DRAFT RECOVERY PLAN
FOR THE
CONTIGUOUS UNITED STATES DISTINCT POPULATION SEGMENT OF CANADA LYNX
(*Lynx canadensis*)

Photo by Keith Williams, U.S. Fish and Wildlife Service

U.S. Fish and Wildlife Service
Mountain-Prairie Region
Denver, Colorado

November 2023 – Draft Recovery Plan

Draft Approved ANNA MUNOZ Digitally signed by ANNA MUNOZ Date: 2023.11.30 11:50:32 -07'00' ______________________ **Date**___________
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Recommended Citation:

U.S. Fish and Wildlife Service. 2023. Draft recovery plan for the contiguous United States distinct population segment of Canada lynx (*Lynx canadensis*). November 2023. U.S. Fish and Wildlife Service, Mountain-Prairie Region, Denver, Colorado. 39 pp.

This draft recovery plan and its associated documents, including the species status assessment (SSA) report and recovery implementation strategy (RIS), can be downloaded from the U.S. Fish and Wildlife Service's website: *https://ecos.fws.gov/ecp/species/3652*.

Technical terms are <u>underlined</u> in their first use and defined in the Glossary at the end of this document.

Prepared by the U.S. Fish and Wildlife Service's Canada Lynx Team, with membership from the Mountain-Prairie Region (6; lead region), the Pacific Region (1), the Southwest Region (2), the Midwest Region (3), and the Northeast Region (5).

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I. Introduction

The Canada lynx (*Lynx canadensis*; lynx) is a North American boreal forest carnivore whose populations are strongly tied to its primary prey, the snowshoe hare (*Lepus americanus*; hare). Both species are broadly distributed across the extensive boreal spruce-fir forests from eastern Canada to Alaska, which constitutes roughly 98 percent of the lynx's range. Because the lynx remains widespread and abundant throughout most of its historical range and does not appear to have suffered range loss or population decline, and because no acute, widespread threats to lynx have been identified, it is designated a species of least concern by the International Union for Conservation of Nature (IUCN; Vashon 2016, entire). However, the southern range margins of both lynx and snowshoe hares, and the boreal forests that support them, extend into the northern contiguous United States. On this southern range periphery, both species usually occur in smaller numbers and at lower densities than are typical in the northern cores of their ranges, and the boreal forest becomes naturally patchy and suboptimal as it transitions to temperate forest types that do not support lynx (Service 2017a, pp. 39–51).

The U.S. Fish and Wildlife Service (Service) designated lynx in the contiguous United States as a distinct population segment (DPS) because of differences in the management of lynx and lynx habitats across the international boundary with Canada and because of the climatic, vegetative, and ecological differences between lynx habitat at the southern extent of its range in the contiguous United States compared to the northern range in Canada and Alaska. The Service listed the lynx DPS as threatened under the Endangered Species Act, as amended (16 U.S.C. 1531 *et seq*; hereafter, Act) in 2000 because of the inadequacy of regulatory mechanisms on some Federal lands to provide for the conservation of lynx habitats and populations at that time (65 FR 16052). In 2003, in response to a court order, the Service reevaluated its finding regarding "significant portion of its range" (SPR) and reaffirmed its designation of lynx in the contiguous United States as a single, threatened DPS (68 FR 40076). The Service prepared a recovery outline for the lynx DPS in 2005 (Service 2005, entire) and designated critical habitat for lynx in 2006 (71 FR 66008). The Service reevaluated and clarified its SPR finding in 2007 (72 FR 1186), revised critical habitat in 2009 (74 FR 8616) and 2014 (79 FR 54782), and completed a species status assessment (SSA) in 2017 (Service 2017a, entire) and an SSA addendum in 2023 (Service 2023, entire).

Currently, the lynx DPS has five discrete resident breeding populations: northern Maine and northeastern New Hampshire; northeastern Minnesota; northwestern Montana and northern Idaho; northcentral Washington; and southwestern Colorado. The current population in Colorado is the result of the 1999–2006 releases of 218 lynx from Canada and Alaska into the San Juan Mountains in the southwest part of the state (Devineau *et al*. 2010, entire). Additionally, occasional lynx occurrence and reproduction were also documented in the Greater Yellowstone Area (GYA) of northwestern Wyoming and southwestern Montana; however, it remains uncertain whether the GYA historically supported a small resident population or if lynx residency and reproduction there are naturally ephemeral. Research and surveys conducted since the lynx DPS was listed indicate that the GYA does not currently support a breeding population (Service 2017a, pp. 46–48, 153–158). Combined, the six areas described above constitute the range of the lynx DPS and represent approximately the southern two percent of the species' entire distribution. We evaluated the current and potential future resiliency of lynx populations in focal areas (i.e., areas of known or modeled high quality habitat capable of supporting resident lynx) within these six areas, which represent SSA units (Figure 1).

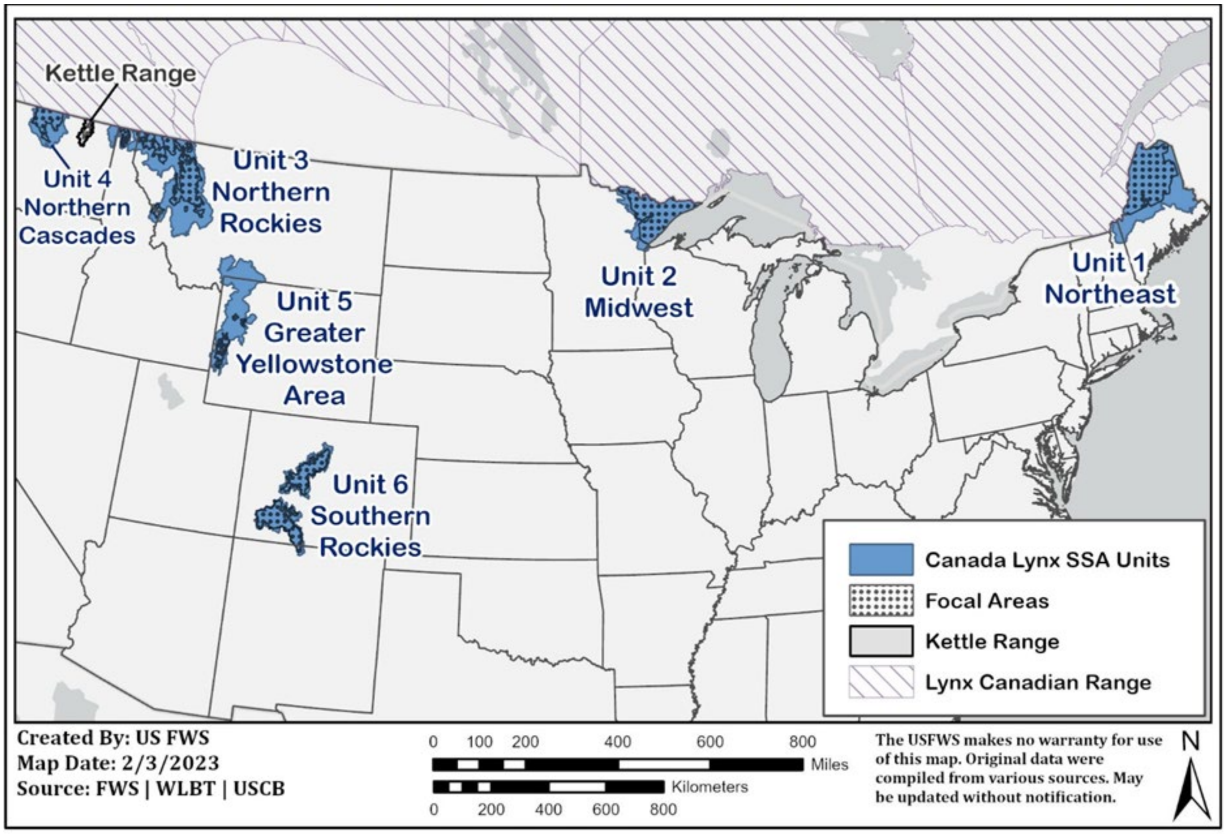

Figure 1. *The six species status assessment (SSA) units for the contiguous United States distinct population segment of the Canada lynx. Focal areas support resident lynx populations (units 1-4 and 6) and/or have habitat modeled as capable of doing so (SSA unit 5). The Kettle Range is the site of an ongoing lynx reintroduction effort, but it is not an SSA unit or focal area for the purposes of this plan.*

In 2017, the Service completed a species status assessment (SSA) for the lynx DPS. An SSA is an in-depth, scientific review of the species' biology and threats, an evaluation of its biological status, and an assessment of the resources and conditions needed to maintain populations over time. In the SSA, we identified individual, population, and DPS requirements or needs and the factors affecting the DPS's survival. We then evaluated the DPS's current and potential future conditions to assess its current and future viability in terms of resiliency, redundancy, and representation (the three Rs). Resiliency is the ability of populations to sustain in the face of stochastic events, or for populations to recover from low reproduction or reduced survival, and is associated with population size, growth rate, and the quality and quantity of habitats. Redundancy is the ability of the DPS to withstand catastrophic events for which adaptation is unlikely and is associated with the number and distribution of populations. Representation is the ability of a species to adapt to changes in the environment and is associated with its diversity, whether ecological, genetic, behavioral, or morphological.

Based on the SSA and an assessment of foreseeable threats, we completed a 5-year status review that recommended the lynx DPS be delisted (Service 2017b, entire). In 2020, the Service was developing a proposed rule to remove the DPS from the list of threatened and endangered species in accordance with the Act. We were concurrently working with State, Tribal, and Federal partners to develop a post-delisting monitoring plan, as required by the Act, to monitor the DPS's status if, and after, it were to be delisted. However, based on an October 2021 settlement agreement in response to litigation on our decision to forgo the development of a recovery plan for the DPS, the Service ceased moving forward with delisting and maintained the DPS's threatened status. We also committed to complete this draft recovery plan by December 2023 and a final recovery plan by December 2024. In April 2022, the Service reached another settlement agreement regarding a 2016 court order that found fault with our 2014 final critical habitat rule. In that agreement, the Service committed to revise the critical habitat designation for the lynx DPS by November 2025. To inform this recovery plan and the forthcoming critical habitat revision, we completed a 2023 addendum to the 2017 SSA (Service 2023, entire) to compile and evaluate new information that has become available since we completed the 2017 SSA.

This streamlined recovery plan for the lynx DPS is informed by the 2017 SSA (Service 2017a, entire) and the 2023 SSA addendum (Service 2023, entire) and focuses primarily on the elements required under section 4(f)(1)(B) of the Act:

(i) A description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the DPS;

(ii) Objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list; and

(iii) Estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal.

The Service has also prepared a draft Recovery Implementation Strategy (RIS), which serves as an operational plan for completing the higher-level recovery actions presented in this recovery plan by achieving specific tasks or activities. The RIS is a separate document from this recovery plan and can be modified as needed if monitoring reveals that expected results are not being achieved, therefore maximizing flexibility of recovery implementation. The SSA can also be updated as needed to incorporate the latest scientific information. To summarize, there are three documents under our 3-part recovery planning framework: (1) the SSA, which provides the foundational scientific information to guide recovery planning; (2) the recovery plan (this document), which provides the recovery vision, objective and measurable recovery criteria, site-specific management actions, and estimates of time and cost; and finally (3) the RIS, which is the operational plan of detailed activities associated with the actions identified in the recovery plan that are needed for recovery.

Overview of Status and Life History

As described above, the lynx DPS was listed due to inadequate regulatory mechanisms rather than documented population declines or substantial range contraction. Despite remaining uncertainty about the exact historical abundance and distribution of lynx in the contiguous United States, evaluation of verified, reliable information does not suggest broadscale breeding range contraction, substantial population declines, or the loss of resident breeding populations in the contiguous United States from historical conditions until the DPS was listed in 2000 (68 FR 40099; 72 FR 1187; 79 FR 54798, 54815; McKelvey *in* Lynx SSA Team 2016, p. 11; Service 2017a, pp. 39–51). In fact, recent estimates provided by lynx experts throughout the DPS range suggest that there are more resident lynx in Maine, Minnesota, and Colorado than were known or suspected when the DPS was listed (Service 2017a, pp. 4, 106). Conversely, lynx numbers in Washington are believed to have declined by half or more since listing in response to large wildfires that have impacted roughly half of the lynx habitat (Lyons *et al*. 2023, entire). It is also possible that small resident or ephemeral populations may have occurred historically adjacent to existing populations. Lynx have also occurred rarely or intermittently in other northern states outside of the areas shown in Figure 1, often in unsuitable habitats. These occurrences were associated with irruptions of lynx from Canada into the contiguous United States when cyclic hare populations in Canada declined roughly every decade (McKelvey *et al*. 2000a, entire; Service 2017a, pp. 42–51).

Bobcats (*Lynx rufus*) are much more common, widespread, and abundant than lynx in most of the contiguous United States, and the two species are difficult to distinguish in the field. Bobcats were often not reliably differentiated in historical trapping records (McKelvey *et al.* 2000a, pp. 208–231, 253); thus, errors in early accounts of lynx distribution based on anecdotal information seem likely (Halfpenny and Miller 1980, pp. 1, 3–8; Meaney 2002, pp. 3–5; Hoving *et al.* 2003, pp. 366–367). Because of the large effect that relatively few errors in identification can have on assessments of the distribution of rare animals, anecdotal (unverified) information should be interpreted with caution, and only verified occurrence data should be used to assess historical and current lynx distributions (McKelvey *et al.* 2000a, pp. 209, 253; McKelvey *et al.* 2008, pp. 553–554). Maps and reports reliant on anecdotal records and occurrences of dispersing lynx in atypical habitats during cyclic irruptions have led to the misperception that resident lynx in the contiguous United States were historically more numerous and more broadly distributed than we now know to be ecologically possible (68 FR 40080; Service 2017a, pp. 39–51).

The following is a brief overview of the biology, natural history, and current and projected future conditions of the lynx DPS, per the SSA report and addendum (Service 2017a, entire; Service 2023, entire). Please refer to the SSA report and addendum for additional information and full analyses.

Summary of Taxonomy, Life History, and Ecology

The Canada lynx (order Carnivora; family Felidae) is one of four species within the genus *Lynx* (Kerr 1792), which also includes the bobcat (*L. rufus*, Schreber 1777), the Eurasian lynx (*L. lynx*, Linnaeus 1758), and the Iberian or Spanish lynx (*L. pardinus*, Temminck 1827). Some sources recognize three subspecies of Canada lynx: *L. canadensis canadensis* (Kerr 1792), *L. c. subsolanus* (Newfoundland lynx, Bangs 1897); and *L. c. mollipilosus* (Arctic lynx, Stone 1900) (Integrated Taxonomic Information System online database, http://www.itis.gov, retrieved July 27, 2023). However, the Cat Specialist Group, a component of the Species Survival Commission of the IUCN, in 2017 determined that morphological, genetic, and biogeographical data do not support the subspecies divisions; they concluded that *L. canadensis* is a monotypic species (Kitchener et al. 2017, p. 41). The Canada lynx is believed to have evolved from the Eurasian lynx in the last 200,000 years in North America as a snowshoe hare specialist (Werdelin 1981, p. 69).

The Canada lynx is a medium-sized cat with long legs and large, well-furred paws, which make it well-adapted for traversing and hunting in deep, powdery snow, where its low foot-loading (weight per surface area of foot) is thought to provide a competitive advantage (Buskirk *et al.* 2000a, p. 90; Buskirk *et al*. 2000b, p. 400; ILBT 2013, pp. 26, 36, 81) over other terrestrial predators of snowshoe hares, the lynx's primary prey. In southern Canada and the northern contiguous United States, where the southern edge of the lynx range overlaps the northern edge of the bobcat range, the two species are easily and often confused because of their similar size and appearance (Halfpenny and Miller 1980, pp. 1, 3–8; McKelvey *et al*. 2000a, pp. 208–231, 253; Meaney 2002, pp. 3–5; Hoving *et al.* 2003, pp. 366–367; Peers *et al.* 2012, pp. 4–5; Gooliaff and Hodges 2018, entire; [but see Thornton *et al*. 2019, entire]). However, the lynx's longer ear-tufts, larger feet, and black-tipped tail distinguish it from the bobcat, which has shorter ear tufts, small feet, and white on the underside of the tail.

All aspects of lynx life history are strongly influenced by hares, which comprise most of the lynx diet throughout its range (Nellis *et al.* 1972, pp. 323–325; Brand *et al.* 1976, pp. 422–425; Koehler and Aubry 1994, pp. 75, 85; Apps 2000, pp. 358–359, 363; Aubry *et al.* 2000, pp. 375–378; Mowat *et al.* 2000, pp. 267–268), including the DPS (Koehler 1990, p. 848; von Kienast 2003, pp. 37–38; Squires *et al.* 2004, p. 15, table 8; Moen 2009, p. 7; Vashon *et al*. 2012, p. 11; Olson 2015, pp. 60–69; Ivan and Shenk 2016, p. 1053). Lynx are highly specialized hare predators and require landscapes that consistently support relatively high hare densities (McCord and Cardoza 1982, p. 744; Quinn and Parker 1987, pp. 684–685; Aubry *et al.* 2000, pp. 375–378). Although lynx take a variety of alternate prey species, especially red squirrels (*Tamiasciurus hudsonicus*), which may be important when hare numbers are low (O'Donoghue *et al*. 1997, pp. 154–155; 1998, pp. 1198–1205; Ivan and Shenk 2016, pp. 1054–1056), hare abundance is the major driver of lynx population dynamics. Lynx denning area selection, pregnancy rates, and litter sizes; survival (kitten, subadult, and adult), recruitment and dispersal rates; and population age structure, home range sizes, density, and distribution, are all strongly influenced by hare abundance (Koehler and Aubry 1994, pp. 75–76, 80–83; Apps 2000, entire; Aubry *et al.* 2000, pp. 375–390; Mowat *et al.* 2000, pp. 270–294; Moen *et al.* 2008, p. 1507; Organ *et al*. 2008, p. 1516; Vashon *et al.* 2012, p. 16; ILBT 2013, pp. 18, 22–24, 26–34).

Lynx populations in Canada fluctuate in response to the decadal cycling of hare populations (Elton and Nicholson 1942, pp. 241–243; Hodges 2000a, pp. 118–123; Mowat *et al.* 2000, pp. 265–272), with synchronous fluctuations in lynx numbers emanating from the core of the Canadian population and spreading over vast areas, generally lagging hare numbers by one year (McKelvey *et al.* 2000a, pp. 232, 239; Mowat *et al.* 2000, pp. 266, 270). When hares are abundant, lynx have higher pregnancy rates and larger litter sizes, higher kitten survival, and lower adult mortality, resulting in rapid population growth during the increase phase of the hare cycle (Slough and Mowat 1996, pp. 955–956; Mowat *et al.* 2000, pp. 266, 270–272, 281–289). When hare populations are low, female lynx produce few or no kittens that survive to independence (Nellis *et al.* 1972, pp. 326–328; Brand *et al.* 1976, pp. 420, 427; Brand and Keith

1979, pp. 837–838, 847; Poole 1994, pp. 612–616; Slough and Mowat 1996, pp. 953–958; O'Donoghue *et al.* 1997, pp. 158–159; Aubry *et al.* 2000, pp. 388–389; Mowat *et al.* 2000, pp. 285–287). When hares decline, lynx mortality rates increase, largely because of starvation, and home range sizes and dispersal/emigration rates also increase (Ward and Krebs 1985, pp. 2821–2823; O'Donoghue *et al.* 1997, pp. 156, 159; Poole 1997, pp. 499–503; Mowat *et al.* 2000, pp. 265–272, 278, 281–294). Lynx numbers decline dramatically during the "crash" phase of the hare cycle (Slough and Mowat 1996, p. 956; Mowat *et al.* 2000, pp. 283–285), when many lynx starve and many others abandon home ranges and disperse in search of food, with many dispersers also dying, often soon after initiating dispersal (Mowat *et al.* 2000, p. 293).

At the southern periphery of the lynx's range (southern Canada and the contiguous United States), hare population cycles are of lower amplitude or absent (Hodges 2000b, pp. 163–173; Hodges *et al*. 2009, pp. 870, 875–876; Scott 2009, pp. 1–44; Environment Canada 2014, p. 1; Hodges *in* Lynx SSA Team 2016a, pp. 16–17), hare densities are typically on the lower end of densities reported for northern populations, and lynx abundances and demographic rates in the south are typically like those of northern lynx populations during hare lows (Koehler and Aubry 1994, p. 93; Apps 2000, pp. 362–367; Aubry *et al*. 2000, pp 382–385). Lynx populations in the DPS seem to function as subpopulations or southern extensions of larger populations in southern Canada (McKelvey *et al.* 2000b, pp. 21, 25, 33; 65 FR 16052–16082; 68 FR 40077–40099; 71 FR 66025–66035; 74 FR 8616–8641; Koen *et al.* 2015, pp. 527–528). The DPS populations are relatively isolated from one another, though most are directly connected via dispersal to lynx populations in Canada (McKelvey *et al.* 2000b, pp. 25–34; Service 2005, p. 2). DPS populations are at the periphery of the species' range, and some, particularly in the West (SSA units 3-6), may behave as islands in a mainland-island metapopulation construct. In such a system, larger islands with higher habitat quality and in closer proximity to the mainland would be more likely to support persistent resident populations and to sometimes act as "sources" that produce surplus animals that may disperse to other islands. Smaller islands with lower habitat quality or at a greater distance from the mainland may, in contrast, act as "sinks" that depend on immigration from source populations (McKelvey *et al.* 2000b, p. 30) and which may support resident lynx only occasionally, intermittently, or temporarily.

Lynx have the highest level of gene flow documented for any carnivore despite large separation distances between core and peripheral populations (Schwartz *et al*. 2002, entire). This is likely because of high dispersal rates, large dispersal distances, and the absence of significant barriers to genetic interchange across most of the continental range of lynx, including the DPS (Schwartz *in* Lynx SSA Team 2016, pp. 11–12). However, Schwartz *et al.* (2003, entire) documented reduced genetic variation (lower mean number of alleles per population and lower expected heterozygosity) among peripheral lynx populations, and Prentice *et al*. (2017, entire) documented natural selection for unique alleles in relatively isolated island populations of lynx in eastern Canada. Within the DPS range, minor genetic sub-structuring was documented among lynx subpopulations in western Montana (Schwartz *in* Lynx SSA Team 2016, p. 12 and Appendix 5). Although genetic differences were small enough to suggest a lack of significant population subdivision (i.e., no indication of genetic isolation, substantial genetic drift, or potential genetic ''bottlenecks'' among DPS populations) (Schwartz *et al.* 2003, p. 1814; 79 FR 54793), the persistence of DPS populations is thought to depend on dispersal from larger lynx populations in the core of the species' range (Schwartz *et al*. 2002, p. 522). More recently, Lama (2021, entire) used whole genome sequences to evaluate connectivity and gene flow between Maine and adjacent Canadian provinces. The author found that genome-wide diversity was lower at the trailing (southern) edge of the range, suggesting that populations at the range periphery already may be showing genetic impacts of isolation.

Additionally, lynx-bobcat hybridization has been documented in Minnesota, Maine, and New Brunswick (Schwartz *et al.* 2004, entire; Homyack *et al.* 2008, entire), where male bobcats bred with female lynx to produce fertile offspring with lynx-like ear tufts, intermediate foot-size, and bobcat-like fur (ILBT 2013, p. 35). In Minnesota from 2000 to 2018, DNA analyses documented 13 distinct hybrid individuals (Moen and Catton *in* Lynx SSA Team 2016a, pp. 13, 19; Catton *et al*. 2018, p. 2). Hybrids have not yet been documented in the western portion of the DPS's range (Schwartz *in* Lynx SSA Team 2016a, p. 12). At a continental scale, Koen *et al*. (2014, pp. 111–113) found a low level of bobcat-lynx genetic introgression (i.e., the transfer of genetic material between species following hybridization and backcrossing to the parental species) but suggested introgression could increase if bobcat distribution shifts northward in the future, as projected due to continued climate warming.

The lynx's physical adaptations (described above) are thought to provide lynx a seasonal advantage over potential terrestrial competitors and predators, which generally have higher foot-loading, causing them to sink into the snow more than lynx (McCord and Cardoza 1982, p. 748; Murray and Boutin 1991, entire; Buskirk *et al.* 2000a, pp. 86–95; Ruediger *et al.* 2000, pp. 1–11; Ruggiero *et al.* 2000, pp. 445, 450). Buskirk *et al.* (2000a, entire) described potential exploitation (for food) and interference (avoidance) competition between lynx and other terrestrial and avian predators of hares, several of which have also been documented to prey on lynx. Documented lynx predators include cougar (*Puma concolor*; also mountain lion), coyote (*Canis latrans*), wolverine (*Gulo gulo*), gray wolf (*Canis lupus*), fisher (*Pekania pennanti*), and other lynx (ILBT 2013, pp. 33, 35). Bobcats are also likely capable of killing lynx in some circumstances. The species above, along with red fox (*Vulpes vulpes*), American marten (*Martes americana*), mink (*Mustela vison*), as well as a suite of avian predators (e.g., northern goshawk [*Accipiter gentilis*], northern hawk-owl [*Surnia ulula*], great gray owl [*Strix nebulosi*], and great-horned owl [*Bubo virginianus*]) may compete with lynx for hares (Buskirk *et al.* 2000a, pp. 86–95; ILBT 2013, p. 16). Of these, coyotes are the most likely to exert local or regionally important exploitation competition impacts to lynx; coyotes, bobcats, and cougars are capable of imparting interference competition effects on lynx (Buskirk *et al.* 2000a, p. 89). Interference would most likely be during summer but could also be during winter in areas lacking deep, unconsolidated snow (ILBT 2013, p. 36). The extent to which predation and competition may influence lynx populations in the DPS remains uncertain (ILBT 2013, pp. 35–36).

Summary of Threats

The Service listed the lynx DPS as threatened under the Act in 2000 because of the inadequacy of existing regulatory mechanisms at that time. More specifically, the Service believed that most lynx populations and potential lynx habitats (broad forest vegetation classes defined as "lynx forest types" [65 FR 16071]) in the contiguous United States occurred on Federal (U.S. Forest Service (USFS), National Park Service (NPS), and Bureau of Land Management (BLM)) lands in the western states, and that the plans that guided management of those lands (particularly

USFS and BLM lands) included "...programs, practices, and activities within the authority and jurisdiction of Federal land management agencies that may threaten lynx or lynx habitat. The lack of protection for lynx in these Plans render them inadequate to protect the species" (65 FR 16052, 16082). The Service found that USFS and BLM management plans did not adequately address potential risks to lynx and, as identified in the Canada Lynx Conservation Assessment and Strategy (LCAS) (Ruediger *et al.* 2000, pp. 2–1 through 6–3), those plans allowed actions that cumulatively could result in significant detrimental effects to lynx in the contiguous United States. As a result, the Service concluded that the lack of Federal land management plan guidance for the conservation of lynx and the potential for those plans to allow or direct actions that could adversely affect lynx constituted a singular, significant threat to the DPS (68 FR 40096).

Since then, the USFS and BLM have worked closely with the Service to develop science-based conservation measures that have been implemented in accordance with formally amended or revised management plans or signed conservation agreements with the Service (Service 2017a, pp. 52–57). In its 2017 5-year status review of the DPS, the Service concluded that lynx conservation measures and habitat management guidance formally adopted by the USFS and BLM substantially addressed the regulatory threat (Service 2017b, p. 5) by conserving lynx habitats and populations on Federal lands. Recently, the USFS and BLM collaborated with the Service on the development of a *Spatial Framework for the Conservation of Canada Lynx Habitat in the Western U.S. and Associated Management Tiers* (*Framework*; WLBT 2022, entire). The interagency *Framework* incorporates new modeling to identify lynx habitats of conservation value and newly published research to guide science-based objectives for forest structural characteristics supportive of lynx conservation and recovery. It demonstrates a continuing effort by the agencies to evaluate new information and bring the best available science to bear on forest management and lynx conservation efforts to address the threat for which the DPS was listed. Additionally, many State, Tribal, and other Federal agencies, academic institutions, and conservation organizations have worked to better understand lynx ecology and resource needs, conserve habitats, and reduce threats to lynx populations in the DPS (Service 2017a, pp. 58–66).

Although the inadequacy of regulatory mechanisms for which the DPS was listed has since been addressed (Service 2017b, p. 5), the Service and its lynx research and management partners have long recognized that projected global climate warming presents the greatest challenge to the long-term conservation of lynx and their boreal forest habitats in the contiguous United States (Service 2005, pp. 11–14; ILBT 2013, pp. 69–71; WLBT 2022, pp. 6–7). In the 2017 SSA, the Service recognized that the lynx, as a boreal forest- and snow-adapted specialist predator, is broadly exposed and highly sensitive to the projected impacts of continued climate warming and has limited capacity to adapt to these projected impacts. Therefore, the Service considers lynx populations in the DPS to be vulnerable (predisposed to be adversely affected) to the projected impacts of climate change (Service 2017a, p. 20). Thus, the Service concluded that continued climate warming and associated impacts, particularly increased wildfire and forest insect activity, were likely to reduce the amount and quality of lynx habitats, lynx numbers, and the resiliency of lynx populations in the contiguous United States (Service 2017a, pp. 4–8). The Service expects all DPS lynx populations to become smaller and more patchily distributed in the future due largely to climate-driven losses in habitat quality and quantity but recognizes that the timing, rate, and extent of climate-mediated impacts remains highly uncertain (Service 2017a, pp. 10, 67–83).

Given the broad agreement that projected climate warming and related impacts present the greatest threat to the long-term viability, conservation, and recovery of the DPS, the Service conducted a climate vulnerability assessment to evaluate the potential timing and magnitude of warming and its potential impacts on DPS lynx populations in its 2023 SSA addendum (Service 2023, Chapter 6.1). In that assessment, we evaluated prevailing temperatures in lynx SSA units and modeled projected warming though the end of this century under three future climate scenarios. We found substantial projected loss of prevailing temperature conditions in half of the SSA focal areas by mid-century and dramatic northward contraction of current temperature envelopes across the DPS by the end of this century, regardless of the climate scenario. Declines occurred most quickly in the Northeast (SSA unit 1) and Northwest (SSA unit 4), with prevailing temperatures persisting longest in the GYA (SSA unit 5) and Southern Rockies (SSA unit 6). Lynx populations in the DPS occur at the southern periphery of the species' range, where current temperature conditions may approach upper thresholds for maintaining snow conditions, forest climatic and vegetation structural characteristics, and prey populations capable of supporting resident lynx populations. We concluded that projected warming is likely to cause a gradual, but steady, decline in the amount and quality of habitats in all focal areas and, thus, a reduction in their ability to support persistent breeding populations in the future.

In addition to regulatory mechanisms and climate change, we also evaluated other factors in the SSA and addendum thought to be capable of exerting population-level influences on DPS populations, including vegetation management, wildland fire management, and habitat loss and fragmentation (Service 2023, Chapters 4.3–4.5). We also summarized other factors that may affect individual lynx but are not thought to exert population-level consequences, including disease, predation, competition, and incidental take (Service 2023, Chapters 4.1, 4.6).

Summary of Current Resiliency

In the 2017 SSA, the Service concluded that the apparent long-term (from historical to current) persistence of resident lynx populations in at least 4 of the 6 SSA units (units 1-4), and the absence of reliable information indicating that the distribution and relative abundance of resident lynx are substantially reduced from historical conditions, suggest that lynx populations in the DPS have exhibited historical and recent resiliency (Service 2017a, pp. 10, 108, 228–236). The current resident population in SSA unit 6, established by the 1999–2006 translocation of 218 lynx from Canada and Alaska, has also demonstrated resiliency thus far. In the 2023 SSA addendum, we conducted a more structured evaluation of the current resiliency of DPS populations by (1) identifying habitat and demographic variables indicative of each focal area's capacity to provide the resources needed by individual lynx to breed, feed, and shelter and to support resilient populations over time and (2) establishing thresholds to define resiliency conditions for each variable (Table 1).

***Table 1**. Resiliency categories and variables evaluated to assess current and future resiliency of Canada lynx populations in focal areas within each SSA unit in the contiguous United States distinct population segment.*

Resiliency Category	Habitat Variables		Demographic Variables	
	Habitat Amount (km²)[1]	Percentage of SSA Unit Focal Area in Appropriate Climate Condition[2]	Estimated Lynx Population Size	Connectivity to Species' Core Range[3]
High	≥ 20,000	75 – 100	400 – 1,000	Directly Connected and Highly Permeable
Moderate	5,000 – 19,999	50 – 74	100 – 399	Indirectly Connected and Moderately Permeable
Low	1,250 – 4,999	25 – 49	25 – 99	Poorly Connected and Marginally Permeable
Not Resilient/ Functionally Extirpated	< 1,250	< 25	< 25	

[1] The focal area within each SSA unit known to contain the abiotic and biotic features necessary to support a resident breeding lynx population or modeled as having a high capability of doing so.
[2] The proportion of each SSA unit focal area that is (or is projected to remain) within the appropriate temperature (mean temperature of the coldest month) range. In units 1 and 2, -15 ºC to -10 ºC; in units 3-6, -10 ºC to -5 ºC.
[3] Canada lynx core range represents areas north of the U.S.-Canada border.

We then evaluated lynx populations in each SSA unit in terms of those resiliency variables and categories to determine the current resiliency of each population (Table 2). Based on this framework, we determined that three SSA units (1, 2, and 3) currently exhibit high overall resiliency, two units (4 and 6) exhibit moderate resiliency, and one unit (5) is not resilient. Only the relatively small population in the northern Cascade Mountains in Washington (SSA unit 4) has clearly suffered reduced resiliency compared to likely historical conditions and since the DPS was listed. Large wildfires there over the past 20 to25 years have affected about half of the lynx habitat, resulting in decreased habitat quality and lynx carrying capacity (Lyons *et al*. 2023, entire). As burned areas regenerate, most should return to good habitat conditions 20 to 40 years post-burn, although areas that experienced high fire severity/intensity may take longer, and some areas may not return to conditions capable of supporting lynx home ranges. Overall, the current resiliency of populations in SSA units 1 and 6 likely represents an increase from historical conditions, and the current resiliency in SSA unit 4 represents a decrease from historical conditions, with the remaining SSA units (2, 3, and 5) exhibiting resiliency typical of historical conditions.

Table 2*. Current resiliency metrics and categorical scores of Canada lynx populations in focal areas within each SSA unit in the contiguous United States distinct population segment.*

SSA Unit	Habitat Variables		Demographic Variables		Overall Unit Resiliency
	Minimum Habitat Amount (km^2)[1]	Percentage of SSA Unit Focal Area in Appropriate Climate Condition[2]	Estimated Lynx Population Size[3]	Connectivity to Species' Core Range[4]	
1 Northeast	28,913	91	750 – 1,000	High	**High**
2 Midwest	21,119	100	100 – 200	High	**High**
3 Northern Rockies	20,606	100	200 – 300	High	**High**
4 Northern Cascades	6,067	87	30 – 35	High	**Moderate**
5 GYA	2,902	100	0 – 10	Moderate	**Not Resilient**
6 Southern Rockies	19,411	89	75 – 150	Low	**Moderate**

[1] The focal area within each SSA unit known to contain the abiotic and biotic features necessary to support a resident breeding lynx population or modeled as having a high capability of doing so. In units 1 and 2, this area is defined by designated critical habitat and other areas that meet the definition of critical habitat (i.e., areas excluded from critical habitat in accordance with section 4(b)(2) of the Act); in units 3-6, this area is defined as high-quality habitat modeled by Olson *et al*. 2021 and Squires et al. *in prep.* and designated as Tier 1 areas by the Western Lynx Biology Team 2022.
[2] The proportion of each SSA unit focal area that is within the appropriate temperature (mean temperature of the coldest month) range. In units 1 and 2, -15 ºC to -10 ºC; in units 3-6, -10 ºC to -5 ºC.
[3] Estimates of current population size are based on expert opinion or published estimates of carrying capacity.
[4] Canada lynx core range represents areas north of the U.S.-Canada border.

Summary of Current Redundancy

In the 2017 SSA, the Service concluded that the broad distribution of resident lynx in large, geographically discrete areas (redundancy) makes the DPS invulnerable to extirpation caused by a single catastrophic event. We also found no evidence that formerly persistent lynx populations have been lost from any large areas, suggesting that redundancy in the DPS has not been meaningfully diminished from historical levels. In fact, as a result of the current population in Colorado, redundancy in the DPS is greater now than it was when the DPS was listed, and may be greater than it was historically, at least for most of the last century (Service 2017a, pp. 10, 106–108, 228–231).

In the 2023 SSA addendum, we similarly concluded that the multiple highly to moderately resilient populations occupying large areas and broadly distributed across a wide geographic extent generally aligns with our understanding of the historical distribution of resident lynx populations within the DPS range. The large sizes and broad geographic distributions of the areas currently occupied by resident lynx populations indicate historical and current redundancy in the DPS sufficient to preclude the possibility of extirpation from catastrophic events (e.g., wildfire, disease, etc.). The degree of current redundancy contributes to DPS viability and limits the risk to the DPS, especially given the low frequency and limited magnitude of events that could possibly cause widespread lynx mortality and impacts at the population scale (Service 2023, Chapter 5.4).

Summary of Current Representation

In the 2017 SSA, the Service concluded that lynx across the range of the DPS occupy a similarly narrow and specialized ecological niche defined by specific vegetation structure, snow conditions, and the abundance of a single prey species; therefore, lynx likely have little ability to adapt to changing environmental conditions (i.e., shift to other forest habitats, snow conditions, or primary prey species). However, resident lynx in the DPS remain broadly distributed across the range of ecological settings that seems to have supported them historically in the contiguous United States. Additionally, lynx have demonstrated high rates of dispersal and gene flow and, therefore, naturally low levels of genetic differentiation across most of the species' range, including the DPS (Lynx SSA Team 2016a, pp. 12–14, 55–56). Because we found no indications of threats to genetic health or reduced adaptive capacity among lynx populations in the DPS, we concluded that the recent level of representation did not appear to have declined from historical conditions (Service 2017a, pp. 107, 231).

In the 2023 SSA addendum, we conducted a more formal assessment of lynx adaptive capacity relative to 12 core attributes defined by Thurman *et al*. (2020, entire) to evaluate whether, and to what extent, lynx may be able to adapt to projected climate warming and related impacts and, thus, how vulnerable the DPS may be to those changes (Service 2023, Chapter 5.3). We found that several lynx attributes (e.g., their broad geographical distribution, exceptional dispersal capability, and ability to quickly increase survival, productivity, and population size in response to cyclic rebounds or other increases in prey) suggest potential adaptive capacity to changing conditions. Other attributes (e.g., high degrees of habitat and prey specialization, naturally low genetic diversity, small DPS population sizes, and high degree of specialization for cold, snowy climate conditions) likely limit the lynx's adaptive capacity, particularly in the DPS range. We again found no indication of current threats to the genetic health or adaptive capacity of lynx populations in the DPS, and the current level of representation does not appear to represent a decrease from historical conditions. However, given the limited opportunity for lynx to shift in space within the range of the DPS and the low likelihood that they will be able to adjust *in situ* to novel climate and habitat conditions, the current degree of representation in the DPS likely limits the capacity of DPS populations to adapt to changes anticipated from continued climate warming.

Summary of Future Conditions

In the 2017 SSA, we relied heavily on formally elicited expert opinion because we lacked crucial demographic information needed to build population models to evaluate possible future conditions for the lynx DPS (Service 2017a, pp. 166–168). Our evaluation focused on the inadequacy of regulatory mechanisms and other factors considered likely to have population-level consequences identified by the Interagency Lynx Biology Team (ILBT) in its 2013 revised LCAS, which include climate change, vegetation (timber) management, wildland fire management, and habitat fragmentation (ILBT 2013, pp. 68–78). Experts generally agreed that projected climate warming and related impacts will likely have the greatest influence on the long-term viability of DPS lynx populations. Based on expert input and evaluation of other information, the Service concluded that DPS populations would likely be smaller and less resilient in the future, and that although extirpation of DPS populations was unlikely by mid-century, it was more likely by the end of this century. Any loss of DPS populations would reduce redundancy and representation within the DPS and, therefore, signal declining DPS viability (Service 2017a, pp. 171–173, 232–237).

In the 2023 SSA addendum, we conducted a climate vulnerability assessment in which we evaluated three climate scenarios and modeled current and projected future temperature conditions in each SSA unit over 20-year periods through the end of this century (Service 2023, Chapter 6.1). We then developed three future scenarios that included the climate projections and a range of conditions for other factors that could impart population-level influences over future conditions for DPS populations over the same time frame to evaluate future population resiliency and DPS viability in terms of redundancy and representation (Service 2023, Chapters 6.2–6.6). We found that lynx in the DPS likely have limited capacity to adapt to impacts of projected climate warming; therefore, we expect climate-mediated loss of future resiliency for all DPS populations, regardless of scenario. Functional extirpation of several populations is likely by the end of the century, even under the lower plausible limit (least climate warming impact) scenario. Extirpations would lead to reduced redundancy and representation in the DPS and, therefore, reduced DPS viability. Based on our projections and assumptions about the relationship between climate warming and lynx population resiliency, we expect DPS viability to be substantially diminished through the end of the century.

Recovery Vision

The recovery vision is the conservation and long-term viability of the Canada lynx DPS. Recovery of the DPS will be signified by:

- Maintenance or improvement of the current resiliency of the five, currently extant SSA units in the DPS;
- Identification and conservation of high-quality lynx habitat and potential climate refugia;
- Continued implementation and refinement of regulatory mechanisms and other conservation measures that incorporate the best available science to ensure the conservation of lynx habitats and populations.

This recovered condition should include five resilient breeding lynx populations distributed across each of the three large representation units in the DPS range (Northeast, Midwest, and West) as follows:

- One population with high resiliency in the Northeastern representation unit;
- One population with high resiliency in the Midwestern representation unit;
- One population with high resiliency and at least two populations with moderate resiliency in the Western representation unit.

Recovery also includes conserving the modeled high-quality habitat and potential climate refugium in the SSA unit 5 (GYA) focal area and identifying and protecting any other potential climate refugia. It also includes evaluating the effectiveness of regulatory mechanisms and refining them as indicated by the best available science to ensure the future long-term conservation of lynx habitats and populations in the contiguous United States. These conditions support the recovery of the DPS by retaining population resiliency (which contributes to DPS viability) by ensuring sufficient representation across the DPS range and redundancy to withstand catastrophic and stochastic events.

Recovery Strategy

The recovery strategy describes the path needed to achieve the recovery vision. For this recovery plan, we measure the viability of the Canada lynx DPS in terms of resiliency, redundancy, and representation as described in the SSA report and addendum (Service 2017a, entire; Service 2023, entire). Through the recovery vision, recovery criteria, and recovery actions outlined in this recovery plan, we attempt to conserve or improve the resiliency of lynx populations to maintain representation and redundancy sufficient to ensure the viability of the DPS.

The recovery strategy for the lynx DPS is to implement the recovery actions described below and the related recovery activities detailed separately in the RIS to maintain or improve the resiliency of all lynx populations in the DPS. Given these considerations, the best available scientific information as summarized in our SSA report (Service 2018, entire) and addendum (Service 2023, entire), and the input of recognized species experts, this recovery plan recommends the conservation of all five currently extant resident breeding populations to preserve the genetic and ecological representation of the DPS across its range and to maintain sufficient redundancy to ensure DPS viability. Because our evaluations in the SSA and the addendum do not indicate substantial range-wide loss of resiliency among populations, or reduced DPS redundancy and representation from historical to recent times, we conclude that maintaining current levels of resiliency, redundancy, and representation for a 20-year recovery period, which corresponds to two lynx population (irruption) cycles and approximately five lynx generation times, will indicate recovery.

Specifically, we envision recovery of the lynx DPS to include one highly resilient population in each of the three broad representation units in the contiguous United States - the Northeast, the Midwest, and the West - and at least two moderately resilient populations in the western representation unit. We believe this number and distribution of resilient populations approximate the historical distribution and abundance of resident lynx in the contiguous United States and, therefore, represents sufficient redundancy and representation to ensure the viability of the DPS.

The recovery strategy also recommends the maintenance or, where necessary, improvement of connectivity between DPS populations and the core of the species' range in Canada and among DPS populations to the extent practicable. Connectivity between the DPS and the northern core of the species' range is believed to be important to the demographic and genetic health of DPS populations. The preservation of genetic diversity across populations is important, not only for short-term persistence, but it also provides future adaptation and evolutionary potential (i.e., representation), thereby increasing the species' probability of persistence over the long term (Newman and Pilson 1997, entire; Neel and Cummings 2003, entire). Because of its exceptional dispersal capability, lynx across the species' range naturally exhibit relatively low genetic variably (Service 2017a, pp. 24–26). This naturally low genetic variability within, and between, populations may compromise the species' ability to adapt to changing environmental conditions; therefore, maintaining existing genetic diversity within and among DPS populations is likely important to the recovery and long-term viability of the DPS.

The recovery strategy also recommends the conservation of modeled, but currently unoccupied, habitat in SSA unit 5 (GYA), which our climate assessment (Service 2023, Chapter 6.1) identifies as a potential climate refugium for lynx, and the identification and conservation of any other potential climate refugia habitats. Finally, this plan recommends continued implementation and refinement of regulatory mechanisms and other conservation measures to ensure the long-term conservation of DPS habitats and populations. To achieve the recovery vision, the recovery strategy for the lynx DPS is to:

- Maintain or improve resiliency in each of the five DPS breeding populations;
- Maintain or improve connectivity between DPS populations and the core of the species' range in Canada and, to the extent practicable, among DPS populations;

- Maintain or restore habitats within the focal areas of all six SSA units and any other areas potentially capable of supporting resident breeding populations;
- Reduce or remove threats to the DPS by maintaining or strengthening habitat protections (i.e., regulatory mechanisms and voluntary conservation efforts); and
- Monitor lynx demography, distribution, connectivity, habitat quality, regulatory mechanisms, and progress in implementing recovery actions and achieving recovery criteria.

The conservation and recovery of the lynx DPS will require continued and strengthened coordination and collaboration among Federal, State, and Tribal partner agencies, the lynx and forest ecology research communities, private landowners in some parts of the DPS range, and Canadian wildlife and forest managers. To fully recover the DPS, we intend to strengthen partnerships to reduce threats and address knowledge gaps that will inform recovery.

This recovery strategy assumes that long-term maintenance of the current size, distribution, and resiliency of lynx populations in the contiguous United States will ensure the viability of the DPS by maintaining sufficient redundancy and representation. Major uncertainties include the timing and magnitude of impacts to DPS populations of projected continued climate warming, and the extent to which the recovery actions and activities we have identified may abate or mitigate those impacts.

II. Recovery Criteria

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the protections afforded by the Act are no longer necessary and a species may be delisted. Delisting is the removal of a species from the Federal Lists of Endangered and Threatened Wildlife and Plants (Lists). Downlisting is the reclassification of a species from an endangered species to a threatened species. The term "endangered species" means any species (species, subspecies, or DPS) that is in danger of extinction throughout all or a significant portion of its range. The term "threatened species" means any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Revisions to the Lists, including delisting or downlisting a species, must reflect determinations made in accordance with sections 4(a)(1) and 4(b) of the Act. Section 4(a)(1) requires that the Secretary determine whether a species is an endangered species or threatened species (or not) because of threats to the species. Section 4(b) of the Act requires that the determination be made "solely on the basis of the best scientific and commercial data available." Although recovery plans provide important guidance on methods of minimizing threats to listed species and measurable objectives against which to measure progress towards recovery, they are guidance and not regulatory documents. Recovery criteria help indicate when we would anticipate that an analysis of a species' status under section 4(a)(1) would result in a determination that the species is no longer an endangered species or a threatened species. A decision to revise the status of, or remove a species from the Lists, however, is ultimately based on an analysis of the best scientific and commercial data available at that time, regardless of whether that information differs from the recovery plan. When changing the status of a species, we first propose the action in the *Federal Register* to seek public comment, followed by a final decision announced in the *Federal*

Register. The following recovery criteria are based on information compiled in the SSA report (Service 2017a, entire) and addendum (Service 2023, entire), and other input provided by scientific experts.

Delisting Criteria

The following recovery criteria, when met collectively for 20 consecutive years (two lynx population/ irruption cycles; five lynx generation times), would indicate that the lynx DPS may no longer need the protections of the Act and that delisting the DPS should be considered:

Recovery Criterion 1 – Demographic: Abundance

Maintain stable or increasing estimates of resident lynx abundance for each of the SSA units over a consecutive 20-year period as specified in Table 3 below. If more robust population estimates become available that improve our understanding of populations sizes, the minimum estimated population sizes in Table 3 may be adjusted.

Table 3*. Minimum estimated population size for each SSA unit needed over a consecutive 20-year period for Canada lynx recovery.*

SSA Unit	DRAFT Minimum Estimated Population Size
1 – Northeast	400
2 – Midwest	100
3 – Northern Rockies	200
4 – Northern Cascades	75
5 – GYA	NA (for this criterion)
6 – Southern Rockies	100

Justification for Criterion 1

Estimated lynx abundance is an objective and measurable criterion fundamental to an assessment of population resiliency and the viability of the lynx DPS. The demographic factor itself is clear and reliable, despite the current lack of accurate, unbiased, and statistically robust population size estimates for all DPS populations (in *Recovery Actions*, below, specifically recovery action 2, we specify the need to develop a consistent and statistically robust approach to measuring and assessing population sizes throughout the DPS in the future). This criterion allows for population size estimates based on carrying capacity calculations or habitat amount and distribution in combination with lynx density and home range size estimates, or other estimators until statistically robust estimators are developed and implemented. Given the relatively low number of lynx in the DPS, the small, estimated sizes of populations in most SSA units, and projections of future climate-mediated impacts (Service 2023, Chapter 6), decreases in abundance below the current resiliency minimums could decrease population resiliency and, therefore, the future viability of the DPS. Lynx abundance may be measured using the best available monitoring methods and data, including but not limited to: (1) population estimates based on habitat amount divided by home range sizes; (2) changes in distribution or occupancy based on snow track and/or camera trap surveys; (3) occupancy modeling; (4) species distribution models; (5) genetic mark-recapture; and (6) expert opinion. The best available information regarding home range sizes, densities, and habitat quantity may also be used to measure this criterion.

For Units with extant lynx populations below the minimum threshold for high resiliency (Units 2, 3, 4, and 6), minimum abundance is based on estimated population size ranges provided by lynx experts most familiar with each population (Service 2017a, pp. 6–9), carrying capacity estimates (e.g., Lewis 2016, entire; Lyons *et al*. 2016, entire), and our assessment of more recent information (e.g., Vashon *et al.* 2008, entire; Mallett 2014, entire; Barber-Meyer *et al*. 2018, entire; Hostetter *et al*. 2020, entire; Olson *et al*. 2021, entire; Lyons *et al*. 2023, entire; Ryan *et al*. 2023, entire; J. Ivan, *pers. comm.*, 2023). These studies reflect the minimum estimated population sizes we think are necessary to maintain resiliency, redundancy, and representation across the DPS. We provide specific rationale for some units below. Note, however, that we do not suggest that units with estimated population sizes exceeding the minimum needed to maintain resiliency actively manage down to the minimum number.

We established this demographic criterion using estimated abundance, which provides a finer-scale measure of resiliency within each unit, rather than relying on our SSA resiliency categories because our resiliency categories encompass population estimate ranges that are too wide to compare relative resiliency among DPS populations for that variable, and therefore, only provide a measure of coarse-scale resiliency (e.g., the "High" resiliency category for population size is 400–1,000 lynx). When combined with uncertainty about the accuracy of all DPS population estimates, this argues against managing for the minimum abundance necessary to retain current resiliency category scores. For instance, if the minimum lynx population size estimate in SSA unit 1 decreased to 400, it would remain in our high resiliency category, even though such a large decline would correspond to substantially reduced resiliency in this population. Likewise, the minimum lynx population estimate in SSA unit 3 could decline by half, from 200 to 100, and still retain its resiliency category score of "Moderate," despite what would undoubtedly represent a biologically meaningful loss in resiliency. Therefore, rather than rely on the resiliency category numbers, we chose to use estimated abundance for this metric.

The estimated lynx population in SSA unit 1 is nearly double the minimum threshold to be highly resilient. The lynx population in the State of Maine (SSA unit 1) over the past 20 years has benefited from anthropogenically-driven increases in the abundance of advanced regenerating forest following landscape-level clear-cutting in the 1970s and 1980s and, as a result, the population is likely larger than historical or natural conditions may have supported (Service 2017a, pp. 6–7). Natural changes in forest structure are expected to result in near-term decreases in the amount of high-quality hare and lynx habitat, followed by longer-term stabilization or slight rebound in the amount of high-quality habitat (Simons-Legaard 2016, pp. 8–12; Simons-Legaard *et al*. 2016, pp. 1263–1267). We selected 400 lynx as the minimum population criterion to account for projected short-term decreases in the amount of high-quality lynx and hare habitat as forest stands mature and return to a natural disturbance regime, while maintaining population stability and this Unit's classification as highly resilient consistent with our Recovery Vision and Recovery Strategy (above; also Table 1).

Although some increases in lynx abundance may be possible in some parts of the DPS, substantial increases in abundance, such that the resiliency of the entire SSA unit increases, may be more challenging. For example, it is possible that lynx numbers in SSA Unit 4 may increase with post-fire forest regeneration and habitat conservation, but there is uncertainty regarding the abundance this unit historically supported or could support in the future.

In addition, the GYA (SSA Unit 5) does not currently support a resident population, but recent habitat modeling indicates it may be capable of supporting a small population (perhaps greater than 25 individuals) if one could be established. Further, our climate modeling in the SSA addendum (Service 2023, Chapter 6.1) identified the GYA focal area as a potential climate refugium (i.e., it is modeled to retain prevailing temperature conditions supportive of lynx longer than most other parts of the DPS range). Although we do not establish a minimum population size for SSA Unit 5, we recognize its potential future contribution to the DPS and make conservation of its modeled habitat an objective under Criterion 3 below. For these reasons, and because of the limitations described above, we think striving to maintain or increase lynx abundance across the DPS range is more likely to achieve lasting recovery rather than simply maintaining the current resiliency category scores for population size described in the SSA addendum and in Tables 1 and 2 above.

As discussed above, there is uncertainty associated with the population estimates provided in Table 3 for this criterion due to the available data and current monitoring methods. If more precise population estimates and additional monitoring methods become available in the future, such as statistically robust population size estimators, the estimated population sizes for this criterion could be updated in a recovery plan revision, as needed. In accordance with section 4(f) of the Act, we would notice and make available for public review and comment any future updates to this criterion, or any updates to any of the statutory elements in this recovery plan.

Recovery Criterion 2 – Demographic: Connectivity

DPS lynx populations in SSA units 1, 2, 3 and 4 maintain high connectivity conditions (directly connected and highly permeable) with the species' core range in Canada. Specifically, the habitat remains highly permeable with evidence of connectivity (e.g., genetic and/or movement) between the DPS and Canada over a consecutive 20-year period, measured at least once every 5 years. Additionally, potential dispersal habitats (i.e., "stepping stones," see below) and corridors are identified and conserved to maintain or improve connectivity between units 3 and 5 and between units 5 and 6 to support lynx dispersal between these units.

Justification for Criterion 2

Connectivity is an objective and measurable variable that is likely to influence the resiliency of DPS populations. Connectivity of the lynx DPS with lynx populations in Canada is important, and periodic immigration of lynx into the DPS from Canada contributes to the resiliency and viability of DPS populations (Service 2017a, pp. 22, 38). However, the extent to which the demographic and genetic health of DPS populations may depend on immigration remains uncertain.

To meet the resiliency goals for each SSA unit, the connectivity category conditions must remain High for units 1, 2, 3, and 4, which are directly adjacent to Canadian populations and are most likely to see north-south movements and genetic exchange (Service 2023, p. 22). Connectivity is maintained by ensuring habitat remains permeable for lynx with no major barriers to movement, such as highways or large blocks of unsuitable habitats. Connectivity to support lynx dispersal between units 3 and 5 and between units 5 and 6 should be maintained by conservation and management of "stepping stone" habitat, or patches of habitat suitable for lynx, as identified by the best available science. The Western Lynx Biology Team (WLBT) defines “stepping stone” habitats as smaller, scattered habitat patches that may facilitate dispersal and foraging between large, well-connected areas of high-quality habitat that can support consistent lynx occupancy and breeding populations (i.e., Tier 1) and large areas with lower proportions of high-quality habitat that may support occasional lynx residency, dispersing individuals, and may not support reproduction (i.e., Tier 2), or in known connectivity hotspots that are unlikely to support residency or reproduction (Tier 3; see WLBT 2022, pp. 13, 23). Maintaining abundant suitable foraging habitat for lynx in those “stepping stone” areas will likely facilitate dispersal and connectivity.

Connectivity will be evidenced by documenting lynx movements through studies of marked individuals on either or both sides of the U.S.-Canada border or via genetic indicators of dispersal, and assessments of the contiguity and conservation status of forested habitats (e.g., mapping, monitoring, and quantifying changes over time), including “stepping stones.” Monitoring methods may include geospatial evaluations of habitats and barriers, radio-telemetry or GPS tracking of individual lynx, genetics, or other new techniques that may be used to assess connectivity, particularly the permeability across the International Border.

Lynx are strong dispersers and have been documented to travel long distances, even across inhospitable landscapes, so it is a reasonable assumption that if forested habitat remains intact (or does not diminish substantially) lynx will continue to be able to move across the border. Collaboration with Canada may be needed in the future to document cross-border travel (e.g., through trapping and marking with identification (e.g., ear tags), radio-telemetry collars, or collecting and comparing genetic data). In the meantime, monitoring habitat condition (i.e., forested habitats and barriers) on both sides of the border is an appropriate and quantifiable evaluation of connectivity potential.

Recovery Criterion 3 – Habitat Quantity

Retain at least 95 percent of the current amount of mapped or modeled lynx habitat, as indicated in Table 4, for each SSA unit over a consecutive 20-year period. If updated habitat information becomes available that improves the estimates of habitat amounts in Table 4, the baseline (current) estimates may be adjusted, and the 95 percent criteria would apply to the revised baseline amounts. We define lynx habitat as those areas known to contain the abiotic and biotic (physical and biological) features necessary to sustain resident breeding lynx populations over time or modeled as having a high capability of doing so (Service 2023, p. 14). In SSA units 1 and 2, lynx habitat is defined by designated critical habitat and other areas that meet the definition of critical habitat (i.e., areas excluded from critical habitat in accordance with section 4(b)(2) of the Act); in units 3-6, lynx habitat is defined as high-quality habitat modeled by Olson *et al*. 2021 and Squires et al. *in prep.* and designated as Tier 1 areas by the WLBT (2022, pp. 22–23, 30).

***Table 4**. Current amounts of mapped or modeled lynx habitat (regardless of structural condition) in each SSA focal area and the amount of habitat currently necessary (95 percent of current) to retain over 20 consecutive years to achieve recovery. If updated habitat information becomes available that improves the estimates of current habitat amounts, the baseline (current) estimates may be adjusted, and the 95 percent would apply to the revised baseline amounts.*

SSA Unit	Current Habitat Amount (km^2)	DRAFT Minimum Habitat Amount Necessary for Recovery (km^2) (95 percent of current)
1 – Northeast	28,913	27,467
2 – Midwest	21,119	20,064
3 – Northern Rockies	20,606	19,576
4 – Northern Cascades	6,067	5,764
5 – GYA	2,902	2,757
6 – Southern Rockies	19,411	18,440

Justification for Criterion 3

The geographical extent of habitat capable of supporting resident lynx influences population sizes in the DPS and is an objective and measurable indicator of population resiliency. Future losses of some lynx habitats are likely unavoidable and, as explained below, increases in the geographical extent of areas containing the abiotic and biotic features necessary to sustain resident lynx populations are unlikely. Therefore, conserving all existing mapped or modeled habitat is not a reasonable goal. However, given the relatively small amount of habitat (compared to the core of the species' range in Canada and Alaska) and the small number of lynx in the DPS, efforts to conserve a high percentage of existing habitat are likely necessary to maintain population resiliency.

Lynx populations require large extents (thousands of square kilometers) of suitable habitat to maintain populations over time (Service 2017a, p. 38). The lynx is a habitat and prey specialist that requires dense boreal and subalpine forests that support abundant snowshoe hares. High hare densities typically occur in only a few structural classes—advanced regeneration and mature multi-storied forests with dense horizontal cover. Because not all lynx habitat is typically in these structural categories at any time, given natural and anthropogenic disturbances and subsequent forest regeneration, lynx habitat is a shifting mosaic of habitat conditions and qualities.

We recognize that lynx use habitats of varying quality, and that habitat quality within population areas changes over time naturally in response to forest disturbance events and subsequent forest regeneration and succession or in response to anthropogenic influences (e.g., timber harvest). In the DPS range, for example, SSA unit 4 has experienced atypically large and intense wildfires over the past 20 years, leading to a decline in the amount of lynx habitat in a structural class that supports dense snowshoe hares and a likely decline in the size of the resident breeding population. In contrast, SSA unit 1, as a result of landscape-level clear-cutting 35 to 50 years ago, and subsequent regeneration of dense conifer forest, currently contains a disproportionate amount of habitat in a structural condition that supports high hare densities; thus, lynx numbers are atypically high.

Factors that may permanently decrease the amount of lynx habitat in the focal areas within each SSA unit are expected to relate primarily to vegetation changes as projected due to climate change. For example, as conditions become warmer and drier, some areas of boreal and subalpine forest may experience conversions to drier forest types or non-forested habitat. Anthropogenic factors that convert boreal/subalpine forest to other forest types or non-forested habitat may also occur but are less likely to occur at a biologically meaningful scale. Examples of anthropogenic activities could include residential and commercial development, silvicultural practices that convert to non-habitat forest types, and others. Recovery criterion 4 helps ensure that regulatory mechanisms that incorporate the potential for conversion to non-habitat are in place and address those potentials so that lynx habitat is not lost at a meaningful scale due to non-climate factors.

We maintain that the overall amount of habitat containing the abiotic and biotic features necessary to support resident breeding populations in the DPS is finite. Although lynx habitats can be lost when boreal forests are permanently converted to another state (e.g., highways or other permanent development), and the forests may shift in response to changing climatic conditions, more habitat cannot be created in areas that lack the necessary abiotic and biotic features. Therefore, conserving as much of the current baseline habitat amount as feasible is an important recovery criterion. We believe maintaining 95 percent of the current baseline habitat amount in each SSA focal area for 20 years will provide sufficient resiliency to extant DPS populations, allowing their continued contributions to DPS redundancy, representation, and viability. Additionally, conserving modeled habitat in the currently unoccupied SSA unit 5 focal area would protect a potential climate refugium to which lynx could potentially be translocated in the future.

Recovery Criterion 4 – Threats-based (Regulatory Mechanisms or other Conservation Plans, Mechanisms)

Maintain or improve Federal regulatory mechanisms and ensure that additional regulations, conservation plans, or other conservation mechanisms are in place that include partner commitments to management actions that conserve lynx habitats and support resilient lynx populations on State, Tribal, and private lands in SSA unit focal areas. Commitments should include management actions that address the recovery criteria listed above (population abundance, connectivity, and amount of habitat), as well as commitments to address projected impacts of climate warming to DPS populations and habitats. Plans, regulations, and management strategies should be revised and updated based on the best available science.

Justification for Criterion 4

The inadequacy of Federal regulatory mechanisms when the Service was considering the lynx's status under the Act was the sole factor for which the DPS was listed as threatened in 2000. Since then, this factor has been largely addressed through the collaborative development and implementation of science-based regulatory mechanisms. The long-term viability of the DPS likely depends on continued implementation and refinement of regulatory mechanisms on Federal lands. However, since the DPS was listed, our understanding of the important contributions of private, State, and Tribal lands to the conservation of the DPS has improved, and continued implementation and refinement of adequate regulations, conservation plans, or other conservation mechanisms on those lands is also necessary to ensure long-term DPS viability and achieve recovery. The adequacy of regulatory mechanisms and other conservation efforts to conserve lynx habitats can be monitored and evaluated and is likely to continue to influence the resiliency of DPS populations and, therefore, the viability of the DPS as a whole.

Regulatory mechanisms and other conservation measures should continue to use the best available science and information to address activities with the potential to affect the quantity and quality of lynx habitats and, therefore, population resiliency. Because the lynx is a habitat and prey specialist, mechanisms that ensure habitat quality and quantity that will support resilient lynx populations are necessary. Regulatory mechanisms must address the species' need for large boreal forest habitats that provide a mosaic of structural stages supporting high hare abundance. Regulatory mechanisms will also need to address projected climate-driven decreases in habitat quantity and quality. The extent to which regulations and other conservation measures guide such activities to avoid, reduce, or mitigate impacts to lynx influences the current and future likelihoods that habitats will provide the ecological requirements to support resilient resident lynx populations. Regulatory mechanisms also need to address the considerable threats to lynx that result from climate change. These include regulatory approaches to manage fires, fuels, and vegetation response, as well as emissions that result in climate warming.

Federal lands make up approximately 64 percent of the lands encompassed by the 6 SSA units (Service 2017a, p. 53). Of those Federal lands, the primary Federal land manager is the USFS (87 percent), with the NPS (11 percent) and the BLM (2 percent) also having the potential to ensure regulatory mechanisms are in place to minimize threats to lynx across the DPS. The Federal agencies have relied heavily upon the LCAS (ILBT 2013, entire) to develop regulations such as lynx-related forest management direction that has been incorporated into the agencies' management plans to conserve lynx habitat and populations. Continuing to update those plans to incorporate best available science and information, and to adapt to a changing climate, will be important. In particular for the western SSA units (3-6), Federal agencies may need to assess and amend strategies and associated management plans to address a comprehensive fuels and fire management strategy that incorporates lynx habitat needs in the face of a warming, drying climate in those SSA units.

Private, State, and Tribal lands make up the remaining 36 percent of the lands encompassed by the 6 SSA units, accounting for almost 27 percent, almost 9 percent, and just over 1 percent of the total, respectively (Service 2017a, p. 58). Important lynx habitats occur on some of those lands, and regulatory mechanisms and/or voluntary conservation commitments are likely necessary to maintain or improve their contributions to the conservation of DPS populations or parts of them. In particular, private lands account for over 90 percent of the SSA unit 1 focal area, and collaborative, voluntary conservation measures on those lands will be important to the long-term resiliency of that area's lynx population.

State regulations can, and should, influence lynx conservation on both State and private lands. State wildlife management regulations should continue to minimize the potential for incidental take (including death or injury) of lynx during legal trapping of other furbearers. State forest management regulations can also influence timber harvest and forest management activities on State and private lands and should be updated to incorporate best available science and recommendations for minimizing impacts to lynx populations and managing habitat to support the population, connectivity, and habitat targets identified above in Recovery Criteria 1, 2, and 3. Other voluntary conservation mechanisms, such as Habitat Conservation Plans (HCPs), should also be updated to reflect best available science and support the identified targets for lynx recovery.

Tribal lands contribute just over 1 percent of lynx habitat (Service 2017a, p. 65). Tribal wildlife management and forest management plans are important tools for guiding actions that will ensure Tribal lands are contributing to lynx recovery. Tribal engagement and indigenous knowledge are also important to ensuring lynx and their habitats are effectively conserved.

III. Recovery Actions

The following is a list of prioritized actions, including site-specific management actions, that when fully implemented are expected to result in recovery of the Canada lynx DPS. Priority 1 actions are based on currently available information that suggests those actions must be taken to prevent extinction or to prevent the DPS from declining irreversibly in the foreseeable future. Priority 2 actions are those that must be taken to prevent a significant decline in population size or habitat quality or some other significant negative impact. Priority 3 actions are all other actions necessary to provide for full recovery of the species. The assignment of priorities does not imply that some recovery actions are of low importance but recognizes that lower priority items may be deferred while higher priority items are being implemented. Please refer to Table 5 for a clear association among recovery actions and the threats addressed by these actions. The RIS contains the specific tasks or activities required to implement these recovery actions.

Priority 1 Actions (*actions that must be taken to prevent extinction*)

1. Continue monitoring lynx occupancy and distribution for each DPS population (Recovery Criterion 1).

2. Develop new techniques to improve and standardize monitoring to detect population trends and changes, derive reliable population size estimates, and refine understanding of the distribution of DPS populations (Recovery Criterion 1).

3. Work with Federal, State and Tribal partners and private landowners to manage forests using the best available science to conserve, improve, or restore lynx and snowshoe hare habitat within each SSA unit (Recovery Criteria 1, 2, 3, 4).

4. Conduct research and monitoring to develop and implement forest management strategies to conserve lynx habitat in each SSA unit given projected climate warming (Recovery Criteria 1, 2, 3).

5. Maintain or enhance connectivity between lynx habitats in SSA units 1-4 and adjacent lynx habitats north of the U.S.-Canada border (Recovery Criteria 1, 2).

6. Maintain or enhance connectivity within the DPS to facilitate lynx dispersal between units 3 and 5 and between units 5 and 6 (Recovery Criteria 1, 2).

7. Ensure long-term protections for lynx and their habitat are in place in all SSA units (Recovery Criterion 4).

8. Identify and conserve potential climate refugia habitats for lynx in each SSA unit (Recovery Criterion 3).

Priority 2 Actions (*actions that must be taken to prevent a significant decline in population size, habitat quality, etc.*)

9. Identify and implement conservation actions, which could include localized population augmentations, as needed, if monitoring in Action 1 indicates concerning genetic or demographic trends (Recovery Criterion 1).

10. Minimize sources of human-caused mortality, particularly vehicle collisions (e.g., cars, logging trucks, snowmachines) and incidental trapping or hunting mortality (including mistaken identity) in each SSA unit (Recovery Criteria 1, 4).

11. Conduct research to further refine understanding of climatic conditions that support lynx populations in each SSA unit (Recovery Criterion 1).

12. Survey for lynx populations outside of SSA units (Recovery Criterion 1).

Priority 3 Actions (*all other actions necessary for full recovery of the species*)

13. Work with partners to improve understanding of the influence of disease, competition, predation, and hybridization on DPS populations (Recovery Criterion 1).

14. Work with partners and stakeholders to identify, and if needed, implement conservation actions, which could include programs to evaluate need and feasibility of translocating lynx into potentially suitable, modeled climate refugium habitats in SSA unit 5 (Recovery Criterion 1).

Table 5. *Listing factors under the Act that may affect the survival of the Canada lynx distinct population segment and associated recovery actions and criteria.*

Listing Factors under the Act	Threats Description	Recovery Actions	Recovery Criteria
Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range	Not considered a threat at listing (beyond nexus to regulatory mechanisms, Factor D, below); Climate warming and related impacts now projected to reduce habitat quality, quantity, and distribution	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13	1, 2, 3, 4
Factor B. Overutilization for Commercial, Recreational, Scientific, or Education Purposes	Not considered a threat at listing; not now considered a current or future threat	NA	NA
Factor C. Disease or predation.	Not considered a threat at listing; some concern that one or both could increase with projected climate warming	12	1
Factor D. Inadequacy of Existing Regulatory Mechanisms	At listing, Federal regulatory mechanisms deemed inadequate to ensure conservation. Specifically, BLM and USFS management plans allowed activities potentially detrimental to lynx habitats and populations	2, 3, 4, 5, 6, 9	1, 2, 3, 4
Factor E. Other natural or manmade factors affecting its continued existence.	Not considered a threat at listing; not now considered a current or future threat	NA	NA

IV. Estimated Time and Costs to Achieve Recovery

We summarized the estimated time and costs to achieve recovery of the Canada lynx DPS (Table 6). The values are derived, when possible, from projected time and costs for actions similar to those described as recovery actions above and do not account for possible future inflation. For some actions, we had no correlates for or estimates of cost and so used best professional judgement regarding potential costs to complete those actions. We estimate that the full implementation of these actions would improve the status of lynx in the contiguous United States DPS and could be completed approximately 20 years following the adoption of this plan. We note that the recovery program may change over time, or the timeframe estimated to implement the recovery actions to achieve recovery of the DPS may take longer than expected. Many of the recovery actions described in this plan address threats to the lynx DPS and may need to continue beyond delisting so that these threats do not reverse progress made in recovering the species. Finally, Federal, State, Tribal and non-governmental organizations (NGOs), and local partners direct a suite of additional activities that, while not specifically directed at lynx, further contribute to recovery of the species. These activities are not part of the estimated costs and may include efforts such as improving habitat quality and restoring ecosystem functions.

Table 6*. Estimated time and costs (in thousands of dollars) of recovery actions for the recovery of the Canada lynx distinct population segment (DPS).*

Recovery Action[1]	Action Summary	Years 1–5	Years 6–10	Years 11–15	Years 16–20	Total
1	Continue monitoring lynx occupancy and distribution for each DPS population	905	835.5	835.5	783	3,359
2	Develop new techniques to improve and standardize monitoring to detect population trends and changes, derive reliable population size estimates, and refine understanding of the distribution of DPS populations	483	383	447	447	1,760
3	Work with Federal, State and Tribal partners and private landowners to manage forests using the best available science to conserve, improve, or restore lynx and hare habitat within each SSA unit	1,000	1,000	1,000	1,000	4,000
4	Conduct research and monitoring to develop and implement forest management strategies to conserve lynx habitat in each SSA unit given projected climate warming	1,500	1,500	1,500	1,500	6,000
5	Maintain or enhance connectivity between lynx habitats in SSA units 1-4 and adjacent lynx habitats north of the U.S.-Canada border	500	500	500	500	2,000

Recovery Action[1]	Action Summary	Years 1–5	Years 6–10	Years 11–15	Years 16–20	Total
6	Maintain or enhance connectivity within the DPS to facilitate lynx dispersal between units 3 and 5 and between units 5 and 6	100	100	100	100	400
7	Ensure long-term protections for lynx and their habitat are in place in all SSA units	1,250	1,250	1,250	1,250	5,000
8	Identify and conserve potential climate refugia habitats for lynx in each SSA unit	872	500	250	250	1,872
9	Identify and implement conservation actions, which could include localized population augmentations, as needed, if monitoring in Action 1 indicates concerning genetic or demographic trends	50	50	50	1,250	1,400
10	Minimize sources of human-caused mortality, particularly vehicle collisions (e.g., cars, logging trucks, snowmachines) and incidental trapping or hunting mortality (including mistaken identity) in each SSA unit	250	250	250	250	1,000
11	Conduct research to further refine understanding of climatic conditions that support lynx populations in each SSA unit	100	750	100	100	1,050
12	Survey for lynx populations outside of SSA units	0	365	341	0	706
13	Work with partners to improve understanding of the influence of disease, competition, predation, and hybridization on DPS populations	100	100	800	800	1,800
14	Work with partners and stakeholders to identify, and if needed, implement conservation actions, which could include programs to evaluate need and feasibility of translocating lynx into potentially suitable, modeled climate refugium habitats in SSA unit 5.	0	0	250	250	500
Total		**7,110**	**7,583.5**	**7,673.5**	**8,480**	**30,847**

1 Recovery actions 1-8 are Priority 1 actions and, therefore, occur early or throughout the 20-year recovery plan time frame. Recovery actions 9-12 are Priority 2 actions and may occur later in the 20-year recovery time frame. Recovery actions 13 and 14 are Priority 3 actions and may occur late in the 20-year recovery time frame.

V. Glossary

Term	Definition
Catastrophic	The outcome of a wide-ranging event that may result in the loss of one or more populations.
Extirpated	The local extinction of a species, where it ceases to exist in a particular area but continues to exist elsewhere.
Irruptions	Cyclic, roughly decadal, mass dispersal events by lynx following cyclic declines in snowshoe hare populations. During irruptions, lynx historically have occurred intermittently and temporarily well outside their normal range, often in atypical habitats that cannot support long-term occupancy (Elton and Nicholson 1942, entire; van Zyll de Jong 1971, p. 16; Gunderson 1978, entire; Thiel 1987, entire; McKelvey *et al*. 2000a, entire).
Redundancy	The number of populations or sites necessary to endure catastrophic losses (Shaffer and Stein 2000, pp. 308–310).
Representation	The genetic diversity necessary to conserve long-term adaptive capability (Shaffer and Stein 2000, pp. 307–308).
Resiliency	The size of populations necessary to endure random environmental variation (Shaffer and Stein 2000, pp. 308–310).
Species viability	A species' (or, in the case of Canada lynx, the DPS's) ability to sustain populations in the wild beyond the end of a specified time period, assessed in terms of its resilience, redundancy, and representation (Service 2016).
Stochastic	Random or non-deterministic events. Can also refer to natural changes in genetic composition of a population, unpredictable fluctuation in environmental conditions, or variation in population demographics (Service 2016).
Viability	See "Species Viability" above.

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