Attachment #2 for the Objection against the Cooke City Fuels and Forest Health Project on the Gardiner Ranger District of the Custer-Gallatin National Forest filed by NEC et al. on August 18, 2025.

Attachment #2 includes the following:

1. E-mail correspondence between the Forest Service and NEC Director Sara Johnson on August 12, 13, 14 and 15 in regards to information requests on landbird assemblage focal species, Forest Plan biennial monitoring reports, and NEPA documents for the Cooke City whitebark pine monitoring program.
2. Summaries of raptor nesting surveys on the Custer-Gallatin National Forest by the Montana Natural Heritage Program personnel in 2024.
3. Forest Service document titled "Updating lynx habitat mapping using best science, corporate standardized data and state-of-the-art GIS technology" dates October 2013.
4. Summary of the whitebark pine monitoring program set up in the Cooke City landscape for years 2011 and 2014 to determine effects of vegetation treatments on cone production, regeneration, and use by Clark's Nutcrackers.
5. Web page of the Custer-Gallatin National Forest in inventory and monitoring -implementation & effectiveness monitoring, last updated March 13, 2025, identifying 37 projects that have some type of monitoring; the Cooke City Whitebark Pine project is not included.

Cooke City Fuels and Forest Health Project

From: Sara Johnson (sjjohnsonkoa@yahoo.com)

To: comments-northern-custergallatin-nepaprojects@usda.gov

Date: Tuesday, August 12, 2025 at 08:29 AM MDT

Hello,

I have 2 information requests for the Cooke City Fuels and Forest Health Project:

1-What are the focal species for forest habitats on the Custer-Gallatin National Forest?

2. Please provide an electronic copy of the Fisher Creek whitebark pine treatment project proposal and decision that was completed in the Cooke City Fuels and Forest Health Project project area.

Sara Johnson, Native Ecosystems Council

From: Sara Johnson <sjjohnsonkoa@yahoo.com>
Sent: Wednesday, August 13, 2025 8:51 AM
To: SM-CUSTER-GALLATIN-NEPA-PROJECTS <comments-northern-custergallatin-nepaprojects@usda.gov>
Subject: [External Email]Information request for Cooke City Fuels and Forest Health Project

Hello,

Yesterday I sent you an information request for 2 things - what are the focal species for the Custer-Gallatin, and 2, I would like a copy of the NEPA decision for the Fisher Creek whitebark pine project noted to have occurred in the Cooke City Fuels and Forest Health Project Area at some time in the past (300 acres of whitebark pine treatments). I would like notification that you received this request. And I am adding a 3rd information request. I have been trying to locate the biennial monitoring reports for the Custer-Gallatin Revised Forest Plan, and have not been successful. Could you please send me electronic copies of any of the biennial monitoring reports completed for the Revised Forest Plan?

Sara Johnson, Director, Native Ecosystems Council

Re: [External Email]Information request for Cooke City Fuels and Forest Health Project

From: Sara Johnson (sjjohnsonkoa@yahoo.com)

To: comments-northern-custergallatin-nepaprojects@usda.gov

Date: Thursday, August 14, 2025 at 08:24 AM MDT

Hi Abby,

Thank you for the information on the Fisher Creek whitebark pine project. As per the focal species for forest-associated wildlife, which includes the "landbird assemblage," I would like to get that information soon, as I have some time crunches for my work on the Cooke City Fuels and Forest Health Project. As you know, everything always happens at once -there is never enough time to get everything done!!!

Sara Johnson

On Wednesday, August 13, 2025 at 12:17:20 PM MDT, SM-CUSTER-GALLATIN-NEPA-PROJECTS <comments-northern-custergallatin-nepaprojects@usda.gov> wrote:

Good afternoon,

After our talk this morning I wanted to provide you with the pre- and post-summary of treatment reports for the Cooke City Whitebark Pine Restoration Project that was completed in the Cooke City Fuels and Forest Health Project area in 2011. Also, I wanted to document that no monitoring reports have been completed based on the 2022 Custer Gallatin National Forest Land Management Plan. I will continue searching to identify the focal species that were discussed in the monitoring plan and get that information to you as soon as possible.

Best regards,

Abigail Hauch
IDT Leader / NEPA Planner
Forest Service

Custer Gallatin National Forest
O: 406-587-6750
10 East Babcock Street
Bozeman, MT 59715

Re: [External Email]Information request for Cooke City Fuels and Forest Health Project

From: Sara Johnson (sjjohnsonkoa@yahoo.com)

To: comments-northern-custergallatin-nepaprojects@usda.gov

Date: Friday, August 15, 2025 at 09:27 AM MDT

Hi Abby,

Thank you for your information on Forest Plan focal species. Apparently there are none for wildlife.

Sara Johnson

On Thursday, August 14, 2025 at 09:05:05 AM MDT, SM-CUSTER-GALLATIN-NEPA-PROJECTS <comments-northern-custergallatin-nepaprojects@usda.gov> wrote:

Good morning,

The term "focal species" is defined in 36 CFR § 219.9. The status of focal species are used to assess the ecological conditions required under § 219.9.

"Focal species. A small subset of species whose status permits inference to the integrity of the larger ecological system to which it belongs and provides meaningful information regarding the effectiveness of the plan in maintaining or restoring the ecological conditions to maintain the diversity of plant and animal communities in the plan area. Focal species would be commonly selected on the basis of their functional role in ecosystems."

Therefore, the focal species to be monitored are determined by the area being studied. "The presence, habitat affiliation, and population trend (status

of) avian species associated with forested vegetation at a forest wide scale" (Forest Plan, p.191). Since this term is utilized in the monitoring plan for the whole Custer Gallatin National Forest the closest comparison for the Cooke City Project would be the species identified in the Wildlife Report. In the case of land bird species and assemblages in the Cooke City Project area, the species and their preferred habitat are identified in Table 37 of the "Cooke City Fuels and Forest Health: Wildlife Effects Analysis" on page 33-34, along with an analysis of the project's possible effects on these species. This report can be found on the Cooke City Fuels and Forest Health Project webpage under the Project Documents tab in the Objection _Specialist Report folder. https://www.fs.usda.gov/r01/custergallatin/projects/57361

Summary of Forest Nesting Raptor Surveys on the Custer-Gallatin National Forest 2023[1]

Dan Bachen, Sr. Zoologist
Montana Natural Heritage Program, Montana State Library

Background and Methods

To survey forest nesting raptors within the area of interest we used a point-based call playback methodology described in Maxell 2016, where we used American Goshawk calls to elicit a territorial response from Goshawks and other raptors present in the area. We selected survey points by overlaying a grid of points (200m x 250m) across the project area and selecting those that were within the treatment polygon boundaries or that fell within 100m of these boundaries. We then vetted these points and removed any that occurred in unsittable habitat or were otherwise inaccessible or unsuitable for survey.

At each point we alternated periods of listening with playing recordings of territorial calls and nestling wail calls for a total of 10 minutes of survey at each point. When any raptor responded to our calls, we made note of the direction of travel then began using the call to find where the animal was most territorial. Within this area we looked for nests and evidence of nesting such as guano deposits (whitewash) and partially consumed prey items. Upon locating these nests, we recorded the location with a GPS unit. We also recorded all other species detected and encountered when traveling between points.

Although this protocol is targeted for survey of goshawks, we have found that other raptor species respond to these calls, and we believe this is an effective protocol for surveys of any territorial raptor found in forest environments.

Results

Cooke City was surveyed June 24th - June 26th, 2024. We surveyed 39 points within Cooke City (Figure 1), representing good coverage within suitable habitat for Northern Goshawk and other raptor species. All survey points were accessible. However, in the Cooke City area points to the north of the town were within poor habitat and we prioritized the other points for survey. We did not detect any raptors or nests during surveys at Cooke City.

[1] The date in the title is incorrect and should reference 2024 surveys. The MNHP Forest Nesting Raptor Surveys report contained results for other projects. This summary includes all information related to the Cooke City fire and Fuels Project contained in that report.

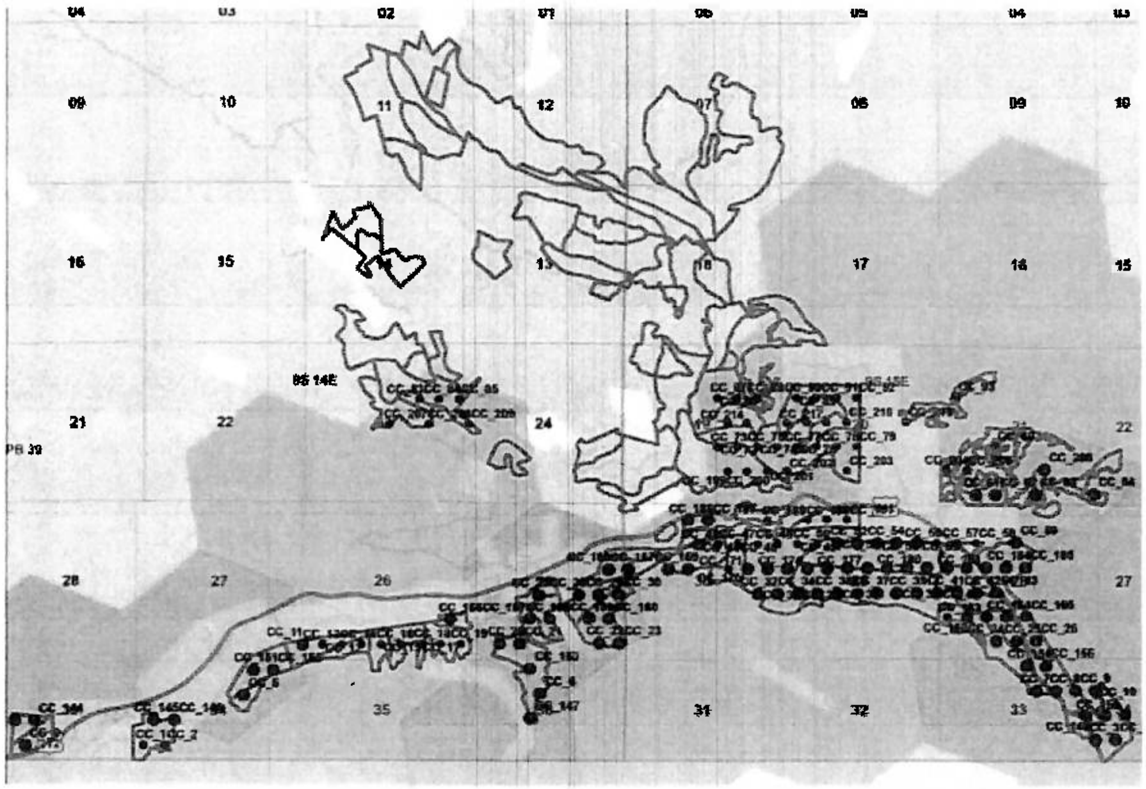

Figure 1. Points surveyed in the Cook City area between June 25th and June 28th 2024. Large green points represent points that were surveyed. Small red points represent points that were not surveyed due to low or unsuitable habitat. No territorial American Goshawks were observed during these surveys.

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We also recorded all other species detected and encountered when traveling between points. Although this protocol is targeted for survey of goshawks, we have found that other raptor species respond to these calls, and we believe this is an effective protocol for surveys of any territorial raptor found in forest environments.

Results

Across both the Cooke City and Ashland areas we surveyed 492 points, 89 within Cooke City (Figure 1) and 403 within Ashland (Figure 2), representing good coverage within suitable habitat for Northern Goshawk and other raptor species. Surveys in the Ashland area were conducted June 4th through June 8th, 2024. Cooke City was surveyed June 24th -June 28th, 2024. All survey points were accessible. However, in the Cooke City area points to the north of the town were within poor habitat and we prioritized the other points for survey.

During surveys on the Ashland District, we documented 2 active Goshawk nests and 3 observations of territorial adult goshawks without nest locations. We also documented 1 active Cooper's Hawk Nest, and a Red-tailed Hawk Nest that may have been active, but use of the nest was not confirmed. A territorial Kestrel was also observed, but no nest was located (Table 1). We did not detect any raptors or nests during surveys at Cooke City.

Within the survey area on the Ashland District there were 3 locations with previous evidence of nesting raptors. A cluster of nests in the vicinity of FR4801 and FR4023 was documented between 1991 and

2013. Surveys within this areas did not detect the species or any active nests. A single nest was recorded in 2004 northwest of the junction of FR4095 and FR4081. No evidence of nesting was observed during our surveys. A nest was observed in 1987 southeast of the junction of FR4411 and FR44112. The area had burned in the interim, and the nest found in this vicinity likely represents a shift in territory for the species.

Table 1. Raptor observations during 2024 Surveys

Species	District	Latitude	Longitude	Detection Type	Comments
American Goshawk	Ashland	45.33274	-106.429	Territorial Adult	Adult flew in before calling sequence started. Confirmed adult, alarm call came back twice flying at 235 degrees, then no response. Went back to point 376 and got another response after one call to the NE @ 19 degrees. No nest located and stopped calling/responding back.
American Goshawk	Ashland	45.33274	-106.42895	Active Nest	Visual of female. Followed back to nest. No whitewash present at base. Photos taken. Waited close by to see if she would return. She did not but stayed close by and very quiet.
American Goshawk	Ashland	45.295663	-106.385419	Territorial Adult	Heard alarm calls when I reached this point. Bearing of 264 degrees. Completed survey, no other interaction from bird. Walked towards direction of response. No further response.
American Goshawk	Ashland	45.3665	-106.34198	Active Nest	Nest Located. Territorial female. Down in nest. Whitewash
American Goshawk	Ashland	45.3987	-106.341	Territorial Adult	Territorial adult responded to calls twice. Each time becoming unresponsive. Area searched extensively over the next few hours. No nest found.
American Goshawk	Ashland	45.29371	-106.317	Territorial Adult	Territorial adult responded to calls. Eventually stopped responding. No nest found
American Kestrel	Ashland	45.29451	-106.345	Territorial Adult	Territorial adult. Unable to locate nest
Cooper's Hawk	Ashland	45.41014	-106.33493	Active Nest	Nest Located. Territorial adult, small amount of whitewash
Red-tailed Hawk	Ashland	45.29681	-106.39	Nest	Heard RTHA adults while walking towards point. Could potentially be an active nest. Did not see adults on nest during whole survey and while investigating nest tree. Coordinates of tree: 45.29681, -106.38996.

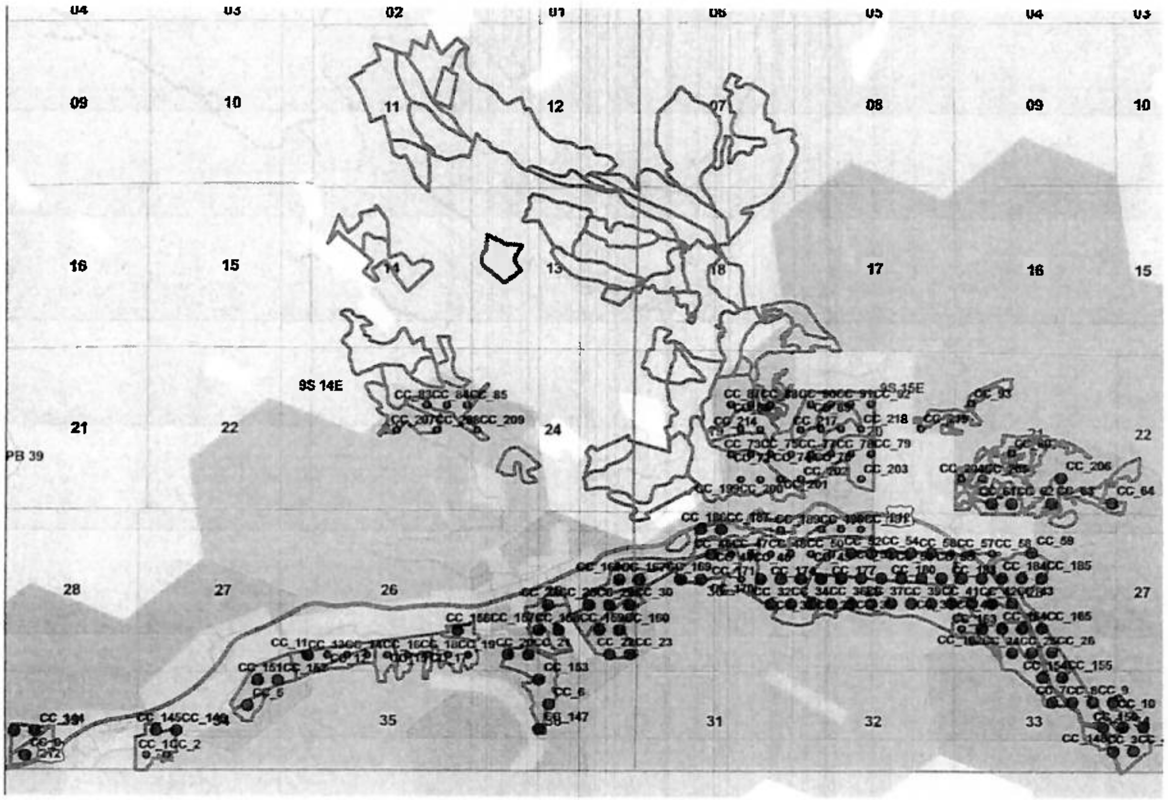


Figure 1. Points surveyed in the Cook City area between June 25th and June 28th 2024. Large green points represent points that were surveyed. Small red points represent points that were not surveyed due to low or unsuitable habitat. No territorial American Goshawks were observed during these surveys.

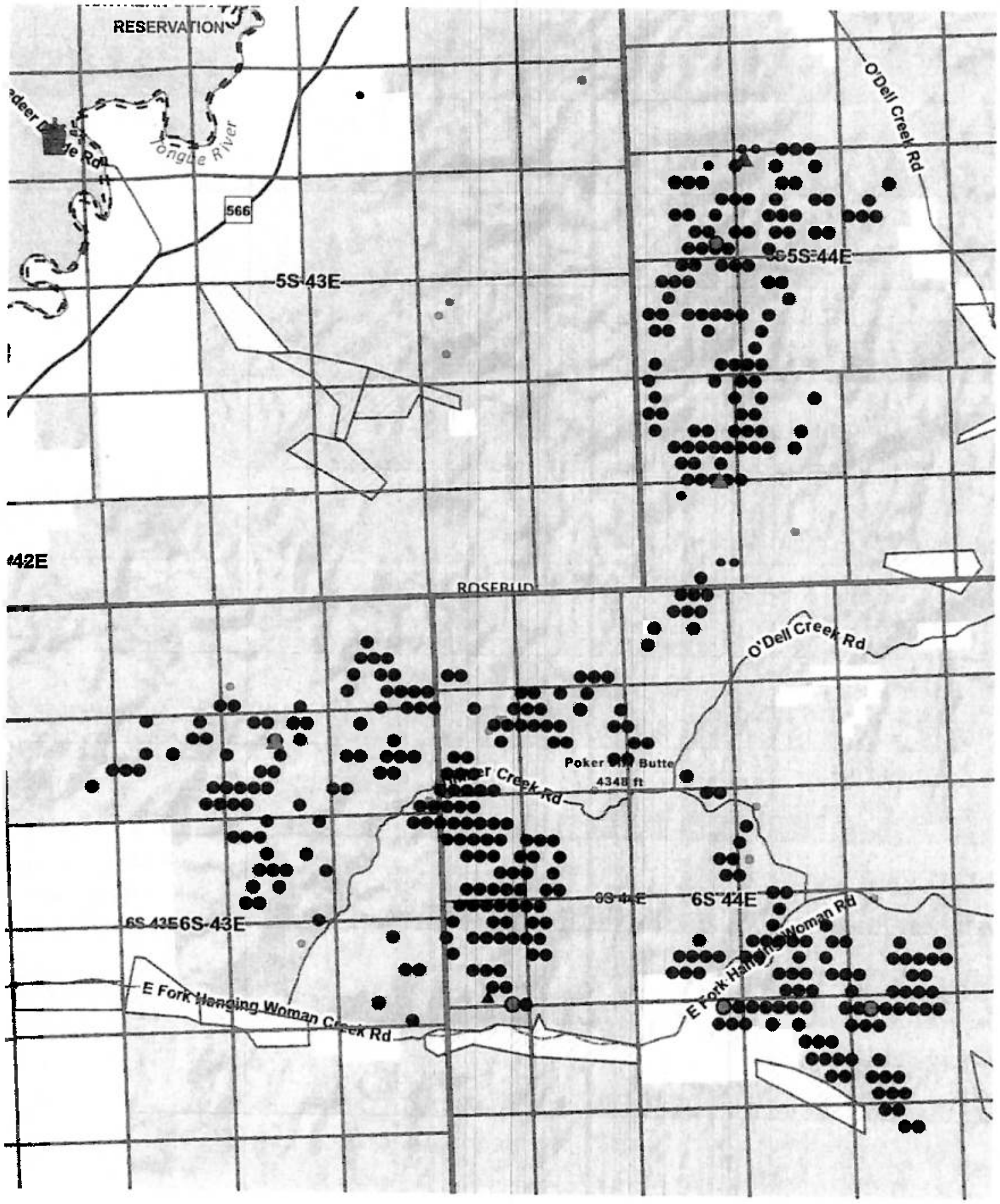


Figure 2. Survey points and detections of raptors in the vicinity of Poker Jim Butte, Ashland District of the Custer-Gallatin National Forest. Green circles are points surveyed or were within documented nests found during these surveys. Small purple points represent points that were not surveyed due to logistical constraints. Triangles represent nest locations and circles detections of territorial individuals. Pink colored shapes represent Northern Goshawks, blue-colored Cooper's Hawk, red-colored American Kestrel, and black-colored Red-tailed Hawk.

United States
Department of
Agriculture

Forest
Service

October 2013

Gallatin and Custer National Forests

Updating lynx habitat mapping using best science, corporate standardized data and state-of-the-art GIS technology

Supervisor's Office, Custer Gallatin National Forest

For more information contact:
Jodie Canfield, Forest Wildlife Program Manager
PO Box 130
Bozeman, MT 59715
(406) 587-6739

Background:

The lynx was listed as threatened in 2000 by the U.S. Fish and Wildlife Service (USFWS). Potential lynx habitat was originally identified and modeled in the early 2000s according to the Lynx Conservation Assessment and Strategy (LCAS). Forests in the Northern Region developed individual lynx habitat models, all of which attempted to map the kind of boreal forest (spruce subalpine fir) conditions that would be expected to produce enough snowshoe hares to support lynx. These were derived from a variety of different databases and spatial information.

Since that time, Forest Plans in the Northern Region have been amended by the Northern Rockies Lynx Management Direction (NRLMD; USFS 2007).

Both the Custer and Gallatin National Forests relied on the Timber Stand Management Record System (TSMRS) in their initial lynx mapping. The Custer model (most recently updated in 2007) included all conifer dominance types that were moderately to well-stocked based on photo-interpretation. There was no attempt to differentiate the spruce and subalpine forest types that would be expected to provide boreal forest conditions. The Gallatin used habitat type labels (some field verified, but often determined from photo-interpretation) associated with TSMRS stands to try to capture those forest stands capable of growing subalpine fir and spruce and thus reflect "boreal forest" conditions.

In 2005, as part the environmental analysis on the proposed Gallatin Forest Travel Plan, the Forest requested a review by the Lynx Biology Team of the Gallatin Forest protocols for mapping lynx habitat and delineating Lynx Analysis Units (LAUs). Although the forest again relied on TSMRS, the habitat maps and LAUs were modified to be more consistent with LCAS direction and to better reflect the biological needs of lynx.

In recognition that 2000 data layers used in lynx mapping were in some cases out-of-date and no longer maintained or updated, the Helena, Gallatin, Custer, and Lewis and Clark National Forests, with Regional Office support, embarked on development of a consistent approach to model and map lynx habitat utilizing Regionally developed data layers and updated GIS analysis techniques, with guidance from recently published literature and from lynx researchers. This process was initiated in 2010 with a template developed by the Lolo National Forest, modified to better reflect conditions on the four eastside forests. The effort was completed in 2013.

As well as mapping lynx habitat, the new model also categorizes habitat into the structural stages identified in the Standards in the NRLMD (VEG S1, VEG S6), and sums up those acres that can be distinguished (by model criteria) as stand initiation that does not yet provide winter snowshoe hare habitat, stand initiation that provides snowshoe hare habitat, stem exclusion habitat, and multistoried mature (forest) hare habitat. Everything not recognized in the model as belonging to those 4 categories where considered "other". This classification relied on National databases that track fires and timber harvest activities (FACTS and Fire History databases), as well as R1VMAP existing vegetation classification. None of the available data layers can "see" into the understory of the forest; therefore, multi-storied forest structure was inferred based on habitat types, size class, and overstory canopy cover.

Based on recent research (Squires; 2010, 2013, and Berg et al. 2012), and conversations with lynx experts (John Squires, Kevin McKelvey), all four forests considered that their original mapping likely over-estimated lynx habitat. In southwest Montana, in the Greater Yellowstone forests (portions of the Gallatin and Custer Forests), both boreal forest and snowshoe hares are relatively scarce and patchily distributed compared to northwestern Montana (Hodges et al. 2009). Spruce-fir stands and mixed spruce-fir with mature lodgepole pine (having dense understory and high degree of horizontal cover) supported the highest densities of snowshoe hares in Yellowstone National Park (YNP) (Hodges and Mills 2005). Murphy et al. (2006) were able to determine the presence of 3 individual lynx including 2 kittens born in different years in YNP, but only within the East zone where andesitic soils supported moist spruce-fir forests with dense understories. They conclude that habitat for lynx in YNP is patchy and lynx in this part of their range use exploratory movements (Squires et al. 2003) and are more likely to prey on alternative species. Only two ranger districts within the eastside assessment area appear to support a small, but persistent lynx population. These include the Lincoln Ranger District on the Helena NF, which lies west of the Continental Divide, and the Rocky Mountain Ranger District on the Lewis and Clark NF, which is east of the Continental Divide.

Outcomes

Each of the four Forests has developed 2013 habitat maps for lynx. The maps are all derived from the same base information (aspect, elevation, and habitat types from the potential natural vegetation Regional layer). The forests tailored their respective maps to reflect differences in ecological capabilities.

The Gallatin and Custer NFs evaluated and compared their historical and new lynx habitat predictions using the established Lynx Analysis Units (LAU). The original LCAS established a threshold of 6,400 acres of potential lynx habitat as the amount needed within an LAU to support lynx.

The outcomes are described in the tables and maps that follow, as well as a comparison with the 2005 mapping. The updated prediction of lynx habitat for both forests represent potential boreal forest conditions that would be expected to support populations of snowshoe hare, the primary prey species for lynx, in numbers that might be sufficient to sustain lynx. **Because of the relatively "coarse" level of data used to infer lynx habitat, the maps are useful only at a broad scale and to set the context for project level analyses. Some level of field (and/or NAIP imagery) verification is needed to better analyze lynx habitat at the project level.**

GNF

For the Gallatin National Forest, the updated lynx habitat map layer was identified using the Regional PNV (potential natural vegetation) classification and including all subalpine fir (abla 1-4) and spruce (picea) classifications. These polygons have many inclusions of non-forest and drier forest types. Therefore, this coarse depiction of lynx habitat was then refined using aspect and elevation. The drier forest inclusions are found on south (s, se, sw) aspects and these were removed. We clipped the map to elevations between 6,000-8,800 feet (the same as in the 2005 map which is based on elevation limits for subalpine fir forests from habitat types described by Pfister et al. 1977). Finally, we used existing vegetation (R1VMAP) and FSVeg spatial habitat type layers to pull out the non-tree inclusions.

The resulting 2013 lynx habitat map includes a total (all ownerships) of 714,559 acres within the established LAU boundaries. This is compared to about a total (all ownerships) of 921,758 acres lynx habitat as it was delineated in 2005.

The current map of lynx Critical Habitat (FWS delineation from 2009) includes the Absaroka-Beartooth Mountains and the Gallatin Range on these 2 forests. It should be noted that the FWS is reviewing the Critical Habitat delineation due to a loss in court over the 2009 Critical Habitat determination and has a proposed out for comment (September 2013). Their proposed rule does not change the boundary of Critical Habitat in southwest Montana from the 2009 designation.

Mapped lynx habitat within the Critical Habitat boundary on the Gallatin National Forest from 2005 was 480,292 acres (all ownerships within an LAU). This compares with 368,727 acres (all ownerships within an LAU) in the 2013 estimate.

CNF

For the Custer National Forest, the updated lynx habitat map layer was identified using the Regional PNV (potential natural vegetation) classification and including all subalpine fir (abla 1-4) and spruce (picea) classifications. These polygons have many inclusions of non-forest and drier forest types. Therefore, this coarse depiction of lynx habitat was then refined using aspect and elevation. The drier forest inclusions are found on south (s, se, sw) and eastern aspects (local biologist input that eastern aspects on the Beartooth District are dry) and these were removed. We clipped the map to elevations between 6,000-10,000 feet (10,000 is about the tree-line in this area of the Custer).

The resulting 2013 lynx habitat map includes a total of 115,518 acres (all ownerships) within the established LAU boundaries. This is compared to about 232,689 acres (all ownerships) that was mapped in 2005.

The current map of lynx Critical Habitat (FWS delineation from 2009) includes the Absaroka-Beartooth Mountains. It should be noted that the FWS is reviewing the Critical Habitat delineation due to a loss in court over the 2009 Critical Habitat determination and has a proposed out for comment (September 2013). Their proposed rule does not change the boundary of Critical Habitat in southwest Montana from the 2009 designation.

The estimate of mapped lynx habitat within the Critical Habitat boundary on the Custer National Forest from 2007 was 154,905 acres (it only included FS ownership within an LAU). This compares with 109,127 acres in the 2013 estimate.

Summary

In summary, the updated mapping represents a change in technique and data layers that allows us to better capture the habitat that is important to lynx on Custer and Gallatin National Forests at the broad scale.

In addition, the habitat map via a structural stage model segregates the potential lynx habitat into several structural stages that are important from the standpoint of applying the standards in the NRLMD.

Literature Cited:

Berg, N. D., Gese, E. M., Squires, J. R., and L. M. Aubry. 2012. Influence of Forest Structure on the Abundance of Snowshoe Hares in Western Wyoming. JWM 76(7): 1480-1488.

Hodges, K. E., Mills, L. S., and K. M. Murphy. 2009. Distribution and Abundance of Showshoe Hares in Yellowstone National Park. Journal of Mammology, 90(4): 870-878.

Hodges, K. E., and L. S. Mills. 2005. Snowshoe hares in Yellowstone. Yellowstone Science 13(2).

Murphy, K. M., Potter, T. M., Halfpenny, J. C., Gunther, K. A., Jones, M. T., Lundberg, P. A., and N. D. Berg. 2006. Distribution of Canada lynx in Yellowstone National Park. Northwest Science, Vol. 80, No. 3: 199-206.

Pfister , R. D., Kovalshik, B. L., Arno, S. F., and R. C. Presby. 1977. Forest Habitat Types of Montana. USDA Forest Service General Technical Report INT-34.

Squires, J. R., N. J. DeCesare, S. Tomson, L. F. Ruggerio, and B. Oakleaf. 2003. Distribution of lynx and other forest carnivores in the Wyoming Range, South-central Wyoming. Final Report, U.S. Forest Service, Rocky Mountain Research Station, Missoula, MT.

Squires, J. R., Decesare, N. J., Kolbe, J. A., and L. F. Ruggiero. 2010. Seasonal Resource Selection of Canada Lynx in Managed Forests of the Northern Rocky Mountains. JWM. 74(8): 1648-1660.

Squires, J. R., Deceare, N. J., Olson, L. E., Kobe, J. A., Hebblewhite, M., and S. A. Parks. 2013. Combining resource selection and movement behavior to predict corridors for Canada lynx at their southern range periphery. Biol. Conserv. 157(2013): pp. 187-195.

U.S. Forest Service. 2007. Northern Rockies Lynx Management Direction Record of Decision. March 2007. http://www.fs.fed.us/r1/planning/lynx/documents.htm.

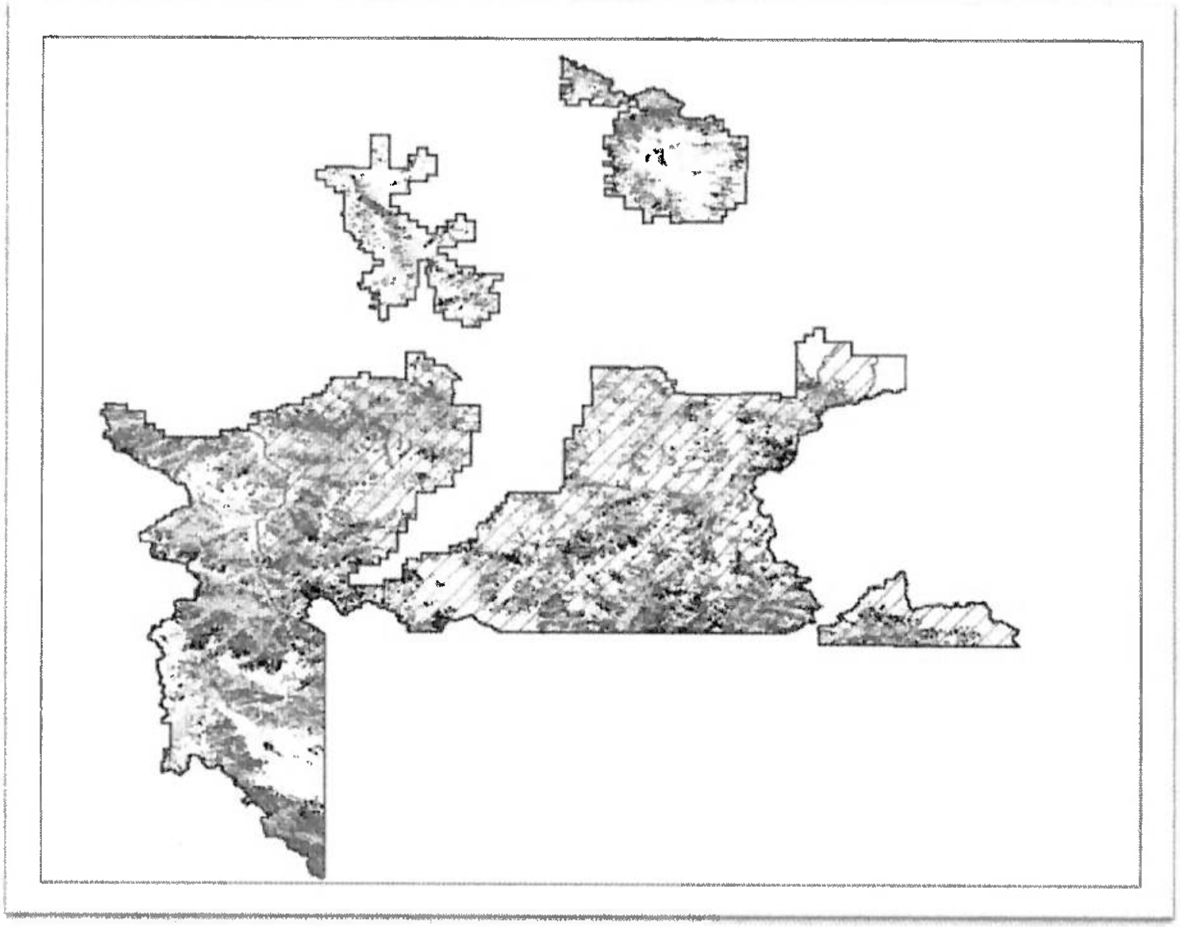
Gallatin NF Potential Lynx Habitat Map Comparison

Components	2005 Map derived from the Timber Stand Management System Data (TSMRS)	2013 Map derived from Northern Region potential natural vegetation and R1VMAP layers
Elevation	6000-8800 feet	6000-8800 feet
Vegetation Source Data	"best" habitat type from photo interpretation or stand exams as entered into TSMRS	Habitat types within the potential natural vegetation Regional data layer; intersected with both TSMRS habitat types and R1VMAP existing vegetation layer; this model uses National Fire and Timber Harvest Activity Databases.
Habitat Parameters	Primary habitat of spruce and subalpine fir habitat types; also included secondary habitats of aspen, sage, willow and wet Douglas fir habitat types if they were within 200 meters of "primary" habitat	All subalpine fir habitat types (4), spruce habitats from PVT layer substracting out non-tree inclusions using R1VMAP and FSVeg Spatial habitat type.
Aspect	None eliminated	Southern aspects eliminated
Total acres of (primary) mapped lynx habitat within LAUs and all ownership	921,757	714,559
Viable LAU (>6400 acres of lynx habitat)	All LAU's	All LAU's
Acres of mapped lynx habitat within an LAU and within FWS Critical Habitat boundary (2009)	480,292	368,727

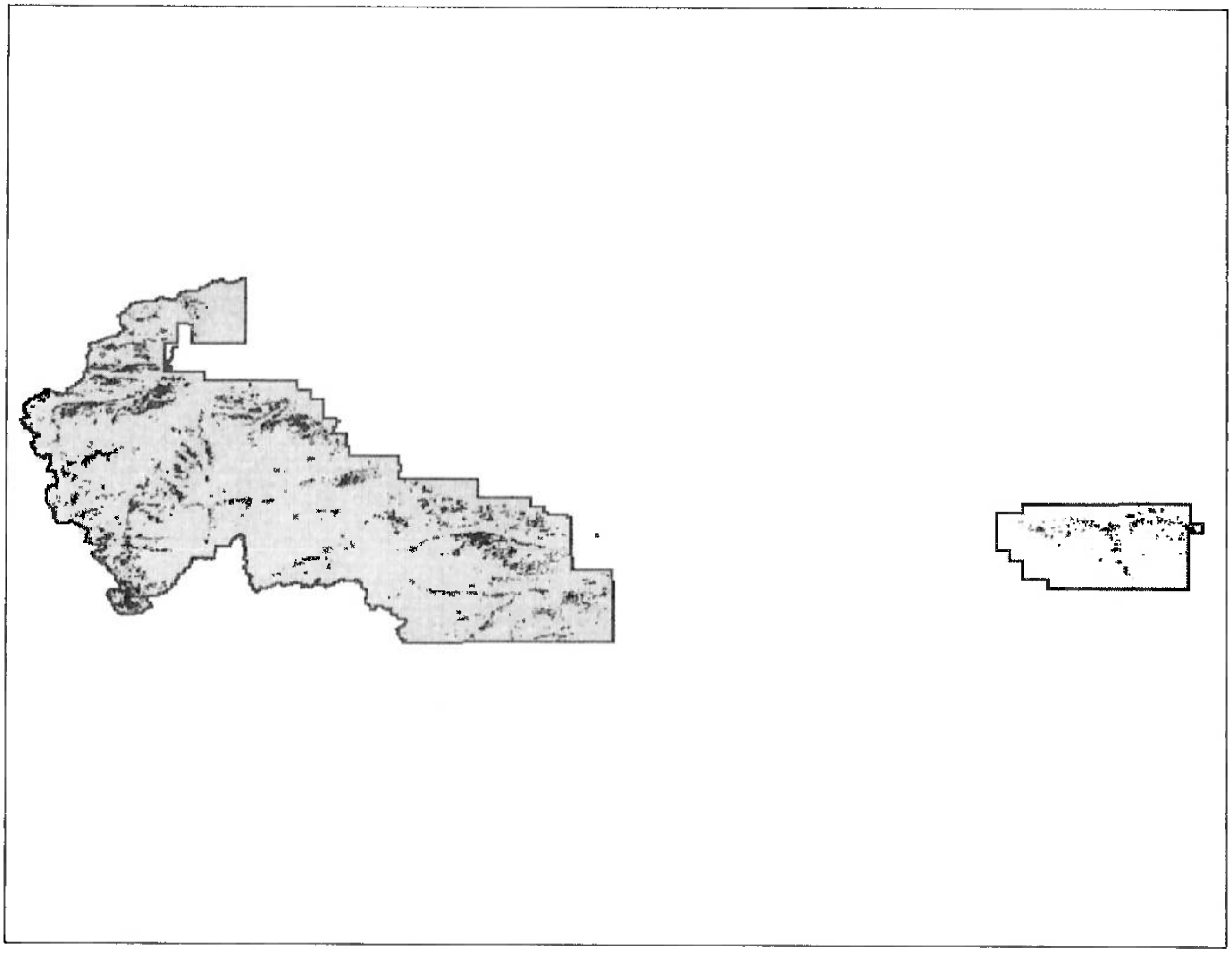
LIT-012904

Custer NF Potential Lynx Habitat Map Comparison:

Components	2007 Map derived from the Timber Stand Management System Data (TSMRS)	2013 Map derived from Regional Corporate Data
Elevation	6000 feet Plus	6000-1000 feet (10,000 is about the tree-line in this area of the Custer)
Vegetation Source Data	TSMRS photo interpreted	Habitat types within the potential natural vegetation Regional data layer; intersected with both TSMRS habitat types and R1VMAP existing vegetation layer; this model uses National Fire and Timber Harvest Activity Databases.
Habitat Parameters	All conifer types that were medium to well-stocked; recent burns were excluded	All subalpine fir PVT types (4), and spruce PVT
Aspect	All included	Southern and eastern aspects removed (eastern aspects on the Beartooth District are dry)
Total acres of mapped lynx habitat within LAUs	232,689 (FS only)	112,988 (FS only) 115,518 total
Viable LAU (>6400 acres of lynx habitat)	All LAU's	Pryor Mountains slightly under viable acre figure
Acres within FWS Critical Habitat boundary (2009)	154,905 (FS only)	106,822 (FS only)



GNF LYNX HABITAT 2013 (cross hatched is within USFWS Critical Habitat Boundary 2009)



CNF LYNX HABITAT 2013 (Blue area is within USFWS Critical Habitat Boundary 2009)

Gallatin Map Comparison (acres):

LAU NAME	Critical habitat from FWS 2009	Total aces within the LAU	Lynx Habitat FS only 2005	TOTAL lynx habitat 2005	Lynx Habitat FS only 2013	TOTAL lynx habitat 2013
AB Wilderness	Y	160,652	89,488	90,543	56,110	56,397
Beartooth Plateau	Y	85,112	17,646	17,786	8,754	9,494
Bridger Bangtails	N	150,816	32,631	41,611	27,766	39,628
East Boulder	Y	87,930	27,954	28,995	24,882	25,412
East Crazies	N	75,516	19,943	20,160	10,410	16,689
East Gallatin	Y	119,022	44,230	53,546	32,449	42,065
Emigrant	Y	72,227	23,868	24,169	28,066	28,689
Gardiner-Tom Miner	Y	154,387	48,071	51,594	37,631	44,816
Henry's Lake Mtns	N	52,233	29,709	30,151	22,443	22,657
Horseshoe	Y	84,623	27,391	27,628	20,627	20,691
Main Boulder	Y	75,078	26,223	26,681	20,585	21,171
Mill Creek	Y	63,978	26,922	26,982	27,689	27,780
North Absaroka	Y	63,402	30,602	30,743	20,434	21,682
North Gallatin	Y	103,313	62,460	67,550	54,954	61,143
North Madison	N	173,103	69,658	108,058	47,156	64,049
South Fork Madison	N	39,992	34,117	34,652	29,289	29,697
Upper Gallatin	Y	125,725	58,764	69,824	50,026	52,200
Upper Madison	N	96,937	51,314	54,156	27,762	27,839
West Boulder	Y	56,760	24,546	24,583	14,652	14,679
West Crazies	N	87,523	43,926	45,772	27,487	31,930
West Gallatin	Y	131,362	72,518	77,043	52,903	55,851
Grand Total			861,981	952,226	642,075	714,559

LAU names in italicized font are considered "secondary transient areas for lynx"

Custer Map Comparison (acres):

LAU NAME	Critical habitat from FWS 2009	Total aces within the LAU	Lynx Habitat (FS only) 2007	Lynx Habitat FS only 2013	TOTAL lynx habitat 2013
Pryors	N	77,987	28,580	6,176	6,391
Rock Creek	Y	151,316	68,370	25,747	26,441
Rosebud	Y	160,100	58,005	19,107	19,318
Stillwater	Y	214,476	77,874	61,958	63,368
			232,689	**112,988**	115,518

Summary of pre-treatment monitoring for Cooke City Whitebark Pine restoration project

Prepared by Teresa Lorenz[1]

December 8, 2011

Introduction

Whitebark pine (*Pinus albicaulis*) is a declining keystone species that occurs in high elevation and subalpine environments in the mountains of western North America. It produces large seeds that are valued by wildlife for food. Few seeds escape being consumed or stored by at least one species, and the importance of vertebrate seed-eaters cannot be overestimated as they exert more influence on regeneration than perhaps any other factor. In fact, whitebark pine relies on a songbird, Clark's nutcracker (*Nucifraga columbiana*), for seed dissemination and consequently, population-wide regeneration. In July 2011, whitebark pine was listed as a candidate species under the Endangers Species Act (ESA) because of repaid declines attributed to an exotic disease, white pine blister rust (caused by the fungus *Cronartium ribicola*), mountain pine beetle (*Dendroctonus ponderosae*) outbreaks, fire suppression, and climate change. To improve stand health and increase opportunities for regeneration, researchers advocate the use of mechanical thinning to cull competing vegetation. The immediate benefits of such restoration activities for individual whitebark pine trees are readily apparent, but the effects of such treatments on overall stand health and the seed-eating vertebrate community have not been previously studied using a before-after control-impact design. The objectives of this project were to monitor whitebark pine health and autumn cone production, as well as rodent and nutcracker abundance in response to such restoration treatments.

Study objectives

Within this broad objective, our study questions included:

1 – Does thinning increase the vigor of whitebark pine trees, and is this realized in an increase in regeneration at the stand-level?

2 – How do restoration treatments affect autumn cone production, and does cone production vary among trees in stands with different aspects, elevations, and pre-treatment stand densities?

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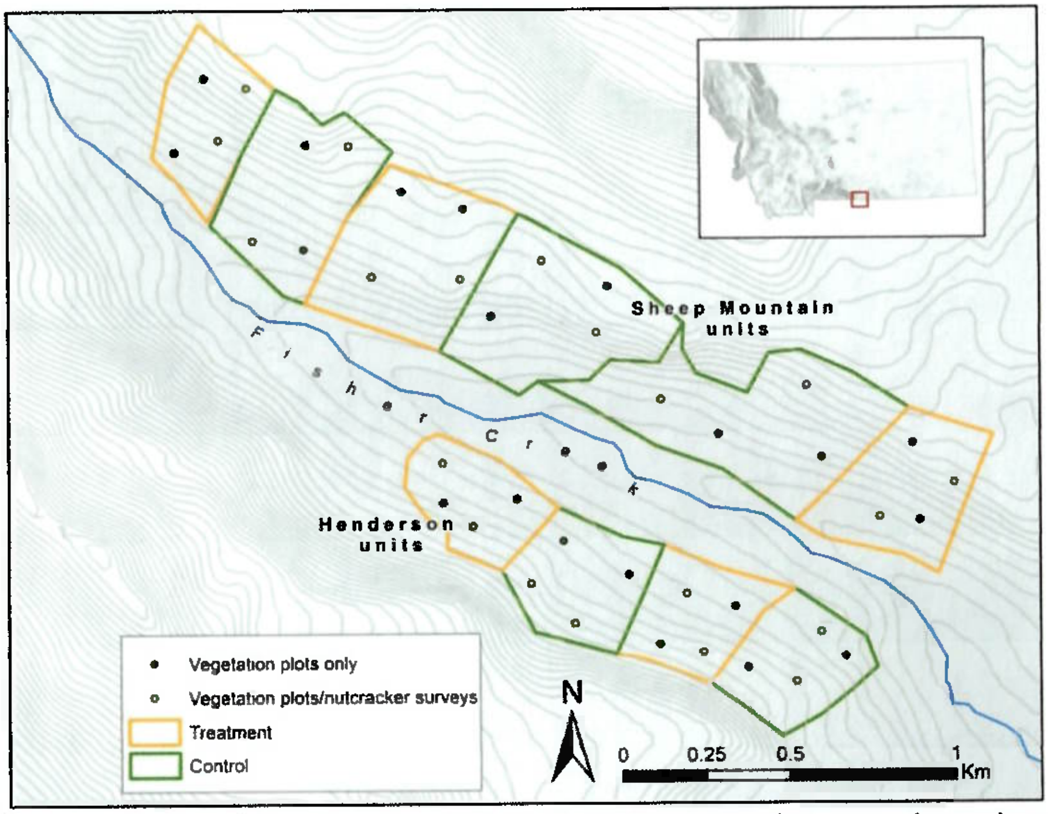

Figure 1. Map of project units and treatments for the whitebark pine restoration project at Cooke City, MT.

the Sheep Mountain site six units. For each adjoining pair of units, we randomly assigned a treatment (mechanical thinning; Table 1) or control (no thinning). Thus there were five units that were treated with mechanical thinning, and five units that were not thinned. These ten study units represented our experimental units and were of approximately equal area (Table 1).

Table 1. Summary of aspect, treatment, and size for ten whitebark pine restoration units at Cooke City, MT.

Site	Unit	Aspect	Proposed treatment	Area in ha (acres)
Henderson	east a	north	thin fir and spruce	14.2 (35.1)
	east b	north	control – no thin	15.2 (37.6)
	west a	north	control – no thin	15.6 (38.6)
	west b	north	thin fir and spruce	13.9 (34.3)
Sheep Mountain	east a	south	control – no thin	14.9 (37.0)
	east b	south	thin fir and spruce	20.6 (51.1)
	mid a	south	thin fir and spruce	21.7 (53.8)
	mid b	south	control – no thin	20.6 (50.9)
	west a	south	thin fir and spruce	15.3 (37.9)
	west b	south	control – no thin	17.3 (42.9)

Methods

The thinning treatment consisted of cutting or girdling all Engelmann spruce (*Picea engelmannii*) and subalpine firs (*Abies lasiocarpa*) surrounding each sapling and adult whitebark pine. Sapling firs and spruces were piled for burning, although many piles were never burned or burned very poorly. All thinning, girdling, and burning activities were completed by autumn 2013. Vegetation and animal monitoring occurred both pre- and post-treatment. The pre-treatment monitoring occurred in September 2011, and post-treatment monitoring during the last week of August in 2014.

Pre-treatment monitoring included vegetation surveys and occupancy surveys for Clark's nutcrackers and pine squirrels (*Tamiasciurus hudsonicus*), as well as small mammal trapping. Post-treatment monitoring included only vegetation and occupancy surveys. We did not conduct small mammal trapping as part of post-treatment monitoring partly because of bear damage to traps in 2011.

Vegetation surveys were conducted at four random plots within each unit for a total of 40 vegetation plots surveyed in both years. We used point-center quarter methods (Cottam and Curtis 1956) to quantify changes to overstory tree composition and BBIRD protocol (Martin et al. 1997) to sample understory plant and ground cover. We conducted cone counts on all monitored whitebark pine trees in each unit and measured infection rates by white pine blister rust. In 2014, we also conducted counts of regenerating conifer saplings.

Within each unit, two of the vegetation survey plots were also locations for occupancy surveys for Clark's nutcrackers and pine squirrels, the two most influential seed eaters in whitebark pine communities. During these surveys, we counted and recorded the distance and direction to all audible and visible nutcrackers and squirrels.

In this report we summarize vegetation and occupancy survey results from 2014. We also make comparisons between vegetation cover and tree densities pre- and post-treatment on treated units, and compare cone and animal abundance between years. Importantly, the thinning treatments were conducted only one year prior to our 2014 surveys and so many of the expected treatment-induced vegetative changes had not yet occurred.

Results

Vegetation surveys

On treatment units ground cover by coarse woody debris (CWD) and litter increased numerically between 2011 and 2014 (Table 2), although overlapping confidence intervals indicate that this increase was non-significant for litter cover and marginally non-significant for CWD (Figure 2). Cover by shrubs decreased, although this decline was likewise marginally non-significant. The increase in CWD and litter is directly attributable to the placement of tree limbs and branches on the ground following the piling treatments, particularly the piling of small diameter, understory spruces and firs.

Table 2. Comparison in mean (standard deviation) cover by vegetation (forbs, grasses, and shrubs) and ground cover (coarse woody debris (CWD), litter, and soil) between pre-treatment (2011) and post-treatment (2014) years.

	Forb	Grass	Shrubs	CWD	Litter	Soil
Pre-treatment (2011)						
Control	23.0 (15.5)	4.9 (7.6)	38.4 (19.5)	16.4 (18.4)	57.6 (15.6)	3.5 (8.6)
Treatment	25.1 (20.1)	8.3 (12.5)	42.8 (19.8)	15.4 (22.7)	62.9 (25.8)	6.5 (13.8)
Post-treatment (2014)						
control	21.2 (11.1)	6.0 (2.8)	38.5 (15.4)	16.4 (18.4)	59.5 (15.4)	2.5 (6.7)
treatment	28.4 (12.6)	2.8 (2.1)	33.1 (12.3)	32.8 (27.6)	75.4 (17.2)	0.8 (0.9)

Photo showing CWD piles (foreground) and girdled Engelmann spruce (tree with red foliage in background) in the Henderson east unit. Most girdled trees were dying but still standing.

We observed that most large, canopy-level spruce and fir trees that had been girdled on treated plots were still partially alive; many of these girdled trees had yellow or red foliage and thus were clearly dying, but had not yet fallen to the ground. While we counted these trees as dead for the purpose of measuring tree densities within stands, most of them had not yet fallen or contributed to the CWD and litter in our measurements of ground cover. Over the next several years, we can therefore expect CWD and litter levels to increase dramatically as these girdled trees die and fall.

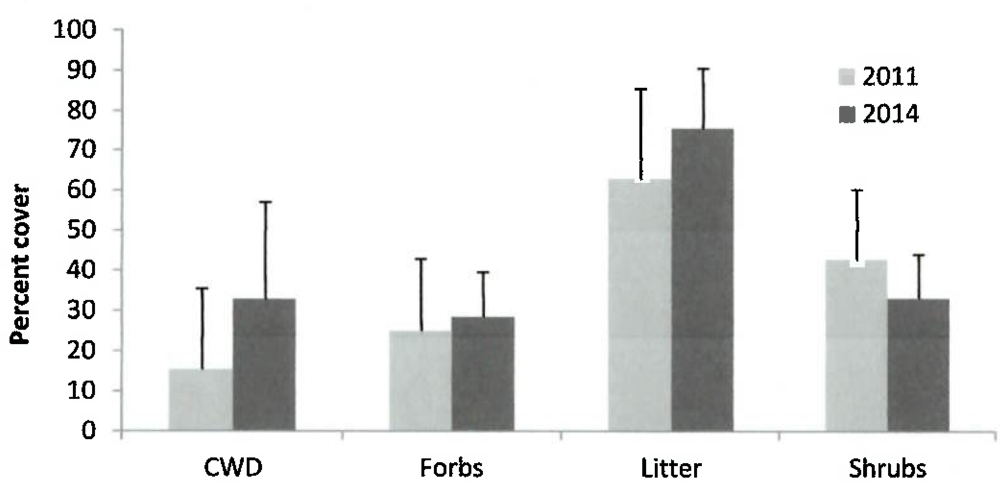

Figure 2. Changes in percent cover (mean and 95% CI) in coarse woody debris (CWD), forbs, littler, and shrubs between 2011 and 2014 on treatment plots

Photo of fallen and standing girdled spruce and fir trees in the treated Sheep Mountain mid unit. As in Henderson, many of the girdled trees were still standing.

Tree densities did not change on untreated units from 2011 to 2014 and therefore we focused on changes within the treated units. Overall densities of both spruce and fir declined following treatments, although changes on most plots were due to steeper declines in Engelmann spruce density, rather than subalpine fir density (Table 3). Total spruce-fir density decreased more on the Henderson units, likely due to an overall higher density of spruces and firs on the north-facing Henderson Mountain slopes. On average, Sheep Mountain subalpine fir density declined by 11 trees/ha while Engelmann spruce density declined by 27 tree/ha, compared to a 36 and 64 tree/ha decline on Henderson units (for subalpine fir and Engelmann spruce, respectively). Not surprisingly, overall whitebark pine tree density did not change appreciably between pre- and post treatment surveys, and the only documented change occurred on one Henderson east plot, where a single whitebark pine died from a mountain pine beetle infection.

Table 3. Changes in tree density (trees/ha) between pre- (2011) and post-treatment (2014) for treated units only. We did not observe changes in tree density on the untreated units.

		Pre-treatment		Post treatment	
Site	**Unit**	**Subalpine fir density**	**Engelmann spruce density**	**Subalpine fir density**	**Engelmann spruce density**
Henderson					
	east a	190.2	148.0	117.7	84.1
	west b	135.8	118.8	139.2	55.7
Sheep Mountain					
	east b	240.2	150.1	216.0	120.1
	mid a	80.6	30.2	73.2	6.6
	west a	113.9	27.8	113.9	<1.0

Table 4. Cone counts on whitebark pine trees pre- (2011) and post-treatment (2014).

Site	Unit	Treatment	2011 total cones	2014 total cones
Henderson	east a	treatment	36	8
	east b	control	156	14
	west a	control	6	0
	west b	treatment	24	0
Sheep Mountain	east a	control	232	84
	east b	treatment	165	61
	mid a	treatment	53	37
	mid b	control	438	200
	west a	treatment	125	7
	west b	control	127	24

Rates of blister rust infection were similar between pre-and post-treatment. In 2011 we documented an average of 3.0 infected whitebark pines per unit, compared to 3.2 in 2014, and the majority (92 percent) of the 2014 infections were from trees identified in 2011 as infected. None of the monitored whitebark pine trees had died from blister rust.

Cone density was lower in 2014 compared to 2011 (Table 4), almost certainly due to natural fluctuations in cone crop size rather than an effect of treatments. The average cones per unit in 2011 (136.2) was more than three times greater than the 2014 average of 43.5 cones per unit. Units that produced the majority of cones in 2011 also produced most cones in 2014; in both years, the Sheep Mountain east and mid units accounted for more than 65 percent of the total measured cone production.

In 2014 we measured regeneration rates of conifers on all plots. Subalpine fir was the most common species of regeneration in all units, accounting for 53 to 100 percent of all regenerating conifers (Table 5). Whitebark pine regeneration was absent on some plots, including the easternmost Sheep Mountain units and one of the Henderson west units.

Table 5. Seedling and sapling subalpine fir, Engelmann spruce and whitebark pines within units in 2014.

Site	Unit	Subalpine fir	Engelmann spruce	Whitebark pine
Henderson	east a	116	16	8
	east b	64	5	4
	west a	94	9	1
	west b	52	2	0
Sheep Mountain	east a	54	0	0
	east b	101	44	0
	mid a	58	2	5
	mid b	51	2	15
	west a	21	3	16
	west b	78	2	1

Occupancy surveys

We completed 600 minutes of surveys on 20 plots for Clark's nutcrackers and pine squirrels in both 2011 and 2014. In 2014 nutcrackers accounted for 50 percent of all detections (66 total detections) within the study unit boundaries, and on average this was 60 percent lower than within-unit nutcracker detections from 2011. This is likely because the whitebark pine cone crop was substantially lower in 2014 compared to 2011, and autumn nutcracker abundance is generally correlated with cone abundance (e.g., McKinney and Tomback 2007, Barringer et al. 2012). Because squirrels are less mobile than nutcrackers and rely on other conifer species for food, it is not surprising that squirrel numbers did not differ as much as nutcrackers between years. Total number of squirrel detections was 37 for 2011 and 48 for 2014. Similar to 2011, chipmunks were rarely detected in 2014, and we observed only a single chipmunk during our 2014 surveys.

Nutcracker ($t = 1.02$, $df = 8$, $P = 0.337$) and squirrel ($t = 1.31$, $df = 8$, $P = 0.228$) numbers did not differ between treatments and controls in 2014. Regardless of treatment, we observed a marginally non-significant correlation between whitebark pine cone counts and Clark's nutcracker detections ($r = 0.463$, $P = 0.089$). Squirrel detections were not associated with whitebark pine cone counts ($r = 0.186$, $P = 0.303$)

Table 6. Mean number of pine squirrels, Clark's nutcrackers, and chipmunks detected during 10-minute point counts pre- and post treatment.

			Pine squirrel		Clark's nutcracker		Chipmunk	
Site	**Unit**	**Treatment**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Henderson								
	east a	treatment	0.7	1.0	1.5	1.5	0.0	0.0
	east b	control	1.2	0.8	2.5	1.8	0.0	0.0
	west a	control	0.5	0.3	1.2	0.7	0.2	0.0
	west b	treatment	0.8	0.8	1.7	0.7	0.0	0.0
Sheep Mountain								
	east a	control	1.5	1.0	3.3	0.7	0.3	0.0
	east b	treatment	0.5	0.7	0.5	0.0	0.0	0.0
	mid a	treatment	0.0	1.3	1.3	2.0	0.0	0.0
	mid b	control	0.7	0.8	2.8	2.5	0.0	0.0
	west a	treatment	0.0	0.7	1.7	0.0	0.0	0.2
	west b	control	0.3	0.5	0.8	1.2	0.2	0.0

Conclusion

We observed few changes in vegetation and animal abundance following thinning treatments, presumably because spruce and fir trees that had been girdled were still partially alive and had not yet fallen. We expect that most of the effects of thinning will not be observed for several years to come, and we encourage future monitoring of these units to document changes to tree density, ground cover, and whitebark pine cone production as the girdled spruce and fir trees die and fall. In particular, as CWD cover increases in stands, it is possible that numbers of granivorous rodents will also increase, and therefore future monitoring of rodent populations will be important.

Despite the limitations of our 2014 monitoring effort, we observed an slight increase in CWD cover in 2014 on the treated units, attributable to the thinning and piling of small-diameter sapling spruces and firs. Densities of live, canopy-level spruces and firs also declined, while whitebark pine density did not change. We did not observe differences in whitebark pine blister rust infection rates, and mountain pine beetle mortality was rare. However, cone abundance was lower in 2014 compared to 2011, and this corresponded with lower numbers of nutcrackers on most units during post-treatment monitoring. Given that whitebark pine cone crops fluctuate widely in natural systems, long-term monitoring will be needed to ascertain whether treatments affect overall cone production and nutcracker visitation rates.

Literature cited

Barringer L.E., D.F. Tomback, M.B. Wunder, and S.T. McKinney. 2012. Whitebark pine stand condition, tree abundance, and cone production as predictors of visitation by Clark's nutcracker. Plos One 7:e37663.

Cottam, G., and J.T. Curtis. 1956. The use of distance measures in phytosociological sampling. Ecology 37:451–460.

Martin, T. E., C. R. Paine, C. J. Conway, W. M. Hochachka, P. Allen, and W. Jenkins. 1997. BBIRD field protocol. Montana Cooperative Wildlife Research Unit, University of Montana, Missoula, USA.

McKinney S.T., and D.F. Tomback. 2007. The influence of white pine blister rust on seed dispersal in whitebark pine. Canadian Journal of Forest Research 37:1044–1057.

Summary of post treatment monitoring for the Cooke City Whitebark Pine restoration project

Prepared by Teresa Lorenz

December 31, 2014

Introduction

Whitebark pine (*Pinus albicaulis*) is a declining keystone species that occurs in high elevation and subalpine environments in western North America. It produces large seeds that are valued by wildlife for food. Few seeds escape being consumed or stored by at least one species, and the importance of vertebrate seed-eaters cannot be overestimated. Whitebark pine relies on a songbird, Clark's nutcracker (*Nucifraga columbiana*), for seed dissemination and population-wide regeneration. In July 2011, whitebark pine was listed as a candidate species under the Endangered Species Act (ESA) because of repaid declines attributed to an exotic disease, white pine blister rust (caused by the fungus *Cronartium ribicola*), mountain pine beetle (*Dendroctonus ponderosae*) outbreaks, fire suppression, and climate change. To improve stand health and increase opportunities for regeneration, researchers advocate the use of mechanical thinning to cull competing vegetation. The immediate benefits of such restoration activities for individual whitebark pine trees are readily apparent, but the effects of such treatments on overall stand health and the seed-eating vertebrate community have not been previously studied using a before-after control-impact design. The objectives of this project were to monitor whitebark pine health and autumn cone production, as well as rodent and nutcracker abundance in response to such restoration treatments.

Study area

This project was conducted in the Fisher Creek drainage of the Gallatin National Forest, near Cooke City, Montana (approximately 45° 01' 11" N, 109° 65' 03" W). Within Fisher Creek, we stratified our experimental design by aspect with one group of units (Henderson) facing generally north and the second (Sheep Mountain) facing south. We further divided Sheep Mountain into blocks by elevation because of considerable variation in elevation across the plot (Figure 1). Consequently, the Henderson site contains four study units and

25 Sheman live traps set at 10 m spacing, and grids are set approximately in the center of units.

Pre-treatment monitoring results

Vegetation surveys

Prior to thinning the units, we found slightly higher amounts of grass and bare soil on south-facing pots, and higher cover by moss on north facing plots (Table 2). This is likely due to differences in moisture retention and evaporative loss between the aspects. We found little difference in vegetation or ground cover by proposed treatment type, and controls and treatments had nearly identical cover by all measured covariates (Table 2).

Table 2. Pre-treatment mean (standard deviation) cover by vegetation (forbs, grasses, and shrubs) and ground cover (coarse woody debris (cwd), litter, moss, rock, and soil) for whitebark pine restoration plots at Cooke City, MT, by aspect and treatment type.

	Forb	Grass	Shrub	Cwd	Litter	Moss	Rock	Soil
Aspect								
North (n=4)[1]	29.9 (8.8)	1.4 (0.4)	33.9 (2.0)	19.1 (2.8)	52.5 (11.7)	20.2 (10.9)	7.5 (5.5)	0.9 (0.9)
South (n=6)	20.2 (8.9)	10.1 (7.8)	45.2 (14.5)	13.7 (7.2)	65.4 (10.5)	10.3 (12.5)	2.6 (1.7)	7.7 (4.7)
Proposed treatment type								
Treatment (n=5)	25.6 (10.5)	6.6 (7.5)	38.3 (10.2)	15.5 (6.8)	60.0 (12.1)	16.1 (14.1)	3.9 (1.0)	4.4 (5.1)
Control (n=5)	22.5 (9.9)	6.5 (8.0)	42. 9 (15.0)	16.3 (6.3)	60.5 (13.9)	12.4 (11.7)	5.2 (6.2)	5.6 (5.3)

[1] n refers to the number units rather than the number of vegetation survey plots within units; there are four to eight vegetation survey plots within each unit

Density of whitebark pine trees was higher for units with a southerly aspect (14.1 trees/ha for southern aspects versus 1.0 trees/ha for northern aspects), and higher for the treatment units (13.7 trees/ha for treatments and 4.0 trees/ha for controls), although these differences were not significant (p = 0.1895 and 0.4033, respectively) (Table 3). The difference in

Table 3. Pre-treatment density of trees, whitebark pine cones, and whitebark pine trees infected by blister rust for units in Fisher Creek, by aspect and treatment type.

Site	Unit	Proposed treatment	Subalpine fir density (trees/ha)	Engelmann spruce density (trees/ha)	Whitebark pine density (trees/ha)	Whitebark pine cone density (cones/ha)	White pine blister rust density (trees/ha)
Henderson (north aspect)							
	east a	treatment	19.0	14.8	< 1	< 5	<1
	east b	control	11.5	2.9	1.0	15	1
	west a	control	13.6	11.9	< 1	< 8	<1
	west b	treatment	19.6	2.8	< 1	< 6	<1
Sheep Mountain (south aspect)							
	east a	treatment	29.7	8.1	5.4	83	1
	east b	control	24.0	15.0	9.0	114	0
	mid a	treatment	8.1	3.0	4.0	13	1
	mid b	control	8.9	4.0	3.0	87	2
	west a	treatment	11.4	22.8	57.0	445	0
	west b	control	12.1	14.1	6.1	55	0

whitebark pine density due to treatment type was attributed to a high density of whitebark pine trees on one vegetation plot on one treatment unit (Sheep Mountain west a). By omitting this one plot from the data set, the density of whitebark pine trees for treatments and controls was nearly identical (2.9 trees/ha for treatments and 4.0 trees/ha for controls). We found no significant differences in cone density or white pine blister rust density by aspect or proposed treatment type.

We intended to measure whitebark pine mortality and infections rates from mountain pine beetle, but the distribution of beetle infected and killed trees was highly clumped. Thus, the variation in beetle infected trees was very high even within units, precluding an accurate assessment of the density of infection by unit. For example, we encountered 17 infected or recently dead trees, but 16 of them occurred on only one plot within a unit, with the other plots containing no infected trees. Data from remote sensing or aerial surveys are likely to estimate beetle mortality much more accurately than our on-the-ground vegetation plots.

Occupancy surveys

We completed a total of 600 minutes of surveys on 20 plots for Clark's nutcrackers and pine squirrels. Nutcrackers accounted for 81% of all detections (178 total detections), but only 58% (104 detections) of those detections were actually within the study unit boundaries (Table 4). The remainder of nutcracker detections were of birds flying overhead or outside the study area boundary and were exclude from all analyses. Pine squirrels accounted for nearly all of the remaining detections (17% of detections, or 37 total detections), with only 4 chipmunks detected across all surveys.

We found no differences in squirrel or nutcracker detections by treatment type (p = 0.6065 for squirrels and 0.8296 for nutcrackers) or aspect (p = 0.3685 for squirrels and 0.9475 for nutcrackers). We likewise found no strong correlations between nutcracker detections and any measured stand characteristics; indeed, the correlation between nutcracker detections

Table 4. Pre-treatment mean number of pine squirrels, Clark's nutcrackers, and chipmunks detected during 10-minute point counts in each unit.

Site	Unit	Proposed treatment	Pine squirrel	Clark's nutcracker	Chipmunk
Henderson (north aspect)					
	east a	treatment	0.7	1.5	0.0
	east b	control	1.2	2.5	0.0
	west a	control	0.8	1.7	0.0
	west b	treatment	0.5	1.2	0.2
Sheep Mountain (south aspect)					
	east a	treatment	1.5	3.3	0.3
	east b	control	0.5	0.5	0.0
	mid a	treatment	0.0	1.3	0.0
	mid b	control	0.7	2.8	0.0
	west a	treatment	0.0	1.7	0.0
	west b	control	0.3	0.8	0.2

and whitebark pine cone density was particularly weak ($r = 0.0094$). This is not necessarily surprising, for even though we expect that nutcrackers would be attracted to cones, they are non-territorial, mobile, and gregarious when harvesting cones, making it difficult to accurately predict their abundance using standard survey methods. Rather, occupancy models would provide a better estimate of nutcracker response to cone production, and treatment type. We hope to complete analyses of nutcracker occupancy models in spring 2012.

Small mammal trapping

We planned to conduct small mammal trapping in eight units, but were only able to trap at six units because of bear damage to traps, particularly on the eastern Sheep Mountain units. Overall, we successfully trapped mammals in all four north-facing (Henderson) units, but only on two south-facing (Sheep Mountain) units. Our analyses are therefore restricted to treatments versus controls, although we include simple comparisons of abundance on north versus south aspects.

Montane voles (*Microtus montanus*) were by far the most common small mammal in the units, accounting for 94% of all captures (Table 5). Density of montane voles estimated from Jolly-Seber models (Jolly 1965, Seber 1965) was slightly higher for control (125 voles/ha) versus treatment units (78 voles/ha). Voles also were also more common on the north-facing units. Generally, voles are associated with higher amounts of herbaceous vegetation and moisture (Sera and Early 2003), and consequently this finding is not necessarily surprising. Deer mice (*Peromyscus maniculatus*) and chipmunks (*Tamias* spp.) were only captured on the south facing units, although this does not necessarily reflect their true distribution since chipmunks were detected on north facing units during occupancy surveys (Table 4).

Table 5. Pre-treatment total number of mammals caught during 800 trap nights on units in Fisher Creek.

Site	Unit	Proposed Treatment	Montane vole	Dusky shrew[1]	Meadow vole	Deer mouse
Henderson (north aspect)						
	east a	treatment	11		1	
	west b	treatment	17			
	west a	control	11			
	east b	control	17	1		
Sheep Mountain (south aspect)						
	west b	control	8	2		
	west a	treatment	9			1
	total		**73**	**3**	**1**	**1**

[1] *Sorex monticolus*

Literature cited

Cottam, G., and J.T. Curtis. 1956. The use of distance measures in phytosociological sampling. Ecology 37:451–460.

Jolly, G. M. 1965. Explicit estimates from capture-recapture data with both death and immigration stochastic model. Biometrika 52:225–247.

MacKenzie, D.I., J.D. Nichols, J.A. Royle, K.H. Pollock, L.L. Bailey, and J.E. Hines. 2006. Occupancy estimation and modeling: inferring patters and dynamics of species occurrence. Academic Press. San Diego, CA.

Seber, G.A.F. 1965. A note on the multiple recapture census. Biometrika 52:249–259.

Sera, W.E., and C.N. Early. 2003. *Microtus montanus*. Mammalian Species 716:1–10.

Summary of post treatment monitoring for the Cooke City Whitebark Pine restoration project

Prepared by Teresa Lorenz

December 31, 2014

Introduction

Whitebark pine (*Pinus albicaulis*) is a declining keystone species that occurs in high elevation and subalpine environments in western North America. It produces large seeds that are valued by wildlife for food. Few seeds escape being consumed or stored by at least one species, and the importance of vertebrate seed-eaters cannot be overestimated. Whitebark pine relies on a songbird, Clark's nutcracker (*Nucifraga columbiana*), for seed dissemination and population-wide regeneration. In July 2011, whitebark pine was listed as a candidate species under the Endangered Species Act (ESA) because of repaid declines attributed to an exotic disease, white pine blister rust (caused by the fungus *Cronartium ribicola*), mountain pine beetle (*Dendroctonus ponderosae*) outbreaks, fire suppression, and climate change. To improve stand health and increase opportunities for regeneration, researchers advocate the use of mechanical thinning to cull competing vegetation. The immediate benefits of such restoration activities for individual whitebark pine trees are readily apparent, but the effects of such treatments on overall stand health and the seed-eating vertebrate community have not been previously studied using a before-after control-impact design. The objectives of this project were to monitor whitebark pine health and autumn cone production, as well as rodent and nutcracker abundance in response to such restoration treatments.

Study area

This project was conducted in the Fisher Creek drainage of the Gallatin National Forest, near Cooke City, Montana (approximately 45° 01' 11" N, 109° 65' 03" W). Within Fisher Creek, we stratified our experimental design by aspect with one group of units (Henderson) facing generally north and the second (Sheep Mountain) facing south. We further divided Sheep Mountain into blocks by elevation because of considerable variation in elevation across the plot (Figure 1). Consequently, the Henderson site contains four study units and

3 – Do more nutcrackers visit the treated sites compared to untreated sites? Are their specific vegetative features that are associated with their abundance during the autumn seed harvest season?

4 – What is the composition of the small mammal community in whitebark pine ecosystems, and how do small mammals respond to restoration treatments?

Study area

This study is being conducted in the Fisher Creek drainage of the Gallatin National Forest, near Cooke City, MT (approximately 45° 01' 11" N, 109° 65' 03" W). Within Fisher Creek, we stratified our experimental design by aspect, with one group of units (Henderson) facing generally north, and the second (Sheep Mountain) facing south. We further divided Sheep Mountain into blocks by elevation, because of considerable variation in elevation across the plot (Figure 1). Consequently, the Henderson site contains four study units and the Sheep Mountain site six units. For each adjoining pair of units, we randomly assigned the treatment (mechanical thinning; Table 1) or control (no treatment). Thus there are five units that will be treated with mechanical thinning, and five units that will not be thinned. These ten study units represent our experimental units and are of approximately equal area (Table 1).

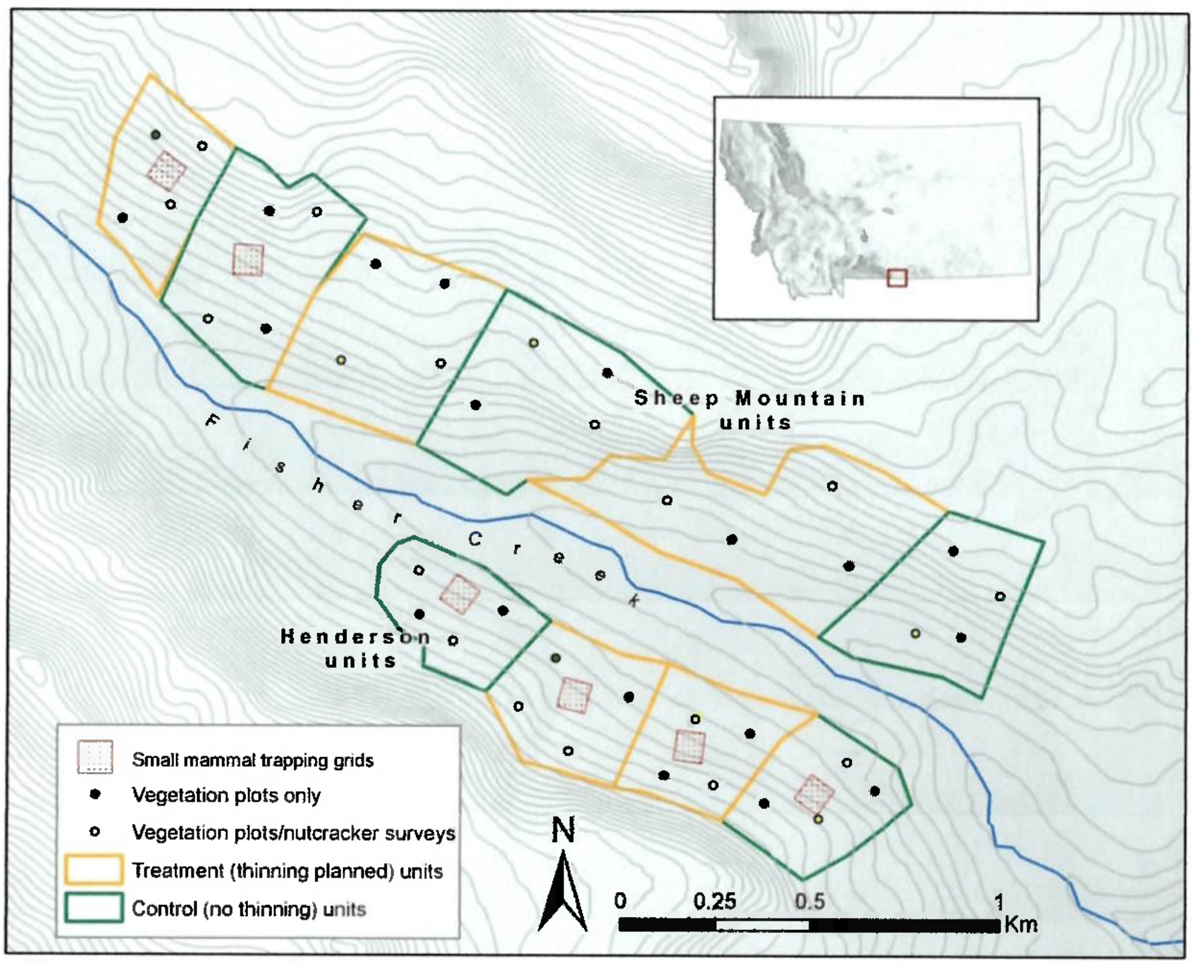

Figure 1. Map of project units for whitebark pine restoration in Fisher Creek, MT.

Table 1. Summary of aspect, treatment type, and size for 10 whitebark pine restoration units in Fisher Creek, MT.

Site	Unit	Aspect	Proposed treatment	Area in ha(acres)
Henderson	east a	north	thin fir and spruce	14.2 (35.1)
	east b	north	control – no thin	15.2 (37.6)
	west a	north	control – no thin	15.6 (38.6)
	west b	north	thin fir and spruce	13.9 (34.3)
Sheep Mountain	east a	south	thin fir and spruce	14.9 (37.0)
	east b	south	control – no thin	20.6 (51.1)
	mid a	south	thin fir and spruce	21.7 (53.8)
	mid b	south	control – no thin	20.6 (50.9)
	west a	south	thin fir and spruce	15.3 (37.9)
	west b	south	control – no thin	17.3 (42.9)

Methods

Our study objectives require monitoring both pre- and post-treatment. Our pre-treatment monitoring occurred in September 2011, and post-treatment monitoring is planned for 2012 and 2013. The treatment is being implemented from October 2011 through August 2012 and consists of thinning (or girdling for very large trees) of non-whitebark pine trees surrounding all sapling and adult whitebark pines.

Our monitoring efforts can be lumped into three general categories: (1) **vegetation surveys**, (2) nutcracker and squirrel **occupancy modeling**, and (3) **small mammal trapping**.

(1) We are using **vegetation surveys** to characterize the structure and composition of the plant community within units. Surveys are being conducted at four random plots within each unit, and at five plots within each small mammal trapping grid (see below), for a total of 80 vegetation plots surveyed each year. Using point-center quarter methods (Cottam and Curtis 1956), we are measuring shrub and ground cover, canopy cover, density of saplings and trees, and white pine blister rust infection rates for whitebark pine trees. We are also conducting cone counts on 16 randomly selected whitebark pine trees in each plot.

(2) Two of the vegetation survey plots mentioned above are also locations for **occupancy surveys** for Clark's nutcrackers and pine squirrels (*Tamiasciurus hudsonicus*), the two most influential seed eaters in whitebark pine communities. Occupancy modeling is a recent and important tool for monitoring of vertebrate populations, and it enables more reliable estimates of density than distance sampling alone (MacKenzie et al. 2006). During these surveys, we note the presence and abundance of all audible and visible nutcrackers and squirrels. By measuring vegetation and whitebark pine cone abundance at these same points, we will be able to relate nutcracker and squirrel abundance not only to the treatment effects, but also to more site-specific, vegetative factors.

(3) We are using mark-recapture techniques to estimate the relative abundance of small mammals in the units, and to determine whether the composition of the rodent community will change in response to the treatment. Our **small mammal trapping** grid consists of

25 Sheman live traps set at 10 m spacing, and grids are set approximately in the center of units.

Pre-treatment monitoring results

Vegetation surveys

Prior to thinning the units, we found slightly higher amounts of grass and bare soil on south-facing pots, and higher cover by moss on north facing plots (Table 2). This is likely due to differences in moisture retention and evaporative loss between the aspects. We found little difference in vegetation or ground cover by proposed treatment type, and controls and treatments had nearly identical cover by all measured covariates (Table 2).

Table 2. Pre-treatment mean (standard deviation) cover by vegetation (forbs, grasses, and shrubs) and ground cover (coarse woody debris (cwd), litter, moss, rock, and soil) for whitebark pine restoration plots at Cooke City, MT, by aspect and treatment type.

	Forb	Grass	Shrub	Cwd	Litter	Moss	Rock	Soil
Aspect								
North (*n*=4)[1]	29.9 (8.8)	1.4 (0.4)	33.9 (2.0)	19.1 (2.8)	52.5 (11.7)	20.2 (10.9)	7.5 (5.5)	0.9 (0.9)
South (*n*=6)	20.2 (8.9)	10.1 (7.8)	45.2 (14.5)	13.7 (7.2)	65.4 (10.5)	10.3 (12.5)	2.6 (1.7)	7.7 (4.7)
Proposed treatment type								
Treatment (*n*=5)	25.6 (10.5)	6.6 (7.5)	38.3 (10.2)	15.5 (6.8)	60.0 (12.1)	16.1 (14.1)	3.9 (1.0)	4.4 (5.1)
Control (*n*=5)	22.5 (9.9)	6.5 (8.0)	42. 9 (15.0)	16.3 (6.3)	60.5 (13.9)	12.4 (11.7)	5.2 (6.2)	5.6 (5.3)

[1] *n* refers to the number units rather than the number of vegetation survey plots within units; there are four to eight vegetation survey plots within each unit

Density of whitebark pine trees was higher for units with a southerly aspect (14.1 trees/ha for southern aspects versus 1.0 trees/ha for northern aspects), and higher for the treatment units (13.7 trees/ha for treatments and 4.0 trees/ha for controls), although these differences were not significant (p = 0.1895 and 0.4033, respectively) (Table 3). The difference in

Table 3. Pre-treatment density of trees, whitebark pine cones, and whitebark pine trees infected by blister rust for units in Fisher Creek, by aspect and treatment type.

Site	Unit	Proposed treatment	Subalpine fir density (trees/ha)	Engelmann spruce density (trees/ha)	Whitebark pine density (trees/ha)	Whitebark pine cone density (cones/ha)	White pine blister rust density (trees/ha)
Henderson (north aspect)							
	east a	treatment	19.0	14.8	< 1	< 5	<1
	east b	control	11.5	2.9	1.0	15	1
	west a	control	13.6	11.9	< 1	< 8	<1
	west b	treatment	19.6	2.8	< 1	< 6	<1
Sheep Mountain (south aspect)							
	east a	treatment	29.7	8.1	5.4	83	1
	east b	control	24.0	15.0	9.0	114	0
	mid a	treatment	8.1	3.0	4.0	13	1
	mid b	control	8.9	4.0	3.0	87	2
	west a	treatment	11.4	22.8	57.0	445	0
	west b	control	12.1	14.1	6.1	55	0

whitebark pine density due to treatment type was attributed to a high density of whitebark pine trees on one vegetation plot on one treatment unit (Sheep Mountain west a). By omitting this one plot from the data set, the density of whitebark pine trees for treatments and controls was nearly identical (2.9 trees/ha for treatments and 4.0 trees/ha for controls). We found no significant differences in cone density or white pine blister rust density by aspect or proposed treatment type.

We intended to measure whitebark pine mortality and infections rates from mountain pine beetle, but the distribution of beetle infected and killed trees was highly clumped. Thus, the variation in beetle infected trees was very high even within units, precluding an accurate assessment of the density of infection by unit. For example, we encountered 17 infected or recently dead trees, but 16 of them occurred on only one plot within a unit, with the other plots containing no infected trees. Data from remote sensing or aerial surveys are likely to estimate beetle mortality much more accurately than our on-the-ground vegetation plots.

Occupancy surveys

We completed a total of 600 minutes of surveys on 20 plots for Clark's nutcrackers and pine squirrels. Nutcrackers accounted for 81% of all detections (178 total detections), but only 58% (104 detections) of those detections were actually within the study unit boundaries (Table 4). The remainder of nutcracker detections were of birds flying overhead or outside the study area boundary and were exclude from all analyses. Pine squirrels accounted for nearly all of the remaining detections (17% of detections, or 37 total detections), with only 4 chipmunks detected across all surveys.

We found no differences in squirrel or nutcracker detections by treatment type ($p = 0.6065$ for squirrels and 0.8296 for nutcrackers) or aspect ($p = 0.3685$ for squirrels and 0.9475 for nutcrackers). We likewise found no strong correlations between nutcracker detections and any measured stand characteristics; indeed, the correlation between nutcracker detections

Table 4. Pre-treatment mean number of pine squirrels, Clark's nutcrackers, and chipmunks detected during 10-minute point counts in each unit.

Site	Unit	Proposed treatment	Pine squirrel	Clark's nutcracker	Chipmunk
Henderson (north aspect)					
	east a	treatment	0.7	1.5	0.0
	east b	control	1.2	2.5	0.0
	west a	control	0.8	1.7	0.0
	west b	treatment	0.5	1.2	0.2
Sheep Mountain (south aspect)					
	east a	treatment	1.5	3.3	0.3
	east b	control	0.5	0.5	0.0
	mid a	treatment	0.0	1.3	0.0
	mid b	control	0.7	2.8	0.0
	west a	treatment	0.0	1.7	0.0
	west b	control	0.3	0.8	0.2

and whitebark pine cone density was particularly weak ($r = 0.0094$). This is not necessarily surprising, for even though we expect that nutcrackers would be attracted to cones, they are non-territorial, mobile, and gregarious when harvesting cones, making it difficult to accurately predict their abundance using standard survey methods. Rather, occupancy models would provide a better estimate of nutcracker response to cone production, and treatment type. We hope to complete analyses of nutcracker occupancy models in spring 2012.

Small mammal trapping

We planned to conduct small mammal trapping in eight units, but were only able to trap at six units because of bear damage to traps, particularly on the eastern Sheep Mountain units. Overall, we successfully trapped mammals in all four north-facing (Henderson) units, but only on two south-facing (Sheep Mountain) units. Our analyses are therefore restricted to treatments versus controls, although we include simple comparisons of abundance on north versus south aspects.

Montane voles (*Microtus montanus*) were by far the most common small mammal in the units, accounting for 94% of all captures (Table 5). Density of montane voles estimated from Jolly-Seber models (Jolly 1965, Seber 1965) was slightly higher for control (125 voles/ha) versus treatment units (78 voles/ha). Voles also were also more common on the north-facing units. Generally, voles are associated with higher amounts of herbaceous vegetation and moisture (Sera and Early 2003), and consequently this finding is not necessarily surprising. Deer mice (*Peromyscus maniculatus*) and chipmunks (*Tamias* spp.) were only captured on the south facing units, although this does not necessarily reflect their true distribution since chipmunks were detected on north facing units during occupancy surveys (Table 4).

Table 5. Pre-treatment total number of mammals caught during 800 trap nights on units in Fisher Creek.

Site	Unit	Proposed Treatment	Montane vole	Dusky shrew[1]	Meadow vole	Deer mouse
Henderson (north aspect)						
	east a	treatment	11		1	
	west b	treatment	17			
	west a	control	11			
	east b	control	17	1		
Sheep Mountain (south aspect)						
	west b	control	8	2		
	west a	treatment	9			1
	total		**73**	**3**	**1**	**1**

[1] *Sorex monticolus*

Literature cited

Cottam, G., and J.T. Curtis. 1956. The use of distance measures in phytosociological sampling. Ecology 37:451–460.

Jolly, G. M. 1965. Explicit estimates from capture-recapture data with both death and immigration stochastic model. Biometrika 52:225–247.

MacKenzie, D.I., J.D. Nichols, J.A. Royle, K.H. Pollock, L.L. Bailey, and J.E. Hines. 2006. Occupancy estimation and modeling: inferring patters and dynamics of species occurrence. Academic Press. San Diego, CA.

Seber, G.A.F. 1965. A note on the multiple recapture census. Biometrika 52:249–259.

Sera, W.E., and C.N. Early. 2003. *Microtus montanus*. Mammalian Species 716:1–10.

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