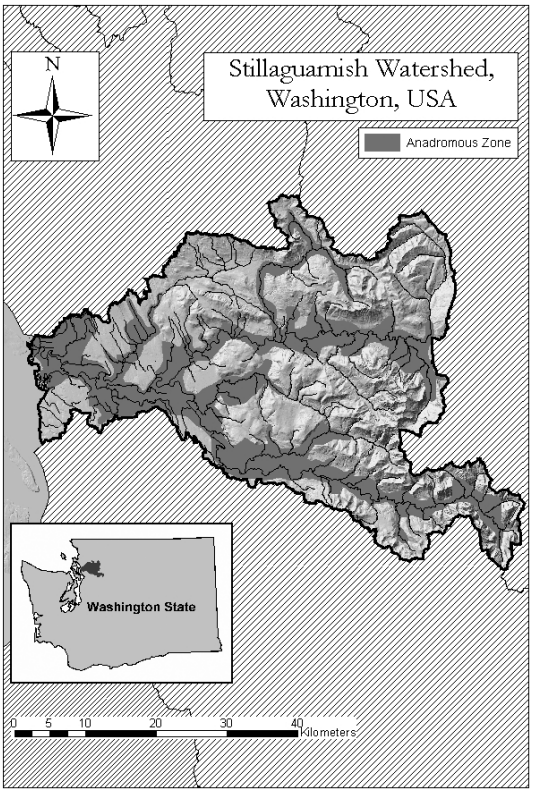

FIGURE 1.—Location of the Stillaguamish River basin, Washington. The light shading delineates the extent of the range of anadromous coho salmon in the basin.

Adult coho salmon enter the Stillaguamish River basin in late summer and early fall. Spawning is concentrated in small, low-gradient tributaries and occurs primarily between November and February. Fry emerge from the gravel in March and April and soon establish their summer rearing territories, typically remaining in their natal streams (Sandercock 1991). Coho salmon juveniles generally spend the summer in the areas of emergence (Sandercock 1991; Beechie et al. 1994); however, some juveniles are gradually displaced downstream as summer progresses (Chapman 1962). With the first fall freshets (usually in late September or October), juveniles migrate as much as 38 km downstream to winter rearing areas (Scarlett and Cederholm 1984). Preferred winter habitats include beaver ponds, off-channel ponds, and protected side channels (Peterson and Reid 1984; Scarlett and Cederholm 1984). Coho salmon smolts leave their winter rearing areas in March and April and migrate to salt water soon after. Most coho salmon in the Stillaguamish River basin spend 14–18 months in fresh water and 16–20 months in the Pacific Ocean before returning to spawn at age 3.

Historic estimates of average beaver densities across the North American continent range from 4 to 27 individuals/km^2 (Seton 1929; Pollock et al. 2003). The low-gradient habitat in the Stillaguamish River basin that exists within the range of coho salmon has physical characteristics typical of good beaver habitat. We believe that historic beaver densities in the low-gradient portions of the basin were likely within the aforementioned range. Currently, the beaver population is considerably reduced relative to historic estimates. Extensive trapping in the watershed during the first wave of Euro-American colonization decimated beaver populations, and much of the land formerly utilized by beaver has been converted to agriculture, tree farms, or residential areas (Mackie 1997). Beaver colonies today are scattered throughout the watershed, and generally are most abundant in areas where access by road is difficult. Beaver are generally absent from the prime habitat of low-gradient streams crossing the main-stem valley floor. Active beaver trapping to eliminate nuisance colonies still occurs in the watershed (WDFW 1997).

Estimation of the current abundance of beaver ponds.—Beaver ponds within the anadromous zone were identified and their surface area measured from black-and-white 1:12,000-scale aerial photographs provided by the Washington Department of Natural Resources (WDNR). We conducted field verification of approximately 10% of the sites to ensure that the ponds were correctly identified as beaver ponds. All field-verified ponds were determined to be beaver ponds; however, a number of beaver ponds not seen in the photographs were found in the field within floodplain channels away from the main stem. These ponds were narrow and long, with minimal canopy opening, and therefore were difficult to identify in aerial photographs. We were not able to systematically survey the entire watershed for these ponds, and thus they were not included in our estimates.

Estimation of the historic abundance of beaver ponds.—We developed a model to estimate the spatial distribution of beaver ponds within the anadromous zone in order to determine the historic abundance of beaver ponds. Observations suggested that the spatial distribution of beaver ponds in a drainage network is generally limited to those areas where beaver dams can withstand winter floods. The erosive capacity of a river can be characterized by stream power, which is described by:

TABLE 1.—Habitat unit usable area equivalents, parr densities, density-independent survival to smoltification, and smolt production potential estimates for five habitat types (from Reeves et al. 1989; Beechie et al. 1994).

Habitat type	Usable area equivalent (units/m^2)	Parr density (parr/unit)	Survival to smolt stage	Potential production
Side-channel and distributary sloughs				
Summer	0.75	1.7	0.25	0.319 smolts/m^2
Winter	0.50	5.0	0.31	0.775 smolts/m^2
Small and large tributaries				
Summer pool	1.00	1.7	0.25	0.425 smolts/m^2
Summer glide	0.70	1.7	0.25	0.297 smolts/m^2
Summer riffle	0.50	1.7	0.25	0.213 smolts/m^2
Winter pool	0.70	5.0	0.31	1.085 smolts/m^2
Winter riffle	0.00			0.000 smolts/m^2
Main stem				600 smolts/km
Pond				
Summer pond (all sizes)	1.00	1.5	0.25	0.375 smolts/m^2
Winter pond <500 m^2	1.00	5.0	0.31	1.550 smolts/m^2
Winter pond >500 m^2	0.50	5.0	0.31	0.775 smolts/m^2
Lake				25 smolts/ha

$$\Omega = \rho g Q S,$$

where Ω is the stream power, ρ is the density of water, g is the gravitational constant, Q is stream discharge, and S is stream slope. We hypothesized that beaver dam locations are constrained to reaches that do not exceed some critical (but unknown) stream power, above which the dams will fail (e.g., during floods). Discharge can be estimated from stream drainage area based on U.S. Geological Survey (USGS) discharge–drainage-area data.

For bankfull discharge (Q_{bf}), the general equation describing this relationship is:

$$Q_{bf} = kA^{\gamma},$$

where A is drainage area and k and γ are empirically derived constants (Dunne and Leopold 1978). By use of peak flow data from 37 USGS gauge stations located on small, low-elevation streams ($A < 1.5 \times 10^7$ m^2; elevation < 700 m) within or near our study watershed, we regressed the bankfull (2-year) flood against drainage area and determined that k was equal to 7.3×10^{-7} and γ was equal to 1.0 ($n = 37$, $r^2 = 0.56$, $P < 0.01$). By substituting for Q_{bf}, the equation for stream power at bankfull discharge may be recast as:

$$\Omega_{bf} = 7.15 \times 10^{-3} AS.$$

Thus, by measuring slope and drainage area (obtained from USGS 7.5′ topographical maps) at current locations of beaver ponds, we estimated the bankfull stream power that corresponded with the current limit of where beaver dams were maintained.

There are no direct measures of historic beaver pond frequency, but in watersheds where beaver have been allowed to recover, they maintain dam frequencies ranging from 2.5 to 16 dams/km (typically >10/km), and generally saturate all available habitat (Naiman et al. 1988; Gurnell 1998; Pollock et al. 2003). We assumed that historic beaver pond frequency was 6 ponds/km within the low-gradient portion ($S \leq 0.04$) of the stream network utilized by coho salmon. The assumption of 6 ponds/km is lower than most frequencies observed in watersheds with relatively undisturbed beaver populations, and therefore is conservative (Pollock et al. 2003).

Delineation of the anadromous zone and estimation of coho salmon production potential.—We calculated coho salmon smolt production for each of five habitat types (Table 1) as the product of total habitat area, juvenile coho salmon density, and coho salmon survival to smolt stage (Reeves et al. 1989; Beechie et al. 1994). Densities and survival rates are shown in Table 1. Each habitat type was assigned a potential smolt production estimate (smolts/m^2) based on published values or on locally collected data from Beechie et al. (1994) (Table 1). Estimates of potential winter smolt production are lower when the average winter stream temperature is less than 7°C (Reeves et al. 1989).

To estimate historic coho salmon production from small and large tributaries, we used the usable area equivalent, rearing density, and survival to smoltification values from Reeves et al. (1989) and Beechie et al. (1994) (Table 1). Estimates for present-day coho salmon production were also ob-

tained from Reeves et al. (1989), but include more detailed data on usable area and potential smolt production in various channel units, such as different pool types (e.g., lateral-scour pool, dam pool, etc.), riffles, and glides.

It is challenging to estimate habitat and coho salmon production losses in main stems and large tributaries because their use by coho salmon is not well known (Beechie et al. 1994). There is no information on the seasonality of coho salmon use in these habitats, so we used the same habitat value for each season. We used 600 smolts/km as an estimate for coho salmon smolt production in main stems, as Beechie et al. (1994) used for the Skagit River, Washington. This estimate originated from data collected on the Bogachiel River by the Washington Department of Fish and Wildlife (WDFW, unpublished data). Annual coho salmon smolt production estimates range between 340 and 2,734 smolts/km (Beechie et al. 1994), and therefore 600 smolts/km is conservative. We calculated historic and current coho salmon smolt production for individual beaver ponds based on the usable area equivalent, rearing density, and survival to smoltification reported in Reeves et al. (1989). We applied a production estimate of 25 smolts/ha to lake habitat based on Reeves et al. (1989) and Beechie et al. (1994).

We used existing coho salmon distribution maps (Williams et al. 1975) combined with a more recent identification of physical barriers, such as falls, dams, impassible culverts, or stream gradients exceeding 20%. Summer and winter coho salmon smolt production potential (SPP) for all habitat types were estimated according to the methods of Reeves et al. (1989) and Beechie et al. (1994), except that we added substantial detail to the estimation of the historical abundance of beaver ponds and their contribution to SPP. Methods and assumptions for coho salmon smolt production estimates from all habitat types except beaver ponds are described in detail in Beechie et al. (1994).

We identified all non-beaver-pond habitat types with a combination of field measurements, USGS 7.5′ topographic maps, 1:12,000-scale orthophotos and 1:24,000-scale hydrography layers from the WDNR, and National Wetlands Inventory maps (Cowardin et al. 1979). Habitat types included the following: (1) side-channel and distributary sloughs, (2) small tributaries, (3) large tributaries and main stems, (4) lakes (surface area $>$ 5 ha), and (5) ponds (surface area $<$ 5 ha) (Beechie et al. 1994). Side-channel sloughs, sometimes called flood overflow channels, diverge and reconnect to a main stem, and usually occur on a floodplain or on the lowest terrace near a main stem. Distributary sloughs are similar to side-channel sloughs except that they do not reconnect with a main stem, instead flowing directly into an estuary. Small tributaries have a summer low-flow width of less than 6 m, whereas channels wider than 6 m are large tributaries or main stems (Beechie et al. 1994).

We also considered several aspects of physical habitat characteristics that could not be measured easily with remotely sensed data, including number of pools, pool area, and available spawning habitat. A decrease in pool spacing (increase in percent pool area) increases coho salmon SPP estimates because juveniles prefer pool habitats, such as backwater areas, sloughs, and beaver ponds (Reeves et al. 1989). Thus, a reduction in the number of pools (decrease in percent pool area) reduces winter and summer coho salmon production. A lack of available spawning habitat can limit coho salmon SPP because not enough fry are produced to seed all available rearing habitat.

We used existing physical habitat data (Beechie and Sibley 1997) and collected additional habitat data throughout the Stillaguamish River basin between the summer and winter of 1995 and 1997. Data collected in these habitat surveys included bankfull width, stream channel gradient, wood loading (e.g., number and volume), percent spawnable area, channel units (e.g., pool, riffle, glide, and rapid), and pool-forming factors (e.g., woody debris, streambank, boulders). Channel units were the same as those defined by Bisson et al. (1982) and Reeves et al. (1989). We measured bankfull width with a tape measure to the nearest 0.1 m and surveyed gradients with a hand level and stadia rod over a representative reach of each segment. We measured wood pieces and counted those that were more than 10 cm wide and 1 m long and that were at least partially situated within the bankfull width. Surface patches of gravel with a minimum area of 1 m^2 were visually identified and measured. Patches were only included if they were located in areas of potential coho salmon spawning, such as the tail-out of pools, riffles, and glides. Gravel area was expressed as percentage of the total wetted channel area. The length and width of each habitat unit was measured by use of a stadia rod or tape measure.

We compared habitat area estimates from our most recent sources to estimates from the earliest aerial photographs (taken in 1933 by Pacific Aerial Surveys), WDNR orthophotographs (1942), U.S. Army Corps of Engineers maps (1930), or unlog-

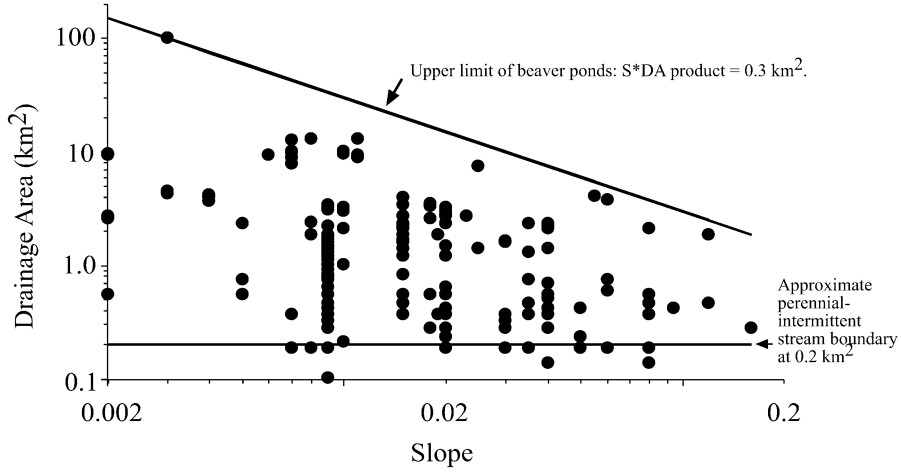

FIGURE 2.—Relationship between stream slope (*S*) and drainage area (DA) for 341 beaver ponds identified within the known distribution of coho salmon in the Stillaguamish River basin, Washington. The upper limit of beaver pond distribution is defined by a *S**DA slope of 0.3 km^2, which corresponds to a value of 2,000 J·s^{-1}·m^{-1} for stream power at bankfull discharge. The lower limit is defined by a DA of 0.1 km^2, below which most streams are intermittent.

ged reference streams when possible. Historical areas of slough habitats (side channel and distributary) were estimated from historical maps, notes, and photographs, as well as from field evidence of their prior locations. Because the early photographic record was preceded by more than half a century of human impacts to these habitat types, our analysis provides a conservative estimate of habitat changes. Present-day slough habitat areas were measured from aerial photographs and in the field. We examined reduction of pool areas in small tributary habitats by comparing pool areas in managed streams to those in unlogged reference streams. Data for reference sites were from Beechie et al. (1994), and data for present-day conditions were derived from stream surveys in the Stillaguamish River basin. Lengths of large tributaries and main stems were also measured from historical maps, notes, and photographs, as well as determined from field evidence of their prior locations. Present-day tributary and main-stem areas were determined from aerial photographs and also measured in the field. Lake areas were measured directly from historical and current maps.

Results

Current and Historic Distribution and Abundance of Beaver Ponds

The portion of the watershed accessible to coho salmon encompassed 1,433 km of streams. Along these streams, we identified 341 beaver dams that created 0.49 km^2 of beaver pond habitat (<0.03% of the drainage basin). Our results showed that existing beaver dams were limited to sites where stream power at bankfull discharge (Ω_{bf}) was less than 2,000 J·s^{-1}·m^{-1} (Figure 2). The lower limit of basin size where beaver build dams were built coincided approximately with the minimum drainage area of perennially flowing streams, which is defined regulatorily as approximately 0.2 km^2 in western Washington (Washington Forest Practices Board 2000). Ninety six percent of the existing beaver dams were built on streams with drainage areas of 0.2 km^2 or greater (Figure 2).

There was a significant difference in bankfull stream power between all stream reaches within the anadromous zone and those reaches where beaver chose to build dams. The average bankfull stream power for reaches where beaver constructed dams was 220 J·s^{-1}·m^{-1}, whereas the average for reaches within the anadromous zone was 3,300 J·s^{-1}·m^{-1} (Kolmogorov–Smirnov two-sample test, $P < 0.001$, Figure 3). There were also significant differences in both slope and drainage area between all available streams and the sites where beaver chose to build dams. The mean slope was 2.1% and the mean drainage area was 2.3 km^2 for streams that hosted beaver dams, whereas these two parameters averaged 3.9% and 121 km^2, respectively, for the entire anadromous zone (Kolmogorov–Smirnov two-sample tests, $P < 0.001$). Although these data also indicated that

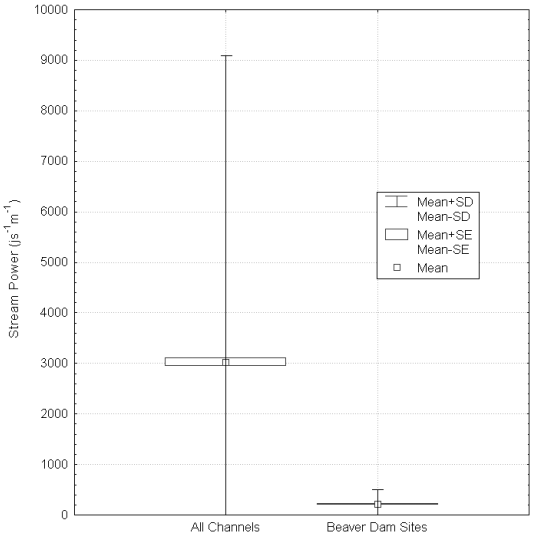

FIGURE 3.—Kolmogorov–Smirnov box plot comparing the stream power at bankfull discharge for all stream channels in the Stillaguamish River basin, Washington, versus the bankfull stream power of channels dammed by beaver.

beaver built dams on higher-gradient streams ($S >$ 0.04), our field observations suggested that the size of such ponds was usually small and that coho salmon generally did not occupy these higher-gradient streams. Therefore, we assumed that beaver ponds built on stream slopes greater than 4% did not contribute historically or currently to coho salmon production.

Based on the above data, we identified stream reaches where beaver ponds suitable for juvenile coho salmon were likely to have occurred historically by creating boundary conditions of a maximum 4% slope, a minimum drainage area of 0.1 km^2, and a maximum bankfull stream power of 2,000 J·s^{-1}·m^{-1} (Figure 2). Of the 1,433 km of coho salmon-accessible stream in the Stillaguamish River basin, 1,091 km (76%) met these criteria. Assuming that the historic size distribution of beaver ponds is the same as the current distribution (Figure 4), we estimated that beaver dams created approximately 9.3 km^2 of pond habitat, covering just 0.5% of the entire watershed.

Current and Historic Coho Salmon Smolt Production Potential

Our analysis suggested that the current coho salmon SPP for the entire basin during summer was approximately 965,000 smolts, and that beaver ponds accounted for 18% of summer SPP (Table 2). The current winter SPP was approximately 971,000, and beaver ponds contributed 38% of winter potential (Table 2). Thus, summer and winter habitats equally limit the current quantity of coho salmon SPP. We also found that percent spawnable area averaged 4.0% and ranged between 0.1% and 20% for the 72 streams inventoried. The

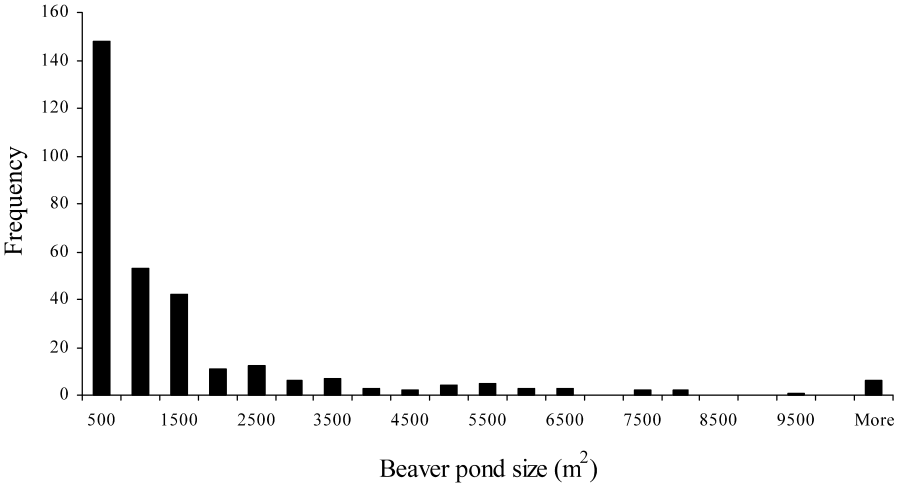

FIGURE 4.—Histogram of current beaver pond surface area on streams (n = 310) with a gradient of 4% or less within the known distribution of coho salmon in the Stillaguamish River basin, Washington. Nearly half (48%) of the ponds have a surface area of less than 500 m^2. The relationship between frequency F and pond surface area (S, in m^2) was described by the exponential decay equation $F = 3.01 + e^{(5.95 - 0.00185)}$ (n = 21, r^2 = 0.98, $P <$ 0.001).

TABLE 2.—Estimates of changes in coho salmon smolt production potential (SPP) from the Stillaguamish River basin, Washington, relative to historic conditions, under an assumption that either summer habitat availability or winter habitat availability is limiting production.

Habitat type	Historic SPP	Current SPP	Numerical change in SPP	Percent change in SPP	Percent of change SPP	Percent of historic SPP
Summer-limited production						
Beaver ponds	1,521,476	169,512	−1,351,964	−89	18	61
Sloughs	292,465	92,603	−199,862	−68	10	12
Tributaries	608,850	596,206	−12,644	−2	62	24
Main stem	78,600	100,800	22,200	28	10	3
Lakes	4,875	5,925	1,050	22	1	0
Total	2,506,266	965,046	−1,541,220	−61	100	100
Winter-limited production						
Beaver ponds	6,085,904	367,750	−5,718,154	−94	38	86
Sloughs	710,535	224,974	−485,561	−68	23	10
Tributaries	285,186	260,186	−25,000	−9	27	4
Main stem	78,600	100,800	22,200	28	10	1
Lakes	4,875	5,925	1,050	22	1	0
Total	7,081,625	971,308	−6,110,317	−86	100	100

majority of spawnable area existed in channels possessing gradients of less than 2%. Based on the Reeves et al. (1989) protocol, we found that only 1 of the 72 streams was physically limited by a lack of spawning gravel.

Our data indicated that, historically, the Stillaguamish River basin was capable of sustaining about 2.5 million juveniles in the summer and 7.1 million juveniles in the winter (Table 2). We estimated that beaver ponds alone could sustain 1.5 million juveniles in the summer and 6.1 million juveniles in the winter. Thus, historically, beaver ponds accounted for 61% of the total summer SPP and 86% of the total winter SPP (Table 2). Because total historic summer SPP was about one-third of winter SPP, juvenile coho salmon production was likely physically limited by the availability of summer habitat. Comparison of current and measured maximum production estimates suggests that the historic SPP of the basin was approximately 2.5 times the current SPP, and that most of the reduction in SPP resulted from the widespread loss of slow-water habitat created by beaver dams, and to a lesser extent, sloughs (Table 2).

Discussion

Abundance of Slow-Water Habitat and Implications for Coho Salmon Smolt Production

Our analyses show the great importance, both historically and currently, of beaver pond habitat for potential juvenile coho salmon production in the Stillaguamish River watershed. Our analyses and the historical record clearly indicate the formerly tremendous abundance of off-channel or slow-water habitats in the form of beaver ponds, lakes, and sloughs, and that much of the broad Stillaguamish River floodplain was composed of wetlands or ponds (Collins et al. 2002; Collins et al. 2003). The widespread trapping of beaver in the early 1800s and the dredging and diking of floodplains in the 1850s were among the first alterations made by European settlers on the Puget Sound region (Beechie et al. 1994; Mackie 1997). Thus, most of the rearing habitat used by coho salmon was eliminated long before commercial fisheries exerted any substantive impact on coho salmon populations and well before estimates of historic coho salmon populations became available.

Although we focused on the historical role of beaver dams in creating slow-water habitat used by juvenile coho salmon, records suggest that natural features, such as floodplain levees, wood jams, oxbow lakes, and distributary sloughs, also created plentiful slow-water habitat (Collins et al. 2003). Because the aerial photographic record only extends back to the 1930s, we were unable to document habitat changes that occurred earlier, and thus we likely underestimated the amount of sloughs, lakes, and other slow-water habitats that historically contributed to coho salmon smolt production. For example, historical records in two river basins directly adjacent to the Stillaguamish River (the Skagit River basin to the north and the Snohomish River basin to the south) indicate vast floodplain wetlands that were likely formed by natural levees (Beechie et al. 1994; Collins et al. 2003). However, these wetlands were likely further

TABLE 3.—Comparison of the coho salmon smolt production potential (SPP) from pools formed by large woody debris (LWD) placement in four restored streams (gradient [S] $\leq$ 0.04) versus pools formed by beaver dams in streams ($S \leq 0.04$) in the Stillaguamish River basin, Washington. Also included are the average SPP values for the 30 km of streams that were surveyed for both LWD abundance and pool area. Pool area estimates for LWD pools are from Pess et al. (1999); beaver pond area estimates are from this study. Estimates of SPP for both LWD pools and beaver ponds are based on data from Hankin and Reeves (1988).

Site	Restored streams		Beaver dams		Average m^2 of pool per unit	Average summer SPP per unit	Average winter SPP per unit
	Reach length (m)	LWD/m	Pond size	N			
LWD pools							
Porter Creek	900	0.1			28	12	30
Segelson Creek	98	0.14			7	3	8
Siberia Creek	390	0.29			15	6	16
Cherokee Creek	700	0.39			5	2	5
Average of restored streams					14	6	15
Average of 30 km of streams					13	6	14
Beaver ponds							
Basinwide <500 m^2				148	220	83	341
Basinwide >500 m^2				162	2,590	971	2,007
Average of beaver dams					1,405	527	1,174

modified by beaver, which is reflected in the names of some areas (e.g., the historic 10,000-acre Beaver Marsh on the Skagit River; Collins et al. 2003). Although large floodplain wetlands likely contained enough water to provide overwintering habitat for coho salmon, beaver dams would have helped to ensure flooding during summer, when production bottlenecks were greater due to limited slow-water habitat. We speculate that beaver likely built dams at breaks in the natural levees, thus raising the level of floodplain marshes and keeping them flooded throughout the summer months. However, to the extent that floodplain marshes historically existed in the Stillaguamish River basin, they were not included in our historical estimates of beaver pond habitat.

Our intent was not to precisely determine which types of coho salmon habitat are attributable to beaver activity. Rather, we sought simply to promote the recognition that beaver, through dam building, historically created abundant slow-water habitat and wetlands that were useful to juvenile coho salmon and many other species, and that most of those habitats are now gone.

At present, a primary physical limitation to coho salmon production increases in the basin is the lack of beaver ponds or similar slow-water habitats. Coho salmon SPP of the Stillaguamish River basin could be increased by a factor of 2.5 if beaver populations and the slow-water pool habitat they create are allowed to expand. Therefore, any watershed restoration plan that excludes beaver as a restoration tool will have limited success in restoring coho salmon populations. In the Stillaguamish River, reclamation of all juvenile coho salmon habitat other than beaver ponds would increase output potential by about 200,000 smolts, primarily from the reclamation of side-channel and distributary sloughs. In comparison, restoration of all former beaver pond habitat would increase smolt production by over seven times that amount. In other words, if we assume an average of 3 dams/beaver colony (Pollock et al. 2003) and an average summer SPP of 527 smolts/dam (Table 3), the establishment of just 125 new beaver colonies within the Stillaguamish River basin could increase the total watershed SPP by the same amount attained by restoring all other habitat types to their historic abundance (Table 2).

Comparison of Potential and Actual Smolt Production

Nelson et al. (1997) used a coded-wire tag study in combination with smolt traps and habitat survey data, and estimated an average production of 650,000 smolts (range 520,000–830,000) over a 4-year period (1993–1996). The higher end of their range approaches our estimate of 970,000 smolts, but is somewhat lower. There are several possible reasons why our SPP estimate was greater than the measured production. Current escapement levels in the Stillaguamish River may be insufficient to fully reach carrying capacity in all streams. This explanation could easily be tested by increasing escapement levels and observing whether there is an increase in smolt output in the following years. Alternatively, the current SPP might have been overestimated because we measured habitat quan-

TABLE 4.—Cost of Large woody debris (LWD) placement per stream kilometer for restoration projects in British Columbia (BC), Washington (WA), and Oregon (OR). Costs are in U.S. dollars. Estimates are based on data from Cederholm et al. (1997).

Site	Description	Distance (km)	Cost ($/km)
Fish Creek, OR	Attached LWD	14.0	50,000
Swamp Creek, WA	Interconnected pools with LWD	0.2	23,000
Porter Creek, WA	Free-fall and cabled LWD	0.5	18,000
Porter Creek, WA	Cabled LWD; extensive engineering	0.5	224,000
East and Lobster creeks, OR	LWD and alcoves	3.4	29,000
Shop Creek, BC	LWD, V-weirs, and boulders	1.0	60,000

tity and then assumed an average smolt production output per unit area of habitat based on the work of Hankin and Reeves (1988), who determined potential production for streams in a relatively natural condition. We did not take into account that some habitats might be highly degraded and therefore unproductive. For example, many floodplain tributaries in the Stillaguamish River basin flow through agricultural lands, and could have water quality problems due to the fertilizers, pesticides, and herbicides present in agricultural runoff. Such streams might have greatly diminished smolt output capacity.

Implications for Habitat Restoration

Much of the recent restoration efforts to create slow-water juvenile coho salmon rearing habitat have focused on instream placement of large woody debris (LWD) rather than encouraging the expansion of beaver populations. However, the SPP per beaver dam ranges from 527 to 1,174 fish, whereas the SPP from a pool formed by instream LWD is about 6–15 individuals, indicating that beaver dams may be the better option (Table 3). Further, the cost of LWD restoration activities can be quite expensive, ranging from US$18,000 to $224,000 per stream kilometer (Table 4). In contrast, allowing beaver to dam streams involves only the cost of translocating the animals and adopting a no-trapping policy to encourage expansion of existing populations. Although LWD placement is often a worthwhile activity, promotion of beaver dam building in suitable areas is often the most cost-effective and appropriate restoration technique for watersheds where coho salmon production is limited by the lack of pool habitat.

Impacts of Beaver Pond Losses on Other Species

Although we focused on coho salmon populations, numerous other species have likely been affected by loss of beaver ponds as well. Beaver ponds have been identified as important habitat for numerous fish, mammalian, avian, and amphibian species (Collen and Gibson 2000; see also reviews by Naiman et al. [1988] and Pollock et al. [1994, 2003]). Published studies indicate that fishes and waterfowl have been the most severely impacted by reduced beaver pond habitat. Within the Pacific coastal ecoregion, fishes identified as making substantial use of beaver ponds include cutthroat trout *Oncorhynchus clarki*, sockeye salmon *O. nerka*, steelhead *O. mykiss*, Dolly Varden *Salvelinus malma*, and chinook salmon *O. tshawytscha* (Gard 1961; Bryant 1983; Swales et al. 1986; Swales et al. 1988; Murphy et al. 1989). For example, Murphy et al. (1989) found that juvenile sockeye salmon heavily used reaches upstream of beaver dams, averaging 0.48 fish/m^2; similar to observations of coho salmon, juvenile sockeye salmon that used these reaches were larger and grew faster than conspecifics that used other instream habitats. Studies to determine how the loss of beaver ponds has affected populations of these and other species would be worthwhile.

Beaver dams create slow-water habitat that is favorable to rearing juvenile coho salmon, and such habitat existed in greater abundance historically than it does today. Decimation of beaver populations in the Stillaguamish River basin has resulted in a drastic loss of pond habitat and a subsequent reduction in the coho salmon SPP. Loss of beaver habitat is the single most important factor currently limiting coho salmon production in the Stillaguamish River basin. As such, there is great potential for increasing coho salmon populations through an increase in the abundance of slow-water habitats, such as those created by beaver dams.

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ARTICLES

FISH AND WILDLIFE MANAGEMENT ON FEDERAL LANDS:

DEBUNKING STATE SUPREMACY

BY

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This Article reviews the authority of federal and state governments to manage wildlife on federal lands. It first describes the most common assertions made by state governments regarding state powers over wildlife and then analyzes the relevant powers and limitations of the United States Constitution and federal land laws, regulations, and policies. Wildlife-specific provisions applicable within the National Park System, National Wildlife Refuge System, National Forest System, Bureau of Land Management, the special case of Alaska, and the National Wilderness Preservation System are covered, as is the Endangered Species Act. We reviewed an extensive collection of cases of conflict between federal and state agencies in wildlife management on federal lands. These cases show how federal land laws, regulations,

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and policies are frequently applied by federal agencies in an inconsistent and sometimes even unlawful fashion. They also demonstrate how commonalities found in state wildlife governance, such as sources of funding and adherence to the North American Model of Wildlife Conservation, often exacerbate conflict over wildlife management on federal lands.

Federal land management agencies have an obligation, and not just the discretion, to manage and conserve fish and wildlife on federal lands. We debunk the myth that "the states manage wildlife and federal land agencies only manage wildlife habitat." The myth is not only wrong from a legal standpoint, but it leads to fragmented approaches to wildlife conservation, unproductive battles over agency turf, and an abdication of federal responsibility over wildlife. Another problem exposed is how the states assert wildlife ownership to challenge the constitutional powers, federal land laws, and supremacy of the United States. While the states do have a responsibility to manage wildlife as a sovereign trust for the benefit of their citizens, most states have not addressed the conservation obligations inherent in trust management; rather, states wish to use the notion of sovereign ownership as a one-way ratchet—a source of unilateral power but not of public responsibility. Furthermore, the states' trust responsibilities for wildlife are subordinate to the federal government's statutory and trust obligations over federal lands and their integral resources.

The Article finishes by reviewing the ample opportunities that already exist in federal land laws for constructive intergovernmental cooperation in wildlife management. Unfortunately, many of these processes are not used to their full potential, and states sometimes use them solely as a means of challenging federal authority rather than a means of solving common problems. Intergovernmental cooperation must be a mutual and reciprocal process, meaning that state agencies need to constructively participate in existing federal processes, and federal agencies should be provided meaningful opportunities to participate in, and influence, state decision making affecting federal lands and wildlife.

I. INTRODUCTION

Some of the most significant cases in the development of federal lands and resources law revolve around questions pertaining to federalism and wildlife management. At stake are weighty issues related to constitutional law, sovereignty, and ownership. Complicating matters is the enduring tension between federal and state governments that is built into American politics, the opaque language sometimes found in federal lands law, and the interjurisdictional nature of wildlife conservation. And, of course, there is the politics of it all, as these cases force federal and state agencies to consider their sources of power and authority, their organizational values and biases, and other deeply polarizing and confrontational issues.

To begin, consider some of the following questions that were decided long ago by the courts: Does the United States Forest Service (USFS) have the authority to kill over-browsing deer deemed to be causing harm to the Kaibab National Forest and to do so in violation of state game laws? Similarly, does the National Park Service (NPS) have the authority to kill deer within Carlsbad Caverns National Park for research purposes without obtaining a state permit? Does Congress have the power to protect wild horses and burros on federal lands when those species compete with ranchers and their cattle for forage? And can the United States Fish and Wildlife Service (FWS) refuse to permit the State of Wyoming to vaccinate elk on the National Elk Refuge?

The courts answered these questions, all in the affirmative,[1] but standoffs between federal and state governments have nonetheless intensified in recent years. We examined several of these conflicts to help guide our research so that we could address the key arguments made by state and federal governments, and focus our analysis on the most relevant provisions related to wildlife as found in federal law, regulation, and policy. Included in our review were cases receiving national attention, such as the recent decision by NPS and FWS to preempt those hunting regulations of the State of Alaska that are in conflict with National Park and Refuge laws. These are rare cases where federal agencies pushed back against state interests. In other high profile cases, federal agencies acquiesced to the states, such as Grand Teton National Park's refusal to apply federal regulations to private inholdings within the boundaries of the Park, thus effectively ceding wildlife management authority to the State of Wyoming on roughly 2,300 acres of land within the Park. Other problematic cases include the management of wolves in federally designated wilderness areas, such as the decision made by USFS to permit the State of Idaho to land helicopters in the Frank Church River of No Return Wilderness in order to track and collar wolves, and to not take action to regulate the State of Idaho's plan to hire a professional trapper to kill two packs of wolves living within the Wilderness for the purpose of increasing the area's elk population. We also investigated cases receiving far less national attention, such as an annual predator killing contest on federal lands in Idaho managed by USFS and the Bureau of Land Management (BLM), and the State of Utah's introduction of non-native mountain goats to establish a population on national forest lands.

In cases like these, the states frequently claim that federal land agencies have limited authority over wildlife management, especially on multiple-use lands managed by USFS and BLM. In making this argument, states commonly assert that they own wildlife and manage it as a trust resource. As they see it, their power and authority over wildlife on federal lands reign supreme, and as the argument goes, neither federal land laws nor the courts have done much to change this historical arrangement. The states often justify their positions and actions by reference to the "North American Model of Wildlife Conservation" (the Model), which is a set of principles to guide state management of wildlife.

In comparison to the states, the federal government responds in a more varied and often inconsistent fashion. Rare is the situation where a federal agency challenges state interests, such as the case with NPS and FWS in Alaska. More common is a federal agency sending mixed messages about its authority over wildlife on federal lands, sometimes flexing its muscle, sometimes acquiescing to the states, and sometimes doing everything it can to watch from the sideline. This inconsistency may be why questions about wildlife management on federal lands have resurfaced with such force in recent years.

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[1] *See infra* notes 136–153, 382 and accompanying text.

This Article sets the record straight by providing a comprehensive examination of the authority of federal agencies to manage wildlife on federal lands, with the goal of providing a more common understanding amongst federal and state agencies. To help ground the research and make it usable to decision makers and federal land and wildlife managers, the research team consists of three academics (Zellmer, Joly, and Nie) and three consultants (all retired federal employees) having decades of experience working for the United States Department of Agriculture's Office of the General Counsel (Pitt), USFS (Haber, a former planning specialist for the agency), and BLM (Barns, a former wilderness specialist at the Arthur Carhart National Wilderness Training Center).

The Article comes in three parts. Part II begins by providing the context of state wildlife governance. It highlights the core claims and arguments most often made by the states and their representative institutions in conflicts like those described above. It reviews the common assertion that states own wildlife and manage it as a trust resource. From there, the Part reviews common themes in state wildlife laws, decision-making processes, and sources of funding. The North American Model of Wildlife Conservation is then described insofar as it relates to federal lands and conflict over wildlife management. The Model was invoked frequently in the cases we examined, and we explain its relevance in Part II and what we view as its shortcomings in Part IV. Part II closes by summarizing some of the most common complaints and recommendations made by the states, through the Association of Fish and Wildlife Agencies (AFWA), regarding the management of wildlife on federal lands. We do so because of the role played by AFWA in negotiating agreements with federal land agencies.

Part III begins by providing the legal context of wildlife management on federal lands. The constitutional setting comes first, with a review of the United States Constitution's Property Clause, Treaty Clause, Commerce Clause, and the Tenth Amendment. The first Subpart closes by reviewing the doctrine of federal preemption and the use of savings clauses in federal land law. It shows that while states have well-established historical authority over wildlife within their borders, this authority is neither exclusive nor necessarily dominant. As found repeatedly by the courts, the Constitution grants the federal government the authority to manage its lands and resources, fulfill its treaty obligations, and control interstate commerce, even when the states object.

Part III then reviews the federal land laws, regulations, and policies of most significance to the management of wildlife on federal lands. Provisions governing the management of endangered and threatened species, the National Park System, National Wildlife Refuge System, National Forest System, public lands administered by BLM, the special case of Alaska, and the National Wilderness Preservation System are covered in this Subpart. Extra attention is provided to the latter because of the disproportionate amount of conflict and controversy generated by wildlife management in federally designated wilderness. The Subpart shows that federal land agencies have considerable powers and statutory duties to manage wildlife

on federal lands, even if they have chosen not to exercise those powers consistently in the past. Also reviewed in each are agency-specific savings clauses and provisions related to intergovernmental cooperation. Though each statute differs in important ways, all provide the states with meaningful and privileged opportunities to participate in decisions regarding the management of wildlife on federal lands. The savings clauses demonstrate Congress's desire to acknowledge some level of state responsibility over wildlife management, but in no way should these clauses be interpreted to diminish the federal government's vast constitutional and statutory authority to manage its own lands and resources, even when objected to by a state.

Our conclusions, analysis, and recommendations come in Part IV. We begin by explaining that federal land management agencies have an *obligation*, and not just the discretion, to manage and conserve fish and wildlife on federal lands, contrary to the myth that "the states manage wildlife, federal land agencies only manage wildlife habitat." We found this mantra repeated throughout our study, and it was commonly made by state *and* federal agencies in multiple cases and contexts. We explain the origins of this myth and explain why it is wrong from a legal standpoint and limited from a biological one. The myth must be debunked, not only because it is legally deficient, but also because federal lands are significant reservoirs of biodiversity and will become even more significant in the future due to the rapid pace of development on nonfederal lands.

We next address the common claim that states own wildlife and that such ownership necessarily limits the authority of federal land agencies to manage and make decisions concerning wildlife. We conclude that the states' assertion that they own wildlife—full stop—is incomplete, misleading, and needlessly deepens divisions between federal and state governments. It is especially problematic when states assert ownership as a basis to challenge or undermine federal authority over wildlife on federal lands. The states are on solid footing when declaring a "sovereign ownership" of wildlife that must be managed as a public trust resource. But, invoking the public trust as a source of authority is simply not credible without its mirror-image, which is the conservation responsibility for trust resources.

We also explain in Part IV why it is important for the federal government to respond to state assertions of trust ownership by emphasizing that it too has statutory and trust obligations over federal lands, which often encompass the conservation of wildlife. This Subpart concludes by discussing how the all too often adversarial relationship between federal and state governments might be addressed in the future by embracing a more cooperative form of "co-trusteeship" between federal, state, and tribal governments. In moving forward, we also recommend a reexamination of how wildlife is managed and funded at the state level, such as finding a more secure and predictable source of funding for nongame management. We also suggest that advocates of the Model consider the significant role played by federal lands in the conservation of wildlife.

Addressed next are two issues of a more technical nature, both of which figured prominently in the cases reviewed for this research. The first is the United States Department of the Interior's policy statement on federal-state relations in wildlife policy. Some of the provisions found in the policy sow confusion amongst federal and state agencies. Most problematic is how the policy proclaims that states have "primary authority" for management of fish and wildlife on federal lands. We take issue with this misinterpretation of the law, the process used to write it, and explain how it can lead to unnecessary confusion and conflict between federal and state governments.

We then discuss the issue of what happens when federal agencies refuse to take action to protect wildlife on federal lands. This scenario played out in several of the cases reviewed as part of this project, with the distinction being between when the agency has a duty to act and when the agency has the authority to act but the action is discretionary. When a federal agency has a duty to act under a statute, regulation, or other legal requirement, the failure to do so through permit issuance or otherwise warrants an injunction of the non-permitted and non-federal activity.

The issue of wildlife management in the National Wilderness Preservation System is also addressed again in Part IV. We review the Wilderness Act[2] and its unambiguous affirmative obligation to preserve wilderness character, which includes fish and wildlife species within wilderness areas, and discuss problematic trends where federal agencies have skirted legal obligations in order to accommodate more political demands, often from state interests advancing a view of management that is antithetical to the Wilderness Act.

Part IV concludes by discussing the importance of intergovernmental cooperation in the management of wildlife on federal lands. Multiple opportunities for cooperation already exist in federal decision-making and planning processes, but they are not used to their full potential. We found that states too often view such opportunities not as a way to meaningfully inform federal decision making, but as a political platform to challenge federal authority. As we see it, intergovernmental cooperation is a two-way street, and while federal agencies must provide opportunities for state participation in federal planning processes, the states should reciprocate by providing opportunities for federal entities to participate meaningfully in state wildlife management decision making and, in appropriate cases, to influence the resolution of issues related to wildlife conservation.

To make the research accessible to those who need it most, the Article is accompanied by a set of frequently asked questions that will be available online.[3] This resource enables users to find succinct answers to their questions with linkages to the most relevant parts of the Article for additional information.

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2 16 U.S.C. §§ 1131–1136 (2012).

3 *Federal Lands & Wildlife*, U. MONT., http://www.cfc.umt.edu/bolle/federal-lands-wildlife (last visited Nov. 11, 2017) (FAQs currently under construction).

II. STATE MANAGEMENT CONTEXT AND STATE PERSPECTIVES ON MANAGING WILDLIFE ON FEDERAL LANDS

This Part provides some initial background on state wildlife law and governance. Common state perspectives on wildlife ownership, the wildlife trust, state wildlife commissions, funding, and the North American Model of Wildlife Conservation are reviewed insofar as they pertain to intergovernmental conflict. These issues emerged frequently in several of the disputes we examined. The Part reviews some of the most common claims and arguments made by state wildlife agencies and their representative institutions. Of course, there is no singular state wildlife agency perspective, and readers should appreciate the diversity found amongst the states. To simplify, we emphasize the views and position of AFWA. AFWA represents North America's state fish and wildlife agencies and is a principle actor in the debate over wildlife management on federal lands.[4] Particular emphasis is placed on AFWA because of its role in negotiating agreements with federal land agencies. We take issue with some of the positions and arguments, as explained below in this Part, and we return to some of the more substantive issues in subsequent Parts of the Article.

A. State Ownership and the Wildlife Trust

Forty-eight states claim sovereign ownership of wildlife.[5] Sovereign ownership differs from proprietary ownership in that it is constrained by the public interest with the requirement that wildlife be managed for the greater good and the benefit of the public.[6] Most often referenced by the states in this context is *Geer v. Connecticut*,[7] in which the Supreme Court of the United States recognized the common state ownership of wildlife and that this power is to be exercised "as a trust for the benefit of the people, and not as a prerogative for the advantage of the government, as distinct from the people, or for the benefit or private individuals as distinguished from the public good."[8] As we discuss in Part III.A, the Supreme Court subsequently overruled *Geer* in *Hughes v. Oklahoma*, but did so in the context of federal laws preempting state laws (based on claims of state ownership).[9] States, in

4 *See About: Overview*, ASS'N FISH & WILDLIFE AGENCIES, https://perma.cc/A2ZW-GQSP (last visited Nov. 11, 2017).

5 Michael C. Blumm & Aurora Paulsen, *The Public Trust in Wildlife*, 6 UTAH L. REV. 1437, 1462, 1488–1504 (2013).

6 *Id.* at 1466–67.

7 161 U.S. 519 (1896), *overruled by* Hughes v. Oklahoma, 441 U.S. 322 (1979).

8 *Id.* at 529. AFWA considers *Geer* as "provid[ing] the single strongest statement of state public trust ownership of fish and wildlife in the Court's jurisprudence." Brief for Ass'n of Fish & Wildlife Agencies as Amici Curiae in Support of Petitioners at 11, Wisconsin v. Lac Courte Oreilles Band of Lake Superior Chippewa Indians of Wis., 135 S. Ct. 1842 (2015) (No. 14-792), 2015 WL 527525, at *11. *Geer* traces the idea to *Martin v. Waddell's Lessee*, 41 U.S. (16 Pet.) 367 (1842). *Geer*, 161 U.S. at 529.

9 *Hughes*, 441 U.S. 325–26. The erosion of *Geer* began with *Missouri v. Holland*, 252 U.S. 416 (1920). There, the Court upheld the constitutionality of the Migratory Bird Treaty Act and

other words, cannot discriminate against interstate commerce based on claims of state ownership of wildlife.[10] The general rule adopted in *Hughes* "makes ample allowance for preserving, in ways not inconsistent with the Commerce Clause, the legitimate state concerns for conservation and protection of wild animals underlying the 19th-century legal fiction of state ownership."[11]

Assertions of sovereign ownership provide the basis for states claiming a "public trust" in wildlife. In their analysis, Blumm and Paulsen find that "courts and legislatures in at least twenty-two states have expressly employed the words 'trust' or 'trustee' when discussing state management of wildlife" and that "courts and legislatures of at least twenty-two other states use trust-like language . . . in proclaiming state ownership of wildlife."[12] The public trust in wildlife is most often invoked by states when declaring broad power and authority to regulate fish and wildlife resources.[13] Less clear is what affirmative conservation duties go along with this trust responsibility. In other words, what must states do, and not do, in order to meet the responsibilities of the wildlife trust?[14] There is relatively little case law on this matter, and states have generally done little to fill in the details.[15] As is the case with the public trust doctrine more broadly, there are many unanswered questions about the exact parameters and possible applications of a "wildlife trust," if the term is to be taken literally.[16] But for purposes

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rejected state claims of "exclusive authority" to manage wildlife under the state ownership doctrine. *Id.* at 434. As eloquently stated by the Court: "the state may regulate the killing and sale of such birds, but it does not follow that its authority is exclusive of paramount powers. To put the claim of the State upon title is to lean upon a slender reed." *Id.*; *see infra* notes 187–190 and accompanying text.

10 *Hughes*, 441 U.S. at 335.

11 *Id.* at 335–36.

12 Blumm & Paulsen, *supra* note 5, at 1471, 1473. "Of the fifty states, only Nevada and Utah have yet to make some acknowledgement of the public trust in wildlife." *Id.* at 1477. Similarly, AFWA emphasizes that "[s]tates, as public trustees, hold wildlife in trust for their citizens." Brief for Ass'n of Fish & Wildlife Agencies as Amici Curiae in Support of Petitioners, *supra* note 8, at 10.

13 Blumm & Paulsen, *supra* note 5, at 1466, 1471–73.

14 *See generally* Susan Morath Horner, *Embryo, Not Fossil: Breathing Life Into the Public Trust in Wildlife*, 35 LAND & WATER L. REV. 23, 24 (2000) ("[P]ractitioners have not been left with any clear authority either as to the resources to which the doctrine should apply, or its necessary features."); Gary D. Meyers, *Variation on a Theme: Expanding the Public Trust Doctrine to Include Protection of Wildlife*, 19 ENVTL. L. 723, 733 (1989) ("Professor Stone's proposal focuses on the practical aspects of such a change, namely that natural objects would be recognized at law, could institute—through a guardian—legal action to prevent or redress harm to the natural objects, and receive direct injunctive or monetary relief."); Patrick Redmond, *The Public Trust in Wildlife: Two Steps Forward, Two Steps Back*, 49 NAT. RESOURCES J. 249, 253 (2009) ("This distinction between proscriptive authority and affirmative duties has evoked numerous subtle philosophical and ethical discussions of the difference between a purely regulatory relationship between the state and its natural resources and a more trust-oriented relationship based on a stewardship ethic or 'duty-based environmentalism.'").

15 *See* Blumm & Paulsen, *supra* note 5, at 1471; Richard M. Frank, *The Public Trust Doctrine: Assessing Its Recent Past and Charting Its Future*, 45 U.C. DAVIS L. REV. 665, 678 (2012); *see also* discussion *infra* Part IV.B.1.

16 Horner, *supra* note 14, at 25.

here, it is enough to note how the open-ended nature and ambiguity of the wildlife trust doctrine is used by the states to assert jurisdictional powers and control over wildlife. We return to the important issues of wildlife ownership and trust management in Part IV.A.2.

B. State Wildlife Laws, Decision Making, and Funding

State wildlife agencies implement their wildlife trust duties through an array of state wildlife laws and regulations. Some of the most common categories found in state codes pertain to protected species, hunting, fishing and trapping, animal damage control, habitat protection, tribal provisions, law enforcement, and hunter-harassment interference.[17] Twenty-one states also have "right to hunt" constitutional provisions.[18] These vary in terms of substance and effect.[19]

Some simply recognize a hunting heritage in a state[20] and the opportunity to harvest wild fish and game subject to state law and regulation,[21] while others create more explicit rights that are nonetheless subject to state management.[22] All but one of these amendments (Vermont's) passed since the mid-1990s, and collectively, they reflect some fear that state hunting traditions are under threat.[23] As we discuss below, they also signify the importance of hunting to state wildlife management.

While state fish and wildlife agencies are structured in numerous ways, a commonalty that most share is that the director or head of the agency is responsible to some sort of politically appointed fish and wildlife commission, board, or advisory council.[24] The powers granted to state wildlife commissions vary, from setting fish and game seasons and bag limits

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17 *See* RUTH S. MUSGRAVE & MARY ANNE STEIN, CTR. FOR WILDLIFE LAW, STATE WILDLIFE LAWS HANDBOOK 14, 18 (1993); *see also Animal Legal and Historical Center Web Site*, MICH. ST. U., https://perma.cc/4EUV-D9VX (last visited Nov. 11, 2017) (providing searchable database of hunter harassment and interference laws).

18 *See State Constitutional Right to Hunt and Fish*, NAT'L CONF. ST. LEGISLATURES (Apr. 20, 2017), https://perma.cc/W53P-J3QQ.

19 *See generally* Stacey L. Gordon, *A Solution in Search of a Problem: The Difficulty with State Constitutional "Right to Hunt" Amendments*, 35 PUB. LAND & RESOURCES L. REV. 3 (2014) (discussing the different state constitutions that guarantee a right to hunt.).

20 *See, e.g.*, MONT. CONST. art. IX, § 7 ("The opportunity to harvest wild fish and wild game animals is a heritage that shall forever be preserved to the individual citizens of the state and does not create a right to trespass on private property or diminution of other private rights.").

21 *See, e.g.*, WYO. CONST. art. I, § 39 ("The opportunity to fish, hunt and trap wildlife is a heritage that shall forever be preserved to the individual citizens of the state, subject to regulation as prescribed by law, and does not create a right to trespass on private property, diminish other private rights or alter the duty of the state to manage wildlife.").

22 *See, e.g.*, VA. CONST. art. XI, § 4 ("The people have a right to hunt, fish, and harvest game, subject to such regulations and restrictions as the General Assembly may prescribe by general law").

23 *State Constitutional Right to Hunt and Fish*, *supra* note 18.

24 *See* Martin Nie, *State Wildlife Policy and Management: The Scope and Bias of Political Conflict*, 64 PUB. ADMIN. REV. 221, 222 (2004).

to charting broader management goals and objectives for the states.[25] Members are typically appointed by the governor and subject to state legislative approval.[26] Most states also have requirements for commission membership, such as a general knowledge of wildlife issues, political and geographic balance, or requiring that they hold a sporting license.[27] The commission framework stems from sport hunters and conservationists wanting to secure their hard-fought protections for fish and game; thus, commissions were created so that sport hunters had a voice in preventing a return of widespread market hunting.[28] More recently, however, state wildlife commissions have been criticized, mostly because some interests believe that their memberships do not adequately represent the diverse values and interests of those people who do not hunt, fish, or trap.[29]

Funding for state wildlife management generally comes from the sale of hunting, fishing, and trapping licenses at the state level and from federal funds generated through targeted excise taxes.[30] The result is that hunting, fishing, and trapping-derived revenue "comprise between 60 and 90 percent of the typical state fish and wildlife agency budget."[31] This arrangement is often referred to as a "user-pay, user-benefit" funding model because states apply most of these funds to the management of sport fish and game species.[32] This funding mechanism serves to reinforce the complaint of non-hunters that their values and interests are not adequately considered in management decisions.[33] As we discuss below, this funding model helps us better understand the position of states in some intergovernmental disputes, as decisions made by federal land agencies can have implications for state wildlife agency budgets that are so dependent on fish and game–generated revenue.[34]

Another initial observation is that the "user-pay, user-benefit" moniker is more complicated than generally stated. A case can be made, for example, that taxpayers, including the non-hunting and non-fishing public, do indeed pay for wildlife *conservation* through the acquisition and management of wildlife *habitat*, both public and private.[35] This takes the form of funding for federal lands, state lands, and contributions to private land conservation.[36]

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25 *See, e.g.*, ERIN SEILER, OR. LEGISLATIVE COMM. SERVS., EXECUTIVE APPOINTMENTS LEGISLATIVE REVIEW (2016), https://perma.cc/FKC9-VUJJ.

26 *See, e.g.*, *id.*

27 *See, e.g.*, *id.*

28 *See* JOHN F. REIGER, AMERICAN SPORTSMEN AND THE ORIGINS OF CONSERVATION 80 (3d ed. 2001).

29 Nie, *supra* note 24, at 223.

30 *Id.*

31 J.F. ORGAN ET AL., THE NORTH AMERICAN MODEL OF WILDLIFE CONSERVATION: TECHNICAL REVIEW 12-04, at 9 (Theodore A. Bookhout ed., 2012), https://perma.cc/68VB-FJ7F.

32 *See id.*

33 *See* Nie, *supra* note 24, at 223–24.

34 *See* ORGAN ET AL., *supra* note 31, at 10 (providing examples of federal agency influence on funding).

35 *See id.* at 27 (explaining contributions of public and private land management to habitat conservation).

36 *See id.*

But in more precise terms of funding wildlife *management* and state wildlife agencies, the user-pay, user-benefit model is less disputed.

The history of the user-pay, user-benefit funding model illustrates the cooperative relationship between federal and state governments in the management of wildlife. Prior to 1937, many states regularly diverted game license revenue to general governmental purposes, other than fish and wildlife management.[37] The Pittman-Robertson Wildlife Restoration Act,[38] more commonly known as the Federal Aid in Wildlife Restoration Act, put an end to this practice.[39] The program put in place by the Act provides federal assistance to states for wildlife restoration projects and plans and hunter education.[40] In order to secure a more certain and predictable stream of funding for wildlife, the Act (and subsequent amendments to it) created a fund from taxes imposed on firearms, ammunition, and archery equipment.[41] However, in order to receive federal funding, the law requires states to prohibit "the diversion of license fees paid by hunters for any other purpose than the administration of [the] State fish and game department."[42] In other words, the law conditions federal funding on states using state game license revenue for wildlife management and conservation.

A similar program focused on fisheries emerged from Congress in 1950. The Dingell-Johnson Sport Fish Restoration Act,[43] also referred to as the Federal Aid in Fish Restoration Act, funds sport fish restoration through excise taxes on fishing equipment, motorboat/small engine fuel, and baits.[44] It similarly includes a predicate for federal funding: states receiving Dingell-Johnson money must apply it to the administration of state fish and game departments.[45] Funding is used for fish restoration and management projects, defined in the law as "the restoration and management of all species of fish which have material value in connection with sport or recreation in the marine and/or fresh waters of the United States."[46]

The Pittman-Robertson and Dingell-Johnson Acts primarily focus on sport fish and game species. State funding for nongame species has not fared as well. Congress addressed this issue in passing the Fish and Wildlife Conservation Act of 1980.[47] Frequently referred to as the "Non-Game Act," this law recognizes that the traditional focus on "recreationally and

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37 *See* Hal Herring, *In Current Rush to Buy Guns and Ammo, Pittman-Robertson Funds Break All Records*, FIELD & STREAM (May 9, 2013), https://perma.cc/DV5X-889Y.

38 16 U.S.C. §§ 669–669i (2012).

39 *See id.* § 669.

40 *Id.* §§ 669b, 669c, 669h-1.

41 *See* M. LYNNE CORN & JANE G. GRAVELLE, CONG. RESEARCH SERV., R42992, GUNS, EXCISE TAXES, AND WILDLIFE RESTORATION 2 fig.1 (2013) (providing yearly data of Pittman-Robertson receipts and distributions).

42 16 U.S.C. § 669.

43 *Id.* §§ 777–777m.

44 *Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service: Federal Aid in Sport Fish Restoration Act*, U.S. FISH & WILDLIFE SERV., https://perma.cc/UG7W-QUMS (last visited Nov. 11, 2017).

45 16 U.S.C. § 777(a).

46 *Id.* § 777a(1).

47 *Id.* §§ 2901–2912.

commercially important species" and "traditional financing mechanisms are neither adequate nor fully appropriate to meet the conservation needs of nongame fish and wildlife."[48] The purpose of the Act is to fix this problem by providing "financial and technical assistance to the States for the development, revision, and implementation of conservation plans and programs for nongame fish and wildlife."[49] Promise notwithstanding, this law never achieved its stated purpose because unlike the Pittman-Robertson and Dingell-Johnson Acts, it does not include an independent and more secure funding mechanism.[50] Instead, the law relied on funding from general congressional appropriations, which to date, Congress never provided to the program.[51]

Several initiatives have been waged in the past, at both national[52] and state[53] levels, to deal with the lack of funding for nongame species management, and a related campaign is currently underway.[54] AFWA is part of a broad coalition seeking a solution to the problem of nongame funding.[55] We return to this issue in Part IV, as we believe it is imperative that states have the capacity and incentives to manage nongame species. Providing these resources will build trust and capacity at the state level, and help harmonize federal-state responsibilities over wildlife on federal lands.

C. The North American Model of Wildlife Conservation

The North American Model of Wildlife Conservation figures prominently in state claims and positions regarding wildlife management on federal lands. The Model was formally adopted by AFWA in 2002, and it views the Model (along with the public trust doctrine) as "the basis for state wildlife law."[56] While the Model has no independent legal authority, it is referenced extensively in AFWA's legal and educational materials, and is

48 *Id.* § 2901(a)(4).

49 *Id.* § 2901(b)(1).

50 Removing Regulations Implementing the Fish and Wildlife Conservation Act, 75 Fed. Reg. 51,420, 51,420–21 (Aug. 20, 2010) (to be codified at 50 C.F.R. pt. 83).

51 *See id.* at 51,420 (removing regulations that implement the Fish and Wildlife Conservation Act because "funds never became available to carry out the Act").

52 One of the more memorable campaigns was the unsuccessful effort in passing the Conservation and Reinvestment Act (CARA) of 2000. H.R. 701, 106th Cong. (2000).

53 *See* Cindy McKinney et al., Investing in Wildlife: State Wildlife Funding Campaigns 20 fig.1 (Apr. 2005) (unpublished M.S. thesis, University of Michigan), https://perma.cc/NSG4-TPD2.

54 *See generally* ASS'N OF FISH & WILDLIFE AGENCIES, SUSTAINING AND CONNECTING PEOPLE TO FISH AND WILDLIFE: A LOOMING CRISIS CAN BE AVOIDED, https://perma.cc/BH9H-Z4NN (last visited Nov. 11, 2017) (discussing incomplete fish and wildlife funding).

55 *Id.*

56 ASS'N OF FISH & WILDLIFE AGENCIES, WILDLIFE MANAGEMENT AUTHORITY: THE STATE AGENCIES' PERSPECTIVE 13 (2014), https://perma.cc/CR2T-U8A2 [hereinafter AFWA TASK FORCE REPORT]; *About: North American Model of Wildlife Conservation*, ASS'N FISH & WILDLIFE AGENCIES, https://perma.cc/NE8Q-38ZM (last visited Nov. 11, 2017).

also invoked frequently by state wildlife agencies and other institutions.[57] While it is beyond the scope of this Article to provide a thorough accounting and analysis of the Model, it plays a significant role in how states frequently frame issues and view their political and legal authority over wildlife.[58] We discuss the Model again in Part IV.B.2 by explaining how it can exacerbate conflict between federal and state governments.

First articulated by University of Calgary biologist Valerius Geist in the mid-1990s, the Model is a set of seven broadly stated principles, which include the following: 1) wildlife resources are a public trust; 2) markets for game are eliminated; 3) allocation of wildlife is by law; 4) wildlife can be killed only for a legitimate purpose; 5) wildlife is considered an international resource; 6) science is the proper tool to discharge wildlife policy; and 7) democracy of hunting is standard.[59]

Embedded within each principle is a descriptive-historical accounting of wildlife conservation and a more normative-prescriptive component. The Model places extraordinary emphasis on the role played by hunters in American wildlife conservation, while paying relatively little regard to the preservation movement or the role played by federal lands and federal environmental law more generally.[60] Conspicuously missing from the Model, for example, is a principle focused on wildlife habitat, of which federal lands would be of obvious significance.

The normative and prescriptive part of the Model is more difficult to assess because of how differently actors interpret and use it. Some proponents of the Model, for example, claim that it "has often been interpreted to be more than its original articulators' intention to describe key components of the philosophy and approach to wildlife conservation that developed in North America."[61] Critics of the Model, by contrast, see it as more than just a description of the past but rather as a narrow set of guiding principles for future wildlife conservation.[62] This is because most references

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57 *See, e.g.*, ARIZ. GAME & FISH DEP'T, NORTH AMERICAN MODEL OF WILDLIFE CONSERVATION, https://perma.cc/Z2XW-X2X3 (last visited Nov. 11, 2017) ("The North American Model of Wildlife Conservation is the world's most successful."); WILDLIFE SOC'Y, STANDING POSITION: THE NORTH AMERICAN MODEL OF WILDLIFE CONSERVATION, https://perma.cc/R4U9-6LBV (last visited Nov. 11, 2017) (explaining that the policy of The Wildlife Society is to "[p]romote and support adherence to the seven core components [of the Model], identified by the Society, as the bedrock of the Model, by state, provincial, and federal governments").

58 *See generally* David Willms & Anne Alexander, *The North American Model of Wildlife Conservation in Wyoming: Understanding It, Preserving It, and Funding Its Future*, 14 WYO. L. REV. 659 (2014).

59 Valerius Geist et al., *Why Hunting Has Defined the North American Model of Wildlife Conservation*, *in* TRANSACTIONS OF THE 66TH NORTH AMERICAN WILDLIFE AND NATURAL RESOURCES CONFERENCE 175, 176–80 (2001), https://perma.cc/C53S-CTCS (citing earlier references and antecedents to the Model).

60 *See id.*

61 John F. Organ et al., *Public Trust Principles and Trust Administration Functions in the North American Model of Wildlife Conservation: Contributions of Human Dimensions Research*, 19 HUM. DIMENSIONS WILDLIFE 407, 408 (2014).

62 *See* Susan G. Clark & Christina Milloy, *The North American Model of Wildlife Conservation: An Analysis of Challenges and Adaptive Options*, *in* LARGE CARNIVORE CONSERVATION: INTEGRATING SCIENCE AND POLICY IN THE NORTH AMERICAN WEST 289, 301 (Susan

to the Model, as discussed further below, go beyond description and use it to justify various positions or decisions made by state wildlife agencies.[63] Clark and Milloy summarize: "Functionally, the model's doctrine (principles) and formula (rules to implement the doctrine) guide current decision making about wildlife; they dictate how decisions are made, by whom, and for what purposes."[64] What is striking to us about the Model is how little academic and professional scrutiny has been applied to it, as it is clearly but one possible accounting of wildlife conservation—past, present, and future.

Whatever might be its strengths and limitations, the Model clearly has political and policy influence, and helps us understand state positions on wildlife management, though often indirectly. Of most relevance here is the Model's emphasis on the public trust doctrine, state primacy, and the importance of hunting to wildlife conservation. The public trust doctrine, as applied to wildlife, is regarded as the Model's cornerstone.[65] Asserting that public trust principles relating to wildlife are most clearly found in state law, AFWA references the Model to "[a]dvocate for the primacy of state management authority for resident wildlife."[66] Again, AFWA's emphasis is that states have authority to manage fish and wildlife resources through a public trust and that it "assigns trustee ownership of fish and wildlife to the states."[67] Access to public resources is commonly asserted in public trust cases (e.g., to oysters, tidelands, or streams), and state wildlife agencies and AFWA make similar linkages between states owning wildlife in trust, which necessitates providing public access to fish and wildlife.[68] We return to the public trust in wildlife issue in Part IV.A.2.

Also of relevance is the Model's emphasis on hunting. As explained by the Model's originators, though other interest groups such as bird enthusiasts played roles in the conservation movement, "[i]t is hunters, however, or, more accurately, *hunting*, that led to development of the [Model's principles and] form[s] the foundation for North American wildlife

G. Clark & Murray B. Rutherford eds., 2014) (questioning "whether the model is capable of conserving wildlife and ecosystems into the future without major adaptations"); *see also* Michael P. Nelson et al., *An Inadequate Construct? North American Model: What's Flawed, What's Missing, What's Needed*, WILDLIFE PROF., Summer 2011, at 58, 58 (arguing that "the rise in the Model's popularity is worrisome in both its descriptive and prescriptive modes: One rests upon an inadequate account of history and the other on an inadequate ethic").

63 *See, e.g.*, *infra* note 66 and accompanying text; *see also* discussion *infra* Part II.D.

64 Clark & Milloy, *supra* note 62, at 312.

65 *See* Organ et al., *supra* note 61, at 408; *see also* WILDLIFE SOC'Y, THE PUBLIC TRUST DOCTRINE: IMPLICATIONS FOR WILDLIFE MANAGEMENT AND CONSERVATION IN THE UNITED STATES AND CANADA 9 (2010), https://perma.cc/5N5W-KG2S.

66 M. CAROL BAMBERY & MARTIN BUSHMAN, ASS'N OF FISH & WILDLIFE AGENCIES, THE STATES: TRUSTEES OF AMERICA'S WILDLIFE 13 (on file with authors).

67 *Federal Interactions with State Management of Fish and Wildlife: Hearing Before the Subcomm. on Fisheries, Water, and Wildlife of the S. Comm. on Environment and Public Works*, 114th Cong. 9 (2016) [hereinafter *Hearing*] (statement of Ronald J. Regan, Executive Director, Association of Fish and Wildlife Agencies).

68 *See* WILDLIFE SOC'Y, *supra* note 65, at 9 (emphasizing the importance of access to the public trust doctrine, including fishing, hunting, trapping, and travel routes).

conservation."[69] AFWA similarly states that "[h]unting and angling are the cornerstones of the North American Model with sportsmen and women serving as the foremost funders of conservation."[70] In this vein, proponents of the Model often speak to the importance of sportsmen and women-derived funds to state fish and wildlife agency budgets.[71] This is not to suggest, however, that all proponents of the Model are necessarily endorsing an exclusive "user-pay, user-benefit" model of funding for the future. In fact, some proponents are actively searching for ways to increase funding for nongame species and want the Model applied to the conservation of biodiversity more broadly.[72] However malleable the Model may prove itself to be in the future, at this point, it is very much hunting-centric, and this helps explain a common position of the states in various disputes, such as when federal agencies make decisions to restrict types of hunter access or when states advocate for more "active management" of wildlife on federal lands.[73]

D. The 2014 AFWA Task Force Report

In 2014, AFWA commissioned a task force to investigate how state wildlife agency directors "perceive the relationship between state and federal agencies, by determining the relationship's implications on states' authority to manage wildlife, and by making recommendations to strengthen the relationship between state and federal conservation agencies."[74] The Task Force Report illuminates how several state directors view the relationship between federal and state governments and the perceived legal sources of tension. Furthermore, many of the recommendations made by the Task Force are made by AFWA in other contexts, and the document was approved by state membership.[75]

The report begins by invoking the North American Model of Wildlife Conservation, the wildlife trust doctrine, and the Tenth Amendment of the

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69 Geist et al., *supra* note 59, at 179; *see also* James R. Heffelfinger et al., *The Role of Hunting in North American Wildlife Conservation*, 70 INT'L J. ENVTL. STUD. 399, 399 (2013) ("Regulated hunting is the foundation of the North American Model of Wildlife Conservation.").

70 *About: North American Model of Wildlife Conservation*, *supra* note 56.

71 *See, e.g.*, AFWA TASK FORCE REPORT, *supra* note 56, at 30; *About: North American Model of Wildlife Conservation*, *supra* note 56.

72 *See, e.g.*, Organ et al., *supra* note 61, at 408 (recommending that all wildlife be managed under the principles of the Model and that it is not synonymous with the user-pay, user-benefit funding model); Willms & Alexander, *supra* note 58, at 659–61 (recommending alternative funding sources for wildlife management).

73 For example, AFWA states that the Model "is the world's most successful system of policies and laws to restore and safeguard fish and wildlife and their habitats through sound science and *active management*." *About: North American Model of Wildlife Conservation*, *supra* note 56 (emphasis added); *see also* Joanna Prukop & Ronald J. Regan, *In My Opinion: The Value of the North American Model of Wildlife Conservation—An International Association of Fish and Wildlife Agencies Position*, 33 WILDLIFE SOC'Y BULL. 374, 376 (2005) (linking the Model to the importance of state primacy and the issue of access to wildlife resources).

74 AFWA TASK FORCE REPORT, *supra* note 56, at 2.

75 *See Hearing*, *supra* note 67, at 60–61 (statement of Executive Director Regan).

U.S. Constitution, which it asserts, "relegates to the states the responsibility of managing wildlife."[76] To make the Model work, says the report, "[a] productive relationship between federal and state agencies" is necessary.[77] Unfortunately, the report finds that "[s]tate wildlife agency leadership harbors growing concern about the increasingly strained relationship between state wildlife agencies and their federal partners" and that there is "considerable and widespread frustration with the interface between federal and state efforts to conserve wildlife."[78]

Survey respondents were asked to identify specific laws, regulations, or policies that they believed were successful or challenging.[79] Most frequently identified as a challenge to the states was the Endangered Species Act[80] (ESA), which is perceived by some state agency directors "as a vehicle for federal overreach, or of inappropriate reallocation of states' wildlife management duties into federal hands."[81] Also standing out in the survey were respondents citing the National Environmental Policy Act[82] (NEPA) as a "hindrance to states' efforts to manage wildlife"[83] due to threats of NEPA-based litigation and the "continued exclusion of states from meaningful partnerships in planning, decision-making, and management, except in the most cursory of consultative efforts."[84]

Of relevance to Part III.B of this Article are some state views on federal land laws in general. Emphasized in the report are the perceived problems associated with the open-ended nature of federal land laws that are believed to be interpreted in a preservationist "hands-off" fashion that makes active management of wildlife more difficult.[85] The task force report summarizes:

> These laws leave room for loose interpretations of land management agency authority. The ambiguity allows local land managers latitude in their decision-making, and they often implement preservationist interpretations that encroach on state authorities. These interpretations, often based on unwritten values, drive agency decisions that are typically contrary to principles of wildlife, fisheries, and habitat management critical for state management.[86]

The Federal Land Policy Management Act[87] (FLPMA) and the National Forest Management Act[88] (NFMA) are discussed in this context, with both

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76 AFWA TASK FORCE REPORT, *supra* note 56, at 5.

77 *Id.* at 2, 4.

78 *Id.* at 2.

79 *Id.* at 6.

80 Endangered Species Act of 1973, 16 U.S.C. §§ 1531–1544 (2012).

81 AFWA TASK FORCE REPORT, *supra* note 56, at 2, 8.

82 National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321–4370h (2012).

83 AFWA TASK FORCE REPORT, *supra* note 56, at 2.

84 *Id.* at 11.

85 *Id.* at 9.

86 *Id.*

87 Federal Land Policy and Management Act of 1976, 43 U.S.C. §§ 1701–1787 (2012).

88 National Forest Management Act of 1976, 16 U.S.C. §§ 472a, 521b, 1600, 1611–1614 (2012) (amending Forest and Rangeland Renewable Resources Planning Act of 1974, Pub. L. No. 93-378, 88 Stat. 476).

laws often viewed as presenting obstacles to the management of "state trust species."[89] These laws were not identified as inherently problematic, rather respondents focused on the "subjective and inconsistent application of their precepts."[90]

The AFWA Task Force makes a number of recommendations for improving relations between federal and state governments, most of which revolve around strengthening the position of state agencies in managing wildlife on federal lands.[91] It also initiated a "legal strategy" in 2013 to enable state agencies "to act in concert to address challenges to their statutory authority to manage wildlife."[92] In short, AFWA aims to clarify—in law, regulation, policy, and public perception—what it sees as the rightful role of the states in managing wildlife on federal lands. Some of these recommendations are offered by AFWA and the Western Association of Fish and Wildlife Agencies (WAFWA) in other contexts,[93] such as recent congressional testimony.[94] For now, we simply summarize the core recommendations of the Task Force and provide the requisite background in other parts of the Article. We return and respond to AFWA's recommendations in Part IV.

The AFWA Task Force begins by recommending training state and federal line managers "on the historic, principled underpinnings of state-federal authority and jurisdiction for managing fish and wildlife in the United States."[95] The proposed training initiative is to be implemented through a Memorandum of Understanding (MOU).[96] A public affairs strategy "to market and defend state wildlife authority interests" is also envisioned as part of this educational effort.[97] Establishing a mediation team to more constructively resolve conflict between federal and state agencies is also recommended.[98]

Driving some of the Task Force's recommendations is a concern that federal land agencies are evolving in a way that is inconsistent with their organic legislation.[99] According to the Task Force, "[a]s conservation becomes more focused on landscape scale efforts, it is important that federal agencies integrate their conservation programs with the state agency

89 AFWA TASK REPORT, *supra* note 56, at 9, 12.

90 *Id.* at 2.

91 *See infra* notes 95–107 and accompanying text.

92 ASS'N OF FISH & WILDLIFE AGENCIES, PROTECTING STATE AUTHORITY FOR FISH AND WILDLIFE MANAGEMENT, https://perma.cc/M3RG-8QEM (last visited Nov. 11, 2017).

93 *See, e.g.*, W. ASS'N OF FISH & WILDLIFE AGENCIES COMM'RS' STATE AUTHS. SUBCOMM., WHITE PAPER: WILDLIFE MANAGEMENT SUBSIDIARITY 4 (2011) ("WAFWA recommends that Congress adopt new provisions that clearly establish state fish and wildlife management authority and direct that all federal regulations and policies be consistent with congressional intent.").

94 *See Hearing*, *supra* note 67, at 5–7 (statement of Executive Director Regan).

95 AFWA TASK FORCE REPORT, *supra* note 56, at 17.

96 *Id.*

97 *Id.* at 29.

98 *Id.* at 28–29.

99 *See, e.g.*, *id.* at 21 ("The []FWS's shift in focus has changed from direct fish and wildlife management with the protection and restoration of either single species or population to the maintenance of ecosystems and biodiversity.").

programs and not get out ahead of the states and the public we serve."[100] The Task Force elaborates:

> [W]e must remember that the foundation for our fish and wildlife programs continues to be the people who enjoy our sports and continue to pay the lion's share of the costs that provide these services. Many state fish and wildlife programs across our nation do not receive either state or federal general appropriations and as such must answer to a narrow constituency of supporters.[101]

This concern leads to the Task Force recommending more substantive legislative changes. The first is to modify the Sikes Act[102] so that management by the Departments of the Interior and Agriculture comport with the law's section pertaining to fish and wildlife management on lands administered by the Department of Defense.[103] This law, often referred to as the "Sikes Act Extension," requires the Secretaries of Interior and Agriculture to "plan, develop, maintain, and coordinate programs for the conservation and rehabilitation of wildlife, fish, and game."[104] The military section of the Sikes Act requires the cooperative preparation of natural resource management plans and that these plans "shall reflect the mutual agreement of the [federal and state] parties concerning conservation, protection, and management of fish and wildlife resources."[105] There is no such language in the law pertaining to "mutual agreement" in the sections pertaining to the Departments of the Interior and Agriculture.[106] The Task Force would like the statute changed to include the following language: "The conservation plans and resulting programs shall reflect the mutual

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100 *Id.*

101 *Id.*

102 16 U.S.C. §§ 670–670m (2012).

103 *Id.* §§ 670f–670h; AFWA TASK FORCE REPORT, *supra* note 56, at 22.

104 16 U.S.C. § 670g(a).

105 *Id.* § 670a(a)(2).

106 Instead, the Sikes Act makes clear:

> Conservation and rehabilitation programs developed and implemented pursuant to this subchapter shall be deemed as *supplemental* to wildlife, fish, and game-related programs conducted by the Secretary of the Interior and the Secretary of Agriculture pursuant to other provisions of law. Nothing in this subchapter shall be construed as limiting the authority of the Secretary of the Interior or the Secretary of Agriculture, as the case may be, to manage the national forests or other public lands for wildlife and fish and other purposes in accordance with the Multiple-Use Sustained-Yield Act of 1960 or other applicable authority.

Id. § 670h(c)(1)(C) (emphasis added) (citation omitted). Furthermore, any wildlife conservation and rehabilitation plans prepared pursuant to the Sikes Act must be consistent with applicable USFS or BLM land management plans. *See id.* § 670h(b); *see also* Michael J. Bean, *The Developing Law of Wildlife Conservation on the National Forest and National Resource Lands*, 4 J. CONTEMP. L. 58, 65 (1977) (finding the Sikes Act Extension to offer "no resolution, indeed no guidance for the resolution, of conflicts involving wildlife conservation and other uses of the public lands" and that "it does nothing to narrow the broad discretion which the federal land management agencies have traditionally exercised in fulfilling their multiple use mandates").

agreement of the parties concerning conservation, protection, and management of fish and wildlife resources."[107]

As we explain later, federal land laws often include a "savings" clause addressing the relationship between federal and state powers.[108] AFWA emphasizes the importance of these provisions and makes a recommendation to "[s]trengthen existing Savings Clauses, expand new Savings Clauses to new congressional legislation as opportunities arise, and vigorously defend savings clauses to establish legal precedent."[109]

The Task Force expresses frustration in how the courts have viewed wildlife savings clauses in the past, most notably in the case of managing wildlife in the National Elk Refuge in Wyoming.[110] As AFWA sees it, these savings clauses should be viewed as unambiguous and represent the clear intention of Congress to "reserve" state power and authority over wildlife on federal lands as "a necessary incident of state sovereignty."[111] To fix this problem, the Task Force recommends replacing existing savings provisions with the following language:

> Nothing in the Act shall be construed as affecting or intending to interfere with the laws of the several states to regulate hunting and fishing or to supersede, abrogate or otherwise impair the state's primary jurisdiction to manage or control fish and resident wildlife in a manner not inconsistent with the purpose of this Act. The Secretary, in carrying out this Act, shall proceed in conformity with such applicable state laws, policies and management plans and shall cooperate with the states and develop jointly agreed upon wildlife management plans.[112]

This proposal is a fundamental reinterpretation of existing wildlife law, and we explain why it should be rejected in Part IV. We discuss savings clauses again in the context of federal preemption and in each section reviewing federal land laws.

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107 AFWA TASK FORCE REPORT, *supra* note 56, at 23.

108 *See* Robert L. Fischman & Angela M. King, *Savings Clauses and Trends in Natural Resources Federalism*, 32 WM. & MARY ENVTL. L. & POL'Y REV. 129, 145 (2007) (describing how these provisions "delimit the degree to which a federal agency should pursue national objectives at the expense of a state's different view" and can provide "a statement, and sometimes a mechanism, for incorporating state interests notwithstanding a statute that seeks to implement a uniform federal program").

109 AFWA TASK FORCE REPORT, *supra* note 56, at 17.

110 *Id.* at 17–18 (citing Wyoming v. United States, 279 F.3d 1214 (2002)).

111 Brief of Amicus Curiae International Ass'n of Fish & Wildlife Agencies in Support of Plaintiff-Appellants & Reversal of the Decision Below at 8, *Wyoming*, 279 F.3d 1214 (10th Cir. 2002) (No. 99-8089) (citing Ward v. Race Horse, 163 U.S. 504, 510 (1896)).

112 AFWA TASK FORCE REPORT, *supra* note 56, at 27.

III. THE LEGAL CONTEXT OF WILDLIFE MANAGEMENT ON FEDERAL LANDS

A. Constitutional Context

The U.S. Constitution provides the framework for federal-state relations and power-sharing arrangements, as well as individual obligations and limitations on authority for each level of government. Key provisions include the Property Clause,[113] Treaty Clause,[114] Commerce Clause,[115] Supremacy Clause,[116] and the Tenth Amendment.[117] This Subpart explains the relevant constitutional clauses and legal precedents regarding federal powers and duties for wildlife management, and consequent implications for state authority.

1. The Property Clause

The United States' vast landholdings are concentrated in the American West and Alaska, but federal land can be found in all fifty states.[118] As a landowner, the United States has proprietary interests over its lands and resources; as a government, it also has sovereign powers over its lands and resources.[119] This Section focuses on the proprietary nature of the federal interest in public lands and wildlife.

a. The Nature and Scope of the Property Clause

The Property Clause gives Congress the "Power to dispose of and make all needful Rules and Regulations respecting the Territory or other Property belonging to the United States."[120] Although the Supreme Court has found that the "full scope of this paragraph has never been definitely settled," it has held that "[p]rimarily, at least, it is a grant of power to the United States of control over its property."[121] In theory, this plenary power is tempered by special duties regarding the administration of public lands and resources. "Executive branch officials, while having wide latitude to make all needful rules regarding the public lands, may have a countervailing trust-like responsibility to protect those resources on behalf of the public."[122] While the

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113 U.S. CONST. art. IV, § 3, cl. 2.

114 *Id.* art. II, § 2, cl. 2.

115 *Id.* art. I, § 8, cl. 3.

116 *Id.* art. VI, cl. 2.

117 *Id.* amend. X.

118 CAROL HARDY VINCENT ET AL., CONG. RESEARCH SERV., R42346, FEDERAL LAND OWNERSHIP: OVERVIEW AND DATA 7–9 tbl.1 (2017), https://perma.cc/FH94-GG8R.

119 *See* Concessions Co. v. Morris, 186 P. 655, 658, 660 (Wash. 1919) (discussing the holding of Fort Leavenworth R.R. Co. v. Lowe, 114 U.S. 525 (1885)).

120 U.S. CONST. art. IV, § 3, cl. 2.

121 Kansas v. Colorado, 206 U.S. 46, 89 (1907).

122 Sandra B. Zellmer, *The Devil, the Details, and the Dawn of the 21st Century Administrative State: Beyond the New Deal*, 32 ARIZ. ST. L.J. 941, 1032 (2000); *accord In re* Steuart Transp. Co., 495 F. Supp. 38, 40 (E.D. Va. 1980) ("Under the public trust doctrine, the State of Virginia *and*

Supreme Court and several other federal courts have alluded to a federal trust responsibility for public lands and resources, the contours of such a responsibility are ill-defined.[123] The contours of the Property Clause power, however, are relatively clear.[124]

United States v. Grimaud[125] was one of the first tests of the Property Clause power to protect federal public lands.[126] The Forest Reserve Act of 1897[127] authorized the Secretary of the Interior to

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the United States have the right and the duty to protect and preserve the public's interest in natural wildlife resources. Such right does not derive from ownership of the resources but from a duty owing to the people." (emphasis added)).

123 *See, e.g.*, Light v. United States, 220 U.S. 523, 536 (1911) (identifying a duty "to protect the public domain from trespass and unlawful appropriation" (quoting United States v. Beebe, 127 U.S. 338, 342 (1888))); W. Va. Div. of the Izaak Walton League of Am., Inc. v. Butz, 522 F.2d 945, 950–55 (4th Cir. 1975) (noting the historic role of USFS as "custodian and protector" of forest reserves); High Country Citizens' All. v. Norton, 448 F. Supp. 2d 1235, 1246 (D. Colo. 2006) (finding a duty to assert federal reserved water rights for the Black Canyon of the Gunnison). In a series of cases involving Redwood National Park, the trust doctrine was invoked to require affirmative action to protect park resources from external threats posed by logging. *See* Sierra Club v. Dep't of the Interior (*Redwoods II*), 398 F. Supp. 284, 293–94 (N.D. Cal. 1975), *modified*, Sierra Club v. Dep't of the Interior (*Redwoods III*), 424 F. Supp. 172 (N.D. Cal. 1976); Sierra Club v. Dep't of the Interior (*Redwoods I*), 376 F. Supp. 90, 95–96 (N.D. Cal. 1974).

124 It is important to note that federal enclaves are distinct from federal public lands. Under the Enclave Clause, "Congress may acquire derivative legislative power from a State . . . by consensual acquisition of land, or by nonconsensual acquisition followed by the state's cession of authority over the land." Kleppe v. New Mexico, 426 U.S. 529, 542 (1976) (citation omitted). Specifically, the Clause gives Congress power "[t]o exercise exclusive Legislation in all Cases whatsoever, over such District (not exceeding ten Miles square) as may, by Cession of particular States, and the Acceptance of Congress, become the Seat of the Government of the United States, and to exercise like Authority over all Places purchased by the Consent of the Legislature of the State in which the Same shall be, for the Erection of Forts, Magazines, Arsenals, dock-Yards, and other needful buildings." U.S. CONST. art. I, § 8, cl. 17. In addition to giving Congress exclusive authority over the seat of federal government (Washington, D.C.), the Enclave Clause provides authority to purchase state land for a variety of federal purposes. *See* GEORGE CAMERON COGGINS & ROBERT L. GLICKSMAN, PUBLIC NATURAL RESOURCES LAW § 3:7 (2d ed. 2017) (noting that "'Needful Buildings' . . . include[s] most federal purposes, including locks and dams, national parks, and national forests" (footnotes omitted)). Congress's power over federal enclaves is highly nuanced. *See* Spencer Driscoll, *Utah's Enabling Act and Congress's Enclave Clause Authority: Federalism Implications of a Renewed State Sovereignty Movement*, 2012 BYU L. REV. 999, 1000. If the state legislature expressly cedes jurisdiction over an enclave purchased by the United States, the United States exercises all legislative powers over the parcel to the exclusion of state authority. *Kleppe*, 426 U.S. at 542; *Fort Leavenworth R.R. Co.*, 114 U.S. at 532, 537–38. Otherwise, the federal and state governments are free to make whatever jurisdictional arrangements they choose regarding wildlife, transportation, and other civil and criminal laws. *See Fort Leavenworth R.R. Co.*, 114 U.S. at 533–42; *see also Kleppe*, 426 U.S. at 542 ("[T]he legislative jurisdiction acquired may range from exclusive federal jurisdiction with no residual state police power, to concurrent, or partial, federal legislative jurisdiction, which may allow the State to exercise certain authority." (citation omitted)); United States v. Parker, 36 F. Supp. 3d 550, 575–76, 584–85 (W.D.N.C. 2014) (holding that, where both the United States and North Carolina had concurrent jurisdiction within a forest enclave, the federal court had authority over a prosecution for the illegal taking of wildlife). Once agreed upon, states cannot unilaterally amend or cancel cession agreements. United States v. Armstrong, 186 F.3d 1055, 1061 (8th Cir. 1999).

125 220 U.S. 506 (1911).

> make provisions for the protection against destruction by fire and depredations upon the public forests and forest reservations . . . and . . . such rules and regulations . . . as will insure the objects of such reservations, namely, to regulate their occupancy and use and to preserve the forests thereon from destruction.[128]

With this authority, the Secretary of Agriculture[129] issued rules requiring ranchers to secure permits to graze livestock in forest reserves.[130]

The defendants were charged with grazing sheep in a forest reserve without a permit.[131] They argued that the Act was unconstitutional insofar as it delegated power to make regulations to the Secretary.[132] The Supreme Court was unsympathetic. It held: "Each reservation had its peculiar and special features," and Congress properly wielded the Property Clause to give the Secretary power to consider local conditions and "to fill up the details" of regulating "occupancy and use . . . to preserve the forests from destruction."[133]

The United States Court of Appeals for the Ninth Circuit reached a similar conclusion in a recent case involving rancher Wayne Hage, who gained a good deal of notoriety for his repeated trespasses on federal public lands in Nevada.[134] The court rejected Hage's argument that state-sanctioned water rights entitled him to any additional easements or appurtenances to graze livestock on federal lands.[135]

The Property Clause power to protect the public lands may also be used to protect natural resources that are intimately associated with the public lands, such as wildlife, water, and air.[136] In *Hunt v. United States*,[137] the Supreme Court held that the Property Clause included the power to thin overpopulated herds of deer on federal lands in order to protect forest

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126 *Id.* at 521–22; *see* Peter A. Appel, *The Power of Congress "Without Limitation": The Property Clause and Federal Regulation of Private Property*, 86 MINN. L. REV. 1, 58–62 (2001) (discussing the Supreme Court's broad interpretations of congressional authority under the Property Clause).

127 Act of June 4, 1897, ch. 2, 30 Stat. 11 (1899).

128 *Id.*, ch. 2, 30 Stat. at 35 (codified as amended at 16 U.S.C. § 551).

129 In 1905, the authority changed from the Secretary of the Interior to the Secretary of Agriculture. *See* Act of Feb. 1, 1905, ch. 288, 33 Stat. 628 (1905).

130 *See Grimaud*, 220 U.S. at 509–10 (discussing, for example, Regulation 45).

131 *Id.* at 509.

132 *Id.* at 510, 513–14.

133 *Id.* at 515–17, 522 (citing Wayman v. Southard, 23 U.S. (10 Wheat.) 1, 42 (1825)); *accord Light*, 220 U.S. 523, 536 (1911) (enjoining grazing on a national forest without a permit and stating that "[t]he United States can prohibit absolutely or fix the terms on which its property may be used").

134 United States v. Estate of Hage, 810 F.3d 712, 716–18 (9th Cir. 2016) (citing, inter alia, *Light*, 220 U.S. at 536); *see* Jason Dearen, *Central 'Sagebrush Rebellion' Case Suffers Defeat*, SAN DIEGO UNION-TRIB. (Sept. 1, 2012), https://perma.cc/PNK5-UX85.

135 *See Hage*, 810 F.3d at 715, 717–18.

136 *See Kleppe*, 426 U.S. 529, 530 (1976) ("Congress' complete authority over the public lands includes the power to regulate and protect the wildlife living there.").

137 278 U.S. 96 (1928).

resources, even if the federal action was contrary to state law.[138] The Court subsequently construed *Hunt* quite broadly in *Kleppe v. New Mexico*, stating that, while *Hunt* found that "damage to the land is a sufficient basis for regulation; it contains no suggestion that it is a necessary one."[139]

Kleppe upheld the Wild Free-Roaming Horses and Burros Act,[140] which prohibited the capture and destruction of unclaimed horses and burros on public lands.[141] When BLM invoked the Act to prevent New Mexico from capturing and selling burros, the state asserted that BLM lacked authority because the burros were neither moving in interstate commerce nor damaging public land.[142] The issue was whether, under the Property Clause, BLM's jurisdiction over burros was a "needful" regulation "respecting" public lands.[143]

The district court below had found that the Act was unconstitutional and opined that the Property Clause authorized the regulation of wild animals only if necessary to protect the public lands from damage.[144] The Supreme Court disagreed, stating that the Property Clause power "necessarily" includes protection of wildlife "integral" to the public lands.[145] The Court noted that in passing the Wild Free-Roaming Horses and Burros Act, "Congress deemed [these] animals 'an integral part of the natural system of the public lands,' and found that federal management was necessary 'for achievement of an ecological balance on the public lands.'"[146] According to Congress, these animals, if preserved in their native habitats, "contribute to the diversity of life forms within the Nation and enrich the lives of the American people."[147]

In reaching its conclusion, the Court explicitly rejected the district court's rationale that federal power over wild horses and burros "conflicts with . . . the traditional doctrines concerning wild animals."[148] It explained that, while "the States have broad trustee and police powers over wild animals within their jurisdictions . . . , those powers exist only 'in so far as [their] exercise may be not incompatible with, or restrained by, the rights conveyed to the Federal government by the Constitution.'"[149] The Court clarified the balance of power between the federal and state governments:

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138 *Id.* at 100.

139 *Kleppe*, 426 U.S. at 537.

140 16 U.S.C. §§ 1331–1340 (2012).

141 *Id.* § 1338(a). *See generally* Robert L. Fischman & Jeremiah I. Williamson, *The Story of* Kleppe v. New Mexico*: The Sagebrush Rebellion as Un-Cooperative Federalism*, 83 U. COLO. L. REV. 123 (2011) (providing the legal history and political implications of this decision).

142 *Kleppe*, 426 U.S. at 533.

143 *Id.* at 536.

144 *See id.* at 534 (citing New Mexico v. Morton, 406 F. Supp. 1237, 1239 (D.N.M. 1975)).

145 *Id.* at 535, 540–41, 546.

146 *Id.* at 535 (quoting 16 U.S.C. § 1331; H.R. REP. NO. 92-681, at 5 (1971) (Conf. Rep.)).

147 16 U.S.C. § 1331.

148 *Kleppe*, 426 U.S. at 534–35 (omission in original) (quoting *Morton*, 406 F. Supp. at 1238).

149 *Id.* at 545 (alteration in original) (quoting *Geer*, 161 U.S. 519, 528 (1896), *overruled by Hughes*, 441 U.S. 322 (1979)).

> "No doubt it is true that as between a State and its inhabitants the State may regulate the killing and sale of [wildlife], but it does not follow that its authority is exclusive of paramount powers." . . . *We hold today that the Property Clause also gives Congress the power to protect wildlife on the public lands, state law notwithstanding.*[150]

In *Wyoming v. United States*,[151] Wyoming challenged the refusal of FWS to permit the state to vaccinate elk on the National Elk Refuge (NER).[152] The United States Court of Appeals for the Tenth Circuit stated that the Property Clause gives Congress the power to choose: "(1) to assume all management authority over the [National Wildlife Refuge System], including the NER, (2) to share management authority over those federal lands with the States, or (3) to preserve to its fullest extent the States' historical role in the management of wildlife within their respective borders."[153] The court held that federal law would preempt state management in the event of an actual conflict "or where state management . . . stand[s] as an obstacle to the accomplishment" of federal objectives.[154]

States often assert their police powers to regulate the public health and welfare through measures that protect natural resources within the state, such as game species, trees, and water.[155] Although there is no explicit "Property Clause" authority in the U.S. Constitution extending to state interests in wildlife, water, or other natural resources, states occasionally assert an ownership interest as an additional source of their authority.[156] The Supreme Court has repeatedly rejected this theory, at least as it relates to wildlife and migratory birds: "To put the claim of . . . State [authority] upon

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150 *Id.* at 545–46 (alteration in original) (emphasis added) (quoting *Missouri*, 252 U.S. 416, 434 (1920)).

151 279 F.3d 1214 (10th Cir. 2002).

152 *Id.* at 1218.

153 *Id.* at 1230.

154 *See id.* at 1234. According to the court, Congress "rejected complete preemption of state wildlife regulation" in the National Wildlife Refuge System, but rather "intended ordinary principles of conflict preemption to apply." *Id.* The United States District Court for the District of California followed *Wyoming* in holding that a state ballot proposition that banned the use of certain kinds of traps and poisons on federal lands was preempted by the Property Clause. Nat'l Audubon Soc'y, Inc. v. Davis, 144 F. Supp. 2d 1160, 1180–81 (N.D. Cal. 2000), *aff'd in part and rev'd in part*, 307 F.3d 835, 837 (9th Cir. 2002), *amended on denial of reh'g*, 312 F.3d 416, 418 (9th Cir. 2002). The Ninth Circuit did not reach the Property Clause issue, instead holding that the proposition was preempted by the National Wildlife Refuge System Administration Act. Nat'l Audubon Soc'y, Inc. v. Davis, 307 F.3d at 854; *accord* Defs. of Wildlife v. Salazar, 651 F.3d 112, 118 (D.C. Cir. 2011) ("tak[ing] the Secretary at his word that Wyoming has no veto over the Secretary's duty to end a practice that is concededly at odds with the long-term health of the elk and bison in the Refuge," while pointing out Wyoming's brief "agreeing that Wyoming does not have a veto").

155 *See, e.g.*, Maine v. Taylor, 477 U.S. 131, 151 (1986) ("[Each state] retains broad regulatory authority to protect . . . the integrity of its natural resources" such as fisheries.); Miller v. Schoene, 276 U.S. 272, 280–81 (1928) (upholding Virginia's decree to cut down infected cedars that were fatal to nearby apple orchards).

156 *See, e.g.*, *Geer*, 161 U.S. 519, 535 (1896) (claiming that ownership of all wild game taken within the state allowed the state to prohibit its removal from the state), *overruled by Hughes*, 441 U.S. 322 (1979)).

title is to lean upon a slender reed."[157] Even absent title, states have "ample allowance for preserving . . . the legitimate state concerns for conservation and protection of wild animals underlying the 19th-century legal fiction of state ownership,"[158] but as noted in *Kleppe*, *Wyoming*, and numerous other cases, state law may not contravene federal law.[159]

b. Property Clause Power to Protect Federal Lands and Resources from External Threats

Not only does the Property Cause supply authority to regulate activities that occur on federal lands, but in certain cases, it also authorizes federal regulation of activities outside of the federal boundaries where necessary to protect the public lands and resources. In *Camfield v. United States*,[160] the owner of several sections of private land acquired from the Union Pacific Railroad fenced his land in a way that also enclosed about 20,000 acres of public lands.[161] When the United States sought to remove the fence under the Unlawful Enclosures Act of 1885,[162] Camfield argued that the United States had no power to control private land use.[163] The Supreme Court upheld the application of the Act to Camfield's property, explaining that under the Property Clause, the federal government "doubtless has a power over its own property analogous to the police power of the several States, and the extent to which it may go in the exercise of such power is measured by the exigencies of the particular case."[164]

The courts have consistently upheld "broad [federal] power to control extraterritorial private activities that might adversely affect federal property."[165] For instance, federal restrictions on businesses situated outside of a national park have been upheld when those business enterprises

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157 *Missouri*, 252 U.S. 416, 434 (1920); *see also Hughes*, 441 U.S. at 332.

158 *Hughes*, 441 U.S. at 335.

159 *Kleppe*, 426 U.S. 529, 545 (1976); *Wyoming*, 279 F.3d 1214, 1227; *see also, e.g.*, *Hughes*, 441 U.S. at 338–39.

160 167 U.S. 518 (1897).

161 *Id.* at 519.

162 43 U.S.C. §§ 1061–1066 (2012).

163 *Camfield*, 167 U.S. at 522.

164 *Id.* at 525; *see* Utah Div. of State Lands v. United States, 482 U.S. 193, 201 (1987) ("The Property Clause grants Congress plenary power to regulate and dispose of land within the Territories . . . ."); United States v. Midwest Oil Co., 236 U.S. 459, 483 (1915) (upholding president's decision to withdraw land to preserve oil reserves); *Light*, 220 U.S. 523, 536 (1911) ("The United States can prohibit absolutely or fix the terms on which its property may be used."); *see also* Organized Fisherman of Fla. v. Hodel, 775 F.2d 1544, 1549 (11th Cir. 1985) (finding that Florida law provided no vested property right for commercial fishing in a national park); Organized Fisherman of Fla. v. Andrus, 488 F. Supp. 1351, 1355 (S.D. Fla. 1980) (refusing to enjoin enforcement of federal regulations restricting fishing in a national park given Congress's "complete power" over public lands which "necessarily includes the power to regulate and protect the wildlife living there" (citing *Kleppe*, 426 U.S. at 540–41)).

165 Appel, *supra* note 126, at 77–78.

affected neighboring parklands.[166] Moreover, federal regulation of activities on state-owned waters was upheld as a valid exercise of Property Clause power to manage the Boundary Waters Canoe Area Wilderness.[167]

Beyond the land itself, it is fair to ask how far federal authority over wildlife and other migratory resources "integral" to the public lands goes when those resources are found outside of the boundaries of the public lands. In *Kleppe*, the contested issue involved the federal regulation of nonfederal activity on federal land (i.e., the State of New Mexico captured wild burros on a grazing allotment), and while the Act in question reached nonfederal land as well, the Supreme Court was not required to address the regulation of state or private activities on nonfederal land.[168]

Other than *Kleppe*, few cases touch upon the Property Clause power to regulate "integral" wildlife outside of the boundaries of the federal lands, perhaps because federal agencies and their employees tend to be reluctant to exercise their power aggressively.[169]

2. The Treaty Clause

The Treaty Clause provides that: "[The President] shall have the Power . . . to make Treaties, provided two thirds of the Senators present

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166 *See, e.g.*, *Armstrong*, 186 F.3d 1055, 1061–62 (8th Cir. 1999) ("[R]egulation requiring that commercial tour boat operators obtain a permit before operating . . . within [Voyageurs National Park] is well within the authority of the NPS."); United States v. Richard, 636 F.2d 236, 240 (8th Cir. 1980) ("[F]ederal regulation may exceed federal boundaries when necessary for the protection of human life or wildlife or government forest land or objectives.").

167 *See, e.g.*, Minnesota v. Block, 660 F.2d 1240, 1249 (8th Cir. 1981) ("Congress' power must extend to regulation of conduct on or off the public land that would threaten the designated purpose of federal lands."); United States v. Brown, 552 F.2d 817, 822 (8th Cir. 1977) (stating that "congressional power over federal lands . . . include[s] the authority to regulate activities on non-federal public waters in order to protect wildlife and visitors on the lands"); *see also* Stupak-Thrall v. United States, 89 F.3d 1269, 1269, 1272 (6th Cir. 1996) (en banc) (an equally divided court affirmed district court in that the federal government could regulate private activities that occurred on the surface of a lake even if the surface was private property); *Organized Fisherman of Fla.*, 775 F.2d 1544, 1549 (11th Cir. 1985) (upholding federal restrictions on fishing on waters within Everglades National Park, some of which were presumably under state jurisdiction); United States v. Lindsey, 595 F.2d 5, 6 (9th Cir. 1979) (stating that the Property Clause "grants to the United States power to regulate conduct on non-federal land when reasonably necessary to protect adjacent federal property or navigable waters"); Grand Lake Estates Homeowners Ass'n v. Veneman, 340 F. Supp. 2d 1162, 1167–69 (D. Colo. 2004) (holding USFS could require special use permits on docks and marinas on Association's land if reasonably necessary to protect the environment and water quality of Arapaho National Recreation Area).

168 *Kleppe*, 426 U.S. at 546 ("We need not, and do not, decide whether the Property Clause would sustain the Act in all of its conceivable applications.").

169 *See generally* Joseph L. Sax & Robert B. Keiter, *Glacier National Park and Its Neighbors: A Study of Federal Interagency Relations*, 14 ECOLOGY L.Q. 207, 226, 260 (1987) (describing how NPS's "distaste for confrontation makes it timid," and how "constrained by bureaucratic prudence and timidity. . . . [NPS] is reluctant to use the law; highly deferential to the traditional turf prerogatives of its neighbors; and hesitant to subject itself to criticism by speaking out forcefully on transboundary issues").

concur."[170] In recognition of the international nature of wildlife conservation, the United States has entered into several landmark wildlife treaties within the past century, which Congress has implemented through domestic legislation.[171] With respect to the management of wildlife on federal lands, the most notable of these include the Migratory Bird Treaty of 1916[172] and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).[173] Other international provisions include the Agreement on the Conservation of Polar Bears,[174] the Pacific Salmon Treaty,[175] the Northwest Atlantic Fisheries Treaty,[176] the Migratory Bird and Game Mammal Treaty with Mexico,[177] and the International Convention for the Regulation of Whaling.[178] These treaties are implemented through the Marine Mammal Protection Act,[179] the Magnuson-Stevens Fishery Conservation and Management Act,[180] the Whaling Convention Act,[181] and other pieces of domestic legislation.[182] The next Section of the Article focuses on the Migratory Bird Treaty's implementing legislation.

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170 U.S. CONST. art. II, § 2, cl. 2.

171 *See, e.g.*, Convention on International Trade in Endangered Species of Wild Fauna and Flora, Mar. 3, 1973, 27 U.S.T. 1087 ("Recognizing . . . that international cooperation is essential for the protection of . . . wild fauna and flora.").

172 Convention Between the United States and Great Britain for the Protection of Migratory Birds in the United States and Canada, Gr. Brit-U.S., Aug. 16, 1916, 39 Stat. 1702 (codified as amended at 16 U.S.C. §§ 703–712 (2012)).

173 Convention on International Trade in Endangered Species of Wild Fauna and Flora, *supra* note 171. CITES is implemented in the United States through the ESA, which, like CITES, controls imports and exports of protected species. 16 U.S.C. § 1531(a)(4)(F); *id.* § 1538(a)(1)(A), (a)(2)(A), (c)–(d); *see* Safari Club Int'l v. Jewell, 960 F. Supp. 2d 17, 67–68 (D.D.C. 2013) (noting that conserving species within their ecosystems is one purpose of the ESA, "but other purposes are 'to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a)[,]' including the CITES" (alteration in original)). As such, the ESA finds its constitutional basis in part in the Treaty Clause, though other provisions of the ESA are more firmly founded on the Commerce Clause. *See infra* discussion Part III.A.3.c.

174 Agreement on the Conservation of Polar Bears, Nov. 15, 1973, 27 U.S.T. 3918.

175 Treaty Between the United States of America and the Canada Concerning Pacific Salmon, Can.-U.S., Jan. 28, 1985, T.I.A.S. No. 11,091.

176 International Convention for the Northwest Atlantic Fisheries, Jul. 3, 1950, 64 Stat. 1067, 1 U.S.T. 477 (codified at 16 U.S.C. §§ 981–991)).

177 Convention Between the United States of America and the United Mexican States for the Protection of Migratory Birds and Game Mammals, Mex.-U.S, Mar. 10, 1972, 23 U.S.T. 260.

178 International Convention for the Regulation of Whaling, Dec. 2, 1946, 62 Stat. 1716, T.I.A.S. No. 1849. For an assessment of wildlife and biodiversity related treaties that have not yet been ratified by the United States, including the Convention on Biological Diversity, see MARY JANE ANGELO ET AL., CTR. FOR PROGRESSIVE REFORM, WHITE PAPER NO. 1201, RECLAIMING GLOBAL ENVIRONMENTAL LEADERSHIP: WHY THE UNITED STATES SHOULD RATIFY TEN PENDING ENVIRONMENTAL TREATIES (2012), https://perma.cc/5NB3-6ZEE.

179 Marine Mammal Protection Act of 1972, 16 U.S.C. §§ 1361–1421h.

180 *Id.* §§ 1801–1891d.

181 Whaling Convention Act of 1949, *id.* §§ 916–916*l*.

182 *See* ANGELO ET AL., *supra* note 178, at 2; David M. Golove, *Treaty-Making and the Nation: The Historical Foundations of the Nationalist Conception of the Treaty Power*, 98 MICH. L. REV. 1075, 1313–15 (2000) (advocating a federalist approach to implementing domestic treaties).

a. Migratory Bird Treaty of 1916

In 1916, the United States entered into a treaty with Great Britain (on behalf of Canada) to ensure the preservation of "such migratory birds as are either useful to man or harmless."[183] The Migratory Bird Treaty Act of 1918[184] (MBTA) ratified the treaty and imposed stringent prohibitions on the taking, capturing, hunting, and killing of protected birds.[185] According to George Cameron Coggins, "[t]he origins of modern federal wildlife law may be traced back to the MBTA."[186]

Almost immediately after ratification and enactment, the states challenged the constitutionality of the treaty and the MBTA.[187] Today, the Supreme Court's opinion in *Missouri v. Holland* remains a significant benchmark for federal Treaty Clause authority.[188] The case involved a suit brought by the State of Missouri to enjoin a federal game warden from enforcing the MBTA, which implements the 1916 treaty by prohibiting any person from pursuing or killing migratory birds except as authorized by regulations issued by the Secretary of Agriculture.[189] More specifically, the MBTA states that it is:

> unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship,

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183 Convention Between the United States and Great Britain for the Protection of Migratory Birds in the United States and Canada, *supra* note 172, at 1702.

184 16 U.S.C. §§ 710–711.

185 *Id.* § 703(a).

186 George Cameron Coggins, *Federal Wildlife Law Achieves Adolescence: Developments in the 1970s*, 1978 DUKE L.J. 753, 764; *see also* Meredith Blaydes Lilley & Jeremy Firestone, *Wind Power, Wildlife, and the Migratory Bird Treaty Act: A Way Forward*, 38 ENVTL. L. 1167, 1179 (2008).

187 *See, e.g.*, *Missouri*, 252 U.S. 416, 432–35 (1920) (holding that the MBTA is constitutional under Congress's express and exclusive Constitutional authority to make and ratify treaties). Prior to ratification and passage of the MBTA, an earlier version of a statute to protect migratory birds had been invalidated as beyond constitutional authority. *See* United States v. Shauver, 214 F. 154, 157–60 (E.D. Ark. 1914) (holding that the statute was unconstitutional for, inter alia, its usurpation of the states' sovereign right to own all animals feræ naturæ, which are denominated as game, for the benefit of its citizens).

188 *Missouri*, 252 U.S. at 432.

189 The MBTA's prohibitions apply broadly to state actors and others. 16 U.S.C § 703(a); *Missouri*, 252 U.S. at 430–31. Courts, however, have since reached conflicting results on the MBTA's ability to restrict federal actors. *See* Humane Soc'y of the U.S. v. Glickman, 217 F.3d 882, 885–87 (D.C. Cir. 2000) (finding that the MBTA applies to federal agencies and federal actors, because the Act enforces a treaty binding upon the United States and, therefore, is binding on the federal agencies); Audubon Soc'y of Portland v. U.S. Fish & Wildlife Serv., No. 04-670-KI, 2005 WL 1713086, at *4 (D. Or. July 21, 2005) (applying the MBTA to federal agencies, but finding that they were not liable for habitat destruction); Ctr. for Biological Diversity v. Pirie, 191 F. Supp. 2d 161, 177–78 (D.D.C. 2002) (applying the MBTA to the Department of Defense and holding it in violation), *vacated as moot sub nom.*, Ctr. for Biological Diversity v. England, Nos. 02-5163, 02-5180, 2003 WL 179848 (D.C. Cir. Jan. 23, 2003). *But see* Sierra Club v. Martin, 110 F.3d 1551, 1556 (11th Cir. 1997) (finding that because federal agencies must conserve birds under other statutes, the MBTA does not apply to federal agencies).

> export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export, any migratory bird, any part, nest, or egg of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird or any part, nest, or egg thereof.[190]

In *Missouri v. Holland*, the Supreme Court held that the Treaty Clause provided a viable avenue for federal regulation of wildlife, despite the state's claim of a predominant interest in the wildlife in question.[191] Under *Missouri v. Holland*, the test to determine a treaty's validity is two-fold: 1) Is the matter involved of national interest? 2) Does the treaty contravene any specific constitutional prohibition?[192] If the first is answered in the affirmative, and the second in the negative, the treaty is valid.[193]

With respect to the Migratory Bird Treaty, the answer to the first question was a resounding "yes," according to the Supreme Court:

> Here a national interest of very nearly the first magnitude is involved. It can be protected only by national action in concert with that of another power. The subject matter [i.e., migratory birds] is only transitorily within the State and has no permanent habitat therein. But for the treaty and the statute there soon might be no birds for any powers to deal with. We see nothing in the Constitution that compels the Government to sit by while a food supply is cut off and the protectors of our forests and our crops are destroyed. It is not sufficient to rely upon the States. The reliance is vain.[194]

As to the second question, the Court explicitly rejected the state's argument that the Treaty contravened the Tenth Amendment, which reserves power to the states if not delegated to the United States by the Constitution.[195] According to the Court, "[t]he treaty in question does not contravene any prohibitory words to be found in the Constitution," nor is the treaty "forbidden by some invisible radiation from the general terms of the Tenth Amendment."[196] Thus, the state's interest in managing migratory birds covered by the MBTA, whether that interest rested upon some claim of ownership (which the Court disregarded) or on traditional state police

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190 16 U.S.C. § 703(a).

191 *Missouri*, 252 U.S. at 432–35.

192 *Id.* at 433.

193 *See* Oona A. Hathaway et al., *The Treaty Power: Its History, Scope, and Limits*, 98 CORNELL L. REV. 239, 266, 279 (2013) (explaining that Treaty Powers are limited by "affirmative guarantees [that] are set forth explicitly in the Bill of Rights' recognition and guarantee of individual rights and in the Constitution's provisions prescribing the structure of the national government . . . [including] the preservation of a continuing role for the states and maintenance of certain areas of state authority and control," but concluding that invalidation is exceedingly rare, so "the real protections against abuse of the treaty power derive from the structural, political, and diplomatic checks on the exercise of the power").

194 *Missouri*, 252 U.S. at 435.

195 *Id.* at 433–34.

196 *Id.*

powers, must give way.[197] It explained, "[v]alid treaties of course 'are as binding within the territorial limits of the States as they are elsewhere throughout the dominion of the United States.'"[198] In the end, the Court held that the Treaty was lawful, and thus, the MBTA was lawful as well pursuant to the Treaty Clause, the Supremacy Clause, and the Necessary and Proper Clause.

3. The Tenth Amendment and the Commerce Clause

The Tenth Amendment often forms the basis of state claims of exclusive jurisdiction over wildlife. The Tenth Amendment states: "The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people."[199] The Tenth Amendment and the Commerce Clause seem to be inextricably entwined in federal wildlife management discussions, so it is necessary to discuss the interplay of both provisions together.

a. The Evolution of the Anti-Commandeering Doctrine

The Tenth Amendment was ratified on December 15, 1791,[200] and is similar to an earlier provision of the Articles of Confederation which read: "Each State retains its sovereignty, freedom, and independence, and every power, jurisdiction, and right, which is not by this confederation *expressly* delegated to the United States, in Congress assembled."[201] Ultimately, the word "expressly" did not appear in the Tenth Amendment as ratified.

Early in American history, the Supreme Court seemed to assume the Tenth Amendment was a strong and limiting power of the Constitution.[202] However, by the early 20th century the Court's view of the Tenth Amendment shifted significantly. In *United States v. Darby*,[203] the Court stated:

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197 *Id.* at 434.

198 *Id.* (quoting Baldwin v. Franks, 120 U.S. 678, 683 (1887)).

199 U.S. CONST. amend. X.

200 *The Bill of Rights: A Transcription*, NAT'L ARCHIVES, https://perma.cc/6WWG-KH2L (last reviewed Nov. 11, 2017).

201 ARTICLES OF CONFEDERATION of 1781, art. II (emphasis added); *see Amendment X: House of Representatives, Amendments to the Constitution*, FOUNDERS' CONST., https://perma.cc/7U44-AZQ3 (last visited Nov. 11, 2017) (discussing James Madison objecting to a proposed version of the Tenth Amendment).

202 *See* Hammer v. Dagenhart, 247 U.S. 251, 275–76 (1918) (invalidating federal child labor laws, and remarking upon the "inherent" power of the states to regulate "purely internal affairs"), *overruled in part by* United States v. Darby, 312 U.S. 100 (1941); *see also* Carter v. Carter Coal Co., 298 U.S. 238, 294–95 (1936) (invalidating federal regulation of coal production and stating that the Framers "meant to carve from the general mass of legislative powers, then possessed by the states, only such portions as it was thought wise to confer upon the federal government . . . with the result that what was not embraced by the enumeration remained vested in the states without change or impairment").

203 312 U.S. 100 (1941).

> The [Tenth A]mendment states but a truism that all is retained which has not been surrendered. There is nothing in the history of its adoption to suggest that it was more than declaratory of the relationship between the national and state governments as it had been established by the Constitution before the amendment or that its purpose was other than to allay fears that the new national government might seek to exercise powers not granted, and that the states might not be able to exercise fully their reserved powers.[204]

Since *Darby*, it has become exceedingly uncommon for the Supreme Court to invalidate federal laws under the Tenth Amendment.[205] The Anti-Commandeering Doctrine arising from *New York v. United States*[206] is the exception. There, the Court invalidated a portion of the Low-Level Radioactive Waste Policy Amendments Act of 1985[207] (RWPA).[208] The RWPA required states to take title to any undisposed low-level radioactive waste within their borders and made each state liable for all damages directly related to that waste.[209] The Court ruled that the imposition of taking title violated the Tenth Amendment, as the federal government could not directly compel states to enforce federal regulations.[210]

In *Printz v. United States*,[211] the Court, again utilizing the Anti-Commandeering Doctrine, found that provisions of the Brady Bill[212] requiring state and local law enforcement officials to conduct background checks on persons attempting to purchase handguns was a violation of the Tenth Amendment, as the Bill forced participation of the state officials in the administration of a federal program.[213] Similarly, in *National Federation of Independent Business v. Sebelius*,[214] the Court held that the Affordable Care Act[215] (also known as Obamacare) coerced the states to expand Medicaid.[216] Although other provisions of the Act were upheld, the Court found that the Medicaid provision effectively forced states to participate by conditioning the continued provision of funds on their agreement to materially alter their Medicaid eligibility criteria.[217]

In the modern era, the Tenth Amendment's primary role in regulating the balance of powers between the federal and state governments is

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204 *Id.* at 124.

205 U.S. CONST. amend. X.

206 505 U.S. 144 (1992).

207 42 U.S.C. §§ 2021b–2021j (2012).

208 *New York*, 505 U.S. at 149.

209 42 U.S.C. § 2021e(d)(2)(C).

210 *New York*, 505 U.S. at 176–77, 184.

211 521 U.S. 898 (1997).

212 Brady Handgun Violence Prevention Act, 18 U.S.C. § 922 (2012).

213 *Printz*, 521 U.S. at 933–34 (citing *New York*, 505 U.S. at 188).

214 567 U.S. 519 (2012).

215 Patient Protection and Affordable Care Act, Pub. L. No. 111-148, 124 Stat. 119 (2010) (codified in scattered sections of 25, 26, and 42 U.S.C.). The Medicaid expansion is codified at 42 U.S.C. § 1396a(a)(10)(A)(i)(VIII) (2012).

216 *Sebelius*, 567 U.S. at 588.

217 *Id.*

expressed through the Anti-Commandeering Doctrine.[218] Commandeering occurs when Congress "require[s] the States in their sovereign capacity to regulate their own citizens," *not* when federal legislation with an administrative and financial impact on state bureaucracy regulates public and private conduct alike.[219]

b. The Tenth Amendment's Application to Wildlife Management

Prior to 1920, very little judicial activity occurred regarding the interplay of the Tenth Amendment and federal wildlife control.[220] One of the first decisions on the scope of the Tenth Amendment regarding federal wildlife control was *Missouri v. Holland*, which upheld the MBTA.[221] As noted above, the Supreme Court flatly rejected Missouri's argument that the MBTA violated the Tenth Amendment, finding that there were no reserved state powers that would stand in the way of federal enforcement of an act arising under the Treaty power.[222]

It was not until *Palila v. Hawaii Department of Land and Natural Resources*[223] that the courts again took up the issue of the Tenth Amendment's implications for federal wildlife management.[224] There, the Hawaii Department of Land and Natural Resources maintained herds of feral sheep and goats for sport-hunting purposes on state-owned lands.[225] These herds were causing significant habitat modification and destruction within the critical habitat of the Palila bird *(Psittirostra bailleui*), a listed species under the ESA.[226] Conservation groups sought declaratory and injunctive relief requiring Hawaii to adopt a plan to eradicate the feral sheep and goat

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218 *See* Massachusetts v. U.S. Dep't of Health & Human Servs., 682 F.3d 1, 12 (1st Cir. 2012) ("Supreme Court interpretations of the Tenth Amendment have varied over the years but those in force today have struck down statutes only where Congress sought to commandeer state governments or otherwise directly dictate the *internal operations* of state government.").

219 Reno v. Condon, 528 U.S. 141, 151 (2000); *see* Nuclear Energy Inst., Inc. v. Envtl. Prot. Agency, 373 F.3d 1251, 1305 (D.C. Cir. 2004) (holding that Congress's designation of a federally owned site for a nuclear repository did not commandeer the state legislative process or officials, but rather merely prescribed the use of federal property); United States v. Washington, 887 F. Supp. 2d 1077, 1101 (D. Mont. 2012) (rejecting Tenth Amendment challenge to federal prosecution of participants in state-authorized medical marijuana program).

220 Although it did not address the Tenth Amendment, in *Geer v. Connecticut*, the Court held that "the ownership of wild animals, so far as they are capable of ownership, is in the state, not as a proprietor, but in its sovereign capacity, as a representative and for the benefit of all its people in common." 161 U.S. 519, 529 (1896) (quoting State v. Rodman, 59 N.W. 1098, 1099 (Minn. 1894)), *overruled by Hughes*, 441 U.S. 322 (1979).

221 *Missouri*, 252 U.S. 416, 435 (1920).

222 *Id.* at 432–33.

223 471 F. Supp. 985 (D. Haw. 1979), *aff'd on other grounds*, 639 F.2d 495 (9th Cir. 1981), *aff'd*, 852 F.2d 1106 (9th Cir. 1988).

224 *Id.* at 995.

225 *Id.* at 989.

226 *Id.* at 988–90; *see* Native Fish and Wildlife Endangered Species, 32 Fed. Reg. 4001, 4001 (Mar. 11, 1967).

herds from the Palila's critical habit.[227] Because Palila are only found in Hawaii and because no federal lands or funds were involved, Hawaii argued that the state retained exclusive sovereignty over the Palila's fate under the Tenth Amendment.[228] The United States District Court for the District of Hawaii held that the Tenth Amendment does not constrain enforcement of the ESA given Congress's power "to enact legislation implementing valid treaties and . . . to regulate commerce."[229] It explained:

> [A] national program to protect and improve the natural habitats of endangered species preserves the possibilities of interstate commerce in these species and of interstate movement of persons . . . who come to a state to observe and study these species, that would otherwise be lost by state inaction.[230]

In *Gibbs v. Babbitt*,[231] individuals and several North Carolina counties challenged a FWS regulation prohibiting the taking of red wolves on private property as an infringement on traditional state power over wildlife.[232] The United States Court of Appeals for the Fourth Circuit found that the regulated activity did "not involve an 'area of traditional state concern,' one to which 'States lay claim by right of history and expertise.'"[233] It reasoned that, while "States have important interests in regulating wildlife and natural resources within their borders," state power over wildlife has long been circumscribed by federal regulatory power.[234] The *Gibbs* court explained that the regulated activity—the taking of wolves—"is not an area in which the states may assert an exclusive and traditional prerogative in derogation of an enumerated federal power," i.e., the Commerce Clause.[235] The court also took note of "the historic power of the federal government to preserve scarce resources in one locality for the future benefit of all Americans."[236]

The Tenth Circuit had the opportunity to consider similar Tenth Amendment arguments in *Wyoming v. United States*, where the State of Wyoming tried to compel FWS to allow it to vaccinate elk against brucellosis at the Jackson Hole National Elk Refuge (NER).[237] In response to Wyoming's

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227 *Palila*, 471 F. Supp. at 987.

228 *Id.* at 992.

229 *See id.* at 995.

230 *Id.* For a detailed discussion of the Commerce Clause and the ESA, see *infra* Part III.A.3.c.

231 214 F.3d 483 (4th Cir. 2000).

232 *Id.* at 499; *see* 50 C.F.R § 17.84(c)(2) (2016).

233 *Gibbs*, 214 F.3d at 486 (citing United States v. Lopez, 514 U.S. 549, 580, 583 (1995) (Kennedy, J., concurring)); *see also id.* at 501 ("[T]he federal government possesses a historic interest in such regulation—an interest that has repeatedly been recognized by the federal courts.").

234 *Id.* at 499 (quoting Minnesota v. Mille Lacs Band of Chippewa Indians, 526 U.S. 172, 204 (1999)); *see also id.* at 501 ("[I]t is clear from our laws and precedent that federal regulation of endangered wildlife does not trench impermissibly upon state powers.").

235 *Id.* at 499.

236 *Id.* at 492. The portion of the court's opinion rejecting the Commerce Clause challenge is discussed below. *See infra* note 264 and accompanying text.

237 *Wyoming*, 279 F.3d 1214, 1218, 1222 (10th Cir. 2002).

argument that the Tenth Amendment reserved the sovereign authority to manage wildlife to the states, the court explained that, while states have historically had broad authority to regulate the wildlife within their borders, that authority is not constitutionally derived.[238] Moreover, given the strength and breadth of the federal Property Clause power, the court found it "painfully apparent that the Tenth Amendment does not reserve to the State of Wyoming the right to manage wildlife, or more specifically vaccinate elk, on the NER, regardless of the circumstances."[239]

Subsequently, in *Wyoming v. U.S. Department of the Interior*,[240] the State of Wyoming argued that federal regulation of wolves violated the Anti-Commandeering Doctrine.[241] Wyoming objected to having only two choices: 1) to change state law to eliminate its predator classification for wolves and commit to maintaining at least fifteen packs of wolves, or 2) to endure the restrictions imposed by the continued protection of wolves under the ESA.[242] The court held that Wyoming had failed to show a violation of the Tenth Amendment through commandeering or otherwise.[243] It explained: "Wyoming is under no mandate to regulate gray wolves. . . . If Wyoming chooses to ignore the [federal requirement], the State simply will find itself perpetually pre-empted from regulating the gray wolf."[244]

In sum, except for those rare instances when the Anti-Commandeering Doctrine is successfully invoked, attempts to use the Tenth Amendment as a basis for state sovereignty over federally protected wildlife have generally failed, from *Missouri v. Holland* to present.

c. The Commerce Clause and Federal Wildlife Management

The federal courts did not immediately support federal wildlife control based on the Commerce Clause. In an early case, *Geer v. Connecticut*, the Supreme Court held that game killed within the state concerned internal state commerce rather than interstate commerce.[245] In subsequent years, several district court opinions followed suit.[246]

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238 *Id.* at 1226–27 (citing 43 C.F.R. § 24.3 (2016)).

239 *Id.* at 1227.

240 360 F. Supp. 2d 1214 (D. Wyo. 2005), *aff'd*, 442 F.3d 1262 (10th Cir. 2006).

241 *Id.* at 1238.

242 *Id.* at 1240.

243 *Id.* at 1240, 1244.

244 *Id.* at 1240–41. *But see* N.M Dep't of Game & Fish v. U.S. Dep't of the Interior, No. CV 16-00462 WJ/KBM, 2016 WL 4536465, at *9 (D.N.M. June 10, 2016) (distinguishing *Wyoming* and noting that FWS's own regulation required FWS to release wolves in compliance with state permit requirements), *rev'd*, 854 F.3d 1236 (10th Cir. 2017).

245 *Geer*, 161 U.S. 519, 534–35 (1896), *overruled by Hughes*, 441 U.S. 322 (1979).

246 *See, e.g.*, United States v. McCullagh, 221 F. 288, 292 (D. Kan. 1915) ("The power of the states, by their laws in the protection of their trust title for the common good of all the inhabitants of the state, to exclude wild bird and animal life lawfully reduced to the exclusive possession of the individual from the operation of the commerce clause of the national Constitution, as was held in *Geer* . . . , has been uniformly maintained by the courts of this country."); *Shauver*, 214 F. 154, 160 (E.D. Ark. 1914) (following *Geer* and setting aside an

With the New Deal, however, the federal government's use of the Commerce Clause power began to expand.[247] By the 1970s, it was clear that *Geer* had lost favor. In *Douglas v. Seacoast Products, Inc.*,[248] the Supreme Court struck down a Virginia statute prohibiting federally licensed vessels owned by nonresidents of Virginia from fishing in Chesapeake Bay, and also prohibiting ships owned by noncitizens to catch fish anywhere in Virginia.[249] The Court stated:

> While [Virginia] may be correct in arguing that at earlier times in our history there was some doubt whether Congress had power under the Commerce Clause to regulate the taking of fish in state waters, there can be no question today that such power exists where there is some effect on interstate commerce.[250]

It concluded that the movement of fishing boats within and between states and to processing plants "certainly" affects interstate commerce.[251]

The following year, in *Baldwin v. Fish & Game Commission of Montana*,[252] a Montana hunting guide sued the State of Montana for discriminating against out of state hunters in the price it charged for elk tags. The Supreme Court observed that, in recent years,

> [t]he Court has recognized that the States' interest in regulating and controlling those things they claim to "own," including wildlife, is by no means absolute. States may not compel the confinement of the benefits of their resources, even their wildlife, to their own people whenever such hoarding and confinement impedes interstate commerce.[253]

With this backdrop, it was not surprising when the Supreme Court expressly overruled *Geer* in 1979 in *Hughes v. Oklahoma*.[254] In that case, Hughes challenged his conviction for unlawfully transporting minnows that had been procured within Oklahoma waters for sale outside the state.[255] The Court held that the state law, which forbade the out-of-state sale of

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indictment for violation of a federal migratory bird protection act). Note, however, that the courts upheld Congress's use of the Commerce Clause to regulate interstate trafficking of state-protected wildlife under the Lacey Act, 16 U.S.C. § 701 (2012). *See, e.g.*, Rupert v. United States, 181 F. 87, 91 (8th Cir. 1910) (upholding the Lacey Act as a valid exercise of the commerce power).

247 *See, e.g.*, Wickard v. Filburn, 317 U.S. 111, 128–29 (1942) (upholding federal Commerce Clause power over wheat grown for home consumption because of its aggregated effects on wheat sold in interstate commerce). For a more recent case with similar reasoning, see Gonzales v. Raich, 545 U.S. 1, 19 (2005) (holding that growing marijuana for personal use affects interstate commerce).

248 431 U.S. 265 (1977).

249 *Id.* at 268–69, 284–85.

250 *Id.* at 281–82 (footnote omitted).

251 *Id.* at 282.

252 436 U.S. 371 (1978).

253 *Id.* at 385–86.

254 *Hughes*, 441 U.S. 322, 326 (1979), *overruling Geer*, 161 U.S. 519 (1896).

255 *See id.* at 324–25.

commercially significant numbers of minnows, was "repugnant to the Commerce Clause."[256]

> The cases defining the scope of permissible state regulation in areas of congressional silence reflect an often controversial evolution of rules to accommodate federal and state interests. *Geer v. Connecticut* was decided relatively early in that evolutionary process. We hold that time has revealed the error of the early resolution reached in that case, and accordingly *Geer* is today overruled. . . . "The 'ownership' language of cases such as those cited by appellant must be understood as no more than a 19th-century legal fiction expressing 'the importance to its people that a State have power to preserve and regulate the exploitation of an important resource.'"[257]

Although the Supreme Court began to establish limits on Congress's use of the Commerce Clause in the 1990s, none of its opinions dilute the strength of *Hughes* or related wildlife precedents. In *United States v. Lopez*,[258] the federal Gun-Free School Zones Act[259] was struck down as "a criminal statute that by its terms has nothing to do with 'commerce' or any sort of economic enterprise, however broadly one might define those terms."[260] Similarly, in *United States v. Morrison*,[261] a provision of the Violence Against Women Act[262] was struck down because it attempted to regulate activities that did not substantially affect interstate commerce.[263]

The federal courts that have addressed wildlife-related issues since *Lopez* and *Morrison* have had no trouble finding federal Commerce Clause power. In the *Gibbs* case discussed above, the court emphasized the direct relationship between the removal of red wolves and negative effects to interstate commerce, finding no need to "pile inference upon inference" to reach that conclusion:

> The taking of red wolves implicates a variety of commercial activities and is closely connected to several interstate markets. The regulation in question is also an integral part of the overall federal scheme to protect, preserve, and rehabilitate endangered species, thereby conserving valuable wildlife resources important to the welfare of our country.[264]

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256 *Id.* at 338.

257 *Id.* at 326, 335 (footnote omitted) (quoting *Seacoast Products, Inc.*, 431 U.S. 265, 284 (1977)).

258 514 U.S. 549 (1995).

259 Gun-Free School Zones Act of 1990, Pub. L. No. 101-647, 104 Stat. 4844.

260 *Lopez*, 514 U.S. at 561.

261 529 U.S. 598 (2000).

262 Violence Against Women Act of 1994, Pub. L. No. 103-322, 108 Stat. 1902 (codified in scattered sections of 18 and 42 U.S.C.)

263 *Morrison*, 529 U.S. at 617. Summarizing, the Court noted that the Commerce Clause provides federal power over: 1) the channels of interstate commerce; 2) the instrumentalities of interstate commerce, or persons or things in interstate commerce; and 3) activities that, in the aggregate, have a substantial effect on interstate commerce. *Id.* at 609.

264 *Gibbs*, 214 F.3d 483, 492 (4th Cir. 2000).

Similarly, the United States Court of Appeals for the District of Columbia Circuit rejected a real estate developer's challenge to the application of the ESA to the arroyo toad, stating that the focus of the Commerce Clause inquiry must be on the regulated activity, not just the toad.[265] When the regulated activity is commercial development, "both the 'actor,' a real estate company, and its 'conduct,' the construction of a housing development, have a plainly commercial character . . . '[with] a plain and substantial effect on interstate commerce.'"[266]

It is now well settled that if the Commerce or Property Clauses are successfully invoked by the federal government as the authority to regulate wildlife, then by definition, inconsistent state law is preempted notwithstanding the Tenth Amendment.

4. Federal Preemption and Savings Clauses

The doctrine of federal preemption, derived from the Supremacy Clause of the U.S. Constitution, holds that state law must yield to federal law where the two conflict.[267] This can happen expressly, for instance, under the Marine Mammal Protection Act where Congress stated: "No State may enforce . . . any State law or regulation related to the taking of any species . . . of marine mammal."[268] Preemption can also be implied. The Supreme Court, in *California Coastal Commission v. Granite Rock Co.*,[269] defined the concept of implied preemption:

> If Congress evidences intent to occupy a given field, any state law falling within that field is pre-empted. If Congress has not entirely displaced state regulation over the matter in question, state law is still pre-empted to the extent it actually conflicts with federal law, that is, when it is impossible to comply with both state and federal law, or where the state law stands as an obstacle to the accomplishment of the full purposes and objectives of Congress.[270]

Therefore, preemption can occur where Congress expressly preempts state law, where Congress occupies a field of law, or where state law interferes

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265 Rancho Viejo, LLC v. Norton, 323 F.3d 1062, 1064, 1072 (D.C. Cir. 2003).

266 *Id.* at 1072–73 (quoting Nat'l Ass'n of Home Builders v. Babbitt, 130 F.3d 1041, 1059 (D.C. Cir. 1997)).

267 *See* U.S. CONST. art. VI, cl. 2 ("This Constitution, and the Laws of the United States which shall be made in Pursuance thereof; and all Treaties made, or which shall be made, under the Authority of the United States, shall be the supreme Law of the Land."); *Kleppe*, 426 U.S. 529, 543 (1976) (stating that "federal legislation necessarily overrides conflicting state laws under the Supremacy Clause"); *Wyoming*, 279 F.3d 1214, 1227 (10th Cir. 2002) ("If Congress so chooses, federal legislation, together with the policies and objectives encompassed therein, necessarily override and preempt conflicting state laws, policies, and objectives . . . .").

268 16 U.S.C. § 1379(a) (2012).

269 480 U.S. 572 (1987).

270 *Id.* at 581 (citations omitted). The Court found that a state mining permit requirement was not preempted because the federal land use and state environmental regulations in question could be interpreted to avoid conflict. *Id.* at 594.

with the implementation of federal law.[271] Federal regulations have the same preemptive effect.[272]

Federal law occupies a field of law (also known as field preemption) where a federal statutory scheme is interpreted to be "so pervasive as to make reasonable the inference that Congress left no room for the States to supplement it."[273] Because federal land management and wildlife laws often contain savings clauses acknowledging some level of state authority, field preemption rarely applies in these areas.[274] Conflict preemption, on the other hand, arises whenever "compliance with both federal and state regulations is a physical impossibility."[275] Conflict preemption is also invoked where state law "stands as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress."[276] The conflict between federal and state laws may be subtle and yet still trigger preemption, as where state law discourages conduct that federal law attempts to encourage, or vice versa.[277] For example, in *National Audubon Society, Inc. v. Davis*,[278] California law banned the use of all leg-hold traps, even by federal officials in the course of their duties.[279] The Ninth Circuit found that, by eliminating a method of predator control, the ban conflicted with the purposes of the ESA by preventing agencies from protecting listed species.[280] Therefore, the state's action prevented the federal law from receiving full effect and was preempted.[281]

Congress may negate or otherwise temper preemption by including a "savings clause" in its legislation. Many federal public health, environmental,

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271 *Id.* at 581; *Nat'l Audubon Soc'y*, 307 F.3d 835, 851 (9th Cir.), *amended on denial of reh'g*, 312 F.3d 416, 418 (9th Cir. 2002).

272 *Granite Rock Co.*, 480 U.S. at 579–81, 591; *see* Hillsborough County v. Automated Med. Labs., Inc., 471 U.S. 707, 713 (1985) ("We have held repeatedly that state laws can be pre-empted by federal regulations as well as by federal statutes.").

273 Gade v. Nat'l Solid Wastes Mgmt. Ass'n, 505 U.S. 88, 98, 108–09 (1992) (quoting Rice v. Santa Fe Elevator Corp., 331 U.S. 218, 230 (1947)) (holding that state occupational health and safety regulations were preempted by Occupations Safety and Health Administration, which occupied that field of law).

274 *See generally* Fischman & King, *supra* note 108 (analyzing savings clauses, their uses and trends, and how they incorporate state cooperation).

275 Fla. Lime & Avocado Growers, Inc. v. Paul, 373 U.S. 132, 142–43 (1963). For a full treatment of this issue, see Julie Lurman & Sanford P. Rabinowitch, *Preemption of State Wildlife Law in Alaska: Where, When, and Why*, 24 ALASKA L. REV. 145 (2007), and Julie Lurman Joly, *National Wildlife Refuges and Intensive Management in Alaska: Another Case for Preemption*, 27 ALASKA L. REV. 27 (2010).

276 Hines v. Davidowitz, 312 U.S. 52, 67 (1941).

277 Lurman & Rabinowitch, *supra* note 275, at 161.

278 307 F.3d 835 (9th Cir. 2002), *amended on denial of reh'g*, 312 F.3d 416, 418 (9th Cir. 2002).

279 *Id.* at 852.

280 *Id.* The court also found that the state's action was preempted by the National Wildlife Refuge Systems Improvement Act because it conflicted with FWS's management authority within national refuges. *Id.* at 854.

281 *Id.* at 852; *see also* North Dakota v. United States, 460 U.S. 300, 318 (1983) (stating state statutes that are "plainly hostile to the interests of the United States" will not be applied); Gibbons v. Ogden, 22 U.S. (9 Wheat.) 1, 211 (1824) ("[T]he act of Congress . . . is supreme; and the law of the State, though enacted in the exercise of powers not controverted, must yield to it.").

and natural resources statutes include savings clauses intended to leave room for state law to provide increased protection consistent with congressional purposes and objectives.[282] In public lands and natural resources statutes, Congress has embraced the principle of cooperative federalism through a variety of savings clauses that disclaim an intention to displace state law related to wildlife, water, and other resources, so long as state law does not conflict with or undermine federal prerogatives.[283] These statutory disclaimers are often quite vague, having been included as compromise measures to ensure passage of a piece of legislation.[284] As Robert Fischman notes:

> Judicial interpretation of a savings clause may elevate or undermine the importance of state interests in federal natural resources programs. Largely, it is the interpretive approach used by a court that determines whether an ambiguous savings clause will compel special consideration not otherwise required under federal law.[285]

Fischman adds that, "[a]lthough the judiciary places the interpretive fulcrum establishing how much leverage states can expect in federal decision-making, administrative policies have and will play the dominant role in shaping cooperative federalism."[286] Other sections of this Article analyze the specific language, agency implementation, and judicial review of savings clauses related to wildlife management on federal lands.

In conclusion, states undoubtedly have well-established historical responsibility over the wildlife within their borders. However, as this Subpart demonstrates, that responsibility is not exclusive, nor dominant, nor constitutionally derived. The U.S. Constitution grants the federal government the authority to manage its own lands and resources, fulfill its treaty obligations, and control interstate commerce, even in the face of objections from the states. And while the Tenth Amendment prevents the federal government from forcing state governments to carry out federal regulatory schemes, it cannot prevent the federal government from implementing those schemes itself.

B. Federal Land Laws and Regulations

This Subpart reviews the laws and regulations of most relevance to wildlife management on federal lands. It begins by explaining how the ESA fundamentally alters the management of all federal land systems. Next, it

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282 Fischman & King, *supra* note 108, at 145.

283 *Id.* at 129–30. Congress has also peppered the organic acts of the federal land management agencies with various directives to cooperate with states in planning and other processes. *Id. See generally* Robert L. Fischman, *Cooperative Federalism and Natural Resources Law*, 14 N.Y.U. ENVTL. L.J. 179 (2005) (discussing cooperation between state and the federal government in the application of natural resource management).

284 Fischman & King, *supra* note 108, at 159–60.

285 *Id.* at 168.

286 *Id.*

reviews the laws and regulations governing wildlife management in the National Park and National Wildlife Refuge Systems. This is followed by a review of the more contentious management and planning frameworks of USFS and BLM. A concise overview of the special case of Alaska is then provided. The Subpart closes by reviewing wildlife management and the National Wilderness Preservation System.

In Part IV, we return to many of the laws, regulations, and policies introduced here to dispel some of the common myths surrounding wildlife management on federal lands and to explain why federal land agencies have an obligation, and not just the discretion, to manage and conserve fish and wildlife on federal lands. The background provided here also shows that multiple opportunities for intergovernmental cooperation already exist within federal decision-making processes, but Part IV.F explains that they are not generally used to their full potential.

1. The Endangered Species Act

Congress passed the ESA in 1973 "to provide a program for the conservation of . . . endangered species and threatened species" and "to provide a means whereby the ecosystems upon which endangered . . . and threatened species depend may be conserved."[287] The ESA establishes an affirmative obligation for the federal government to use "all methods and procedures which are necessary to bring any [listed] species to the point at which the measures provided in this [Act] are no longer necessary,"[288] and states that "all federal departments and agencies shall seek to conserve endangered . . . and threatened species."[289] In defining "conserve" and "conservation," the ESA establishes an affirmative obligation to use "all methods and procedures which are necessary to bring any endangered . . . or threatened species to the point at which the measures provided" by the statute are no longer necessary.[290]

A secondary indicator as to the goals of the statute can be found in Congress's explicit recognition of the "esthetic, ecological, educational, historical, recreational, and scientific value" of rare species.[291] As Freyfogle and Goble have argued, this list of recognized values suggests that the statute is intended to do more than preserve a remnant population in a zoo or at easily visited locations, though this might meet the needs for the esthetic and recreational values.[292] Instead, in order to preserve their ecological and scientific values, species and their habitats must be preserved in many natural locations, potentially including areas where they have been extirpated.[293]

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287 ESA, 16 U.S.C. § 1531(b) (2012).

288 *Id.* § 1532(3). The goal of the statute is not to "list" species but to recover their populations so that they can be "delisted."

289 *Id.* § 1531(c).

290 *Id.* § 1532(3).

291 *Id.* § 1531(a)(3).

292 ERIC T. FREYFOGLE & DALE D. GOBLE, WILDLIFE LAW: A PRIMER 233–34 (1st ed. 2009).

293 *Id.*

To understand the role of the ESA in federal land and wildlife management, three central pieces of the statute are most relevant: 1) the listing determination,[294] 2) the obligation for federal agencies to conserve species and to avoid jeopardizing the continued existence of the listed species or destroying critical habitat,[295] and 3) the take prohibition.[296] These sections of the statute detail the government's responsibilities and sources of authority. In addition, several provisions of the ESA address federal-state relations with respect to the conservation and management of listed species.[297] Each of the relevant sections is addressed below.

a. Listing Determinations (Section 4)

Only those species listed as threatened or endangered are protected by the ESA.[298] Listing a species as threatened or endangered is often the result of a citizen petition requesting the listing, though listings may also stem from direct agency initiative (either FWS or, for anadromous and ocean species, the National Marine Fisheries Service (NMFS)).[299] In either case, the species must meet the definition of either "threatened" or "endangered" in order to secure the protections provided under the statute.[300] An "endangered" species is one that is "in danger of extinction throughout all or a significant portion of its range," and "threatened" species are "likely to become an endangered species within the foreseeable future."[301]

The decision to list a species as either threatened or endangered must be made "solely on the basis of the best scientific and commercial data available."[302] The data hurdles that must be surmounted are formidable, and even if met, the agency may decide that the listing is "warranted but precluded" by other more urgent species' needs given the agency's historically tight funding.[303] However, once species are listed they are entitled to the full protections of the statute regardless of the economic consequences.[304]

Section 4 includes a number of factors to be considered in the listing decision. One inquiry is to assess "the inadequacy of existing regulatory

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294 16 U.S.C. § 1533.

295 *Id.* § 1536(a).

296 *Id.* § 1538.

297 *See, e.g.*, *id.* § 1535 (cooperation with states); *id.* § 1533(b)(1) (listing criteria); *id.* § 1539(a)(2)(B) (incidental take permits).

298 *See id.* § 1533(d).

299 *Id.* § 1533(b)(3)(A); *see* FREYFOGLE & GOBLE, *supra* note 292, at 236; *Endangered Species Act: Overview*, U.S. FISH & WILDLIFE SERV., https://perma.cc/CTB5-GTZ5 (last updated Nov. 1, 2017).

300 16 U.S.C. § 1533(d).

301 *Id.* § 1532(6), (20).

302 *Id.* § 1533(b)(1)(A).

303 FREYFOGLE & GOBLE, *supra* note 292, at 248–49. These "candidate species" receive no protection under the ESA, but the candidate status may provide an opportunity and an incentive for state and private action to prevent listing. *Id.*

304 *See* Tenn. Valley Auth. v. Hill, 437 U.S. 153, 174 (1978).

mechanisms."[305] This means that state laws and regulations pertaining to wildlife, or the lack thereof, are assessed when making listing determinations. Another factor is particularly relevant when it comes to state involvement in ESA implementation: "[conservation] efforts, if any, being made by any State."[306] Accordingly, state efforts to conserve a species may be deemed to offset other threats, such as habitat destruction, and effectively bring the species below the threshold necessary to warrant a federal listing.[307] FWS's Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE) allows FWS to consider conservation efforts that have not yet been implemented so long as FWS evaluates the certainty with which the efforts will be implemented and effective.[308] However, courts have found that speculative future plans and voluntary conservation efforts will not suffice to avoid listing.[309]

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305 16 U.S.C. § 1533(a)(1)(D).

306 *Id.* § 1533(b)(1)(A).

307 Policy for Evaluation of Conservation Efforts When Making Listing Decisions, 68 Fed. Reg. 15,100, 15,113 (Mar. 28, 2003) (to be codified at 50 C.F.R. ch. 4); *see also* Kevin Cassidy, *Endangered Species' Slippery Slope Back to the States: Existing Regulatory Mechanisms and Ongoing Conservation Efforts Under the Endangered Species Act*, 32 ENVTL. L. 175, 178–79 (2002) (discussing instances where state and local conservation efforts were invoked to avoid listing).

308 Policy for Evaluation of Conservation Efforts When Making Listing Decisions, 68 Fed. Reg. at 15,114 (requiring a "high level of certainty that the effort will be implemented and/or effective"); *see also* Permian Basin Petroleum Ass'n v. Dep't of the Interior, 127 F. Supp. 3d 700, 712 (W.D. Tex. 2015) (invalidating FWS's decision to list the lesser prairie chicken as inconsistent with PECE), *appeal dismissed*, No. 16-50453 (5th Cir. 2016).

309 *See, e.g.*, Alaska v. Lubchenco, 825 F. Supp. 2d 209, 219–20 (D.D.C. 2011) (rejecting Alaska's claim that NMFS failed to consider the state's conservation efforts before listing the beluga whale and concluding that "it is not enough for the State to identify conservation efforts that *may* be beneficial to a species' preservation"; instead, "the efforts must actually be in place and have achieved some measure of success in order to count"); Defs. of Wildlife v. Norton, 258 F.3d 1136, 1146 (9th Cir. 2001) (rejecting FWS's reliance on a Conservation Agreement (CA) to justify withdrawing a proposed listing because, in several areas designated as management areas for the species, "the designation process was either incomplete or wholly unstarted" and "[n]owhere d[id] the Secretary account for the effects of failure to implement the CA immediately in those areas where delay was expected"); *see also* Or. Nat. Res. Council v. Daley, 6 F. Supp. 2d 1139, 1154–55 (D. Or. 1998) ("NMFS may only consider conservation efforts that are currently operational"; NMFS cannot rely on voluntary measures to preclude listing because "like those planned in the future, [they] are necessarily speculative."); Sw. Ctr. for Biological Diversity v. Babbitt, 939 F. Supp. 49, 51 (D.D.C. 1996) ("[FWS] cannot use promises of proposed future actions as an excuse for not making a determination based on the existing record."). *But see* Defs. of Wildlife v. Zinke, 849 F.3d 1077, 1084 (D.C. Cir. 2017) (holding that FWS properly relied on future implementation of a wolf management plan by the State of Wyoming because the plan was not speculative but rather was "sufficiently certain to be implemented based on the strength of the State's incentives"); Defs. of Wildlife v. Jewell, 70 F. Supp. 3d 183, 197–98 (D.D.C. 2014) (holding that FWS may consider state programs that are not yet fully implemented, as "implementation and effectiveness are often assessed in relative rather than absolute terms; when faced with regulatory uncertainty and risk to certain species, the Service can still chart a course of action, provided it assesses and controls for that uncertainty and risk"), *aff'd*, 815 F.3d 1 (D.C. Cir. 2016).

b. Federal Obligations (Section 7)

i. Affirmative Duty to Conserve (Section 7(a)(1))

The ESA states that the Departments of Interior and Commerce must utilize all of their programs to promote the statute's goals.[310] The ESA also mandates that *all* federal agencies utilize their authority in the furtherance of the purposes of the ESA.[311] There are few reported cases directly on point, but at least a handful of courts have found that section 7(a)(1) has substantive "teeth."[312] In *Defenders of Wildlife v. Andrus*, the advocacy group argued that regulations for bird hunting at twilight failed to protect listed species against misidentification by hunters.[313] The United States District Court for the District of Columbia, interpreting this section of the statute, found that the ESA requires that the agency "do far more than merely avoid the elimination of protected species," rather there is "an affirmative duty to increase the population of protected species."[314]

The court came to a similar decision in *Carson-Truckee Water Conservancy District v. Watt*.[315] The cities of Reno and Sparks, Nevada challenged the Department of the Interior's refusal to release greater quantities of water from the Stampede Dam and Reservoir.[316] The Department of the Interior cited section 7(a)(1) to support its position that the water levels in the reservoir must be maintained at higher levels in order to preserve the spawning ability of two endangered fish (the cui-ui and the Lahotan cutthroat trout).[317] Ultimately, the court agreed with the federal government's argument that it had a duty "to replenish the species so that they are no longer endangered or threatened with extinction," rather than merely avoiding jeopardy.[318]

By contrast, several courts have refused to mandate the implementation of specific conservation measures, instead finding that the federal agencies

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310 16 U.S.C. § 1536(a)(1). For convenience, we reference FWS throughout this Article, but similar duties are imposed upon NMFS, an agency within the Department of Commerce.

311 *Id.*

312 *See* Defs. of Wildlife v. Andrus, 428 F. Supp. 167, 169–70 (D.D.C. 1977) (holding that the ESA clearly implied that FWS must "use all methods necessary" to boost species populations for their removal from the protective class); *see also Tenn. Valley Auth.*, 437 U.S. 153, 173 (1978) ("One would be hard pressed to find a statutory provision whose terms were any plainer than those in § 7 of the [ESA]. Its very words affirmatively command all federal agencies 'to *insure* that actions *authorized, funded*, or *carried about* by them do not *jeopardize* the continued existence' of an endangered species or '*result* in the destruction or modification of habitat of such species.'" (quoting 16 U.S.C. § 1536)).

313 *Andrus*, 428 F. Supp. at 169.

314 *Id.* at 170.

315 549 F. Supp. 704, 710 (D. Nev. 1982), *aff'd sub nom.*, Carson-Truckee Water Conservancy Dist. v. Clark, 741 F.2d 257, 262 (9th Cir. 1984).

316 *Clark*, 741 F.2d at 259; *Watt*, 537 F. Supp. at 107–08.

317 *Clark*, 741 F.2d at 259, 261–62.

318 *Watt*, 549 F. Supp. at 708–10; *see also* Sierra Club v. Glickman, 156 F.3d 606, 618 (5th Cir. 1998) (finding that section 7(a)(1) required the United States Department of Agriculture to develop its own conservation program for listed species dependent on the Edwards aquifer).

have a great deal of discretion in the steps that they take to satisfy section 7(a)(1).[319] For example, in *Defenders of Wildlife v. U.S. Fish & Wildlife*,[320] the court rejected arguments that USFS should develop and implement its own conservation program for the endangered Mexican wolf and deferred to the agency's decision to act in cooperation with FWS's recommendations in furtherance of previously established wolf reintroduction and recovery goals.[321] Similarly, in *Defenders of Wildlife v. Babbitt*,[322] the court held that the federal agencies had not violated section 7(a)(1), even though they had not implemented all possible measures for conservation of the endangered Sonoran pronghorn, absent a showing that the agencies had failed entirely to carry out conservation programs.[323]

To summarize, FWS and other federal agencies are obligated to prevent jeopardy and authorized to proactively improve the circumstances of listed species. Additionally, while the ESA creates a duty to increase populations of protected species, it appears that courts are often unwilling to require the implementation of specific conservation measures.

ii. Prohibition Against Jeopardy (Section 7(a)(2))

Federal agencies must also ensure that their actions are "not likely to jeopardize the continued existence" of listed species.[324] In *Tennessee Valley Authority v. Hill*,[325] the Supreme Court established that, instead of balancing interests between wildlife conservation and economic development, the ESA demands that species conservation be elevated above other concerns, which could include state interests in wildlife.[326]

In order to ensure that federal actions do not jeopardize listed species, federal agencies undertaking actions that could harm species must formally consult with FWS.[327] For purposes of section 7, "federal actions" include projects that are funded, authorized, or constructed directly by any federal agency, and projects with discretionary involvement or control by any

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319 *See, e.g.*, Leatherback Sea Turtle v. Nat'l Marine Fisheries Serv., No. 99–00152 DAE, 1999 WL 33594329, at *13–14 (D. Haw. Oct. 18, 1999) (finding that NMFS satisfied its section 7(a)(1) duty by issuing conservation recommendations and biological opinions); Coal. for Sustainable Res., Inc. v. U.S. Forest Serv., 48 F. Supp. 2d 1303, 1306, 1315–16 (D. Wyo. 1999) (rejecting plaintiff's argument that USFS should implement certain timber harvest and snow management programs for the benefit of listed species), *vacated for lack of ripeness*, 259 F.3d 1244 (10th Cir. 2001).

320 797 F. Supp. 2d 949 (D. Ariz. 2011).

321 *Id.* at 958–59.

322 130 F. Supp. 2d 121 (D.D.C. 2001).

323 *Id.* at 135; *see also* Pyramid Lake Paiute Tribe of Indians v. U.S. Dep't of the Navy, 898 F.2d 1410, 1417–19 (9th Cir. 1990) (holding that section 7(a)(1) did not require the Navy to adopt the "least burdensome alternative" to ensure the conservation of listed species; rather, the Navy retained discretion in meeting the ESA's conservation mandate).

324 ESA, 16 U.S.C. § 1536(a)(2) (2012).

325 437 U.S. 153 (1978).

326 *See id.* at 184 (noting "[t]he plain intent of Congress in enacting [the ESA] was to halt and reverse the trend toward species extinction, whatever the cost").

327 16 U.S.C. § 1536(a)(4).

federal agency.[328] If a listed species may be present within the project area, the federal "action agency" must conduct a biological assessment (BA) to identify any such species likely to be affected by the federal action and evaluate the effects.[329] In turn, through its biological opinion (BiOp), FWS must determine whether the potential harm to the species violates section 7(a)(2) and, if so, devise less harmful alternatives or mitigation measures.[330]

FWS has interpreted the phrase "jeopardize the continued existence of a species" as any action "that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild."[331] According to the Ninth Circuit in *National Wildlife Federation v. National Marine Fisheries Service*,[332] an action that may jeopardize a species can be of any magnitude, slight or severe, since the important factor is the degree of risk to the particular species.[333] Furthermore, the court stated that jeopardy determinations must consider the action's effect on species recovery, not simply species survival.[334] Therefore, even actions that pose only slight dangers may "jeopardize" the species if the effect of that action poses a high degree of risk to the species.

iii. Prohibition Against Adversely Modifying Critical Habitat (Section 7(a)(2))

At the time a species is listed as endangered or threatened, FWS must also designate its critical habitat.[335] Critical habitat is an area where there are "physical or biological features . . . essential to the conservation of the species and . . . which may require special management considerations."[336] Critical habitat designation is based on "the best scientific data available and after taking into consideration the economic impact, the impact on national security, and any other relevant impact."[337] By directing FWS to consider economic impacts, the designation decision involves a much broader inquiry than is required for the listing determinations.

Section 7 prohibits federal agencies from taking actions that may "result in the destruction or adverse modification of [critical] habitat."[338] FWS regulations specify that:

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328 *Id.* § 1536(a); 50 C.F.R. § 402.02 (2016); *see* Sierra Club v. Bureau of Land Mgmt., 786 F.3d 1219, 1224–25 (9th Cir. 2015).

329 16 U.S.C. § 1536(c).

330 *Id.* § 1536(b)(3).

331 50 C.F.R. § 402.02.

332 524 F.3d 917 (9th Cir. 2008).

333 *See id.* at 930.

334 *Id.* at 931.

335 16 U.S.C. § 1533(a)(3)(A), (b)(6)(C).

336 *Id.* § 1532(5)(A)(i).

337 *Id.* § 1533(b)(2).

338 *Id.* § 1536(a)(2).

> Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for [both the survival and recovery] of a listed species . . . includ[ing] . . . those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features.[339]

In *Center for Native Ecosystems v. Cables*,[340] the Tenth Circuit held that critical habitat is adversely modified by any actions "that adversely affect a species' recovery and the ultimate goal of delisting."[341] This interpretation makes the critical habitat protection a significant prohibition.

c. Take Prohibition (Section 9)

The ESA prohibits the "take" of listed species.[342] "Take" is defined by Congress as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect."[343] This broad protection has been further enlarged by the Supreme Court's determination that "harm" in this definition includes habitat modification or degradation,[344] though a showing that animals have actually been killed or injured may be required to prove that harm has occurred.[345] A prohibited take can be either intentional (e.g., hunting and trapping) or unintentional (e.g., poisoning and other contamination).[346] Unlike the requirements of section 7, section 9 applies to all persons, not just federal agencies.[347]

While the take prohibition is unqualified for endangered species, it is up to the agency to determine the breadth of its applicability for threatened species.[348] FWS can make the prohibitions of section 9 applicable, either in whole or in part, to threatened species.[349] However, FWS's discretion in this area is not without limits. In *Sierra Club v. Clark*,[350] the United States Court of Appeals for the Eighth Circuit struck down FWS regulations that permitted the hunting of threatened wolves because the ESA only empowers FWS to issue regulations for the "conservation" of species, and regulated taking is only permissible under "extraordinary" circumstances which were not present in that case.[351]

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339 50 C.F.R. § 402.02 (2016) (emphasis omitted).

340 509 F.3d 1310 (10th Cir. 2007).

341 *Id.* at 1322.

342 16 U.S.C. § 1538(a)(1)(B)–(C).

343 *Id.* § 1532(19).

344 Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687, 708 (1995) (citing 50 C.F.R. § 17.3).

345 *See id.* at 696 n.7; FREYFOGLE & GOBLE, *supra* note 292, at 266.

346 FREYFOGLE & GOBLE, *supra* note 292, at 236–37.

347 16 U.S.C. § 1538(a)(1).

348 *Id.* § 1533(d).

349 *Id.*

350 755 F.2d 608 (8th Cir. 1985).

351 *Id.* at 610, 612–13; *see* 16 U.S.C. § 1532(3).

i. Incidental Take Statements and Incidental Take Permits (Section 7(a)(2) and Section 10)

Federal activities covered by a "no jeopardy" BO may be shielded from section 9 "take" liability if FWS has also issued an incidental take statement (ITS) that excuses the actor from liability when a covered species is incidentally taken during the course of an otherwise lawful activity.[352] While an ITS provides protection against federal prosecution, it also constitutes a binding agreement with FWS that may include limitations and other prohibitions for the shielded activity.[353] In addition, section 10(a) allows "take" by nonfederal actors under prescribed conditions in exchange for a habitat conservation plan (HCP).[354] To issue an incidental take permit (ITP) under section 10(a), FWS must find that:

> (i) the taking will be incidental;
>
> (ii) the applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking;
>
> (iii) the applicant will ensure that adequate funding for the plan will be provided;
>
> (iv) the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and
>
> (v) the measures, if any, [that the Secretary may require as being necessary or appropriate for purposes of the plan] will be met.[355]

In recent years, FWS has utilized its ability to issue ITPs more frequently, in part to alleviate the perceived harshness of the ESA's prohibitions and in part to foster "creative partnerships between the private sector and all levels of government in the interests of protected species and habitat conservation."[356] For example, a court upheld an ITP that authorized the State of Utah, Cedar City, and the Paiute Tribe to trap prairie dogs that

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352 16 U.S.C. § 1536(a)(2), (b)(4); *see* Ramsey v. Kantor, 96 F.3d 434, 446 (9th Cir. 1996) (holding that states did not violate the ESA when they issued fishing regulations allowing taking of listed salmon without obtaining a section 10 permit where NMFS issued a section 7 incidental take statement that clearly anticipated the states would promulgate fishing regulations in accordance with its terms).

353 *See, e.g.*, 50 C.F.R. § 17.32(b)(2) (2016); *see also Endangered Species Permits: HCPs - Frequently Asked Questions*, U.S. FISH & WILDLIFE SERV., https://perma.cc/Z3PV-WQFC (last updated Apr. 14, 2015) (describing the binding legal obligations included in Habitat Conservation Plans that are usually required when a party obtains an incidental take permit).

354 16 U.S.C. § 1539(a)(2)(A).

355 *Id.* § 1539(a)(2)(B).

356 Robert L. Fischman & Jaelith Hall-Rivera, *A Lesson for Conservation from Pollution Control Law: Cooperative Federalism for Recovery Under the Endangered Species Act*, 27 COLUM. J. ENVTL. L. 45, 69, 75–76 (2002).

were damaging private and tribal land, and relocate them to a parcel of land covered by a conservation easement surrounded by BLM lands.[357]

States have avoided liability for a "take" under both ITSs and ITPs, and both tools have the potential to be used to foster cooperation with states in the interest of species conservation. If either an ITS or an ITP is issued without adequate safeguards for the species, however, the ESA's conservation objectives may be undermined.

d. Cooperation with States (Section 6)

The ESA carves out a role for the states to assist in achieving the ESA's protective purposes by providing that, in carrying out the statute, FWS "shall cooperate to the maximum extent practicable with the States."[358] Through this provision, Congress recognized the expertise of state agencies and required FWS to solicit and consider relevant information from them, such as preparing proposed and final rules to designate critical habitat.[359] In addition, the ESA empowers FWS to "enter into agreements with [states] for the administration and management of any area established for the conservation of [listed] species."[360] FWS may also enter into cooperative agreements with any state that establishes and maintains an "adequate and active" program for the conservation of listed species.[361] These programs are enacted statutorily and are referred to as "state endangered species acts."[362]

In addition, the statutory savings clause states that the ESA should not be construed "to void any State law or regulation which is intended to conserve migratory, resident, or introduced fish or wildlife, or to permit or prohibit sale of such fish or wildlife."[363] However, states may not take measures to protect or enhance non-endangered resident wildlife if such measures would take or otherwise endanger listed species.[364]

FWS and NFMS also adopted an interagency policy to guide their work with the states in ESA implementation. The policy begins by recognizing that

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357 WildEarth Guardians v. U.S. Fish & Wildlife Serv., 622 F. Supp. 2d 1155, 1159, 1168 (D. Utah 2009).

358 16 U.S.C. § 1535(a).

359 *See, e.g.*, Alaska Oil & Gas Ass'n v. Salazar, 916 F. Supp. 2d 974, 997 (D. Alaska 2013) (discussing FWS and state's various joint efforts and ultimately finding that FWS complied with § 1535(a) in designating polar bear critical habitat).

360 16 U.S.C. § 1535(b).

361 *Id.* § 1535(c)(1). For details, see COGGINS & GLICKSMAN, *supra* note 124, § 29:19.

362 Deborah F. Buckman, Annotation, *Construction and Application of State Endangered Species Acts*, 44 A.L.R. 6th 325 (2009); *see* 16 U.S.C. § 1535.

363 16 U.S.C. § 1535(f).

364 *See Nat'l Audubon Soc'y*, 307 F.3d 835, 853 (9th Cir.) (invalidating California's prohibition on leghold traps), *amended on denial of reh'g*, 312 F.3d 416, 418 (9th Cir. 2002). *Cf.* Animal Prot. Inst. v. Holsten, 541 F. Supp. 2d 1073, 1080–81 (D. Minn. 2008) (finding that the savings clause did not shield a state hunting program from judicial invalidation or protect the state game agency from liability for violating the ESA's taking clause); United States v. Glenn-Colusa Irrigation Dist., 788 F. Supp. 1126, 1134 (E.D. Cal. 1992) ("[T]o the extent that [a state's] law on taking is less protective than the [ESA], it is preempted.").

"States possess broad trustee and police powers over fish, wildlife and plants and their habitats within their borders [and u]nless preempted by Federal authority, States possess primary authority and responsibility for protection and management of fish, wildlife and plants and their habitats."[365] The policy specifies ways in which the states can help carry out the purposes of the ESA, such as by taking prelisting conservation actions and utilizing state expertise and information in the ESA recovery process.[366]

Section 6 and the interagency policy provisions encourage cooperative federalism to effectuate the purposes of the ESA. Like many other federal environmental statutes, the ESA provides a floor, not a ceiling, for species protection.[367] The ESA clearly preempts inconsistent or less restrictive state laws.[368] And most state-level endangered species acts are relatively limited in comparison to the federal law, with most states having no mechanism for recovery, consultation, critical habitat, or citizen enforcement.[369]

2. The National Park System

a. The 1916 Organic Act

The National Park Service Organic Act[370] makes conservation of park resources, including wildlife, a primary management goal:

> [To] promote and regulate the use of the National Park System by means and measures that conform to the fundamental purpose . . . *to conserve the scenery, natural and historic objects, and wild life in the System units* and to provide for the enjoyment of the scenery, natural and historic objects, and wild life in such manner and by such means as will leave them *unimpaired* for the enjoyment of future generations.[371]

Courts have construed this provision as a directive that, between the competing goals of conservation of park resources and facilitating public

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365 Endangered and Threatened Wildlife and Plants: Notice of Interagency Cooperative Policy Regarding the Role of State Agencies in Endangered Species Act Activities, 59 Fed. Reg. 34,274, 34,725 (July 1, 1994).

366 *Id.*

367 16 U.S.C. § 1535(c), (f); *see* Robert L. Fischman, *Predictions and Prescriptions for the Endangered Species Act*, 34 ENVTL. L. 451, 462 (2004).

368 16 U.S.C. § 1535(f) ("Any State law or regulation respecting the taking of an endangered species or threatened species may be more restrictive than the exemptions or permits provided for in this chapter or in any regulation which implements this chapter but not less restrictive than the prohibitions so defined."); *see, e.g.*, *Nat'l Audubon Soc'y*, 307 F.3d at 851–53 (holding that California's rule prohibiting use of leg-hold traps by federal employees was preempted by the ESA); Swan View Coal., Inc. v. Turner, 824 F. Supp. 923, 938 (D. Mont. 1992); *Glenn-Colusa Irrigation Dist.*, 788 F. Supp. at 1134.

369 Susan George & William J. Snape III, *State Endangered Species Acts*, *in* ENDANGERED SPECIES ACT: LAW, POLICY, AND PERSPECTIVES 345, 346 (Donald C. Baur & W.M. Robert Irvin eds., 2d ed. 2010) (concluding that "most acts lack all but the most basic elements of a legislative scheme to protect a state's imperiled species").

370 Ch. 408, 39 Stat. 535 (1916) (codified in scattered sections of 54 U.S.C.).

371 54 U.S.C. § 100101 (Supp. II 2015) (emphasis added).

enjoyment of park resources, conservation generally takes precedence.[372] Notably, the Organic Act's phrase authorizing management for the enjoyment of scenery, natural and historic objects, and wildlife is cabined by the admonition that enjoyment may only occur "in such manner and by such means as will leave them [i.e., park resources] unimpaired for the enjoyment of future generations."[373] Absent an explicit contrary mandate in the relevant individual park establishment act, in the event of a conflict, NPS must prioritize conservation over public enjoyment.[374]

b. National Park Service Management Policy

NPS's own Management Policies recognize that conservation of park resources is "predominant."[375] More specifically:

> Congress, recognizing that the enjoyment by future generations of the national parks can be ensured only if the superb quality of park resources and values is left unimpaired, has provided that when there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is to be predominant. This is how courts have consistently interpreted the Organic Act.[376]

Issues related to wildlife management come squarely within the purview of the conservation mandate. "Impairment" includes disruption of

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372 *See, e.g.*, Greater Yellowstone Coal. v. Kempthorne, 577 F. Supp. 2d 183, 192–93 (D.D.C. 2008) (invalidating NPS's Winter Use Plan because it violated the conservation mandate by impairing Yellowstone's soundscape, wildlife, and air quality); Fund for Animals v. Norton, 512 F. Supp. 2d 49, 54–55 (D.D.C. 2007) (finding that NPS had articulated a satisfactory explanation regarding limited use of snowmobiles in Yellowstone); Fund for Animals v. Norton, 294 F. Supp. 2d 92, 108 (D.D.C. 2003) (overturning decision to allow snowmobiles in Yellowstone because NPS had not explained reversal of earlier conclusion that snowmobiles caused impairment); *see also* Bicycle Trails of Marin v. Babbitt, 82 F.3d 1445, 1453 (9th Cir. 1996) (noting the "overarching concern" of the Organic Act is "resource protection"); Defs. of Wildlife v. Salazar, 877 F. Supp. 2d 1271, 1306–07 (M.D. Fla. 2012) (remanding decision to increase off-road vehicle (ORV) use because of failure to explain change in position as to ORV's adverse impacts to wildlife, soil, and hydrology); Bluewater Network v. Salazar, 721 F. Supp. 2d 7, 24–38 (D.D.C. 2010) (remanding NPS's decision to allow jet skis in two national parks given the impacts to wildlife, water and air quality, soundscapes, aquatic vegetation, and visitor experience); Edmonds Inst. v. Babbitt, 42 F. Supp. 2d 1, 16 (D.D.C. 1999) (noting that the primary purpose of the Organic Act is "conservation of wildlife resources"); Nat'l Rifle Ass'n of Am. v. Potter, 628 F. Supp. 903, 909 (D.D.C. 1986) ("In the Organic Act, Congress speaks of but a single purpose, namely conservation.").

373 54 U.S.C. § 100101(a).

374 Eric Biber & Elisabeth Long Esposito, *The National Park Service Organic Act and Climate Change*, 56 NAT. RESOURCES J. 193, 223–24 (2016). *But see* Nat'l Parks Conservation Ass'n v. U.S. Dep't of Interior, 46 F. Supp. 3d 1254, 1278, 1337 (M.D. Fla. 2014) (applying an establishment act that shuffles these priorities and finding that the establishment acts for Big Cypress Preserve and Addition Lands mandate multiple uses, including ORV use on designated trails), *aff'd*, 835 F.3d 1377 (11th Cir. 2016).

375 NAT'L PARK SERV., MANAGEMENT POLICIES 2006 § 1.4.3 (2006), https://perma.cc/3R3K-EUP8 [hereinafter NPS MANAGEMENT POLICIES].

376 *Id.*

natural abundance, diversity, and ecological integrity, and is not limited to those impacts that "are so intense or sustained that they result in 'the elimination of a native species or significant population declines in a native species.'"[377]

NPS's Management Policies direct NPS to "maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems."[378] Native species are "all species that have occurred, now occur, or may occur as a result of natural processes on lands designated as units of the national park system."[379] NPS commits itself to preserving, maintaining, and restoring both populations of species and their habitats, and to "minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them."[380] In addition, the Management Policies state that NPS will cooperate and work with state and tribal governments, federal agencies, and other land managers to encourage the conservation of species populations and habitats "whenever possible."[381] Although the Policies are not judicially enforceable, courts have not hesitated to find that deviations from the Policies are arbitrary and capricious.[382]

c. Hunting and Fishing

Courts have occasionally upheld NPS decisions that adversely impact wildlife, including decisions to cull deer and other wildlife from parks where the wildlife is undermining conservation goals by destroying vegetation or harming other species.[383] As a general rule, however, hunting and other types of consumptive resource utilization within units of the National Park System are prohibited as contrary to the conservation ethic articulated in the

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377 *Bluewater Network*, 721 F. Supp. 2d at 36 (rejecting NPS's interpretation of impairment to allow mortality and other "regular" adverse effects to wildlife as a "draconian" definition that was inconsistent the Organic Act).

378 NPS MANAGEMENT POLICIES, *supra* note 375, § 4.4.1.

379 *Id.* § 4.4.1.3.

380 *Id.* § 4.4.1.

381 *Id.* § 4.4.1.1.

382 *See, e.g.*, *Bluewater Network*, 721 F. Supp. 2d at 20 n.13 ("While these Policies are not judicially enforceable, they are 'relevant insofar as NPS puts forth the Policies as justification for the decision under review.'" (citations omitted)).

383 *See, e.g.*, Davis v. Latschar, 202 F.3d 359, 359–60 (D.C. Cir. 2000) (upholding NPS plan to cull deer); N.M. State Game Comm'n v. Udall, 410 F.2d 1197, 1200–01 (10th Cir. 1969) (similar); Grunewald v. Jarvis, 930 F. Supp. 2d 73, 84–86 (D.D.C. 2013) (similar), *aff'd*, 776 F.3d 893 (D.C. Cir. 2015); Friends of Animals v. Caldwell, No. 2:09-cv-5349, 2010 WL 4259753, at *1, *7 (E.D. Pa. Oct. 27, 2010), *aff'd*, 434 F. App'x 72 (3d Cir. 2011) (similar); *see also* WildEarth Guardians v. Nat'l Park Serv., 703 F.3d 1178, 1191–93 (10th Cir. 2013) (upholding NPS plan to cull elk); Wilkins v. Sec'y of Interior, 995 F.2d 850, 851 (8th Cir. 1993) (reversing district court and upholding NPS plan to remove wild horses); Intertribal Bison Coop. v. Babbitt, 25 F. Supp. 2d 1135, 1140–41 (D. Mont. 1998) (upholding NPS plan to manage Yellowstone bison), *aff'd*, 175 F.3d 1149 (9th Cir. 1999); Greater Yellowstone Coal. v. Babbitt, 952 F. Supp. 1435, 1445–46 (D. Mont. 1996) (upholding NPS plan to authorize capture or killing of bison by state officials), *aff'd*, 108 F.3d 1385 (9th Cir. 1997).

Organic Act.[384] Specific establishment legislation for individual parks authorizes limited subsistence or recreational hunting, trapping, or fishing within approximately thirty-one NPS units.[385] Those areas permitting hunting, trapping, or fishing typically do so in conformance with applicable federal and state laws.[386] NPS regulations prohibit commercial fishing in the parks.[387] However, in *Alaska Wildlife Alliance v. Jensen*,[388] the Ninth Circuit held that NPS has the discretion to permit commercial fishing in non-wilderness areas of certain Alaska parks.[389]

3. The National Wildlife Refuge System

a. The National Wildlife Refuge System Improvement Act (1997)

The National Wildlife Refuge System is unique among federal land conservation units in its explicit focus on wildlife and ecosystem conservation as its dominant use.[390] FWS manages the Refuge System under the auspices of the National Wildlife Refuge System Administration Act,[391] which was amended in 1997 by the National Wildlife Refuge System Improvement Act.[392] The agency also provides detailed explanations of its statutory obligations in its regulations[393] and the FWS Manual.[394]

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384 COGGINS & GLICKSMAN, *supra* note 124, § 32:14; *see* United States v. Jarrell, 143 F. Supp. 2d 605, 605–06, 609 (W.D. Va. 2001) (upholding conviction for hunting in Shenandoah National Park); *Organized Fisherman of Fla.*, 488 F. Supp. 1351, 1355 (S.D. Fla. 1980) (denying a preliminary injunction to enjoin enforcement of NPS regulations that restricted fishing practices in a national park).

385 Jessica Almy, Student Article, *Taking Aim at Hunting on National Park Service Lands*, 18 N.Y.U. ENVTL. L.J. 184, 185 (2010); *see Nat'l Rifle Ass'n*, 628 F. Supp. 903, 907 n.4 (D.D.C. 1986) (finding express authorization for hunting in the enabling acts of thirty-one NPS properties).

386 36 C.F.R. § 2.2(b)(4) (2016); 43 C.F.R. § 24.4(f) (2016); *Organized Fishermen of Fla.*, 775 F.2d 1544, 1549 (11th Cir. 1985) (finding that, despite Florida law, there was no right to engage in commercial fishing in Everglades National Park); United States v. Knauer, 635 F. Supp. 2d 203, 212 (E.D.N.Y. 2009) (holding that permission for commercial fishing or hunting in Gateway National Park was left to NPS); *see also* Fund for Animals v. Mainella, 294 F. Supp. 2d 46, 48, 52 (D.D.C. 2003) (refusing to enjoin state's bear hunt in Delaware Gap National Recreation Area since statutory language provided that federal regulation was required only when NPS exercised its discretion to place limitations on hunting or to provide areas for intensive management).

387 36 C.F.R. §§ 2.3(d)(4), 5.3; *see* S.F. Herring Ass'n v. U.S. Dep't of Interior, No. 13–cv–01750–JST, 2014 WL 172232, at *4–6 (N.D. Cal. Jan. 15, 2014) (finding that NPS had authority to issue citations to commercial fishermen in San Francisco Bay near the Golden Gate Recreational Area).

388 108 F.3d 1065 (9th Cir. 1997).

389 *Id.* at 1067, 1074.

390 *National Wildlife Refuge System Improvement Act of 1997 Public Law 105-57*, U.S. FISH & WILDLIFE SERV., https://perma.cc/S8FN-FHHT (last updated Aug. 19, 2009).

391 National Wildlife Refuge System Administration Act of 1966, 16 U.S.C. §§ 668dd–668ee (2012); *see The Refuge System and FWS*, U.S. FISH & WILDLIFE SERV., https://perma.cc/4N9R-GDXQ (last visited Nov. 11, 2017).

392 National Wildlife Refuge System Improvement Act of 1997, Pub. L. No. 105-57, 111 Stat. 1252 (1997).

393 *See* 50 C.F.R. pts. 31–32 (2016).

The Act authorizes the agency to permit the use of any area within the system for any purpose as long as it is determined that the proposed use is compatible with the "major purposes for which the areas were established."[395] The Act further clarifies that all actions on a refuge must be compatible with both the mission of the refuge system and the purposes of the relevant individual refuge (as determined by the establishment legislation of that refuge).[396] Where the system mission and refuge purposes conflict, refuge purposes should be given precedence, while still fulfilling the system mission to the extent that is possible.[397] The agency's discretion in determining whether a use is compatible is further limited by the requirement that compatibility be based on "sound professional judgment."[398] Furthermore, agency regulations require compatibility determinations to: 1) be written, 2) identify the proposed or existing use that the compatibility determination applies to, and 3) state whether the proposed use is in fact a compatible use based on "sound professional judgment."[399]

The mission of the refuge system, as provided by the Act, "is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."[400] In meeting the mission of the system, the statute lays out explicit obligations for the agency.[401] Three of these statutory requirements are particularly relevant to this discussion and are elaborated upon in greater detail below:

> In administering the system the Secretary shall—
>
> (A) provide for the conservation of fish, wildlife, and plants, and their habitat within the System;
>
> (B) ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans;
>
> . . . .

394 *See Service Manual Chapters: Series 600 – Land Use and Management Series*, U.S. FISH & WILDLIFE SERV., https://perma.cc/Q93L-S223 (last updated Nov. 2, 2017).

395 16 U.S.C. § 668dd(d)(1)(A).

396 *Id.* § 668ee(1). Establishment legislation is of key importance in refuge management as a source of refuge purposes and a guide to refuge management. Many refuges have purposes derived from multiple pieces of establishment legislation, which can lead to confusion regarding the relative priorities of the various refuge purposes. ROBERT L. FISCHMAN, THE NATIONAL WILDLIFE REFUGES: COORDINATING A CONSERVATION SYSTEM THROUGH LAW 164 (2003).

397 16 U.S.C. § 668dd(a)(4)(D).

398 *Id.* § 668ee(1); *see* Del. Audubon Soc'y v. Salazar, 829 F. Supp. 2d 273, 288–89 (D. Del. 2011) (finding that a dune restoration decision was within sound professional judgment when it was "supported by scientific literature").

399 50 C.F.R. § 25.12 (2016).

400 16 U.S.C. § 668dd(a)(2).

401 *See id.* § 668dd(a)(4).

> (E) ensure effective coordination, interaction, and cooperation with owners of land adjoining refuges and the fish and wildlife agency of the States in which the units of the System are located.[402]

Two significant court cases interpret many of the provisions of the Act. In *Wyoming v. United States*, the state argued that FWS interfered with the state's sovereign right to manage wildlife by prohibiting the state from vaccinating elk against brucellosis on refuge lands.[403] The Tenth Circuit ultimately determined that ordinary principles of preemption applied; if the state's actions would conflict with federal mandates or present an obstacle to their accomplishment, then the state is preempted by the Improvement Act.[404] In *National Audubon Society, Inc. v. Davis*, environmental groups challenged California over a state law banning the use of all leg-hold traps in the state, including those used on federal lands or to protect endangered species.[405] The Ninth Circuit found that the ban conflicted with FWS's statutory authority to manage refuges, and so the state law was preempted.[406] These two cases are discussed in detail below.[407]

i. Provide for the Conservation of Fish, Wildlife, Plants, and Their Habitats

The Refuge Improvement Act groups the terms "conserving," "conservation," "manage," "managing," and "management" together, and provides a single definition for all of them: "to sustain and, where appropriate, restore and enhance, healthy populations of fish, wildlife, and plants."[408] As the *Wyoming* court states, it would be impossible for the agency to meet its obligation for conservation "unless [refuges] are consistently directed and managed as a national system."[409] Furthermore, that court found that "Congress undoubtedly intended a preeminent federal role for the FWS in the care and management of the [National Wildlife Refuge System]."[410] The *Audubon* court concurred in this reasoning,

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402 *Id.*

403 *Wyoming*, 279 F.3d 1214, 1222, 1229 (10th Cir. 2002).

404 *Id.* at 1234–35.

405 307 F.3d 835, 842–44 (9th Cir.), *amended on denial of reh'g*, 312 F.3d 416 (9th Cir. 2002).

406 *Id.* at 854.

407 *See infra* notes 409–411, 426–433 and accompanying text.

408 16 U.S.C. § 668ee(4) (2012).

409 *Wyoming*, 279 F.3d 1214, 1233 (10th Cir. 2002) (quoting H.R. REP. NO. 105-106, at 8 (1997)).

410 *Id.* at 1234. In another case, *Defenders of Wildlife v. Salazar*, the D.C. Circuit defined "conservation" in this context by referencing the specific facts of the case. 651 F.3d 112, 115–17 (D.C. Cir. 2011). In that case, FWS was accused of violating the conservation mandate of the Improvement Act by failing to commit to a deadline to end the agency's elk feeding program in the National Elk Refuge. *Id.* at 115. The court determined that there was "no doubt that unmitigated continuation of supplemental feeding would undermine the conservation purpose of the National Wildlife Refuge System," yet the court determined that a phased (rather than an abrupt) ending of that program was reasonable. *Id.* at 117.

referencing the goals of the Improvement Act and FWS's authority over refuge lands in its finding that state law was preempted.[411]

ii. Ensure That the Biological Integrity, Diversity, and Environmental Health of the System Are Maintained

While the statute itself does not define these terms, FWS defines them in its manual.[412] The manual states that the "highest measure of biological integrity, diversity, and environmental health is viewed as those intact and self-sustaining habitats and wildlife populations that existed during historic conditions."[413] Therefore, the agency "favor[s] management that restores or mimics natural ecosystem processes or functions."[414] The agency's manual also lays out the major principles underlying the biological integrity policy, the first of which is that wildlife conservation must always be the primary concern in the management of the refuges,[415] and that ensuring biological integrity, diversity, and environmental health is necessary for the agency to fulfill the system mission of conservation.[416]

The requirement to maintain "biological integrity, diversity, and environmental health" requires refuge officials to "manage lands to conserve the full range of wild species and plant communities" that existed in a refuge before it was substantially changed by humans, and also "calls for the conservation of basic ecological processes with little human alteration, including the natural biological processes that shape genomes, organisms, and communities."[417] As Fischman describes the biological integrity requirement: "No other organic mandate employs as unconditional or specific a series of ecological criteria to constrain management and promote conservation."[418]

iii. Ensure Effective Coordination, Interaction, and Cooperation

Congress clearly intended for FWS to cooperate meaningfully with other land managers, particularly states. Included in the statute is a requirement that the agency issue a conservation plan for each refuge that is "consistent with the provisions of this Act and, to the extent practicable, consistent with fish and wildlife conservation plans of the State in which the refuge is located."[419] As the *Wyoming* court states, the Improvement Act calls

411 *Nat'l Audubon Soc'y*, 307 F.3d at 854.

412 U.S. FISH & WILDLIFE SERV., SERVICE MANUAL 610 FW 3, BIOLOGICAL INTEGRITY, DIVERSITY, AND ENVIRONMENTAL HEALTH § 3.6 (2001), www.fws.gov/policy/601fw3.html.

413 *Id.* § 3.10.

414 *Id.* § 3.7(E).

415 *Id.* § 3.7(A).

416 *Id.* § 3.7(B).

417 FREYFOGLE & GOBLE, *supra* note 292, at 212.

418 FISCHMAN, *supra* note 396, at 126; *see also Defs. of Wildlife*, 651 F.3d 112, 116 (D.C. Cir. 2011) (emphasizing the agency's "biological integrity" mandate).

419 16 U.S.C. § 668dd(e)(1)(A)(iii) (2012).

for, "at a minimum, state involvement and participation in the management of the [National Wildlife Refuge System] as that system affects surrounding state ecosystems."[420] However, in understanding the statute we must give effect to all of the language provided, and while Congress strongly encourages cooperation, it also tempers that goal by finding that it is only necessary "to the extent practicable," otherwise the agency would not be capable of fulfilling its congressionally designated mission.[421] As the *Wyoming* court observed: "Congress undoubtedly intended a preeminent federal role for the FWS in the care and management of the [National Wildlife Refuge System]."[422]

iv. Savings Clause

The Improvement Act also contains two savings clauses. First, the Act prohibits the taking of any fish or animal within refuges without FWS permission,[423] but the prohibition does not extend beyond refuge boundaries: "Nothing in this Act shall be construed to authorize the Secretary to control or regulate hunting or fishing of fish and resident wildlife on lands or waters that are not within the System."[424] Next, the Act provides that:

> Nothing in this Act shall be construed as affecting the authority, jurisdiction, or responsibility of the several States to manage, control, or regulate fish and resident wildlife under State law or regulations in any area within the System. Regulations permitting hunting or fishing of fish and resident wildlife within the System shall be, to the extent practicable, consistent with State fish and wildlife laws, regulations, and management plans.[425]

The state in *Wyoming* argued that the first sentence of the savings clause retains to the state "the absolute right to manage wildlife . . . free from federal intervention."[426] However, the Tenth Circuit found that as a matter of statutory construction the first sentence cannot be read in isolation; instead, the clause must be understood in its entirety, giving effect to the whole clause.[427] The second sentence of the savings clause indicates that federal regulation of wildlife on refuges only has to be consistent with state law "to the extent practicable."[428] So while consistency is encouraged, it is not mandated at the expense of the other requirements of the statute.

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420 *Wyoming*, 279 F.3d 1214, 1231 (10th Cir. 2002).

421 16 U.S.C. § 668dd(e)(1)(A)(iii); *Wyoming*, 279 F.3d at 1233.

422 *Wyoming*, 279 F.3d at 1234.

423 16 U.S.C. § 668dd(c); *see* United States v. Kilpatrick, 347 F. Supp. 2d 693, 695 (D. Neb. 2004) (upholding conviction for trespassing on and shooting deer in a closed portion of a wildlife refuge).

424 *Id.* § 668dd(*l*).

425 *Id.* § 668dd(m).

426 *Wyoming*, 279 F.3d at 1231.

427 *Id.*

428 16 U.S.C. § 668dd(m); *Wyoming*, 279 F.3d at 1232.

The *Wyoming* court also found that if the first sentence is read so as to exclude the possibility of FWS authority to manage wildlife in ways that might conflict with state law, such a result "would be inconsistent with the [Improvement Act's] 'mission . . . to administer a national network of lands.'"[429] Interpreting the statute as prohibiting FWS from ever acting contrary to state law would leave the state "free to manage and regulate the [refuge] in a manner the FWS deemed incompatible with the [refuge's] purpose."[430] The *Wyoming* court found it "highly unlikely . . . that Congress would carefully craft the substantive provisions of the [Improvement Act] to grant authority to the FWS to manage the [refuge] and promulgate regulations thereunder and then essentially nullify those provisions and regulations with a single sentence."[431] The *Audubon* court agreed, stating "the first sentence of the savings clause was not meant to eviscerate the primacy of federal authority over [National Wildlife Refuge] management."[432] To the extent that state law conflicts with or undermines statutory requirements or federal objectives, it is preempted.[433] The Department of the Interior has adopted this cooperative federalism interpretation of the savings clause as well.[434]

v. Compatibility Determinations

The compatibility determination forms the central criterion for determining whether or not actions will be allowed to proceed on refuge lands and therefore is the key mechanism in implementing the statute's goal of conservation. A compatible use is one that "in the sound professional judgment of [FWS] will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge."[435] In implementing this provision, FWS must consider direct, indirect, and cumulative impacts of the proposed use.[436] However, actions categorized as

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429 *Wyoming*, 279 F.3d at 1234 (omission in original) (quoting 16 U.S.C. § 668dd(a)(2)).

430 *Id.*

431 *Id.* at 1234–35 (citation omitted); *see* Geier v. Am. Honda Motor Co., 529 U.S. 861, 870 (2000) ("[T]his Court has repeatedly 'decline[d] to give broad effect to savings clauses where doing so would upset the careful regulatory scheme established by federal law.'" (second alteration in original) (quoting United States v. Locke, 529 U.S. 89, 106–07 (2000)).

432 *Nat'l Audubon Soc'y*, 307 F.3d 835, 854 (9th Cir.), *amended on denial of reh'g*, 312 F.3d 416 (9th Cir. 2002).

433 *Id.*; *see* Sch. Bd. of Avoyelles Par. v. U.S. Dep't of Interior, 647 F.3d 570, 582 (5th Cir. 2011) (finding that Louisiana law was in direct conflict with Property Clause and the National Refuge Act and was therefore pre-empted insofar as the Louisiana statute—allowing owner of estate that has no access to public road to claim right of passage over neighboring property—"would permit the School Board to enter, use, or otherwise occupy Refuge lands in violation of FWS regulations").

434 43 C.F.R. § 24.4(e) (2016).

435 16 U.S.C. § 668ee(1) (2012); 50 C.F.R. § 25.12(a) (2016).

436 Final Compatibility Policy Pursuant to the National Wildlife Refuge System Improvement Act of 1997, 65 Fed. Reg. 62,484, 62,489 (Oct. 18, 2000).

"refuge management activity" do not require compatibility determinations,[437] though refuge management activities must be actions in furtherance of the system mission or refuge purposes and so are inherently compatible.[438] State wildlife management activities may be considered "refuge management activities" if they are taken "pursuant to a cooperative agreement between the State and [FWS] where the Refuge Manager has made a written determination that such activities support fulfilling the refuge purposes or the System mission."[439] Because compatibility determinations must be made using "sound professional judgment,"[440] the *Wyoming* court found that a reviewing court has "law to apply," and the determinations are reviewable in court.[441]

In conclusion, Congress delegated to FWS the responsibility to manage the national wildlife refuges in accordance with the specific requirements laid out in both the Refuge Improvement Act and the establishment legislation for individual refuges. Ultimately, it is up to refuge managers to determine whether it is "practicable" and "consistent" for state laws to be applied on refuge lands.[442] As the *Wyoming* court stated: "The first sentence of the saving clause does not deny the FWS, where at odds with the State, the authority to make a binding decision bearing upon the 'biological integrity, diversity, and environmental health of the System.'"[443] Both the compatibility requirement and the mandate to promote biological integrity, diversity, and environmental health impose legally enforceable restrictions and obligations on FWS that cannot be cast aside at the request of states.

4. The National Forest System

a. The 1897 Organic Act

USFS's 1897 "Organic Act"[444] authorizes the establishment of national forests.[445] It states in part that "[n]o national forest shall be established, except to improve and protect the forest within the boundaries, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States."[446] The law also authorizes USFS to regulate "the occupancy

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437 *Id.* at 62,488; U.S. FISH & WILDLIFE SERV., SERVICE MANUAL 610 FW 1, GENERAL OVERVIEW OF WILDERNESS STEWARDSHIP POLICY § 1.5(V) (2008) [hereinafter FWS WILDERNESS POLICY].

438 50 C.F.R. § 25.12(a); Final Compatibility Policy Pursuant to the National Wildlife Refuge System Improvement Act of 1997, 65 Fed. Reg. at 62,489; *see* Joly, *supra* note 275, at 45–46.

439 Final Compatibility Policy Pursuant to the National Wildlife Refuge System Improvement Act of 1997, 65 Fed. Reg. at 62,488.

440 16 U.S.C. § 668ee(1).

441 *Wyoming*, 279 F.3d 1214, 1237 (10th Cir. 2002).

442 FREYFOGLE & GOBLE, *supra* note 292, at 215.

443 *Wyoming*, 279 F.3d at 1234 (quoting 16 U.S.C. § 668dd(a)(4)(B)).

444 Act of June 4, 1897, ch. 2, 30 Stat. 11, 34–36 (codified as amended at 16 U.S.C. §§ 473–482, 551 (2012)).

445 16 U.S.C. § 475.

446 *Id.*

and use" of the national forests and "to preserve the forests thereon from destruction."[447]

The Organic Act is silent on fish and wildlife management on national forests. In an early wildlife decision, however, the Supreme Court found USFS to have broad powers in protecting the national forests (in this case the Kaibab) from damage inflicted by deer in northern Arizona.[448] The power of the United States, said the Court, to "protect its lands and property does not admit of doubt, the game laws of any other statute of the state to the contrary notwithstanding."[449]

b. The Multiple-Use Sustained-Yield Act of 1960

In 1960, Congress passed the Multiple-Use Sustained-Yield Act[450] (MUSYA). For the first time, it was statutorily recognized that USFS had some responsibility to consider fish and wildlife values on the national forests.[451] MUSYA states in pertinent part: "It is the policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, *and wildlife and fish* purposes."[452] This language does not require USFS to conserve wildlife in any specific way, only to consider wildlife and fish in the context of multiple-use decision making. As defined in the law, multiple use means:

> The management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various

447 *See id.* § 551 ("The Secretary of Agriculture shall make provisions for the protection against destruction by fire and depredations upon the public forests and national forests which may have been set aside or which may be hereafter set aside under the provisions of section 471 of this title, and which may be continued; and he may make such rules and regulations and establish such service as will insure the objects of such reservations, namely, to regulate their occupancy and use and to preserve the forests thereon from destruction." (footnote omitted)); *see also* Forest Serv. Emps. for Envtl. Ethics v. U.S. Forest Serv., 689 F. Supp. 2d 891, 905 (W.D. Ky. 2010) (finding that USFS unlawfully delegated its Organic Act authority in allowing the National Wild Turkey Federation to issue special use permits on forest lands).

448 *Hunt*, 278 U.S. 96, 100 (1928).

449 *Id.* (citations omitted).

450 Multiple-Use Sustained-Yield Act of 1960, Pub. L. No. 86–517, 74 Stat. 215 (codified as amended at 16 U.S.C. §§ 528–531).

451 16 U.S.C. § 528.

452 *Id.* (emphasis added).

> resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.[453]

As the courts generally view it, the multiple-use mandate "breathe[s] discretion at every pore"[454] and grants USFS wide latitude in determining the "proper mix of uses" for national forest lands.[455] In *Perkins v. Bergland*, the plaintiffs argued that MUSYA contained standards that cabined USFS's discretion over the proper number of grazing permits to protect the public land from damage.[456] The Ninth Circuit disagreed:

> These sections of MUSYA contain the most general clauses and phrases. For example, the agency is "directed" in section 529 to administer the national forests "for multiple use and sustained yield of the several products and services obtained therefrom," with "due consideration [to] be given to the relative values of the various resources in particular areas." This language, partially defined in section 531 in such terms as "that [which] will best meet the needs of the American people" and "making the most judicious use of the land," can hardly be considered concrete limits upon agency discretion. Rather, it is language which "breathe[s] discretion at every pore." What appellants really seem to be saying when they rely on the multiple-use legislation is that they do not agree with the Secretary on how best to administer the forest land on which their cattle graze. While this disagreement is understandable, the courts are not at liberty to break the tie by choosing one theory of range management as superior to another.[457]

Since *Perkins v. Bergland*, the courts have consistently found that USFS has broad discretion under the multiple-use framework.[458] This includes *Wyoming v. U.S. Department of Agriculture*, where the Tenth Circuit upheld the 2001 Roadless Rule[459] over challenges that the Rule failed to satisfy the statutory multiple-use mandate because it precluded timber harvesting in

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453 *Id.* § 531(a).

454 Perkins v. Bergland, 608 F.2d 803, 806 (9th Cir. 1979) (alteration in original) (quoting Strickland v. Morton, 519 F.2d 467, 469 (9th Cir. 1975)).

455 Wyoming v. U.S. Dep't of Agric., 661 F.3d 1209, 1268 (10th Cir. 2011).

456 *Perkins*, 608 F.2d at 806.

457 *Id.* at 806–07 (alterations in original) (citations and footnotes omitted).

458 *See, e.g.*, Cal. Forestry Ass'n v. Bosworth, No. 2:05-cv-00905-MCE-GGH., 2008 WL 4370074, at *4 (E.D. Cal. Sept. 24, 2008); Pac. Rivers Council v. U.S. Forest Serv., No. 2:05-cv-00953-MCE-GGH., 2008 WL 4291209, at *16–17 (E.D. Cal. Sept. 18, 2008), *aff'd in part and rev'd in part*, 689 F.3d 1012 (9th Cir. 2012); California *ex rel.* Lockyer v. U.S. Dep't of Agric., No. 2:05-cv-0211-MCE-GGH., 2008 WL 3863479, at *7–8 (E.D. Cal. Aug. 19, 2008), *aff'd sub nom.*, Sierra Forest Legacy v. Sherman, 646 F.3d 1161 (9th Cir. 2011); Nat. Res. Def. Council, Inc. v. U.S. Forest Serv., 634 F. Supp. 2d 1045, 1058 (E.D. Cal. 2007); Clinch Coal. v. Damon, 316 F. Supp. 2d 364, 378 (W.D. Va. 2004); Sierra Club v. Marita, 845 F. Supp. 1317, 1328 (E.D. Wis. 1994), *aff'd*, 46 F.3d 606 (7th Cir. 1995); Wind River Multiple-Use Advocates v. Espy, 835 F. Supp. 1362, 1372 (D. Wyo. 1993), *aff'd*, 85 F.3d 641 (10th Cir. 1996); Big Hole Ranchers Ass'n v. U.S. Forest Serv., 686 F. Supp. 256, 264 (D. Mont. 1988).

459 Special Areas; Roadless Area Conservation, 66 Fed. Reg. 3244 (Jan. 12, 2001).

certain areas.[460] The court reaffirmed MUSYA's discretionary nature and found that, while the Rule did not permit timber harvesting, it permitted other multiple uses, such as "'outdoor recreation,' 'watershed,' and 'wildlife and fish purposes.'"[461]

A relatively short and simple savings clause is also provided in MUSYA: "Nothing herein shall be construed as affecting the jurisdiction or responsibilities of the several States with respect to wildlife and fish on the national forests."[462] However, as noted above, in *California Coastal Commission v. Granite Rock Co.*, the Supreme Court held that federal law preempted the extension of state land use plans onto national forest lands because the savings clause merely indicates that ordinary principles of preemption govern such disputes.[463] By the same token, contradictory state regulation of wildlife in the national forests would be preempted despite the savings clause.[464]

c. The National Forest Management Act of 1976

Born out of the timber clear-cutting controversies of the 1960s and 1970s, NFMA was passed in order to better balance timber management, resource use, and environmental protection.[465] Unlike the highly discretionary Organic Act and MUSYA, NFMA provides substantive and procedural planning requirements, goals, and constraints on the agency, including obligations for managing fish and wildlife.[466] NFMA requires the writing of land and resource management plans (LRMPs or forest plans) by every national forest and grassland in the National Forest System (NFS).[467]

NFMA created a three-tiered regulatory approach to planning.[468] At the highest level, national-level NFMA regulations govern the development and revision of second-tier forest plans.[469] Forest plans typically make zoning and suitability decisions, and limit and regulate various activities within a forest area, therefore acting as a gateway through which subsequent project-level proposals must pass.[470] Forest plans also include long-term goals and desired

460 *Wyoming*, 661 F.3d at 1267–69; *accord* Am. Whitewater v. Tidwell, 959 F. Supp. 2d 839, 863 (D.S.C. 2013), *aff'd*, 770 F.3d 1108 (4th Cir. 2014); Ark Initiative v. Tidwell, 816 F.3d 119, 128 (D.C. Cir.), *cert. denied*, 137 S. Ct. 301 (2016).

461 *Wyoming*, 661 F.3d at 1268–69 (quoting 16 U.S.C. § 528 (2012)).

462 16 U.S.C. § 528.

463 *Granite Rock Co.*, 480 U.S. 572, 585, 593–94 (1987).

464 *Hunt*, 278 U.S. 96, 100 (1928) (upholding federal removal of deer from the Kaibab National Forest to protect the forest from damage caused by overgrazing, despite objections from the state).

465 16 U.S.C. § 1600.

466 *See id.* §§ 1603–1604; 36 C.F.R. § 219.1 (2016).

467 16 U.S.C. § 1604(a).

468 *Id.* § 1604. For a more elaborate explanation of this tiered approach, see *Citizens for Better Forestry v. U.S. Department of Agriculture*, 341 F.3d 961, 965–66 (9th Cir. 2003).

469 *Citizens for Better Forestry*, 341 F.3d at 965 (citing 16 U.S.C. § 1604(g)).

470 Scott W. Hardt, *Federal Land-Use Planning and Its Impact on Resource Management Decisions*, *in* PUBLIC LAND LAW II (Rocky Mountain Mineral Law Found., Special Inst. 1997).

conditions of the land and resources.[471] Site-specific projects make up the third tier of planning.[472] Any such proposed use of a national forest is subject to the requirement in NFMA that "[r]esource plans and permits, contracts, and other instruments for use and occupancy of National Forest System lands shall be consistent with" the applicable forest plan.[473] Thus, to the extent that states are subject to USFS authority, that authority must be exercised in conformance with the provisions in the current forest plan.

i. NFMA and Wildlife

One of NFMA's most powerful provisions is its wildlife diversity mandate.[474] It requires that forest plans "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives."[475] According to Wilkinson and Anderson's authoritative history of NFMA's development, the diversity provision was meant to require "[USFS] planners to treat the wildlife resource as a controlling, co-equal factor in forest management and, in particular, as a substantive limitation on timber production."[476] Regulations implementing NFMA address requirements for diversity in greater detail.[477] If state wildlife management actions occur on national forest lands they must be considered in this statutory and regulatory context, and may be subject to preemption based on USFS's authority and obligations for wildlife diversity.[478]

Most "first-generation" forest plans were written pursuant to the 1982 NFMA regulations. Those regulations required that "[f]ish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area."[479] While this language emphasized management of habitat, the regulation also established a minimum population threshold, at least in concept, by defining "viable population" as "one which has the estimated numbers and distribution of

471 *See generally* Michael J. Gippert & Vincent L. DeWitte, *The Nature of Land and Resource Management Planning Under the National Forest Management Act*, 3 ENVTL. LAW. 149 (1996) (discussing the various planning processes under NFMA); *see also* Ohio Forestry Ass'n v. Sierra Club, 523 U.S. 726, 729 (1998) (describing the nature of forest plans).

472 *Citizens for Better Forestry*, 341 F.3d at 966.

473 16 U.S.C. § 1604(i).

474 *See generally* Courtney A. Schultz et al., *Wildlife Conservation Planning Under the United States Forest Service's 2012 Planning Rule*, 77 J. WILDLIFE MGMT. 428 (2013) (exploring the broad implications for wildlife management under the 2012 Planning Rule).

475 16 U.S.C. § 1604(g)(3)(B).

476 CHARLES F. WILKINSON & H. MICHAEL ANDERSON, LAND AND RESOURCE PLANNING IN THE NATIONAL FORESTS 296 (1987).

477 *See, e.g.*, National Forest System Land and Resource Management Planning, 47 Fed. Reg. 43,026, 43,050 (Sept. 30, 1982) (to be codified at 36 C.F.R. pt. 219).

478 *See, e.g.*, 36 C.F.R. § 219.26 (2016) (discussing the requirements for pursuing and maintaining ecological diversity).

479 National Forest System Land and Resource Management Planning, 47 Fed. Reg. at 43,048 (to be codified at 36 C.F.R. § 219.19); *see, e.g.*, Seattle Audubon Soc'y v. Moseley, 80 F.3d 1401, 1404–05 (9th Cir. 1996) (applying viability regulations to northern spotted owl).

reproductive individuals to insure its continued existence is well distributed in the planning area."[480]

Existing forest plans will be revised (many during the next decade) and amended under new NFMA implementing procedures codified in the 2012 Planning Rule.[481] They include a different set of substantive requirements for management of wildlife. For ESA-listed species, forest plan components (e.g., desired future conditions, objectives, standards, and guidelines) must provide the "ecological conditions necessary to[] contribute to" their recovery.[482] For other at-risk species, referred to as species of conservation concern (SCC), forest plan components must provide the "ecological conditions necessary to . . . maintain a viable population of each species of conservation concern within the plan area."[483] There is an exception for SCC management: where population viability is beyond the authority of USFS or capability of the land, USFS must coordinate to the extent practicable with others having management authority over lands relevant to a larger population.[484]

The 2012 Planning Rule defines "ecological conditions" to include "habitat and other influences on species and the environment."[485] Other influences include "human uses."[486] The Rule defines "viable population" as "[a] population of a species that continues to persist over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments."[487] Like its predecessor, the 2012 Planning Rule thus establishes population levels for at-risk species as a goal, which is to be achieved by providing ecological conditions and regulating human uses.

Forest plans may be considered as "regulatory mechanisms," as defined by the ESA, during the listing process and may be a basis for not listing a species.[488] Regulations of the United States Department of Agriculture

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480 National Forest System Land and Resource Management Planning, 47 Fed. Reg. at 43,048 (to be codified at 36 C.F.R. § 219.19).

481 National Forest System Land Management Planning, 77 Fed. Reg. 21,162 (Apr. 9, 2012).

482 36 C.F.R. § 219.9(b)(1).

483 *Id.* Agency planning policy requires that species identified by states as being at risk be considered as potential SCC. U.S. FOREST SERV., FOREST SERVICE HANDBOOK: LAND MANAGEMENT PLANNING HANDBOOK § 1909.12 (2013).

484 36 C.F.R. § 219.9(b)(2).

485 *Id.* § 219.19.

486 *Id.*

487 *Id.* § 219.49.

488 *See* Greater Yellowstone Coal., Inc. v. Servheen, 665 F.3d 1015, 1030–32 (9th Cir. 2011) (finding forest plan direction was properly considered a valid regulatory mechanism for providing protection for grizzly bears). The decision to list Canada lynx as a threatened species was based largely on the lack of regulatory mechanisms in federal plans. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Contiguous U.S. Distinct Population Segment of the Canada Lynx and Related Rule, 65 Fed. Reg. 16,052, 16,074 (Mar. 24, 2000) (to be codified at 50 C.F.R. pt. 17) ("Therefore, amendment of Forest Plans to provide protection for lynx and lynx habitat is needed to conserve habitat for lynx and its prey on Federal forest lands. Without such amendments, the species is threatened."). The decision to not list the greater sage grouse was based largely on plans for federal lands that conserved the species. *See* Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to

(USDA) require USFS—and other USDA agencies—to "avoid actions which may cause a species to become threatened or endangered."[489] Under current plans and policies, species identified as "sensitive" were so designated in part to avoid their listing under the ESA,[490] and agency actions may not create "significant trends towards federal listing."[491] Current forest plans must ensure that viable populations of sensitive species are maintained.[492] The relationship of newly identified SCC and the ESA has not been as clearly articulated, but their role in developing adequate forest plan regulatory mechanisms should be similar.

When forest plans are amended or revised, they are also subject to the substantive requirements of the ESA for listed species.[493] This means that they cannot jeopardize the continued existence of listed species,[494] or destroy or adversely modify any critical habitat that has been designated,[495] or result in prohibited incidental take.[496] Forest plans may also be viewed as the primary means by which the agency is "carrying out programs for the conservation of" listed species, in accordance with section 7(a)(1) of the ESA.[497]

When it prepares forest plans under NFMA, USFS may include plan components that govern activities affecting wildlife.[498] These plan components may include both desired ecological conditions and restrictions

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List Greater Sage-Grouse (Centrocercus urophasianus) as an Endangered or Threatened Species, 80 Fed. Reg. 59,858, 59,858 (Oct. 2, 2015) (to be codified at 50 C.F.R. pt. 17).

489 U.S. DEP'T OF AGRIC., NO. 9500-004, DEPARTMENTAL REGULATION: FISH AND WILDLIFE POLICY § 1(d) (2008), https://perma.cc/7T2X-FD7T.

490 U.S. FOREST SERV., FOREST SERVICE MANUAL [FSM] § 2670.22(1) (2005).

491 *Id.* § 2670.32(4).

492 *Id.* § 2672.41 (2009).

493 *See, e.g.*, Cottonwood Envtl. Law Ctr. v. U.S. Forest Serv., 789 F.3d 1075, 1086–88 (9th Cir. 2015), *cert. denied*, 137 S. Ct. 293 (2016).

494 *See, e.g.*, Res. Ltd. v. Robertson, 35 F.3d 1300, 1304 n.3 (9th Cir. 1993) (finding FWS conditioned its "no jeopardy" conclusion on the USFS's continued adherence to grizzly bear guidelines).

495 *See Cottonwood*, 789 F.3d at 1088 (reinitiation of consultation on forest plans required after designation of critical habitat for Canada lynx).

496 Recently settled litigation involving the Superior National Forest Plan claimed that USFS is responsible for the take of Canada lynx resulting from hunting and trapping on the national forest. Complaint for Declaratory and Injunctive Relief at 2, 6, Ctr. for Biological Diversity v. Tidwell, No. 1:16-cv-01049-TSC (D.D.C. June 6, 2016).

497 16 U.S.C. § 1536(a)(1) (2016). The Preamble to the 2012 Planning Rule states that the requirement to contribute to recovery, "will further the purposes of § 7(a)(1) of the ESA, by actively contributing to threatened and endangered species recovery and maintaining or restoring the ecosystems upon which they depend." National Forest System Land Management Planning, 77 Fed. Reg. 21,162, 21,215 (Apr. 9, 2012) (to be codified at 50 C.F.R. pt. 219). The FWS Handbook for consultation states that a programmatic review based on section 7(a)(1) is appropriate for Federal agency planning and program management documents. U.S. FISH & WILDLIFE SERV. & NAT'L MARINE FISHERIES SERV., CONSULTATION HANDBOOK: PROCEDURES FOR CONDUCTING CONSULTATION AND CONFERENCE ACTIVITIES UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT 1-1, 5-1 (1998), https://perma.cc/LN7H-HNNL.

498 *See* National Forest System Land and Resource Management Planning, 47 Fed. Reg. 43,026, 43,044 (Sept. 30, 1982) (to be codified at 36 C.F.R. § 219.11) (listing ecological factors as a planning criteria).

on activities that are likely to adversely affect these conditions.[499] Such restrictions could be applicable to state actions occurring in a national forest.[500] However, the 2012 Planning Rule states that plans do not themselves regulate uses by the public, such as hunting and fishing.[501]

ii. Wildlife and Special Use Authorization

Several wildlife conflicts playing out in the national forests involve the question of whether or not USFS should authorize a wildlife-focused action by a nonfederal actor. For example, states may be engaged in introducing new species on national forest lands, or limiting or removing species that are undesirable from the state's perspective. Questions may arise about USFS's role in these state actions and the applicability of federal law to them.

USFS implements forest plans by authorizing specific uses that promote achievement of the desired outcomes, such as plant and animal diversity and viable populations.[502] It may also authorize activities that would not necessarily promote these outcomes.[503] This is often the case with requests for special use authorizations by applicants for permits, which could include state and local governments.[504] A forest plan may include mandatory requirements (e.g., standards or guidelines) applicable to the issuance of such permits.[505]

The objective of the USFS special uses program is to "[a]uthorize and manage special uses of National Forest System lands in a manner which protects natural resources and public health and safety, consistent with [forest plans]."[506] Permits may be granted only if "[t]he proposed use cannot reasonably be accommodated on non-National Forest System lands."[507]

Almost all uses of NFS lands, improvements, and resources are designated "special uses."[508] Wildlife management activities on national

499 *See id.*

500 A conflict between a state action and NFMA's diversity requirement could possibly arise where a state game species is considered at-risk by USFS. This is the case for bighorn sheep, where the State of Wyoming passed a law authorizing removal of bighorn sheep if USFS were to eliminate domestic sheep grazing. WYO. STAT. ANN. § 11-19-604(e) (2017); *see also* Idaho Wool Growers Ass'n v. Vilsack, 7 F. Supp. 3d 1085, 1092 (D. Idaho 2014) (finding USFS's forest plan "committed 'no clear error in judgment'" by reducing domestic sheep grazing in order to prevent disease transmission to bighorn sheep), *aff'd*, 816 F.3d 1095 (9th Cir. 2016).

501 36 C.F.R. § 219.2(b)(2) (2016). A forest plan direction to limit public uses must be implemented by a closure order, pursuant to *id.* § 261.50, and may include special closures to protect wildlife pursuant to *id.* § 261.53(a).

502 *Id.* § 219.9.

503 *Id.* § 219.9(b)(2).

504 *Id.* § 251.50(a).

505 *Id.* § 251.52.

506 FSM § 2702 (2011).

507 *Id.* § 2703.2(2)(b).

508 36 C.F.R. § 251.50(a), (e) (some uses are not considered "special uses" because they are regulated by separate authorities); *see also* FSM § 2701.1 (listing the various authorities for different kinds of special uses).

forests by nonfederal parties would be considered special uses.[509] Before conducting a special use, individuals or entities must obtain a special use authorization from the authorized officer, unless that requirement is waived by regulation.[510] There is no waiver provision that necessarily allows state actions taken on NFS lands without a permit. A special use authorization is normally not required for hunting or fishing.[511] However, USFS may manage public recreation of any kind by issuing a closure order.[512]

iii. Coordination with State and Local Governments

NFMA includes a requirement to coordinate with the land and resource management planning processes of state and local governments in the development of forest plans.[513] The 2012 Planning Rule requires review of the planning and land use policies of state and local governments, consideration of the objectives of these policies, and opportunities to reduce conflicts.[514] However, it explicitly does not permit the responsible USFS official to "conform the management to meet non-[USFS] objectives or policies."[515]

The 2012 Planning Rule also requires the official responsible for forest planning to "encourage States, counties, and other local governments to seek cooperating agency status in the NEPA process for development, amendment, or revision of a plan."[516] The role of such cooperating agencies is to assist in the environmental review process.[517] NEPA also includes a requirement to "cooperate with State and local agencies to the fullest extent possible to reduce duplication between NEPA and State and local requirements."[518] In addition, NEPA documents must identify any inconsistencies with state and local plans or laws, and "describe the extent to which the agency would reconcile its proposed action with the plan or

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509 36 C.F.R. § 251.50(a).

510 *Id.* § 251.50(c)–(e) (the requirement for a special use permit is waived for most noncommercial recreational activities not involving a large organized group, most forms of travel on NFS roads, uses with nominal effects, and uses regulated by a state agency or another federal agency in a manner that adequately protects national forest lands and resources).

511 *Id.* § 251.50(c).

512 *Id.* § 261.50; *see also id.* § 261.70(a)(4) (among other reasons, closure orders are authorized for the "[p]rotection of threatened, endangered, rare, unique, or vanishing species of plants, animals, birds or fish, or special biological communities").

513 *See* NFMA, 16 U.S.C. § 1604(a) (2012) (providing that, "as appropriate," forest plan revisions should be "coordinated with the land and resource management planning processes of State and local governments and other Federal agencies"); *see also* 36 C.F.R. § 219.4(b)(1) (requiring NFMA officials to coordinate with the "equivalent and related planning efforts" of Tribes, agencies, and state and local governments).

514 36 C.F.R. § 219.4(b)(2).

515 *Id.* § 219.4(b)(3); *see, e.g.*, Letter from USDA Forest Serv., Intermountain Region, to Matt Mead, Governor of Wyo. (Feb. 20, 2015) (on file with authors) (Bridger-Teton National Forest refused to "adopt" a Wyoming plan for bighorn sheep, describing it only as "a valuable framework").

516 36 C.F.R. § 219.4(a)(1)(iv).

517 *Id.* § 219.4(a)–(b).

518 40 C.F.R. §§ 1501.6, 1506.2(b) (2016).

law."[519] There is no general NEPA requirement to coordinate decision-making processes or for USFS decisions to be consistent with state plans.

In conclusion, although it is clear that USFS must coordinate the development of LRMPs with tribal, state, and local governments, this coordination requirement does not give such nonfederal entities equal footing in managing NFS lands, nor does it require USFS to act and manage NFS lands consistent with these nonfederal plans.

d. U.S. Forest Service Cooperation in Wildlife Management

Federal regulations applicable to USFS require cooperation among wildlife management agencies:

> The Chief of [USFS], through the Regional Foresters and Forest Supervisors, shall determine the extent to which national forests or portions thereof may be devoted to wildlife protection in combination with other uses and services of the national forests, and, in cooperation with the Fish and Game Department or other constituted authority of the State concerned, he will formulate plans for securing and maintaining desirable populations of wildlife species, and he may enter into such general or specific cooperative agreements with appropriate State officials as are necessary and desirable for such purposes. Officials of [USFS] will cooperate with State game officials in the planned and orderly removal in accordance with the requirements of State laws of the crop of game, fish, fur-bearers, and other wildlife on national forest lands.[520]

USFS directives provide additional coordination guidance.[521] In particular, they require development of a written Memorandum of Understanding with each state involving policies or procedural matters.[522]

Hunting, fishing, and trapping on NFS lands are subject to state fish and wildlife laws and regulations, unless those regulations conflict with federal laws or they would permit activities that conflict with land and resource management responsibilities of USFS or that are inconsistent with direction in forest plans.[523] Memorandums with state fish and wildlife agencies must

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519 *Id.* § 1506.2(d) ("To better integrate environmental impact statements into State or local planning processes, statements shall discuss any inconsistency of a proposed action with any approved State or local plan and laws (whether or not federally sanctioned). Where an inconsistency exists, the statement should describe the extent to which the agency would reconcile its proposed action with the plan or law.").

520 36 C.F.R. § 241.2.

521 *See* FSM § 2671.1 (2005).

522 *Id.* § 2611.1 (1990).

523 *Id.* § 2643.1 (1995); *see, e.g.*, Meister v. U.S. Dep't of Agric., 623 F.3d 363, 379–80 (6th Cir. 2010) (stating that it is not beyond USFS's authority to consider using a forest plan to prohibit gun hunting in areas to be managed for non-motorized recreation); La. Sportsmen All. v. Vilsack, 984 F. Supp. 2d 600, 611 (W.D. La. 2013) (holding that a forest plan may prohibit hunting deer with dogs to reduce conflicting uses), *rev'd on other grounds*, 583 F. App'x 379 (5th Cir. 2014); Ctr. for Biological Diversity v. U.S. Forest Serv., No. CV–12–8176–PCT–SMM, 2013 WL 3335234,

"recognize the role of [USFS] in cooperating in the development of State fish and wildlife laws and regulations, especially those addressing hunting, fishing, and trapping as they would apply to occupancy and use of National Forest System lands."[524]

"Introductions or stocking of species may be made to restore resources following environmental changes, [and] to provide recreation opportunities where reproduction is insufficient to meet demand."[525] Authority is also provided to "restore locally extinct indigenous species, to recover threatened and endangered species, and to introduce new species in coordination with State and Federal agencies."[526] A prior joint agreement with appropriate state fish and wildlife agencies is needed for any introductions.[527] "Such MOU's must document agreements on each fish and wildlife translocation project and appropriate environmental documentation."[528] When stocking and reintroductions occur, USFS "has the responsibility to prevent damage to resources occurring on [NFS] lands" and comply with the ESA and Wilderness Act.[529]

State cooperative agreements are found in MOUs that are appended to the USFS Manual as regional supplements that pertain to the states found in each region. For example, an MOU between Idaho and USFS commits USFS to considering state goals when developing its forest plans.[530] It also recognizes that special use permits may be needed for some state actions on federal lands.[531] The MOU requires prior consultation (but not permission) for use of chemicals and for transplants or introductions of wildlife or fish "with sufficient lead time to permit joint field investigations regarding the effects of such programs on National Forest System lands."[532] It also contains a savings clause regarding state and federal authorities.[533]

e. Special Designated Areas Managed by the U.S. Forest Service

The laws and regulations reviewed above generally apply throughout the NFS, but the System also includes special areas, designated by Congress or the President, that may include additional authority and direction for

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*3 (D. Ariz. July 2, 2013) (determining that USFS has authority to regulate the use of lead bullets to protect California condors), *rev'd on other grounds*, 640 F. App'x 617 (9th Cir. 2016).

524 FSM § 2643.

525 *Id.* § 2640.3(3); *see also* Exec. Order No. 11,987, 3 C.F.R. § 116 (1977) (generally restricting federal agencies from introducing exotic species to lands they administer and encouraging the prevention of introductions by other levels of government and by private citizens).

526 FSM § 2640.3. "The State has the responsibility to make the determination as to which wildlife and fish species are native or indigenous." *Id.* § 2641.

527 *Id.* §§ 2640.41–.42.

528 *Id.* § 2641.

529 *Id.*

530 *Id.* § 1561.2(A)(3) (1994).

531 *Id.* § 1561.2(A)(6)–(7).

532 *Id.* § 1561.2(B)(6)–(8).

533 *Id.* § 1561.2(C)(12).

managing wildlife. These include an assortment of USFS-administered national recreation areas, conservation areas, and other specially designated landscapes.[534] These include national monuments that are established by the President using the Antiquities Act.[535] A recent national monument established on NFS lands (which also includes BLM lands) is the Sand to Snow National Monument in California.[536] President Obama's Proclamation establishing the monument emphasizes the area's "remarkable species richness that makes it one of the most biodiverse areas in southern California," that it "is home to 12 federally listed threatened and endangered animal species" and "frequented by over 240 species of birds," and that the area's "intersection of mountains makes th[e] area a critical bridge for wildlife traversing the high elevations of southern California's desert landscape."[537] The Proclamation orders USFS and BLM to use "their respective applicable legal authorities" to implement these wildlife-focused purposes of the national monument and includes a savings clause stating that the Proclamation does nothing "to enlarge or diminish the jurisdiction of the State of California, including its jurisdiction and authority with respect to fish and wildlife management."[538]

5. Public Lands Managed by the Bureau of Land Management

a. Federal Land Policy Management Act (1976)

Of most relevance to wildlife on public lands managed by BLM is the Federal Land Policy Management Act of 1976. FLPMA is considered to be BLM's Organic Act because it consolidated and articulated the agency's mission and management responsibilities.[539] Its full history is beyond the purview of this Article, but it is commonly recognized that the Act was designed, in part, to correct the agency's historic practice of prioritizing livestock grazing and mining as the dominant uses of public lands.[540] In FLPMA, Congress declared that fish and wildlife values were to be balanced with other resources and uses of the public lands, and expressed a policy that:

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534 For a comprehensive listing of "special recreation and conservation overlays," see GEORGE CAMERON COGGINS ET AL., FEDERAL PUBLIC LAND AND RESOURCES LAW 946–47 (6th ed. 2007); NAT. RES. LAW CTR., PROTECTIVE DESIGNATIONS ON FEDERAL LANDS: CASE STUDIES OF NATIONAL CONSERVATION AREAS, NATIONAL MONUMENTS, NATIONAL PARKS, NATIONAL RECREATION AREAS, AND WILDERNESS AREAS 2 (2004); Martin Nie & Michael Fiebig, *Managing the National Forests Through Place-Based Legislation*, 37 ECOLOGY L.Q. 1, 15–23 (2010).

535 Antiquities Act of 1906, 54 U.S.C. §§ 320301–320303 (Supp. III 2016); *see id.* § 320301.

536 Proclamation No. 9396, 81 Fed. Reg. 8379 (Feb. 18, 2016).

537 *Id.* at 8380.

538 *Id.* at 8382–83.

539 *See* DEBRA L. DONAHUE, THE WESTERN RANGE REVISITED: REMOVING LIVESTOCK FROM PUBLIC LANDS TO CONSERVE NATIVE BIODIVERSITY 203 (1999); JAMES R. SKILLEN, THE NATION'S LARGEST LANDLORD: THE BUREAU OF LAND MANAGEMENT IN THE AMERICAN WEST 102 (2009).

540 *See* DONAHUE, *supra* note 539, at 206–07; SKILLEN, *supra* note 539, at 102–03.

> [T]he public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use.[541]

FLPMA also codified a multiple-use mandate,[542] which is defined as follows:

> [T]he management of the public lands and their various resource values so that they are utilized in the combination that will best meet the present and future needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; the use of some land for less than all of the resources; a combination of balanced and diverse resource uses that takes into account the long-term needs of future generations for renewable and nonrenewable resources, including, but not limited to, recreation, range, timber, minerals, watershed, *wildlife and fish*, and natural scenic, scientific and historical values; and harmonious and coordinated management of the various resources without permanent impairment of the productivity of the land and the quality of the environment with consideration being given to the relative values of the resources and not necessarily to the combination of uses that will give the greatest economic return or the greatest unit output.[543]

Three components of this definition are essential to understanding BLM's multiple-use mandate. First, it means that some lands may be used for less than all of the possible resources and values present in an area. In fact, some land may be used for only one resource or value. Second, "multiple use" means that some lands may be used for purposes that do not return the greatest profit to individuals, corporations, or federal, state, or local governments. Third, the diverse resources for which BLM is given direction to manage include "wildlife and fish," and not just fish and wildlife *habitat*. We return to this issue in Part IV.A.

Similar to other federal land laws, Congress recognized the national interest in these public lands and wanted their management to be based on a systematic inventory and an informed land use planning process. To this end, FLPMA requires the preparation of resource management plans.[544] In preparing these plans, the agency must consider such things as the "present and potential uses of the public lands[,] . . . the relative scarcity of the values involved," to "rely, to the extent it is available, on the inventory of the public

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541 43 U.S.C. § 1701(a)(8).

542 Congress first codified a multiple-use management for BLM in the Classification and Multiple Use Act of 1964, 43 U.S.C. §§ 1411–1418 (1970) (omitted as obsolete in 1976).

543 43 U.S.C. § 1702(c) (2012) (emphasis added).

544 *Id.* § 1712.

lands, their resources, and others values," and "weigh long-term benefits to the public against short-term benefits."[545]

As in the case of the national forests, the multiple-use mandate given to BLM provides a great deal of agency discretion.[546] But this discretion is not boundless. The agency violates FLPMA if it fails to "engage in any reasoned or informed decisionmaking process" concerning the implementation of multiple use.[547] FLPMA's multiple-use mandate is also bounded by two additional provisions of FLPMA: 1) the requirement to avoid "permanent impairment . . . [to] the quality of the environment,"[548] and 2) the requirement that the Secretary of Interior (and hence BLM) must "take any action necessary to prevent unnecessary or undue degradation of the lands."[549]

i. Areas of Critical Environmental Concern

FLPMA requires BLM's land use planning process to "give priority to the designation and protection of areas of critical environmental concern" (ACECs).[550] As defined in FLPMA:

> The term "areas of critical environmental concern" means areas within the public lands where special management attention is required (when such areas are developed or used or where no development is required) to protect and prevent irreparable damage to important historic, cultural, or scenic values, *fish and wildlife resources* or other natural systems or processes, or to protect life and safety from natural hazards.[551]

This is a unique provision in federal land law. ACECs are often designated because of the fish and wildlife values associated with them.[552] Congress, in unambiguous fashion, ordered the agency to *prioritize* the designation and protection of ACECs.[553] This means that BLM should be giving ACECs priority for consideration in the planning process and extra

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545 *Id.* § 1712(c)(4)–(7).

546 *See, e.g.*, Nat. Res. Def. Council, Inc. v. Hodel, 624 F. Supp. 1045, 1058 (D. Nev. 1985), *aff'd*, 819 F.2d 927 (9th Cir. 1987).

547 Nat'l Wildlife Fed'n, 140 Interior Dec. 85, 101 (IBLA 1997). For a more complete history of this case and its implications for multiple use, see generally Joseph M. Feller, *The Comb Wash Case: The Rule of Law Comes to the Public Rangelands*, 17 PUB. LAND & RESOURCES L. REV. 25 (1996).

548 43 U.S.C. § 1702(c).

549 *Id.* § 1732(b). *See generally* Roger Flynn, *Daybreak on the Land: The Coming of Age of the Federal Land Policy and Management Act of 1976*, 29 VT. L. REV. 815 (2005) (reviewing the application of this provision as it relates to water, mining, and property rights).

550 43 U.S.C. § 1712(c)(3).

551 *Id.* § 1702(a) (emphasis added).

552 Karin P. Sheldon & Pamela Baldwin, *Areas of Critical Environmental Concern: FLPMA's Unfulfilled Conservation Mandate*, 28 COLO. NAT. RESOURCES ENERGY & ENVTL. L. REV. 1, 28 (2017).

553 Debra L. Donahue, *Federal Rangeland Policy: Perverting Law and Jeopardizing Ecosystem Services*, 22 J. LAND USE & ENVTL. L. 299, 337–38 (2007).

weight in decision making.[554] As summarized in a recent study: "The legislative history of FLPMA establishes Congress' clear intent to provide for special protection of ACECs and to direct BLM to accord priority for that protection over other multiple uses in the agency's inventory, land designation and planning activities."[555] The study finds that such prioritization has not taken place and recommends a number of steps be taken to meet FLPMA's mandate. This includes "restor[ing] the visibility and effectiveness of ACECs"—in BLM regulations, policy guidance, and budget justifications—and providing them "the heightened level of protection required by FLPMA."[556]

ii. Bureau of Land Management Regulation and Policy

Three provisions are of particular importance to wildlife management on public lands managed by BLM. The first is the "fundamentals of rangeland health" regulation that requires standards and guidelines to be developed by BLM, including those focused on wildlife habitat.[557] The regulation requires that "[h]abitats are, or are making significant progress toward being, restored or maintained for Federal threatened and endangered species, Federal proposed or candidate threatened and endangered species, and other special status species."[558]

The second is found in the BLM Manual for management of "special status species."[559] This policy was written pursuant to FLPMA, the ESA, and other laws.[560] BLM special status species are defined as: "(1) species listed or proposed for listing under the [ESA], and (2) species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA."[561] The objectives of the policy are "[t]o conserve and/or recover ESA-listed species and the ecosystems on which they depend so that ESA protections are no longer needed for these species," and "[t]o initiate proactive conservation measures that reduce or eliminate threats to Bureau sensitive species to minimize the likelihood of and need for listing of these species under the ESA."[562] Candidate species for ESA listing are included in BLM's sensitive species category.[563] Furthermore, BLM must address "Bureau sensitive species and their habitats in land use plans and associated NEPA documents."[564] With

554 *See id.* (noting that Congress repeatedly emphasized the "priority" to be given to ACECs).

555 Sheldon & Baldwin, *supra* note 552, at 5.

556 *Id.* at 61, 63.

557 43 C.F.R § 4180.1 (2016).

558 *Id.* § 4180.1(d).

559 BUREAU OF LAND MGMT., MANUAL TRANSMITTAL SHEET: 6840—SPECIAL STATUS SPECIES MANAGEMENT (2008), https://perma.cc/ME8D-HBTM.

560 *Id.* § 6840.03.

561 *Id.* § 6840.01.

562 *Id.* § 6840.02.

563 *Id.* § 6840.01; *see also id.* at Glossary 5.

564 *Id.* § 6840.2A1(B).

respect to implementation-level planning, BLM "should consider all site-specific methods and procedures needed to bring species and their habitats to the condition under which management under the Bureau sensitive species policies would no longer be necessary."[565]

The third regulation pertains to the issuance of special recreation permits. Wildlife is implicated when it is the object of a commercial or competitive event.[566] BLM is obligated to regulate the use and occupancy of public lands,[567] and its regulations and policy require special recreation permits for "commercial use, organized group activities or events, competitive use, and for use of special areas."[568] Discretion is provided to the agency over whether to issue a permit based on the following factors:

> (a) Conformance with laws and land use plans,[569]
>
> (b) Public safety,
>
> (c) Conflicts with other uses,
>
> (d) Resource protection,
>
> (e) The public interest served,
>
> (f) Whether in the past [the applicant] complied with the terms of [the] permit or other authorization from BLM and other agencies, and
>
> (g) Such other information that BLM finds appropriate.[570]

BLM may also impose stipulations and conditions on the permit "to meet management goals and objectives and to protect lands and resources and the public interest."[571]

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565 *Id.*

566 43 C.F.R. § 2932.11 (2016) ("[Y]ou must obtain a Special Recreation Permit for: (1) Commercial use, including vending associated with recreational use; or (2) Competitive use."); *see also id.* § 2932.14(b) ("Outfitters and guides providing services to hunters, trappers, or anglers must obtain Special Recreation Permits from BLM. Competitive event operators and organized groups may also need a Special Recreation Permit for these activities.").

567 FLPMA, 43 U.S.C. § 1732(b) (2012).

568 43 C.F.R. § 2931.2. A competitive use is defined as "[a]ny organized, sanctioned, or structured use, event, or activity on public land in which 2 or more contestants compete" and either register, enter, or apply for the event and/or use a "predetermined course or area." *Id.* § 2932.5. Commercial use means "recreational use of the public lands and related waters for business or financial gain," and the activity, service, or use is commercial if "[a]ny person, group, or organization makes or attempts to make a profit, receive money, amortize equipment, or obtain goods or services, as compensation from participants in recreational activities occurring on public lands led, sponsored, or organized by that person, group, or organization." *Id.*

569 Permits must be consistent with the applicable resource management plan for the area. *See* 43 U.S.C. § 1732(a); 43 C.F.R. § 1610.5–3(a).

570 43 C.F.R. § 2932.26.

571 *Id.* § 2932.41.

b. The National Landscape Conservation System

BLM is also tasked with managing units within the National Landscape Conservation System (NLCS).[572] NLCS includes BLM-administered national conservation areas (NCAs) and similar designations, national monuments, and wilderness study areas, and provides direction, either through statute or presidential proclamation, in how to manage individual units.[573] It is beyond the scope of this Article to review the full extent and diversity of the NLCS. Importantly, however, most conservation areas and monuments managed by BLM include special provisions, going beyond FLPMA, that pertain to wildlife management and the biological values associated with the designations. For example, a purpose declared by Congress in establishing the Morley Nelson Snake River Birds of Prey NCA in Idaho is to "provide for the conservation, protection, and enhancement of raptor populations and habitats and the natural and environmental resources and values associated therewith."[574] Many of these laws also include wildlife savings clauses, some simply stating that nothing in the designation "shall be deemed to enlarge or diminish the jurisdiction" of the state "with respect to fish and wildlife management."[575] In 2009, Congress formally recognized and established the NLCS and provided another wildlife-specific savings clause that would serve as a backup if the enabling legislation was silent on the matter.[576]

c. Federal-State Interactions

FLPMA includes a provision encouraging the coordination and consistency of federal and state land use plans:

> [T]o the extent consistent with the laws governing the administration of the public lands, coordinate the land use inventory, planning, and management

572 16 U.S.C. § 7202(c) (2012).

573 *Id.* § 7202(b). BLM manages roughly 4.1 million acres of NCAs and lands with similar designations, and roughly 9.5 million acres of national monuments. BUREAU OF LAND MGMT., NATIONAL LANDSCAPE CONSERVATION SYSTEM: NATIONAL CONSERVATION AREAS AND SIMILAR DESIGNATIONS, https://perma.cc/XYV3-H4UZ (last updated Oct. 2016); BUREAU OF LAND MGMT., NATIONAL LANDSCAPE CONSERVATION SYSTEM: NATIONAL MONUMENTS, https://perma.cc/8F7Y-6CNV (last updated Jan. 2017). Federal wilderness areas are also included in the NLCS, and we address those areas in Part III.B.7.

574 16 U.S.C. § 460iii–2(a)(2).

575 *E.g.*, Proclamation No. 7398, 66 Fed. Reg. 7359, 7361 (Jan. 22, 2001).

576 Omnibus Public Land Management Act of 2009, Pub. L. No. 111-11, 123 Stat. 991 (codified as amended in scattered sections of 7, 16, 33, 36, 42, and 43 U.S.C.)

> "Nothing in this chapter shall be construed as affecting the authority, jurisdiction, or responsibility of the several States to manage, control, or regulate fish and resident wildlife under State law or regulations, including the regulation of hunting, fishing, trapping and recreational shooting on public land managed by the Bureau of Land Management. Nothing in this chapter shall be construed as limiting access for hunting, fishing, trapping, or recreational shooting."

16 U.S.C. § 7202(d)(2).

> activities of or for such lands with the land use planning and management programs of other Federal departments and agencies and of the States and local governments within which the lands are located . . . . In implementing this directive, the Secretary shall, to the extent he finds practical, keep apprised of State, local, and tribal land use plans; assure that consideration is given to those State, local, and tribal plans that are germane in the development of land use plans for public lands; assist in resolving, to the extent practical, inconsistencies between Federal and non-Federal Government plans, and shall provide for meaningful public involvement of State and local government officials, both elected and appointed, in the development of land use programs, land use regulations, and land use decisions for public lands, including early public notice of proposed decisions which may have a significant impact on non-Federal lands. Such officials in each State are authorized to furnish advice to the Secretary with respect to the development and revision of land use plans, land use guidelines, land use rules, and land use regulations for the public lands within such State and with respect to such other land use matters as may be referred to them by him. Land use plans of the Secretary under this section *shall be consistent with State and local plans to the maximum extent he finds consistent with Federal law and the purposes of this Act.*[577]

This provision provides state governors the opportunity to advise BLM of their positions on draft land use plans. BLM must consider this advice in so-called "consistency reviews."[578]

In short, there are several engagement points for state and local governments to participate in the land use planning process and multiple responsibilities on the part of BLM to respond to state and local concerns. But this entire process is conditioned on federal primacy: that priority be given to federal law and purposes in the land use planning processes. We return to this provision in Part IV.F, as we believe the coordination/consistency provisions of FLPMA provide a constructive opportunity for federal and state governments to plan for the management and conservation of wildlife across political jurisdictions.

FLPMA's savings clause pertaining to wildlife provides additional direction on federal-state interactions regarding wildlife management:

> That nothing in this Act shall be construed as authorizing the Secretary concerned to require Federal permits to hunt and fish on public lands or on lands in the National Forest System and adjacent waters or as enlarging or diminishing the responsibility and authority of the States for management of fish and resident wildlife. However, the Secretary concerned may designate areas of public land and of lands in the National Forest System where, and establish periods when, no hunting or fishing will be permitted for reasons of

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577 43 U.S.C. § 1712(c)(9) (2012) (emphasis added).

578 Resource Management Planning, 81 Fed. Reg. 89,580, 89,666 (Dec. 12, 2016) (to be codified at 43 C.F.R. § 1610.3–3); *see* New Mexico *ex rel.* Richardson v. Bureau of Land Mgmt., 565 F.3d 683, 721 (10th Cir. 2009) ("A meaningful opportunity to comment is all the regulation requires."); W. Expl., LLC v. U.S. Dep't of the Interior, No. 3:15–cv–00491–MMD–VPC, 2017 WL 1237971, at *16 (D. Nev. Mar. 31, 2017) ("The statute and regulations are silent on how detailed or specific BLM needs to be," and that BLM met its obligation to resolve inconsistencies between local plans and federal sage grouse plans "to the extent practical.").

> public safety, *administration, or compliance with provisions of applicable law*. Except in emergencies, any regulations of the Secretary concerned relating to hunting and fishing pursuant to this section shall be put into effect only after consultation with the appropriate State fish and game department. Nothing in this Act shall modify or change any provision of Federal law relating to migratory birds or to endangered or threatened species.[579]

This provision was at the center of a dispute involving a proposed wolf hunt on federal lands by the State of Alaska. In *Alaska v. Andrus*,[580] the United States District Court for the District of Alaska found that this provision of FLPMA, along with the multiple-use mandate, "taken together clearly provide the Secretary with the power to halt the wolf hunt."[581] Furthermore, said the court, under the power of "'[a]dministration,' the Secretary is commanded to manage the public lands under principles of multiple use [and m]ultiple use includes the management of wildlife."[582] Although FLPMA grants authority to either permit or prohibit the wolf hunt, this authority, in and of itself, did not trigger NEPA when the agency failed to exercise it because there was no major federal action.[583] The NEPA application question was at the heart of two circuit court reviews, both affirming that the non-exercise of power by the Secretary did not trigger NEPA, though the Ninth Circuit seemed to lament that it did "not reach the intriguing questions of statutory construction and application that would lurk in defining the Secretary's power to supersede the State in managing wildlife."[584] We return to the questions unresolved by these courts in Part IV.D.

The Department of the Interior sought to provide more guidance on federal-state relationships through a policy statement in 1983.[585] In essence, Department of Interior's Policy simply recognizes some of the principles of wildlife federalism that we covered in Parts II and III.A of the Article, from states as trustees of wildlife to federal constitutional powers to manage

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579 43 U.S.C. § 1732(b) (emphasis added).

580 429 F. Supp. 958 (D. Alaska 1977), *aff'd*, 591 F.2d 537 (9th Cir. 1979).

581 *Id.* at 961–62.

582 *Id.* at 962.

583 *Id.* at 963; *see* NEPA, 42 U.S.C. § 4332(c) (2012); COGGINS & GLICKSMAN, *supra* note 124, § 17:16 (noting that "[i]f federal and state projects are sufficiently interrelated to constitute a single 'federal action' for NEPA purposes, state agencies may be enjoined for NEPA violations").

584 Alaska v. Andrus, 591 F.2d 537, 538 (9th Cir. 1979). The District of Columbia Circuit reached the same conclusion regarding NEPA, but used language in dicta that was relatively favorable to the state's authority to manage wildlife. *See* Defs. of Wildlife v. Andrus, 627 F.2d 1238, 1250 (D.C. Cir. 1980) ("We are simply unable to read [FLPMA's] cautious and limited permission to intervene in an area of state responsibility and authority as imposing such supervisory duties on the Secretary that each state action he fails to prevent becomes a 'Federal action.'").

585 Department of the Interior Fish and Wildlife Policy; State-Federal Relationships, 48 Fed. Reg. 11,642, 11,642 (Mar. 18, 1983) (to be codified at 43 C.F.R. pt. 24). Although the Policy appears in the C.F.R. "as a matter of convenience to the public," *id.*, it was not subject to the rulemaking requirements of the Administrative Procedure Act, 5 U.S.C. § 553 (2012), and as such does not carry the force of law. Christensen v. Harris County, 529 U.S. 576, 587 (2000).

wildlife. For example, the Policy states that "[f]ederal authority exists for specified purposes while State authority regarding fish and resident wildlife remains the comprehensive backdrop applicable in the absence of specific, overriding Federal Law."[586]

The Policy goes further than these fundamental principles of federalism, however, by stating that it is intended "to reaffirm the basic role of the States in fish and resident wildlife management, especially where States have primary authority and responsibility, and to foster improved conservation of fish and wildlife."[587] In other sections, the Policy recognizes that "[s]tate jurisdiction remains concurrent with Federal authority,"[588] and asserts that, in passing FLPMA, Congress "recognized and reaffirmed the primary authority and responsibility of the States for management of fish and resident wildlife on such lands."[589] While the Policy does acknowledge basic constitutional principles pertaining to the Property Clause, Commerce Clause, federal preemption, and treaty-making powers,[590] it also makes the often-repeated assertion that BLM "has custody of the land itself and the habitat upon which fish and resident wildlife are dependent" and that "[m]anagement of the habitat is a responsibility of the Federal Government,"[591] thereby implying that BLM only has power over the land and not the wildlife that inhabit it.

In Part IV.C, we explain the fundamental problems with the Department of Interior's Policy on federal-state relationships and discuss the implications resulting from this problematic interpretation of law.

6. The Special Case of Alaska

a. Alaska National Interest Lands Conservation Act

Alaska presents a unique situation within the federal public lands system. Alaska includes all of the same land categories and federal laws that exist elsewhere in the country. However, federal land managers in Alaska must also contend with the Alaska National Interest Lands Conservation Act[592] (ANILCA), which creates new land categories[593] and statutory exceptions[594] that do not exist elsewhere, as well as an overarching system of subsistence management which adds an additional management

586 43 C.F.R. § 24.1(a) (2016).

587 *Id.* § 24.2(a).

588 *Id.* § 24.3(c).

589 *Id.* § 24.4(c).

590 *Id.* § 24.3.

591 *Id.* § 24.4(d).

592 16 U.S.C. §§ 3101–3233 (2012).

593 *See, e.g.*, *id.* § 3201 (establishing National Preserves, a subcategory of National Park Lands on which sport hunting is permitted); *id.* § 410hh-2.

594 Such as exceptions to the prohibitions laid out by the Wilderness Act. For instance, snow machine use, which is banned as mechanized transport in every other state, is permitted in Alaska Wilderness Areas where that use was established before the creation of the Wilderness Area. *See id.* §§ 3121(a)–(b), 3170(a), 3171(a).

mission/goal to nearly all federal lands in Alaska.[595] In *Sturgeon v. Frost*,[596] the Supreme Court explicitly acknowledged this unusual status, stating that "ANILCA repeatedly recognizes that Alaska is different . . . . [And] ANILCA itself accordingly carves out numerous Alaska-specific exceptions."[597]

i. Subsistence

It is the subsistence requirement that is the single biggest difference between managing wildlife on federal lands in Alaska and managing them in the rest of the country. ANILCA is the establishment legislation for nearly every federal conservation unit in the state.[598] This creates an opportunity for uniformity in management strategy across agencies and conservation units that could not exist elsewhere in the country where units were set aside in a more haphazard manner. Taking advantage of that opportunity, ANILCA establishes that subsistence shall be permitted on all federal lands with few exceptions,[599] and creates a subsistence preference that applies to rural Alaskans that grants them a priority position in relation to other consumptive users of fish and game.[600]

Subsistence is defined by ANILCA as "the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption."[601] More colloquially, it refers to rural hunting, fishing, and gathering of resources for personal use.[602] When ANILCA was originally passed, the intent of the statute was for the state to administer the subsistence hunting program (like all other hunting programs) on federal lands, and merely required that the state abide by ANILCA's requirements.[603] It soon became clear, however, that the state could not implement the rural subsistence preference because it violated the state's constitutional requirement for equal access to fish and game, according the Alaska Supreme Court.[604] Several efforts were made to amend the Alaska constitution so that the state could reclaim authority over all

595 *See generally id.* §§ 3111–3126 (establishing the overarching system of subsistence management under ANILCA).

596 136 S. Ct. 1061 (2016).

597 *Id.* at 1070.

598 16 U.S.C. §§ 410hh–410hh-1; *id.* §§ 460mm–460mm-2; *id.* § 539; ANILCA, Pub. L. No. 96-487, §§ 302–303, 94 Stat. 2371, 2385–93 (1980); *id.* §§ 601–603, 94 Stat. 2412–15; *id.* §§ 701–704, 94 Stat. 2371, 2417–19.

599 The exceptions are within the original boundaries of Denali National Park and Preserve and Glacier Bay National Park and Preserve, which were both expanded by ANILCA. 16 U.S.C. § 410hh-1(1), (3)(a).

600 *See id.* § 3112(2) ("[N]onwasteful subsistence uses of fish and wildlife and other renewable resources shall be the priority consumptive uses of all such resources on the public lands of Alaska.").

601 *Id.* § 3113.

602 ANILCA states that "the situation in Alaska is unique in that, in most cases, no practical alternative means are available to replace the food supplies and other items gathered from fish and wildlife which supply rural residents dependent on subsistence uses." *Id.* § 3111(2).

603 *Id.* § 3115(d).

604 McDowell v. State, 785 P.2d 1, 9 (Alaska 1989).

hunting, but those attempts were never successful.[605] In 1990, the Federal Subsistence Board, which mirrors the functions of the state's Board of Game, was created, and the federal government began to assume control of subsistence hunting on federal lands.[606]

ANILCA instructs the agencies to manage subsistence "consistent with sound management principles, and the conservation of healthy populations of fish and wildlife," and "consistent with management of fish and wildlife in accordance with recognized scientific principles and the purposes for each unit."[607] ANILCA also states that "[n]othing in this title shall be construed as . . . permitting the level of subsistence uses of fish and wildlife within a conservation system unit to be inconsistent with the conservation of healthy populations, and within a national park or monument to be inconsistent with the conservation of natural and healthy populations, of fish and wildlife."[608] So the management standard for all federal public lands is the requirement to maintain healthy populations, but for national park lands, the requirement is to maintain natural and healthy populations of wildlife. Agencies must also evaluate the effect of all uses on public lands on subsistence uses and needs, and formally notify subsistence users if there could be any effects on subsistence harvests as a result of other uses.[609]

ii. Sport Hunting

Sport hunting (non-subsistence hunting) is permitted on most non-park lands in Alaska and is managed largely through the state regulatory process, as it is elsewhere in the United States.[610] However, ANILCA creates a new category of park lands called "Preserves" where sport hunting and commercial trapping are permitted.[611] The State of Alaska regulates sport hunting statewide, including on federal lands.[612] However, conflicts have arisen between the state's hunting regulations, which express the state's wildlife laws and goals, and the wildlife management goals expressed by several federal statutes. For instance, the State of Alaska is required to intensively manage wildlife populations in order to maximize a sustained yield of desirable prey (e.g., moose, caribou, and deer).[613] This intensive

605 FRANK NORRIS, ALASKA SUBSISTENCE: A NATIONAL PARK SERVICE MANAGEMENT HISTORY 162–63 (2002).

606 *Id.* at 165; Kyle Joly, Sanford P. Rabinowitch & Julie Lurman Joly, *Dual Management of Wildlife in Alaska: Making Federal Practice Align with Federal Mandates*, 32 GEORGE WRIGHT F. 18, 18 (2015).

607 16 U.S.C. § 3112(1).

608 *Id.* § 3125(1).

609 *Id.* § 3120(a).

610 *Id.* § 3202(c).

611 *Id.* §§ 410hh–2, 3201; *see* Alaska; Hunting and Trapping in National Preserves, 80 Fed. Reg. 64,325, 64,325 (Oct. 23, 2015) (to be codified at 36 C.F.R. pt. 13).

612 Alaska; Hunting and Trapping in National Preserves, 80 Fed. Reg. at 64,326.

613 ALASKA STAT. § 16.05.255(e) (2016).

management requirement often leads to predator reduction efforts.[614] NPS on the other hand is required to maintain natural and healthy populations of all species according to ANILCA and "to conserve the scenery and the natural and historic objects and the wild life" according to the NPS Organic Act.[615] NPS policies implementing the Organic Act require the agency to "protect natural ecosystems and processes, including the natural abundances, diversities, distributions, densities, age-class distributions, populations, habitats, genetics, and behaviors of wildlife."[616] These state and federal goals are mutually exclusive.[617]

In 2015, NPS promulgated new regulations restricting how the state's sport hunting laws could apply within parks, so that they do not conflict with NPS's legal obligations under the Organic Act and ANILCA.[618] The new rules clarify that state wildlife regulations that conflict with NPS regulations or laws are not applicable on NPS lands.[619] The Alaska Regional Park Service Director will publish a list, at least annually, of all state-permitted activities that are prohibited on NPS lands.[620]

There has been a great deal of criticism of these rule changes. NPS's effort has been characterized by the state as statutory overreach and a violation of the public trust doctrine,[621] though both ANILCA and the Organic Act recognize NPS's authority to regulate these activities.[622]

Once the NPS rules were successfully promulgated, FWS began a similar rulemaking process. FWS's effort to follow a similar course was initially marked by efforts to block the development of such rules on national wildlife refuges,[623] though FWS's effort was eventually successful,

614 *See* Alaska; Hunting and Trapping in National Preserves, 80 Fed. Reg. at 64,326 ("In the last several years, the State of Alaska has allowed an increasing number of liberalized methods of hunting and trapping wildlife and extended seasons to increase opportunities to harvest predator species.").

615 54 U.S.C. § 100101 (Supp. II 2015) (previously codified at 16 U.S.C. § 1).

616 *See* Alaska; Hunting and Trapping in National Preserves, 80 Fed. Reg. at 64,326 (citing NPS MANAGEMENT POLICIES, *supra* note 375, §§ 4.1, 4.4.1, 4.4.1.2, and 4.4.2).

617 Lurman & Rabinowitch, *supra* note 275, at 165.

618 Alaska; Hunting and Trapping in National Preserves, 80 Fed. Reg. at 64,325. This rule change has been followed by a similar rule change on National Wildlife Refuges. *See infra* notes 623–624 and accompanying text.

619 36 C.F.R. § 13.42(a), (f) (2016).

620 *Id.* § 13.42(f)(1).

621 *See, e.g.*, Doug Vincent-Lang, *Alaska Must Reject Feds' Claim to Control Hunting in Preserves and Refuges*, ALASKA DISPATCH NEWS (June 26, 2016), https://perma.cc/2F3L-VGYN. Lang is the former director of Wildlife Conservation at the Alaska Department of Fish and Game. *Id.*

622 Alaska; Hunting and Trapping in National Preserves, 80 Fed. Reg. at 64,329, 64,333.

623 Senator Sullivan (R. AK) submitted an amendment, which was ultimately never passed, to the Bipartisan Sportsmen's Act of 2015 that would prohibit FWS from implementing regulations restricting the application of state hunting rules on Refuge lands. Sam Friedman, *Sullivan Moves to Prohibit Federal Refuge Predator Hunt Rules*, FAIRBANKS DAILY NEWS-MINER (Jan. 20, 2016), https://perma.cc/E7EA-WNY9.

and the rules were promulgated.[624] Ultimately, in 2017, Congress—exercising its authority under the Congressional Review Act[625]—abolished the FWS regulations.[626] Therefore, the FWS regulations are no longer in force (though this elimination of the regulations does not speak in any way to their legality), while the NPS regulations remain in place. Furthermore, while the FWS regulations have been eliminated, the statutes animating them are still in place. FWS still possesses the authority, and often the obligation, to prevent the state from acting in ways contrary to federal mandates regarding wildlife management on refuges, regardless of the status of these particular regulations. As NPS states, "the State's responsibility [to manage fish and wildlife] is not exclusive and it does not preclude federal regulation of wildlife on federal public lands, as is well-established in the courts and specifically stated in ANILCA."[627]

7. The National Wilderness Preservation System

a. The Policy and Objectives of the Wilderness Act

The Wilderness Act of 1964 expresses the following policy:

> In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition, it is hereby declared to be the policy of the Congress to secure for the American people of present and future generations the benefits of an enduring resource of wilderness. For this purpose there is hereby established a National Wilderness Preservation System to be composed of federally owned areas designated by Congress as "wilderness areas", and *these shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness*.[628]

The Act defines wilderness[629] and imposes a duty on the federal agencies to administer designated areas for "preserving the wilderness character."[630] In addition, Congress designated fifty-four areas managed by USFS,[631] detailed inventory procedures,[632] prohibited a number of uses,[633] and

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624 Non-Subsistence Take of Wildlife, and Public Participation and Closure Procedures, on National Wildlife Refuges in Alaska, 81 Fed. Reg. 52,248 (Aug. 5, 2016) (to be codified at 50 C.F.R. pts. 32 and 36).

625 5 U.S.C. §§ 801–808 (2012). The law authorizes Congress to review and repeal federal agency regulations passed within the last sixty legislative days. *Id.* § 801(a)(3).

626 Act of Apr. 3, 2017, Pub. L. No. 115-20, 131 Stat. 86 (providing congressional disapproval).

627 Alaska; Hunting and Trapping in National Preserves, 80 Fed. Reg. at 64,331.

628 16 U.S.C. § 1131(a) (2012) (emphasis added).

629 *Id.* § 1131(c).

630 *Id.* § 1133(b).

631 *Id.* § 1132(a); KATIE HOOVER, CONG. RESEARCH SERV., RL31447, WILDERNESS: OVERVIEW AND STATISTICS (2015).

adopted special provisions to clarify certain other uses.[634] Sections of the Act particularly relevant to managing wildlife in wilderness areas include the definition of wilderness and the federal responsibility to preserve wilderness character; the prohibited uses; and the congressionally authorized special provisions that apply to managing wildlife in wilderness.

i. Preserving Wilderness Character

Congress directed each federal agency managing a wilderness to "preserve its wilderness character."[635] To implement this requirement, the four wilderness-managing agencies have endorsed the following definition of wilderness character:

> Wilderness character is a holistic concept based on the interaction of (1) biophysical environments primarily free from modern human manipulation and impact, (2) personal experiences in natural environments relatively free from the encumbrances and signs of modern society, and (3) symbolic meanings of humility, restraint, and interdependence that inspire human connection with nature. Taken together, these tangible and intangible values define wilderness character and distinguish wilderness from all other lands.[636]

Specifically, five qualities of wilderness character are identified in the Act's definition of wilderness: untrammeled; natural; undeveloped; solitude or primitive and unconfined recreation; and other features of value, including ecological and scientific features.[637] We review each of these qualities below.

Untrammeled. In one of the most poetic passages found in the U.S. Code, the Wilderness Act provides that "wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are

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632 16 U.S.C. § 1132(b)–(d). BLM's authority to inventory for wilderness characteristics and to manage areas designated by Congress was expressed in FLPMA. 43 U.S.C. §§ 1711, 1782 (2012).

633 16 U.S.C. § 1133(c).

634 *Id.* § 1133(d).

635 *Id.* § 1133(b).

636 PETER LANDRES ET AL., RMRS-GTR-340, KEEPING IT WILD 2: AN UPDATED INTERAGENCY STRATEGY TO MONITOR TRENDS IN WILDERNESS CHARACTER ACROSS THE NATIONAL WILDERNESS PRESERVATION SYSTEM 7 (2015) [hereinafter KIW2]; *see* Memorandum from Chair, Interagency Wilderness Steering Committee to Chair, Interagency Wilderness Policy Council, Interagency Wilderness Steering Committee's *Keeping It Wild 2* Recommendations (Sep. 21, 2015) (approved by the Wilderness Policy Council Dec. 23, 2015). Understanding the complex meaning of the term "wilderness character" has been an ongoing task for the federal agencies mandated to preserve it for over a decade. *See* PETER LANDRES ET AL., RMRS-GTR-212, KEEPING IT WILD: AN INTERAGENCY STRATEGY TO MONITOR TRENDS IN WILDERNESS CHARACTER ACROSS THE NATIONAL WILDERNESS PRESERVATION SYSTEM 5–7 (2008) [hereinafter KIW]; PETER LANDRES ET AL., RMRS-GTR-151, MONITORING SELECTED CONDITIONS RELATED TO WILDERNESS CHARACTER: A NATIONAL FRAMEWORK, at iii–iv, 4–6 (2005).

637 16 U.S.C. § 1131(c).

untrammeled by man" that "generally appears to have been affected primarily by the forces of nature" and "retain[s] its primeval character and influence."[638] Untrammeled means "essentially unhindered and free from the intentional actions of modern human control or manipulation."[639] In terms of wildlife management, this concept precludes intentional manipulation of species, populations, and individuals (with the exception of casual, noncommercial hunting and fishing, where allowed).[640] The Untrammeled Quality is a unique requirement among federal land management legislation; it is what puts the "wild" in "wilderness." When manipulation is necessary—for instance, to comply with another law such as the ESA or to improve another quality of wilderness character—action should be taken with the utmost restraint and humility.[641]

Natural. The Act provides that wilderness is "protected and managed so as to preserve its natural conditions."[642] This means that ecological systems within wilderness areas "are substantially free from the effects of modern civilization."[643] In terms of wildlife management, wilderness ecosystems should retain their native or indigenous species composition, distribution patterns, and ecological processes, including predator-prey dynamics, disturbance regimes, and abiotic and biotic fluctuations.[644] These ecosystems should be uncompromised by non-native species, or by artificially increased (or decreased) populations of native species or other biophysical conditions.[645] While the Untrammeled Quality reflects the wilderness character mandate to halt actions undertaken to consciously manipulate "the earth and its community of life," the Natural Quality minimizes the adverse ecological effects to a wilderness area from intentional or unintentional actions, as well as the adverse effects from larger scale ecological change occurring outside the wilderness—for example, the spread of non-native species and habitat fragmentation.[646]

Undeveloped. The Wilderness Act also identifies wilderness as "an area of undeveloped Federal land . . . without permanent improvements or human habitation," "where man himself is a visitor who does not remain . . . with the imprint of man's work substantially unnoticeable."[647] This means that wilderness is unmarred by "the sights and sounds of modern human occupation."[648] The Act's prohibition on "improvements" is not restricted to those that are permanent, but includes any physical developments (e.g.,

638 *Id.*

639 KIW2, *supra* note 636, at 10–11.

640 *See id.* at 104.

641 *See* Sandra B. Zellmer, *Wilderness Imperatives and Untrammeled Nature*, *in* ENVIRONMENTAL LAW AND CONTRASTING IDEAS OF NATURE: A CONSTRUCTIVIST APPROACH 179, 184–85 (Keith H. Hirokawa ed., 2014).

642 16 U.S.C. § 1131(c).

643 KIW2, *supra* note 636, at 11; *see also id.* at 39.

644 *Id.* at 41–43.

645 *Id.* at 11.

646 *Id.* at 101, 109–10.

647 16 U.S.C. § 1131(c).

648 KIW2, *supra* note 636, at 11; *see also id.* at 45–48.

structures, installations, and both permanent and temporary roads) as well as temporal developments (i.e., where the wilderness is "developed" for the duration of the use of the prohibited tool, such as motor vehicles, motorized equipment, and mechanical transport).[649] Again, restraint and humility are key: "[In wilderness areas] we stand without our mechanisms that make us immediate masters over our environment."[650] The implications for wildlife management are discussed in greater detail below.[651]

Solitude or Primitive and Unconfined Recreation. Wilderness areas provide "outstanding opportunities for solitude or a primitive and unconfined type of recreation."[652] This means that, in wilderness, recreational opportunities occur "in an environment that is relatively free from the encumbrances of modern society, and for the experience of the benefits and inspiration derived from self-reliance, self-discovery, physical and mental challenge, and freedom from societal obligations."[653] In terms of wildlife management, recreational opportunities to enjoy wildlife (including hunting and fishing) are allowed within the constraints of preserving wilderness character as a whole—that is, without structures, installations, the use of motorized equipment, motor vehicles, or mechanical transport, and without manipulating populations for a more "desirable" (and less natural) assemblage of species.[654]

Other Features of Value. Finally, the Wilderness Act provides that wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."[655] "This quality captures important elements or 'features' of a particular wilderness that are not [necessarily] covered by the other four qualities."[656] In terms of wildlife management, the ecological and scientific values are key, and in most cases, they are already addressed within the purview of the Natural Quality.[657]

ii. Within and Supplemental

Under section 4(a) of the Wilderness Act: "The purposes . . . are hereby declared to be within and supplemental to the purposes for which national forests and units of the national park and national wildlife refuge systems are established and administered."[658] As section 4(b) makes clear, however, "each agency administering any area designated as wilderness shall be responsible for *preserving the wilderness character* of the area and shall so administer such area for such other purposes for which it may have been

649 *See* 16 U.S.C. § 1133(c).
650 Howard Zahniser, *The Need for Wilderness Areas*, 59 LIVING WILDERNESS 37, 38 (1956).
651 *See* discussion *infra* Part III.B.7.a.iii.
652 16 U.S.C. § 1131(c).
653 KIW2, *supra* note 636, at 11–12; *see also id.* at 51–55.
654 *Id.* at 51, 78.
655 16 U.S.C. § 1131(c).
656 KIW2, *supra* note 636, at 12; *see also id.* at 57–60.
657 *Id.* at 39, 57–58.
658 16 U.S.C. § 1133(a).

established as also *to preserve its wilderness character*."[659] For all four agencies, upon designation as wilderness, the preservation of wilderness character becomes the primary duty of the underlying unit,[660] and management of other purposes must meet the requirements of the Wilderness Act in addition to the requirements of each agency's Organic Act.[661]

All four land management agencies struggle with this concept, but it has been especially problematic for FWS and NPS, largely because many employees of these two agencies believe that their conservation-oriented purposes are equivalent to wilderness preservation.[662] How these agencies have addressed this problem is discussed below.[663] Implications and continuing issues surrounding "within and supplemental" are discussed in Part IV.E. The "within and supplemental" requirement crops up routinely with respect to justifying uses explicitly prohibited by the Wilderness Act.[664]

iii. Prohibition of Certain Uses

Section 4(c) of the Wilderness Act specifically prohibits ten uses.[665] These are all subject to two exceptions: "Except as specifically provided for in this chapter, and subject to existing private rights."[666] Notably, there are no "existing private rights" associated with the management of wildlife in wilderness, and other specific provisions are discussed below.[667] Two of the ten prohibited uses—commercial enterprise and permanent roads—are subject *only* to these two exceptions (unless specifically authorized in subsequent legislation).[668] The prohibition on commercial enterprises has been a significant issue in wildlife management.

Commercial enterprise is defined as "a project or undertaking of or relating to commerce."[669] Only three types of commercial activity may be allowed in wilderness, as they are specifically provided for in the Act:

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659 *Id.* § 1133(b) (emphasis added).

660 *See* Wilderness Watch v. Vilsack, 229 F. Supp. 3d 1170, 1182 (D. Idaho 2017) ("Congress made preservation of wilderness values 'the primary duty of [USFS], and it must guide all decisions as the first and foremost standard of review for any proposed action.'" (quoting Greater Yellowstone Coal. v. Timchak, No. CV-06-04-E-BLW, 2006 WL 3386731, at *6 (D. Idaho Nov. 21, 2006))), *amended by* No. 4:16-CV-012-BLW, 2017 WL 3749441 (D. Idaho Aug. 30, 2017).

661 16 U.S.C. § 1133(a).

662 *See* Sandra B. Zellmer, *Wilderness Management in National Parks and Wildlife Refuges*, 44 ENVTL. L. 497, 500 (2014) (analyzing wilderness management on dominant use lands).

663 *See* discussion *infra* Part III.B.7.c

664 *See* discussion *infra* Part IV.E.

665 16 U.S.C. § 1133(c).

666 *Id.*

667 *See* discussion *infra* Part III.B.7.a.iv.

668 ROSS W. GORTE, CONG. RESEARCH SERV., R41649, WILDERNESS LAWS: STATUTORY PROVISIONS AND PROHIBITED AND PERMITTED USES 10–11 (2011).

669 *See* Wilderness Soc'y v. U.S. Fish & Wildlife Serv. (*Tustemena Lake*), 353 F.3d 1051, 1061, 1065 (9th Cir. 2003) (en banc) (stating that commercial means "work that is intended for the mass market" and "even non-profit entities may engage in commercial activity"), *amended en banc by* 360 F.3d 1374 (9th Cir. 2004).

livestock grazing,[670] exercising certain mineral rights,[671] and commercial services.[672] Absent those three activities, no commercial enterprise can take place in wilderness, and no wilderness resources can be removed for financial gain, including animals or parts of animals such as antlers and fur.[673] Therefore, collection of wilderness wildlife resources may be allowed only for personal use. Not only is it a violation of the Wilderness Act to remove wilderness resources for financial gain, but also, no action may be taken to enhance a commercial activity, even if the activity itself takes place entirely outside the wilderness and even if it causes only "minimal intrusion on wilderness values."[674]

Although commercial enterprises and permanent roads are tightly proscribed by the Wilderness Act, the other eight prohibited uses—temporary roads; use of motor vehicles, motorized equipment, and motorboats; landing of aircraft; any other form of mechanical transport; structures; and installations—are subject to an exception "as necessary to meet minimum requirements for the administration of the area for the purpose of this chapter."[675] This "minimum requirements" exception has three components.

For the purpose of this Act. As described above, the purpose of the Wilderness Act, and congressional direction to the federal agencies on the means of accomplishing that purpose, is to preserve wilderness character.[676] Unless necessary in the exercise of a legal right, or unless specifically allowed elsewhere in the Wilderness Act (or other federal law), Congress has made it clear that otherwise-prohibited uses cannot be authorized for any purpose other than preserving wilderness character.[677]

For the administration of the area. Otherwise-prohibited uses cannot be authorized to facilitate management objectives or activities occurring *outside* of the wilderness area.[678] Notably, in section 4(c), Congress clearly

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670 16 U.S.C. § 1133(d)(4).

671 *Id.* § 1133(d)(3).

672 *Id.* § 1133(d)(5); *see supra* notes 693–696 and accompanying text.

673 *See* BUREAU OF LAND MGMT., MANUAL TRANSMITTAL SHEET: 6340—MANAGEMENT OF DESIGNATED WILDERNESS AREAS (PUBLIC) § 1.6(C)(21)(c)(ix)(E) (2012), https://perma.cc/287T-JA3V [hereinafter BLM MANUAL] ("Sale of wildlife products gathered from wilderness is prohibited.").

674 *Tustemena Lake*, 353 F.3d at 1062, 1066–67 (prohibiting FWS approval of salmon stocking within the Kenai Wilderness).

675 16 U.S.C. § 1133(c).

676 *See* discussion *supra* Part III.B.7.a.i.

677 16 U.S.C. § 1133(b)–(c).

678 *See* High Point, LLLP v. Nat'l Park Serv., 850 F.3d 1185, 1197–98 (11th Cir. 2017) (finding that, just as a van filled with tourists could not "be construed as 'necessary' to meet the 'minimum requirements' for administering the area," neither could enlargement of a dock (a prohibited structure) be construed as an "existing private right[]" given the narrow construction applied to Wilderness Act exceptions (citing Wilderness Watch v. Mainella, 375 F.3d 1085, 1092 (11th Cir. 2004))); High Sierra Hikers Ass'n v. U.S. Forest Serv., 436 F. Supp. 2d 1117, 1134, 1137, 1144 (E.D. Cal. 2006) (holding that the repair, maintenance, and operation of dams in a wilderness area to enhance downstream flows for fisheries and to preserve historical values was not necessary to meet minimum requirements for the administration of the area as the

referenced "*the area*";[679] not, as the Act does elsewhere, the National Wilderness Preservation System as a whole.[680] In other words, prohibited uses cannot be authorized in Wilderness A to preserve the wilderness character of Wilderness B, unless they also preserve the wilderness character of Wilderness A.

Necessary to meet minimum requirements. Defining the "minimum" "necessary" is a work of art. One court cautioned that a generic finding of necessity will not suffice, and while it declared that the agencies need not "make a finding of '*absolute* necessity,'"[681] it offered no measure of exactly how necessary is necessary enough to meet the statute's requirements when coupled with the qualifier "minimum."[682] To guide the agencies, the Arthur Carhart National Wilderness Training Center (Carhart) has devised a two-step process: first, managers must determine if any action is *necessary* to address a problem of wilderness stewardship; if so, managers must then determine what the *least amount* of an otherwise prohibited use is necessary to accomplish the problem identified in the first step.[683] Though not specifically required by the Act, Carhart's *Minimum Requirements Decision Guide* is the most frequently used tool for making a minimum requirements decision, and the two-step analysis process has become ubiquitous.[684] In any event, the courts have made it clear that before the federal agency can authorize one of these prohibited uses, it must explain why non-prohibited uses would be insufficient to preserve the area's wilderness character.[685]

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enhancement of fisheries was not necessary to meet minimum requirements for the administration of the area).

679 16 U.S.C. § 1133(c).

680 *See, e.g.*, *id.* § 1281(b) ("Any portion of a component of the national wild and scenic rivers system that is within the national wilderness preservation system . . . shall be subject to the provisions of both the Wilderness Act and this chapter . . . .").

681 Wilderness Watch, Inc. v. U.S. Fish & Wildlife Serv. (*Kofa*), 629 F.3d 1024, 1037 n.8 (9th Cir. 2010) (emphasis added).

682 *See id.* at 1049 & n.9 (Bybee, J., dissenting) (arguing that the word "necessary" should be construed broadly, as it has with respect to other legislation, but failing to recognize that none of the other examples couples "necessity" with the Wilderness Act's qualifier "minimum").

683 *See* ARTHUR CARHART NAT'L WILDERNESS TRAINING CTR., MINIMUM REQUIREMENTS DECISION GUIDE: OVERVIEW 1, 3 (2016), https://perma.cc/XDH4-F6BP.

684 *See, e.g.*, Director's Order No. 41, Jonathan Jarvis, Dir., Nat'l Park Serv., U.S. Dep't of Interior, Wilderness Stewardship § 6.4 (May 13, 2013), https://perma.cc/5XKB-L9TJ (requiring national parks to follow the two-step analysis process when completing the minimum requirements analysis); ARTHUR CARHART NAT'L WILDERNESS TRAINING CTR., MINIMUM REQUIREMENTS DECISION GUIDE: U.S. FOREST SERVICE GUIDELINES 1 (2008), https://perma.cc/8YL6-S3V7 ("Use of the MRDG is not currently required by law or agency policy . . . . However, use of the MRDG or a similar minimum requirements analysis (MRA) process was strongly recommended by the chief in a 2000 memo."); BLM MANUAL, *supra* note 673, app. B-1 ("BLM will use the Minimum Requirements Decision Guide (MRDG) developed by the Arthur Carhart National Wilderness Training Center."); FWS WILDERNESS POLICY, *supra* note 437, § 1.20 (requiring national wildlife refuge staff to attend a wilderness training at Carhart before making minimum requirement decisions).

685 *See Kofa*, 629 F.3d at 1037–38 ("[T]he key question—whether water structures were necessary at all—remains entirely unanswered and unexplained by the record . . . . [N]owhere in the record does the Service explain why [conforming] actions, alone or in combination, are insufficient . . . ."); *cf.* High Sierra Hikers Ass'n v. Blackwell, 390 F.3d 630, 646 (9th Cir. 2004)

iv. Special Provisions

The Wilderness Act contains a number of "special provisions."[686] Three of these are applicable to the management of wildlife in wilderness. One special provision deals wholly with wildlife management, the so-called savings clause: "Nothing in this chapter shall be construed as affecting the jurisdiction or responsibilities of the several States with respect to wildlife and fish in the national forests."[687] As with similar savings clauses discussed above, this provision retains federal jurisdiction over wildlife on federal lands, while recognizing the traditional interest of the states with respect to wildlife management insofar as consistent with Wilderness Act purposes.[688] Federal land managers cannot defer to state management prerogatives when doing so would violate the express terms of the Wilderness Act,[689] or undermine the purposes of the Act.[690]

The second relevant special provision involves pre-existing uses of aircraft or motorboats. The Wilderness Act states "the use of aircraft or motorboats, where these uses have already become established, may be permitted to continue subject to such restrictions as the Secretary . . . deems

(construing the Wilderness Act's provision for commercial services "to the extent necessary for activities which are proper for realizing the recreational or other wilderness purposes of the areas," and holding that in order to invoke that exception, the agency must make a reasoned finding of necessity (quoting 16 U.S.C. § 1133(d)(5))).

686 16 U.S.C. § 1133(d).

687 *Id.* § 1133(d)(7). This provision was extended to BLM: "Once an area has been designated for preservation as wilderness, the provisions of the Wilderness Act which apply to national forest wilderness areas shall apply with respect to the administration and use of such designated area." FLPMA, 43 U.S.C. § 1782(c) (2012) (citation omitted).

688 *See* Lindsay Sain Jones, Note, *The Problem with the Bureau of Land Management's Delegation of Wildlife Management in Wilderness*, 47 GA. L. REV. 1281, 1310 (2013) (stating that the savings clause does not affect "the nature of the jurisdiction or responsibility of the states with respect to wildlife on federal lands"; thus "the federal government's jurisdiction over wildlife on federal lands remains intact"); *cf.* Izaak Walton League of Am. v. St. Clair, 353 F. Supp. 698, 707 (D. Minn. 1973) (holding that, despite the general rule that the federal government has no inherent police power and that zoning is a power of the states, state zoning provisions were not applicable within a national forest wilderness area), *rev'd on other grounds*, 497 F.2d 849 (8th Cir. 1974).

689 *See Kofa*, 629 F.3d at 1027, 1039–40 (invalidating a cooperative initiative with Arizona to maintain water structures); *Tustemena Lake*, 353 F.3d 1051, 1066–67, 1069 (9th Cir. 2003) (en banc) (prohibiting a salmon enhancement project as a prohibited "commercial enterprise" even though the state had previously administered and maintained regulatory control over the project), *amended en banc by* 360 F.3d 1374 (9th Cir. 2004); Californians for Alts. to Toxics v. U.S. Fish & Wildlife Serv., 814 F. Supp. 2d 992, 996 (E.D. Cal. 2011) (invalidating a joint federal-state plan to restore cutthroat trout to its historic range in a wilderness area by eradicating non-native trout with rotenone); *High Sierra Hikers Ass'n*, 436 F. Supp. 2d 1117, 1122, 1137 (E.D. Cal. 2006) (holding that the repair, maintenance, and operation of dams in a wilderness area to enhance fisheries was not necessary to meet minimum requirements and thus was prohibited despite involvement and support of the California Department of Fish and Game).

690 *See* Wolf Recovery Found. v. U.S. Forest Serv., 692 F. Supp. 2d 1264, 1266, 1269–70 (D. Idaho 2010) (affirming a decision to allow the Idaho Fish and Game Commission to use helicopters to monitor wolves in the Frank Church Wilderness, but only because the activity was "designed to aid the restoration of a specific aspect of the wilderness character of the Frank Church Wilderness that had earlier been destroyed by man").

desirable."[691] Agency regulations and policy specify the conditions to allow such uses and also limit the permissible locations to established sites to be used by the public, rather than for any agency's administrative uses (such as wildlife management), which is subject to the more liberal analysis of simply meeting the "minimum necessary" test.[692]

Third, while commercial activity in wilderness is severely restricted, commercial services are allowable "to the extent necessary for activities which are proper for realizing . . . wilderness purposes."[693] In a series of cases over outfitters in wilderness areas on the Inyo National Forest as well as the Sequoia-Kings Canyon Wilderness, the courts have made it clear that "the [federal] agency's primary responsibility is to protect the wilderness, not cede to commercial needs."[694] Determining the "extent necessary" is paramount: "[The] argument that [certain services] are not specifically forbidden in the wilderness area confuses the absence of a specific prohibition with the requirement of *necessity*; the fact that something is otherwise 'legal' does not make it necessary."[695] In allocating guiding permits, the federal agency errs if it "elevate[s] recreational activity over the long-term preservation of the wilderness character of the land."[696]

b. Subsequent Wilderness Legislation with Wildlife Provisions[697]

A common refrain from wilderness managers is that "the Act designating *my* wilderness contains special direction on the management of wildlife." In most cases, however, the precise language of any given piece of

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691 16 U.S.C. § 1133(d)(1); *see also* Wilderness Watch, Inc. v. Bureau of Land Mgmt., 799 F. Supp. 2d 1172, 1176, 1181 (D. Nev. 2011) (holding that this exception supported BLM's determination to allow police department to conduct search and rescue helicopter training where aircraft use pre-dated designation as protected wilderness area); United States v. Gregg, 290 F. Supp. 706, 706–08 (W.D. Wash. 1968) (upholding conviction for an unauthorized landing of an airplane in a wilderness, but noting that the Secretary could, by regulation, "create an exception to this blanket prohibition at places where the use of aircraft was established before the passage of the Act").

692 *See, e.g.*, U.S. FOREST SERV., HELICOPTER LANDINGS IN WILDERNESS: FINAL ENVIRONMENTAL IMPACT STATEMENT 2–3 (1997), https://perma.cc/BS2C-PGTU ("Established helicopter use was for general public access, not helicopter access authorized by . . . law (such as . . . administrative use by [USFS] or other agencies)."); *see also* Memorandum from James Sippel, Wilderness Planner, Bureau of Land Mgmt., to Robert Taylor, Assistant Field Manager for Nat'l Landscape Conservation Sys., & Juan Palma, Las Vegas Field Manager (Mar. 1, 2007) (on file with authors) (stating that this section of the Wilderness Act is "in reference to previously existing landing strips used as fly-in trailheads" in relatively few wilderness areas).

693 16 U.S.C. § 1133(d)(5).

694 High Sierra Hikers Ass'n v. U.S. Dep't of the Interior, 848 F. Supp. 2d 1036, 1042, 1047 (N.D. Cal. 2012); *see also Blackwell*, 390 F.3d 630, 636, 647 (9th Cir. 2004).

695 High Sierra Hikers Ass'n v. Weingardt, 521 F. Supp. 2d 1065, 1078 (N.D. Cal. 2007) (emphasis added) (noting the agency's conclusion "improperly equates 'preference' with 'need'").

696 *Blackwell*, 390 F.3d at 636, 647.

697 For a comprehensive analysis of wildlife management provisions in post-1964 wilderness bills, see *Federal Lands & Wildlife*, *supra* note 3 (FAQs currently under construction).

subsequent legislation makes no substantive difference in the implementation of the Wilderness Act's provisions.[698]

As of 2017, Congress has designated 711 wilderness areas[699] since the original fifty-four were designated in 1964.[700] Each subsequent bill contains nearly identical "boilerplate" regarding administration of the area: "Subject to valid existing rights, this wilderness area shall be administered by the Secretary . . . in accordance with the Wilderness Act."[701]

The first wilderness legislation to include extra special language[702] specifically pertaining to wildlife was passed in 1972, with the establishment of the Sawtooth National Recreation Area, including the Sawtooth Wilderness.[703] The relevant language of this extra special provision makes no actual difference in wildlife management within the Sawtooth Wilderness.[704] In 1978, Congress started the custom of including not only the blanket "boilerplate" direction,[705] but also repeating or rewording the Wilderness Act's statement on wildlife jurisdiction and responsibilities.[706]

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698 *See infra* notes 707–708 and accompanying text.

699 *National Wilderness Preservation System Fact Sheet*, WILDERNESS CONNECT, https://perma.cc/7EUS-4TBN (last updated June 27, 2017).

700 Shannon Meyer & Peter Landres, *A National Wilderness Preservation System Database*, INT'L J. WILDERNESS, April 2000, at 13, 13.

701 *See, e.g.*, Act of Mar. 21, 1968, Pub. L. No. 90-271, § 3, 82 Stat. 51, 52 (codified at 16 U.S.C. § 1132 (2012)) ("The . . . Wilderness shall be administered by the Secretary . . . in accordance with the provisions of the Wilderness Act governing areas designated by that Act as wilderness areas, except that any reference in such provisions to the effective date of the Wilderness Act shall be deemed to be a reference to the effective date of this Act."); Sawtooth National Recreation Area and Jerry Peak Wilderness Additions Act, Pub. L. No. 114-46, § 102(a), 129 Stat. 477, 477 (2015) (similar); Big Sur Wilderness and Conservation Act of 2002, Pub. L. No. 107-370, § 3(a), 116 Stat. 3071, 3073 (similar). With minor variations, this wording is found in every subsequent law designating wilderness.

702 We use the term "extra special language" to describe provisions other than those found in the Special Provisions enumerated at 16 U.S.C. § 1133(d) or other direction found in the Wilderness Act of 1964.

703 Sawtooth National Recreation Area Act, Pub. L. No. 92-400, §§ 1(a), 8, 86 Stat. 612, 612, 614 (1972) (codified at 16 U.S.C. §§ 460aa–460aa-14).

704 *See* 16 U.S.C. § 460aa-7 (providing that hunting and fishing "shall" be permitted "within the boundaries of the recreation area in accordance with applicable laws of the United States and the State of Idaho, except that the Secretary may designate zones where, and establish periods when, no hunting or fishing shall be permitted for reasons of public safety, administration, or public use and enjoyment," after consultation with the State; the consultation requirement is inapplicable in emergencies); *id.* § 460aa-1(b) ("The lands designated as the Sawtooth Wilderness Area . . . shall be administered in accordance with the provisions of this Act and the provisions of the Wilderness Act whichever is more restrictive . . . ." (citation omitted)).

705 *See supra* note 701 and accompanying text (describing boilerplate language found in all bills designating wilderness areas).

706 *See, e.g.*, Act of Oct. 21, 1978, Pub. L. No. 95-495, § 14, 92 Stat. 1649, 1657 ("Nothing in this Act shall be construed as affecting the jurisdiction or responsibilities of the State with respect to fish and wildlife in the wilderness . . . ."); *cf.* Clark County Conservation of Public Land and Natural Resources Act of 2002, Pub. L. No. 107-282, § 208(a), 116 Stat. 1994, 2005 (reasserting that nothing "affects or diminishes" state jurisdiction).

Of the 139 laws designating wilderness since the passage of the 1964 Act,[707] only four have extra special language that create minor effects in wilderness stewardship of wildlife resources in those particular wilderness areas,[708] and only one has extra special language affecting that particular wilderness that is completely out of the norm of all other wilderness legislation. That bill designated the Wovoka Wilderness and is embedded within the Carl Levin and Howard P. 'Buck' McKeon National Defense Authorization Act for Fiscal Year 2015.[709] The unique provisions of this law are as confusing as they are astonishing, and so are given extended attention here as an extreme outlier. On the one hand, the legislation states the Wovoka "shall be administered by the Secretary in accordance with the Wilderness Act"[710] and House Report 101-405 Appendix B.[711] The law then adds: "The State, including a designee of the State, may conduct wildlife management activities . . . in accordance with the . . . 'Memorandum of Understanding: Intermountain Region [USFS] and the Nevada Department of Wildlife State of Nevada' and signed . . . [in] 1984."[712] The legislation says "may," retaining a measure of federal discretion. But the cited MOU, which does not mention wilderness, contains contradictory direction and does not conform to federal law: "[USFS] agrees [t]o recognize the Department [of Wildlife of the State of Nevada] as the agency responsible for the preservation and management of the wildlife resources in Nevada and for determining the regulations under which fish and wildlife will be managed, utilized, and protected."[713] There is no authority for a state to determine federal regulations, and this provision is contradicted later in the document: "[E]ach and every provision of the Memorandum is subject to the laws of the State of Nevada, the laws of the United States, and the regulations of the Secretary of Agriculture."[714] The MOU also defines "exotic" wildlife species as "those species that do not or have not existed within the continental United States within recorded historical times."[715] By this definition, any

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707 Methodology for counting wilderness bills varies. Here, we count as a separate law bills with their own public law number, separate titles within one public law, and separate sections where the law refers to that section as a Wilderness Act.

708 *See* California Desert Protection Act of 1994, Pub. L. No. 103-433, §§ 503, 506(b), 108 Stat. 4471, 4490 (directing the Secretary to allow hunting in the Mojave National Preserve Wilderness, which was created largely out of BLM lands where hunting was permitted); North Cascades National Park Service Complex Fish Stocking Act, Pub. L. No. 113-137, § 3, 128 Stat. 1741, 1741 (2014) (mandating fish stocking in the North Cascades NPS Complex); Endangered American Wilderness Act of 1978, Pub. L. No. 95-237, § 4(c), 92 Stat. 40, 44 (directing the USFS to conduct wildlife research in cooperation with the State of Idaho in the Gospel-Hump Wilderness); Lee Metcalf Wilderness and Management Act of 1983, Pub. L. No. 98-140, § 2(c), 97 Stat. 901, 901–02 (limiting the use of motor vehicles for wildlife management in the Lee Metcalf Wilderness).

709 Pub. L. No. 113-291, § 3066(b)(1), 128 Stat. 3292, 3838 (2014) (codified in scattered sections of 10, 16, 40, and 46 U.S.C.).

710 *Id.* § 3066(c)(1), 128 Stat. at 3839.

711 *Id.* § 3066(d)(2)(B)(ii), 128 Stat. at 3841; *see* H.R. REP. NO. 101-405 (1990).

712 *Id.* § 3066(d)(5), 128 Stat. at 3842.

713 FSM § 1561.2 exhibit 3(A)(1) (1994).

714 *Id.* § 1561.2 exhibit 3(C)(16).

715 *Id.* § 1561.2 exhibit 3(B)(6)(1).

species from anywhere in the world that is currently anywhere within the continental United States is not exotic (and, according to the MOU, no USFS-advanced approval is necessary for species within the continental United States to be transplanted by the State).[716] This conflicts with the Executive Order defining exotic species as, "with respect *to a particular ecosystem*, any species . . . that is not native *to that ecosystem*," and defining a native species as, "with respect to a particular ecosystem, a species that, *other than as a result of an introduction*, historically occurred or currently occurs in that ecosystem."[717]

Two other statutes are notable in that they contain language affecting the management of wildlife in multiple wilderness areas. The first is ANILCA, which contains far more extra special language on a variety of issues than any other wilderness-designating language "in recognition of the unique conditions in Alaska."[718] Concerning wildlife, ANILCA provides that in national forest wilderness areas the Secretary *may* allow activities and facilities to enhance aquaculture "in a manner which adequately assures protection, preservation, enhancement, and rehabilitation of the wilderness resource."[719] Other provisions dealing with wildlife center on allowable public uses, rather than management actions per se. These include construction of certain structures—with some Secretarial discretion—to facilitate the taking of fish and wildlife,[720] and public use of motor vehicles for subsistence hunting.[721] Additional analysis of the wildlife provisions in ANILCA is found in Part III.B.6.

The other wilderness legislation with extra special language affecting multiple areas is in Title I of the California Desert Protection Act of 1994,[722] which designated sixty-nine wilderness areas under the stewardship of BLM.[723] Section 103(f) contains a unique provision: "Management activities to maintain or restore fish and wildlife populations and . . . habitats . . . *may* be carried out . . . *and shall include the use of motorized vehicles by the appropriate State agencies*."[724] The contradictory use of "shall" and "may" caused considerable confusion in the offices tasked with stewardship of

716 *See id.* § 1561.2 exhibit 3(B)(6) (requiring Regional Forester approval "before transplanting nonindigenous, Federally classified endangered or threatened or exotic[] wildlife species" but not for all other species).

717 Exec. Order No. 13,112, 3 C.F.R. § 159 (2000) (emphasis added) (defining "alien" and "native" species); *see also Frequently Asked Question About Invasive Species*, U.S. FISH & WILDLIFE SERV., https://perma.cc/A9YV-MRHT (last updated Nov. 20, 2012) ("Other terms sometimes used for exotic species include 'non-native[]' 'non-indigenous,' and 'alien.' . . . These definitions come from Executive Order 13112.").

718 16 U.S.C. § 3203(a) (2012).

719 *Id.* § 3203(b).

720 *Id.* § 3204(a).

721 *Id.* § 3121(b).

722 *Id.* §§ 410aaa–410aaa-83.

723 *See, e.g.*, California Desert Protection Act of 1994, Pub. Law No. 103-433, § 102(3), (55), (61), 108 Stat. 4471, 4473, 4479–80 (designating, among others, the Bighorn Mountain Wilderness, Rodman Mountains Wilderness, and Sheephole Valley Wilderness).

724 *Id.* § 103(f), 108 Stat. at 4482 (emphasis added).

these areas.[725] Ultimately, BLM determined the correct interpretation of this language is that "BLM continues to hold the ultimate responsibility for managing any actions occurring with in [sic] the wilderness areas . . . [and w]hen BLM and [the California Department of Fish and Wildlife (CDFG)] cooperatively determine the need [for any access by CDFG] . . . CDFG and their volunteer organizations will be allowed to continue to use motor vehicles to carry out these necessary activities."[726]

Another notable wilderness bill is the Arizona Desert Wilderness Act of 1990,[727] which was the first of many laws to direct wildlife management "in accordance with appropriate policies and guidelines such as those set forth in Appendix B of [House Report 101-405]."[728] As discussed below, this House Report is a verbatim transcript of the substantive portions of the 1986 International Association of Fish and Wildlife Agencies (IAFWA) agreement,[729] and Congressional direction here contains two important points: 1) management actions "*may* be carried out"—i.e., action is not mandatory but discretionary; and 2) actions should be "consistent with relevant wilderness management plans"—i.e., discretion to take action lies with the federal land manager.[730] In short, except for aerial fish stocking,[731] the federal responsibility to manage wildlife in such a way as to preserve an area's wilderness character was not changed.

Some more recent laws in Nevada and Idaho have lengthy sections on wildlife management that affirm federal discretion, but (with one exception)[732] these sections change nothing of substance from the authority found in the Wilderness Act itself.[733] The considerable confusion and

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725 Memorandum from Ed Hartey, State Dir., Bureau of Land Mgmt., to Dist. Managers of Bakersfield and Cent. Cal. Dist., Bureau of Land Mgmt. (Sept. 30, 1997), https://perma.cc/T4MU-N2GT.

726 *Id.*

727 Pub. L. No. 101-628, 104 Stat. 4469 (codified at 16 U.S.C. § 460ddd).

728 *Id.* § 101(h), 104 Stat. at 4474; *see* H.R. REP. NO. 101-405 (1990).

729 *See* discussion *infra* Part III.B.7.d.

730 Arizona Desert Wilderness Act of 1990, § 101(h), 104 Stat. at 4474.

731 *See* U.S. FOREST SERV., BUREAU OF LAND MGMT. & INT'L ASS'N OF FISH & WILDLIFE AGENCIES, APPENDIX I: POLICIES AND GUIDELINES FOR FISH AND WILDLIFE MANAGEMENT IN NATIONAL FOREST AND BUREAU OF LAND MANAGEMENT WILDERNESS I-8 to -9 (1986), https://perma.cc/YE3K-8DEF [hereinafter IAFWA 1986 AGREEMENT]. Under the IAFWA 1986 Agreement: "Aerial stocking of fish *shall* be permitted for those waters in wilderness where this was an established practice before wilderness designation or where other practical means are not available." *Id.* (emphasis added). While "[a]erial stocking requires approval by the administering agency," agency discretion is limited in that such use of aircraft is exempted from the "minimum necessary" requirement as discussed above in Part III.B.7.a.iii. *Id.* at I-9.

732 *See supra* notes 709–717 and accompanying text (discussing the Wovoka Wilderness legislation). We review extra special wildlife provisions in wilderness law in more detail in the FAQs accompanying this Article. *See Federal Lands & Wildlife*, *supra* note 3 (FAQs currently under construction).

733 *See* Clark County Conservation of Public Land and Natural Resources Act of 2002, Pub. L. No. 107-282, § 208, 116 Stat. 1994 (2005); Lincoln County Conservation, Recreation, and Development Act of 2004, Pub. L. No. 108-424, § 209, 118 Stat. 2403, 2411–12; Tax Relief and Health Care Act of 2006, Pub. L. No. 109-432, § 329, 120 Stat. 2922, 3036–37; Omnibus Public Land Management Act of 2009, Pub. L. No. 111-11, § 1503(b)(8), 123 Stat. 991, 1035–36; Carl Levin and Howard P. "Buck" McKeon National Defense Authorization Act for Fiscal Year 2015,

misinterpretation of these laws by federal managers, state employees, and nongovernmental organizations is discussed in Part IV.E.

c. Agency Policy

Each of the four agencies has developed policy measures to guide wilderness managers. According to NPS's policy, both planning and management activities "must ensure that wilderness character is likewise preserved" within designated units of the National Park System.[734] It provides: "The purpose of wilderness in the national parks includes the preservation of wilderness character and wilderness resources in an unimpaired condition and, in accordance with the Wilderness Act, wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use."[735] "In addition to managing these areas for the preservation of the physical wilderness resources, planning for these areas must ensure that the wilderness character is likewise preserved."[736]

FWS's policy provides that, upon designation, wilderness character becomes an additional purpose of any wilderness area within a refuge. More specifically, the agency's policy states: "As we carry out individual refuge establishing purpose(s), the Administration Act purposes, the Refuge System mission and goals, and [FWS]'s mission in areas designated as wilderness, we do so in a way that preserves wilderness character."[737]

For the National Forest System, USFS's policy states that "[w]ildlife and fish management programs shall be consistent with wilderness values."[738] It commits the agency to "[b]ase any [USFS] recommendation to State wildlife and fish agencies on the need for protection and maintenance of the wilderness resource";[739] "[p]rovide an environment where the forces of natural selection and survival rather than human actions determine which and what numbers of wildlife species will exist";[740] and "[d]iscourage measures for direct control (other than normal harvest) of wildlife and fish populations."[741] In addition, practical application of the USFS policies reflects the *Policies and Guidelines for Fish and Wildlife Management in*

Pub. L. No. 113-291, §§ 3064(e), 3066(d), 128 Stat. 3292, 3831–32, 3841–42 (2014). For a section-by-section analysis of these laws, see *Federal Lands & Wildlife*, *supra* note 3 (FAQs currently under construction).

734 NPS MANAGEMENT POLICIES, *supra* note 375, §§ 6.1, 6.3.1.

735 *Id.* § 6.1.

736 *Id.* § 6.3.1.

737 FWS WILDERNESS POLICY, *supra* note 437, § 1.12(B).

738 FSM § 2323.32(2) (2006).

739 *Id.* § 2323.32(1). This provision recognizes that states also have responsibilities for the protection of wildlife in wilderness and calls for cooperative federalism in fish and wildlife management. *Id.*

740 *Id.* § 2323.31(1).

741 *Id.* § 2323.32(3).

National Forest and Bureau of Land Management Wilderness developed with AFWA.[742] This document is discussed below.

BLM's wilderness policy was completely rewritten in 2012.[743] Though never explicitly stated, the wildlife section of this policy purposefully adheres more closely to the IAFWA 1986 Agreement than the 2006 Agreement.[744] Importantly, the 2012 BLM policy provides that "States have *a* primary and critical role" rather than "*the* primary role" in wildlife management,[745] recognizing that the states' interests are not supreme, but that either the states or the federal agency may initiate wildlife stewardship proposals in wilderness. In addition, the policy plainly declares "[t]he ultimate responsibility to preserve wilderness character rests with the BLM"; it emphasizes wilderness preservation and requires the use of the Carhart *Minimum Requirements Decision Guide* for any wildlife management action.[746] It also clarifies the prohibition on commercial use of wildlife.[747]

d. Wilderness and the Association of Fish & Wildlife Agencies

While Congress has not substantially changed wildlife management in wilderness with the recent legislation discussed above, for a little more than a decade there have been significant efforts to do so through legally questionable policy channels and nontransparent agreements between federal agencies and IAFWA or AFWA (the Association changed names in 2006).

In 1986, USFS and BLM made a comprehensive revision of their wilderness management directives with the cooperation of IAFWA.[748] This agreement consists of a statement of purpose, general sideboards for the management of fish and wildlife in wilderness, and details regarding specified actions that may or may not be taken in cooperation with the states.[749] It maintains federal control over decision-making processes,

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742 *See id.* § 2323.32(5) (citing U.S. FOREST SERV. ET AL., POLICIES AND GUIDELINES FOR FISH AND WILDLIFE MANAGEMENT IN NATIONAL FOREST AND BUREAU OF LAND MANAGEMENT WILDERNESS (2006), https://perma.cc/M8MK-WDCY [hereinafter AFWA 2006 AGREEMENT]). For details on the AFWA 2006 Agreement, see discussion *infra* Part III.B.7.d.

743 BLM MANUAL, *supra* note 673 (superseding BUREAU OF LAND MGMT., MANUAL TRANSMITTAL SHEET: 8560—MANAGEMENT OF DESIGNATED WILDERNESS AREAS).

744 *See, e.g.*, *id.* § 1.6(C)(21)(c)(v) (discussing chemical treatment of pesticides). *Compare* AFWA 2006 AGREEMENT, *supra* note 742, at 6 (providing a less comprehensive policy and guidelines for application of pesticides), *with* IAFWA 1986 AGREEMENT, *supra* note 731, at I-6 to -7 (providing a more comprehensive policy and guidelines for application of pesticides).

745 BLM MANUAL, *supra* note 673, § 1.6(C)(21)(b)(i) (emphasis added). This is a shift from the misleading language of 43 C.F.R. § 24.3 (2016). *See* discussion *infra* Part IV.C.

746 BLM MANUAL, *supra* note 673, § 1.6(C)(21)(b)(ii)–(iii), app. B-1 (discussing application of the ARTHUR CARHART NAT'L WILDERNESS TRAINING CTR., *supra* note 683).

747 *Id.* § 1.6(C)(21)(c)(ix)(E).

748 IAFWA 1986 AGREEMENT, *supra* note 731, at I-1.

749 *Id.* at I-1 to -2. Fourteen specific action areas are listed: use of motorized equipment; fish and wildlife research and management surveys; facility development and habitat alteration; threatened and endangered species; angling, hunting, and trapping; population sampling; chemical treatment; spawn taking; fish stocking; aerial fish stocking; transplanting wildlife;

recognizes the responsibility afforded federal managers by the Wilderness Act, and is guided by the following direction: "Fish and wildlife management activities will emphasize the protection of natural processes . . . [and] by the principle of doing only the minimum necessary to manage the area as wilderness."[750] As noted above, these guidelines were incorporated into House Report 101-405 and referenced in several subsequent wilderness bills.[751]

Although USFS, BLM, and IAFWA "reaffirmed [their] mutual commitment" to the 1986 Agreement in 1995[752] and again in 2002,[753] the agencies initiated a complete revision of the document and ultimately issued a revamped "Policies and Guidelines" in 2006.[754] There were remarkable changes between the 1986 Agreement and the 2006 Agreement.[755] The solicitor assigned to review the 2006 Agreement on behalf of the Department of the Interior noted several problems with it, including significant inconsistencies with federal law.[756] At least one AFWA officer was unconcerned: "[U.S. Department of the Interior] Solicitors balked but BLM Director made the decision to sign."[757]

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wildlife damage control; visitor management to protect wilderness wildlife resources; and management of fire. *Id.* at I-2 to -11.

750 *Id.* at I-1. The 1986 Agreement veers off course in one respect, found in the section on aerial fish stocking: "Aerial stocking of fish *shall* be permitted for those waters in wilderness where this was an established practice before wilderness designation or where other practical means are not available." *Id.* at I-8 to -9 (emphasis added).

751 *See supra* notes 710–712, 727–729 and accompanying text.

752 Memorandum from Jack Ward Thomas, Chief, U.S. Forest Serv., et al., to Reg'l Foresters et al., Int'l Ass'n of Fish & Wildlife Agencies 1 (Feb. 23, 1995) (on file with authors).

753 Memorandum from Dale N. Bosworth, Chief, U.S. Forest Serv., et al., to State Gov't Members of the Int'l Ass'n of Fish & Wildlife Agencies, et al. 1–2 (Aug. 9, 2002) (on file with authors) (noting "the statutory endorsement of the existing guidelines by the Arizona Desert Wilderness Act").

754 AFWA 2006 AGREEMENT, *supra* note 742.

755 *Compare* IAFWA 1986 AGREEMENT, *supra* note 731, at I-5 ("[S]uch actions [related to threatened and endangered species] must be necessary for the perpetuation or recovery of the species and it must be demonstrated that the actions cannot be done more effectively outside wilderness."), *with* AFWA 2006 AGREEMENT, *supra* note 742, at 8–9 (omitting the language from the IAFWA 1986 Agreement).

756 *See* Facsimile Transmission from Kris Clark, Div. of Land & Water Res., U.S. Dep't of the Interior, to Dwight Fielder, Bureau of Land Mgmt., & Jeff Jarvis, Bureau of Land Mgmt. 1, 6–7 (Aug. 10, 2005) (on file with authors) ("[T]he handling of the 'minimum requirements' analysis appears to conflict with the Wilderness Act . . . . [It] materially changes the meaning of the provision [of section 4(c) in the Wilderness Act]," "[The Agreement fails to recognize that] Federal law, including regulations and discretionary actions, preempt[s] state jurisdiction."); *see also* e-mail from Kris Clark to E. Dwight Fielder, Chief, Div. of Fish, Wildlife & Plant Conservation, Bureau of Land Mgmt. (June 22, 2006) (on file with authors) (explaining that "decisions about federal agency management of wildlife in wilderness areas is not the appropriate subject for negotiation with an outside group" and stating that the Agreement's characterizations of the Wilderness Act "are misleading and in many cases incorrect").

757 E-mail from Gary J. Taylor, Legislative Dir., Ass'n of Fish & Wildlife Agencies, to Duane Shroufe et al. (July 18, 2006) (on file with authors) (also noting "USDI Solicitors question[ed] [the] legal status of AFWA being able to speak for the states. Whatever . . . the important thing is that it is signed." (omission in original)); *see also id.* (stating that the USFS Chief, BLM Director,

A complete inventory of the changes is available elsewhere,[758] but problematic additions or deletions include the following:

- Declaring that "State fish and wildlife management activities that do not involve Wilderness Act prohibitions identified . . . in Section 4(c) . . . are generally exempt from authorizations by the Federal administering agencies,"[759] when in fact federal requirements to preserve wilderness character go beyond prohibiting section 4(c) uses and include prevention of any action that may degrade an area's wilderness character (e.g., introducing a non-native species).[760]

- Giving states responsibility to determine whether wildlife and fish species are indigenous, thereby possibly degrading the Natural Quality of wilderness character.[761] Associated with this change is the deletion of the IAFWA 1986 Agreement prohibition on stocking exotic fish.[762]

- Identifying any state plans and agreements as sufficient to establish if an action is necessary in wilderness, when the Wilderness Act states prohibited uses can be approved only to manage the area for the purpose of the Act.[763]

- Deleting a passage committing the agencies to being guided by the principle of doing "only the minimum necessary to manage the area as wilderness," and assigning authority for completing the "minimum requirements" analysis in part to the states,[764] when the Act unequivocally gives federal agencies the sole responsibility to manage wilderness areas and preserve their wilderness character.[765]

- Analyzing implementation alternatives on the basis of impacts to "the wilderness characteristics (naturalness, outstanding

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and AFWA Executive Vice President "all agreed no fanfare, news release or anything spotlighting it").

758 ARTHUR CARHART NAT'L WILDERNESS TRAINING CTR., POLICIES AND GUIDELINES FOR FISH AND WILDLIFE MANAGEMENT IN NATIONAL FOREST AND BUREAU OF LAND MANAGEMENT WILDERNESS: A COMPARISON OF THE 1986 IAFWA AND 2006 AFWA DOCUMENTS, https://perma.cc/KR83-7CNK (last updated May 30, 2017).

759 AFWA 2006 AGREEMENT, *supra* note 742, at 5.

760 *See* discussion *supra* Part.III.B.7.a.i.

761 AFWA 2006 AGREEMENT, *supra* note 742, at 5.

762 *See* IAFWA 1986 AGREEMENT, *supra* note 731, at I-8 ("Exotic species of fish shall not be stocked.").

763 Wilderness Act, 16 U.S.C. § 1133(c) (2012); AFWA 2006 AGREEMENT, *supra* note 742, at 5, 16.

764 *See* IAFWA 1986 Agreement, *supra* note 731, at 1 (containing the now-deleted language about doing only the minimum necessary); AFWA 2006 Agreement, *supra* note 742, at 14 ("[T]he intent of this attachment is to document the analysis process used by the BLM and [USFS], in cooperation with the State fish and wildlife agencies, to determine the 'minimum requirements' for accomplishing fish and wildlife projects and activities within a wilderness area.").

765 16 U.S.C. § 1133(b).

> opportunities for solitude or primitive and unconfined recreation, and other special features)," and omitting consideration of other important impacts, in particular, to the untrammeled quality and the undeveloped quality.[766]

These provisions, and other AFWA initiatives, reflect AFWA's fundamental misunderstanding of the federal role in managing wildlife. According to AFWA: "The state fish and wildlife agencies are responsible for fish and wildlife management within their borders, even on most federal public lands—including federal lands designated as Wilderness."[767] While the states have duties related to wildlife management, no statute grants them authority in wilderness—or other federal lands—superior to the federal agencies.[768]

It is clear from the plain text of the Wilderness Act that Congress intended the preservation of wilderness character as the primary purpose of the Act. Congress was adamant that wilderness areas shall be "administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment *as wilderness*,"[769] and that allowing otherwise prohibited uses to meet minimum necessary requirements must be for the purpose of the Act,[770] not for meeting "states' abilities to accomplish big game harvest objectives."[771] The misconception that federal agencies should only utilize "[w]ilderness management planning processes that support the state wildlife agencies and their wildlife management responsibilities and goals"[772] is exactly backward. In wilderness, state wildlife agencies should support—and cannot undermine—the congressional mandate to preserve wilderness character. While the state agencies may not be required to do so, the federal agencies must evaluate any action that may degrade wilderness character and are required to deny any action that does so.[773]

IV. ANALYSIS AND RECOMMENDATIONS

A. The Federal Obligation to Manage and Conserve Fish and Wildlife on Federal Lands

We begin our analysis by recognizing that federal land agencies have an *obligation*, and not just the discretion, to manage and conserve fish and

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766 AFWA 2006 AGREEMENT, *supra* note 742, at 17.

767 John Kennedy, Speech at the National Wilderness Conference in Albuquerque, New Mexico: Fish and Wildlife Management in Wilderness 2 (Oct. 17, 2014) [hereinafter Kennedy Speech] (transcript on file with authors).

768 *See* 16 U.S.C. § 1133(a)(3) ("Nothing in this chapter shall modify the statutory authority under which units of the national park system are created.").

769 *Id.* § 1131(a) (emphasis added).

770 *Id.* § 1133(c).

771 Kennedy Speech, *supra* note 767, at 6.

772 *Id.* at 11.

773 16 U.S.C. § 1133(b).

wildlife on federal lands. Before explaining, it is important to first dispel the common myth that "the states manage wildlife, federal land agencies only manage wildlife habitat."[774] We found this mantra repeated throughout our study, and it was commonly invoked by state *and* federal agencies in multiple cases and contexts.

The mantra has a long history and can be traced to the different sources of federal and state powers regarding wildlife management. As discussed in Part II.A, states claim ownership of wildlife and a commensurate public trust duty to manage it in the public's interest. On the other hand, the Property Clause of the U.S. Constitution provides federal land agencies with vast plenary powers to manage public lands—and the wildlife thereon.[775] Writing in 1970, the Public Land Law Review Commission noted that "[h]istorically, the states have regulated the game population, and the Federal Government has managed the habitat."[776] But the Commission also observed that, "increasingly, . . . the line between the traditional functions has become shadowy" because of the interplay between wildlife populations and habitat.[777] The Commission released its report prior to passage of the ESA, NFMA, and FLPMA.[778] And while these laws gave federal land agencies new responsibilities to conserve at-risk species and manage wildlife, and not just wildlife habitat, the "federal lands-habitat" refrain continued.

Part of the mantra's endurance is also due to the states' traditional role in regulating hunting, fishing, and trapping. As discussed previously, FLPMA and the Sikes Act include provisions related to hunting and fishing on public lands administered by USFS and BLM, meaning that federal agencies most often defer to the states when it comes to regulating the harvest of fish and wildlife on federal lands.[779] Congress has shown no interest in usurping this traditional role of the states. However, wildlife management goes beyond simply setting harvest levels and methods. Just because the federal government has traditionally deferred to the states in establishing regulations pertaining to hunting, fishing, and trapping does not mean "the states manage wildlife, and federal land agencies manage wildlife habitat." We suspect that this non sequitur explains why the mantra has been so rarely questioned in the past.

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774 *See, e.g.*, *Kleppe*, 426 U.S. 529, 534 n.4, 536–37 (1976) ("[The State of New Mexico] contend[s] that the [Property] Clause grants Congress essentially two kinds of power: (1) the power to dispose of and make incidental rules regarding the use of federal property; and (2) the power to protect federal property. According to [the State], the first power is not broad enough to support legislation protecting wild animals that live on federal property; and the second power is not implicated since the Act is designed to protect the animals, which are not themselves federal property, and not the public lands.").

775 *See id.* at 546; Blumm & Paulsen, *supra* note 5, at 1461.

776 PUB. LAND LAW REVIEW COMM'N, ONE THIRD OF THE NATION'S LAND: A REPORT TO THE PRESIDENT AND TO THE CONGRESS BY THE PUBLIC LAND LAW REVIEW COMMISSION 158 (1970), https://perma.cc/7R83-JWLF.

777 *Id.*

778 *See id.* at iii (submitting the report in 1970). The ESA, NFMA, and FLPMA were passed in 1973, 1976, and 1976, respectively. *See supra* notes 87–88, 287 and accompanying text.

779 *See supra* notes 104–105, 579–582 and accompanying text.

The mantra is wrong from a legal standpoint, limited from a biological one, and problematically simplifies the complexity of wildlife-habitat relationships. We take issue with the mantra because it invariably leads to fragmented approaches to wildlife conservation and unproductive battles over agency turf, and it often leads to an abdication of federal responsibility over wildlife.

We begin with a review of the public land laws surveyed in Part III.B. We then turn to the public trust and national interest in federal lands, and finally to the biological and ecological concerns perpetuated by the wildlife-habitat mantra.

1. Federal Land Laws Governing Wildlife Management

Part III.B makes clear that Congress directed all four federal land management agencies to manage wildlife on federal lands and to not just provide wildlife habitat. The ESA is a good starting point because the Act and its regulations so clearly intertwine the fate of species and ecosystems. The two are linked together under the law, and the statute mandates that all federal land agencies utilize their authorities to effectuate the purposes of the Act.[780] And the purpose of the Act, after all, is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved."[781] Furthermore, the meaning of "harm," in the definition of "take" includes "significant habitat modification or degradation."[782] The ESA obligates federal agencies to conserve species and to avoid jeopardizing the continued existence of the listed species or destroying critical habitat.[783]

The ESA is also significant because of the role played by federal lands in the conservation of listed and candidate species. The most recent assessment, completed in 2008, measured the distribution of ESA-status species (listed as endangered, threatened, or candidate) and species defined by NatureServe as imperiled.[784] It found that federal lands are significant reservoirs of biodiversity.[785] Lands managed by USFS and the Department of Defense (DOD) stood out in terms of supporting the greatest number of species with status under the ESA. Both agencies harbored about 23% of species with ESA-status (at least 355 species for each agency), followed by

780 ESA, 16 U.S.C. § 1536(a)(1) (2012); *see supra* note 311 and accompanying text.

781 16 U.S.C. § 1531(b).

782 50 C.F.R. § 17.3(c)(3) (2016).

783 16 U.S.C. § 1536(a)(1)–(2).

784 Bruce A. Stein et al., *Federal Lands and Endangered Species: The Role of Military and Other Federal Lands in Sustaining Biodiversity*, 58 BIOSCIENCE 339, 341 (2008). NatureServe provides independent conservation status assessments for extinction risks facing species in the United States. *Id.* at 340; *About Us*, NATURESERVE, https://perma.cc/K8TD-6J8R (last visited Nov. 11, 2017) ("[W]e collect decision-quality data about imperiled species and entire ecosystems, transform that data into knowledge products and visualizations, and provide meaning through expert analyses and support to guide decision-making, implement action, and enhance conservation outcomes.").

785 Stein et al., *supra* note 784, at 346.

NPS (19%), FWS (18%), and BLM (16%).[786] USFS also harbored the most NatureServe-defined imperiled species: approximately 27% of the total (at least 821 species).[787] This was followed by BLM (20%) and DOD lands (15%).[788]

To put these percentages in context, consider the importance of national forest lands to fish and wildlife more broadly:

> The 193 million acres of the National Forest System support much of North America's wildlife heritage, including: habitat for 430 federally listed threatened and endangered species, six proposed species, and 60 candidate species, with over 16 million acres and 22,000 miles of streams designated as critical habitat for endangered species; approximately 80% of the elk, mountain goat, and bighorn sheep habitat in the lower 48 States; nearly 28 million acres of wild turkey habitat; approximately 70% of the Nation's remaining old growth forests; over 5 million acres of waterfowl habitat; habitat for more than 250 species of migratory birds; habitat for more than 3,500 rare species; some of the best remaining habitat for grizzly bear, lynx, and many reptile, amphibian and rare plant species; over two million acres of lake and reservoir habitat; and over two hundred thousand miles of fish-bearing streams and rivers.[789]

Amongst federal land agencies, BLM has the "fewest ESA status species" and "ranks second for number of imperiled species."[790] Nonetheless, over 245 ESA-listed species and at least another 31 candidate species are found on BLM lands, and roughly 450 rare and listed plant and animal species "are believed to occur only on BLM-managed lands."[791] While private and other landholdings are essential to biodiversity conservation, federal lands will play an increasingly crucial role in the future.[792]

The wildlife conservation mandates given to NPS and FWS are unambiguous in the obligation to prioritize the conservation of fish and wildlife. The National Park Service Organic Act makes the conservation of

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786 *Id.* at 343 & fig.2.

787 *Id.*

788 *Id.*

789 U.S. FOREST SERV., BIOLOGICAL ASSESSMENT OF THE UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL FOREST SYSTEM LAND MANAGEMENT PLANNING RULE FOR FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES; SPECIES PROPOSED FOR FEDERAL LISTING; SPECIES THAT ARE CANDIDATES FOR FEDERAL LISTING ON NATIONAL FOREST SYSTEM LANDS 17–18 (2011), https://perma.cc/F4EP-4LQZ.

790 Stein et al., *supra* note 784, at 345.

791 *Threatened and Endangered Species*, BUREAU LAND MGMT., https://perma.cc/2RYC-DFY2 (last visited Nov. 11, 2017); *see Threatened and Endangered . . .* , FLICKR, https://perma.cc/W65S-3QD4 (last visited Nov. 11, 2017) (follow "Show more" hyperlink).

792 Stein and colleagues conclude that "[g]iven the current and projected pace of private land development, we can expect that federal lands will assume greater importance for the protection of our native species." Stein et al., *supra* note 784, at 346; *see also* U.S. FOREST SERV., FUTURE OF AMERICA'S FORESTS AND RANGELANDS: FOREST SERVICE 2010 RESOURCES PLANNING ACT ASSESSMENT 11 (2012), https://perma.cc/ZDB2-TJUR (reviewing how development pressure on nonpublic lands is affecting "the ability of those public lands to sustain important ecosystem services and biodiversity"); *The Disappearing West*, CTR. FOR AM. PROGRESS, https://perma.cc/RU3C-54L2 (last visited Nov. 11, 2017) (discussing the loss of natural land due to human development and the need for private, state, and federal conservation efforts).

park resources, including wildlife, a primary management goal, and the courts are consistent in their reading that conservation is to be prioritized over facilitating public enjoyment.[793] Furthermore, the enjoyment of park resources and wildlife may only occur in "such manner and by such means as will leave them unimpaired for the enjoyment of future generations."[794] The wildlife conservation mandate is even more well defined for national wildlife refuges. The 1997 Improvement Act prioritizes "the conservation of fish, wildlife and plants, and their habitats within the System" and seeks to "ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans."[795] The laws governing national parks and wildlife refuges make clear the obligation to conserve fish and wildlife and its habitat.

The wildlife-habitat mantra is most often invoked in the context of USFS and BLM management.[796] But the multiple-use mandates given to both agencies require that these lands be managed for fish and wildlife purposes, with no distinction made between wildlife and wildlife habitat.[797] The multiple-use mandates provide USFS and BLM considerable discretion, but that does not mean that the agencies can arbitrarily opt out of managing fish and wildlife where laws or regulations require such management.

NFMA provides a more substantive and enforceable mandate for USFS: "[to] provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives."[798] Land and Resource Management Plans, whether written pursuant to the 1982 or 2012 NFMA regulations, must ensure the viability of species in planning areas.[799] The regulations differ in how the viability requirement is defined, but both regulations emphasize the importance of habitat or "ecological conditions" in meeting the diversity mandate.[800] Yet the definitions of viability, in both sets of regulations, focus on the population of species (e.g., their distribution, persistence, resilience, etc.).[801]

FLPMA provides BLM with no wildlife diversity mandate, and it possesses more discretion than other federal land agencies. But this discretion is limited by FLPMA and its regulations.[802] Multiple use is defined in the Act to include "wildlife and fish."[803] Though "habitat for fish and wildlife and domestic animals" is referenced in FLPMA as well, the language

793 *See* discussion *supra* Part II.B.2.a.

794 54 U.S.C. § 100101(a) (Supp. II 2015).

795 16 U.S.C. § 668dd(a)(4) (2012).

796 *See, e.g.*, *Kleppe*, 426 U.S. 529, 536–37 (1976) (invoking the wildlife mantra to challenge federal jurisdiction over unbranded and unclaimed horses and burros on public lands administered by USFS and BLM).

797 *See, e.g.*, 16 U.S.C. § 1604(e)(1); FLPMA, 43 U.S.C. § 1702(c) (2012).

798 16 U.S.C. § 1604(g)(3)(B).

799 36 C.F.R. § 219.9(b) (2012); *id.* § 219.19 (1983).

800 *Id.* §§ 219.9(b), 219.19 (2012); *id.* § 219.19 (1983).

801 *Id.* § 219.19 (2012); *id.* (1983).

802 43 U.S.C. § 1712(c).

803 43 C.F.R. § 1601.0-5(i) (2016).

is embedded in a more inclusive section focused on the ecological and other values for which public lands must be managed.[804] The Act also requires BLM's land use planning process to "give priority to the designation and protection of areas of critical environmental concern,"[805] and "to protect and prevent irreparable damage" to the "fish and wildlife resources" found within these areas.[806] Furthermore, whatever discretion BLM has regarding wildlife conservation becomes much less relevant once a species found on BLM lands is protected by the ESA.

2. The Public Trust and National Interest in Federal Lands

In addition to the statutory requirements summarized above, many of these federal land laws include trust-like language pertaining to the national interest in federal lands, non-impairment, and intergenerational responsibility that further clarifies the federal obligation to conserve wildlife. The NPS Organic Act, for example, requires the conservation of "scenery, natural and historic objects, and wild life" therein and also requires the provision for the enjoyment of the same "in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."[807] The mission of the National Wildlife Refuge System, as provided by the Improvement Act, "is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."[808] In the Wilderness Act, Congress secured "for the American people of present and future generations the benefits of an enduring resource of wilderness."[809] Section 101 of NEPA expresses the federal government's responsibility to use all practicable means to "fulfill the responsibilities of each generation as trustee of the environment for succeeding generations."[810] Finally, the ESA includes similar language pertaining to the multiple values of species "to the Nation and its people" and the importance of "better safeguarding, for the benefit of all citizens, the Nation's heritage in fish, wildlife, and plants."[811]

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804 43 U.S.C. § 1701(a)(8).

805 *Id.* § 1712(c)(3).

806 *Id.* § 1702(a).

807 54 U.S.C. § 100101(a) (Supp. II 2015).

808 National Wildlife Refuge System Administration Act of 1966, 16 U.S.C. § 668dd(a)(2) (2012); *see also* Robert L. Fischman & Robert S. Adamcik, *Beyond Trust Species: The Conservation Potential of the National Wildlife Refuge System in the Wake of Climate Change*, 51 NAT. RESOURCES J. 1, 6 (2011) (analyzing FWS's "variable and amorphous application of 'trust' terminology and the doctrine that such terminology reflects").

809 16 U.S.C. § 1131(a).

810 NEPA, 42 U.S.C. § 4331(b)(1) (2012).

811 16 U.S.C. § 1531(a); *see also Palila*, 471 F. Supp. 985, 994 (D. Haw. 1979), *aff'd on other grounds*, 639 F.2d 495 (9th Cir. 1981), *aff'd*, 852 F.2d 1106 (9th Cir. 1988). According to the court: "It is also possible that Congress can assert a property interest in endangered species which is superior to that of the state. . . . The importance of preserving such a national resource may be of such magnitude as to rise to the level of a federal property interest." *Palila*, 471 F. Supp. at

While the multiple-use statutes of USFS and BLM do not specifically reference an intergenerational trust, it is implied in various provisions pertaining to the national interest in federal lands and the command to not impair them. MUSYA, for instance, requires USFS to manage multiple uses in a combination "that will best meet the needs of the American people . . . without impairment of the productivity of the land."[812] NFMA speaks to "the public interest" and serving "the national interest" in the renewable resources program.[813] And finally, FLPMA similarly recognizes "the national interest" in public lands and requires multiple-use management to "meet the present and future needs of the American people" as well as "long-term needs of future generations," and to do so "without permanent impairment of the productivity of the land and the quality of the environment."[814] The public trust is also acknowledged in Department of the Interior regulations on intergovernmental cooperation in fish and wildlife management:

> The Secretary of the Interior reaffirms that fish and wildlife must be maintained for their ecological, cultural, educational, historical, aesthetic, scientific, recreational, economic, and social values to the people of the United States, and that these resources are held in public trust by the Federal and State governments for the benefit of present and future generations of Americans.[815]

As the statutory language suggests, applying trust principles to lands as varied as those found in the federal system is challenging. It is one thing, for example, to find a trust duty for the national parks, but it becomes murkier when thinking of the routine multiple-use decisions that must be made by USFS and BLM, decisions that often involve the private use of public resources. But even here, there is an understanding by the courts that such private uses must be for "national and public purposes,"[816] and that anti-monopoly restrictions impose a constraint on Congress in making decisions about federal lands as a trust resource.[817] At least one prominent scholar places federal public lands "at the outer reaches of the public trust doctrine."[818] This is in part because federal public land law is a field heavy

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995 n.40. *See generally* Mary Christina Wood, *Protecting the Wildlife Trust: A Reinterpretation of Section 7 of the Endangered Species Act*, 34 ENVTL. L. 605 (2004) (analyzing the wildlife trust doctrine).

812 16 U.S.C. §§ 529, 531(a).

813 *Id.* § 1600(2)–(3).

814 43 U.S.C. §§ 1701(a)(2), (a)(7), 1702(c) (2012).

815 43 C.F.R. § 24.1(b) (2016).

816 *Light*, 220 U.S. 523, 537 (1911).

817 *See Camfield*, 167 U.S. 518, 524 (1897) ("[The United States] would be recreant to its duties as trustee for the people . . . to permit any individual or private corporation to monopolize them for private gain . . . ."); United States v. Trinidad Coal & Coking Co., 137 U.S. 160, 170 (1890) ("[I]n making regulations for disposing of [lands], Congress took no thought of their pecuniary value, but, in the discharge of a high public duty and in the interest of the whole country, sought to develop the material resources of the United States . . . .").

818 Charles F. Wilkinson, *The Public Trust Doctrine in Public Land Law*, 14 U.C. DAVIS L. REV. 269, 273 (1980).

with statutes and regulations, leaving some to question the relevance of applying a common law–based trust doctrine,[819] and also because, in the past, Congress has not hesitated to deploy its Property Clause powers to privatize federal public lands and resources.[820] But by the same token, when it appears Congress has chosen to dispose of federal property, the Court has demanded a clear expression of congressional intent.[821]

The issue of a federal trust duty has received vigorous judicial and scholarly debate in recent years,[822] but the courts have nonetheless referenced a public trust duty in numerous federal land cases.[823] It is fair to say that the federal public trust, like the Property Clause, "favors retention of federal land in national ownership (retention), national over state and local authority (nationalization), and environmental preservation (conservation)," as a matter of constitutional common law.[824]

Whether employed as an interpretive canon by the courts or a conservation tool by the federal agencies, the federal public trust provides a useful way of understanding the broad obligations of federal agencies to

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819 *See id.* at 276 ("The legislative matrix is sufficiently comprehensive that doubts can fairly be raised as to whether there is room for a broad, common law doctrine to operate.").

820 *See id.* (explaining that the government "sold or . . . transferred away" its public lands to allow settlement of the western United States and that "[n]o serious suggestion could be made that private title to some 1.4 billion acres is clouded due to the United States' inability to convey clear title"); *Light*, 220 U.S. at 537 (describing the federal public trust doctrine as applicable to "[a]ll the public lands of the nation [which] are held in trust for the people of the whole country" but also stating that Congress had sole power to dispose of those lands).

821 *See* John D. Leshy, *A Property Clause for the Twenty-First Century*, 75 U. COLO. L. REV. 1101, 1110 (2004) ("[T]he Court demands that Congress express itself more clearly when it wants to dispose of federal lands than when it retains them."). Leshy places the *Light* opinion within the burgeoning conservation thrust of 20th century cases. *See id.* at 1120. Although the Court remarked that Congress, when exercising its rights incident to proprietorship and sovereignty, holds the power to "establish[] a forest reserve for what it decides to be national and public purposes . . . [or] disestablish a reserve," it in fact upheld federal authority to reserve and protect its public lands from destruction by unregulated grazing. *Light*, 220 U.S. at 537.

822 Much of the recent debate stems from a misinterpretation of *PPL Montana, LLC v. Montana*, 565 U.S. 576 (2012). *See, e.g.*, Juliana v. United States, 217 F. Supp. 3d 1224, 1256, 1258 (D. Or. 2016) ("[A] close reading of *PPL Montana* reveals that it says nothing about the viability of federal public trust claims."). For additional background, see Amicus Curiae Brief of Law Professors in Support of Granting Writ of Certiorari at 3–8, Alec L. *ex rel.* Loorz v. McCarthy, 135 S. Ct. 774 (2014) (No. 14-496), 2014 WL 5841697, at *3–8 [hereinafter Amicus Curiae Brief] (arguing the lower court misapplied *PPL Montana*). *See generally* Hope M. Babcock, *Using the Federal Public Trust Doctrine to Fill Gaps in the Legal Systems Protecting Migrating Wildlife from the Effects of Climate Change*, 95 NEB. L. REV. 649 (2017) (arguing the legal basis for a federal version of the public trust doctrine); Michael C. Blumm & Lynn S. Schaffer, *The Federal Public Trust Doctrine: Misinterpreting Justice Kennedy and* Illinois Central Railroad, 45 ENVTL. L. 399, 408–09 (2015) (discussing Justice Kennedy's comments in *PPL Montana* regarding the public trust doctrine).

823 *See* Wilkinson, *supra* note 818, at 298 (identifying thirty-six court opinions describing "the inland public lands as being held in trust"); *Juliana*, 217 F. Supp. 3d at 1258–89 (applying the public trust doctrine to the federal government as a fundamental attribute of sovereignty).

824 *See* Leshy, *supra* note 821, at 1101 (reviewing Property Clause powers); *Juliana*, 217 F. Supp. 3d at 1260 ("[P]ublic trust rights both predated the Constitution and are secured by it.").

manage and conserve wildlife located on or integral to federal lands.[825] We are not suggesting that the trust doctrine will provide a precise guide or formula that can be used by federal agencies to make complicated wildlife decisions. Rather, it will require that federal agencies explicitly consider their own trust obligations in decision-making processes and stop the practice of reflexively acquiescing to state claims of wildlife authority.

The famous "Mono Lake decision" by the California Supreme Court provides a constructive way of thinking about this obligation and what it means in practice.[826] There, the court had to reconcile two different systems of legal thought—the prior appropriation doctrine and public trust doctrine of Western water law—that were on a "collision course."[827] Though the court did not dictate any "particular allocation" of water in the dispute, leaving that decision to the water management agencies, it did make clear that there is "an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible."[828] The public trust duty, said the court, "imposes a duty of continuing supervision over the taking and use of the appropriated water."[829] In the case, the court asked state agencies to integrate two different doctrines of law and corrected the State of California who "mistakenly thought itself powerless to protect" trust resources.[830] Federal agencies similarly have statutory and trust obligations for federal lands and wildlife, and these responsibilities must be factored into their decision-making processes.

Another trust responsibility of relevance is that between the federal government and Indian tribes. While we cannot give this complicated issue full consideration, it is important to recognize yet another layer of trust responsibilities found on federal lands. The federal government has a unique trust responsibility to protect the rights, assets, and property of Indian tribes.[831] This trust responsibility extends to protecting those off-reservation

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825 *See* Melissa K. Scanlan, *A Comparative Analysis of the Public Trust Doctrine for Managing Water in the United States and India*, *in* ROUTLEDGE HANDBOOK OF WATER LAW AND POLICY 23, 25 (Alistair Rieu-Clarke et al. eds., 2017) (describing the trust as a judicial presumption that the state cannot privatize or substantially impair trust resources without a clear statutory directives and findings); William D. Araiza, *The Public Trust Doctrine as an Interpretive Canon*, 45 U.C. DAVIS L. REV. 693, 738 (2012) (characterizing the public trust doctrine as "[a]n interpretive canon . . . that provides courts with a judicially manageable method of vindicating the fundamental principle of public purpose in government management of natural resources").

826 Nat'l Audubon Soc'y v. Superior Court of Alpine Cty., 658 P.2d 709, 711–12 (Cal. 1983).

827 *Id.* at 712.

828 *Id.* at 728, 732.

829 *Id.* at 728.

830 *Id.* at 732.

831 "Though sovereign, Indian tribes are not foreign nations, but rather distinct political communities 'that may more correctly perhaps be denominated domestic, dependent nations,' whose 'relations to the United States resemble that of a ward to his guardian.'" Martin Nie, *The Use of Co-Management and Protected Land-Use Designations to Protect Tribal Cultural Resources and Reserved Treaty Rights on Federal Lands*, 48 NAT. RESOURCES J. 585, 595 (2008) (quoting Cherokee Nation v. Georgia, 30 U.S. (5 Pet.) 1, 2 (1831)). "A less paternalistic way of thinking about this trust relationship" is cast in terms of property; "the federal government has a

use rights that were reserved by tribes through treaties.[832] Hundreds of treaties precede the creation of federal land agencies, and many of these contain provisions that reserved rights on what is now federally managed land.[833] These off-reservation treaty rights often include "hunting and fishing rights, gathering rights, water rights, grazing rights, and subsistence rights."[834] The trust responsibility to protect these rights is recognized by Congress, the Executive Branch, and the courts.[835]

3. The Ecological Fallacy of Separating Wildlife from Habitat

The "states manage wildlife, federal land agencies manage habitat" mantra is also problematic from a biological and wildlife management perspective. This is because it creates a reductionist and oversimplified dichotomy between wildlife and habitat. It is obvious that 1) land management decisions made by federal agencies impact fish and wildlife populations, and 2) the decisions made by state agencies about fish and wildlife populations impact federal land and resources. Consider, for example, the impact a federal oil and gas lease can have on a state-managed mule deer population, or a state introducing non-native mountain goats to a national forest and the impact this introduction will have to that forest's alpine environment. Now, imagine in the latter case, USFS acquiescing to the introduction of non-native mountain goats on the grounds that the agency does not have authority over wildlife management and that it simply manages habitat. In cases like this, the habitat mantra becomes an abdication of federal responsibility over wildlife and its habitat.

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duty to prevent harm to another sovereign's property." *Id.* (citing Mary Christina Wood, *Indian Land and the Promise of Native Sovereignty: The Trust Doctrine Revisited*, 1994 UTAH L. REV. 1471, 1503–04 (1994)).

832 *Id.*

833 *See id.* at 585–86, 596 (discussing reserved treaty rights of Native Nations on federal lands and approaches for protecting such rights).

834 *Id.* at 597.

835 *See* Exec. Order 13,175, 3 C.F.R. § 304 (2000) ("The United States has a unique legal relationship with Indian tribal governments as set forth in the Constitution of the United States, treaties, statutes, Executive Orders, and court decisions. Since the formation of the Union, the United States has recognized Indian tribes as domestic dependent nations under its protection. The Federal Government has enacted numerous statutes and promulgated numerous regulations that establish and define a trust relationship with Indian tribes."); Order No. 3335, Sally Jewel, Sec'y of the Interior, Reaffirmation of the Federal Trust Responsibility to Federally Recognized Indian Tribes and Individual Indian Beneficiaries § 3 (Aug. 20, 2014) (providing background on the trust responsibility including a review of relevant statutes and case law). USFS "recognizes the Federal Government has certain trust responsibilities and a unique legal relationship with federally recognized Indian Tribes." 36 C.F.R. § 219.4(a)(2) (2016); *see also* U.S. FOREST SERV. HANDBOOK § 1509.13(11) (2016) (discussing consultation with Indian tribes); Joint Secretarial Order No. 3206, Sec'y of the Interior & Sec'y of Commerce, American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act § 1 (June 5, 1997), https://perma.cc/U45L-UWXF ("This Order further acknowledges the trust responsibility and treaty obligations of the United States toward Indian tribes and tribal members and its government-to-government relationship in dealing with tribes.").

The fields of wildlife biology and management recognize the complex interplay between wildlife and habitat. For example, state wildlife agencies often make clear in their educational and outreach materials that wildlife management *is* habitat management.[836] And a popular text views habitat

> as a concept that is related to a particular species, and sometimes even to a particular population, of plant or animal. Habitat, then, is an area with a combination of resources (like food, cover, water) and environmental conditions (temperature, precipitation, presence or absence of predators and competitors) that promotes occupancy by individuals of a given species (or population) and allows those individuals to survive and reproduce.[837]

What is wildlife? The authors propose a similarly inclusive definition that includes "the full array of all biota present in an ecosystem as well as their ecological functions."[838] From here, the text goes on to analyze the interconnections between wildlife and habitat, while noting the obvious: "That vegetation plays a central role in the life of many animals is self-evident."[839] The authors, as do others in the field, call for managing wildlife in this larger ecosystem context.[840] In some ways, the call differs little from Aldo Leopold's views of "thinking like a mountain" and protecting the integrity of biotic communities: "The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land."[841]

B. State Wildlife Governance

1. State Ownership and the Wildlife Trust

The common claim that "states own wildlife"—full stop—is incomplete, misleading, and needlessly deepens divisions between federal and state governments. The claim is especially dubious when states assert ownership as a basis to challenge federal authority over wildlife on federal lands. As

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836 *See, e.g.*, Mont. Fish, Wildlife & Parks, *Fish & Wildife: Fish Habitat*, MONTANA.GOV, https://perma.cc/5QWH-7TKS (last visited Nov. 11, 2017) ("Habitat is the KEY to fish and wildlife management in Montana.").

837 MICHAEL L. MORRISON ET AL., WILDLIFE—HABITAT RELATIONSHIPS: CONCEPTS AND APPLICATIONS 10 (3d ed. 2006).

838 *Id.* at 380.

839 *Id.* at 43.

840 *Id.* at 12; *see, e.g.*, Michael A. Huston, *Introductory Essay: Critical Issues for Improving Predictions*, *in* PREDICTING SPECIES OCCURRENCES: ISSUES OF ACCURACY AND SCALE 7, 7 (J. Michael Scott et al. eds., 2002) (explaining that theories of "how certain processes are expected to produce particular ecological patterns" are important "for the management and conservation of natural resources, including endangered species and biodiversity"); BRENDA C. MCCOMB, WILDLIFE HABITAT MANAGEMENT: CONCEPTS AND APPLICATIONS IN FORESTRY 7 (2d. ed. 2016) ("[V]egetation management by forest-land managers is probably the greatest factor influencing the abundance and distribution of animals in our forests today.").

841 ALDO LEOPOLD, A SAND COUNTY ALMANAC: WITH ESSAYS ON CONSERVATION FROM ROUND RIVER 137–41, 239 (1953).

reviewed in Part III.A, the U.S. Supreme Court has rejected this argument time and again. "To put the claim of the State upon title is to lean upon a slender reed," ruled the Court in *Missouri v. Holland*.[842] Decades later, in *Hughes v. Oklahoma*, the Court called such claims a "19th-century legal fiction."[843]

The states are on firm ground when declaring a "sovereign ownership" of wildlife that must be managed in the public interest. However, a more accurate phrase is to say that states manage wildlife under a doctrine of "sovereign trusteeship."[844] In Part II, we highlighted trust-like language found in state constitutions, statutes, and case law. The so-called "wildlife trust doctrine" is essentially a branch of the public trust doctrine. It requires governmental trustees to manage the corpus of the trust—in this case wildlife—in the public interest and for the benefit of present and future generations, who are the beneficiaries of the trust.[845] But the development and application of the wildlife trust is limited when contrasted to other trust resources, such as navigable waterways, submerged lands, and public access.[846]

While rejecting claims of state ownership, the *Hughes* Court makes clear that there nevertheless remain "*legitimate state concerns* for conservation and protection of wild animals" and that the states are not "powerless to protect and conserve wild animal life within their borders."[847] The *Kleppe* Court also acknowledged that "States have broad trustee and police powers over wild animals within their jurisdictions."[848] Although it did not elaborate on these powers, the Court emphasized that they were nevertheless subject to the constitutional powers and supremacy of the federal government.[849] Similarly, in *Baldwin v. Fish & Game Commission of Montana*, the Court remarked that "the State's control over wildlife is not exclusive and absolute in the face of federal regulation."[850] In Part III.A, we

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842 252 U.S. 416, 434 (1920).

843 441 U.S. 322, 335 (1979), *overruling Geer*, 161 U.S. 519 (1896).

844 Mary Christina Wood, *The Tribal Property Right to Wildlife Capital (Part I): Applying Principles of Sovereignty to Protect Imperiled Wildlife Populations*, 37 IDAHO L. REV. 1, 59 (2000).

845 *See Juliana*, 217 F. Supp. 3d 1224, 1254 (D. Or. 2016) ("[B]asic trust principles . . . impose upon the trustee a fiduciary duty to 'protect the trust property against damage or destruction.' The trustee owes this duty equally to both current and future beneficiaries of the trust." (citation omitted)).

846 *See, e.g.*, Frank, *supra* note 15, at 678 ("[T]here has been precious little development of public trust principles in the fish and wildlife context over the past three decades. . . . [T]he reported decisions that do exist seem reluctant to apply public trust principles vigorously to protect fish and wildlife resources."). *But see* Robin Kundis Craig, *A Comparative Guide to the Western States' Public Trust Doctrines: Public Values, Private Rights, and the Evolution Toward an Ecological Public Trust*, 37 ECOLOGY L.Q. 53, 84–86 (2010) (noting that California courts, for example, have applied the public trust doctrine to wildlife).

847 *Hughes*, 441 U.S. at 336, 338 (emphasis added).

848 *Kleppe*, 426 U.S. 529, 545 (1976).

849 *Id.*

850 *Baldwin*, 436 U.S. 371, 386 (1978) ("Nor does a State's control over its resources preclude the proper exercise of federal power."); *see also* Otter v. Jewel, 227 F. Supp. 3d 117, 124–26, (D.D.C. 2017) (holding that sovereign ownership of wildlife based on a state statute did not

reviewed other cases where the courts struck down state wildlife laws—and assertions of state ownership of wildlife—as being in violation of the U.S. Constitution, thus clarifying that state powers over wildlife on federal lands are qualified.

The problem is that states seem to most frequently reference ownership and a public trust in wildlife when declaring broad powers to manage it in opposition to federal (or tribal) interests. In other words, states often claim the powers of a trustee without the accompanying responsibilities.[851] The public trust in wildlife raises a number of related questions. What are the state's affirmative conservation duties under their trust obligations? What must they refrain from doing? Does the doctrine apply to just game species or to biological diversity more broadly?[852] Does it help resolve conflicts amongst species and if so how? Does the doctrine extend to the protection of wildlife habitat? How is the doctrine enforced and, in particular, do private citizens—the beneficiaries of the trust—have the ability to challenge state agencies to ensure protection of trust resources?[853] How can a state exert its trust responsibilities for wildlife on federal lands when a state's trust responsibility is limited to the people of that state only, while federal land and its resources are to be managed for the benefit of all Americans? It is only when these and related questions are sufficiently answered by the states that the term "sovereign ownership" can be used meaningfully.[854]

To summarize, unqualified proclamations that states own wildlife and that the rights associated with ownership limit federal agencies from taking actions to conserve wildlife and its habitat must be challenged. We appreciate that the term "state ownership" is sometimes used as a shortcut to express the trust principles on which it is based and to characterize the state's substantial interest in conserving wildlife. But the term is too often used by the states as a way to challenge federal authority—as if "ownership"

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mean that management of sage grouse on federal lands by the federal government produced an injury-in-fact for the purpose of state standing to challenge federal land management plans), *appeal filed sub nom.*, Otter v. Zinke, No. 17-5050 (D.C. Cir. Mar. 28, 2017).

851 *See* Horner, *supra* note 14, at 28 ("[S]tates have been quick to assert their 'rights' with respect to public trust resources . . . . Unfortunately, their corresponding 'duties' have not been as readily accepted.").

852 *See, e.g.*, Jeremy T. Bruskotter et al., *Rescuing Wolves from Politics: Wildlife as a Public Trust Resource*, 333 SCIENCE 1828, 1828–29 (2011) (arguing that states should utilize the public trust doctrine to protect wildlife species in need of support); Edward A. Fitzgerald, *The Alaskan Wolf War: The Public Trust Doctrine Missing in Action*, 15 ANIMAL L. 193, 197 (2009) ("The public trust doctrine . . . imposes a fiduciary duty on state government to protect and preserve public resources. . . . [It] 'demands fair procedures, decisions that are justified, and results that are consistent with protection and perpetuation of the resource.'").

853 *See* Ctr. for Biological Diversity, Inc. v. FPL Grp., Inc., 83 Cal. Rptr. 3d 588, 603 (Cal. Ct. App. 2008) (affirming that the public has standing to challenge the state's management of wildlife under the public trust doctrine).

854 Eric Freyfogle and Dale Goble summarize: "The problem with taking [wildlife] trust language literally is that there is no trust document that sets forth the precise terms of the trust." FREYFOGLE & GOBLE, *supra* note 292, at 33. So far, they say, "courts have had little or no occasion to struggle with these issues" and "[t]he duties states have and the limits they face in managing wildlife remain largely undecided." *Id.* at 34; *accord* Blumm & Paulsen, *supra* note 5, at 1471; Horner, *supra* note 14, at 27.

provides them with more clout than "trust responsibility"—and it does little to help solve conflict or find common ground with federal agencies.[855]

Further complicating matters is that the state's wildlife trust duty, insofar as it is defined at all, is subject to the federal government's statutory and trust obligations over federal lands. As we discussed above, courts have found a trust responsibility for federal lands and integral resources. Although its potential application and parameters remain ill-defined, the cases tend to reinforce and strengthen federal powers over public lands, not limit them.[856] This is in stark contrast to cases addressing the state public trust doctrine, which tend to restrict legislative and executive actions that run counter to trust responsibilities.[857] This is not to suggest, however, that the doctrine cannot be used to impose limits and obligations on federal agencies. The Redwood National Park litigation is the most well-known example.[858] In a series of cases involving the Park, national park statutes *and* the public trust doctrine were invoked to require affirmative action be taken to protect park resources from external threats posed by logging.[859] There was, according to the court, an obligation to act: "any discretion vested in the Secretary concerning time, place and specifics of the exercise of such

855 As summarized by the Tenth Circuit in the Wyoming National Elk Refuge dispute: "FWS's apparent indifference to the State of Wyoming's problem and the State's insistence of a 'sovereign right' to manage wildlife on the [National Elk Refuge] do little to promote 'cooperative federalism.'" *Wyoming*, 279 F.3d 1214, 1240 (10th Cir. 2002).

856 *See Juliana*, 217 F. Supp. 3d 1224, 1253, 1260 (D. Or. 2016) (applying the public trust doctrine to the federal government as a fundamental attribute of sovereignty, and finding that "plaintiffs' public trust rights both predated the Constitution and are secured by it"); Eric Pearson, *The Public Trust Doctrine in Federal Law*, 24 J. LAND RESOURCES & ENVTL. L. 173, 175 (2004) (noting that the trust doctrine "supplements federal power rather than restricts it"); Wilkinson, *supra* note 818, at 284 ("[T]he trust concept was used to reach results in favor of the United States, that is, to create and reinforce federal powers."). *But see* MICHAEL C. BLUMM & MARY CHRISTINA WOOD, THE PUBLIC TRUST DOCTRINE IN ENVIRONMENTAL AND NATURAL RESOURCES LAW 305 (2d ed. 2015) (challenging the notion that the trust obligation does not impose a restraint on federal land management and noting that these early cases never tested the issue, as many of them centered on the federal government's ability to protect federal lands from trespassers).

857 *See* Ill. Cent. R.R. Co. v. Illinois, 146 U.S. 387, 452–54 (invalidating a transfer of state trust lands—submerged lands under Lake Michigan—to a private company); Robin Kundis Craig, *Adapting to Climate Change: The Potential Role of State Common-Law Public Trust Doctrines*, 34 VT. L. REV. 781, 784 (2010) (discussing how "the classic statement of the American public trust doctrine" provides limitations on the States' ability to alienate trust resources).

858 *See Redwoods III*, 424 F. Supp. 172, 175 (N.D. Cal. 1976) (finding that the Department of the Interior had taken all the necessary steps required of it to protect Redwood National Park under the Redwood National Park Act, 16 U.S.C. §§ 79a–79j (2012), and therefore was discharged of its previous failure to perform duties required by law); *Redwoods II*, 398 F. Supp. 284, 287, 293–94 (N.D. Cal. 1975) (stating that there is a "general trust duty" to conserve and provide for enjoyment of "scenery and natural and historic objects and wildlife . . . in such manner and by such means as will leave them unimpaired"), *modified*, *Redwoods III*, 424 F. Supp. 172 (N.D. Cal. 1976); *Redwoods I*, 376 F. Supp. 90, 93, 95–96 (N.D. Cal. 1974) (finding that any discretion vested in the Secretary of Interior was subordinate to his obligations to protect the park under the public trust doctrine as "guardian of the people of [the] United States over the public lands" and the Redwood National Park Act).

859 *Redwoods III*, 424 F. Supp. at 172–73; *Redwoods II*, 398 F. Supp. at 285; *Redwoods I*, 376 F. Supp. at 93.

powers is subordinate to his paramount legal duty imposed, not only under his trust obligation but by the statute itself, to protect the park."[860]

In moving forward, then, there would be value in attempting to harmonize the multiple trust obligations found on federal lands. As a starting place, the federal government must respond to state assertions of ownership and a wildlife trust by making clear that it too has statutory and trust obligations over federal lands, and they may extend to the conservation of wildlife. In some cases, the implication may be that the federal interest in wildlife preempts that of the states. But, in other cases when there are no competing objectives, a more cooperative form of "co-trusteeship" is possible. Mary Christina Wood uses this term to characterize the multiple trust obligations—at the federal, state, and tribal levels—as they apply to the interjurisdictional nature of salmon conservation and resource management more generally.[861] This co-trustee approach provides one way of reframing what is too often an adversarial relationship between federal and state governments. As Wood explains, the co-trustee framework creates mutual rights to transboundary assets along with collective responsibilities for conserving the resource.[862]

2. Hunting and the North American Model of Wildlife Conservation

Several conflicts examined as part of this project are partially driven by the way in which wildlife is managed and funded at the state level. Many of the cases reviewed as part of this research involve federal agency actions that are perceived to be in conflict with the state's interest in promoting and regulating fishing, hunting, and trapping. The Alaska cases provide the clearest examples, as the State of Alaska views actions by NPS and FWS to be in direct opposition to the state's mandate to intensively manage wildlife population in order to maximize a sustained yield of prey species in order to achieve high levels of human harvest.[863] The wolf management cases in Idaho

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860 *Redwoods I*, 376 F. Supp. at 96.

861 Mary Christina Wood, *Advancing the Sovereign Trust of Government to Safeguard the Environment for Present and Future Generations (Part I): Ecological Realism and the Need for a Paradigm Shift*, 39 ENVTL. L. 43, 84–85 (2009).

862 *Id.* at 85. Wood calls the approach a "sovereign cotenancy" over shared assets. *Id.* "A cotenancy is a 'tenancy under more than one distinct title, but with unity of possession.'" *Id.* She cites, among other cases, *Puget Sound Gillnetters Ass'n v. U.S. District Court for the Western District of Washington*, 573 F.2d 1123, 1126 (9th Cir. 1978), *vacated sub nom.*, Washington v. Wash. State Commercial Passenger Fishing Vessel Ass'n, 443 U.S. 658 (1979), where the Ninth Circuit "invoked the cotenancy model to describe shared sovereign rights to migrating salmon." Wood, *supra* note 861, at 85 & n.226. The most referenced case pertaining to co-trusteeship is *United States v. 1.58 Acres of Land Situated in Boston, Suffolk, Massachusetts*, 523 F. Supp. 120, 123–24 (D. Mass. 1981). *See* Amicus Curiae Brief, *supra* note 822, at 7 (reviewing the co-trustee/cotenancy model and its application to wildlife and other resources); Wood, *supra* note 861, at 71 & n.149 (stating that the public trust doctrine is not only prevalent in litigation at state level but applies with equal force to the federal government).

863 *See, e.g.*, *Alaska*, 591 F.2d 537, 539 (9th Cir. 1979) (discussing Alaska's challenge to the Secretary of the Interior's decision "to close . . . federal lands to [a state-run] wolf-kill program," which had been "designed to relieve pressure upon the caribou herd").

provide another example.[864] In the Frank Church River of No Return Wilderness, the State of Idaho undertook actions to protect elk from wolves and did so in complete contravention of the Wilderness Act.[865]

In these cases, and others, those outside interests challenging federal agency action/inaction on state wildlife management express a deep mistrust in a state's willingness to protect nongame species and predators. Clearly, some interests prefer federal management, or continued protection under the ESA or federal land law, because they believe that most states prioritize the management of fish and game and the revenue it produces through their license-based funding systems.

This is one reason why it is important for the states to find a more secure and predictable stream of funding for nongame management. Increased funding for nongame species would build capacity at the state level and help harmonize federal-state responsibilities over wildlife on federal lands. It is also necessary to broaden the base of wildlife funding at the state level. Doing so would bring states closer to the principles of wildlife trust management. Jacobson and others get to the crux of the matter:

> According to the [public trust doctrine], wildlife is owned by no one and held in trust for the benefit of all, but with the user pay-benefit model, those who both derive direct benefits from wildlife and fund wildlife conservation from user fees may believe they have the only legitimate voice in governance of public wildlife conservation and management. Further, this model logically encourages those who pay via licenses and permits for the privilege of using wildlife to expect greater benefits than those who do not pay. This is a potentially fatal, deeply rooted inconsistency between rhetoric and reality in wildlife management in the United States, given the core premise of the [public trust doctrine] that wildlife is a public resource and no single stakeholder group should benefit from wildlife management more than others.[866]

It is beyond the scope of this Article to comprehensively address the North American Model of Wildlife Conservation. But, we were surprised to find the Model referenced so often in the cases examined, as it is merely a set of principles and is not based in law or regulation.[867] Its frequent invocation by AFWA and the states is problematic, from providing a

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864 *See, e.g.*, *Wilderness Watch*, 229 F. Supp. 3d 1170, 1174, 1182–83 (D. Idaho 2017) (finding that USFS's approval of the efforts made by the Idaho Department of Fish and Game's (IDFG) to collar elk violated NEPA and the Wilderness Act), *amended by* No. 4:16-CV-012-BLW, 2017 WL 3749441 (D. Idaho Aug. 30, 2017); Maughan v. Vilsack, No. 4:14-CV-0007-EJL, 2014 WL 12605649, at *1–2 (D. Idaho July 25, 2014) (discussing plaintiffs' claim that a wolf trapping and hunting program conducted by IDFG in a wilderness area violated NFMA, NEPA, the Wilderness Act, and other federal laws).

865 *Wilderness Watch*, 229 F. Supp. 3d at 1174, 1182–83.

866 Cynthia A. Jacobson et al., *A Conservation Institution for the 21st Century: Implications for State Wildlife Agencies*, 74 J. WILDLIFE MGMT. 203, 205–06 (2010).

867 *See supra* notes 56–57 and accompanying text.

particularly narrow and hunting-centric view of conservation history to asserting the power and authority of the states to regulate wildlife.[868]

First, the Model is often used to emphasize the importance of hunting, hunter access, and the significance of license-based revenue for state wildlife agencies.[869] This exacerbates the potential for intergovernmental conflict by displaying an institutional bias toward game species and hunters, primarily because of the role hunters play in funding state wildlife agencies. Instead of building bridges between federal and state governments, the Model is wielded to draw distinctions between federal and state priorities.

In addition, the Model further undermines the potential for cooperative federalism by failing to include a principle focused on habitat and the role played by federal lands in the conservation of wildlife. As detailed above, federal lands and the habitat they provide are increasingly significant to biodiversity.[870] Any story of wildlife conservation failing to acknowledge the contribution of federal lands—and the laws and regulations governing them—is woefully incomplete.

Another problem is that while the Model has a principle regarding wildlife as an international resource, it includes no such principle related to intergovernmental cooperation within the United States.[871] This makes little sense because of the transboundary and interjurisdictional nature of wildlife conservation. Some proponents of the Model suggest that it "must be viewed as a dynamic set of principles that can grow and evolve" and that its "future rests to a high degree on the adaptability and application of its principles to contemporary wildlife conservation needs."[872] If so, the Model must consider more seriously how states can cooperate, as co-trustees, with federal and tribal governments in the conservation of wildlife.

C. The Department of Interior's Policy Statement on Federal-State Relationships

In Part III.B.5.c, we reviewed the Interior Department's 1983 policy statement and regulations on federal-state relations in wildlife policy. Although the Policy appears in the Code of Federal Regulations "as a matter of convenience to the public,"[873] it was not subject to the rulemaking

868 *See, e.g.*, Brief for the Ass'n of Fish & Wildlife Agencies as Amicus Curiae in Support of Petitioners, *supra* note 8, at 10 (referencing the Model to assert, "States have legal authority to manage fish and wildlife within their borders, except for federally protected species"); *see also* discussion *supra* Part II.C (providing examples of the Model's role in various cases).

869 *See, e.g.*, Kennedy Speech, *supra* note 767, at 1, 6 (invoking the Model, on behalf of the Wyoming Game and Fish Department and AFWA's State-Federal Relations Committee, to criticize management of federal wilderness areas because of restrictions on types of hunter use and access).

870 *See supra* notes 784–788 and accompanying text.

871 ORGAN ET AL., *supra* note 31, at 19.

872 *Id.* at 29.

873 Department of the Interior Fish and Wildlife Policy; State-Federal Relationships, 48 Fed. Reg. 11,642, 11,642 (Mar. 18, 1983) (to be codified at 43 C.F.R. pt. 24).

requirements of the Administrative Procedure Act[874] (APA),[875] and as such does not carry the force of law.[876] Despite its lack of weight, the Policy—which is not a bona fide regulation—was referenced in several of the cases we examined as part of this research and is frequently cited by agency officials.[877]

Most of the provisions reiterate basic principles of federalism as applied to wildlife management on federal lands with references to the Property, Commerce, Treaty, and Supremacy Clauses of the U.S. Constitution.[878] The Policy also provides that fish and wildlife "are held in public trust by the Federal and State governments for the benefit of present and future generations of Americans."[879] It makes clear that "Congress may choose to preempt State management of fish and wildlife on Federal lands," but then asserts that Congress nonetheless "reaffirmed the basic responsibility and authority of the States to manage fish and resident wildlife on Federal lands."[880]

The most plausible construction of this language is that the states manage wildlife (including regulating hunting, fishing, and trapping) up to the point where the federal government determines that state-regulated activities conflict with federal law and regulation. This construction comports with our review of the case law in Part III.A, which expresses the vast constitutional powers held by Congress to conserve wildlife on federal lands.

A separate provision of the Department of Interior's Policy muddies the water, however, by purporting to "reaffirm the basic role of the States in fish and resident wildlife management, especially where States have primary authority and responsibility, and to foster improved conservation of fish and wildlife."[881] The word "primary" is not defined, and it is used in an inconsistent fashion throughout the Policy.[882] Moreover, it is not clear "where" (or when) states have such "primary" authority. In one section, the Policy refers to state wildlife authority as providing a "comprehensive backdrop applicable *in the absence of specific, overriding Federal law*."[883] When placed in context, however, it becomes clear that this provision is merely another type of savings clause, recognizing state authority and

874 5 U.S.C. §§ 551–559, 701–706, 1305, 3105, 3344, 4301, 5335, 5372, 7521 (2012).

875 *Id.* § 553.

876 *Christensen*, 529 U.S. 576, 587 (2000).

877 *See, e.g.*, Final Appropriate Refuge Uses Policy Pursuant to the National Wildlife Refuge System Improvement Act of 1997, 71 Fed. Reg. 36,408, 36,410 (June 26, 2006); N.M. Dep't of Game & Fish v. U.S. Dep't of the Interior, 854 F.3d 1236, 1243 (2017).

878 43 C.F.R. § 24.3(a) (2016).

879 *Id.* § 24.1(b).

880 *Id.* § 24.3(a)–(b).

881 *Id.* § 24.2(a).

882 *Compare id.* ("This policy is intended to reaffirm the basic role of the States in fish and resident wildlife management, especially where States have primary authority and responsibility . . . ."), *with id.* § 24.4(c) ("Congress in the Federal Land Policy and Management Act . . . reaffirmed the primary authority and responsibility of the States for management of fish and resident wildlife on such lands.").

883 *Id.* § 24.1(a) (emphasis added).

responsibility where appropriate under existing law, and where appropriate to achieve the objective of "improved conservation of fish and wildlife."[884]

The Policy is more problematic with respect to lands managed by BLM, where it asserts, without citing any specific statutory provision, that FLPMA "explicitly recognized and reaffirmed the primary authority and responsibility of the States for management of fish and resident wildlife on such lands."[885] The problem is that FLPMA did no such thing. The word "primary" is not used in the statute nor is it implied.[886] And, the regulations cannot "reaffirm" a principle of federalism that does not exist today and did not exist at the time of FLPMA's enactment.[887] Furthermore, as we discuss in Part III.B.5.c, FLPMA's savings clause does nothing to enlarge or diminish state responsibilities for wildlife management on federal lands, and it explicitly reserves to the Secretary of Interior the authority to prohibit hunting and fishing for reasons of public safety, administration, and compliance with applicable laws.[888]

The Department of Interior's Policy on federal-state relations, particularly for BLM lands, represents an erroneous interpretation of the law. In its entirety, as currently written, the Policy is internally inconsistent, easily misconstrued, and provides little practical guidance because it does not sort through the fundamental tensions involved in managing wildlife on federal lands. To the extent it attempts to provide guidance, it is confusing and, in some passages, plainly contrary to law.[889] Although it is fair to say that states may manage wildlife on federal lands unless state management strategies or measures conflict with federal prerogatives, neither BLM nor

884 *Id.* § 24.2(a).

885 *Id.* § 24.4(c).

886 Confusing matters even further, in another section of the same provision, the Department of the Interior acknowledges its responsibility for multiple-use management as defined in FLPMA, "including fish and wildlife *conservation*." *Id.* (emphasis added).

887 Much of what eventually became FLPMA can be traced to the work of the Public Lands Law Review Commission whose recommendations were published as *One Third of the Nation's Land* in 1970. *See generally* PUB. LAND LAW REVIEW COMM'N, *supra* note 776. The Commission's chapter on fish and wildlife management demonstrates what was understood to be the balance of federal-state power prior to FLPMA's passage in 1976. Far from affirming the "primary authority" of the states to manage wildlife on federal lands, the Commission emphasized the extent of federal powers to preempt the states. *Id.* at 158. Referenced within their recommendations pertaining to fish and wildlife is a 1964 opinion by the Solicitor of the Interior stating that "regulation of the wildlife populations on federally owned land is an appropriate and necessary function of the Federal Government when the regulations are designed to protect and conserve the wildlife as well as the land," concluding that "this authority is superior to that of a state." *Id.* (quoting 71 Interior Dec. 469, 473, 476 (1964)).

888 FLPMA, 43 U.S.C. § 1732(b) (2012).

889 *See* APA, 5 U.S.C. § 706(2) (2012) (directing courts to set aside agency actions that are "not in accordance with law" or "contrary to constitutional right, power, privilege, or immunity"); United States v. Mead Corp., 533 U.S. 218, 234–35 (2001) (finding that informal agency interpretations are not entitled to *Chevron* deference but only receive the level of deference "proportional to its 'power to persuade'" (quoting Skidmore v. Swift & Co., 323 U.S. 134, 140 (1944))).

the Department of Interior has the authority to rewrite FLPMA,[890] much less to redraw the constitutional boundaries of federal and state powers that were so clearly addressed in *Kleppe v. New Mexico*.[891] There, the Supreme Court explained why "'the complete power' that Congress has over public lands *necessarily* includes the power to regulate and protect the wildlife living there."[892] Accordingly, we recommend that the Policy be corrected, this time using APA rulemaking procedures with adequate notice and meaningful opportunities for all interested stakeholders to comment.

D. Failure to Act: The APA, NEPA, and Beyond

As shown in Part III.A, the constitutional authority of federal land agencies to manage wildlife is well settled, and federal land laws and regulations provide the discretion and sometimes the obligation to conserve wildlife on federal lands. One of the most difficult contemporary questions concerns circumstances where federal agencies have refused to take action to protect wildlife on federal lands.

When states are involved, the general questions tend to be: 1) must the state ask the federal agency for permission to undertake its proposed use of federal land, and 2) if so, what if a state does not do so? The answer to the first question depends on whether the federal agency has a legal duty to act. Such duties may be found in the statutory authorities discussed in Part III.B or in regulations furthering the purposes of those authorities. It is important to distinguish those circumstances where the agency has a duty to act from those where the agency has the authority to act but action is discretionary. A failure to engage in a discretionary act is characterized by law as mere "inaction" while a failure to execute a mandatory duty is characterized as a judicially reviewable "failure to act."[893] The distinction has legal significance with regard to the second question above.

As explained by the Supreme Court in *Norton v. Southern Utah Wilderness Alliance* (*SUWA*),[894] in order for courts "to avoid judicial entanglement in abstract policy disagreements" there must be a "*discrete* agency action" that an agency is required to take.[895] There was no duty for BLM to act to prohibit motorized use in wilderness study areas in *SUWA* because the statutory provision at issue in FLPMA "is mandatory as to the object to be achieved, but it leaves BLM a great deal of discretion in deciding

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890 *See* 43 U.S.C. §§ 1702(a), 1702(c) (defining the terms "areas of critical environmental concern" and "multiple use" in ways that limit federal land use).

891 *Kleppe*, 426 U.S. 529, 539–41 (1976).

892 *Id.* at 540–41 (emphasis added); *see also supra* notes 145–150 and accompanying text (discussing *Kleppe* in detail).

893 Under the APA, a reviewing court may "compel agency action unlawfully withheld." 5 U.S.C. § 706(1) (2012). "[A]gency action" is defined as "the whole or a part of an agency rule, order, license, sanction, relief, or the equivalent or denial thereof, *or failure to act*." *Id.* § 551(13) (emphasis added). For analysis, see generally Julie Lurman, *Subsistence at Risk: Failure to Act and NEPA Compliance in Post-ANILCA Alaska*, 36 ENVTL. L. 289 (2006).

894 542 U.S. 55 (2004).

895 *Id.* at 66.

how to achieve it."[896] Similarly, the Department of the Interior had no duty under FLPMA to intervene in the State of Alaska's aerial wolf control program on federal lands in *Defenders of Wildlife v. Andrus* because the statutory language was discretionary; thus, there was no judicially reviewable "failure to act."[897]

In addition to FLPMA, the plaintiffs in both *SUWA* and *Defenders of Wildlife* alleged violations of NEPA.[898] The courts determined that where there was simply inaction, NEPA procedures were not required.[899] Conversely, failure to act when there is a legal obligation to do so may trigger NEPA.[900] While NEPA itself does not compel any particular federal action, a NEPA analysis is required whenever a federal action is otherwise compelled by law—whether the agency engages in that action or fails to do so.[901] Moreover, "[n]onfederal actors may . . . be enjoined under NEPA if their proposed action cannot proceed without the prior approval of a federal agency."[902]

As described in Part III.B, the federal agencies have, where necessary, determined through regulations the circumstances where permits or other approvals are required prior to the use and occupancy of federal lands. In general, failure by a federal agency to require the necessary approval represents a "failure to act" and may result in the non-permitted activity being enjoined.[903]

In *Maughan v. Vilsack*,[904] a court declined to enjoin the State of Idaho from contracting to kill wolves in a national forest wilderness area.[905] However, the court cautioned that its decision was only for the purposes of

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896 *Id.* at 59–61, 66.

897 *Defs. of Wildlife*, 627 F.2d 1238, 1239–40, 1249–50 (D.C. Cir. 1980) (citing 43 U.S.C. § 1732). Claimants also do not appear to be able to sue a state based on federal inaction. *See* Wilderness Soc'y v. Kane County, 632 F.3d 1162, 1169–71 (10th Cir. 2011) (explaining that environmental groups had no rights in federal lands that would give them standing to challenge defendant county's actions on those lands based on preemption under the Supremacy Clause of the U.S. Constitution).

898 *SUWA*, 542 U.S. at 61; *Defs. of Wildlife*, 627 F.2d at 1240.

899 *SUWA*, 542 U.S. at 73; *Defs. of Wildlife*, 627 F.2d at 1245, 1247.

900 *See* 40 C.F.R § 1508.18 (2016) (defining "actions" subject to NEPA as including "circumstance[s] where the responsible officials fail to act and that failure to act is reviewable" under the APA or otherwise).

901 Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989); *see* Lurman, *supra* note 893, at 294–95 (explaining that NEPA attaches "if action were *mandated* (under a separate statute) but that action was not taken . . . this is failure to act").

902 Fund for Animals, Inc. v. Lujan, 962 F.2d 1391, 1397 (9th Cir. 1992).

903 *See id.* Such injunctions are not limited to NEPA violations. *See* Karuk Tribe of Cal. v. U.S. Forest Serv., 681 F.3d 1006, 1016, 1030 (9th Cir. 2012) (holding that USFS's approval of Notices of Intent to mine constituted "agency action" under the ESA and thus required consultation); Dubois v. U.S. Dep't of Agric., 102 F.3d 1273, 1283, 1299–1301 (1st Cir. 1996) (expansion of ski resort enjoined where USFS failed to require a National Pollutant Discharge Elimination System permit).

904 No. 4:14-CV-0007-EJL, 2014 WL 201702 (D. Idaho Jan. 17, 2014).

905 *Id.* at *1, *5 (accepting, for the purpose of the temporary restraining order and injunction analysis, the USFS's conclusion that "the activity is regulated by a State agency in a manner adequate to protect the lands and resources," which is one of the exceptions found in the USFS's special use permit regulations).

a temporary restraining order, and "USFS has not yet reached a determination regarding the [Idaho Fish and Game] program let alone concluded that a special use permit is required."[906] Until that time, there was no federal action subject to NEPA.[907] In *Wilderness Watch v. Vilsack*,[908] the same court enjoined the use of data obtained by the State of Idaho under a special use permit to use helicopters in the same wilderness area.[909] It concluded that the State "must obtain approval from [USFS] before undertaking [its] project in the [w]ilderness [a]rea," and "that any action taken by [Idaho] without [USFS] approval would be contrary to the Wilderness Act."[910]

In *Friends of Columbia Gorge, Inc. v. Elicker*,[911] the United States District Court for the District of Oregon construed the USFS special use permit regulations to apply to approval of a reintroduction plan that would use federal land to establish a population of mountain goats in the Columbia Gorge National Scenic Area.[912] For this and other reasons, USFS was required to comply with NEPA.[913] In Utah, the state released mountain goats on land adjacent to the Manti-La Sal National Forest, which proceeded to occupy a research natural area on the national forest that was designated to protect plant species that would be vulnerable to trampling.[914] These species included three plant species listed as "sensitive" by USFS.[915] The United States District Court for the District of Utah held that "allowing" the mountain goats on national forest land was not a federal agency action, and that the same special use permit regulations did not require such permits

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906 *Id.* at *5.

907 *See id.* at *6 (explaining that USFS's failure to require an EIS was not a final agency action).

908 229 F. Supp. 3d 1170, 1183 (D. Idaho 2017), *amended by* No. 4:16-CV-012-BLW, 2017 WL 3749441 (D. Idaho Aug. 30, 2017).

909 *Id.* at 1177, 1183.

910 *Id.* at 1182 (referencing Wilderness Act, 16 U.S.C. § 1133(c) (2012)). The injunction was based in part on a violation of NEPA. *Id.* In Part III.B.7.a.iii, *infra*, we assess other issues posed by this case, in particular, the Wilderness Act's requirement that USFS make a finding that the activity is "necessary to meet minimum requirements for the administration of the area" before issuing its approval. *But cf.* WildEarth Guardians v. U.S. Forest Serv., No. 4:14-cv-00488-REB, 2017 WL 1217099, at *1 & n.2, *5–9 (D. Idaho Mar. 31, 2017) (Predator hunting "derbies" organized by private parties and occurring on national forest lands did not meet any of the regulatory criteria requiring a special use authorization, and did not have effects subject to NEPA. However, the court struck documents submitted by plaintiffs suggesting such permits had been issued by USFS for six other organized hunts. BLM was initially a defendant in this case but the parties reached an agreement to settle those claims, regarding different regulatory language, out of court.).

911 598 F. Supp. 2d 1136 (D. Or. 2007), *vacated*, No. 05-CV-646-BR, 2011 WL 3205773 (D. Or July 27, 2011).

912 *Id.* at 1153, 1159; *see also* 36 C.F.R. § 251.50 (2016) (describing USFS's special use permitting system).

913 *Friends of Columbia Gorge*, 598 F. Supp. 2d at 1155.

914 Utah Native Plant Soc'y v. U.S. Forest Serv., No. 2:16-cv-56-PMW, 2017 WL 822098, at *1–2 (D. Utah Mar. 2, 2017), *appeal filed*, No. 17-4074 (10th Cir. May 4, 2017).

915 *Id.* at *1.

"every time state-managed wildlife enters federal land."[916] These cases indicate that it is incumbent on the land managers to evaluate any state action against the regulatory criteria for permits so that they can properly authorize (or deny) the use and occupancy of federal lands.

As noted in Part III.B, federal agencies are encouraged to complete MOUs with the states for cooperative management of fish and wildlife resources. It is the purpose of these MOUs to clearly delineate the authorities of the parties and assign responsibilities among them, and this should include identification of actions that would require a permit. It is critical that the assignment of authorities reflect the legal principles described above. Moreover, the MOU process should not be used to relinquish federal authorities without recognizing that such decisions may constitute actions subject to federal procedures required by the ESA or NEPA.[917] The agencies should expect scrutiny of the assignment of blanket authority to states using MOUs.[918] For example, the relinquishment of federal authority to manipulate water levels in a national wildlife refuge was enjoined because it constituted a federal action subject to NEPA.[919] Similarly, an MOU that delegated authority to the state to assert federal reserved water rights in the Black Canyon of the Gunnison violated the federal agency's nondiscretionary duties to protect federal resources.[920] Conversely, BLM's decision to relinquish management of elk feeding grounds to the State of Wyoming through an MOU rather than through land use permits was upheld in *Greater Yellowstone Coalition v. Tidwell*[921] because FLPMA authorized BLM to enter into such agreements, rendering a permit requirement superfluous.[922] The court also affirmed the applicability of NEPA to the MOU in lieu of the permit process.[923]

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916 *Id.* at *4, *9, *11. However, the court also indicated that USFS would have authority to remove the goats and would "need to take a position" after sufficient study. *Id.* at *7. USFS had earlier told the state it objected to the reintroduction. *Id.* at *1–2. The authority to remove wildlife was established in *Hunt*, 278 U.S. 96, 100 (1928), and *Kleppe*, 426 U.S. 529, 545–46 (1975).

917 *See Defs. of Wildlife*, 627 F.2d 1238, 1244 (D.C. Cir. 1980) ("[E]xamples of federal 'permission' [requiring compliance with NEPA] were such concrete acts as decisions 'to issue a lease, approve a mining plan, issue a right-of-way permit, or *take other action to allow private activity*. . . .'" (omission in original) (quoting *Kleppe*, 427 U.S. at 399)).

918 *See* Gallatin Wildlife Ass'n v. U.S. Forest Serv., No. CV-15-27-BU-BMM, 2016 WL 3282047, at *9–10 (D. Mont. June 14, 2016) (finding NEPA violations in an EIS for a Forest Plan where USFS failed to disclose MOUs with the State of Montana and grazing permittees that acknowledged that the state would allow permittees to kill bighorn sheep to prevent comingling with domestic sheep), *appeal filed*, No. 16-35665 (9th Cir. filed Aug. 19, 2016).

919 Bunch v. Hodel, 642 F. Supp. 363, 365 (W.D. Tenn. 1985); *see also High Country Citizens' All.*, 448 F. Supp. 2d 1235, 1242–43, 1249 (D. Colo. 2006) (holding that the relinquishment of a federal reserved water right was an agency action subject to judicial review).

920 *High Country Citizens' All.*, 448 F. Supp. 2d at 1241–42, 1245, 1253 ("A permanent relinquishment of a water right with a 1933 priority date for such a scientifically, ecologically and historically important national park must be viewed as a major action requiring compliance with NEPA.").

921 572 F.3d 1115 (10th Cir. 2009).

922 *Id.* at 1119, 1127–28.

923 *Id.* at 1128.

An important take-away point is that MOUs cannot be used to evade legal obligations.[924] Neither can they change a regulatory requirement, as that can only be done through APA rulemaking, nor can MOUs be used to alter statutory provisions, as that power is reserved to Congress.[925] As a subsidiary point, if a federal agency were to use an MOU to transfer authority to a state to undertake actions that would be subject to federal requirements, such as those required by the ESA or NEPA, those requirements would attach to the MOU decision itself because that decision would constitute "affirmative conduct" necessary before a nonfederal actor could proceed.[926]

E. The National Wilderness Preservation System

While all agencies have the authority to assert federal supremacy over the management of fish and wildlife on federal lands in order to fulfill their statutory mission, in federal wilderness areas the affirmative obligation to preserve wilderness character—including fish and wildlife species within wilderness areas—is mandated to the federal land-managing agency.[927]

Courts have pointed out, "the Wilderness Act is as close to an outcome-oriented piece of environmental legislation as exists. Unlike NEPA, . . . the Wilderness Act emphasizes outcome (wilderness preservation) over procedure."[928] That outcome, as detailed above in Part III.B.7, is one where an area's wilderness character is protected in full, meaning as far as possible, without human manipulation; where otherwise-prohibited uses are limited only to those necessary for the purpose of preserving that area's wilderness character; where all commercial uses are prohibited, except those commercial services necessary for realizing *wilderness* purposes; and where each federal agency recognizes that whatever the original reason for an area's designation, once it is also designated as wilderness, management must conform to the Wilderness Act. Moreover, where subsequent legislation mentions wildlife management, those provisions must be read in tandem with the Wilderness Act, keeping in mind "the elementary rule" of

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924 *See id.* at 1125, 1128 (requiring compliance with NEPA when a federal agency enters into an MOU).

925 *See, e.g.*, *High Country Citizens' All.*, 448 F. Supp. 2d at 1249, 1252 ("This Court finds that the effect of the [MOUs] was actually to remove the administration of the Black Canyon resources from the National Park Service in direct contravention of [federal law]."); *Greater Yellowstone Coal.*, 572 F.3d at 1127 (explaining that FLPMA requires BLM to "ensure the uses approved through cooperative agreements are in compliance with other statutes imposing limitations on the uses of federal land and the activities of federal agencies").

926 *See* Mineral Policy Ctr. v. Norton, 292 F. Supp. 2d 30, 54–55 (D.D.C. 2003) (explaining that "whether the federal agency must undertake 'affirmative conduct' before the non-federal actor may act" is a factor in determining whether an action is a "major Federal action").

927 *Wilderness Watch*, 229 F. Supp. 3d 1170, 1181–82 (D. Idaho 2017) ("Congress made preservation of wilderness values 'the primary duty of [USFS], and it must guide all decisions as the first and foremost standard of review for any proposed action.'" (quoting *Greater Yellowstone Coal.*, CV–06–04–E–BLW, 2006 WL 3386731, at *6 (D. Idaho Nov. 21, 2006))), *amended by* No. 4:16-CV-012-BLW, 2017 WL 3749441 (D. Idaho Aug. 30, 2017).

928 *High Sierra Hikers Ass'n*, 436 F. Supp. 2d 1117, 1138 (E.D. Cal. 2006).

statutory construction that exceptions to the Act's overarching preservation mission are to be construed narrowly.[929]

We have reviewed dozens of agency-approved or state-proposed wildlife management actions in wilderness areas, and where errors in stewardship have been made we observed certain trends. It has long been noticed that the most common flaw in making a minimum requirements analysis or other evaluation document is that they are often "[w]ritten to support a pre-determined decision" where preserving wilderness character is not the default conclusion.[930] But beyond that, we have observed a fundamental misunderstanding of many facets of the law and an apparent willingness to skirt legal obligations so as to accommodate more political desires. Two illustrative examples are analyzed below.

In 2007, FWS and the Arizona Game and Fish Department (AGFD) proposed to build two new wildlife waters in the Kofa Wilderness in Arizona, in addition to the sixty-five waters previously developed, to halt bighorn sheep population decline.[931] FWS authorized the construction as a project categorically excluded from detailed environmental analysis under NEPA.[932] It made a rudimentary minimum requirements analysis[933] and approved the construction.[934] The Ninth Circuit found that FWS had not provided a reasoned determination of necessity in employing the prohibited use of an installation.[935] Its opinion created a litmus test for a minimum requirements analysis:

> [A] *generic* finding of necessity does not suffice; the Service must make a finding that the structures are "necessary" to meet the "*minimum* requirements for the administration of the area . . . ." [T]he key question—whether water structures were necessary at all—remains entirely unanswered . . . . [T]he Service's own . . . [Investigative Report] identified many different actions [FWS could have taken]. . . . Importantly, in contrast to the creation of new structures within the wilderness, the Wilderness Act does not prohibit any of

929 Spokane & Inland Empire R.R. Co. v. United States, 241 U.S. 344, 350 (1916) ("[E]xceptions from a general policy which a law embodies should be strictly construed, that is, should be so interpreted as not to destroy the remedial processes intended to be accomplished by the enactment."); *see* Wilderness Watch v. U.S. Forest Serv., 143 F. Supp. 2d 1186, 1206 (D. Mont. 2000); *see also* discussion *supra* Part III.B.7.b (discussing subsequently enacted, site-specific wilderness legislation).

930 WILDERNESS ADVISORY GRP., U.S. FOREST SERV., MINIMUM REQUIREMENTS ANALYSIS: FAQS AND COMMON ERRORS 16 (2015), https://perma.cc/Q5MG-JNTV.

931 KOFA NAT'L WILDLIFE REFUGE & ARIZ. GAME & FISH DEP'T, INVESTIGATIVE REPORT AND RECOMMENDATIONS FOR THE KOFA BIGHORN SHEEP HERD 8–10, 23 (2007), https://perma.cc/B362-GJUZ [hereinafter KOFA INVESTIGATIVE REPORT]; U.S. FISH & WILDLIFE SERV., KOFA NATIONAL WILDLIFE REFUGE & WILDERNESS AND NEW WATER MOUNTAINS WILDERNESS INTERAGENCY MANAGEMENT PLAN AND ENVIRONMENTAL ASSESSMENT 43–44 (1996).

932 KOFA NAT'L WILDLIFE REFUGE, U.S. FISH & WILDLIFE SERV., CATEGORICAL EXCLUSION: YAQUI AND MCPHERSON TANKS REDEVELOPMENT PROJECTS (2007), https://perma.cc/6P7L-EJ46 [hereinafter REDEVELOPMENT CX].

933 *Id.*

934 *See Kofa*, 629 F.3d 1024, 1031 (9th Cir. 2010) (describing the minimal analysis and the construction process).

935 *Id.* at 1037.

> those actions. . . . Yet nowhere in the record does the Service explain why those actions, alone or in combination, are insufficient to restore the population of bighorn sheep. . . . The documents as a whole demonstrate that the Service began with the assumption that water structures are necessary and reasoned from that starting point.[936]

Subsequently, FWS released a formal determination that concluded it was necessary to have built these two more wildlife waters in addition to the sixty-five already developed because the installations need to be no more than three miles apart for "[o]ptimal distribution of water, especially for lactating ewes."[937]

In the meantime, FWS authorized the killing of certain mountain lions in the Kofa Wilderness to limit predation on bighorns.[938] The rationale was that "[a]lthough mountain lions are also a natural wildlife resource, . . . mountain lion predation is likely additive to other sources of mortality and sufficient to prevent [FWS] from attaining bighorn sheep population objectives."[939] The explicit bighorn population objectives were "based on . . . the need to maintain a population large enough . . . to support regional and landscape level transplant programs," and to make it easier for hunters to locate "trophy rams."[940] The minimum requirements analysis correctly identified the No Action alternative as the one that would best protect wilderness character.[941] However, the Preferred Alternative—the removal of "offending" lions—was chosen.[942] This choice, as with others made in this series of decisions, was based on supporting analyses that were fundamentally flawed.

One of the new tanks (Yaqui) is itself outside the wilderness, and only part of the catchment system is within the wilderness.[943] The Yaqui could have been constructed without a catchment system, with water supplied by a tanker on the adjacent road outside the wilderness.[944] As constructed, the Yaqui tank cannot have been the minimum necessary under any

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936 *Id.* at 1037–38 (citation omitted). The court listed the options that should have been analyzed, including eliminating hunting, cancelling the transplant program, and killing predators. *Id.* at 1037.

937 KOFA NAT'L WILDLIFE REFUGE, U.S. FISH & WILDLIFE SERV., NECESSITY DETERMINATION: CONSTRUCTION OF THE MCPHERSON AND YAQUI WILDLIFE WATER CATCHMENTS 1, 4 (2014), https://perma.cc/DR8D-G24N [hereinafter NECESSITY DETERMINATION].

938 *See* KOFA NAT'L WILDLIFE REFUGE, U.S. FISH & WILDLIFE SERV., FINAL ENVIRONMENTAL ASSESSMENT: LIMITING MOUNTAIN LION PREDATION ON DESERT BIGHORN SHEEP ON THE KOFA NATIONAL WILDLIFE REFUGE 5 (2009), https://perma.cc/22WH-ZAFU [hereinafter LION EA] (analyzing various alternatives for limiting mountain lion predation on desert bighorn sheep, including the removal of certain mountain lions that have "killed two or more desert bighorn sheep within a six-month period").

939 *Id.*

940 *Id.* at 7, 10.

941 *Id.* at 112–13.

942 *Id.* at 104, 114.

943 REDEVELOPMENT CX, *supra* note 932, at 3.

944 *See id.* ("The Yaqui Tank Redevelopment Project is planned to take place immediately adjacent to the designated road that follows Moonshine Wash and as a result, is nearly all within the 200-foot-wide area that is outside of designated Wilderness.").

circumstance. Yet, FWS claims these two particular installations are among only twenty-four critical for bighorn survival in the Kofa National Wildlife Refuge.[945] At the least, that would mean all the remaining wildlife water developments in the Kofa Wilderness fail the test of "necessity" by FWS's own analysis. Therefore, these developments cannot be maintained and should be removed, since their presence manipulates the "community of life," creates unnatural conditions in the desert environment, and violates the wilderness definition as "undeveloped Federal land retaining its primeval character and influence."[946]

In addition, killing predators, while not explicitly prohibited by the Wilderness Act, is implicitly prohibited as an action that trammels "the earth and its community of life."[947] Perhaps in response to the vastly greater number of pictures of predators and mule deer than of bighorn sheep recorded at the guzzlers,[948] FWS wrote: "Desert bighorn sheep will likely use the new water sources more frequently as they become familiar with the location of the waters."[949] There is no discussion of how the predators and mule deer became familiar with the locations so much faster than the sheep. To decrease predation on sheep, it would be more consistent with the area's wilderness character to stop providing supplemental water for bighorn predators and their alternate prey that appear to be less well-adapted to the harsh desert environment of the Kofa Wilderness than desert bighorn sheep.[950]

In the end, these errors are dwarfed by the fundamental mistake of skewing management of the Kofa Wilderness to meet a population goal of 800 bighorns—"considered the carrying capacity of the refuge"—with the objective to re-establish them as a "transplant source herd."[951] To do so, AGFD and FWS determined that they needed to provide water in all areas of suitable sheep habitat, including areas that were otherwise "unavailable" for sheep due to the absence of water sources.[952] Maximizing production is an

945 *See* KOFA INVESTIGATIVE REPORT, *supra* note 931, at 32 tbl.2 (listing twenty-four "[c]ritical bighorn sheep waters on the Kofa [National Wildlife Refuge]," including Yaqui and McPherson tanks).

946 Wilderness Act, 16 U.S.C. § 1131(c) (2012).

947 *See* KIW, *supra* note 636, at 7 (stating that the untrammeled quality of wilderness "is degraded by modern human activities or actions that control or manipulate the components or processes of ecological systems inside the wilderness"); *see also supra* notes 638–641 and accompanying text (analyzing the untrammeled nature of wilderness).

948 Author Chris Barns, in analyzing the remote camera studies of the two new guzzlers, found that in the first year bighorn were seen utilizing the guzzlers only twice. The three top predators of bighorns (lions, bobcats, and coyotes) were documented at the installations over 500 times; mule deer were photographed over 800 times.

949 NECESSITY DETERMINATION, *supra* note 937, at 1.

950 *See id.* at 6 (describing how bighorn sheep can survive up to fifteen days without drinking water during the hot summer months); Bill Broyles & Tricia L. Cutler, *Effect of Surface Water on Desert Bighorn Sheep in the Cabeza Prieta National Wildlife Refuge, Southwestern Arizona*, 27 WILDLIFE SOC'Y BULL., 1082, 1085 (1999) (finding that the availability of perennial surface water did not affect bighorn populations on another desert wilderness refuge).

951 KOFA INVESTIGATIVE REPORT, *supra* note 931, at 14, 19.

952 *Id.* at 9.

agricultural model, not a wilderness model. In nature, not every nook and cranny is filled with a "desirable" species and devoid of "offending" animals. Although FWS claims that its objective is to "provid[e] the public with the opportunity to view wild sheep in their native habitat,"[953] native habitat is not one with artificial water provided every three miles in an area cleansed of predators. Policy guidance from FWS is quite clear: "On wilderness areas within the Refuge System, we conserve fish, wildlife, and plants by preserving the wilderness environment."[954] In the Kofa Wilderness, FWS has failed to do so by taking actions that degrade its untrammeled quality and that are not the minimum necessary, all for non-wilderness purposes.[955]

Sometimes federal agencies try to apply the law but are opposed not only by state agencies but by wilderness-oriented advocacy groups. In 2011, the Nevada Department of Wildlife (NDOW) requested a multi-year authorization from BLM's Ely and Southern Nevada District Offices for using helicopters to access wildlife water developments within designated wilderness areas.[956] BLM failed to undertake any analysis to determine whether any water installations were necessary in the first place. However, in preparation for their draft Environmental Assessment (EA), BLM conducted a minimum requirements analysis on methods of access, concluding that helicopter access was necessary for fifteen of the twenty big game water developments but that the others could be accessed on foot or by horse.[957] In the comment period following release of the draft EA, comments from an advocacy group supported helicopter access to all of the installations because it would be more economical for NDOW.[958] In addition

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953 NECESSITY DETERMINATION, *supra* note 937, at 2.

954 FWS WILDERNESS POLICY, *supra* note 437, § 2.16(A); *see also id.* § 2.16(B)(3) ("All decisions and actions to modify ecosystems, species population levels, or natural processes must be: (a) Required to respond to a human emergency, or (b) The minimum requirement for administering the area as wilderness and necessary to accomplish the purposes of the refuge, *including Wilderness Act purposes*. In addition, such decisions and actions must: (i) Maintain or restore the biological integrity, diversity, or environmental health of the wilderness area; or (ii) Be necessary for the recovery of threatened or endangered species." (emphasis added)).

955 Other agencies have engaged in similar actions based on similarly flawed analyses. *See, e.g.*, U.S. FOREST SERV., PRELIMINARY ENVIRONMENTAL ASSESSMENT FOR AUTHORIZATION OF HELICOPTER LANDINGS IN WILDERNESS 8–9, 16 & tbl.3 (2014) (authorizing up to 450 helicopter landings for capturing bighorn sheep despite almost half of the bighorn habitat being outside wilderness); NAT'L PARK SERV., ISLE ROYALE NATIONAL PARK: DRAFT ENVIRONMENTAL IMPACT STATEMENT TO ADDRESS THE PRESENCE OF WOLVES, at iv, vii (2016), https://perma.cc/BD8G-CT4G (identifying a Preferred Alternative that restocks the island with wolves, despite correctly analyzing the No Action Alternative as the one that best preserves wilderness character).

956 *See* BUREAU OF LAND MGMT., ENVIRONMENTAL ASSESSMENT: ISSUANCE OF AUTHORIZATIONS TO NEVADA DEPARTMENT OF WILDLIFE FOR WILDLIFE WATER DEVELOPMENT INSPECTION, MAINTENANCE AND REPAIRS WITHIN BLM WILDERNESS AREAS IN NEVADA 1–4 (2011), https://perma.cc/NWH6-9S52.

957 *Id.* app. A. Access to one of the wildlife waters was determined to be as little as 0.2 miles from the boundary on a closed road. *Id.*

958 *See* Shaaron Netherton, Friends of Nevada Wilderness, Comment to *Environmental Assessment: Issuance of Authorizations to Nevada Department of Wildlife for Wildlife Water Development Inspection, Maintenance and Repairs within BLM Wilderness Areas in Nevada* (Dec. 30, 2011) (on file with authors) [hereinafter Friends of Nevada Wilderness Comment] ("[I]n these times of extremely tight budgets . . . we believe it is critical that this EA should help

to prioritizing economics over preservation, the letter contained two other fundamental errors. First, it asserted that NDOW "is responsible for the maintenance of these large game guzzlers."[959] To the contrary, at some point after wilderness designation, BLM needed to determine whether each of the water installations is "necessary to meet minimum requirements for the administration of the area" as wilderness.[960] If so, it is BLM's responsibility to maintain them—though BLM may ask the state to undertake that responsibility—because preserving wilderness character is solely a federal responsibility.[961] If not, no maintenance can be allowed, and eventually the installations should be removed to comply with the Wilderness Act.[962]

Second, the letter claimed: "It is clear in both the Clark and Lincoln County legislation that Congress intended that helicopter use be allowed."[963] However, Congress used the word "may" in the legislation, demonstrating its intent that helicopter use be considered, not that it be automatically approved.[964] Senator Harry Reid specifically noted that while helicopter access may be needed for some monitoring and maintenance, "some guzzlers can be easily accessed after a short hike from a road."[965]

In the end, BLM authorized NDOW helicopter access to all sites, referring to "[a]dditional information . . . obtained during the comment

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facilitate cooperation between the BLM and [NDOW] on the issue of inspection and maintenance of wildlife water developments."). This instance is not the only time this organization has urged BLM to prioritize nonconforming wildlife developments. *See* e-mail from Shaaron Netherton, Exec. Dir., Friends of Nev. Wilderness, to Neil Kornze, Bureau of Land Mgmt. (Apr. 1, 2014) (on file with authors) (asking that radio collars no longer be defined as an installation so sportsmen could put them on wildlife in wilderness).

959 Friends of Nevada Wilderness Comment, *supra* note 958.

960 *See* Wilderness Act, 16 U.S.C. § 1133(c) (2012) (requiring BLM to do a minimum requirements analysis).

961 *See* discussion *supra* Part III.B.7.

962 *See* 16 U.S.C. § 1133(c) (permitting installations only where they are "necessary to meet the minimum requirements for the administration of the area" as wilderness).

963 Friends of Nevada Wilderness Comment, *supra* note 958.

964 Lincoln County Conservation, Recreation, and Development Act of 2004, Pub. L. No. 108-424, § 209(c), 118 Stat. 2403, 2412 ("Consistent with section 4(d)(1) of the Wilderness Act . . . the State may continue to use aircraft, including helicopters, to survey, capture, transplant, monitor, and provide water for wildlife populations . . . ."); Clark County Conservation of Public Land and Natural Resources Act of 2002, Pub. L. No. 107-282, § 208(c), 116 Stat. 1994, 2005 (similar); *see also* Tax Relief and Health Care Act of 2006, Pub. L. No. 109-432, § 329(c), 120 Stat. 2922, 3036 (similar). Under the Wilderness Act, preexisting uses of aircraft are "subject to such restrictions as the Secretary . . . deems desirable." 16 U.S.C. § 1133(d)(1). Those restrictions are set forth in agency policy: "BLM has discretion to either allow or prohibit the continuation of aircraft use where it has already been legally established prior to the designation of a wilderness area. Administrative use of aircraft is normally authorized under section 4(c) of the Wilderness Act, only where it is necessary to meet minimum requirements for the administration of the area for the purpose of the Wilderness Act." BLM MANUAL, *supra* note 673, § 1.6(C)(2)(b).

965 Letter from Harry Reid, U.S. Senator, to Robert A. Abbey, Dir., Bureau of Land Mgmt. (May 27, 2010) (on file with authors).

period" in disregard of the Wilderness Act and BLM's own analysis.[966] This result degrades wilderness character by allowing prohibited uses that were shown not to be the minimum necessary—due, in part, to a mistaken reading of the extra special language in designating legislation.

As we have shown, the Wilderness Act unequivocally expresses the federal obligation to assert authority over fish and wildlife to assure the interests of all Americans in the preservation of wilderness character. We are troubled by the cases discussed above, and others, that demonstrate a problematic tendency on the part of some federal land agencies to reflexively acquiesce to state interests when contrary to wilderness law. The federal agencies must renew their dedication to preserving wilderness character.

F. Intergovernmental Cooperation

The states and AFWA have repeatedly asserted that there are not enough opportunities for intergovernmental cooperation in wildlife management and that more opportunities need to be created.[967] Wildlife conservation absolutely requires intergovernmental cooperation and transboundary thinking beyond political jurisdictions. One early example of such cooperation can be found in the Lacey Act,[968] which, among other things, provides federal penalties for transporting in interstate commerce any wildlife taken in violation of state law.[969] Another example is provided by the Pittman-Robertson and Dingell-Johnson Acts, discussed in Part II.B, as both provide significant sources of federal funding for state wildlife management.

There is real value in constructive relationships between federal and state agencies, and we strongly encourage their development. To that end, there are three central points to be made:

1) Multiple opportunities for intergovernmental cooperation already exist within federal decision-making processes, but they are not always fully utilized. For instance, the Sikes Act, ESA, FLPMA, NFMA, NWRSIA, and several others contain such opportunities.

2) Intergovernmental cooperation must be a mutual and reciprocal obligation in order to live up to the name and to be as effective as possible. Therefore, there ought to be equal opportunity for federal entities to comment on and participate in state wildlife management decision-making processes, and that is not always the case.

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966 BUREAU OF LAND MGMT., DECISION RECORD FOR THE ISSUANCE OF AUTHORIZATIONS TO NEVADA DEPARTMENT OF WILDLIFE FOR WILDLIFE WATER DEVELOPMENT INSPECTION, MAINTENANCE AND REPAIRS WITHIN BLM WILDERNESS AREAS IN NEVADA (2012), https://perma.cc/7TMU-HPFG.

967 *See, e.g.*, AFWA TASK FORCE REPORT, *supra* note 56, at 22 (suggesting that the cooperative language found in the Sikes Act could be strengthened and extended to all land management agencies).

968 Lacey Act Amendments of 1981, 16 U.S.C. §§ 3371–3378 (2012).

969 *Id.* § 3373(a).

3) Intergovernmental cooperation cannot be a euphemism for the idea that either entity always gets what it wants. It ought to be, and generally is, an opportunity for informing agency decision making in meaningful ways. The law determines which level of government has the final decision-making authority.

1. Existing Opportunities for Intergovernmental Cooperation at the Federal Level

In Part III.B of this Article, it was noted that the authorizing statutes for the various land units already provide multiple opportunities for intergovernmental cooperation at the federal level. For instance, in the NWRSIA and FLPMA's planning and land acquisition programs, substantive opportunities for intergovernmental cooperation are prescribed by statute.[970] In addition to these opportunities for cooperation are those opportunities provided in other federal statutes and programs, such as NEPA, the Landscape Conservation Cooperative (LCC) network coordinated by FWS, the Joint Ventures program of FWS, and the State Wildlife Grants Program.[971]

NEPA presents what is probably the best-known opportunity for intergovernmental cooperation. NEPA declares that it is the policy of the U.S. government to work "in cooperation with State and local governments" to pursue the "conditions under which man and nature can exist in productive harmony."[972] To carry out the policy of cooperation, NEPA requires the federal agency conducting an Environmental Impact Statement (EIS) to provide early notification to, and solicit the views of, any state entity which may be significantly impacted.[973] Any disagreements about

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970 *See, e.g.*, National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. § 668dd(e)(3) (directing FWS to consult with "adjoining Federal, State, local, and private landowners and affected State conservation agencies" when preparing comprehensive conservation plans); FLPMA, 43 U.S.C. § 1701(a)(2) (2012) ("[T]he national interest will be best realized if the public lands and their resources are periodically and systematically inventoried and their present and future use is projected through a land use planning process coordinated with other Federal and State planning efforts.").

971 For a review of these and other programs, see Vicky J. Meretsky et al., *A State-Based National Network for Effective Wildlife Conservation*, 62 BIOSCIENCE 970, 970–72 (2012) (describing collaborative conservation programs, including the Joint Ventures program and LCC network). *See also* NEPA, 42 U.S.C. § 4331(a) (2012) ("[I]t is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures . . . in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans."). *See generally* LANDSCAPE CONSERVATION COOPS., NETWORK STRATEGIC PLAN (2014), https://perma.cc/4NGE-VU6W (describing the strategic plan for the LCC network); *Joint Ventures Overview*, U.S. FISH & WILDLIFE SERV., https://perma.cc/NGY8-AADQ (last modified Nov. 12, 2015) (providing an overview of the Joint Ventures program); *State Wildlife Grant Program—Overview*, U.S. FISH & WILDLIFE SERV., https://perma.cc/LKZ9-4QAT (last updated July 20, 2016) (providing an overview of the State Wildlife Grant Program).

972 42 U.S.C. § 4331(a).

973 *Id.* § 4332(D)(iv).

impacts between federal and state agencies must be enumerated within the EIS.[974] States may also obtain official cooperating agency status, which requires the lead NEPA agency to "[u]se the environmental analysis and proposals of cooperating agencies with jurisdiction by law or special expertise, to the maximum extent possible consistent with its responsibility as lead agency."[975] This provides state governments with much greater access to the federal decision-making processes than the general public enjoys.

One example of successful cooperation wrought by NEPA is the EIS process that was initiated following the *Wyoming v. United States* case about the National Elk Refuge.[976] In the aftermath of that decision FWS and NPS (which manages neighboring Grand Teton National Park) embarked on a joint-EIS process to develop a plan to guide the management of bison and elk across that federal landscape.[977] Because of the intergovernmental integration and cooperation made possible by that process, the state chose to incorporate some of the recommendations from the EIS in their own Bison Brucellosis Management Action Plan in 2008.[978]

In an even more focused attempt to encourage integrated management, the LCC program was developed in 2010 in an attempt to facilitate collaboration between all levels of government, including federal, state, local, and tribal governments, as well as interested nongovernmental organizations, in order to "tackle large-scale and long-term conservation challenges."[979] There are twenty-two LCCs in the network.[980] Each is self-directed by a voluntary steering committee, though the whole enterprise is coordinated through FWS.[981] The goals of the LCC program are to develop "science-based information about the implications of climate change and other stressors . . . ; [d]evelop shared, landscape-level conservation objectives and . . . strategies . . . ; [f]acilitate [scientific exchange]; [m]onitor and evaluate the effectiveness of LCC . . . strategies . . . ; [and d]evelop . . . linkages" between LCCs.[982] A 2015 National Academy of Sciences review concluded that the LCC program provided a framework for achieving landscape-level cooperation and "recognized the LCCs' ability to create opportunities for identifying common conservation goals and leveraging

974 *Id.*

975 40 C.F.R. § 1501.6(2) (2016).

976 *See supra* notes 151–154 and accompanying text.

977 U.S. FISH & WILDLIFE SERV. & NAT'L PARK SERV., FINAL BISON AND ELK MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT STATEMENT 3 (2007), https://perma.cc/7VUM-BETP.

978 WYO. GAME & FISH DEP'T, JACKSON BISON HERD (B101) BRUCELLOSIS MANAGEMENT ACTION PLAN 8 (2008), https://perma.cc/293Y-WM6F.

979 *Beyond Boundaries*, LANDSCAPE CONSERVATION COOPERATIVE NETWORK, https://perma.cc/RT6U-R5QN (last visited Nov. 11, 2017); *see* Order No. 3289, Ken Salazar, Sec'y of the Interior, Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources 3 (Feb. 22, 2010), https://perma.cc/T4WQ-LKGL.

980 LANDSCAPE CONSERVATION COOPS., *supra* note 971, at 20.

981 *Id.*; *Organizational Structure*, LANDSCAPE CONSERVATION COOPERATIVE NETWORK, https://perma.cc/C49A-TNXU (last visited Nov. 11, 2017); *Landscape Conservation Cooperative Staff*, LANDSCAPE CONSERVATION COOPERATIVE NETWORK, https://perma.cc/E3PU-ZAGA (last visited Nov. 11, 2017).

982 LANDSCAPE CONSERVATION COOPS., *supra* note 971, at 3.

efforts of diverse partners at a much greater scale than any one entity could achieve alone."[983]

Unfortunately, simply because cooperative processes are in place—through NEPA and many other statutes—does not always ensure that the federal agencies apply them in a way designed to elicit true state and local government cooperation. Bryan and others document several instances where federal processes are merely used as hoops to jump through rather than opportunities for true collaboration.[984] Federal agencies will need to improve internal culture and education to ensure existing opportunities for collaboration are as successful as possible.

Furthermore, even when state and local governments take advantage of opportunities to participate in federal processes, their intention is not always true cooperation. Bryan and others write:

> From the local government perspective, a guarantee of early and meaningful involvement in the federal land planning process is an important factor in determining whether to participate at all. . . . On the federal side, agencies desire local government participants who are well-informed about the federal planning process, do not use the process for political grand-standing, and reciprocate by including federal planners in local land use planning.[985]

For instance, there has been a movement recently among local governments to try to use the coordination clauses in FLPMA and NFMA to force federal agencies to conform their actions to the wishes of local interests.[986] However, this is not a reasonable interpretation of the statutes, as was demonstrated in Part III.B of this Article. Both laws temper the coordination clauses with additional language that emphasizes that even though coordination is a worthy goal, it cannot come at the expense of federal agencies meeting their statutory obligations.[987] Local and state governments

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983 Press Release, Landscape Conservation Coop. Network, National Academy of Sciences Releases Its Review of the Landscape Conservation Cooperatives (Dec. 3, 2015), https://perma.cc/PQV9-UYYJ.

984 *See* Michelle Bryan et al., *Cause for Rebellion? Examining How Federal Land Management Agencies & Local Governments Collaborate on Land Use Planning*, GEO. WASH. J. ENERGY & ENVTL. L., Spring 2015, at 1, 14–16. ("[C]ollaboration must be genuine and not perfunctory to truly be successful in the long term . . . .").

985 *Id.* at 2.

986 Joshua Zaffos, *Counties Use a 'Coordination' Clause to Fight the Feds*, HIGH COUNTRY NEWS (May 11, 2015), https://perma.cc/G7TP-62FR.

987 *See* NFMA, 16 U.S.C. § 1604(e) (2012) (requiring land and resource management plans to comply with the agency's multiple use and sustained yield mandate); FLPMA, 43 U.S.C. § 1712(c)(9) (2012) ("The Secretary shall . . . [coordinate] to the extent consistent with the laws governing the administration of the public lands . . . ."). Even the Public Lands Council, an interest group which represents cattle and sheep producers who hold public grazing permits, has recognized that this is a disingenuous reading:

> Unfortunately, some local governments have taken the BLM consistency requirement to mean that by simply handing the BLM their land use plan, the BLM will be forced to comply with it. Not only is this incorrect, it undermines the ongoing negotiation and information sharing process that is at the core of coordination. Experienced

must work to improve their own use of federal processes and to get involved knowledgably with the intention of being good partners.

2. Opportunities to Cooperate at the State Level

If states are truly looking for meaningful cooperation between federal and state entities regarding wildlife management, then significant opportunities for federal input in state decision making must exist as well. State and local governments regulate the uses of private and state lands that are adjacent to federal lands, and that may cause spill-over effects onto federal lands.[988] For example, the National Parks Conservation Association (NPCA) recently complained that the proposed Greater Yellowstone grizzly bear delisting plan "[f]ails to provide [NPS] a formal seat at the table to work with state agencies on the management of park bears that occasionally move beyond park borders."[989] Without formal mechanisms to promote and institutionalize intergovernmental cooperation, those issues will rarely be considered. Federal law, regulation, and policy encourage intergovernmental cooperation, but there does not appear to be a similar emphasis found in state law and regulation. Again, cooperation, to be effective, must be a two-way street.

For example, when it comes to local land use decisions that have obvious impacts on wildlife, there is rarely an opportunity for federal involvement in the decision making. One exception is Oregon, where "local governments are specifically instructed to collaborate with federal agencies in areas such as natural resources, estuaries, and coastal shorelands."[990] Oregon might serve as an example of how other states could modify laws and regulations to encourage such cooperation. "[W]estern states could do much to advance the issue of local-federal land use planning by simply noting, in nonadversarial language, the importance of that issue in their enabling legislation."[991] For true cooperation to be successful, local, state, and federal governments must work as partners.[992] To that end, states should create similar opportunities for federal agencies to engage in state and local decision making.

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coordinators recognize that the BLM has no obligation to adhere to any local plan or policy that is inconsistent with federal laws and regulations.

PUB. LANDS COUNCIL, A BEGINNER'S GUIDE TO COORDINATION 10 (2012), https://perma.cc/YW3C-B3CE; *see About PLC*, PUB. LANDS COUNCIL, https://perma.cc/manage/create (last visited Nov. 11, 2017).

988 *See* Bryan et al., *supra* note 984, at 1–5 (providing an overview of local and state land use planning).

989 Stephanie Adams, *Iconic Grizzlies Deserve a More Thoughtful Plan*, BOZEMAN DAILY CHRON. (Oct. 15, 2016), https://perma.cc/W6MN-6NGP.

990 Bryan et al., *supra* note 984, at 4.

991 *Id.* at 5.

992 *Id.* at 2.

3. Cooperation Does Not Equal Federal Acquiescence

In none of the cooperation sections reviewed in Part III.B does the statute in question *require* the federal government to follow state preferences. And in all cases, the statutes do not *permit* the federal agency to relinquish its statutory obligations, even in the face of state dissent. Cooperation under these federal statutes is an opportunity for other levels of government to have privileged access to the decision-making process, to ensure that concerns are considered, and available data is exchanged.

Agencies should absolutely determine if it is possible to meet the needs of other governmental entities, but they cannot be expected to jettison their own statutory or constitutional obligations to reach that goal. For instance, in Alaska, where the state determined that the requirements of ANILCA conflicted with the state constitution, the resolution was that the state could not be forced to implement that statute.[993] Likewise, if a federal agency determines that a state's request conflicts with its own legal mandates, it too must refuse to acquiesce to them.[994] However, in the absence of legal conflicts, we encourage state and federal entities to seriously consider, and if possible accommodate, the interests of other governmental entities.

"[W]ildlife move across eco-regions . . . but management approaches change across arbitrary boundaries."[995] It is crucial, therefore, that all levels of government cooperate and coordinate their efforts as much as is possible given the legal framework in which they operate. As the court in *Wyoming* stated: "Wildlife management policies affecting the interests of multiple sovereigns demand a high degree of intergovernmental cooperation."[996] A structure for such cooperation is still largely absent from state processes, and while such a structure is already embedded in federal programs, federal agencies could still improve its implementation in order to better fulfill its intent.

V. CONCLUSION

This is a tumultuous time to be writing about public lands, federalism, and wildlife. Each has been impacted by the deep ideological fissures, polarization, and partisanship characterizing modern American politics. Of course, there has always been a tension between federal and state interests in the management of federal lands and resources. Some of the earliest and most precedential disputes in the field initially revolved around wildlife management and the respective powers of federal and state governments. Slowly, over time, the courts answered these questions and made clear the extensive powers of the federal government to manage public lands and the wildlife thereon. These include *Missouri v. Holland* (1920), *Hunt v. United States* (1928), *Kleppe v. New Mexico* (1976), *Hughes v. Oklahoma* (1979),

993 *McDowell*, 785 P.2d 1, 3, 9 (Alaska 1989).
994 *See* discussion *supra* Part III.A.4.
995 Bryan et al., *supra* note 984, at 2 (omission in original).
996 *Wyoming*, 279 F.3d 1214, 1218 (10th Cir. 2002).

and dozens of other cases at all levels of the judicial system. A consistent pattern of primary federal authority emerges from these cases, but even where the Supreme Court corrected itself in overturning *Geer v. Connecticut*, it did so carefully and constructively, finding in favor of the federal government and interstate commerce but also recognizing the "legitimate state concerns for conservation and protection of wild animals."[997]

A tension between federal and state interests is embedded in federal land and resources law. In each of the statutes reviewed in Part III.B, Congress required these lands and resources to be managed in the national interest and recognized that federal authority is superior to that of the states. At the same time, Congress appreciated the historical and important position of the states in managing wildlife, and these statutes accordingly provide them a meaningful role to play in federal lands planning and management.

While the law is clear, the politics of wildlife management is not. In 1981, George Coggins and Michael Ward reviewed the law of wildlife management on federal lands and concluded that the "jurisdictional imbroglio is more political than legal."[998] Nothing has changed in this regard. As discussed in Part II, some state interests continue to insist on their "sovereign rights" to manage wildlife on federal lands, notwithstanding the decisions made by the courts and Congress over the years. On the other hand are federal land agencies that are often in self-denial about their responsibilities for wildlife management and conservation. Too often adopting an overly narrow view of their responsibilities, we found federal land agencies applying their authorities in an inconsistent fashion, to the dismay of the states and those outside interests willing to challenge them.

The most unfortunate consequence of the federal-state conflicts reviewed here is that they draw attention away from the practice of wildlife conservation. A more productive way to proceed in the future is by working more constructively within the carefully crafted legal framework provided by the U.S. Constitution and federal land law rather than against it, and by embracing the conservation obligations that are inherent in federal lands and wildlife trust management.

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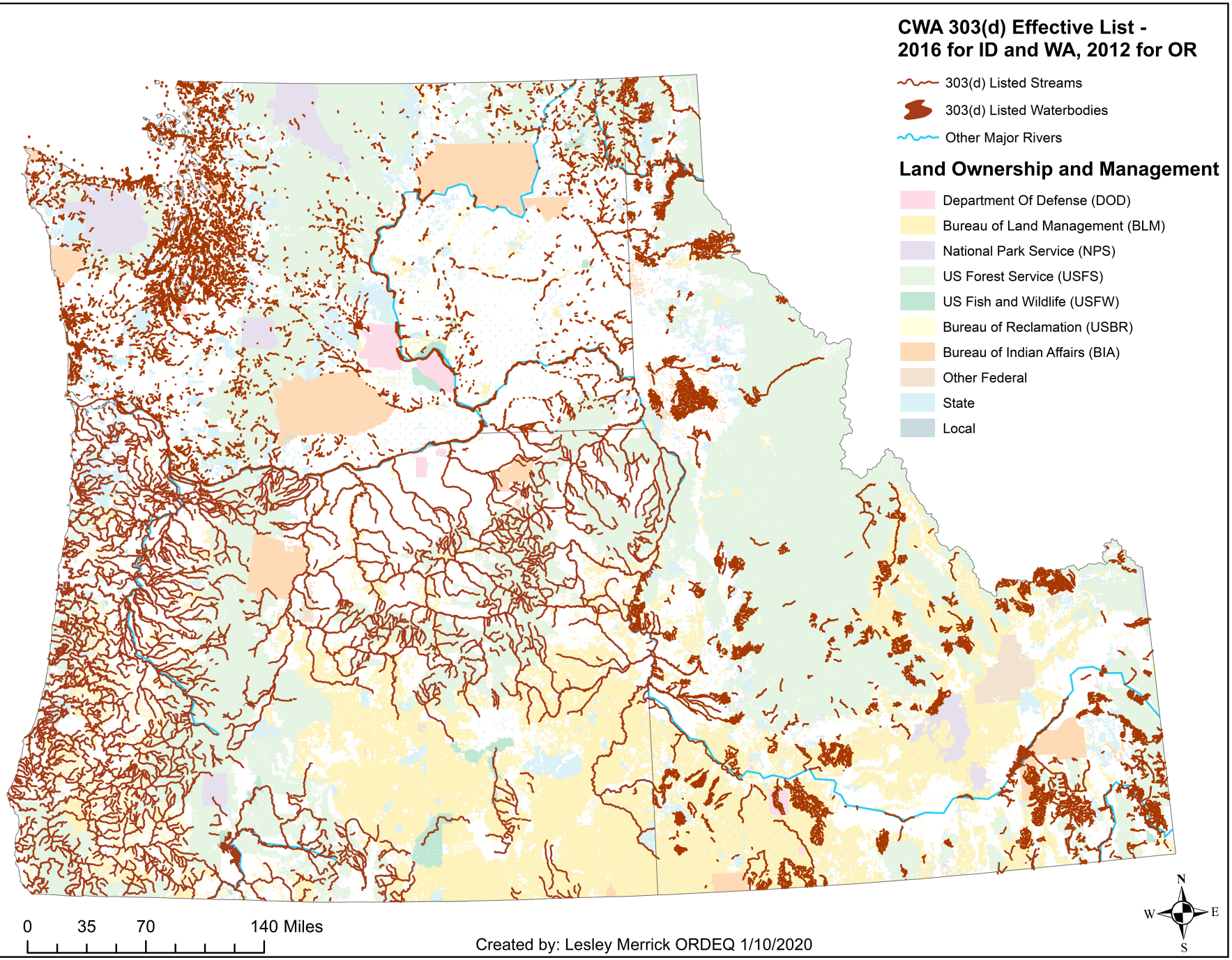
997 *Hughes*, 441 U.S. 322, 335–36 (1979), *overruling Geer*, 161 U.S. 519 (1896).

998 George Cameron Coggins & Michael E. Ward, *The Law of Wildlife Management on the Federal Public Lands*, 60 OR. L. REV. 59, 60, 84 (1981). Coggins and Ward note that, in creating the "delicate allocation of management jurisdiction" in federal land law, "Congress has been extremely solicitous of state sensibilities" and that "[s]ome members of Congress applaud . . . the federal self-denial." *Id.* at 75, 83–84. They conclude that "[t]he main legislative theory seems to be on the order of 'let's just muddle through as best we can and let the courts handle the hard cases.'" *Id.* at 84–85.


CWA 303(d) Effective List -
2016 for ID and WA, 2012 for OR
303(d) Listed Streams
303(d) Listed Waterbodies
Other Major Rivers
Land Ownership and Management
Department Of Defense (DOD)
Bureau of Land Management (BLM)
National Park Service (NPS)
US Forest Service (USFS)
US Fish and Wildlife (USFW)
Bureau of Reclamation (USBR)
Bureau of Indian Affairs (BIA)
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140 Miles
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Created by: Lesley Merrick ORDEQ 1/10/2020

A Thermal Map for all Oregon Streams

Data providers:

Funded by:

The aquatics community within Oregon has amassed significant amounts of stream temperature data through their collective monitoring efforts in previous decades. As part of a broader regional effort, the NorWeST project has developed a comprehensive interagency stream temperature database for Oregon that consists of 18,774 summers of monitoring effort at 6,461 unique sites (map inset). Those data were used with spatial statistical network models (details at the SSN/STARS website: www.fs.fed.us/rm/boise/AWAE/projects/SpatialStreamNetworks.shtml) to develop an accurate stream temperature model (R^2 = 90%; RMSE = 1.0˚C), which was then used to predict high resolution (1 kilometer) historical and future climate scenarios for all of Oregon's streams. This poster depicts a historical scenario of the mean August temperature from 1993-2011 mapped to the USGS 1:100,000-scale NHDPlus hydrography layer trimmed to exclude reaches >15% slope. NorWeST stream climate scenarios are available as ArcGIS shapefiles from the project website (www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html) and can also be viewed dynamically online (www.sciencebase.gov/flexviewer/NorWeST/). Daily summaries (min/max/mean) of the temperature data used to develop the temperature model are available through the website if permission was given for their distribution. All data are attributed to the original source agency and contributing biologists/hydrologists in metadata files.

By providing open access to stream temperature information in user-friendly formats, the NorWeST project is facilitating coordination of monitoring activities among organizations, better conservation planning, and new research on temperature dynamics and thermal ecology. The analytical infrastructure used to develop the Oregon stream temperature model consists of a new class of spatial statistical model for data on stream networks that could also be used with water chemistry attributes (e.g., pH, alkalinity, conductivity, etc.), various biological datasets (species occurrence, abundance, genetic attributes), or habitat surveys to provide a wealth of new information about streams.

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Spatial Statistical Network Models

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Isaak, D., E. Peterson, J. Ver Hoef, S. Wenger, J. Falke, C. Torgersen, C. Sowder, A. Steel, M. Fortin, C. Jordan, A. Reusch, N. Som, P. Monestiez. 2014. Applications of spatial statistical network models to stream data. *Wiley Interdisciplinary Reviews - Water* **1**:277-294.

Peterson, E., J. Ver Hoef, D. Isaak, J. Falke, M. Fortin, C. Jordan, K. McNyset, P. Monestiez, A. Ruesch, A. Sengupta, N. Som, E. Steel, D. Theobald, C. Torgersen, and S. Wenger. 2013. Modeling dendritic ecological networks in space: an integrated network perspective. *Ecology Letters* **16**:707-719.

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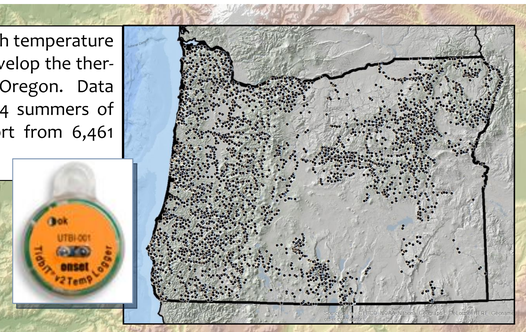
NorWeST StreamTemp

Scenario 1: Mean August Stream Temperature 1993 - 2011

20° 14 12 8

Stream sites with temperature data used to develop the thermal map for Oregon. Data consist of 18,774 summers of monitoring effort from 6,461 unique sites.



NorWeST Team: Dan Isaak, David Nagel, Seth Wenger, Matt Groce, Erin Peterson, Jay Ver Hoef, Charlie Luce, Steve Hostetler, Jason Dunham, Jeff Kershner, Brett Roper, Dona Horan, Gwynne Chandler, Sherry Wollrab, Sharon Parkes, Colette Breshares, Neil Bernklau, Sam Chandler

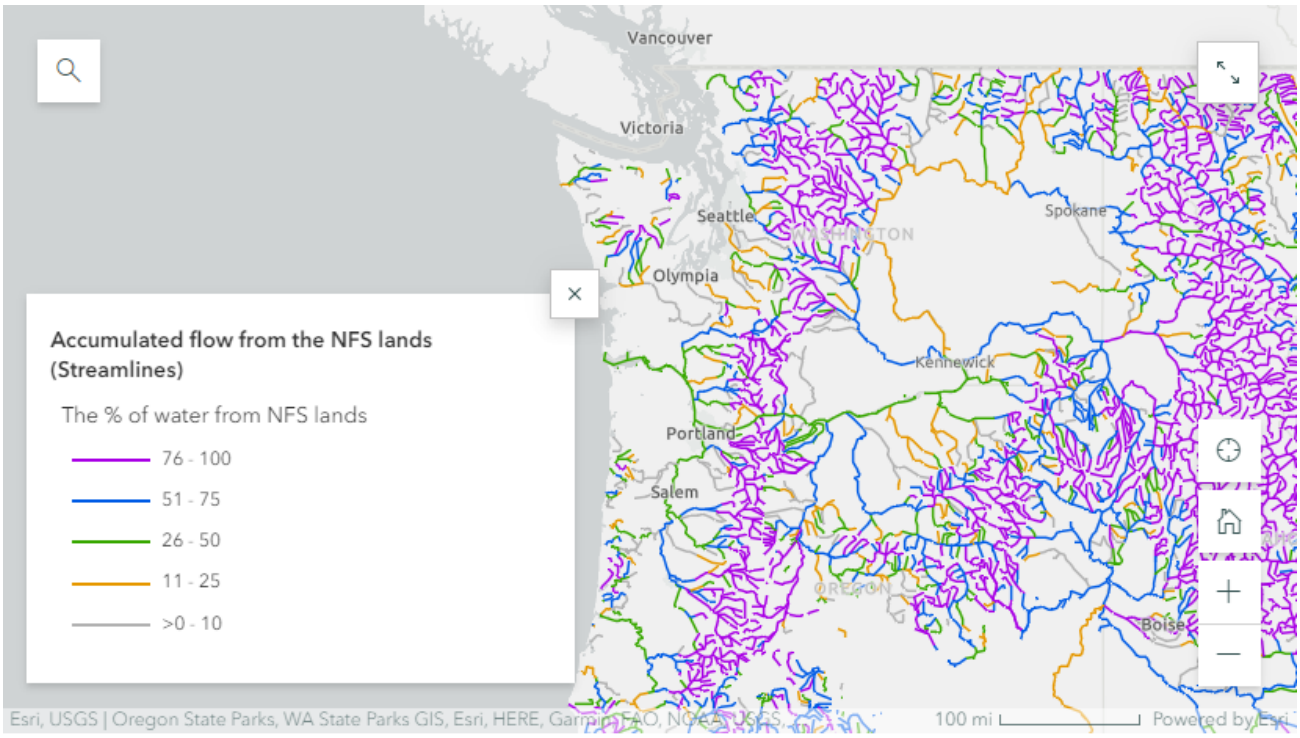
Nehalem River
COLUMBIA RIVER
Umatilla River
Grande Ronde River
Wallowa River
SNAKE RIVER
Willamette River
Clackamas River
Deschutes River
N. Santiam River
S. Santiam River
John Day River
Powder River
Burnt River
Crooked River
Silvies River
Silver Creek
Malheur River
Owyhee River
Umpqua River
Coquille River
Rogue River
Illinois River
Sprague River
Stonewall Bank

0 20 40 60 80 100 Kilometers

Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, HERE, Geonames.org, and other contributors

Surface Water Supply that originates on USFS Lands[1]

(Percent of mean annual surface water supply from USFS lands)



Percentage of the total 2001–2015 mean annual surface water supply that originated on National Forest System lands by sub-watershed streamline. Surface water supply is the total amount of surface water available at the outlet of each sub-watershed, including flow accumulated from sub-watersheds upstream after accounting for inter-basin transfers. Streamlines are colored according to the fraction of total water supply at the watershed outlet that originated on National Forest System lands.

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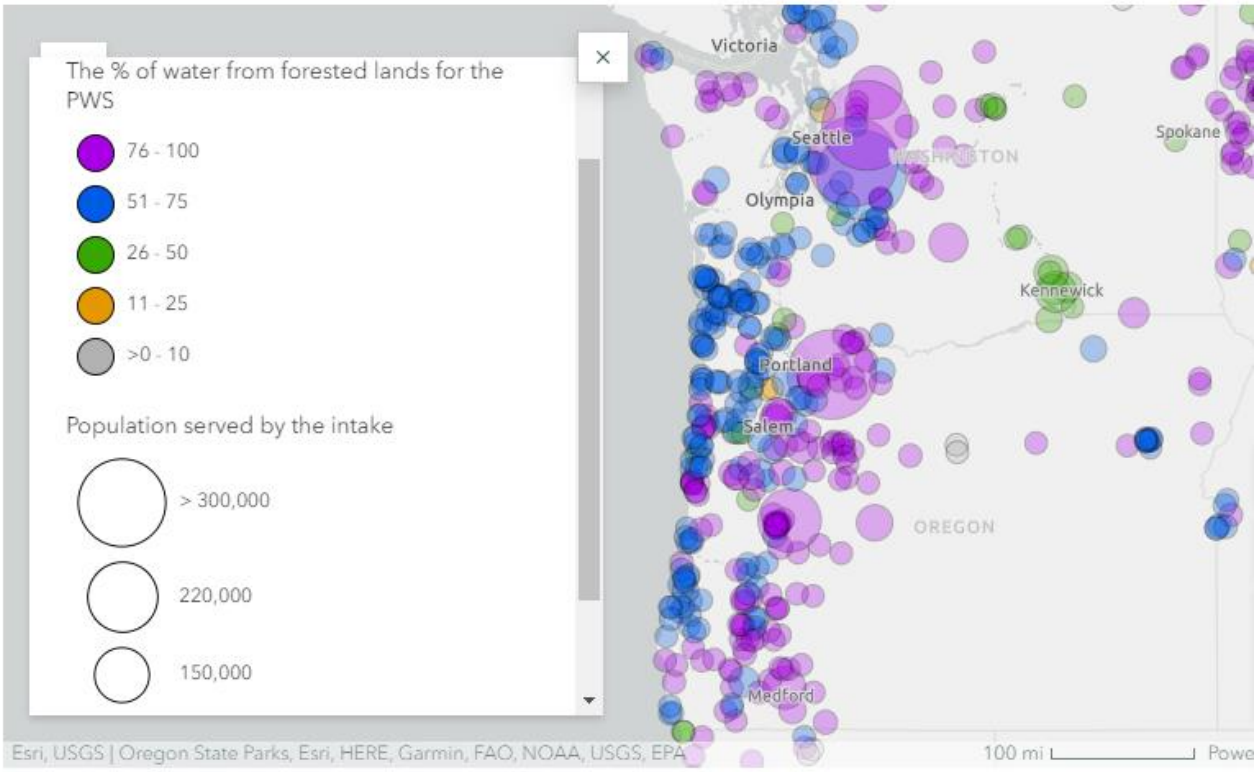
1 From story map: https://storymaps.arcgis.com/stories/28f7829baf494a6e9bd8d76e9aeeaa50
Based on this publication: Liu, Ning; Dobbs, G. Rebecca; Caldwell, Peter V.; Miniat, Chelcy F.; Sun, Ge; Duan, Kai; Nelson, Stacy A.C.; Bolstad, Paul V.; Carlson, Christopher P. 2022. Quantifying the role of National Forest System and other forested lands in providing surface drinking water supply for the conterminous United States. Gen. Tech. Rep. WO-100. Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office. 40 p. plus supplement . https://doi.org/10.2737/WO-GTR-100

Drinking Water provided by USFS, other forested lands

(Percent of water from forested lands for public water supplies)



Public surface drinking water intakes where some amount of source water originated on National Forest System and other forested lands. Circles representing intakes are colored by the percentage of surface drinking water from National Forest System and other forested lands after accounting for inter-basin transfers and sized by the population served. Intake locations are approximate.

Communications

Ecological Applications, 30(8), 2020, e02225

Smokey the Beaver: beaver-dammed riparian corridors stay green during wildfire throughout the western United States

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Abstract. Beaver dams are gaining popularity as a low-tech, low-cost strategy to build climate resiliency at the landscape scale. They slow and store water that can be accessed by riparian vegetation during dry periods, effectively protecting riparian ecosystems from droughts. Whether or not this protection extends to wildfire has been discussed anecdotally but has not been examined in a scientific context. We used remotely sensed Normalized Difference Vegetation Index (NDVI) data to compare riparian vegetation greenness in areas with and without beaver damming during wildfire. We include data from five large wildfires of varying burn severity and dominant landcover settings in the western United States in our analysis. We found that beaver-dammed riparian corridors are relatively unaffected by wildfire when compared to similar riparian corridors without beaver damming. On average, the decrease in NDVI during fire in areas without beaver is 3.05 times as large as it is in areas with beaver. However, plant greenness rebounded in the year after wildfire regardless of beaver activity. Thus, we conclude that, while beaver activity does not necessarily play a role in riparian vegetation post-fire resilience, it does play a significant role in riparian vegetation fire resistance and refugia creation.

Key words: *beaver; burn; dam; drought; Normalized Difference Vegetation Index; remote sensing; riparian; vegetation; wildfire.*

Introduction

Beavers are native to North America (*Castor canadensis*) and to Eurasia (*Castor fiber*; Naiman et al. 1988, Wróbel 2020). They occupy a variety of landscapes, including mountain streams, lowland valleys, coastal estuaries, deserts, arctic tundra, and temperate forests. (Naiman et al. 1988, Leidholt-Bruner et al. 1992, Pilliod et al. 2017, Tape et al. 2018). Beavers are well known ecosystems engineers; they build channel-spanning dams from wood, stone, and mud that ultimately create the broad ponds and wetlands that beavers thrive in (Hammerson 1994). Beavers also excavate mud from the pond bottom and dig channels (also referred to as canals) radiating from the pond out into the surrounding landscape, which fill with water and increase their area of influence (Gurnell 1998). The combination of building flow obstructions (dams), accumulating water (ponds), and spreading that water out in the landscape (channels) gives beavers the unique potential to modulate environmental extremes such as flood and drought (Hood and Bayley 2008, Pilliod et al. 2017, Fairfax and Small 2018, Westbrook et al. 2020). When it comes to water, beavers slow it, spread it, and store it.

Due to the fact that beaver channels and dams spread water out in the landscape and store it broadly in adjacent soils (Fig. 1, top), the vegetation near beaver ponds doesn't experience as much reduced water availability during drought (Macfarlane et al. 2016, Pilliod et al. 2017, Fairfax and Small 2018; Fig. 1, middle). Drought-stricken vegetation burns more easily than lush, green vegetation (Liu et al. 2010), so it follows that the vegetation around beaver ponds would be more difficult to burn than vegetation around undammed creeks (Fig. 1, bottom). Although this concept has been observed, discussed, and documented in photographs (Fig. 2), the

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potential difference in vegetation health during wildfire in areas with and without beaver has not yet been quantified (Foster et al. 2020). In this study, we use satellite-derived Normalized Difference Vegetation Index (NDVI) data from the year before, year of, and year after a major wildfire to examine the vegetation changes of riparian corridors with and without beaver. We include data from five large wildfires located in five different western U.S. states, Colorado, California, Oregon, Idaho, and Wyoming, to quantify the extent to which, if any, vegetation in beaver-dammed riparian areas can stay green during wildfire.

Methods

Site selections and descriptions

We examined fires with differing burn severities and landcover to help determine whether the response of riparian areas with beaver-dam complexes to wildfire could be generalized beyond specific case studies. Table 1 provides a brief summary of the fires included in this study and the data used for each. The fires included in this study occurred in a variety of landcover types as determined by the 2016 National Landcover Database (Homer et al. 2020). Three of the fires studied occurred in shrubland dominant landscapes, and two occurred in forest dominant landscapes. The burn severity of the fires varied as well, with three fires that were majority unburned to low burn severity, and two fires that were majority moderate to high burn severity. Burn severity and fire perimeters were collected from the Monitoring Trends in Burn Severity Database and the GeoMAC Wildland Fire Support Database. (Eidenshink et al. 2007, USGS 2019). Fires occurred in areas with varying drought status in the years before, of, and after the fire. Drought severity was determined using the Palmer Drought Severity Index from the NOAA Gridded Climate Divisional Dataset (Palmer 1965, Vose et al. 2014). Full detailed fire information can be found in Appendix S1: Table S1.

Each fire contained creeks with heterogeneous patches of beaver activity. We determined where beavers were influencing riparian corridors in our study by locating and recording the position of beaver dams, ponds, and beaver-dug channels using satellite images acquired through Google Earth. Previous studies have successfully used aerial imagery and Google Earth to locate and identify beaver dams (Macfarlane et al. 2015, Puttock et al. 2015, Fairfax and Small 2018).

General process for evaluating impact of beavers on riparian wildfire resistance

Our procedure to determine whether, and to what extent, beaver activity protects riparian vegetation during wildfire is outlined below and again graphically in Appendix S2: Fig. S1.

(1). Collect geospatial (e.g., coordinates of dams, pond area polygon, dam length vectors) for each beaver dam within the fire perimeters.
(2). Extract remotely sensed NDVI along each creek that had patches of beaver activity on approximate date (month and day) of wildfire in year before, during, and after wildfire.

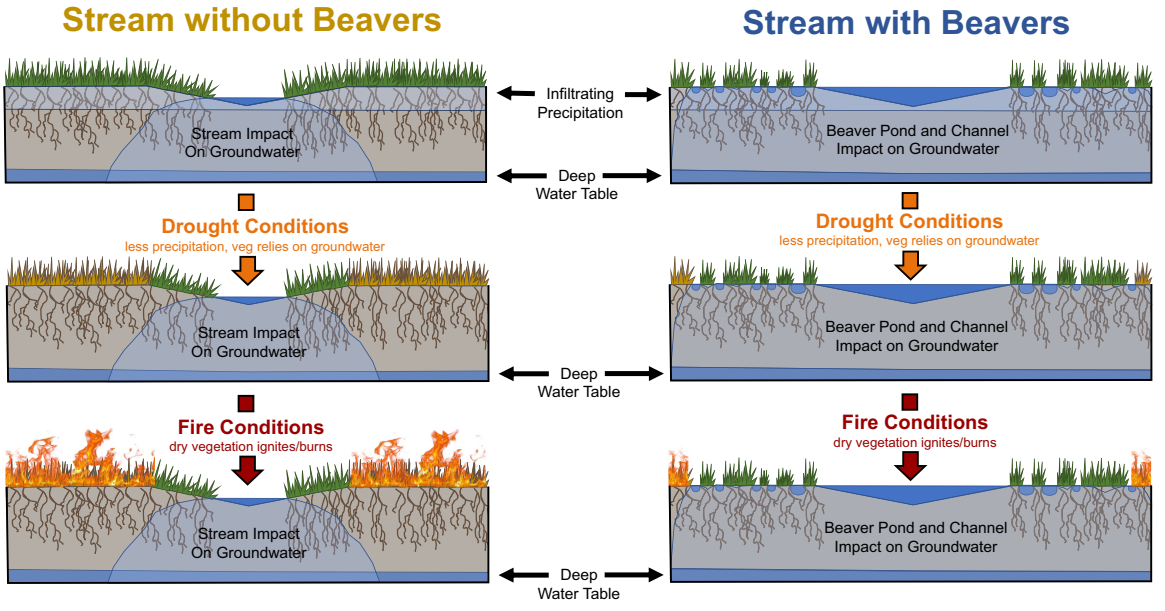

Fig. 1. Conceptual model of vegetation response to normal conditions (top), drought (middle), and fire (bottom) in creeks with (right) and without (left) beaver. [Color figure can be viewed at wileyonlinelibrary.com]

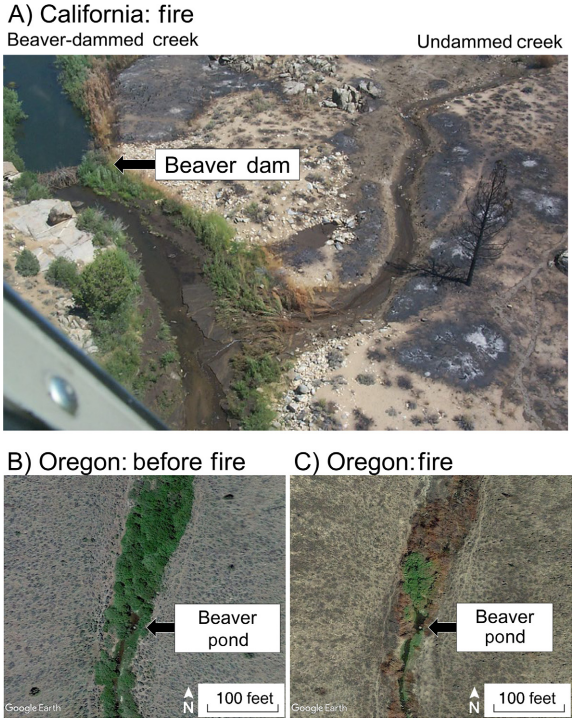

FIG. 2. Photographs of vegetation response to wildfire around beaver ponds. In both examples, vegetation near beaver ponds stayed green while other nearby riparian vegetation burned. (A) Adjacent creeks with and without beaver damming during the Manter Fire in California. Photograph from the Burned Area Emergency Response (BAER) team. (B) A creek with a beaver pond on it in Oregon prior to the Buzzard Complex Fire. (C) The same location as B, except image is from immediately after the wildfire (Google Earth). 1 foot = 0.30 m. [Color figure can be viewed at wileyonlinelibrary.com]

(3). Difference between pre-fire NDVI and fire NDVI is calculated at each site and graphically compared to locations of beaver dams.

(4). Divide creeks into sections broadly impacted by beaver activity and sections that do not have beaver activity, unscaled NDVI Differences in beaver and non-beaver areas are compared at the creek and wildfire scales.

(5). Use the maximum NDVI Difference on each creek to scale the changes in NDVI so sites can be compared while accounting for variation in burn severity, landcover, and climate.

(6). Compare scaled NDVI changes in areas with and without beaver across all study sites.

Following these steps allows us to move from site-specific case studies of individual creeks within larger wildfire-impacted landscapes, to generalized vegetation response to wildfire in riparian corridors with and without beaver activity.

NDVI collection and calculations

Previous studies indicate that Normalized Difference Vegetation Index (NDVI) can be used as a proxy for overall riparian vegetation health, and that it can be estimated from remotely sensed data (Macfarlane et al. 2016). High NDVI (values close to 1) generally indicated lusher, greener vegetation while very low NDVI (values close to 0 or negative) generally indicate unhealthy, senesced, or dying vegetation. In more densely vegetated areas, including riparian zones, an NDVI below 0.3 is considered to be indicative of low plant health and productivity (Nagler et al. 2001, Donnelly et al. 2016, Huntington et al. 2016, Silverman et al. 2019). In this study, we use the 0.3 NDVI threshold, Google Earth aerial imagery, and landcover data to determine where riparian vegetation is present before the fires.

Apart from the 2000 Manter Fire in California, we calculated NDVI from Landsat 8 imagery. Landsat 8 imagery is available from April 2013 through the present, has 30 × 30 m pixel resolution on its red (R) and near-infrared (NIR) bands, and a 16-d recurrence interval. For the Manter Fire, we used Landsat 7 imagery. Landsat 7 imagery is available from April 1999 through the present and has the same pixel resolution in R and NIR and recurrence interval as Landsat 8. The Landsat imagery dates used for each fire are summarized in Appendix S1: Table S1 and were chosen based on timing and cloud-free status. The NDVI is calculated from Landsat acquired reflectivity data according to Eq. 1 (Tucker 1979):

$$\mathrm{NDVI} = (\mathrm{NIR}x02010; \mathrm{RED})/(\mathrm{NIR} + \mathrm{RED}) \quad (1)$$

where NIR is the near-infrared band reflectivity and RED is the red band reflectivity. All images came with a

TABLE 1. Brief summary of fire information included in study.

State	Year	Name	Area within perimeter (acres)	No. beaver dams	Burn severity (%; unburned–low/moderate/high)	Dominant landcover
California	2000	Manter	79,182	57	46/32/22	shrubland
Colorado	2016	Beaver Creek	38,380	364	38/23/39	forest
Idaho	2018	Sharps	64,811	62	57/43/<1	shrubland
Oregon	2014	Buzzard Complex	395,348	48	87/13/<1	shrubland
Wyoming	2018	Badger Creek	21,322	190	54/36/10	forest

Note: 1 acre = 0.40 ha.

quality assessment statement regarding whether the integrity of data had been affected by instrument artifacts or atmospheric conditions and were sourced directly from the USGS Earth Resources Observation and Science (EROS) Center Science Processing Architecture (ESPA; USGS 2014). We extracted NDVI values at each pixel immediately adjacent to the creek (≤30 m distance from creek edge) for all creeks in the study in the year before, the year of, and the year after the fire on the approximate date (month and day) of the wildfire. Higher values indicate greener vegetation. This narrow area is the most heavily and consistently impacted by beaver activity and least likely to be influenced by short term changes in beaver occupancy. However, beaver activity often supports riparian vegetation well beyond the 30 m radius (Gurnell 1998). A larger data set with on-ground riparian zone surveys before, during, and after wildfire would be needed to robustly quantify the total area of riparian zone influenced by beaver activity. In the absence of that data, our results should be interpreted as a conservative assessment of the refugia that beavers can support during wildfires.

Vegetation response to wildfire was calculated by subtracting the NDVI during the wildfire from the NDVI at the same time of year in the year prior to the wildfire

$$\text{NDVI Difference} = \text{NDVI}_{\text{prex02010;fire}}x02010; \text{NDVI}_{\text{fire}}. \quad (2)$$

With this formulation, smaller values for NDVI difference indicate greater resistance to wildfire, i.e., the plants stayed greener and burned less. This type of formulation has been utilized in prior work to evaluate change in vegetation condition as a response to environmental stressors (Nagler et al. 2001, Macfarlane et al. 2016, Fairfax and Small 2018, Silverman et al. 2019).

We considered the 95th percentile NDVI difference value to be the maximum NDVI difference occurring on each creek. These values are the scaling factors that allow for comparisons between creeks and wildfires while accounting for burn heterogeneity within fire perimeters and variations in vegetation cover, climate, and burn intensity between fires using the following formulation:

$$\text{Scaled NDVI difference} = (\text{NDVI difference})/(\text{Max NDVI difference on creek}). \quad (3)$$

The lower the scaled NDVI difference value, the more fire resistant the riparian vegetation in that section of creek is. We used the scaled NDVI difference calculated for each pixel along each creek to generate two populations of data: one from sections of creek that had beaver activity, one from sections of creek that did not have beaver activity. To be considered part of a section with beaver damming, it had to be within 30 m longitudinally of a beaver pond, dam, or channel. This is a conservative estimate of the spatial scale of hydrologic connectivity around beaver ponds (Wegener et al. 2017). Each population of data contains data from multiple creeks, fires, landcover types, burn intensities, climate histories, and years, thus the results of comparing the populations should be considered more generalizable than only comparing within a given creek or wildfire perimeter. In addition to comparing mean values and general distributions of data, we perform statistical comparisons to quantify the significance of our results. We use the Kolmogorov-Smirnov (KS) test (Massey 1951) and the Welch two-sample *t* test (Welch 1947). The KS test evaluates whether two populations of data come from a single distribution of data or two distinct distributions, and the *t* test evaluates the likelihood that both samples have identical mean values. For all tests, $P < 0.05$ was our threshold for significance. The population size of pixels used for statistical tests of NDVI difference at the creek scale, wildfire scale, and combined data scale are in Appendix S4: Tables S1 and S2.

Results

NDVI along creek profiles

We collected the NDVI along each creek in the study in the year before, during, and after the fire on the approximate date (month and day) of the wildfire. Our data from a creek in the Manter Fire in California is shown in Fig. 3 and is representative of the results we saw across all creeks. In Fig. 3 (top), the locations of beaver dams are marked along the *x*-axis with black squares. Higher NDVI values indicate greener vegetation. The full set of plots showing NDVI before, during, and after fire as a function of distance along creek can be found in Appendix S3: Fig. S1.

From the pre/during NDVI profiles along each creek, we calculated the NDVI difference (Eq. 2) and again plotted it as a function of distance along creek with the position of beaver dams marked by black boxes. Fig. 3 (bottom) shows the NDVI difference plot derived from the data in Fig. 3 (top). The full set of plots showing NDVI difference as a function of distance along creek can be found in Appendix S4: Fig. S1. A lower NDVI difference value indicates greater resistance to wildfire, i.e., plants in that area are burning less if at all. These NDVI difference profiles were split into sections with and without beaver damming according to the criteria listed in *Methods: NDVI collection and calculations.* From the 12 creeks in the study, we ultimately split them into a total of 61 sections: 32 sections with beaver damming and 29 sections without beaver damming. We calculated the maximum NDVI Difference value for each creek, which is used as the scaling factor to allow comparisons between creeks. These are summarized in Appendix S4: Table S1.

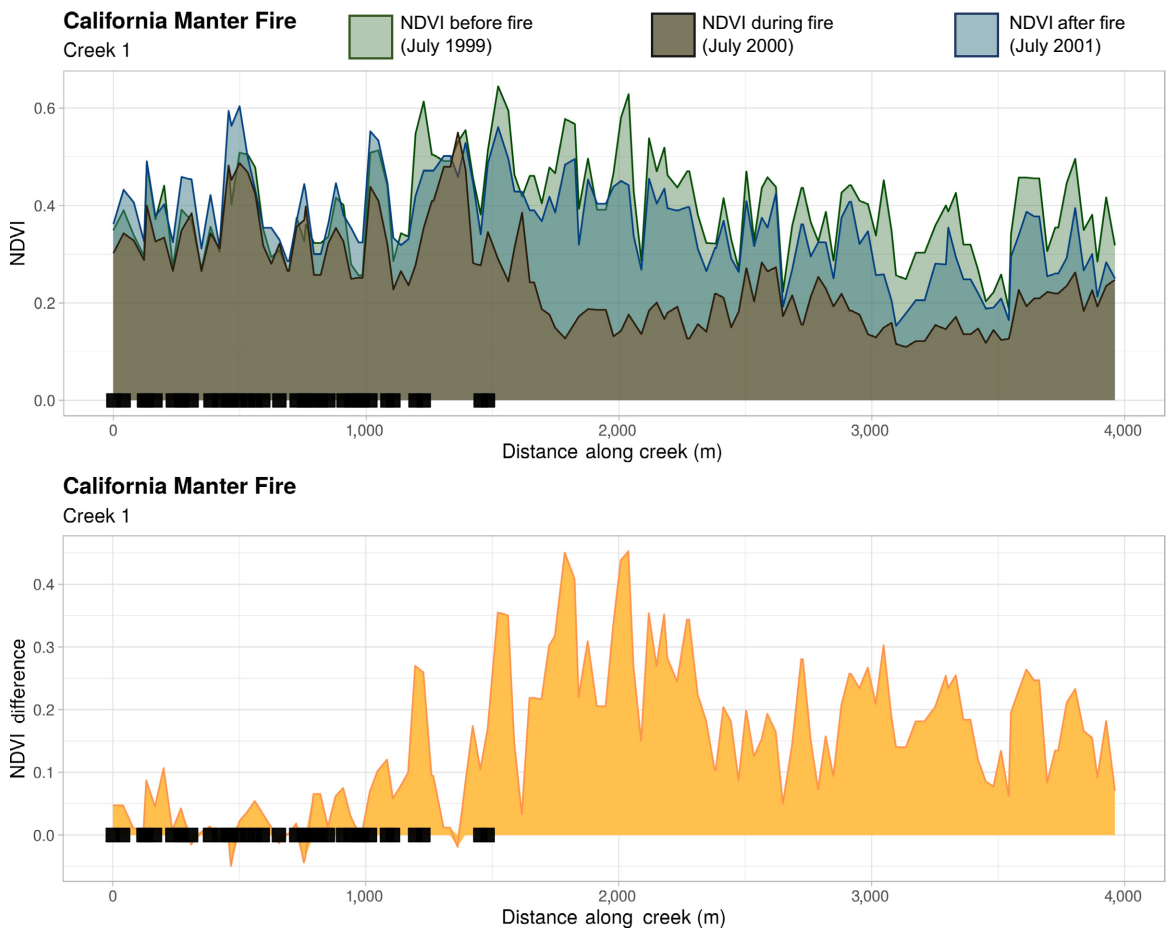

FIG. 3. (Top) NDVI before (green), during (brown), and after (blue) wildfire along a creek in California during the 2000 Manter Fire. Higher NDVI values indicate greener plants. (Bottom) NDVI Difference (Pre-Fire NDVI minus Fire NDVI) along the same creek. The locations of beaver dams are marked with black squares along the *x*-axis. [Color figure can be viewed at wileyonlinelibrary.com]

Unscaled and scaled NDVI differences from all sites

We determined that beaver impacted areas had significantly higher NDVI on the individual creek scale (unscaled NDVI difference), within a wildfire (unscaled NDVI difference), and in our combined data (scaled NDVI difference). The full set of box and whisker plots detailing these results are in Fig. 4. The average scaled NDVI difference in sections of creek without beaver activity was 3.05 times larger than in areas with beaver activity (0.58 without beavers, 0.19 with beavers). These differences were significant using both statistical tests, with $P < 0.001$. We compared pre-fire to post-fire NDVI in areas with beaver vs areas without beaver to probe whether beaver damming may also play a role in riparian corridor recovery in the year after a fire occurs. The full details of these comparisons can be found in Appendix S4: Table S3. We found very little difference (average NDVI difference = 0.07) between pre-fire and post-fire NDVI, and that beaver activity was not correlated with whether the pre-fire or post-fire year was greener (higher NDVI). Thus, the ability for a burned riparian area to rebound after fire is not dependent on beaver activity.

DISCUSSION

Our results indicate that beaver damming plays a significant role in protecting riparian vegetation during wildfires, and that this is a consistently observable phenomenon across landscapes. The riparian vegetation near beaver dams maintained NDVI values during wildfire that were similar to their pre-fire values. Meanwhile the riparian NDVI was significantly reduced from its pre-fire value when not near a beaver dam. The scaled NDVI differences in sections of creek that did not have beaver were on average more than three times as affected by fire as areas that had beaver. This is consistent with our conceptual model for fire resistance (Fig. 1) and with observed fire burn patterns around beaver ponds (Fig. 2). When a fire does ignite, our data suggests that the beaver-dammed riparian areas have stored water that

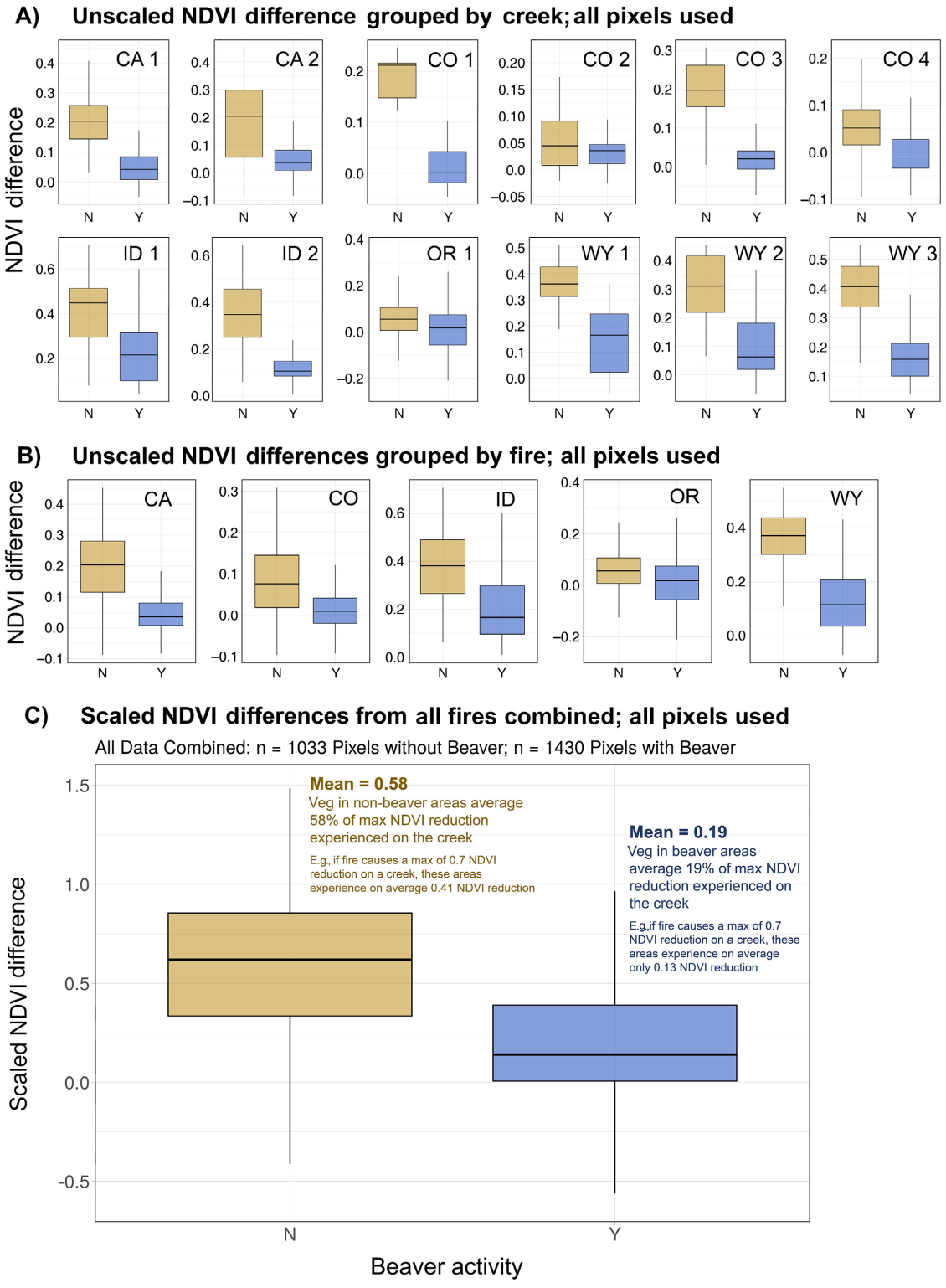

FIG. 4. Box plots of NDVI difference (pre-fire NDVI minus fire NDVI) in beaver (Y) vs. non-beaver (N) areas at three scales: (A) individual creek scale, (B) wildfire scale, and (C) all data combined. Lower absolute NDVI difference and scaled NDVI difference values indicate greater vegetation (veg) resistance to wildfire, i.e., plants burned less. The difference in means and distributions for every box plot shown was statistically significant ($P < 0.05$). NDVI Differences are unscaled in panels A and B. NDVI differences are scaled by the maximum (max) NDVI difference in panel C. [Color figure can be viewed at wileyonlinelibrary.com]

kept plants hydrated enough to make it energetically unfavorable to burn. It's similar to trying to start a fire with a pile of wet leaves versus with dry kindling.

These ribbons of fire-resistant riparian corridor may be particularly important for species that are unable to physically escape wildfire. They can provide temporary habitat for fish, amphibians, reptiles, small mammals, wild and domestic ungulates, and birds that are unable to outrun/outfly the spread of flames. While we found that beaver activity does play a significant role in maintaining vegetation greenness during wildfires, it does not appear to play a significant role in the ability for a riparian corridor to rebound in the year following fire. Riparian vegetation NDVI rebounded in the year following the fire regardless of proximity to beaver activity. Thus, we would describe beaver activity as creating refugia during wildfire, but not necessarily changing the long-term landscape outcomes.

The western United States used to have much more wetland area than it does today, so it is possible that historically beavers were less necessary for creating fire-resistant landscape patches (Mitsch and Gosselink 1993). But as it stands today, wetland habitat is very limited and beavers can create and maintain wetland habitat that persists through flood, drought, and, as we have shown in this study, fire. This has immediate relevance to scientists and practitioners across the North America and Eurasia, particularly in places with increasing wildfire risk and existing or planned beaver populations. Perhaps instead of relying solely on human engineering and management to create and maintain fire-resistant landscape patches, we could benefit from beaver's ecosystem engineering to achieve the same goals at a lower cost.

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Supporting Information

Additional supporting information may be found online at: http://onlinelibrary.wiley.com/doi/10.1002/eap.2225/full

Data Availability Statement

The data that support the findings of this study are openly available in Pangaea at https://doi.pangaea.de/10.1594/PANGAEA.900944.

Communications