North Star Nature Preserve Wildlife Monitoring Report – 2020 - 2021 Field Seasons

Pitkin County, Colorado

June 18, 2024

Prepared for:
PITKIN COUNTY OPEN SPACE & TRAILS
530 East Main Street
Aspen, CO 81611

Prepared by:
COLORADO WILDLIFE SCIENCE, LLC
0100 Elk Run Drive Ste 128
Basalt, CO 81621

Colorado Wildlife Science

Page left intentionally blank

CONTENTS

TABLES

FIGURES

MAPS

PHOTOS

Suggested Citation:

Colorado Wildlife Science LLC. 2024. North Star Nature Preserve Annual Wildlife Monitoring Report – 2020-2021 Field Seasons. Unpublished technical report submitted to Pitkin County Open Space & Trails. Colorado Wildlife Science, Basalt, CO 81621

1.0 INTRODUCTION

This report documents the results of the periodic wildlife monitoring activities conducted at North Star Nature Preserve (North Star). North Star provides habitat for a variety of wildlife, some of which are permanent residents while others pass through the area on an occasional or seasonal basis. The interspersion of the biotic (e.g., conifer and deciduous forest, grasslands, mixed montane shrubland, riparian shrubland, and wetlands) and abiotic (e.g., lotic and lentic surface water) habitat types and the intergrades between North Star's adjacent habitat types results in a rich wildlife community. This habitat diversity provides an abundance of food, cover, and reproduction sites. In addition, the importance of North Star to wildlife results from its landscape connection to the undeveloped lands of the White River National Forest (WRNF); North Star is situated such that it provides an important ungulate migration link between summer and winter ranges on the WRNF.

For the purpose of this report, wildlife is defined as free-ranging terrestrial vertebrates (i.e., wild mammals, birds, and herpetofauna). The wildlife resources of North Star are listed and described including the results of multi-taxa, mammal, nocturnal and diurnal raptor, and songbird field surveys. This report also addresses species listed and candidates to be listed under the federal Endangered Species Act and United States Department of Agriculture Forest Service Region 2 sensitive species that are known or have the potential to occur on North Star (also referred to as "the property"). The report concludes with management and monitoring recommendations to be integrated into future adaptive management plans for North Star. Avian surveys were conducted in early June 2020, diurnal raptor surveys were completed on June 4, 2021, nocturnal birds were surveyed on June 29, 2021, and general wildlife surveys were completed at North Star on August 23, 2021.

2.0 EXISTING MANAGEMENT

The primary management goal at North Star is to protect and restore the ecosystem processes that support the property's native biological diversity (OST 2020). This includes ensuring that recreation activities do not result in significant impairment of habitat or interfere with the restoration of North Star to optimum ecological condition.

Recreation at North Star is currently prohibited from the majority of the property year-round. In winter, use is restricted to a small groomed Nordic skiing loop between the river and the highway. In the summer, use is restricted to one nature walk loop trail and three river access points. The majority of the human presence here is river users that float through, accessing the river from upstream USFS lands. Pitkin County OST is collaborating with USFS on management in this area.

While the primary focus is on ecosystem protection, the management plans also aim to accommodate recreation that is compatible with the preservation goals and historic use (OST 2020). Recreation and public access are limited to the Roaring Fork River waterway and specific corridors on the east side of the river. Human activity is prohibited on the majority of the property year-round, with exceptions for administrative access and occasional educational tours. In winter, all use is restricted to a small groomed Nordic skiing loop between the river and the highway. In the summer, use is restricted to one nature walk loop trail and three river access points. The majority of the human activity at North Star is from river users that float through the property, accessing the river from upstream USFS lands. Pitkin County OST is collaborating with USFS on management in this area.

Through careful planning, ecological inventory and monitoring, habitat restoration, and adaptive management, Pitkin County Open Space & Trails (OST) prioritizes biodiversity protection while allowing some public access to the area. OST has successfully implemented management actions at

North Star that have improved ecological conditions since the property was acquired. By working to meet the management goals set forth in the management plan, OST continues to emphasize and support research, protection, and enhancement of North Star's natural processes and communities.

3.0 LITERATURE REVIEW

Prior to conducting field surveys, a variety of published and online resources were reviewed regarding distribution, occurrence, behavior, habitat requisites and other species information. These resources included:

- USFWS current list of federally protected species for the North Star area (Appendix A);
- CPW SAM data (CPW 2023);
- 2023 CNHP conservation status data for sensitive wildlife species occurrences and PCAs (CNHP 2023);
- Mammals of Colorado (Armstrong et al. 2011);
- Amphibians and Reptiles in Colorado (Hammerson 1999);
- Colorado Breeding Bird Atlas (Kingery 1998, Wickersham 2007);
- The Birds of North America (Poole 2005);
- USFS Rocky Mountain Region Species Conservation Program: Species Conservation Assessments (USFS 2006); and
- NatureServe Explorer (NatureServe 2023).

3.1 PITKIN COUNTY OPEN SPACE & TRAILS REPORTS

The following reports were reviewed for information pertaining to wildlife species occurrences and other pertinent information. The only report in Table 1 that provides data on species abundance or estimated population sizes is the Colorado Wildlife Science (CWS) authored 2011 Avian Monitoring Report (Colorado Wildlife Science LLC (CWS) 2011).

Table 1. OST Reports Reviewed

Report	Author	Year	Description
Vegetation & Wildlife Monitoring Report	Peak Ecological & CWS	2019	Summarizes past actions and various studies that have occurred at North Star Nature Preserve over the last decade and includes the results of several new studies conducted in 2018.
North Star Nature Preserve Annual Wildlife Monitoring Report	CWS	2019	Summarizes the results of 2017 North Star field surveys.
Beaver Occupancy Survey Tech Memo	CWS	2018	Describes American beaver occupancy, use, and habitat at North Star. Includes management recommendations and habitat maps.
Great Blue Heron Colony Assessment	CWS	2018	Assessment of Great Blue Herons at North Star. Includes heronry occupancy data from 2000 through 2018 as well as species background & conservation status, management recommendations, as well as habitat maps.

Report	Author	Year	Description
Ecological Communities & Fluvial Geomorphology Baseline Report: North Star Nature Preserve	Golder Associates & CWS	2015	Describes & evaluates the ecological communities and fluvial geomorphology of North Star based on baseline surveys completed in 2014. The report was intended to provide OST with the resource information necessary to create a new adaptive management plan for the property.
OST Avian Monitoring Report: 2000-2008	CWS	2011	Reports results of point-transect monitoring & recommends Management Indicator Species for North Star Nature Preserve, and Seven Star Open Space.
Great Blue Herons at James H. Smith North Star Open Space	CWS	2009	Letter describing conservation status, ecology, and use of North Star by Great Blue Herons.
North Star Nature Preserve Resource Management Plan: Wildlife Resources	CWS	2005	Summarizes the results of wildlife monitoring conducted in 2004 & recommends management actions to improve conditions for wildlife at North Star.
Roaring Fork Watershed Biological Inventory 1997-1999	CNHP	1999	Three year effort to identify the locations in the Roaring Fork Watershed with natural heritage significance.

4.0 SPECIAL STATUS SPECIES[1]

4.1 FEDERALLY LISTED SPECIES

The property was submitted to the U.S. Fish & Wildlife Service (USFWS) via the IPaC system (https://ipac.ecosphere.fws.gov/) on April 19, 2024 requesting an official list of Threatened, Endangered, or Candidate species that may occur on or within proximity to the property or may be affected by decisions regarding management of the property. An official list was received and is attached in Appendix A. Species protected under the federal Endangered Species Act (ESA) that may occur on or within proximity to North Star are listed in Appendix A. Three federally protected or candidate species are known or have the potential to occur on or adjacent to North Star: Canada lynx (*Lynx canadensis*), gray wolf (*Canis lupus*), and monarch butterfly. No designated critical habitat exists for any listed species within or adjacent to North Star.

4.1.1 Federally Listed Species – Extirpated

One of North America's top predators, grizzly bears (*Ursus arctos horribilis*), once roamed the upper Roaring Fork Valley as recently as the 1950s. Grizzlies (Threatened) are listed under the ESA. The anthropogenic extirpation of these apex predators has had unknown effects on the populations of the Roaring Fork valley's other predators and former prey.

4.2 STATE OF COLORADO THREATENED AND ENDANGERED LIST

The State of Colorado list of Endangered and Threatened species (including Species of Concern) (CPW 2022b) was reviewed. Six species on that list could potentially occur at North Star: bald eagle (*Haliaeetus leucocephalus*), western toad (*Anaxyrus boreas boreas*), Colorado River (GB-lineage) cutthroat trout (*Oncorhynchus clarkii pleuriticus*), northern leopard frog (*Lithobates pipiens*), river otter (*Lontra canadensis*), and Townsend's big-eared bat (*Corynorhinus townsendii pallescens*).

[1] Additional information on special status species is included in Appendix G.

Western toads (southern Rocky Mountain population), GB-lineage cutthroats, and leopard frogs are designated by Colorado Parks & Wildlife (CPW) as Tier 1 Species of Concern and Bald Eagles and river otters are Tier 2 Species of Concern (CPW 2015). In addition, it should be noted that greater sandhill cranes (*Grus canadensis tabida*), a Tier 1 Species of Concern, have been observed at North Star during migration but do not breed within the Roaring Fork watershed.

4.3 COLORADO NATURAL HERITAGE PROGRAM DATA

Review of the latest Colorado Natural Heritage Program (CNHP) data (CNHP 2023), in combination with the CNHP Roaring Fork Biological Inventory (Spackman et al. 1999) revealed 17 vertebrate species of conservation concern (global or state rank ≤ 3) recorded within proximity to North Star (Appendix H).

5.0 COLORADO PARKS & WILDLIFE CONSULTATION SUMMARY

A consultation request regarding current wildlife use of North Star and the surrounding area and current management was sent to CPW District Wildlife Manager Kurtis Tesch on April 19, 2024. Mr. Tesch responded in person with the following key points:

1. He concurs with the management recommendations made in this report.
2. CPW would like to be formally included in and/or consulted in preparation of any new or updated management plans.
3. CPW would also like to be formally included in and/or consulted in planning the management of the Wildwood put-in since the rapid increase in river use is likely affecting wildlife at North Star.[2]
4. OST should continue to work closely with CPW regarding moose occurrences at North Star and continue to be willing to close the property via the put-ins and access points when a North Star moose is determined to be aggressive towards people.
5. OST should continue monitoring wildlife at North Star to be sure that management as a nature preserve is prioritized over recreational activities.

6.0 WILDLIFE MONITORING PURPOSE & OBJECTIVES

6.1 PURPOSE OF MONITORING

Monitoring may be defined as the "…measurement of environmental characteristics over an extended period of time to determine status or trends in some aspect of environmental quality" (Suter 1993). In general, monitoring data are intended to detect long term change in ecological systems, provide insights into the ecological mechanisms and consequences of that change, and help decision makers determine if the observed changes dictate a correction to management practices (Noon et al. 1999). Due to financial considerations and the purpose of the monitoring effort, it is not possible or even desirable to embark upon a monitoring regimen that adheres to a statistically valid experimental design. Rather, a few taxonomic groups and single species are monitored as umbrellas using accepted monitoring methods to produce descriptive information that will help guide the

[2]The Wildwood area referenced here by CPW is USFS property, so OST does not have enforcement or management authority. At the time of writing, however, OST is collaborating with the USFS on management of the Wildwood river access and making an effort to manage access to the extent possible given the agreement with the USFS.

adaptive management process.

The primary purpose of the North Star monitoring effort is to:

1. Determine whether current management affects habitat quality and effectiveness;
2. Document changes in wildlife use of North Star over time; and
3. Guide adaptive changes in the ecological and recreation management of North Star.

Monitoring results are intended to be part of the greater adaptive management scheme described in the management plan for the property. Adaptive management incorporates an iterative process that sets management goals and objectives, describes management actions, and monitors and evaluates results. Goals and objectives are then modified, management actions are adjusted, re-implemented, and then results are again monitored and evaluated. This process is implemented on a regular cycle to respond to environmental changes and shifts in community values.

Long-term monitoring programs give the best picture of the status of wildlife populations over time. Well-designed short term surveys and inventories can indicate the current status and distribution of wildlife but are often valid only in the area where they are conducted.

It is important to note that the result of these surveys are not intended to provide population estimates, they do not evaluate species health, and, in many cases they do not, at this time, provide reliable trends in population numbers or densities at North Star. Avifauna are the only taxonomic group for which we are able to estimate trends in population density at this time since birds have been monitored under the same protocol at North Star for more than 20 years. All other taxonomic groups and/or survey methods have only been implemented since 2014 with a total of three monitoring efforts. As such, not enough data has been collected to provide statistically significant results. In addition, most of the survey methods are not intended to provide statistically significant estimates of population size or density but rather to provide a snapshot in time regarding the species richness and diversity at North Star as part of the adapted management process. The surveys will also serve as baseline data for the long term monitoring program.

6.2 MONITORING OBJECTIVES

Specifically, the objectives of the monitoring effort at North Star were to:

1. Document spatial and temporal patterns of species occurrence and/or activity;
2. Document species richness for selected indicator species or guilds;
3. Evaluate whether detected changes in species composition and/or activity could potentially result from current management;
4. Determine whether richness, abundance, and community composition patterns of terrestrial vertebrates change over time and explore to what degree that change is due to management decisions or actions; and
5. Determine the effectiveness of current management in balancing human use with protection of biological diversity.

7.0 METHODS & RESULTS

A variety of wildlife monitoring surveys were conducted. Survey techniques included Terrestrial Visual Encounter Surveys (TVES); Multiple Species Inventory and Monitoring (MSIM) (Manley et al.

2006) camera trap arrays; diurnal raptor (Kennedy and Stahlecker 1993, Joy et al. 1994, Watson et al. 1999, Balding 2001), and owl broadcast surveys (Takats and Holroyd 1997, Bibby et al. 2000, Barnes and Belthoff 2008, Blakesley 2009); and avian point-transect surveys (CWS 2021). These methods and the results of the surveys are presented below.

7.1 GENERAL WILDLIFE SURVEYS

General wildlife surveys were conducted to determine wildlife species diversity and habitat use. The method used for these surveys was Terrestrial Visual Encounter Surveys (TVES), arranged in consideration of the MSIM configuration (Manley et al. 2006). TVES are general wildlife surveys designed to detect a variety of terrestrial species, especially mammals (e.g., ungulates, lagomorphs, rodents), reptiles, and diurnal raptors (Forys and Humphrey 1997, Weckerly and Ricca 2000), as well as less common or difficult to detect landbirds (Manley et al. 2006). As a result, TVES is a core survey method for all classes of vertebrates as a companion to taxon-specific core survey methods. Sampling areas were contained within a 200 m radius hexagonal area occupying approximately 10 ha (Figure 1). The relatively large area occupied by the sampling hexagon reflects the desire for surveys to encounter the variety of vegetation types and conditions that occur in proximity to the center point, thus increasing the number of species available for detection (Manley et al. 2006). In addition, all visits to the property were considered walking surveys and any direct or indirect wildlife encounters of note were recorded.

7.2 SURVEY METHODS

Surveys were implemented on the two MSIM TVES hexagons established by CWS in 2014 (Golder Associates and CWS 2014). The two hexagons were laid out to sample as many of North Star's various habitat types as possible while respecting the integrity of the protocol (Map 1). The TVES were conducted on August 23, 2021 between 0700 and 1400 hours. Two qualified observers searched within each hexagon. Observers followed a transect that loops through the hexagon at ~50 m spacing (Figure 1). The length of each route on each half of the sample unit is approximately 1200 m, for a total of 2400 m, and covers approximately 10 hectares (24.7 ac). Observers used pre-established GPS coordinates along the center line and perimeter of the hexagon and a compass to walk the transect lines. All areas within 2 meters of either side of the transect line were surveyed.

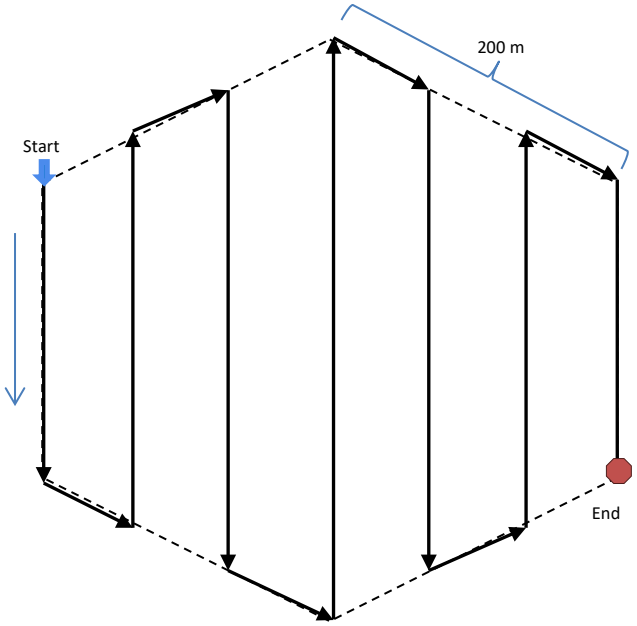


Figure 1. TVES hexagonal sampling unit (from Manley et al. 2006).

7.3 RESULTS

In 2021, the two TVES at North Star resulted in 954 detections (Table 3) of 10 mammal species[3] and 11 total wildlife species[4]. In 2021, sign was detected (e.g., scat, tracks, excavation, foraging, rubs, beds, dens) or direct observation was made of the following mammals (in

[3] It is important to note that this number does not represent the number of individual animals but, rather, each occurrence of sign detected of individual or multiple animals. It should be considered as an index of the activity of wildlife as a whole or of individual species at North Star.
[4] Includes raptors, Galliformes, and herpetofauna but not songbirds.

order of abundance): Northern pocket gopher (NPG; *Thomomys talpoides*), Rocky Mountain elk (*Cervus canadensis nelsoni*), Rocky Mountain mule deer (*Odocoileus hemionus hemionus*), vole spp. (*Microtus* spp.), red squirrel (*Tamiasciurus hudsonicus*), American black bear (*Ursus americanus*), North American beaver (*Castor canadensis*), least chipmunk (*Neotamias minimus*), North American moose (*Alces americanus*), coyote (*Canis latrans*), and western terrestrial garter snake (*Thamnophis elegans*).

Table 2. TVES detections at North Star Nature Preserve in 2014, 2017, and 2021

Species	North Hex			South Hex			Total		
	2014	2017	2021	2014	2017	2021	2014	2017	2021
Beaver	5	0	8	-	2	7	5	2	15
Black Bear	0	0	6	5	33	7	5	33	13
Canada Goose	2	1	3	-	-	-	2	1	3
Cooper's Hawk	-	-	-	-	1	-	-	1	-
Coyote	7	-	2	-	1	1	7	1	3
Dusky Grouse	-	-	-	1	-	-	1	-	-
Golden-Mantled Ground Squirrel	-	-	-	2	-	-	2	-	-
Great Blue Heron	2	-	-	-	-	-	2	-	-
Least Chipmunk	-	-	-	2	-	8	2	-	8
Mule Deer	37	13	29	17	15	39	54	28	68
North American Moose	-	-	2	-	2	4	-	2	6
North American Red Squirrel	-	-	-	4	18	14	4	18	14
Northern Pocket Gopher	92	18	276	26	112	262	118	130	538
Red-tailed Hawk	1	-	-	-	-	-	1	-	-
Rocky Mountain Elk	54	1	102	95	70	119	149	71	221
Spotted Sandpiper	1	-	2	1	-	1	2	-	3
Vole spp.	89	5	37	20	58	21	109	63	58
Western Terrestrial Garter Snake	-	-	4	-	-	-	-	-	4
Total	**290**	**38**	**471**	**173**	**312**	**483**	**463**	**350**	**954**

A total of 11 mammal species have been detected during TVES at North Star. In 2021, western terrestrial garter snakes were the only animal species detected for the first time. The only mammal species detected in prior years that was not detected in 2021 was golden-mantled ground squirrel (*Callospermophilus lateralis*).

CWS detected the presence of many birds during TVES, but the only detections recorded were those of raptors, Galliformes (e.g., grouse, turkeys, etc.), wading birds, or any occurrence of particular interest (e.g., rare, first detection, etc.). Such birds recorded during the TVES were American kestrel (*Falco sparverius*), dusky grouse (*Dendragapus obscurus*), and wild turkey (*Meleagris gallopavo*). (Songbird detections were not recorded since they are monitored at North Star under a separate monitoring effort), most recently completed in 2020, results discussed in Section 7.8 of this report. Bird species detected in prior years but not detected in 2021 were Cooper's hawk (*Accipiter cooperii*), great blue heron (*Ardea herodias*), and red-tailed hawk (*Buteo jamaicensis*).

Vole presence was determined by the occurrence of trail castings or "eskers" and/or dens (Halfpenny 1986, Elbroch 2003). NPG sign included mounds of dirt formed by soil they have removed from their tunnels to form a conical mound (Halfpenny 1986) as well as eskers, entry holes, and runways. Vole

and gopher eskers were differentiated by size. Vole castings are smaller – typically less than 1 inch in diameter (Halfpenny 1986) and shorter – typically no more than a few feet long (Elbroch 2003). In addition, the following mammal species were detected via direct observation during the TVES: coyote, least chipmunk, mule deer, and red squirrel.

Table 3. Comparison of TVES detections by cover type at North Star Nature Preserve - 2014, 2017, and 2021

Cover Type	2014		2017		2021	
	n	%	*n*	%	*n*	%
Douglas Fir Mixed Forest	26	5.6%	9	2.6%	31	2.8%
Grass, Native or Non-native	330	71.0%	242	69.1%	581	51.7%
Mixed Montane Shrubland	4	0.9%	-	-	5	0.4%
Mountain Big Sagebrush-Rabbitbrush Shrubland	6	1.3%	12	3.4%	109	9.7%
Narrowleaf Cottonwood Riparian Forest	6	1.3%	11	3.1%	14	1.2%
Open Water	1	0.2%	-	-	-	-
Quaking Aspen Forest or Woodland	47	10.1%	58	16.6%	343	30.5%
Willow Riparian Shrubland	45	9.7%	18	5.1%	40	3.6%

The greatest number of detections in all three monitoring years was in North Star's grass-dominated habitat types but the proportion of detections has declined each year. In 2021, 51.7% of the detections were in the old hay fields/pastures and riparian grasslands, as compared to 69.1% in 2017 and 71.0% in 2014. This decline corresponds to an increase in detections within the aspen dominated forest and woodland areas; in 2014 only 10.1% of the detections occurred within aspen, increasing to 16.6% in 2017 and almost doubling to 30.5% in 2021. This suggests that the aspen types at North Star may currently support a greater proportion of the property's biological diversity than in the past. Similarly, the proportion of detections within the sagebrush-rabbitbrush shrublands at the periphery of the alluvial fans has also increased in each monitoring year, from only 1.3% in 2014 to 3.4% in 2017 and 9.7% in 2021. This increase, however, could be attributed solely to the substantial increase in the number of detections of NPG activity in those areas. Total detections of NPGs, it should be noted, dominate the overall detections in 2021 with 56.4% of all detections. In comparison, NPG detections only accounted for 25.5% of total detections in 2014 and 37.1% in 2017.

A possible reason for the increased NPG activity within the alluvial fans could be a result of management activities. One possible contributing factor is the plugging of the fen drainage channel. When the drainage from the fen was plugged, the area of saturation greatly expanded within the grassland areas at North Star, directly reducing the acreage of NPG habitat. The alluvial fans, however, are above the higher water table, thus providing a bit of a refuge of dry soils for North Star's numerous pocket gophers.

As discussed above, it is important to remember that correlations are not determinative but, rather, may be simply coincidental resulting from stochastic events such as a cold, wet spring or a larger/smaller snowpack than in other sampling years. Although some results may be the beginning of a trend one cannot determine whether change has indeed occurred until additional data is collected over time. Nonetheless managers should take note of substantial changes in detections especially when it has persisted consistently for more than one sampling period. One should also consider that sampling methods such as TVES are a one-day snap shot and be careful when making conclusions unsupported by the data.

7.3.1 Ungulates

Elk and mule deer sign was detected in greater abundance in 2021 than in 2014 or 2017 and, after a decline in 2017, the number of detections for both species increased substantially in 2021 (Figure 2). There were a total of 221 detections of elk in 2021 as compared to 71 in 2017 and 149 in 2014. Similarly, 68 occurrences of mule deer sign were detected in 2021, 28 in 2017, and 54 in 2014. This, however, is not necessarily indicative of any changes in management or activity and may be simply a result of environmental stochasticity. Variation in weather-related conditions (e.g., timing of snow accumulation/melt, depth of snowpack) may have resulted in both species using the property for an extended period in winter or during the fall and spring transition periods in 2014 and 2021 but to a lesser degree in 2017; animals may have moved through the property over a shorter period in 2017 or had greater access to higher elevations earlier in the spring or later into the fall in 2017. Whatever the reason, the fact that elk and deer sign was encountered in greater numbers and concentrations indicates that current management is, at the least, not negatively affecting their use of the property. This metric, however, should be tracked over the next few monitoring efforts to determine if there is indeed a trend toward greater elk and mule deer use of the property over time. Future efforts may also benefit from comparisons to environmental conditions in years when surveys occurred.

The greatest proportion of mule deer detections in each year were within the aspen forest and woodland habitat types, closely followed by grasslands (Table 5). Conversely, elk detections in all years were predominantly within the grassland cover types, with the second greatest proportion of detections occurring within aspen types. Mule deer seem to clearly prefer the cover types that offer greater representation of shrub cover (i.e., aspen woodland, sagebrush shrubland, mixed montane shrubland, and willow riparian shrubland) and while elk were detected in all cover types, grassland and aspen were demonstrably preferred. This is logical given that deer are primarily browsers (i.e., leaves, forbs, woody twigs) while elk can consume either browse or grass but tend to prefer grass when available (Kufeld et al. 1973, Edge et al. 1988, McCorquodale 1993, Bauer and Bauer 1995, Johnson et al. 2000, Toweill et al. 2002).

Moose detections increased over time with no detections of moose or their sign in 2014, 2 detections in 2017, and 6 in 2021. This accurately reflects the substantial increase in moose activity at North Star in recent years.

Table 4. Comparison of TVES detections (%) of elk and mule deer by cover type at North Star Nature Preserve - 2014, 2017, and 2021

Cover Type	2014		2017		2021	
	Elk	Deer	Elk	Deer	Elk	Deer
Douglas Fir Mixed Forest	8.7%	-	2.8%	-	4.6%	
Grass, Native or Non-native	63.8%	40.7%	50.7%	32.1%	42.5%	38.1%
Mixed Montane Shrubland	1.3%	-	-	-	1.8%	-
Mountain Big Sagebrush-Rabbitbrush Shrubland	1.3%	-	16.9%	-	1.8%	10.7%
Narrowleaf Cottonwood Riparian Forest	1.3%	5.6%	-	-	5.0%	-
Quaking Aspen Forest or Woodland	18.1%	11.1%	29.6%	14.3%	39.6%	40.5%
Willow Riparian Shrubland	5.4%	42.6%	-	53.6%	4.6%	10.7%

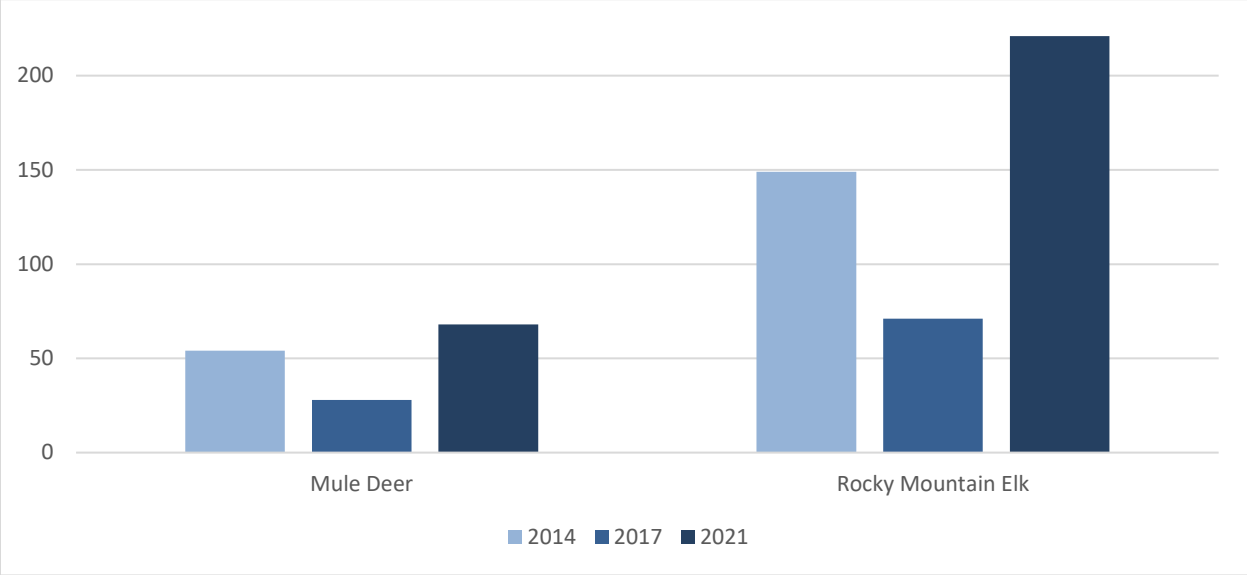


Figure 2. Comparison of elk and mule deer TVES detections at North Star in 2014, 2017, and 2021

7.3.2 Species Diversity and Richness

Species diversity was calculated using the Shannon diversity index (a.k.a. Shannon–Wiener diversity index or Shannon Index). The Shannon Index (Barnes and Spurr 1998) is a popular metric used in ecology. It is based on Claude Shannon's formula for entropy and estimates species diversity. The index takes into account the number of species living in a habitat (richness) and their relative abundance (evenness). The higher the value, the higher the estimated species diversity. Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon index increases as both the richness and the evenness of the community increase.

Table 5. Comparison of species diversity (Shannon Index) based on species detected via TVES in 2014, 2017, and 2021

Metric	2014	2017	2021
Species Diversity	1.52	1.72	1.36
Species Richness (SE)	19.2 (7.51)	22.1 (4.05)	21.9 (7.21)

We calculated species richness using SpadeR (Chao et al. 2015) to obtain the rarefaction curves and species richness estimators after randomizing the samples 100 times. The iChao1 estimate of true species richness (i.e., actual number of species in an area) was chosen as the non-parametric estimator as it performs well on small samples, removes a large portion of the negative bias which was associated with traditional estimators, and has good accuracy and coverage probability for the associated confidence intervals (Chiu et al. 2014).

Species diversity as measured by the results of the TVES was similar for 2014, 2017, and 2021 with the greatest estimated species richness in 2017 and the lowest in 2021 (Table 6). If we consider the standard error, estimated species richness based on the TVES results was statistically unchanged for the three sampling years (Table 6). This may indicate that the assemblages of terrestrial wildlife are remaining somewhat stable over time. If we continue to monitor wildlife at North Star by means of TVES, we can continue to use these metrics as indices of species diversity and richness at North Star and track the data over time to determine if there are any detectable trends.

7.4 RARE AND NOCTURNAL MAMMALS

7.4.1 Survey Methods

Infrared cameras and associated scent stations were used to detect uncommon[5] and nocturnal mammals. Survey locations were generally selected to effectively sample the wildlife occurring within the major habitat types at North Star. Five camera/scent stations were established across the property (Map 1). At each station, a motion sensitive monitoring camera was used to document species encounters. Bushnell Trophy Cam and/or Browning Recon Force Elite cameras were set up to capture color photos during the day and infrared photos at night. Infrared LED night vision flash was used so that a visible flash would not scare wildlife or disclose the location of the cameras to humans. Each time the sensor detected movement, 3 still photos and 1 brief video were captured. This method, also used in 2018, increased the likelihood that the species was correctly identified and improved our ability to detect and count groups of animals. The camera and infrared detector were attached to a tree or other suitable substrate[6], with the bait no higher than 0.5 m above the ground, and the camera positioned to detect visitation to the base of the bait tree. The camera and sensor are generally arranged vertically on the same tree or on adjacent trees. Cameras and detectors are attached to trees using Slate River EZ-Aim Trail Camera Mounts and to T-posts using EZ-Aim T Post Game Camera Mounts.

Camera stations were baited and set to maximize detections of a variety of species. The primary bait was a Cornish game hen secured to the vertical substrate with wire mesh and baling wire, approximately 0.5-1.5 m from the ground. The camera was positioned such that any visitation to the tree triggered the camera. A mixture of Caven's Gusto brand, a skunk scent gland derivative (a lure for mustelids), Carman's Superior Animal Lures Trails End® Lure (a lure for wild canids and felids), and lanolin was used as a long-distance attractant. The lure mixture was prepared by combining a 1 oz jar of Gusto and 0.5 oz of Trails End with 32 oz of heated lanolin in liquid form. Approximately 1 to 3 tablespoons (T) of the mixture was placed within 4 m of the station on a substrate such as a tree branch. The mixture was applied on the setup day and was not reapplied or removed for the duration of the survey.

Photo 1. Spotted mule deer fawns captured at camera trap #4

Each camera was left in place for a minimum of 14 days. In 2021, the cameras were left in place for a more extended period in an attempt to more accurately assess the presence of rare species and use of the property through the entire summer (May 1 through August 30). There were, however, some substantial gaps due to bear and elk damage.

[5] "Uncommon" in this case refers to animals that are uncommon across the landscape, such as mountain lions and others that have large home ranges.
[6] When no tree was available, a T-post was used and left in place for future monitoring.

7.4.2 Results[7]

One hundred ninety-six unique occurrences of wildlife were recorded (or "captured") by the 5 monitoring cameras at North Star in 2021. A total of 11 species[8], including 6 mammals and 5 birds, were captured in 2021 (Table 7). Of these, elk were captured most frequently (Photos 2, 3), followed by mule deer (Photos 1, 4), coyote (Photo 5), moose (Photo 6), black bear (Photo 7), and striped skunk (*Mephitis mephitis*; Photo 8). The only new species that was captured by CWS monitoring cameras on the property in 2021 was striped skunk (See Appendix E for sample monitoring photos). Species for which this method was specifically designed to monitor – those that occur at low density on the landscape, are difficult to detect, or nocturnal/crepuscular – captured by the cameras included black bear, moose, and striped skunk.

Table 6. Occurrences of species of interest captured by the monitoring cameras in 2014, 2017, and 2021

Species	Total Captures		
	2014	2017	2021
American Kestrel	10	-	3
American Robin	-	1	-
Black-billed Magpie	-	-	3
Black Bear	35	31	8
Canada Goose	-	-	2
Cooper's Hawk	-	1	-
Coyote	11	1	20
Dusky Grouse	3	-	-
Elk	11	13	97
Moose	-	5	9
Mountain Bluebird	2	-	-
Mule Deer	36	28	53
Pacific Marten	-	8	-
Raccoon	1	-	-
Red Squirrel	4	7	-
Striped Skunk	-	-	1
Steller's Jay	-	-	1
Vesper Sparrow	-	1	1
Wild Turkey	1	1	1

Although caution should be taken when making comparisons between project years since the survey period varied each year, there were some interesting differences in the results of the camera trap data between the three sampling years. Black bears were detected in substantially lower numbers in 2021 than in prior years despite a longer sampling period, the greatest number of coyote captures occurred in 2021, moose were detected in greater numbers than years past, which was an expected result given the increase in moose activity observed by OST staff and the public, and deer and elk

[7] Caution should be taken when making comparisons between project years since the survey period each year varied.
[8] A total of 19 species have been captured by the monitoring cameras since 2014.

captures were appreciably greater than in previous years but this could, in part, be somewhat 2021 attributable to the greater sampling period. It is notable, however, that the elk captures were over 48% greater than in 2014 and 211% greater than in 2017; this could be a positive result of management actions but could also be a result of variations in the early summer snowpack and other

Photo 2. Elk calf observed by and photographed by CWS at North Star June 27, 2021

exogenous factors. Multiple spotted mule deer fawns (Photo 1) were documented by the monitoring cameras but no spotted elk calves were captured. Given, however, that 84 unique captures of elk occurred in May and June in 2021, the peak calving season, multiple elk calves were captured in 2014 and 2017, and CWS observed a spotted calf on the property (Photo 2), it is likely that parturition and rearing continues at North Star.

A few mammals known to occur at North Star were not detected by cameras in 2021 including American mink (*Neovison vison*), bobcat (*Lynx rufus*), mountain lion (*Puma concolor*), mountain cottontail (*Sylvilagus nuttallii*), Pacific marten (*Martes caurina*), and snowshoe hare (*Lepus americanus*).

Diel Activity & Seasonal Activity

Although, as described above, this survey method is specifically implemented to document the occurrence of rare, low-density, or nocturnal/crepuscular species, it is also a valuable method to determine diel use by the mammalian community occurring on the property as well as seasonal use of the property by wide ranging and migratory species such as black bears and the ungulates. Wildlife presence was documented at every hour of the day, but peak wildlife captures by the monitoring cameras was clearly bimodal with activity peaks occurring in the hours around dawn (5:00 AM through 8:00 AM) and from late afternoon through midnight (4:00 PM through 12:00 AM) (Figure 3); this pattern has been consistent for all three sampling years. This makes sense given that many of these species are considered crepuscular (e.g., bears, coyote, elk, mule deer).

These diel activity patterns provide managers valuable information regarding wildlife activity at North Star as well as potential influences of recreational activity on wildlife activity and behavior, and can aid in planning and design of recreational infrastructure.

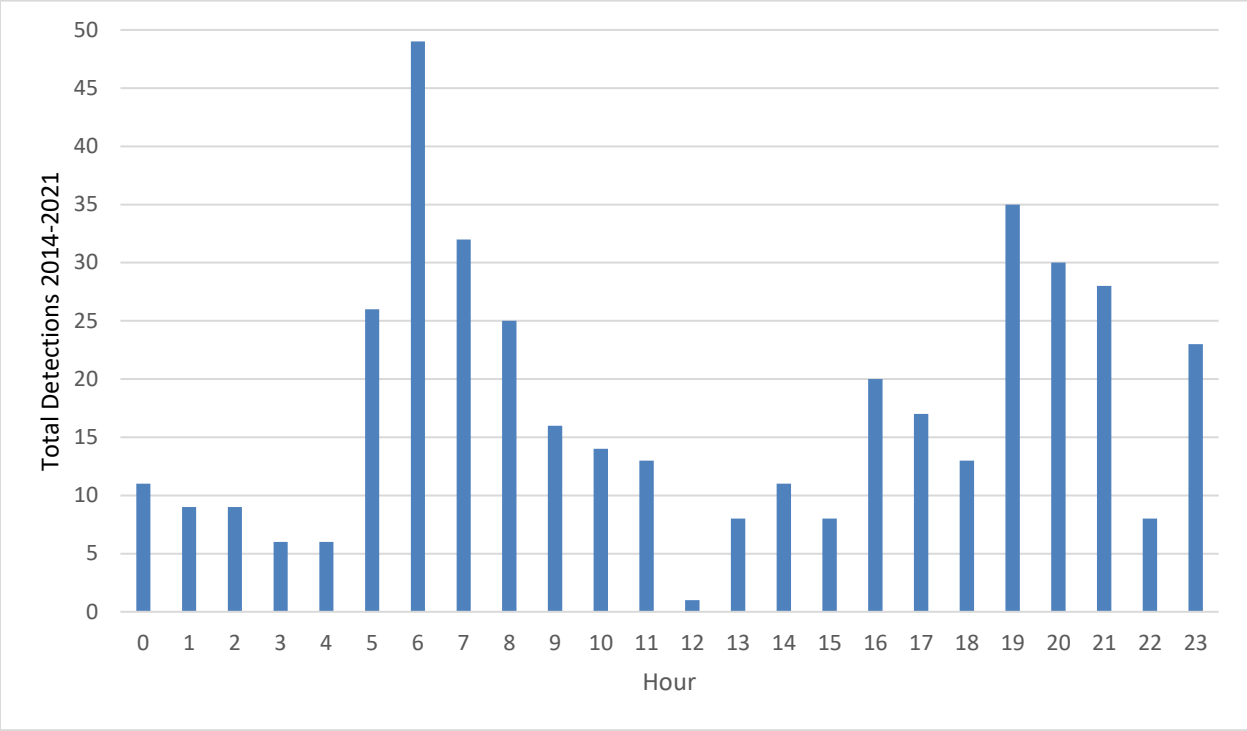


Figure 3. Diel activity pattern detected via cameras at North Star (total of 2014, 2017, and 2021)

Species Richness – Camera Data

As with the TVES data, species richness was calculated for the monitoring camera data using the iChao1 estimate of true species richness. Species richness based on the 2021 camera data, 19.8 (SE 11.6), is less than estimated species richness in 2017 (34.8 SE 17.1) and 2014 (20.8 SE 9.6) but these estimates are not significantly different and are likely due to environmental stochasticity.

7.5 OWLS & OTHER NOCTURNAL BIRDS

As top predators, owls play an important trophic role in ecosystems. Consequently, owls are considered good indicators of ecological health. Due to their nocturnal behavior and time of breeding activity, however, owls often go undetected using traditional avian population monitoring methods. Therefore, although nocturnal broadcast surveys do not detect a large number of species per unit effort, they can generate reliable monitoring data on an important group of predators.

7.5.1 Survey Methods

In 2021, following the recommended OST protocol (Takats et al. 2001), nocturnal bird surveys (Map 1) were conducted at points established at regular intervals of 500 m such that they maximized representation of the different cover types while minimizing the likelihood of detecting the same owl at multiple stations. Each point was surveyed at the time of year when vocal activity of the majority of owl species is greatest (early June). Owls are strongly territorial during their breeding season, and readily respond to perceived conspecific intruders. Consequently, when a recorded owl calls within an owl's territory, the owl usually responds by calling back and often flying closer to the

surveyor/source of recorded call (Fuller and Mosher 1987, Takats et al. 2001). Portions of this protocol were adapted from surveys conducted in western Montana since the mid 1980's (Holt and Hillis 1987).

The calls of all owl species that may occur at North Star were broadcast in approximate order of increasing size. This is important because some larger species of owls may compete with or prey upon smaller species; thus, smaller owls are less inclined to begin vocalizing if the larger species have already begun to vocalize. Any detection was recorded by the locations of survey points. A compass bearing and distance to the owl was also recorded with the location documented via GPS (RISC 2001, Takats et al. 2001, Blakesley 2009, Kissling and Lewis 2009). All other wildlife encountered was recorded by species and location. Calling equipment consisted of a smart phone connected to a Cass Creek Big Horn XL© speaker, producing 80-110 dB output at 1 meter. Particular effort was made to note the occurrence of any non-owl nocturnal birds such as nightjars.

7.5.2 Results

The 2021 nocturnal bird surveys were conducted on June 5 at North Star. The survey effort detected 2 species of nocturnal birds. A Northern Saw-whet Owl (*Aegolius acadicus*) responded to our broadcast at points #8 and #15 (Map 2). The calling owl was observed perched in a mature narrowleaf cottonwood approximately 79 meters east-southeast of point 8 (39.1686, -106.7921). A subsequent nest search was conducted the following day but no nest or nesting cavity was found. In 2017, a Saw-whet Owl was detected from calling point #5 and was perched in a narrowleaf cottonwood approximately 185 m due east (94°) of the point (CWS 2018a). The detection of the same owl species in two survey years may indicate that a pair of these small owls are nesting at North Star and confirms that North Star provides suitable habitat for Saw-whets during the breeding season.

In addition, Common Nighthawks (*Chordeiles minor*) were detected from points 2, 3, 4, and 5. Their nasal call was detected at least inconsistently from all of the points within proximity to the slopes of Richmond Ridge. Nighthawks have not been detected at North Star during previous surveys. These ground nesting aerial insectivores occur in urban and rural areas throughout the United States and Canada (except for the southwestern United States and Newfoundland), from the northern limit of the forest, down through central Mexico and as far south as Panama and possibly Colombia (Wickersham 2007). This member of the nightjar family is presumed to have a large population size but may be experiencing a slow decline possibly resulting from habitat loss or pesticide use (NatureServe 2022).

Calls and sounds were documented from at least 7 other species during the nocturnal bird survey, including: coyotes (observed), chorus frogs (*Pseudacris triseriata*), elk (observed), mallards (*Anas platyrhynchus*), soras (*Porzana carolina*), Virginia rails (*Rallus limicola*), and Wilson's snipe (*Gallinago delicata*).

7.6 DIURNAL RAPTOR SURVEYS

Raptors, also known as birds of prey, are a group of birds composed of the orders Falconiformes (i.e., diurnal birds of prey) and Strigiformes (i.e., owls, nocturnal birds of prey). Due to differences in their behavior, raptors are split into diurnal and nocturnal (Section 7.3.2 above) groups for surveying purposes. Specific objectives were to determine the presence and distribution of diurnal raptor species that use North Star as part of their home range during the breeding season. Although all diurnal raptors are active during the day, they vary in detectability.

Some, such as Red-tailed Hawks, are readily observed when soaring over open fields or shrublands.

Others, notably the Accipiters, tend to be more difficult to reliably detect due to their preference for vegetation cover. Inconspicuous diurnal raptors were targeted for inventory purposes using call broadcast surveys. Surveys were conducted during the early summer to increase the chance of detecting multiple species, which generally vary in their nesting chronology. Accipiter broadcast surveys were combined with informal surveys for all raptors during the other survey methods included in this report (e.g., TVES, owl surveys).

7.6.1 Survey Methods

Broadcast survey methods were based on those outlined by Kennedy and Stahlecker (1993) and Joy et al. (1994), with modifications to suit project specific needs. Broadcast stations were established every 250± m along a single 2,122 m transect (Map 1). The survey was limited to this transect since it sufficiently covered the potential nesting habitat for the target species. The spacing between stations was based on the literature (Kennedy and Stahlecker 1993, Joy et al. 1994, Watson et al. 1999) concerning typical spacing of accipiter nesting areas and rough estimates of the broadcast range of the broadcast caller, striving for an interval that would maximize chances of detecting any existing territories. In addition to the broadcast survey, visual nest searches were conducted throughout North Star to determine whether any inactive nests or non-responsive nesting raptors occurred on the property.

At each station, the observer broadcast alarm calls in four directions, at 45° angles to the transect. Each 10-sec broadcast in a specific direction was followed by 30 sec of scanning and listening for responses. At each station, the observer broadcast Sharp-Shinned Hawk (*Accipiter striatus*), Cooper's Hawk (*A. cooperii*), and American goshawk (*A. gentilis*) alarm calls, in that order, to avoid potential size-related inhibitory effects[9]. If a focal species was detected, the observer would record the species, age, and sex, when possible; an assessment of the observer's confidence in identifying the responding species (i.e., confident or not confident, as supported by a description of what was heard and/or seen); time of response; time elapsed since first call broadcast; species of call broadcasted immediately preceding the detection; response type (i.e., call, call and approach, call and flyby, silent approach, silent fly-by); estimated distance and bearing to response; station number and location; and general vegetation characteristics surrounding the detection point (i.e., maturity and stature of aspen forest).

Photo 3. Cooper's hawk captured at camera trap #1 on September 30, 2021

7.6.2 Summary of Results

The 2021 diurnal raptor survey was conducted on June 4. Three raptor species were detected during

[9] Although broadcasts were limited to Accipiter calls, Buteos (e.g., red-tailed hawks) respond to these calls as well. This is likely due to the perceived predator/competitor interaction.

the broadcast surveys: Cooper's hawk, osprey (*Pandion haliaetus*), and red-tailed hawk (*Buteo jamaicensis*). A red-tailed hawk responded to the broadcasts from point 1 by flying in from the east and calling as it circled above the point calling and then flew back in the general direction from whence it came. An osprey was then observed flying southeasterly west of the river from point 2 approximately 20 feet above the ground. No osprey or red-tailed hawk nests were located on the property. CWS regularly observes both ospreys and red-tailed hawks at North Star each year during the breeding season and it is likely that both species are nesting in proximity to the property.

A solitary Cooper's hawk was observed in an aspen tree between points 7 and 8 (39.1654, -106.7963) and then responded to broadcast Goshawk alarm calls at point 7. The hawk was observed again in dense foliage at the known nest near point 8 (39.1647, -106.7957). No nestlings or eggshells were observed in the nest. Another Cooper's Hawk was then observed flying toward the nest from a point between points 8 and 9. This individual was smaller than the first hawk indicating that this was likely the male of a mated pair and the first Cooper's observed was the female. An adult Cooper's hawk was subsequently captured at camera trap #1 on September 30, 2021 (Photo 3).

7.7 COLONIAL WADING BIRDS

7.7.1 Great Blue Heron

North Star was, until 2018, home to a colony of great blue herons. A heronry existed at the south end of North Star for more than 28 years. Until 2006, it was located on the west side of the river in spruce trees. As is often the case, however, the accumulation of guano at the base of the trees resulted in the decline, and in some cases, death of the nest trees. Following the removal of a barn across the river to the northeast, the herons established a new location in the narrowleaf cottonwoods and spruce in the current location (See Figure 1 in CWS 2018b). Although monitoring of the herons was not part of this monitoring effort, the herons were monitored by Charlie Hopton of Aspen in cooperation with OST and the BCR Colony Watch program from 2000 through 2014.

Table 7. Great blue heron activity at North Star

Year	Nests	Active nests	Adults	Juveniles
2000	NA	4	4	4
2001	NA	7	7	7
2002	NA	7	14	24
2003	NA	8	16	19
2004	11	11	22	30
2005	13	11	22	20
2006	No Data	No Data	No Data	No Data
2007	15	6	9	6
2008	No Data	6	12	8
2009	No Data	4	6	0
2010	No Data	8	No Data	11
2011	No Data	6	No Data	No Data
2012	7	5	10	6
2013	No Data	3	No Data	5
2012	7	5	10	6

Year	Nests	Active nests	Adults	Juveniles
2013	No Data	3	No Data	5
2014	7	4	8	7
2015	No Data	No Data	No Data	No Data
2016	No Data	No Data	No Data	No Data
2017	3	0	6	0
2018	2	0	4	0
2019	-	-	-	-
2020	-	-	-	-
2021	-	-	-	-

The heron nesting and productivity data indicates a substantial decrease in occupancy and production at the North Star heronry (Figure 4; Table 8). A sharp drop in active nests, adults and juveniles coincided with the change in location. In 2017, the occupancy dropped precipitously to only 2 nests

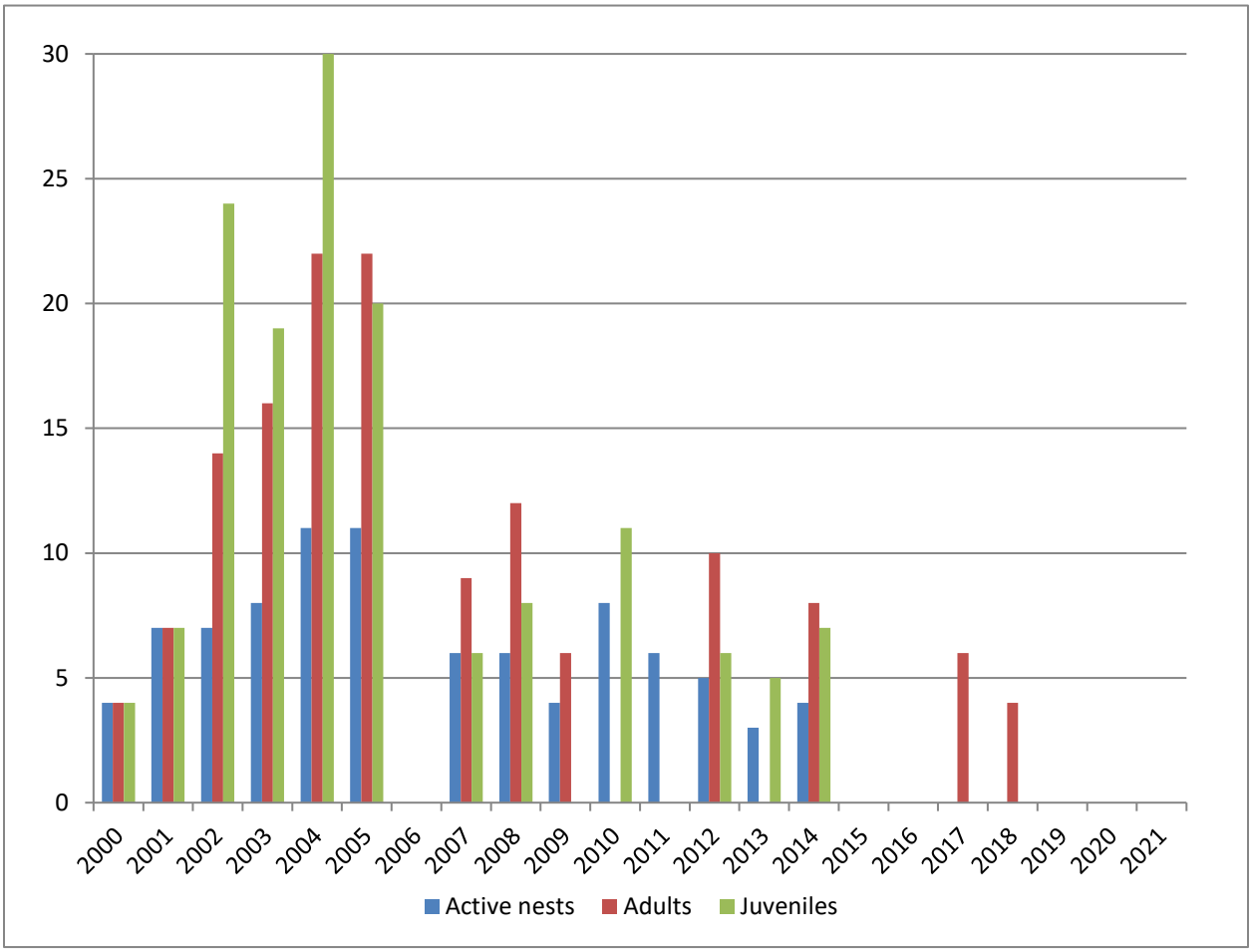


Figure 4. Great blue heron nesting and productivity data 2000-2021 (note: no data available for 2006, 2015, and 2016)

with nestlings, with zero fledged. Although the reduced productivity coincides with the exponential growth in recreational river use, golden eagles have occasionally been observed in proximity to the heronry. Given that there has been direct observation of golden eagles preying on heron nestlings at Rock Bottom Ranch and Cattle Creek, it is likely that the decline at North Star has resulted from

synergistic disturbance effects (Durães et al. 2013, Pringle et al. 2015).

As reported in a Technical Memorandum from CWS to OST in 2018 (CWS 2018c), CWS initiated a dual effort to: (1) more accurately monitor the success of the heronry and, (2) investigate the proximate cause of the apparent heronry decline. This effort concluded that the decline and abandonment of the heronry coincided with both a significant increase in river-based recreation in the reach adjacent to the nest stands and serious decline in the nest stands themselves. Unfortunately, due to the abandonment in 2018, CWS was unable to observe behavior of the nesting herons in response to recreationists. Observers, however, were able to document (fourteen observations from May through July) that when herons were hunting within the river itself, they flushed 100% of the time upon sighting a paddle board, kayak, or canoe approaching them. This has certainly led to a significant reduction in the value of the river from Wildwood to North Star as a foraging area. On eight occasions, however, we observed herons hunting in off-river foraging sites at North Star when recreationists were present on the river. In all eight instances the foraging heron did not appear to react to the observed human activity.

CWS concluded that, overall, great blue heron nesting habitat conditions have declined at North Star over the past few years due to both the increased recreation and natural processes (e.g., heron guano acidification of soils often kills nest trees over time). Importantly, CWS noted that OST has taken substantial steps to reduce the potential impact of the river activity on herons through the 2020 management plan (OST 2020). The impact could be further reduced by continuing to implement the mitigation measures recommended in the 2018 CWS tech memo (CWS 2018c). In addition, OST's efforts to restore the extent of the North Star fen, protect foraging areas on the west side of the river, and protect and enhance the alternate nest stands (as recommended in the CWS tech memo) combine to make it feasible that great blue herons could return to North Star in the near future.

7.8 2020 AVIAN POINT TRANSECTS

The avian monitoring program for Pitkin County Open Space and Trails Program (OST) was designed to provide OST managers with information regarding birds and their habitat that can be a tool to evaluate whether management actions are meeting the objectives set forth by a given management plan. In general, birds can be observed closely without harm to the birds or to the humans watching them. Therefore, it is relatively easy to collect large amounts of data in a time and cost effective manner (Davis 1989, Castri et al. 1992). Birds can provide early warning of natural responses to environmental impacts (Noss 1990, Munn 1993, Woodley 1996b, a). Changes in bird species composition and density can be used to assess wildlife habitat quality based on the assumptions that the population density or relative abundance of a single species or suite of species can serve as an index of habitat quality for that species, may indicate habitat suitability for other species, and that species-habitat relationships can be adequately understood. These data are intended to provide information to managers to assure proper documentation of the potential effects of management actions on species of conservation concern. Bird survey results must also be considered within the context of external factors that impact birds and bird populations across their entire range. Such factors include but are not limited to winter range habitat loss, land use changes in winter range and migration routes, stochastic weather events, pesticide use across their range, change in predator populations, etc.

7.8.1 Survey Methods

Avian surveys were conducted in 2020 using point transects following the OST protocol originally developed in 1999 based on the Rocky Mountain Bird Observatory's (RMBO, now Bird Conservancy

of the Rockies or BCR) Monitoring Colorado's Birds protocol (Leukering et al. 1998) and updated in 2009 (Hanni et al. 2009) and in 2019 (McLaren et al. 2019). The protocol was designed to be statistically rigorous and produce data for analysis of population trends of approximately 159 bird species that breed in Colorado (Leukering and Levad 2000). Observers record all avian species detected at each point. Whereas the RMBO point-transect sampling effort is stratified by habitat, OST modified the protocol to stratify by discrete properties in order to provide information that can be used by OST managers as part of the adaptive management of a given property (CWS 2011).

ArcGIS (ESRI 2008) was used to lay out a grid of systematic point count stations on North Star, each separated by at least 250 meters (Map 2). Each point has been monumented via GPS. Point transects were performed after all migratory species returned to the area and as early in the season as snowpack permitted. Surveys started approximately 30 minutes before sunrise and finished before 11am. A minute was allowed for the birds to resume normal behavior, then birds were recorded for five minutes, as suggested by Bibby et al. (2000) and per the protocol. The distance from the observer to the bird was estimated based on its location when first detected. For each bird detected, observers recorded the species, sex, how it was detected (e.g., call, song, other, etc.), and distance from the observation point. Observers also recorded certain species that occur in low density across the landscape (e.g., raptors, woodpeckers, Galliformes) along the line transect in between points (Leukering and Levad 2000), and tree squirrels (i.e., red squirrels) were recorded at each point in recognition of their proclivity toward nest predation. Per OST, a complete analysis of results including density estimates and population trends will be completed every 10 years (see CWS 2011). For the purposes of periodic reports, species richness and relative abundance is reported.

7.8.2 Results

Three hundred forty-two individuals representing 52 species were detected in 2020. As in previous monitoring years, species richness (iChao1) and species diversity (Shannon Index) were calculated (See Section 7.3.2 above). In addition, relative abundance (%) of each bird species detected was determined using the expression n/N x 100 where n is the number of observations for a particular bird species and N is the total number of observations detected for all species.

Total bird densities at North Star ranged from 84 to 188 birds/ha over the time series. Density varied among species with a majority estimated at less than 10 birds/ha and only broad-tailed hummingbird and yellow warbler having more than 10 birds/ha in most survey years. Broad-tailed hummingbird densities varied widely over the time series, ranging between 7 and 69 birds/ha while densities of yellow warbler were more consistent, ranging between 27 and 62 birds/ha.

Linear trends of densities at North Star were generally upward over the timeseries for all avifauna, with 9 species having statistically significant upward trends. Densities of song sparrows increased from about 5 birds/ha in 2001 to about 8 birds/ha in 2020. Violet-green swallow had low densities of zero (0) to 6 birds/ha in the 2000s and 5 to 17 birds/ha in the 2010s. House wren densities increased from about 2 birds/ha in 2001 to nearly 4 birds/ha in 2020. Trends in densities were downward for three species – red-winged blackbird, black-billed magpie, and great blue heron – over the monitoring

period. Densities of red-winged blackbird ranged between 5 and 17 birds/ha between 2001 and 2011 but were less than about 5 birds/ha starting in 2013 and declines continued through 2020 (see discussion in Section 9). Black-billed magpie densities were approximately 0.75 birds/ha in 2001 and decreased through 2013 to less than about 0.20 birds/ha and subsequently increased to nearly 0.75 birds/ha in 2020. Densities of great blue heron declined from a high of nearly 2 birds/ha in 2001 through the 2000s and were less than about 0.35 birds/ha during the 2010s and no herons detected

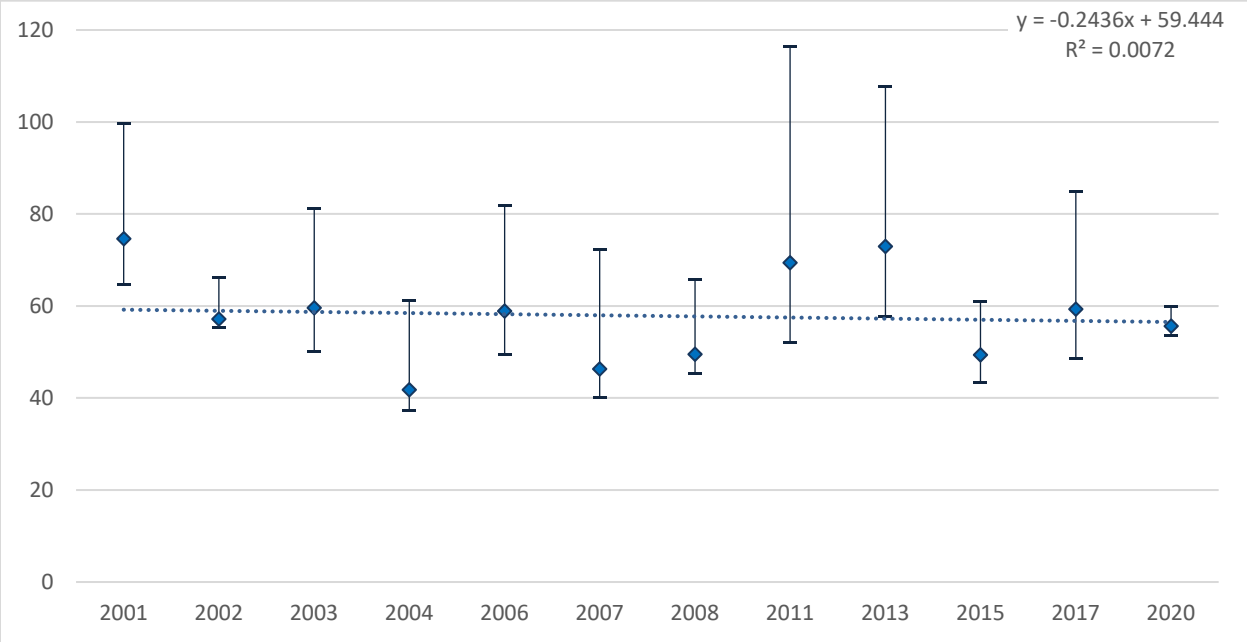


Figure 5. iChao1 estimate of true avian species richness (with 95% confidence interval) at North Star 2001-2020

in 2020 (See discussion in Section 7.1).

Species Richness

From 2001 to 2020, the estimate of true species richness for the North Star point-transect varied from a high of 74.6 in 2001 to a low of 41.7 in 2004; estimated species richness at North Star in 2020 was 55.6. Although the linear trend indicates a very slight downward trend, only 0.7% of the variation in species richness can be explained by the model (Figure 6). In addition, since the 95% confidence interval of these estimates overlap, the differences should not be considered statistically significant and the estimated species richness should be considered more or less unchanged over the sampling period.

Species Diversity

As discussed above, the Shannon Diversity Index (or simply "Shannon Index") is a heterogeneity measure that incorporates species richness; it is considered sensitive to the addition of rare species (Krebs 1989). The Shannon Index combines two quantifiable measures: species richness (number of species within the community) and species equitability (a measure of how similar the abundances of different species are). Typically, the value of the Shannon Index ranges from 1.5 (low species evenness and diversity) to 3.5 (high species evenness and diversity), though values beyond these limits may be encountered (Margalef 1972, Magurran 2004). The calculated Shannon Index avian species detected by means of the point-transect protocol varied from a low of 2.86 in 2006 to a high of 3.49 for 2020.

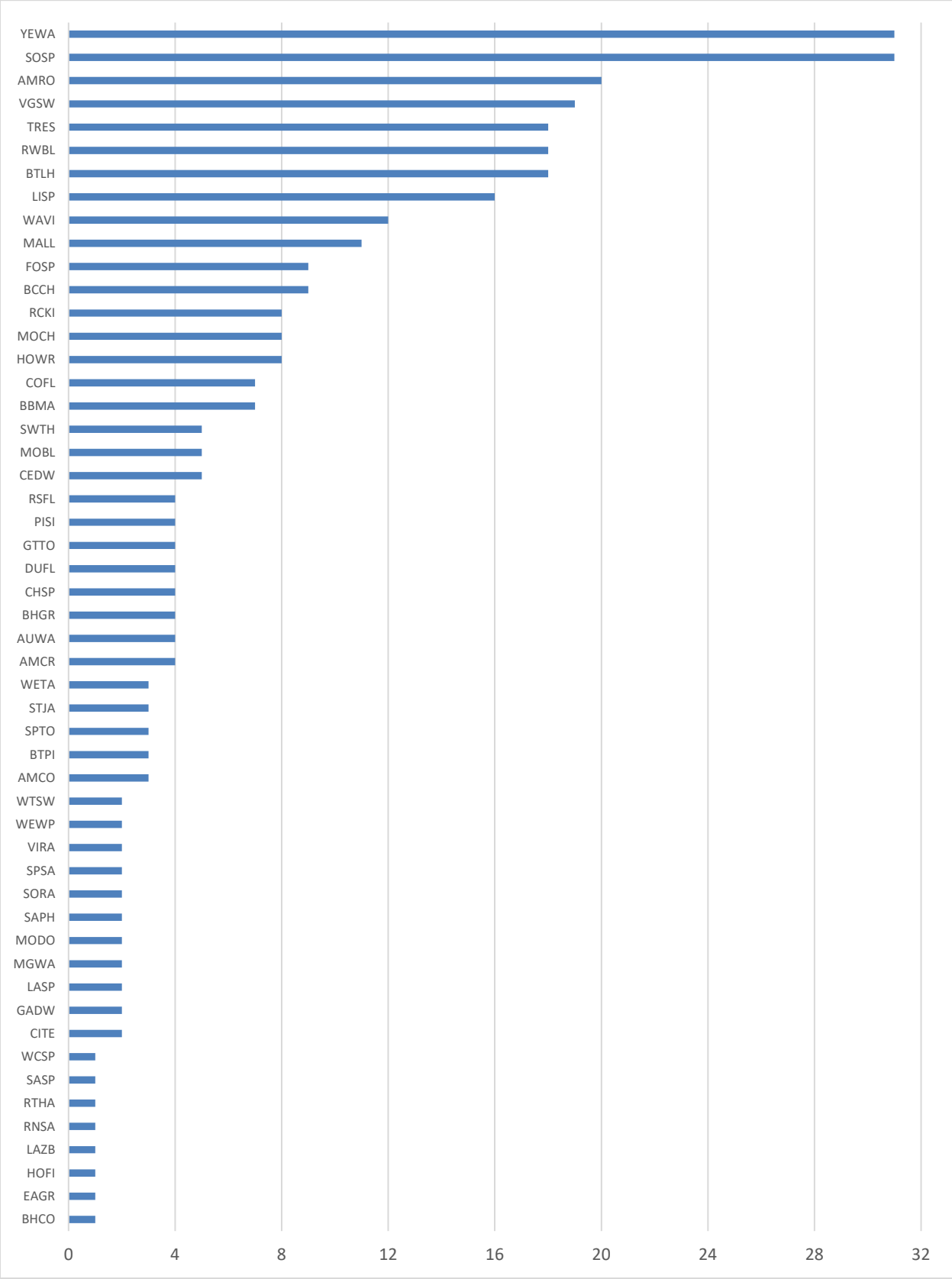


Figure 6. Relative abundance of bird species detected at North Star in 2020 (See Appendix C for key to four letter codes).

The avian species diversity in each monitoring year is relatively high (all years > 2.8) but, again, between years variance is relatively low (σ^2=0.03). Unlike species richness, the linear trend is slightly upward from 2001 to 2020, but only 2.3% of the variation in species richness can be explained by the model (Figure 6) and therefore, the trend should not be considered significant.

Relative Abundance

In 2020, the 10 most abundant species represented 56.7% of the total individuals detected (Table 9).

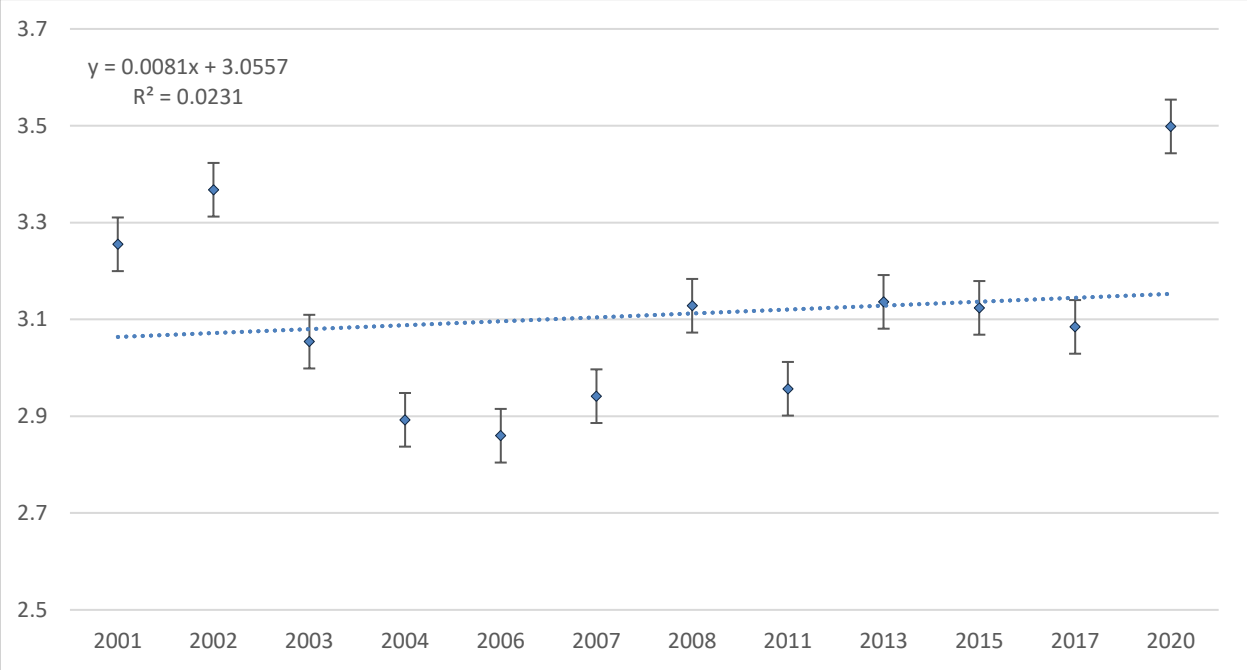


Figure 7. Avian species diversity (Shannon Index) with standard error at North Star 2001-2020

This is a relatively low proportion as compared to prior monitoring years, thus the high species diversity as reported in the previous section. Song sparrows, yellow warblers, American robins, violet-green swallows, and broad-tailed hummingbirds were, respectively, the 5 most abundant species detected.

Table 8. Relative abundance of ten most abundant bird species (2020)

Species	n	Relative Abundance
Song Sparrow	31	9.10%
Yellow Warbler	31	9.10%
American Robin	20	5.80%
Violet-green Swallow	19	5.60%
Broad-tailed Hummingbird	18	5.30%
Red-winged Blackbird	18	5.30%
Tree Swallow	18	5.30%
Lincoln's Sparrow	16	4.70%
Warbling Vireo	12	3.50%
Fox Sparrow	11	3.20%
Black-capped Chickadee	9	2.60%

Species	n	Relative Abundance
Mallard	9	2.60%
House Wren	8	2.30%
Mountain Chickadee	8	2.30%
Ruby-crowned Kinglet	8	2.30%

Interestingly, broad-tailed hummingbirds and fox sparrows were both detected within the top 10 most abundant species for the first time since avian monitoring was first implemented at North Star. Although 52 species were detected, 8 species were represented by only 1 individual, and 11 species were represented by only 2 individuals (Figure 6). The only species detected in 2020 not detected in previous monitoring efforts were eared grebe (1), lark sparrow (3), and white-throated swift (2).

Sensitive Species vs. Synanthropes

Synanthropic species and human-sensitive species respond differently to land management and human activity (Johnston 2001, Odell et al. 2003, Glennon and Kretser 2013, Sofaer et al. 2020). The relative abundance of detected species at North Star known to be habitat specialists or particularly sensitive to human activity (i.e., sensitive species; e.g., Fox Sparrow, Western Flycatcher[10]) to the number of individuals of habitat generalist species and species known to be tolerant of human activity (i.e., synanthropes; e.g., American Robin, Black-billed Magpie) was also calculated. The ratio favored the specialist/sensitive species with a ratio of 4.4:1. This is within the range of variation for this metric but above the mean (4.1:1) and median (4.2:1) as calculated for each year from 2001-2008 (CWS 2011). This could be indicative of improved habitat conditions at North Star for human sensitive species. Densities of sensitive species were generally greater than those of synanthropic species, ranging from 54 to 124 birds/ha in comparison to 23 to 60 birds/ha for the synanthropes.

7.8.3 Species of Concern

There are 32 bird species that have been detected at North Star in 2020 or earlier monitoring years that are designated by one or more governmental agencies or conservation organizations as having special status or have been found to be in decline (Table 10).

Table 9. List of bird species with special management designation detected at North Star in 2020

Species	CNHP	USFS	USFWS	BLM	CPW	PIF ACAD	IMBCR
American Dipper							
American Goshawk	G5 S3B	R2S		Sens	SGCN, Tier 2		
American Kestrel							RC
Bald Eagle	G5 S4B, S4N	R2S		Sens	SGCN, Tier 2		
Band-tailed Pigeon	N4B,N4N S4B				SGCN		RC
Black-billed Magpie						UCS	
Broad-tailed Hummingbird				Sens			RC
Common Nighthawk							RC
Cooper's Hawk	N5B,N5N S3S4B,S4N						
Eared Grebe	G5 S3B						

[10] In 2023, ornithologists lumped Pacific-slope and Cordilleran flycatchers together as Western Flycatcher after treating them as separate species since 1989.

Species	CNHP	USFS	USFWS	BLM	CPW	PIF ACAD	IMBCR
Green-tailed Towhee		MIS					RC
Hairy Woodpecker		MIS					
Lark Sparrow	N5B S4						
Lewis's Woodpecker	G4 S4	R2S	BCC	Sens	SGCN, Tier 2	Watch List/Tipping	RC
Lincoln's Sparrow		MIS					
Loggerhead Shrike	N4 S3S4B	R2S	BCC	Sens		Common Bird in Steep Decline	
Mallard		MIS					
Mountain Bluebird		MIS					RC
Mountain Chickadee							RC
Northern Flicker							
Northern Pygmy Owl	G4G5 S3B						
Olive-sided Flycatcher	N4B S3S4B	R2S	BCC		SGCN	Watch List/Tipping	RC
Plumbeous Vireo						RS	RC
Pine Siskin						Common Bird in Steep Decline	
Red-naped Sapsucker		MIS	BCC				RC
Vesper Sparrow		MIS					RC
Violet-green Swallow							RC
Virginia's Warbler		MIS/R2S	BCC		SGCN	Watch List Yellow	RC
Warbling Vireo		MIS					
Western Flycatcher							RC
Wilson's Warbler	N5B S4B	MIS					
White-throated Swift							RC

Special management designations: USFS=United States Forest Service, R2S=Region 2 Sensitive Species, MIS=Management Indicator Species; USFWS=U.S. Fish & Wildlife Service; IMBCR=Integrated Monitoring for Bird Conservation Regions; BLM=Bureau of Land Management; CPW=Colorado Parks & Wildlife; SGCN=Species of Greatest Conservation Need; PIF ACAD=Partners In Flight Avian Conservation Assessment Database; BCC=Conservation Concern, RC=BCR 16 Regional Concern; Sens=BLM Colorado Sensitive Species; SSC=State Special Concern; SE=State Endangered; ST=State Threatened.

7.9 OTHER

Three western terrestrial garter snakes were observed during TVES at North Star in 2021 for the first time. These common, mildly venomous snakes occur throughout Colorado (except for the plains) to an elevation of approximately 11,000 feet (Hammerson 1999).

8.0 MANAGEMENT INDICATOR SPECIES

Management Indicator Species (MIS) were recommended for North Star in the 2011 Avian Monitoring Report (CWS 2011) and the 2014 Ecological Communities & Fluvial Geomorphology Baseline Report (Golder Assoc. & CWS 2014). Most of these species remain appropriate today and

are discussed below; the current exception is great blue herons which, as discussed above, are not currently nesting at North Star.

Table 10. Recommended MIS

Habitat	Species	Report(s)
Aspen Forest or Woodland	Warbling Vireo	CWS 2011, Golder Assoc. & CWS 2014
Broad-scale Habitat Generalist	Rocky Mountain Elk	Golder Assoc. & CWS 2014
Broad-scale Riparian Specialist	Great Blue Heron	CWS 2011, Golder Assoc. & CWS 2014
Broad-scale Riparian Specialist	American Beaver	CWS 2018a
Emergent Wetlands	Red-winged Blackbird	CWS 2011, Golder Assoc. & CWS 2014
Riparian Shrubland	Lincoln's Sparrow	CWS 2011, Golder Assoc. & CWS 2014
Riparian Shrubland	Song Sparrow	CWS 2011, Golder Assoc. & CWS 2014
Riparian Woodland	Yellow Warbler	CWS 2011, Golder Assoc. & CWS 2014
Riparian Woodland	Western Flycatcher	CWS 2011, Golder Assoc. & CWS 2014

8.1 ASPEN FOREST OR WOODLAND

Warbling Vireo

In Colorado, the vast majority of Warbling Vireos breed in aspen woodlands of the western mountains (Barrett 1998). They are also commonly found in montane and lowland riparian forests but are rarely found where conifers dominate. Data collected over the 13 monitoring years that the North Star point transect (first implemented by OST in 2001) has been surveyed indicate that there may have been a slight increase in estimated density of Warbling Vireos at North Star (Figure 8) but this trend is not statistically significant (p=0.67).

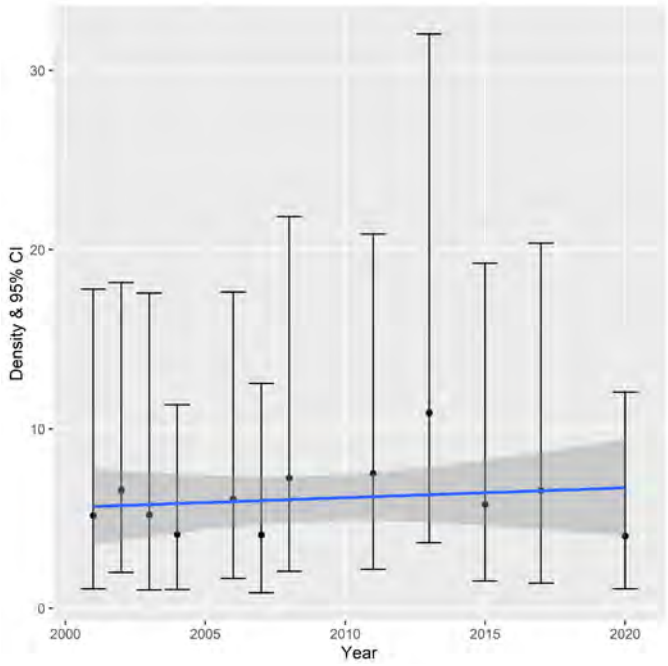


Figure 8. Estimated density with 95% confidence interval of Warbling Vireos at North Star

Since 2001 Warbling Vireo detections varied from a low of 10 in 2008 and a high of 28 in 2013 (Table 12) with a median of 15. In addition, Warbling Vireo relative abundance at North Star varied from 2.89% in 2007 to a high of 7.93% in 2013. As described by Golder and CWS (2014), the aspen forest and woodlands at North Star are in poor condition due to moisture stress, possibly induced in part through climate change, combined with wildfire suppression, and disease damage through wildlife-induced entry of cytospora, anthracnose, and other canker-borne diseases. The aspen stands are also not successfully reproducing due to heavy elk herbivory. This is a concern regarding the aspen-dependent species at North Star and, although there

are healthy aspen stands within proximity to the property, it would be wise to consider management actions to improve the health of North Star's aspen woodlands.

Table 11. Number of Warbling Vireos detected and relative abundance by year.

Year	# Birds Detected	Relative Abundance
2001	20	5.43%
2002	17	5.19%
2003	15	4.55%
2004	12	4.41%
2006	15	3.76%
2007	15	2.89%
2008	10	5.86%
2011	18	5.46%
2013	28	7.93%
2015	11	5.24%
2017	16	5.56%
2020	12	3.51%

8.2 BROAD-SCALE HABITAT GENERALIST

Rocky Mountain Elk

Elk are monitored via the TVES and monitoring camera components of the MSIM effort at North Star. As reported above, the 2021 TVES detected 221 unique sets of elk tracks, pellet piles, or other sign. In addition, the cameras captured 97 occurrences of elk at North Star during the monitoring period. Although the 2021 TVES results are substantially greater than the 71 TVES detections in 2017 or 149 in 2014, these data may not reflect a trend but, rather, may be due to year-to-year variation in weather-related factors such as depth of snowpack, timing of snow melt, etc. At the very least, however, it seems clear that elk continue to use and depend on North Star, and the 2021 camera monitoring data indicates that elk are present on the property through the non-winter months. Although peak elk use of North Star occurs in the spring and fall transition periods, a relatively large number of elk occupy North Star throughout the summer including the peak calving and rearing period (June 1 through July 30th). Consequently, it is likely that elk calving occurs at North Star and elk are certainly using the property for rearing. It is noteworthy that although elk calves were captured by monitoring cameras in both 2014 and 2017, none were captured by the monitoring cameras in 2021.

8.3 BROAD-SCALE RIPARIAN SPECIALIST

American Beaver

CWS conducted a beaver occupancy survey supplemental to the regular OST monitoring protocols (Colorado Wildlife Science LLC (CWS) 2018a). That survey found that the population of beavers has increased at North Star, and that increase in beavers and the corresponding increase in beaver influenced areas, and beaver dens or lodges have paralleled the improved health of the riparian ecological system at North Star. Although it is difficult to determine how many beavers occupy the river reach at North Star, it is likely that each of the 2 freestanding lodges and the 3 or 4 bank lodges are occupied by a single beaver family or colony. Beaver colonies usually consist of an adult pair along with the young of the current and previous years (Olson and Hubert 1994, Longcore 2007). Some studies have estimated that their activities can influence up to 40% of the total length of 2nd to 5th

order streams[11] (Naiman et al. 1988, Olson and Hubert 1994).

Great Blue Heron

Although Great Blue Herons continue to use North Star for foraging and roosting, they no longer nest on the property. A new heronry, however, has been established within two miles of North Star on the Roaring Fork. There is a reasonable likelihood that once the North Star nest stands declined such that they no longer provided sufficient support and cover, the North Star herons relocated upstream. As discussed above (Section 7.71), there may have been a synergy of the declining nest stands with the increase in river-based recreation that resulted in the move but it cannot be determined what the ultimate cause of the relocation (See Section 7.7.1 above for more detail).

The observed change in this MIS led to a focused study and change in management actions and mitigation, per the recommendations of that targeted study (CWS 2018c). OST then incorporated the recommended management actions and mitigation into the 2020 North Star Management Plan (OST 2020) which was, in turn, implemented in the field (e.g., new quiet zone signage, enforcement, nest and perch tree protection, tree regeneration actions, and foraging area enhancements). CWS identified replacement nest stands and documented important foraging areas that continue to be used by herons (CWS 2018c) and OST has taken action to protect both resources (OST 2020). OST will continue to monitor North Star's use by great blue herons to determine whether additional management actions are warranted and feasible in accordance with the OST adaptive management regime.

8.4 EMERGENT WETLANDS

Red-winged Blackbird

It appears that the breeding population of red-winged blackbirds at north Star is declining (Figure 8). Red-winged Blackbirds are one of the most abundant species in North America with an estimated winter population of 150 million (Nelms et al. 1994). They are most commonly associated with permanently flooded emergent wetlands, but they will nest in a variety of habitats including riparian areas and grasslands (Kingery 1998). Emergent wetland nest sites like the fen at North Star, however, may be 10 times more successful than upland nest sites and experience higher reproductive success in natural habitats (60-77%) than in anthropogenic habitats (<25%) (Vierling 2000). They construct nests in sturdy herbaceous vegetation, and feed primarily on emergent aquatic insect larva. Predation is a major cause of nest failures and birds breeding in anthropogenic habitats suffer higher predation rates than those which nested in natural habitats. This difference may be due

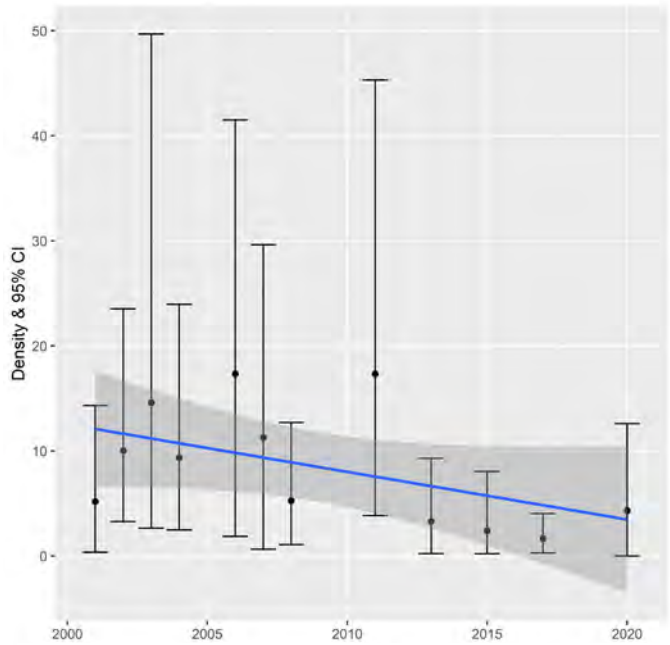


Figure 9. Estimated density with 95% confidence interval of Red-winged Blackbirds at North Star

[11] The Roaring Fork River at North Star is a 5th order stream.

in large part to the presence of human-commensal predators, such as domestic cats and raccoons (Vierling 2000).Recent analyses show significant population declines in many abundant avian species, especially marsh-nesting species including the red-winged blackbird. Hypothesized causes include reduced nesting success resulting from changing land-use patterns (Robinson and McChesney 2022). Loss of emergent wetland habitats may be the most significant threat. Vierling (2000) argued that natural wetlands act as source habitats that may be helping to sustain regional populations of blackbirds in an urbanizing landscape. Any factors that reduce nesting success within remaining marshes, therefore, may contribute disproportionately to regional population declines (Tozer et al. 2010). Diversions, overgrazing by native and domestic ungulates, and cutting or burning tall emergent vegetation such as cattails and bulrushes for agriculture and other management purposes reduces breeding habitat. Fragmentation of habitat for recreation, transportation infrastructure, or development reduces breeding success. In addition, red-winged blackbirds are a common host for Brown-headed Cowbirds (Wickersham 2007).

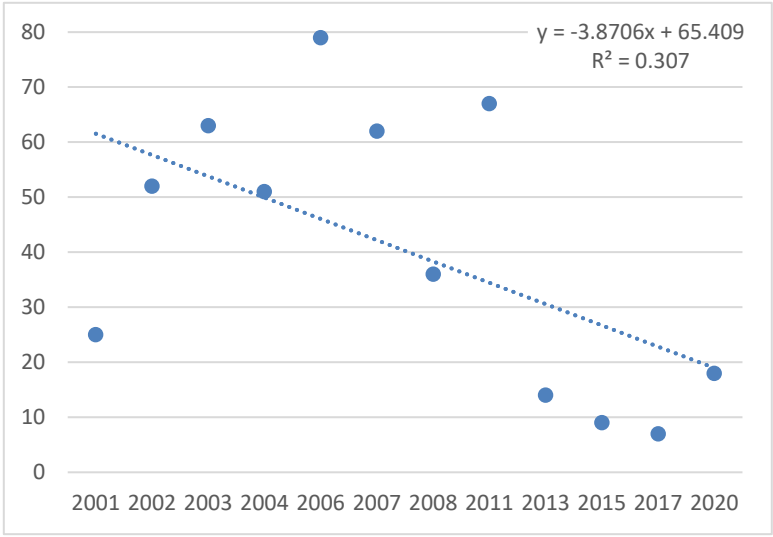


Figure 10. Red-winged blackbird detection trend 2001-2020 (note: no data available for 2009, 2010, 2012, 2014, and 2016)

Only 7 red-winged blackbirds were documented at North Star in 2017, 9 in 2015, and 14 in 2013. These raw counts were far below the median of 51.5 recorded from 2001-2011 and substantially below the range of variability from 2001-2011 (n_{min} = 25; n_{max} = 79). Although these data are raw counts, this apparent decline should be researched further to determine if management actions are negatively affecting the population of red-winged blackbirds at North Star. In 2020, however, 18 blackbirds were detected, which was the largest number detected since 2011. The linear trend of the raw data indicates a slight downward trend but only 30.7% of the variation in detections can be explained by the model. The remaining 69.3% can be explained by unknown variables or inherent variability.

8.5 RIPARIAN SHRUBLANDS

Lincoln's Sparrow

This common songbird breeds in high elevation shrubby habitats associated with wet meadows, freshwater marshes, riparian thickets, or forest edge. They prefer mesic areas with dense vegetation, often willow and alder (Rising 1996) and serve as an indicator for the condition of North Star's riparian shrub communities. Lincoln's Sparrow is a distinct microsite specialist, preferring low willow cover with dense ground vegetation and building its nest in sites that are relatively wet (Ammon 1995a). Interspersion of riparian shrubs and dense graminoids is considered essential for reproduction

(Ammon 1995a) which is typically from around June 1 to around August 10 (Kingery 1998). In Colorado, Lincoln's sparrows lower elevational limit is around 8,000 feet (Stephens and Anderson 2003), and nest sites are typically found in the subalpine and montane zones (Kingery 1998).

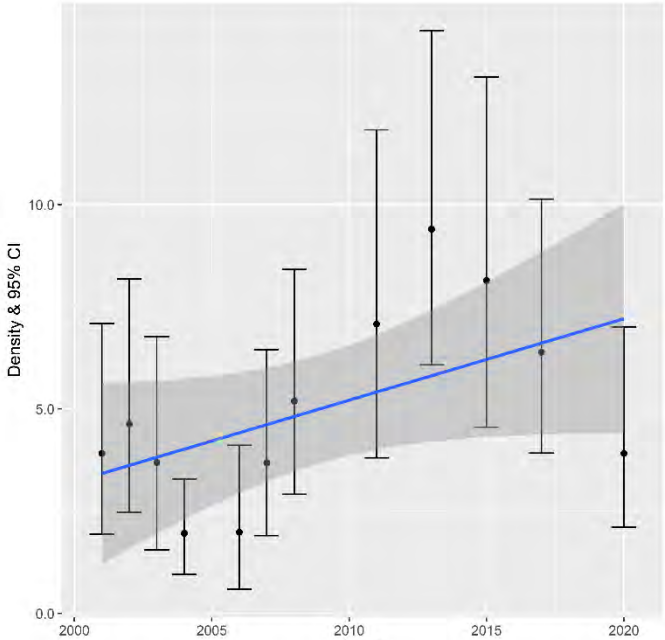


Figure 11. Estimated density with 95% confidence interval of Lincoln's sparrows at North Star

Lincoln's sparrow's riparian habitat is negatively affected by grazing and browsing by mule deer and elk, riparian and riverine recreation, and alteration of flood regimes. Conversely, their habitat can be positively affected via riparian restoration and facilitation of seasonal flooding by managers. Breeding Lincoln's sparrows are particularly sensitive to human activity, which is known to cause nest desertion (Ammon 1995b). Also, nest parasitism by Brown-headed Cowbirds may be more common near human activity (Ammon 1995b).

The density of Lincoln's sparrows at North Star are increasing over time with a statistically significant upward trend ($p<0.05$)[12]. Annual densities of Lincoln's sparrow were significantly different for 10 of the 66 comparisons, with 2013 being larger than most other survey estimates. The increasing density of Lincoln's sparrows at North Star are likely a good indicator that management of North Star's riparian shrublands is resulting in greater representation of boggy willow-sedge dominated habitat where shrub cover is dense (Knopf et al. 1988, Ammon 1995b, Cicero 1997).

Song Sparrow

Because song sparrows are strongly associated with montane willow carrs, montane riparian shrublands, and emergent wetlands (Wickersham 2007), population trends of this riparian obligate are considered indicative of changes in the types of riparian habitat occurring at North Star. In semiarid western Colorado, the role of humans can often be negative because song sparrows nest primarily in wet thickets, which are reduced or eliminated by grazing, water diversion, and conversion to agriculture (Ohmart 1994, Sanders and Edge 1998).

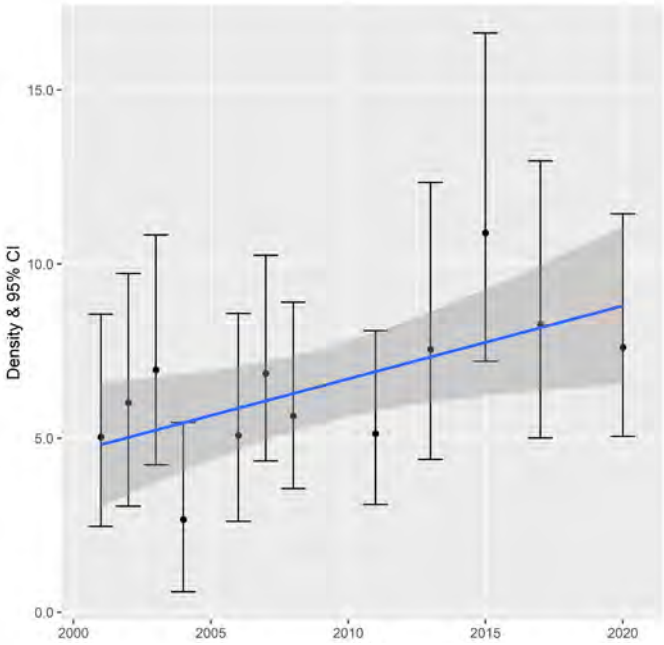


Figure 12. Estimated density with 95% confidence interval of song sparrows at North Star

Density of this ground nester at North Star is increasing over time with a statistically

[12] As calculated by repeated measures analysis of variance (ANOVA).

significant upward trend ($p<0.05$)[13]. Densities increased from about 5 birds/ha in 2001 to about 8 birds/ha in 2020. In addition, as described above, song sparrows were widespread, being detected at greater than 90% of points during one or more surveys and detected at more than 50% of points during all surveys. The relatively stable rate of detections (SD=6.9; median=27.5) may indicate that the mosaic of riparian shrublands at North Star are being successfully managed by OST to benefit those species dependent on the habitat types similar to those of the song sparrow; continued protection and restoration efforts within this habitat type may improve conditions for song sparrows.

8.6 RIPARIAN WOODLANDS

Yellow Warbler

Yellow warblers are among the most common species in the riparian bird community (Knopf 1985) and one of the most common and widely distributed warblers in North America (Knopf and Sedgwick 1992a). In Colorado, Yellow Warblers breed in deciduous habitats across the state (Andrews and Righter 1992, Kingery 1998, Wickersham 2007). Preferred breeding habitat, however, is deciduous (i.e., cottonwood) riparian woodlands and shrublands (Dunn and Garrett 1997, Wickersham 2007). Breeding territories often include tall trees for singing and foraging with a shrub (typically willow) understory for nesting (Stauffer and Best 1980, USFS 1994). Many authors have documented preference for moist habitats with vertical structure (e.g., Stauffer and Best 1980).

Yellow warblers are particularly sensitive to cowbird brood parasitism (Clark and Robertson 1981, Burgham and Picman 1989, Hobson and Sealy 1989). Yellow warblers do, however, defend against these attacks by constructing false nest bottoms over the cowbird's eggs. Nesting near a colony of blackbirds reduces the cowbird threat since the blackbirds will drive away the cowbirds (Terres 1980, Hobson and Sealy 1989).

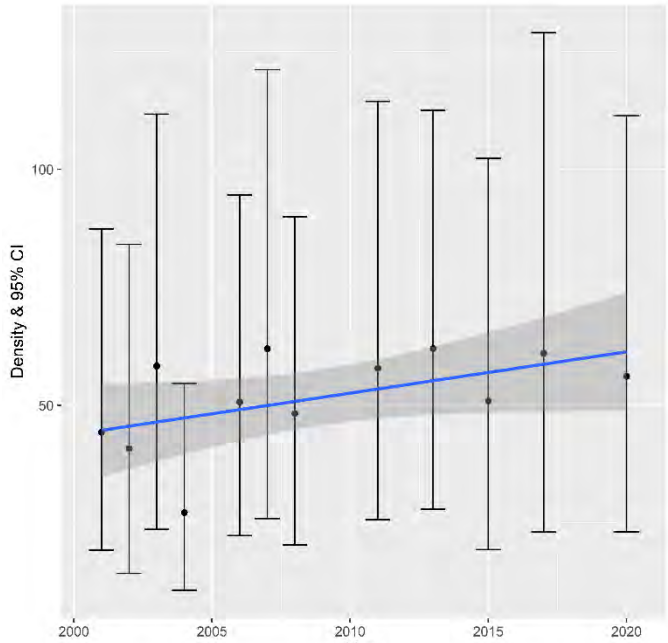


Figure 13. Estimated density with 95% confidence interval of yellow warblers at North Star

In Colorado, breeding occurs approximately from May 16 through August 19 (Kingery 1998). Nests are built 0.5-2.0 m above the ground in a bush or tree (Knopf and Sedgwick 1992b). A clutch of three to six eggs is laid and then incubated by the female alone for about twelve days (Lowther et al. 1999).

Riparian habitat destruction and degradation is the most significant threat for this species. Cottonwood riparian forests at North Star (R. Orthner, personal communication) and in western Colorado are on a trajectory toward rapid decline (Andersen et al. 2007). Regeneration of these forests has been disrupted in many areas due to overgrazing (by both livestock and elk) and flood control. Residential, transportation, and recreational development in riparian areas has led to reduction of cottonwood riparian patch size, resulting in corresponding reduction in the richness and abundance

[13] As calculated via linear regression and repeated measures ANOVA.

of habitat interior species (Davidson and Knight 2001).

Despite the threats to yellow warblers, they are common at North Star, being detected at more than 90% of points during one or more surveys and detected at greater than 50% of points during all surveys. Yellow warbler was one of only two species having more than 10 birds/ha in most survey efforts (broad-tailed hummingbird was the other), with consistent densities of yellow warbler ranging between 27 and 62 birds/ha. Estimated densities of yellow warblers have been increasing at North Star during the monitoring period and this positive trend may be statistically significant (p=0.094). As described above, yellow warblers are somewhat preferential of riparian areas with a substantial tree component. Accordingly, the positive trend in densities is likely indicative of a riparian woodland with a complex vertical structure at North Star. As the cottonwoods at North Star continue to decline, however, the property will lose an important structural component of its riparian habitat and birds, like the yellow warbler, that depend on this complexity may suffer. It is important to note that brown-headed cowbirds have been present at North Star for the entire monitoring period but do not, as of this writing, seem to be negatively affecting the yellow warbler population on the property.

Western Flycatcher[14]

Western flycatchers (formerly "Cordilleran flycatchers") were selected as MIS because they are strongly associated with the mixed or cottonwood riparian and woodlands (Wickersham 2007) that occur at North Star. Such habitats, with both water and gaps of light in the forest, provide not just an

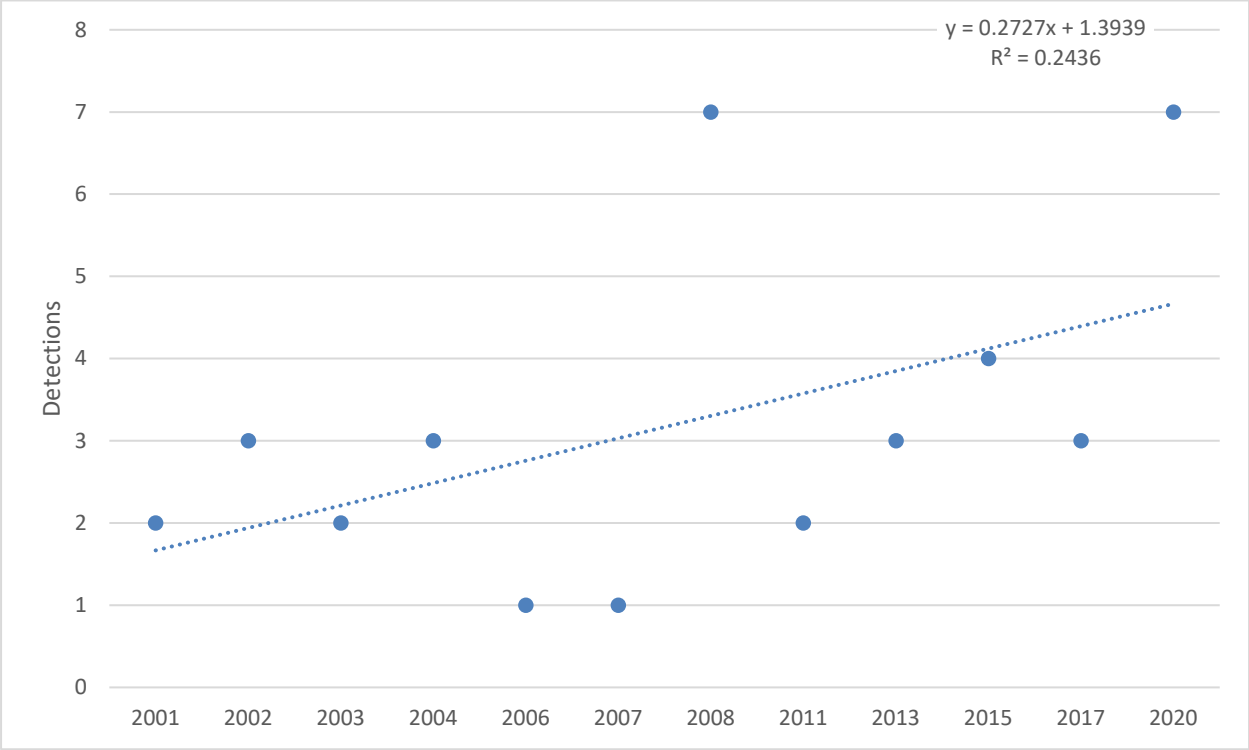


Figure 14. Western Flycatcher detections at North Star

abundance of insects and foraging perches but also nest sites for these tree-nesting insectivores. Though Colorado's population of these conspicuous flycatchers appears to be stable, degradation and/or loss of habitat due to residential, infrastructure, and recreation development could negatively affect populations (Colorado Partners in Flight 2000).

[14] The sample sizes of western flycatcher detections were too small to estimate densities. Instead, raw data is used for descriptive purposes.

Like yellow warblers who depend on riparian forest but below the forest canopy and song sparrows which are denizens of the riparian shrubland layer, detections of canopy dwelling western flycatchers may be increasing over time. Since only 24% of the trend is explained by the model, however, one should be careful in making conclusions or management decisions based on this information. Nonetheless, there appears to be a distinct, if not significant, upward trend over the 12 monitoring efforts. Either way, given that they are a strong indicator of the health and integrity of North Star's riparian forest and woodlands, OST should continue to track this species closely and, if detections begin to decline, management actions to further protect and/or restore the riparian forest and woodlands at North Star may be prudent. Elk herbivory of cottonwood suckers is a direct threat to the long-term persistence of the large tree component of North Star's riparian community, and as the cottonwoods age and die, so may the primary habitat for western flycatchers at North Star.

Table 12. Number of western flycatchers detected and relative abundance by year

Year	# Birds Detected	Relative Abundance
2001	2	1.92%
2002	3	1.04%
2003	2	1.52%
2004	3	1.10%
2006	1	0.25%
2007	1	0.29%
2008	7	2.28%
2011	2	0.68%
2013	3	0.85%
2015	4	0.95%
2017	3	1.03%
2020	7	2.05%

9.0 RECOMMENDATIONS

As discussed above, OST takes an adaptive approach to management of open space properties. Each of the recommended management actions, whether for a specific MIS, or for the general welfare of wildlife on the property, must be evaluated to determine if it is having the desired effect on the target taxa. If the result of management actions is outside the range of desired outcomes that action should be discontinued or altered based on sound data resulting from monitoring.

1. Continue TVES, wildlife camera surveys, avian point transects, diurnal raptor surveys, nocturnal bird surveys, and beaver surveys on a long-term basis to develop more comprehensive species lists, determine population trends and diel use patterns, and evaluate the effects of management actions on MIS.

    a. These surveys should be conducted at an interval equal to or less than every 3 years in order to produce data that will facilitate the adaptive management process in a cost-effective manner while reducing the influence of annual stochasticity. Surveys that produce statistically robust data (e.g., avian point transects) should be repeated more frequently than methods that merely produce observational data (e.g., TVES).

    b. Avian monitoring should be implemented every other year. From an effective monitoring perspective, every other year is realistically the largest interval that should be used. If done at greater intervals, e.g., every 3 years, and you have a "throw away" year similar to

2015 where late snowy/stormy weather altered migration timing and patterns, then the effective interval is every 6 years with 4 consecutive years of no data.

2. Great Blue Heron activity should be noted, and any pair bonding, nest building, or nesting behavior observed by OST staff, volunteers, or visitors should be investigated to determine whether herons have reestablished a colony at North Star.
    a. If Great Blue Herons reestablish a heronry at North Star the seasonal river "quiet zone" should be reinstituted.
        1) The quiet zone should be established 300 meters (984 ft) up- and down-stream of the heron colony and a 200 m (656 ft) land-based buffer from March 1 through July 31 (Bjorkland 1975, Wershkul et al. 1976, Grubb 1979, Vos et al. 1985, Watts and Bradshaw 1994, Carlson and McLean 1996, Summers 1996, Vennesland 2000).
        2) Given the sharp rise in river based recreation at North Star, the river quiet zone would be necessary to maintain the persistence of a heronry at North Star.
    b. Maintain the interpretive signage on the river bank at the Wildwood put-in. Signs should explain the conservation significance of the heron colony, their sensitivity to disturbance at the early stages of nesting, and about their natural history.
    c. Additional signage warning of the approaching "quiet zone" should be placed near the bank on the property immediately upstream of North Star.
    d. Protect the potential alternative nesting stands identified in the 2018 CWS Great Blue Heron Colony Assessment Technical Memorandum (CWS 2018c). Nesting herons periodically relocate their colonies and alternate nesting stands provide places to relocate (Vennesland 2000).
    e. Install 36" metal flashing on trees if herons begin building new nests at North Star to inhibit terrestrial predators (e.g., bears, bobcats, raccoons).
    f. Continue to enhance and restore off-river foraging areas on and within proximity to North Star.
3. Consider elk exclosures within aspen stands and around areas of narrowleaf cottonwood regeneration as controls to evaluate browsing pressure and/or as a means to ensure sapling recruitment.
4. Preserve standing dead trees; the loss of snags reduces nesting sites.
5. Avoid disturbance of side channels where beavers are active.
    a. Establish 50 foot terrestrial buffer zones and river-based quiet zones around beaver lodges, dens, and activity (e.g., foraging) areas. Exclude or limit recreational use of the important side channel foraging areas identified in the 2018 beaver occupancy tech memo (CWS 2018b).
6. Evaluate the progress of the riparian restoration project to determine whether it is on a trajectory to achieve management goals.
7. For major habitat or recreation development projects, targeted surveys (e.g., nest searches) should be conducted prior to implementation and for a few years following completion to determine effects on wildlife communities and MIS.

8. Continue the recreation closure on the west side of the river, and the dog prohibition to protect ungulate migration, winter, and reproduction activity as well as bird breeding and nesting activity at North Star.
9. A detailed investigation of the red-winged blackbird decline should be conducted to determine whether management decisions are impacting the population at North Star.
10. Maintain waterfowl breeding, foraging, nesting, and loafing habitat; maintain forage opportunities for wading birds, and support red-winged blackbird breeding habitat.
11. Qualitatively monitor aspen recruitment at North Star to determine whether it is sufficient to maintain the important aspen woodland component.
12. OST should develop a grey wolf policy for North Star and all of its properties. Such a policy should be developed in collaboration with CPW and OST's consulting wildlife biologist. Educational materials and interpretation about wolves should be made available to people visiting OST properties and trails. Such a policy should include potential management actions if the following occurs:
    a. A solitary wolf is observed on or within proximity to an OST property;
    b. More than one wolf is observed on or within proximity to an OST property indicating the presence of a pack; or
    c. A den is established on or within proximity to a property.
13. OST should not interfere with natural predator-prey interactions between wolves and deer, elk or other prey species that occur on their properties.

10.0 LITERATURE CITED

Adams, R. A. 2003. Bats of the Rocky Mountain West: natural history, ecology, and conservation. University Press of Colorado, Boulder.

Ammon, E. M. 1995a. Lincoln's Sparrow (*Melospiza lincolnii*). The Birds of North America Online (A. Poole, Editor). Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/191, Ithaca, NY.

Ammon, E. M. 1995b. Reproductive Strategies and Factors Determining Nest Success in Subalpine Ground-Nesting Passerines. University of Colorado Boulder, CO.

Andersen, D. C., D. J. Cooper, and K. Northcott. 2007. Dams, Floodplain Land Use, and Riparian Forest Conservation in the Semiarid Upper Colorado River Basin, USA. Environmental Management **40**:453-475.

Andrews, R., and R. Righter. 1992. Colorado birds : a reference to their distribution and habitat. 1st edition. Denver Museum of Natural History, Denver, Colo.

Armstrong, D. M., J. P. Fitzgerald, and C. A. Meaney. 2011. Mammals of Colorado. 2nd edition. Denver Museum of Nature & Science/University Press of Colorado, Boulder, Colo.

Baigas, P. E., J. R. Squires, L. E. Olson, J. S. Ivan, and E. K. Roberts. 2015. Using environmental features to model highway crossing behavior of Canada lynx in the Southern Rocky Mountains.

Bailey, A. M., and R. J. Niedrach. 1965. Birds of Colorado. Denver Museum of Natural History, Denver, CO.

Balding, T. 2001. Tape-recorded broadcasts of nestling alarm and adult nest defense calls to attract Merlins. Passenger Pigeon **63**:40-42.

Barnes, B. V., and S. H. Spurr. 1998. Forest ecology. 4th edition. Wiley, New York.

Barnes, K. P., and J. R. Belthoff. 2008. Probability of detection of Flammulated Owls using nocturnal broadcast surveys. Journal of Field Ornithology **79**:321-328.

Barrett, N. M. 1998. Warbling Vireo. Pages 308-309 *in* H. E. Kingery, editor. Colorado Breeding Bird Atlas. Colorado Bird Atlas Partnership and Colorado Division of Wildlife, Denver, CO.

Bauer, E. A., and P. Bauer. 1995. Mule deer: behavior, ecology, conservation. Voyageur Press, Stillwater, MN.

Bibby, C. J., N. D. Burgess, D. A. Hill, and S. H. Mustoe. 2000. Bird Census Techniques, 2nd Edition. Academic Press, London.

Bjorkland, R. G. 1975. On the death of a midwestern heronry. Wilson Bulletin **87**:284-287.

Blakesley, J. A. 2009. Owl surveys in Rocky Mountain and Great Sand Dunes National Parks: Final Report. Rocky Mountain Bird Observatory, Brighton, CO. 23 pp.

Burgham, M. C. J., and J. Picman. 1989. Effect of brown-headed cowbirds on the evolution of yellow warbler anti-parasite strategies. Animal Behaviour **38**:298-308.

Carlson, B. A., and E. B. McLean. 1996. Buffer Zones and Disturbance Types as Predictors of Fledging Success in Great Blue Herons, *Ardea herodias*. Colonial Waterbirds **19**:124-127.

Castri, F. d., J. R. Vernhes, and T. Younés. 1992. Inventoring and monitoring biodiversity: a proposal for an international network. Biology International **27**.

Chao, A., K. H. Ma, T. C. Hsieh, and C. H. Chiu. 2015. Online Program SpadeR (Species-richness Prediction And Diversity Estimation in R). Program and User's Guide. Available at http://chao.stat.nthu.edu.tw/wordpress/software_download/.

Chiu, C.-H., Y.-T. Wang, B. A. Walther, and A. Chao. 2014. An Improved Nonparametric Lower Bound of Species Richness via a Modified Good–Turing Frequency Formula. Biometrics **70**:671-682.

Cicero, C. 1997. BOGGY MEADOWS, LIVESTOCK GRAZING, AND INTERSPECIFIC INTERACTIONS: INFLUENCES ON THE INSULAR DISTRIBUTION OF MONTANE LINCOLN'S SPARROWS (MELOSPIZA LINCOLNII ALTICOLA). The Great Basin Naturalist **57**:104-115.

Ciucci, P., and L. D. Mech. 1992. Selection of Wolf Dens in Relation to Winter Territories in Northeastern Minnesota. Journal of Mammalogy **73**:899-905.

Clark, K. L., and R. J. Robertson. 1981. Cowbird parasitism and evolution of anti-parasite strategies in the yellow warbler. The Wilson Journal of Ornithology **932**:249-258.

CNHP. 2023. Statewide List of Tracked Species and Communities. Online database available at https://cnhp.colostate.edu/ourdata/trackinglist/. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Colorado Parks & Wildlife (CPW). 2015. Colorado State Wildlife Action Plan - A Strategy For Conserving Wildlife in Colorado. Colorado Parks & Wildlife, Denver, CO.

Colorado Parks & Wildlife (CPW). 2022a. Draft Colorado Wolf Restoration and Management Plan. Presented to Colorado Parks and Wildlife Commission 9 December 2022 Colorado Parks & Wildlife, Fort Collins, CO 80526.

Colorado Parks & Wildlife (CPW). 2022b. Threatened and Endangered List - Colorado Parks & Wildlife. Available: http://wildlife.state.co.us/WildlifeSpecies/SpeciesOfConcern/ThreatenedEndangeredList/ListOfThreatenedAndEndangeredSpecies.htm. Colorado Parks & Wildlife, Colorado Department of Natural Resources.

Colorado Parks & Wildlife (CPW). 2023. CPW All Species Activity Mapping Data. Available online at http://www.arcgis.com/home/group.html?owner=rsacco&title=Colorado%20Parks%20and%20Wildlife%20-%20Species%20Activity%20Data. Colorado Parks & Wildlife, Fort Collins, CO.

Colorado Partners in Flight. 2000. Partners in Flight Land Bird Conservation Plan -- Colorado. Colorado Partners in Flight, , Estes Park, CO. .

Colorado Wildlife Science LLC (CWS). 2011. Avian Monitoring Report: 2000-08 Field Seasons. J. Lowsky, lead author. Unpublished technical report submitted to Pitkin County Open Space & Trails. Colorado Wildlife Science, Basalt, CO. 87 pp.

Colorado Wildlife Science LLC (CWS). 2016. Sky Mountain Park Habitat Treatment Update. Unpublished Technical Memorandum to Pitkin County Open Space & Trails. Colorado Wildlife Science LLC, Basalt, CO.

Colorado Wildlife Science LLC (CWS). 2018a. 2017 North Star Nature Preserve Wildlife Monitoring Report, Unpublished technical report prepared for Pitkin County Open Space & Trails. Basalt, CO.

Colorado Wildlife Science LLC (CWS). 2018b. Beaver Occupancy Survey. Unpublished technical memorandum to Pitkin County Open Space & Trails. 29 pp., Basalt, CO.

Colorado Wildlife Science LLC (CWS). 2018c. Great Blue Heron Colony Assessment. Unpublished technical memorandum to Pitkin County Open Space & Trails. 21 pp., Basalt, CO.

Colorado Wildlife Science LLC (CWS). 2021. Field Protocol for Avian Monitoring of Pitkin County Open Space Properties. Unpublished report. Basalt, CO.

Davidson, A. S., and R. L. Knight. 2001. Avian nest success and community composition in a western riparian forest. Journal of Wildlife Management 65:334-34.

Davis, G. E. 1989. Design of a long-term ecological monitoring program for Channel Islands National Park, California. Natural Areas Journal **9**:80-89.

deRoode, J. C. 2015. Monarchs as herbivores, prey, and hosts. Pages 43-46 *in* K. S. Oberhauser, K. R. Nail, and S. Altizer, editors. Monarchs in a Changing World: Biology and Conservation of an Iconic Butterfly. Cornell University Press, Ithaca, NY.

Dexter, C. 1998. River survey of west-central Colorado, for yellow-billed cuckoo and riparian weeds. Report prepared for the Bureau of Land Management. Bureau of Land Management, Grand Junction, CO. 26 pp.

Dolbeer, R. A., and W. R. Clark. 1975. Population ecology of snowshoe hares in the central Rocky Mountains. Journal of Wildlife Management **39**:535-549.

Dunn, J. L., and K. L. Garrett. 1997. A Field Guide to Warblers of North America.

Durães, R., L. Carrasco, T. B. Smith, and J. Karubian. 2013. Effects of forest disturbance and habitat loss on avian communities

in a Neotropical biodiversity hotspot. Biological Conservation **166**:203–211.

Edge, W. D., C. L. Marcum, and S. L. Olson-Edge. 1988. Summer forage and feeding site selection by elk. Journal of Wildlife Management **52**:573-577.

Elbroch, M. 2003. Mammal Tracks & Sign: A Guide to North American Species. Stackpole Books, Mechanicsburg, PA.

ESRI. 2008. ArcGIS version 9.x, version 9.2. Environmental Systems Research Institute, Redlands, California, USA.

Forys, E. A., and S. R. Humphrey. 1997. Comparison of 2 methods to estimate density of an endangered lagomorph. Journal of Wildlife Management **61**:86-92.

Fuller, M. R., and J. A. Mosher. 1987. Raptor survey techniques.*in* B. A. G. Pendleton, B. A. Millsap, K. W. Cline, and D. M. Bird, editors. Raptor Research Management Techniques Manual National Wildlife Federation, Washington D. C.

Gaines, D., and S. A. Laymon. 1984. Decline, status and preservation of the yellow-billed cuckoo in California. Western Birds **15**:49-80.

Glennon, M. J., and H. E. Kretser. 2013. Size of the ecological effect zone associated with exurban development in the Adirondack Park, NY. Landscape and Urban Planning **112**:10-17.

Golder Associates. 2014. 2014 Vegetation Assessment Summary - Sky Mountain Park. Lakewood, CO.

Golder Associates, and Colorado Wildlife Science LLC (CWS). 2014. Ecological Communities & Fluvial Geomorphology Baseline Report: North Star Nature Preserve. R. Mandel & J. Lowsky, lead authors. Unpublished technical report submitted to Pitkin County Open Space & Trails. Lakewood, CO. 215 pp.

Grubb, M. M. 1979. Effects of increased noise levels on nesting herons and egrets. Proceedings of 1978 Conference of Colonial Waterbird Group:49-54.

Halfpenny, J. 1986. A field guide to mammal tracking in North America. Second edition. Johnson Publishing Company, Boulder, Colorado.

Hammerson, G. A. 1999. Amphibians and reptiles in Colorado. 2nd edition. University Press of Colorado; Colorado Division of Wildlife, Niwot, Colo.

Hanni, D. J., C. M. White, J. A. Blakesley, G. J. Levandoski, and J. J. Birek. 2009. Point Transect Protocol. Unpublished report. Rocky Mountain Bird Observatory, Brighton, CO. 37 pp.

Hobson, K. A., and S. G. Sealy. 1989. Responses of yellow warblers to the threat of cowbird parasitism. Animal Behaviour **38**:510-519.

Holt, D. W., and J. M. Hillis. 1987. Current Status and Habitat Associations of Forest Owls in Western Montana. USDA Forest Service General Technical Report, RM-142, pgs 281-288, Winnipeg, Manitoba.

Interagency Lynx Biology Team. 2013. Canada lynx conservation assessment and strategy. 3rd edition. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication Rl-13-19, Missoula, MT.

Ivan, J. 2012. Monitoring Canada Lynx in Colorado Using Occupancy Estimation: Initial Implementation in the Core Lynx Research Area. . Pages 26-34 *in* C. D. o. P. a. Wildlife, editor. Wildlife Research Report, Mammals Research Program, Fort Collins, CO. 195 pp.

Ivan, J. S., and T. M. Shenk. 2016. Winter diet and hunting success of Canada lynx in Colorado. The Journal of Wildlife Management **80**:1049-1058.

Johnson, B. K., J. W. Kern, M. J. Wisdom, S. L. Findholt, and J. G. Kie. 2000. Resource selection and spatial separation of mule deer and elk during spring. Journal of Wildlife Management **64**:685-697.

Johnston, R. F. 2001. Synanthropic birds of North America. Pages 49-67 *in* J. M. Marzluff, R. Bowman, and R. Donnelly, editors. Avian Ecology and Conservation in an Urbanizing World. Springer US, Boston, MA.

Joy, S. M., R. T. Reynolds, and D. G. Leslie. 1994. Northern Goshawk Broadcast Surveys: Hawk Response Variables and Survey Costs.*in* W. M. Block, M. L. Morrison, and M. H. Resier, editors. The Northern Goshawk: Ecology and Management, Studies in Avian Biology No. 16:24.

Kennedy, P. L., and D. W. Stahlecker. 1993. Responsiveness of nesting Northern Goshawks to taped broadcasts of 3 conspecific calls. Journal of Wildlife Management **57**:249-257.

Kingery, H. E. 1998. Colorado breeding bird atlas. Colorado Bird Atlas Partnership : Colorado Division of Wildlife, Denver, Colo.

Kissling, M. L., and S. B. Lewis. 2009. Distribution, abundance, and ecology of forest owls in Southeast Alaska. U.S. Fish and Wildlife Service, Juneau Field Office and Alaska Department of Fish and Game, Division of Wildlife Conservation, Douglas, Alaska.

Knopf, F. L. 1985. Significance of riparian vegetation to breeding birds across an altitudinal cline. Pages 105-111 *in* Johnson, RR, Zeibell, CD, Patton, DR, Ffolliott, PF, Hamre, RH (Tech. Coord.), Riparian Ecosystems and their Management: Reconciling Conflicting uses. First North American Riparian Conference, Rocky Mountain Forest and Range Experimental Station.

Knopf, F. L., and J. A. Sedgwick. 1992a. An Experimental Study of Nest-Site Selection by Yellow Warblers. The Condor **94**:734-742.

Knopf, F. L., and J. A. Sedgwick. 1992b. An experimental study of nest-site selection by Yellow Warblers. Condor **94**:734-742.

Knopf, F. L., J. A. Sedgwick, and R. W. Cannon. 1988. Guild Structure of a Riparian Avifauna Relative to Seasonal Cattle Grazing. The Journal of Wildlife Management **52**:280-290.

Koehler, G. M. 1990. Snowshoe hare, Lepus americanus, use of forest successional stages and population changes during 1985-1989 in North-central Washington. Canadian Field-Naturalist **105**:291-293.

Koehler, G. M., and K. B. Aubry. 1994. Lynx. Pages 74-98 *in* L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, L. J. Lyon, and W. J. Zielinski, editors. The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx and Wolverine in the Western United States. Gen. Tech. Rep. RM-254. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Ft. Collins, CO.

Koehler, G. M., and J. D. Brittell. 1990. Managing Spruce-Fir Habitat for Lynx and Snowshoe Hares. Journal of Forestry **88**:10-14.

Krebs, C. J. 1989. Ecological Methodology. Harper- Collins Publishers, New York.

Kufeld, R. C., O. C. Wallmo, C. Feddema, and United States. Forest Service. 1973. Foods of the Rocky Mountain mule deer. Rocky Mountain Forest and Range Experiment Station Forest Service U.S. Dept. of Agriculture, Fort Collins, Colo.

Laymon, S. A. 1980. Feeding and nesting behavior of the yellow-billed cuckoo in the Sacramento Valley.

Leukering, T., M. Carter, A. Panjabi, D. Faulkner, and R. Levad. 1998. Rocky Mountain Bird Observatory Point Transect Protocol: Revised May 2006. Rocky Mountain Bird Observatory, Brighton, CO. 113 pp.

Leukering, T., and R. Levad. 2000. Monitoring Colorado's Birds: Final Report for the 1999, First Full-effor Year. Rocky Mountain Bird Observatory, Brighton, CO. 178 pp.

Longcore, T. 2007. Management by Assertion: Beavers and Songbirds at Lake Skinner (Riverside County, California). Environmental Management **39**:460-471.

Lowther, P. E., C. Celada, N. K. Klein, C. C. Rimmer, and D. A. Spector. 1999. Yellow Warbler (*Dendroica petechia*).*in* A. Poole, editor. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, NY. Retrieved from the Birds of North America Online http://bna.birds.cornell.edu/bna/species/454/.

M. P. Ward, R., and C. Krebs. 2011. Behavioural responses of lynx to declining snowshoe hare abundance. Canadian Journal of Zoology **63**:2817-2824.

Manley, P. N., B. V. Horne, J. K. Roth, W. J. Zielinski, M. M. McKenzie, T. J. Weller, F. W. Weckerly, and C. Vojta. 2006. Multiple species inventory and monitoring technical guide. Gen. Tech. Rep. WO-73. . Department of Agriculture, Forest Service, Washington Office. 204 p., Washington, DC.

McCorquodale, S. M. 1993. Winter foraging behavior of Elk in the shrub-steppe of Washington. Journal of Wildlife Management **57**:881-890.

McKelvey, K. S., K. B. Aubry, and Y. K. Ortega. 2000. History and distribution of lynx in the contiguous United States. Pages 207-264 *in* L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, G. M. Koehler, C. J. Krebs, K. S. McKelvey, and J. R. Squires, editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Denver, CO.

McLaren, M. F., C. M. White, N. J. V. Lanen, J. J. Birek, J. M. Berven, and D. J. Hanni. 2019. Integrated Monitoring in Bird Conservation Regions (IMBCR): Field protocol for spatially-balanced sampling of land bird populations. Unpublished report. Bird Conservancy of the Rockies, Brighton, Colorado, USA.

Mech, L. D. 1989. Wolf Population Survival in an Area of High Road Density. The American Midland Naturalist **121**:387-389.

Mech, L. D., S. H. Fritts, G. L. Radde, and W. J. Paul. 1988. Wolf Distribution and Road Density in Minnesota. Wildlife Society Bulletin (1973-2006) **16**:85-87.

Mladenoff, D. J., R. G. Haight, T. A. Sickley, and A. P. Wydeven. 1997. Causes and Implications of Species Restoration in Altered Ecosystems. BioScience **47**:21-31.

Munn, R. E. 1993. Monitoring for Ecosystem Integrity. Pages 105-116 *in* J. K. S. Woodley, and G. Francis, editor. Ecological Integrity and the Management of Ecosystems. St-Lucie Press, Florida.

Naiman, R. R., C. A. Johnston, and J. C. Kelley. 1988. Alteration of North American streams by beaver. BioScience **38**:753-762.

NatureServe. 2022. NatureServe Explorer: *An online encyclopedia of life* [web application]. . NatureServe Web Service, Arlington, Virginia. Available online at http://www.natureserve.org/explorer.

NatureServe. 2023. NatureServe Explorer: *An online encyclopedia of life* [web application]. . NatureServe Web Service, Arlington, Virginia. Available online at https://explorer.natureserve.org/.

Nelms, C. O., W. J. Bleier, D. L. Otis, and G. M. Linz. 1994. Population Estimates of Breeding Blackbirds in North Dakota, 1967, 1981- 1982 and 1990. American Midland Naturalist **132**:256.

Noon, B. R., T. A. Spies, and M. R. Raphael. 1999. Chapter 2: Conceptual basis for designing an effectiveness monitoring program. Pages 21-48 *in* P. N. R. S. USDA Forest Service, General Technical Report PNW-GTR-437, editor. The Strategy and Design of Effectiveness Monitoring Program for the Northwest Forest Plan.

Norman, W. S. Q., and J. E. Thompson. 1987. Dynamics of an Exploited Canada Lynx Population in Ontario. The Journal of Wildlife Management **51**:297-305.

Noss, R. F. 1990. Indicators for monitoring biodiversity: A hierarchical approach. Conservation Biology **4**:355-364.

Odell, E. A., D. M. Theobald, and R. L. Knight. 2003. Incorporating Ecology into Land Use Planning: The Songbirds' Case for Clustered Development. Journal of the American Planning Association **69**:72-82.

Ohmart, R. D. 1994. The effects of human-induced changes in the avifauna of western riparian habitats.

Olson, R., and W. A. Hubert. 1994. Beaver: Water resources and riparian habitat manager. University of Wyoming Cooperative Extension.

Pitkin County Open Space & Trails (OST). 2020. North Star Nature Preserve Management Plan. Pitkin County, Aspen, CO.

Poole, A., editor. 2005. The Birds of North America Online: http://bna.birds.cornell.edu/BNA/ Cornell Laboratory of Ornithology, Ithaca, NY.

Poole, K. 1994. Characteristics of an Unharvested Lynx Population during a Snowshoe Hare Decline.

Pringle, R. M., D. M. Kimuyu, R. L. Sensenig, T. M. Palmer, C. Riginos, K. E. Veblen, and T. P. Young. 2015. Synergistic effects of fire and elephants on arboreal animals in an African savanna. Journal of Animal Ecology **84**:1637–1645.

Quinn, N. W. S., and G. Parker. 1987. Lynx. Pages 683-694 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch, editors. Wild furbearer management and conservation in North America. Ontario Ministry of Natural Resources, Ontario, Canada.

Rinkevich, S. E., J. L. Ganey, J. L. W. Jr., G. C. White, D. L. Urban, A. B. Franklin, W. M. Block, and E. Clemente. 1995. General biology and ecological relationships of the Mexican Spotted Owl,. Pages 19-35 *in* K. J. Cook, editor. Recovery plan for the Mexican Spotted Owl. Vol. I. USDI Fish and Wildl. Serv., Albuquerque, NM.

RISC. 2001. Inventory Methods for Raptors: standards for Components of BC's Biodiversity No. 11, Version 2. Ministry of Sustainable Resource Management, Environment Inventory Branch for the Terrestrial Ecosystems Task Force, Victoria, BC, Canada.

Rising, J. D. 1996. A guide to the identification and natural history of the sparrows of the United States and Canada. Academic Press, San Diego, CA.

Robinson, S. K., and H. M. McChesney. 2022. Nesting success of red-winged blackbirds (Agelaius phoeniceus) in marshes in an anthropogenic landscape. R Soc Open Sci **9**:220266.

Ruediger, B., J. Claar, S. Gniadek, B.Holt, L.Lewis, S. Mighton, B. Naney, G. Patton, T. Rinaldi, J. Trick, A. Vandehey, F.Wahl, N. Warren, D. Wenger, and A. Williamson. 2000. Canada Lynx Conservation Assessment and Strategy. Missoula, MT. 142 pp.

Ruggiero, L. F., K. B. Aubry, S. W. Buskirk, G. M. Koehler, C. J. Krebs, K. S. McKelvey, and J. R. Squires. 2000. Ecology and conservation of lynx in the United States. RMRS-GTR-30WWW. USDA Forest Service. Rocky Mountain Research Station. University of Colorado Press. 480 p.

Sanders, T. A., and W. D. Edge. 1998. Breeding Bird Community Composition in Relation to Riparian Vegetation Structure in the Western United States. Journal of Wildlife Management **62**:461-473.

Shenk, T. 2009. Lynx Update, May 25, 2009. Available: http://wildlife.state.co.us/NR/rdonlyres/1E7C95D0-53F3-41EB-82DD-26134C0FF261/0/LynxUpdateMay252009.pdf. Colorado Division of Wildlife, Fort Collins, CO.

Shenk, T. M., and R. H. Kahn. 2010. The Colorado lynx reintroduction program. Colorado Division of Wildlife, Denver, CO.

Slough, B., and G. Mowat. 1996. Lynx Population Dynamics in an Untrapped Refugium.

Sofaer, H. R., C. H. Flather, C. S. Jarnevich, K. P. Davis, and L. Pejchar. 2020. Human-associated species dominate passerine communities across the United States. Global Ecology and Biogeography **29**:885-895.

Spackman, S., K. Fayette, J. Siemers, K. Murell, and M. Sherman. 1999. Roaring Fork Watershed Biological Inventory 1997-1999. Colorado Natural Heritage Program, Fort Collins, CO.

Squires, J., E. Roberts, M. Hebblewhite, and J. Ivan. 2011. The Effects of Winter Recreation on the Movements and Resource Use of Canada Lynx on the Vail Pass Recreation Area: A Pilot Administrative Study.

Squires, J. R., N. J. Decesare, J. A. Kolbe, and L. F. Ruggiero. 2010. Seasonal Resource Selection of Canada Lynx in Managed Forests of the Northern Rocky Mountains. The Journal of Wildlife Management **74**:1648-1660.

Squires, J. R., and T. Laurion. 2000. Lynx home range and movements in Montana and Wyoming: preliminary insights. Pages 337–349 *in* L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, G. M. Koehler, C. J. Krebs, K. S. McKelvey, and J. R. Squires, editors. Ecology and conservation of lynx in the United States. RMRS-GTR-30WWW. USDA Forest Service. Rocky Mountain Research Station. University of Colorado Press. 480 p, Boulder, CO.

Stauffer, D. E., and L. B. Best. 1980. Habitat selection by birds of riparian communities: evaluating effects of habitat alterations. Journal of Wildlife Management **44**:1-15.

Stephens, R. M., and S. H. Anderson. 2003. Lincoln's Sparrow (*Melospiza lincolnii*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/lincolnssparrow.pdf.

Steury, T. D., and D. L. Murray. 2004. Modeling the reintroduction of lynx to the southern portion of its range. Biological Conservation **117**:127-141.

Summers, K. 1996. Management guidelines for Great Blue Heron colonies in British Columbia.

Suter, G. W. 1993. Ecological risk assessment, Boca Raton, FL.

Takats, D. L., C. M. Francis, G. L. Holroyd, J. R. Duncan, K. M. Mazur, R. J. Cannings, W. Harris, and D. Holt. 2001. Guidelines for Nocturnal Owl Monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada, Edmonton, Alberta.

Takats, D. L., and G. L. Holroyd. 1997. Owl broadcast surveys in the Foothills Model Forest, Alberta, Canada. Pages 421-431 *in* Biology and conservation of owls of the Northern Hemisphere: 2nd International Symposium,

February 5-9 1997. U.S.Department of Agriculture, Forest Service, General Technical Report NC-190, St. Paul, MN, Winnipeg, Manitoba.

Terres, J. K. 1980. The Audubon Society encyclopedia of North American birds. A. Knopf, New York. 1100pp.

Thiel, R. P. 1985. Relationship between Road Densities and Wolf Habitat Suitability in Wisconsin. The American Midland Naturalist **113**:404-407.

Thompson, R. W., and J. C. Halfpenny. 1989. Canada lynx presence on Vail Ski Area and proposed expansion areas. Western Ecosystems, Inc, Lafayette, CO.

Toweill, D. E., J. W. Thomas, and D. P. Metz. 2002. North American elk: ecology and management. 1st edition. Smithsonian Institution Press, Washington [D.C.].

Tozer, D. C., E. Nol, and K. F. Abraham. 2010. Effects of local and landscape-scale habitat variables on abundance and reproductive success of wetland birds. Wetlands Ecology and Management **18**:679-693.

U. S. Department of Agriculture Forest Service. 2006. Species Conservation Program: Species Conservation Assessments [Online]. USDA Forest Service, Rocky Mountain Region, Available: http://www.fs.fed.us/r2/projects/scp/assessments/index.shtml.

USDA Forest Service. 2008a. Record of Decision, Southern Rockies Lynx Amendment Management Direction.*in* R. M. R. USDA Forest Service, editor., Denver, CO. 35 pp with attachments.

USDA Forest Service. 2008b. Southern Rockies Lynx Amendment. Environmental Impact Statement. Rocky Mountain Region, USDA Forest Service, Lakewood, CO.

USDA Forest Service. 2008c. Supplemental Biological Assessment for the Southern Rockies Lynx Amendment. Rocky Mountain Region, USDA Forest Service, Lakewood, CO.

USDA Forest Service. 2009. Southern Rockies Lynx Amendment. Implementation Guide. Rocky Mountain Region, USDA Forest Service, Lakewood, CO.

USFS. 1994. Neotropical Migratory Bird Reference Book. USDA Forest Service Pacific Southwest Region, San Francisco, CA.

Vennesland, R. G. 2000. The effects of disturbance from humans and predators on the breeding decisions and productivity of the Great Blue Heron in south-coastal British Columbia. M.S. Simon Fraser University, Burnaby, B.C.

Vierling, K. T. 2000. Source and sink habitats of red-winged blackbirds in a rural/suburban landscape. Ecological Applications **10**:1211-1218.

Vos, D. K., R. A. Ryder, and W. D. Graul. 1985. Response of breeding great blue herons (Ardea herodias) to human disturbance in north central Colorado. Colonial Waterbirds **8**:13-22.

Watson, J. W., D. W. Hays, and D. J. Pierce. 1999. Efficacy of Northern Goshawk broadcast surveys in Washington State. Journal of Wildlife Management **63**:98-106.

Watts, B. D., and D. S. Bradshaw. 1994. The influence of human disturbance on the location of great blue heron colonies in the lower Chesapeake Bay. Colonial Waterbirds **17**:184-186.

Weckerly, F. W., and M. A. Ricca. 2000. Using presence of sign to measure habitats used by Roosevelt elk. Wildlife Society Bulletin **28**:146-153.

Wershkul, D. F., E. McMahon, and M. Lieitschuh. 1976. Some effects of human activities on the great blue heron in Oregon. Wilson Bulletin **88**:660-662.

Western Ecological Resource Inc. (WER). 2011. Biological & Historical Resource Surveys - Pitkin County, City of Aspen, & Town of Snowmass Village. Boulder, CO.

Wickersham, L. 2007. Colorado Breeding Bird Atlas II. San Juan Institute of Natural and Cultural Resources. Durango, Colorado. Found online at http://www.cobreedingbirdatlasii.org.

Wiggins, D. A. 2006. American Bittern (*Botaurus lentiginosus*): a technical conservation assessment [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/americanbittern.pdf.

Wolff, J. O. 1980. The Role of Habitat Patchiness in the Population Dynamics of Snowshoe Hares. Ecological Monographs **50**:111-130.

Woodley, S. 1996a. Monitoring, assessing and reporting upon ecological change: implications for planning and management. Environments **24**:60–68.

Woodley, S. 1996b. A scheme for ecological monitoring in national parks and protected areas. Environments **23**:50–59.

Appendix A. USFWS Consultation Letter

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Western Colorado Ecological Services Field Office
445 West Gunnison Avenue, Suite 240
Grand Junction, CO 81501-5711
Phone: (970) 628-7180 Fax: (970) 245-6933

In Reply Refer To: 04/19/2024 20:29:19 UTC
Project Code: 2024-0079794
Project Name: North Star Nature Preserve Wildlife Monitoring

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through IPaC by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological

evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see Migratory Bird Permit | What We Do | U.S. Fish & Wildlife Service (fws.gov).

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

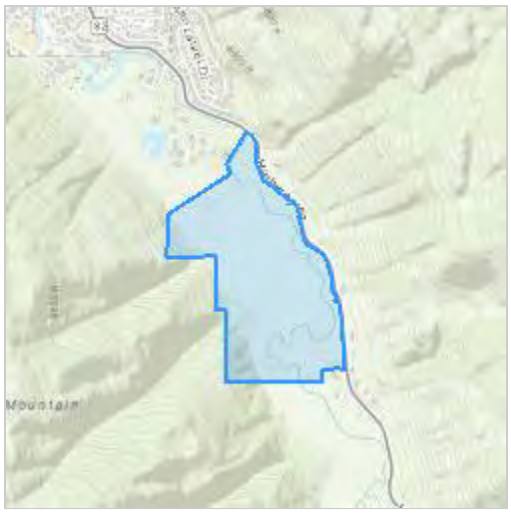
This species list is provided by:

Western Colorado Ecological Services Field Office
445 West Gunnison Avenue, Suite 240
Grand Junction, CO 81501-5711
(970) 628-7180

PROJECT SUMMARY

Project Code: 2024-0079794
Project Name: North Star Nature Preserve Wildlife Monitoring
Project Type: Management Plans Land Management/Restoration
Project Description: This report documents results of the 2021-2022 wildlife monitoring conducted on the North Star Nature Preserve in Aspen, CO.
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@39.169859535962395,-106.79445121211197,14z



Counties: Pitkin County, Colorado

ENDANGERED SPECIES ACT SPECIES

There is a total of 11 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 4 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Canada Lynx *Lynx canadensis* Population: Wherever Found in Contiguous U.S. There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3652	Threatened
Gray Wolf *Canis lupus* Population: CO No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4488	Experimental Population, Non-Essential

BIRDS

NAME	STATUS
Mexican Spotted Owl *Strix occidentalis lucida* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8196	Threatened
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

FISHES

NAME	STATUS
Bonytail *Gila elegans* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. This species only needs to be considered under the following conditions: ▪ Water depletions in the upper Colorado River basin adversely affect this species and its critical habitat. Effects of water depletions must be considered even outside of occupied range. Species profile: https://ecos.fws.gov/ecp/species/1377	Endangered
Colorado Pikeminnow *Ptychocheilus lucius* Population: Wherever found, except where listed as an experimental population There is **final** critical habitat for this species. Your location does not overlap the critical habitat. This species only needs to be considered under the following conditions: ▪ Water depletions in the upper Colorado River basin adversely affect this species and its critical habitat. Effects of water depletions must be considered even outside of occupied range. Species profile: https://ecos.fws.gov/ecp/species/3531	Endangered
Humpback Chub *Gila cypha* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. This species only needs to be considered under the following conditions:	Threatened

NAME STATUS

- Water depletions in the upper Colorado River basin adversely affect this species and its critical habitat. Effects of water depletions must be considered even outside of occupied range.

Species profile: https://ecos.fws.gov/ecp/species/3930

Razorback Sucker *Xyrauchen texanus* Endangered

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
This species only needs to be considered under the following conditions:

- Water depletions in the upper Colorado River basin adversely affect this species and its critical habitat. Effects of water depletions must be considered even outside of occupied range.

Species profile: https://ecos.fws.gov/ecp/species/530

INSECTS

NAME STATUS

Monarch Butterfly *Danaus plexippus* Candidate

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/9743

Silverspot *Speyeria nokomis nokomis* Threatened

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/2813

FLOWERING PLANTS

NAME STATUS

Ute Ladies'-tresses *Spiranthes diluvialis* Threatened

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/2159

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

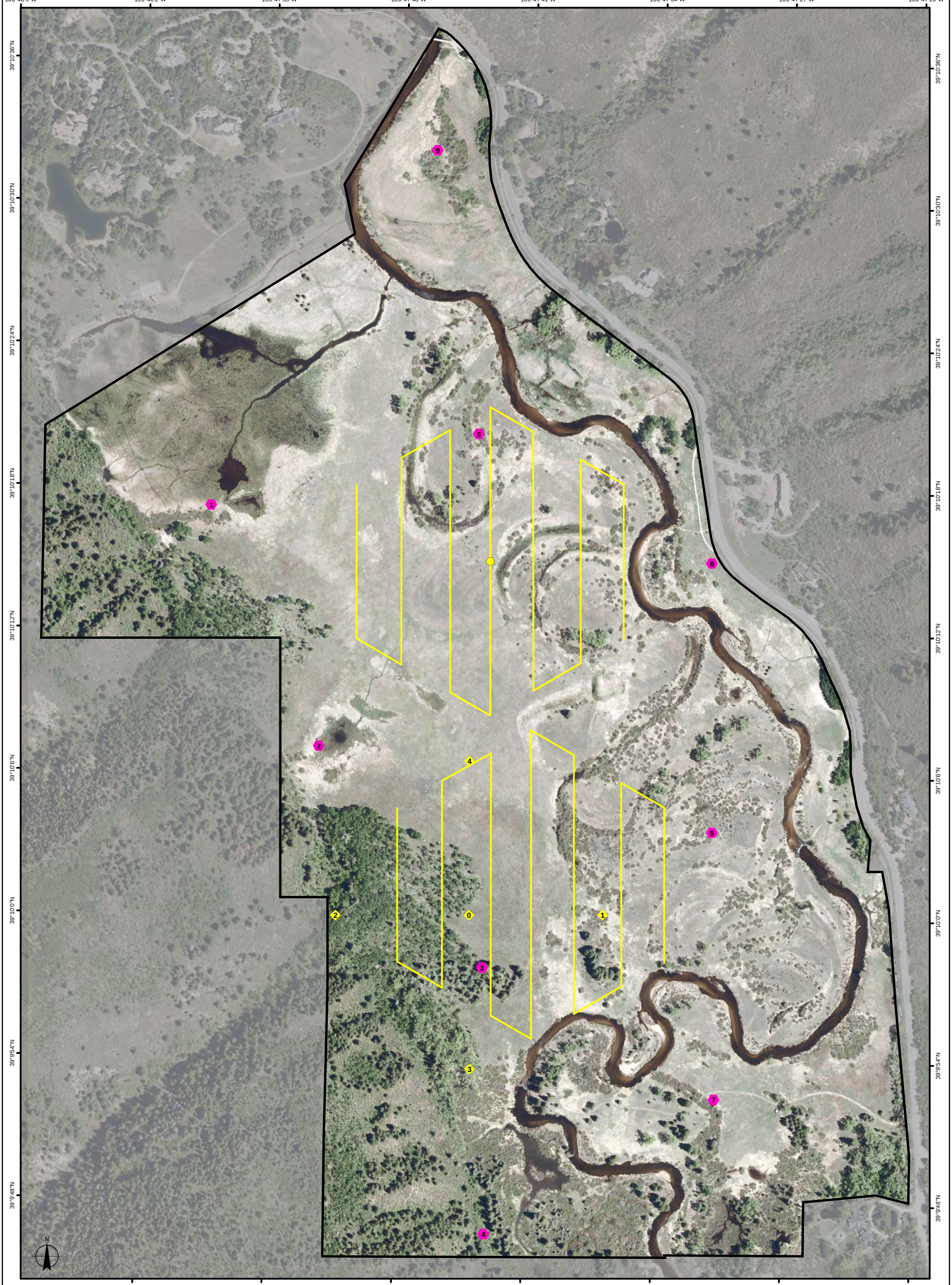
IPAC USER CONTACT INFORMATION

Agency:	Colorado Wildlife Science, LLC
Name:	Jonathan Lowsky
Address:	Colorado Wildlife Science, LLC
Address Line 2:	0100 Elk Run Drive STE 128
City:	Basalt
State:	CO
Zip:	81621
Email	jonathan@coloradowildlifescience.com
Phone:	9706184740

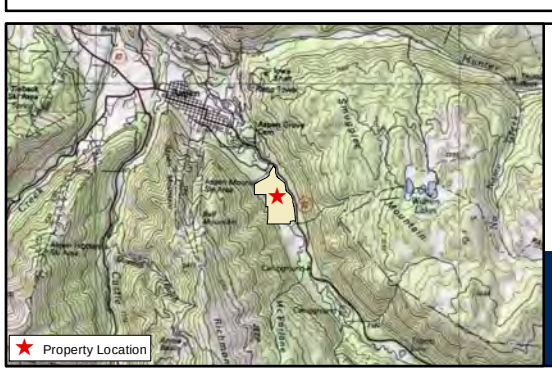
Appendix B. Maps

106°48'9"W 106°48'2"W 106°47'55"W 106°47'48"W 106°47'41"W 106°47'34"W 106°47'27"W 106°47'20"W

39°10'36"N 39°10'30"N 39°10'24"N 39°10'18"N 39°10'12"N 39°10'6"N 39°9'54"N 39°9'48"N



106°48'2"W 106°47'55"W 106°47'48"W 106°47'41"W 106°47'34"W 106°47'27"W 106°47'20"W



North Star Nature Preserve

Pitkin County, CO

Wildlife Monitoring Report

Map 1. TVES Transects & Camera Locations, & Nocturnal Bird Surveys

Legend:

- Property Boundary
- 3 — Nocturnal Bird Survey Point
- TVES Transect Leg
- 3 — Camera Survey Point

0 25 50 100 150 200 Meters

1 in = 115 meters

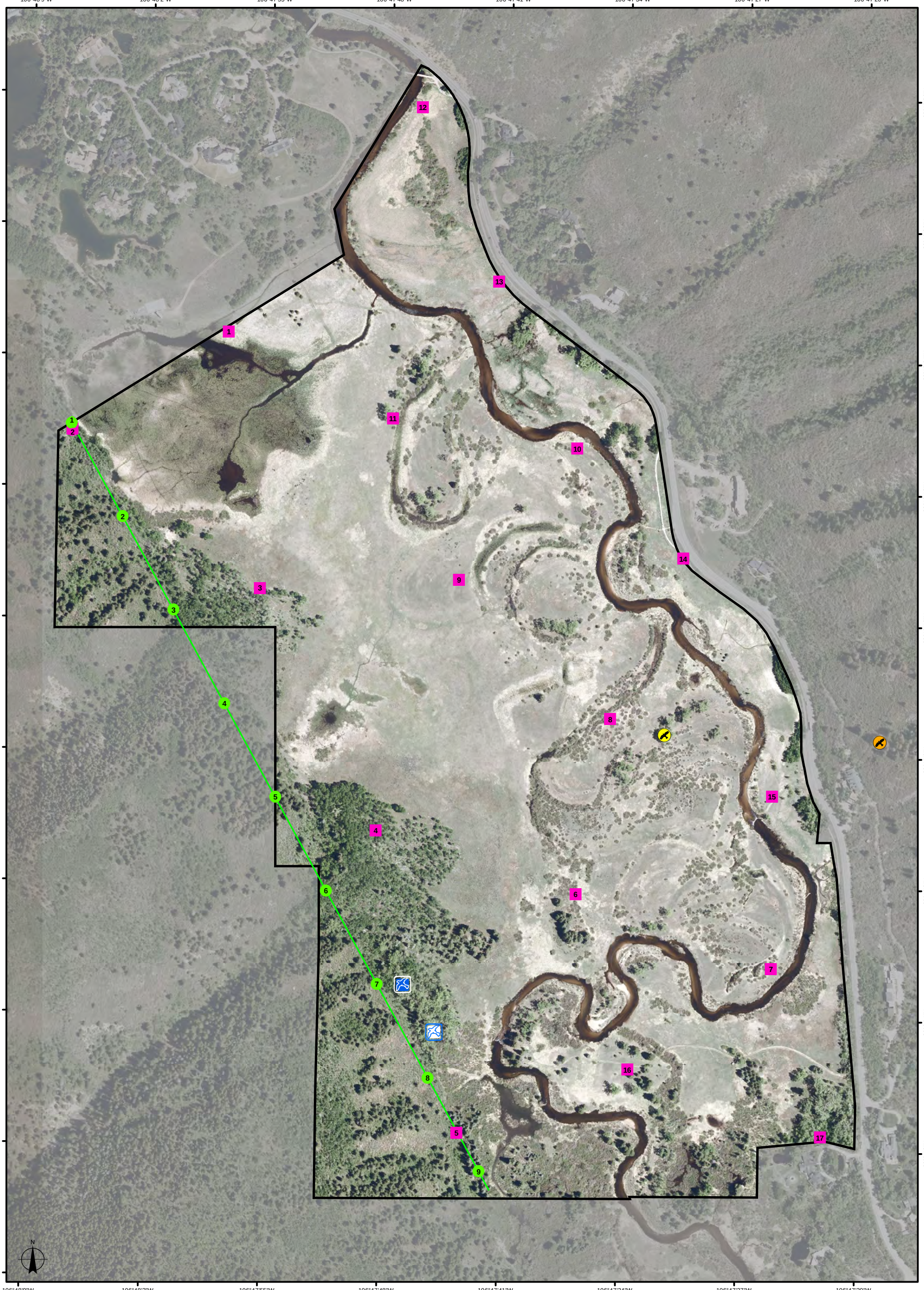
NOTE: Boundaries are approximate

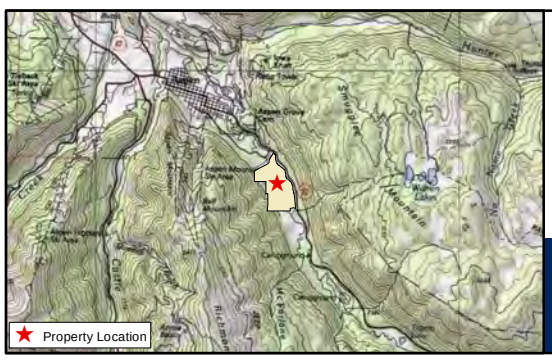
Base Layer Source:
Pitkin County GIS
2022 Digital Orthophotos

COLORADO WILDLIFE SCIENCE
Wildlife & Wildfire Research, Management & Consulting
0100 Elk Run Dr, Ste 128, Basalt, CO 81621
970.618.4740
www.coloradowildlifescience.com

106°48'9"W 106°48'2"W 106°47'55"W 106°47'48"W 106°47'41"W 106°47'34"W 106°47'27"W 106°47'20"W

39°10'36"N 39°10'30"N 39°10'24"N 39°10'18"N 39°10'12"N 39°10'6"N 39°10'0"N 39°9'54"N 39°9'48"N





North Star Nature Preserve

Pitkin County, CO

Wildlife Monitoring Report

Map 1. Avian Point Transect, Diurnal Raptor Transect, & Observations/Detections of Note

Legend:

- Property Boundary
- 3 — Avian Monitoring Point
- 3 — Nocturnal Bird Point Transect
- 2017 N. Saw-Whet Owl Detection
- 2021 N. Saw-Whet Owl Detection
- Cooper's Hawk Nest (Active)
- 2021 Cooper's Hawk Observation

0 25 50 100 150 200 Meters

1 in = 125 meters

NOTE: Boundaries are approximate

Base Layer Source:
Pitkin County GIS
2022 Digital Orthophotos

COLORADO WILDLIFE SCIENCE
Wildlife & Wildfire Research, Management & Consulting
0100 Elk Run Dr, Ste 128, Basalt, CO 81621
970.618.4740
www.coloradowildlifescience.com

Appendix C. List of bird species detected during avian monitoring 2001-2020

	Common Name	Scientific Name	4-Letter Code
1	American Coot	*Fulica americana*	AMCO
2	American Crow	*Corvus brachyrynchos*	AMCR
3	American Dipper	*Cinclus mexicanus*	AMDI
4	American Goldfinch	*Spinus tristis*	AMGO
5	American Goshawk (formerly Northern Goshawk)	*Accipiter atricapillus*	AGOS
6	American Kestrel	*Falco sparverius*	AMKE
7	American Pipit	*Anthus rubescens*	AMPI
8	American Robin	*Turdus migratorius*	AMRO
9	Yellow Warbler	*Turdus migratorius*	AMRO
10	Band-tailed Pigeon	*Patagioenas fasciata*	BTPI
11	Bank Swallow	*Riparia riparia*	BANS
12	Barn Swallow	*Hirundo rustica*	BARS
13	Belted Kingfisher	*Megaceryle alcyon*	BEKI
14	Black-billed Magpie	*Pica hudsonia*	BBMA
15	Black-capped Chickadee	*Poecile atricapillus*	BCCH
16	Black-headed Grosbeak	*Pheucticus melanocephalus*	BHGR
17	Blue-gray Gnatcatcher	*Polioptila caerulea*	BGGN
18	Brewer's Blackbird	*Euphagus cyanocephalus*	BRBL
19	Broad-tailed Hummingbird	*Selasphorus platycercus*	BTLH
20	Brown Creeper	*Certhia americana*	BRCR
21	Brown-headed Cowbird	*Molothrus ater*	BHCO
22	Canada Goose	*Branta canadensis*	CANG
23	Cedar Waxwing	*Bombycilla cedrorum*	CEDW
24	Chipping Sparrow	*Spizella passerina*	CHSP
25	Cinnamon Teal	*Anas cyanoptera*	CITE
26	Common Raven	*Corvus corax*	CORA
27	Cooper's Hawk	*Accipiter cooperi*	COHA
28	Dark-eyed Junco	*Junco hyemalis*	DEJU
29	Dusky Flycatcher	*Empidonax oberholseri*	DUFL
30	Dusky Grouse	*Dendragapus obscurus*	DUGR
31	Eared Grebe	*Podiceps nigricollis*	EAGR
32	European Starling	*Sturnus vulgaris*	EUST
33	Fox Sparrow	*Passerella iliaca*	FOSP
34	Gadwall	*Mareca strepera*	GADW
35	Great-horned Owl	*Bubo virginianus*	GHOW
36	Golden Eagle	*Aquila chrysaetos*	GOEA
37	Great Blue Heron	*Ardea herodias*	GBHE
38	Green-tailed Towhee	*Pipilo chlorurus*	GTTO
39	Green-winged Teal	*Anas carolinensis*	GWTE

	Common Name	Scientific Name	4-Letter Code
40	Hairy Woodpecker	*Picoides villosus*	HAWO
41	Hermit Thrush	*Catharus guttatus*	HETH
42	House Finch	*Haemorhous mexicanus*	HOFI
43	House Wren	*Troglodytes aedon*	HOWR
44	Killdeer	*Charadrius vociferus*	KILL
45	Lark Sparrow	*Chondestes grammacus*	LASP
46	Lazuli Bunting	*Passerina amoena*	LAZB
47	Lesser Goldfinch	*Spinus psaltria*	LEGO
48	Lewis's Woodpecker	*Melanerpes lewis*	LEWO
49	Lincoln's Sparrow	*Melospiza lincolnii*	LISP
50	MacGillivray's Warbler	*Geothlypis tolmiei*	MGWA
51	Mallard	*Anas platyrynchus*	MALL
52	Mountain Bluebird	*Sialia currucoides*	MOBL
53	Mountain Chickadee	*Poecile gambeli*	MOCH
54	Mourning Dove	*Zenaida macroura*	MODO
55	Northern Shrike	*Lanius borealis*	NOSH
56	Orange-crowned Warbler	*Oreothlypis celata*	OCWA
57	Olive-sided Flycatcher	*Contopus cooperi*	OSFL
58	Osprey	*Pandion haliaetus*	OSPR
59	Pied-billed Grebe	*Podilymbus podiceps*	PBGR
60	Pine Siskin	*Carduelis pinus*	PISI
61	Plumbeous Vireo	*Vireo plumbeus*	PLVI
62	Red-naped Sapsucker	*Sphyrapicus nuchalis*	RNSA
63	Red-shafted Flicker	*Colaptes auratus cafe*	RSFL
64	Red-tailed Hawk	*Buteo jamaicensis*	RTHA
65	Red-winged Blackbird	*Agelaius phoeniceus*	RWBL
66	Ring-necked Duck	*Aythya collaris*	RNDU
67	Ruby-crowned Kinglet	*Regulus calendula*	RCKI
68	Savannah Sparrow	*Passerculus sandwichensis*	SASP
69	Say's Phoebe	*Sayornis saya*	SAPH
70	Song Sparrow	*Melospiza melodia*	SOSP
71	Sora	*Porzana carolina*	SORA
72	Spotted Sandpiper	*Actitis macularia*	SPSA
73	Spotted Towhee	*Pipilo maculatus*	SPTO
74	Steller's Jay	*Cyanocitta stelleri*	STJA
75	Swainson's Thrush	*Catharus ustulatus*	SWTH
76	Tree Swallow	*Tachycineta bicolor*	TRES
77	Vesper Sparrow	*Pooecetes gramineu*	VESP
78	Violet-green Swallow	*Tachycineta thalassina*	VGSW
79	Virginia Rail	*Rallus limicola*	VIRA
80	Virginia's Warbler	*Oreothlypis virginiae*	VIWA

	Common Name	Scientific Name	4-Letter Code
81	Warbling Vireo	*Vireo gilvus*	WAVI
82	Western Flycatcher (formerly Cordilleran Flycatcher)	*Empidonax difficilis*	WEFL
83	Western Kingbird	*Tyrannus verticalis*	WEKI
84	Western Tanager	*Piranga ludoviciana*	WETA
85	Western Wood-pewee	*Contopus sordidulus*	WEWP
86	White-breasted Nuthatch	*Sitta carolinensis*	WBNU
87	White-crowned Sparrow	*Zonotrichia leucophrys*	WCSP
88	White-throated Swift	*Aeronautes saxatalis*	WTSW
89	Wild Turkey	*Meleagris gallopavo merriami*	WITU
90	Wilson's Snipe	*Gallinago delicata*	WISN
91	Yellow-rumped Warbler	*Setophaga coronata*	AUWA
92	Yellow Warbler	*Setophaga petechia*	YEWA

Appendix D. Photos

Photo 4. Bull elk in velvet

Photo 5. Bull elk with cows

Photo 6. Mule deer buck in velvet

Photo 7. Coyote

Photo 8. Bull moose

Photo 9. Black bear sniffing the trapping lure

Photo 10. Striped skunk

Appendix E. CPW Moose, Mule Deer, Bighorn Sheep, & Elk Habitat Definitions

MOOSE

CONCENTRATION AREA: That part of the range of a species where densities are 200% higher than the surrounding area during a specific season.

OVERALL RANGE: The area which encompasses all known seasonal activity areas within the observed range of a population of moose.

SUMMER RANGE: That part of the overall range where 90% of the individuals are located during the summer months. This summer time frame will be delineated with specific start/end dates for each moose population within the state (ex: May 1 to Sept 15). Summer range is not necessarily exclusive of winter range.

WINTER RANGE: That part of the overall range where 90 percent of the individuals are located during the winter months. This winter time frame will be delineated with specific start/end dates for each moose population within the state (ex: November 15 to April 1).

MULE DEER

CONCENTRATION AREA: That part of the overall range where higher quality habitat supports significantly higher densities than surrounding areas. These areas are typically occupied year round and are not necessarily associated with a specific season. Includes rough break country, riparian areas, small drainages, and large areas of irrigated cropland.

HIGHWAY CROSSING: Those areas where mule deer movements traditionally cross roads, presenting potential conflicts between mule deer and motorists.

MIGRATION CORRIDORS: A specific Mappable site through which large numbers of animals migrate and loss of which would change migration routes.

OVERALL RANGE: The area which encompasses all known seasonal activity areas within the observed range of a mule deer population.

RESIDENT POPULATION: An area that provides year-round range for a population of mule deer. The resident mule deer use all of the area all year; it cannot be subdivided into seasonal ranges although it may be included within the overall range of the larger population.

SEVERE WINTER: That part of the overall range where 90% of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten. SUMMER RANGE: That part of the overall range where 90% of the individuals are located between spring green-up and the first heavy snowfall. Summer range is not necessarily exclusive of winter range; in some areas winter range and summer range may overlap.

WINTER CONCENTRATION: That part of the winter range where densities are at least 200% greater than the surrounding winter range density during the same period used to define winter range in the average five winters out of ten.

WINTER RANGE: That part of the overall range where 90 percent of the individuals are located during the average five winters out of ten from the first heavy snowfall to spring green-up, or during a site specific period of winter as defined for each DAU.

ROCKY MOUNTAIN ELK

HIGHWAY CROSSING: Those areas where elk movements traditionally cross roads, presenting potential conflicts between elk and motorists.

MIGRATION CORRIDORS: A specific Mappable site through which large numbers of animals migrate and loss of which would change migration routes.

OVERALL RANGE: The area which encompasses all known seasonal activity areas within the observed range of an elk population.

PRODUCTION AREA: That part of the overall range of elk occupied by the females from May 15 to June 15 for calving. (Only known areas are Mapped and this does not include all production areas for the DAU).

RESIDENT POPULATION: An area used year-round by a population of elk. Individuals could be found in any part of the area at any time of the year; the area cannot be subdivided into seasonal ranges. It is most likely included within the overall range of the larger population.

SEVERE WINTER: That part of the range of a species where 90 percent of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten. The winter of 1983-84 is a good example of a severe winter.

SUMMER CONCENTRATION: Those areas where elk concentrate from mid-June through mid-August. High quality forage, security, and lack of disturbance are characteristics of these areas to meet the high energy demands of lactation, calf rearing, antler growth, and general preparation for the rigors of fall and winter.

SUMMER RANGE: That part of the range of a species where 90% of the individuals are located between spring green-up and the first heavy snowfall, or during a site specific period of summer as defined for each DAU. Summer range is not necessarily exclusive of winter range; in some areas winter range and summer range may overlap.

WINTER CONCENTRATION: That part of the winter range of a species where densities are at least 200% greater than the surrounding winter range density during the same period used to define winter range in the average five winters out of ten.

WINTER RANGE: That part of the overall range of a species where 90 percent of the individuals are located during the average five winters out of ten from the first heavy snowfall to spring green-up, or during a site specific period of winter as defined for each DAU.

Source: CPW 2023

APPENDIX F. Coordinates of monitoring sites

STATION	LATITUDE	LONGITUDE
1	39° 10' 25.10" N	106° 47' 57.45" W
2	39° 10' 20.57" N	106° 48' 6.53" W
3	39° 10' 13.42" N	106° 47' 55.41" W
4	39° 10' 2.43" N	106° 47' 48.42" W
5	39° 9' 48.67" N	106° 47' 43.42" W
6	39° 9' 59.64" N	106° 47' 36.64" W
7	39° 9' 56.35" N	106° 47' 25.12" W
8	39° 10' 7.65" N	106° 47' 34.74" W
9	39° 10' 13.91" N	106° 47' 43.73" W
10	39° 10' 19.98" N	106° 47' 36.91" W
11	39° 10' 21.23" N	106° 47' 47.74" W
12	39° 10' 35.47" N	106° 47' 46.24" W
13	39° 10' 27.57" N	106° 47' 41.63" W
14	39° 10' 15.03" N	106° 47' 30.59" W
15	39° 10' 4.21" N	106° 47' 25.19" W
16	39° 9' 51.66" N	106° 47' 33.45" W
17	39° 9' 48.69" N	106° 47' 22.09" W

Table 13. Avian monitoring station locations with ID number and Lat/Long (DMS) location

STATION	LATITUDE	LONGITUDE
1	39° 10' 20.85" N	106° 48' 6.59" W
2	39° 10' 16.61" N	106° 48' 3.53" W
3	39° 10' 12.37" N	106° 48' 0.46" W
4	39° 10' 8.13" N	106° 47' 57.40" W
5	39° 10' 3.89" N	106° 47' 54.34" W
6	39° 9' 59.65" N	106° 47' 51.28" W
7	39° 9' 55.41" N	106° 47' 48.21" W
8	39° 9' 51.17" N	106° 47' 45.15" W
9	39° 9' 46.93" N	106° 47' 42.09" W

Table 14. Diurnal raptor broadcast points

STATION	LATITUDE	LONGITUDE
1	39° 10' 17.20" N	106° 47' 58.32" W
2	39° 10' 7.12" N	106° 47' 52.33" W
3	39° 9' 57.87" N	106° 47' 43.32" W
4	39° 9' 46.64" N	106° 47' 43.03" W
5	39° 10' 3.68" N	106° 47' 30.97" W
6	39° 10' 20.34" N	106° 47' 43.89" W
7	39° 9' 52.45" N	106° 47' 30.68" W
8	39° 10' 15.03" N	106° 47' 31.17" W
9	39° 10' 32.27" N	106° 47' 46.33" W

Table 15. Nocturnal bird broadcast points

STATION	LATITUDE	LONGITUDE
1	39° 10' 6.56" N	106° 47' 44.15" W
2	39° 10' 0.16" N	106° 47' 36.82" W
3	39° 9' 53.58" N	106° 47' 43.91" W
4	39° 10' 0.00" N	106° 47' 51.28" W
5	39° 10' 6.56" N	106° 47' 44.15" W

Table 16. Monitoring camera stations

GRID	LATITUDE	LONGITUDE
North	39° 10' 0.09" N	106° 47' 44.07" W
South	39° 10' 14.99" N	106° 47' 43.17" W

Table 17. TVES hexagon center points

APPENDIX G. Special Status Species

FEDERALLY LISTED SPECIES

As described above, the property was submitted to USFWS via the IPaC system requesting an official list of Threatened, Endangered, or Candidate species on April 19, 2024 may occur on or within proximity to the property or may be affected by decisions regarding management of the property. Species protected under the ESA that may occur on or within proximity to North Star are listed below in Table 1. Three federally protected or candidate species are known or have the potential to occur on or adjacent to North Star: Canada lynx (*Lynx canadensis*), gray wolf (*Canis lupus*), and monarch butterfly.

Table 18. Threatened, Endangered, or Candidate species that occur at North Star, have the potential to occur at North Star, or be affected by management of North Star

Common Name *Latin Name*	Occurrence Habitat	Status‡	Potential Habitat on the Property
BIRDS			
Mexican Spotted Owl *Strix occidentalis lucida*	Occurs in forested mountains and canyonlands throughout the SW U.S. & Mexico. Ranges from UT, CO, AZ, NM & western portions of TX, south into several states of Mexico. Does not occur uniformly throughout its range. Instead, it occurs in disjunct areas that correspond with isolated mountain ranges and canyon systems.	FT, ST	No
	Complex forest or rocky canyons that contain uneven-aged, multi-level and old-aged, thick forests below 9,500 feet elevation. Nests in standing snags and hollow trees (Rinkevich et al. 1995)		
Western Yellow-Billed Cuckoo *Coccyzus americanus*	In CO west of the Continental Divide, probably never common (Bailey and Niedrach 1965, Kingery 1998) & now extremely rare (Kingery 1998). One confirmed nesting observation occurred along Yampa River near Hayden during the Breeding Bird Atlas surveys conducted from 1987-1994 (Kingery 1998) & one cuckoo, representing a probable nesting pair in surveyed lowland river riparian habitat along 6 rivers in west-central CO (Dexter 1998).	FT, SC	No
	Nest almost exclusively in low to moderate elevation riparian woodlands with native broadleaf trees and shrubs that are 20 hectares (ha) (50 acres (ac)) or more in extent within arid to semiarid landscapes (Laymon 1980, Gaines and Laymon 1984, Kingery 1998). Feed on grasshoppers, caterpillars, beetles, and other insects.		
MAMMALS			
Canada Lynx ***Lynx canadensis***	**Colorado is the southern limit of the North American distribution of the species, and the population is considered isolated from those in the Northern Rockies (McKelvey et al. 2000).**	**FT, SE**	**Yes**
	Found primarily within the subalpine and upper montane forests zones typically from 8,000 to 12,000 feet in elevation. Early successional spruce/fir and lodgepole pine forests used for foraging, mature and old growth spruce/fir and lodgepole pine containing large downed woody debris used for denning. Riparian areas, mixed aspen/conifer, mature spruce/fir, and shrublands to forested lynx habitat also used for foraging.		
Gray Wolf ***Canis lupus***	**CO is part of the gray wolf's native range, but wolves were eradicated by the 1940s. Individual wolves have ventured into CO from WY. Two packs have established in NW CO but have since disappeared; others may persist. As the result of a statewide voter-led initiative passed in November 2020, CPW released 10 wolves onto public land in Summit and Grand counties in 2023 in an effort to create a permanent, self-sustaining wolf population in Colorado.**	**FE, SE**	**Yes**
	No particular habitat preference. In Minnesota and Wisconsin, usually occurs in areas with few roads, which increase human access and incompatible land uses (Thiel 1985, Mech et al. 1988, Mech 1989) but can occupy semi-wild lands if ungulate prey are abundant and if not killed by humans (Mladenoff et al. 1997). Young are born in an underground burrow that has been abandoned by another mammal or dug by wolf. In Minn., dens usually were not near territory boundaries; den use was traditional in most denning alpha females studied for more than 1 year; possibly the availability of a stable food supply source helped determine den location (Ciucci and Mech 1992).		

Table 18. Threatened, Endangered, or Candidate species that occur at North Star, have the potential to occur at North Star, or be affected by management of North Star

Common Name *Latin Name*	Occurrence: Habitat	Status‡	Potential Habitat on the Property
FISH			
Colorado pikeminnow *Ptychocheilus lucius*	Large, swift-flowing muddy rivers with quiet warm backwaters in the Green, Yampa, White, Colorado, Gunnison, San Juan, and Dolores Rivers.	FE, ST	No
Razorback sucker *Xyrauchen texanus*	Often associated with sand, mud, and rock substrate in areas with sparse aquatic vegetation, where temperatures are moderate to warm within the Colorado River system.	FE, SE	No
Humpback chub *Gila cypha*	Prefers deep, fast-moving, turbid waters often associated with large boulders and steep cliffs in the Green, Yampa, and Colorado Rivers.	FE, ST	No
Bonytail chub *Gila elegans*	Large, swift-flowing waters of the Colorado River system.	FE, SE	No
INVERTEBRATES			
Monarch butterfly *Danaus plexippus*	The monarch is globally distributed throughout 90 countries. They are well known for their long-distance migration in the North American populations. Descendants of these migratory monarch populations expanded from North America to other areas of the world where milkweed (*Asclepias* spp.; their larval host plant) was already present or introduced. The monarch is widely distributed across the United States.	FC	No
	Monarchs occur in a variety of urban & rural habitat types especially those that have milkweed, *Gomphocarpus* spp., and *Calotropis* spp. (closely related genera), and other flowering forbs that are foraged upon for nectar. Monarchs lay eggs on plants in the milkweed family (*Asclepiadaceae*) and larvae feed only on milkweeds, primarily those in the genus *Asclepias*, of which monarchs are known to use more than 30 species in the wild (deRoode 2015)		
Silverspot butterfly *Speyeria nokomis nokomis*	Total historic range approximately 200,000 sq km in the southwestern U. S., but only one Colorado occurrence has been documented within the past 20 years. Selby (following Miller and Brown 1981) interprets the historic range as eastern Utah, western Colorado, northeastern Arizona and northern New Mexico (2007).	FC	No
	Streamside meadows and open seepage areas with an abundance of violets in generally desert landscapes.		

‡Status: T = Threatened; E = Endangered; P = Proposed; FC = Candidate for federal listing; SC = State species of concern

Canada Lynx
Current Distribution, Status, and Trend

Status

Federal: Threatened, State: Threatened, Region: Threatened

Canada lynx were listed as threatened on March 24, 2000 (Federal Register: March 24, 2000 [Volume 65, Number 58]).

Distribution

The primary range of the Canada lynx is found in the boreal forests of Alaska and Canada. The Southern Rocky Mountains represent the southern margin of the lynx's geographic range. The Southern Rockies, however, is considered a provisional core area by the US Fish and Wildlife Service (Interagency Lynx Biology Team 2013). Currently, lynx are documented as permanently inhabiting the

White River National Forest (WRNF), with confirmed breeding activity. These lynx are from the 2000 and 2003 CDOW lynx release projects in southern Colorado.

Lynx Analysis Unit

A Lynx Analysis Unit (LAU) is an area of at least the size used by an individual lynx, from 25 – 50 square miles. An LAU is the unit for which the effects of a project are analyzed (USDA Forest Service 2009). North Star does not occur within a WRNF LAU.

Southern Rockies Lynx Amendment

This document discloses information specific to analyzing projects under the Southern Rockies Lynx Amendment (SRLA; USDA Forest Service 2008a), which amended the Land and Resource Management Plans on eight Region 2 National Forests. The SRLA adds consistent management direction to promote conservation of the Canada lynx on National Forest Service (NFS) land in the Southern Rocky Mountains. The aim is to help ensure that the appropriate information is used in the effects analysis and provided to the USFWS, thus streamlining consultations on SRLA projects.

The management direction is designed to strike a reasonable balance in providing for the conservation of lynx habitat while also allowing appropriate levels of human uses to occur. The decision adds one goal, 13 objectives, 7 standards, and 34 guidelines related to all activities (ALL), vegetation management (VEG), grazing management (GRAZ), human uses (HU), and linkage areas (LINK). Goals are general descriptions of desired results; objectives are descriptions of desired resource conditions; standards are management requirements designed to meet the objectives; and guidelines are recommended management actions that will normally be taken to meet the objectives, but are not required.

Under this decision, standards are applied only to vegetation management activities that have the potential to directly affect snowshoe hare (*Lepus americanus*) prey and thus may impact lynx at the population level. Other activities that may have possible adverse effects on individual lynx are subject to guidelines. Any deviations from guidelines would be considered only after analysis of site-specific conditions, and in compliance with ESA Section 7 consultation requirements.

Life History

Lynx are temperate forest dwelling carnivores. In Colorado they are mostly dependent upon snowshoe hare for prey; red squirrels (*Tamiasciurus hudsonicus*) are probably secondary in importance (Shenk and Kahn 2010, Ivan and Shenk 2016). They also have been documented preying upon other mammals, grouse, and ptarmigan during the summer months. Hares not only determine where lynx are found, but also influence how many lynx may occupy an area. In the northern portions of their geographic range they undergo dramatic fluctuations in population based on the ten-year cycle of hare abundance. In the southern portions of their range (Colorado), these population fluctuations are not as evident and lynx populations appear similar to those occurring during the hare population lows in the northern portions of their ranges (Dolbeer and Clark 1975, Wolff 1980, Koehler and Brittell 1990).

In the southern Rocky Mountains, lynx are predominately found above 8,000 feet in Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), and lodgepole pine (*Pinus contorta*) forests. They typically use areas during winter where low topographic relief creates continuous forest communities of varying stand ages and provides moist forest floor conditions to support hares. Typically, lynx require a mosaic of forested habitats in which to den, forage, rest, and travel. Riparian and wetland shrub communities found in valleys, drainages, wet meadows, and moist timberline

locations may support important prey resources (Ruediger et al. 2000).

The status of Canada lynx, along with life history information (e.g., general ecology, prey relationships, characteristics of foraging, denning, and security habitat, landscape connectivity, movement patterns, and the effects of recreational activities on lynx) may be found in Koehler and Aubry (1994), Ruggiero et. al (2000), Squires et. al (2011), Interagency Lynx Biology Team (2013), Shenk (2009), and Squires et al. (2010). This analysis tiers to these documents and to the SRLA Environmental Impact Statement (USDA Forest Service 2008b), Record of Decision (2008a), Supplemental Biological Assessment (USDA Forest Service 2008c), and Implementation Guide (2009). The SRLA provides Objectives, Standards, and Guidelines at the Forest level to provide for the habitat needs of Canada lynx. The lynx baseline data contained in these documents represents the best and most current scientific information available.

Status of Canada Lynx in Colorado

In an effort to restore a viable population of Canada lynx to the southern portion of their former range, the Colorado Division of Wildlife (now CPW) reintroduced 218 individuals into Colorado from 1999-2006. In 2010, CPW determined that the reintroduction effort had met all the benchmarks of success, and that a viable, self-sustaining population of Canada lynx had been established (Ivan 2012).

Within areas of high use in southwestern Colorado, mature Engelmann spruce-subalpine fir forest stands with 42-65% canopy cover and 15-20% conifer understory cover has been the forest community most commonly used by lynx (Shenk 2009). Little difference in aspect, slope, or elevation was detected for long beds, travel, and kill sites. Den sites, however, were located at higher elevations on steeper and more commonly north-facing slopes with a dense understory of coarse woody debris.

Monitoring by the CPW suggests two primary areas of use by reintroduced and monitored lynx. The first is the core research area and a secondary core area centered in the Collegiate Peaks Wilderness. High use is also documented for the area east of Dillon, both north and south of 1-70, and the area north of State Highway 50 centered around Gunnison and then north to Crested Butte. These last two high use areas are smaller in extent than the two core areas.

Habitat Use by Lynx

Shenk (2009) reported the results of radio/satellite telemetry investigation into landscape-scale habitat use by Colorado lynx. Her results were based on 10,935 aerial locations collected from 1999 - 2008. Throughout the year, Engelmann spruce / subalpine fir was the dominant cover used by lynx. A mixed Engelmann spruce / subalpine fir - aspen forest was the second most common cover type used throughout the year. Various riparian and riparian-mix areas were the third most common cover type where lynx were found during the daytime flights. Use of Engelmann spruce / subalpine fir forests and Engelmann spruce / subalpine fir-aspen forests was similar throughout the year. There was a trend in increased use of riparian areas beginning in July, peaking in November, and dropping off from December through June.

Site-scale habitat data collected from CPW snow-tracking efforts confirms that, at the level of individual sites used by lynx for daily activities, Engelmann spruce and subalpine fir are the most common forest stands used by lynx during the winter in southwestern Colorado (Shenk 2009). Comparisons were made among sites used for long beds[15], dens, travel, and where they made kills. Little difference in aspect, slope, or elevation was detected for long beds, travel and kill sites. At these

[15] Long beds are sites where a lynx lays in the snow for an extended period, characterized by having an iced surface.

three types of sites, lynx typically used gentler slopes at a mean elevation of 10,410' AMSL, and varying aspects with a slight preference for north facing slopes. Mean percent total overstory was higher for long bed and kill sites than travel or den sites.

Engelmann spruce provided a mean of 36%± overstory for kills and long beds, with travel sites averaging 28% and den sites having the lowest mean percent overstory of 23%. Willow overstory was highly variable and no dens were located there. In contrast, the most common understory species were Engelmann spruce, subalpine fir, willow, and aspen. Various other species such as ponderosa pine, lodgepole pine, cottonwood, birch, and others were also found in less than 5% of the habitat plots. If present, willow provided the greatest percent cover within a plot followed by Engelmann spruce, subalpine fir, aspen and coarse woody debris for long beds, kills and travel sites.

Den sites had significantly higher percent understory cover, in comparison with long-beds, travel, and kill sites (Shenk 2009). Understory at den sites was primarily made up of coarse woody debris. The most common tree species was Engelmann spruce. Subalpine fir and aspen were also present in >35% of the plots. Most habitat plots were vegetated with trees of DBH < 6". As DBH increased, percent occurrence decreased within the plot. Although decreasing in abundance as size increased, most lynx-use sites except for dens had trees in each of the DBH categories, indicating mature forest stands.

Habitat used by lynx varies seasonally, most likely due to the greater diversity of prey species available in summer versus winter (Ivan and Shenk 2016). During winter, lynx select for mature multi-story stands dominated by large Engelmann spruce and subalpine fir with dense horizontal cover (Squires et al. 2010). During summer, lynx broaden their resource use to select younger forests with high horizontal cover, abundant total shrubs, abundant small-diameter trees, and dense saplings, especially spruce-fir saplings.

Mortality

Reported causes of lynx mortality vary between studies. The most commonly reported causes include starvation of kittens (Quinn and Parker 1987, Koehler 1990), human-caused mortality, mostly fur trapping (Norman and Thompson 1987, M. P. Ward and Krebs 2011). Of the total 218 adult lynx released, there were 115 known mortalities as of May 25, 2009. Starvation was a significant cause of mortality in the first year of releases only. Mortalities occurred throughout the areas through which lynx moved. The primary known causes of death included 30.4 percent human-induced deaths, which were confirmed or probably caused by collisions with vehicles or gunshot. Malnutrition and disease/illness accounted for 18.3 percent of the deaths. Other mortality factors included predation or probable predation by mountain lions (*Puma concolor*), bobcat (*Lynx rufus*), and lynx, as well as other trauma-caused deaths. An additional 37.4 percent of known mortalities were from unknown causes (Shenk 2009).

Lynx Home Range & Movement

Canada lynx home range size varies by the animal's gender, abundance of prey, season, and density of lynx populations (Koehler and Aubry 1994, Poole 1994, Slough and Mowat 1996, Ruediger et al. 2000, Steury and Murray 2004). Lynx maintain large home ranges, averaging 8 to 800 km^2 (Koehler and Aubry 1994, Ruediger et al. 2000, Squires and Laurion 2000). The size of their home range varies depending on abundance of prey, gender, age, season, and the density of lynx populations. When densities of prey decline, lynx enlarge their home ranges to obtain sufficient amounts of food to survive and reproduce. Males tend to have larger home ranges than females.

Three types of lynx movements are relevant with respect to habitat connectivity, all of which must

be maintained at the project level for an action to be considered consistent with the ALL S1 Standard of the SRLA (USDA Forest Service 2008c). During their daily movements, lynx select continuous forest and frequently use ridges, saddles, and riparian areas. They typically avoid large openings in the forest canopy (greater than 100 meters) and normally use coniferous or deciduous vegetation greater than 6 feet in height with a closed canopy for traveling (Koehler and Aubry 1994). Daily movements range from a low of 1.2 miles for female lynx with kittens, to a high of 3.3 miles during periods of low hare abundance (Interagency Lynx Biology Team 2013). One study observed a female lynx to have movements of up to 6.2 miles per day during the summer and 5.3 miles per day during the winter.

Lynx landscape-level movements include exploratory movements[16] and dispersal movements[17]. Exploratory movements have been documented to range from 9 up to 452 miles (Interagency Lynx Biology Team 2013). Dispersal distances have been detected up to 620 miles. Despite the large distances covered during landscape-level movement, the distances traveled each day are similar to normal daily movements within the lynx's home range. Dispersal and movements of transients can occur year-round, while male, breeding season movements generally occur from January into April, peaking in February and March.

There is some evidence that lynx inhabiting the more fragmented Southern Rockies may cross larger openings somewhat more freely than their northern counterparts. For example, Thompson and Halfpenny (1989) reported that they backtracked a lynx that crossed a 4,400 foot wide subalpine grassland within the Vail Ski Area. Another of the lynx released in Colorado by the CPW traveled as far as Nebraska prior to being shot. Poole and Mowat (cited with no date in Ruediger et al. 2000) reported observing lynx crossing several hundred-meter-wide openings, frozen lakes and rivers greater than 1 km wide during their investigations in the Northwest Territories. These movements, at the present time, are considered atypical and/or movements associated with dispersal.

Permeability of transportation corridors to lynx movements is central to their persistence in Colorado given the large spatial extent of transportation networks and the high mobility of lynx. Baigas et al. (2015) investigated the degree to which highways were permeable to movements of resident Canada lynx in the Southern Rocky Mountains based on highway crossings (n = 593) documented with GPS telemetry. All lynx crossed highways when present in home ranges at an average rate of 0.6 crossings per day. Lynx mostly crossed highways during the night and early dawn when traffic volumes were low. Five of 13 lynx crossed highways less frequently than expected when compared to random expectation, but even these individuals crossed highways frequently in parts of their home range. At the fine scale, lynx selected crossings with low distances to vegetative cover and higher tree basal area; they found no support that topography or road infrastructure affected lynx crossing. At the landscape scale, lynx crossed highways in areas with high forest canopy cover in drainages on primarily north-facing aspects. The predicted crossing probabilities generated from their landscape-scale RSF model across western Colorado were successful in identifying known lynx crossing sites as documented with independent snow-tracking and road-mortality data. Connectivity of lynx habitat has been identified as an important consideration for the southern Rockies, because of the extreme topographic relief juxtaposed with human developments such as highways and residential communities. In the Remanded Rule (Federal Register Vol. 68, p. 400786), the FWS concluded that the population-level threat to lynx attributable to high traffic volume on roads that bisect suitable lynx habitat and associated suburban developments is low. The FWS, however, recognized that a higher risk exists in Colorado than elsewhere in the range of the lynx (Interagency Lynx Biology Team

[16] Exploratory movements are long-distance movements beyond identified home range boundaries, in which the animal returned to its original home range.
[17] Dispersal is the permanent movement of an animal to a new home range.

2013).

In the SRLA (USDA Forest Service 2008c), 38 linkage areas were identified in Colorado and southern Wyoming. Management direction for these areas is to maintain connectivity of habitat and facilitate lynx movements. Some of these linkage areas, however, may be located in proximity to existing human developments or may not currently contain the conditions or structures needed to provide habitat connectivity. Ski resort development, a growing and affluent population, and telecommuting capabilities have converged to spur rapid growth in some mountain valleys. Transportation corridors continue to be modified and expanded to handle increasing volumes of traffic and speeds, altering historical movement patterns of wide-ranging species and creating barriers to movement. These and other factors, both historical and current, have eliminated or degraded some landscape linkages, which increases the importance of remaining linkage areas.

Landscape Linkages

As a result of the patchy, discontinuous nature of lynx habitat in Colorado, the maintenance of habitat connectivity is thought to be critical to the maintenance of a viable population. Linkage areas occur both within and between geographic areas where blocks of lynx habitat are separated by intervening areas of non-lynx habitat such as basins, valleys, agricultural lands, or where lynx habitat naturally narrows between blocks (USDA Forest Service 2008c). Connectivity provided by linkage areas can be degraded or severed by human infrastructure such as high-use highways, subdivisions, or other developments.

Any continuous forested corridor between and/or across mountain ranges that provide lynx habitat may provide such connectivity. Narrow forested mountain ridges or shrub-steppe plateaus may provide a linkage between more extensive areas of lynx habitat. Wooded riparian communities may provide travel cover across otherwise open valley floors between mountain ranges, or lower elevation ponderosa pine or pinyon-juniper woodlands may link high elevation spruce-fir forests (Ruediger et al. 2000).

The closest and most relevant linkage area identified in the SRLA Environmental Impact Statement (USDA Forest Service 2008b) is the Dowd Junction linkage area near Eagle-Vail which is roughly 36 miles northwest of the property.

Lynx Habitat Baseline

As discussed above, preferred habitat for lynx is classic boreal forest and subalpine (i.e., Engelmann spruce – subalpine fir) forest. Of greater importance is the presence of snowshoe hares, their main food source. Lynx can be found in spruce-fir, lodgepole pine, Douglas fir (*Pseudotsuga menziesii*), and aspen forests especially when snowshoe hares are present. The distribution of that habitat on the WRNF is conveyed in the 2017 Forest-wide GIS lynx mapping coverage developed in collaboration with USFWS. Although this mapping omits private property, one can infer the habitat classification given the mapping of adjacent types on the WRNF. Habitat in this dataset is mapped as follows (USDA Forest Service 2008b):

Primary Vegetation: Primary vegetation consists of Engelmann spruce, subalpine fir, aspen-conifer mix and lodgepole pine that occurs on spruce-fir habitat types (seral lodgepole pine).

Secondary Vegetation: Other cool moist habitat types that are not included in the primary vegetation definition above may provide lynx habitat when they are interspersed with primary vegetation. Secondary vegetation was identified by selecting vegetation polygons that were within 300 meters from primary vegetation polygons.

Unsuitable: Currently unsuitable vegetation refers to vegetation that is in the stand initiation structural stage. The SRLA defines this generally as trees that are less than 10 to 30 years old that have not grown tall enough to protrude above the snow during winter.

Non-Habitat: Non-lynx vegetation is any vegetation that is not primary, secondary, or currently unsuitable and can include non-vegetated cover types (alpine, rock, or water) or other vegetated cover types. Non-lynx vegetation includes climax lodgepole pine or dry aspen types (not within 300 meter buffer of primary vegetation), ponderosa pine, pinyon-juniper, grass, forb, riparian – dominated by grass/forb, cottonwood, and other shrub species.

Gray Wolf

Colorado and the Roaring Fork Watershed are part of the gray wolf's historic distribution but wolves were eradicated in the state by the 1940s. Over the past decade, the USFWS restored gray wolves in Wyoming, Idaho, Montana, New Mexico and Arizona and there are now wolves known within Colorado. Over the past decade, CPW has confirmed or has had probable wolf dispersals that occurred in 2004, 2006, 2009, and 2015. In the summer of 2019, a wolf from the Snake River Pack (a pack in Wyoming) was located in Jackson County, Colorado (CPW 2022a). CPW received reports in January 2020 of six large canids that were seen near the Wyoming and Utah borders. CPW staff were able to locate and visually confirm the presence of the pack.

CPW has subsequently developed a Colorado Wolf Restoration and Management Plan (CWRMP) to guide fulfillment of the planning components of the statutory requirements of CRS 33-2-105.8. The CWRMP should be consulted for information regarding Colorado wolf reintroduction and legal status.

Between December 18 - 22, 2023, CPW released 10 gray wolves onto public land in Summit and Grand counties in an effort to create a permanent, self-sustaining wolf population and fulfill voter approval to re-establish gray wolves in Colorado.

U.S. FOREST SERVICE SENSITIVE SPECIES

The current USFS Region 2 Sensitive Species list is dated July 13, 2018 (R2 Supplement FSM 2600, Chapter 2670, Supplement No. 2670-2018-1). Potential habitat for only 2 USFS Region 2 sensitive wildlife species occurs on or within proximity to the site. Table 3 identifies the USFS sensitive wildlife species considered and evaluated in this report.

Table 19. U. S. Forest Service, Rocky Mountain Region Sensitive Species and their potential to occur at North Star

Species	Suitable Habitat on North Star	Basic Habitat Description
BIRDS		
American Bittern *Botaurus lentiginosus*	No	Eastern plains & mountain parks. Inhabits larger (≥7½ ac) cattail marshes with tall emergent vegetation; occasional in adjacent wet meadows, "rarely breeds on wetlands smaller than 3 ha" (Wiggins 2006).
Black Swift *Cypseloides niger*	No	Nests behind or next to waterfalls & wet cliffs. Forages over forests & open areas.
Black Tern *Chlidonias niger surinamensis*	No	Nest & forage in marshes & edges of lakes, rivers with emergent vegetation historically in North Park, San Luis Valley, South Platte & Arkansas river valleys.
Black-backed Woodpecker *Picoides arcticus*	No	Coniferous forests. Does not occur in CO.
Boreal Owl *Aegolius funereus*	No	Mature spruce/fir & mixed conifer forested areas with preference for wet situations (bogs or streams) for foraging.
Brewer's Sparrow *Spizella breweri*	No	Higher quality sagebrush shrublands; may be found in alpine willow stands.
Burrowing Owl *Athene cunicularia*	No	Open grasslands with available small mammal burrows.
Cassin's Sparrow *Peucaea cassinii*	No	Heavily grazed eastern plains.
Chestnut-collared Longspur *Calcarius ornatus*	No	Tallgrass prairie of northern plains.
Columbian Sharp-tailed Grouse *Tympanachus phasianellus columbianus*	No	Mid elevation mountain sagebrush/grassland habitat usually adjacent to forested areas, potential habitat on NW corner of WRNF Blanco District, NE Eagle County.
Ferruginous Hawk *Buteo regalis*	No	Open grassy prairies & shrub steppe communities. Nests in trees or shrubs along streams or on steep slopes. Highly dependent on prairie dogs & jackrabbits as prey.
Flammulated Owl *Psiloscops flammeolus*	**Yes**	**Depends on cavities for nesting, open forests for foraging, brush for roosting. Occupy open ponderosa pine or forests with similar features (dry montane conifer or aspen, with dense saplings).**
Grasshopper Sparrow *Ammodramus savannarum*	No	Open grasslands of eastern plains.
Greater Prairie-chicken *Tympanuchus cupido*	No	Sagebrush & grassland habitat in northeastern CO.
Greater Sage-grouse *Centrocercus urophasianus*	Yes (Extirpated)	Large sagebrush shrublands in northwestern CO including Routt & northern Eagle County.
Harlequin Duck *Histrionicus histrionicus*	No	Relatively rapid streams of moderate size, typically surrounded by undisturbed forest. Extirpated in CO.

Species	Suitable Habitat on North Star	Basic Habitat Description
Lesser Prairie-chicken *Tympanuchus pallidicinctus*	No	Mixed grass-dwarf shrub communities on sandy soils; principally the sand sagebrush-bluestem association in CO, KS, OK, TX & NM. Leks occur on knolls or ridges with relatively short &/or sparse vegetation.
Lewis's Woodpecker *Melanerpes lewis*	**Yes**	**Open pine forests, burnt over areas with snags & stumps, riparian & rural cottonwoods, & pinyon-juniper woodlands.**
Loggerhead Shrike *Lanius ludovicianus*	**Yes**	**Sagebrush shrublands, mountain parks; may be found in willow stands. Nests in shrubs or small trees, preferably thorny such as hawthorn. Most common at 4,000 to 6,000 ft elevation.**
Long-billed Curlew *Numenius americanus*	No	Forages predominately in grasslands, but also uses wet meadows & agricultural habitats including plowed & active crop fields.
McCown's Longspur *Rhynchophanes mccownii*	No	Shortgrass prairie.
Mountain Plover *Charadrius montanus*	No	Grassland/cropland on eastern plains.
American Goshawk *Accipiter gentilis*	**Yes**	**Mature forest generalist. Often found in mixed conifer/aspen and pure aspen stands. Nests primarily in mature aspen & pine trees. Throughout WRNF nesting above 7,500 ft to 11,000 ft.**
Northern Harrier *Circus cyaneus*	**Yes**	**Rare summer resident in mountain marshes & wetlands. In alpine tundra in fall migration. Uses shrublands for foraging. Documented in Garfield, Eagle, Pitkin, & Rio Blanco Counties, generally ranges up to 10,000 ft in summer.**
Olive-sided Flycatcher *Contopus cooperi*	**Yes**	**Mature spruce/fir or Douglas-fir forests with preference for natural clearings, bogs, stream & lakeshores with water-killed trees, forest burns & logged areas with standing dead trees. Generally from 7,500 to 11,000 ft.**
Purple Martin *Progne subis*	**Yes**	**Nests in decadent aspen trees or snags from 8,000 to 9,000 ft. near streams or water. In Garfield, Eagle, Pitkin, Mesa, & Rio Blanco Counties.**
Sagebrush Sparrow *Artemisiospiza nevadensis*	No	Sagebrush shrublands, found in Garfield County & western Eagle County up to ~6,500 ft.
Short-eared Owl *Asio flammeus*	No	Grasslands, marshes, & agricultural areas on eastern plains & mountain parks.
Trumpeter Swan *Cygnus buccinator*	No	Shallow lake & wetlands from Alaska east across w. Canada to Hudson Bay lowlands of Manitoba, Ontario, Quebec & east to Nova Scotia, New Brunswick, & Newfoundland. Casual fall & early winter migrant on eastern plains.
White-tailed Ptarmigan *Lagopus leucurus*	No	Alpine tundra, high-elevation willow thickets, krummholz, spruce-fir (winter).
MAMMALS		
American Hog-nosed Skunk *Conepatus leuconotus*	No	Canyons, mesas, & riparian valleys, with additional observations from grasslands through parts of Arizona, New Mexico, SE Colo.
Pacific Marten *Martes caurina*	**Yes**	**Spruce/fir & mixed conifer forests with complex physical structure.**
Black-tailed Prairie Dog *Cynomys ludovicianus*	No	Historically inhabits the eastern third of CO below 6,000 ft.
Desert Bighorn Sheep *Ovis canadensis nelsoni*	No	Rocky desert environments.
Fringed Myotis *Myotis thysanodes*	**Yes**	**Conifer, oak shrublands; caves, mines, building roosts, western WRNF including Rio Blanco, Garfield, & Mesa up to 7,500'.**

Species	Suitable Habitat on North Star	Basic Habitat Description
Gunnison's Prairie Dog *Cynomys gunnisoni*	No	Shortgrass & mid-grass prairie, grass-shrub habitats in low valleys, & mesic, high elevation sites on the CO Plateau in SE UT, SW CO, northern AZ, & NW, west-central, & central NM.
Hoary Bat ***Lasiurus cinereus cinereus***	**Yes**	**Conifer & deciduous tree cavities or cliffs on edge of clearings up to 9,500 ft.**
Kit Fox *Vulpes macrotis*	No	Found in desert scrublands of western CO.
North American Wolverine *Gulo gulo luscus*	No	Occupy high elevations with deep, persistent, & reliable spring snow cover.
Pygmy Shrew *Sorex hoyi montanus*	No	In subalpine spruce-fir forest edges that are adjacent to wetlands, fens, or standing water habitats. Documented on WRNF Sopris District above 9,500 ft.
River Otter ***Lontra canadensis***	**Yes**	**Riparian habitats that traverse a variety of other habitats. Mainly larger river systems.**
Rocky Mountain Bighorn Sheep *Ovis canadensis canadensis*	No	Rocky, steep, or rugged terrain for escape cover with open grass-dominated habitats nearby for foraging. Summer range at high elevation & winter range in valley bottoms or where snow depth is minimal.
Spotted Bat *Euderma maculatum*	No	Cliff/Rock/Scree in arid Douglas-fir or Ponderosa Pine canyons associated with water, 6-8,000'.
Swift Fox *Vulpes velox*	No	Grassland prairies of the Great Plains in a variety of habitats including shortgrass & mid-grass prairies, plowed fields & fencerows, & sagebrush.
Townsend's Big-eared Bat ***Corynorhinus townsendii townsendii***	**Yes**	**Forages in semi-desert shrublands, pinyon-juniper woodlands & open montane forests. Rare to uncommon during summer. Roosts in caves, mines & mature forests. Generally not found above 10,500 ft.**
White-tailed Prairie Dog *Cynomys leucurus*	No	Desert scrublands; most records are below 8,500 ft.
Wyoming Pocket Gopher *Thomomys clusius*	No	Dry, gravelly, shallow-soil ridge tops only in Sweetwater & Carbon counties in WY with some indication occurrences in northern CO.
AMPHIBIANS & REPTILES		
Black Hills Redbelly Snake *Storeria occipitomaculata pahasapae*	No	Wet meadows, woodlands, & forest-meadow edge habitats in eastern North America west to the eastern borders of OK, KS, & SD.
Boreal Toad ***Anaxyrus boreas boreas***	**Yes**	**Subalpine forest habitats with marshes, wet meadows, streams, beaver ponds, & lakes, 7000-12,000 ft.**
Canyon Treefrog *Hyla arenicolor*	No	Found in western desert & south eastern CO.
Columbia Spotted Frog *Rana luteiventris*	No	Coniferous or mixed forests, grasslands, & riparian areas of sage-juniper brushlands in AK through BC & western AB & WA, OR, ID, MT, WY, UT, & NV.
Desert Massasauga *Sistrurus catenatus edwardsii*	No	Shortgrass prairie habitat with abundant sand sage, buffalograss, & blue grama in CO.
Great Basin Spadefoot *Spea intermontana*	No	Found in western CO at elevations below 7,000 ft.
Longnose Leopard Lizard *Gambelia wislizenii*	No	Occurs in west-central CO & southwestern CO at elevations below 5,200 ft.
Milk Snake *Lampropeltis triangulum taylori*	No	Occurs throughout most of eastern, southern, & western CO at elevations primarily below 7,800 ft.

Species	Suitable Habitat on North Star	Basic Habitat Description
Midget Faded Rattlesnake *Crotalus oreganus concolor*	No	Occurs in desert & semi-desert habitats. Records for CO restricted to Garfield, Mesa, & San Miguel Counties.
Northern Leopard Frog *Lithobates pipiens*	**Yes**	**Riparian & wetland areas, rarely above 8,500 ft.**
Plains Leopard Frog *Lithobates blairi*	No	All types of water bodies & frequently wander far from water on the eastern plains.
Wood Frog *Lithobates sylvaticus*	No	Sedge wetlands with adjoining grassy meadows, willow bogs, coniferous forests, & aspen in north-central CO.
Sources for species occurrence & habitat association include the following: Adams (2003), Armstrong et al. (2011), Hammerson (1999), Kingery (1998), & unpublished information provided by FS staff (P. Nyland pers. comm. 2017) & CO Parks & Wildlife (CPW) staff (J. Logan pers. comm. 2017; K. Bakich pers. comm. 2017)		

APPENDIX H. All Wildlife Species Known or Suspected to Occur at North Star

Species are grouped by taxonomic group, and then sorted alphabetically by common name. Legend: Occurrence at North Star: B – Breeding Season, C – Confirmed Occurrence, P – Possible Occurrence, H – Habitat Present/Likely Occurrence, S – Suspected Occurrence, X – Extirpated, Xr – Extirpated/Reintroduced, L – Likely Occurs, M – Known to Occur during Migration, Y – Occurs Year-round. Federal Status: LE – listed Endangered, LT – listed Threatened, LT* - listed Threatened status applies to Distinct Population Segment only, C – Candidate, P – Petitioned, N - Not Warranted. State Listing: SE – state endangered, ST – state threatened, SC – Special Concern. Agency Sensitive: BLM – Bureau of Land Management, USFS – U.S. Forest Service, USFWS - U.S. Fish and Wildlife Service Birds of Conservation Concern for Bird Conservation Regions 16 and 18. NatureServe Global/State Status: 1 – critically imperiled, 2 – imperiled, 3 – vulnerable, 4 – apparently secure, but with cause for long-term concern, 5 – demonstrably secure, T – subspecies status, Q – taxonomic uncertainty, B – breeding, N – non-breeding, NR – not ranked, X - extirpated.

Common Name	*Species*	Occurrence at North Star	CPW State Wildlife Action Plan Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	NatureServe Global Status Rank	CNHP/NatureServe State Status Rank	Declining Trend
AMPHIBIANS												
Blanchard's cricket frog	*Acris blanchardi*	B-C								G5	SH	x
Northern leopard frog	*Lithobates pipiens*	X-H	Tier 1		SC	x	x			G5	S3	x
Tiger salamander	*Ambystoma tigrinum*	B-C								G5	S5	
Western (boreal) toad	*Anaxyrus boreas boreas*	A-C	Tier 1	P	SE	x	x			G4T1T2Q	S1	x
BIRDS												
American coot	*Fulica americana*	B-C								G5	S5B,S4N	
American crow	*Corvus brachyrhynchos*	B-C								G5	S5	
American peregrine falcon	*Falco peregrinus anatum*	M-C	Tier 2		SC	x	x	x		G4T4	S2B	
American robin	*Turdus migratorius*	B-C								G5	S5	
Bald eagle	*Haliaeetus leucocephalus*	B-C	Tier 2		SC	x	x	x		G5	S1B,S3N	
Band-tailed pigeon	*Patagioenas fasciata*	B-C	Tier 2							G4	S4B	x
Bank swallow	*Riparia riparia*	B-C								G4	S4B	
Barn swallow	*Hirundo rustica*	B-C								G5	S5	
Belted kingfisher	*Megaceryle alcyon*	B-C								G5	S5B	
Black-billed magpie	*Pica hudsonia*	B-C								G5	S5	
Black-capped chickadee	*Poecile atricapillus*	B-C								G5	S5	
Black-headed grosbeak	*Pheucticus melanocephalus*	B-C								G5	S4B	
Boreal owl	*Aegolius funereus*	H-P	Tier 2			x				G5	S2	
Brewer's sparrow	*Spizella breweri*	B-C	Tier 2			x	x	x		G5	S4B	x

Common Name	*Species*	Occurrence at North Star	CPW State Wildlife Action Plan Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	NatureServe Global Status Rank	CNHP/NatureServe State Status Rank	Declining Trend
Brewer's blackbird	*Euphagus cyanocephalus*	B-C								G5	S5B,S4N	
Broad-tailed hummingbird	*Cynanthus latirostris*	B-C					x			G5	S5	
Brown creeper	*Certhia americana*	B-C								G5	S5	
Brown-capped rosy-finch	*Leucosticte australis*	B-C	Tier 1				x	x	x	G4	S3B,S4N	
Brown-headed cowbird	*Molothrus ater*	B-C								G5	S5	
Canada goose	*Branta canadensis*	B-C								G5	S5	
Cassin's finch	*Peucaea cassinii*	B-C	Tier 2					x		G5	S5	x
Cedar waxwing	*Bombycilla cedrorum*	B-C								G5	S5B,S4N	
Chipping sparrow	*Spizella passerina*	B-C								G5	S4B,S5N	
Cinnamon teal	*Spatula cyanoptera*	B-C								G5	S5B	
Common raven	*Corvus corax*	B-C								G5	S5	
Cooper's hawk	*Accipiter cooperii*	B-C								G5	S3S4B,S4N	x
Dark-eyed junco	*Junco hyemalis*	B-C								G5	S5	
Dusky flycatcher	*Empidonax oberholseri*	B-C								G5	S5B	
Dusky grouse	*Dendragapus obscurus*	B-C								G5	S5	
Eared grebe	*Podiceps nigricollis*	B-C								G5	S3B	
Flammulated owl	*Psiloscops flammeolus*	P-H	Tier 2			x		x	x	G4	S4	
Fox sparrow	*Passerella iliaca*	B-C								G5	S4B	
Gadwall	*Mareca strepera*	B-C								G5	S5B	
Golden eagle	*Aquila chrysaetos*	B-C	Tier 1				x	x		G5	S3S4B,S4N	
Great blue heron	*Ardea herodias*	B-C								G5	S3B	
Great horned owl	*Bubo virginianus*	B-C								G5	S5	
Green-tailed towhee	*Pipilo chlorurus*	B-C								G5	S5	x
Greater sandhill crane	*Antigone canadensis tabida*	M-C	Tier 1		SC					G5T5	S2B,S4N	
Green-winged teal	*Anas crecca*	B-C								G5	S5B,S4N	
Hairy woodpecker	*Dryobates villosus*	B-C								G5	S5	
House finch	*Haemorhous mexicanus*	B-C								G5	S5	
House wren	*Troglodytes aedon*	B-C								G5	S5	
Killdeer	*Charadrius vociferus*	B-C								G5	S5	

Common Name	*Species*	Occurrence at North Star	CPW State Wildlife Action Plan Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	NatureServe Global Status Rank	CNHP/NatureServe State Status Rank	Declining Trend
Lark sparrow	*Chondestes grammacus*	B-C								G5	S5	
Lazuli bunting	*Passerina amoena*	B-C	Tier 2							G5	S5B	x
Lewis's woodpecker	*Melanerpes lewis*	B-C	Tier 2			x	x	x		G4	S4	x
Lincoln's sparrow	Melospiza lincolnii	B-C								G5	S5B	
MacGillivray's warbler	*Geothlypis tolmiei*	B-C								G5	S4B	
Mallard	*Anas platyrhynchos*	B-C								G5	S5	
Mountain bluebird	*Sialia currucoides*	B-C								G5	S5	
Mountain chickadee	*Poecile gambeli*	B-C								G5	S5	
Mourning dove	*Zenaida macroura*	B-C								G5	S5	
Northern flicker	*Colaptes auratus*	B-C								G5	S5	
Northern goshawk	*Accipiter gentilis*	B-C	Tier 2			x	x			G5	S3B	
Northern harrier	*Circus cyaneus*	B-C	Tier 2			x				G5	S3B	
Northern pygmy-owl	*Glaucidium gnoma*	B-C								G4G5	S3B	
Northern saw-whet owl	*Aegolius acadicus*	B-C								G5	S5	
Northern shrike	*Lanius borealis*	B-C								G5	S5N	
Osprey	*Pandion haliaetus*	B-C								G5	S3B	
Pied-billed grebe	*Podilymbus podiceps*	M-C								G5	S5B	
Pine siskin	*Spinus pinus*	B-C								G5	S5	x
Plumbeous vireo	*Vireo plumbeus*	B-C								G5	SNRB	
Red-naped sapsucker	*Sphyrapicus nuchalis*	B-C								G5	S5	x
Red-tailed hawk	*Buteo jamaicensis*	B-C								G5	S5	
Red-winged blackbird	*Agelaius phoeniceus*	B-C								G5	S5	
Ring-necked duck	*Aythya collaris*	M-C								G5	S4B	
Ruby-crowned kinglet	*Corthylio calendula*	B-C								G5	S5B	
Savannah sparrow	*Passerculus sandwichensis*	B-C								G5	S4B	
Say's phoebe	*Sayornis saya*	B-C								G5	S5B	
Sharp-shinned hawk	*Accipiter striatus*	B-P								G5	S3S4B,S4N	
Song sparrow	*Melospiza melodia*	B-C								G5	S5	
Sora	*Porzana carolina*	B-C								G5	S3S4B	x

Common Name	*Species*	Occurrence at North Star	CPW State Wildlife Action Plan Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	NatureServe Global Status Rank	CNHP/NatureServe State Status Rank	Declining Trend
Spotted sandpiper	*Actitis macularius*	B-C	Tier 2					x		G5	S5	
Spotted towhee	*Pipilo maculatus*	B-C								G5	S5	
Steller's jay	*Cyanocitta stelleri*	B-C								G5	S5	
Swainson's thrush	*Catharus ustulatus*	B-C								G5	S5B	
Tree swallow	*Tachycineta bicolor*	B-C								G5	S5	
Vesper sparrow	*Pooecetes gramineus*	B-C								G5	S5	
Violet-green swallow	*Tachycineta thalassina*	B-C								G5	S5	
Virginia rail	*Rallus limicola*	B-C								G5	S4B	x
Virginia's warbler	*Oreothlypis virginiae*	B-C	Tier 2						x	G5	S5	
Warbling vireo	*Vireo gilvus*	B-C								G5	S5B	
Western flycatcher	*Empidonax difficilis*	B-C								G5	S5B	
Western kingbird	*Tyrannus verticalis*	B-C								G5	S5B	
Western tanager	*Piranga ludoviciana*	B-C								G5	S4B	
Western wood-pewee	*Contopus sordidulus*	B-C								G5	S5	
White-breasted nuthatch	*Sitta carolinensis*	B-C								G5	S5B,S4N	
White-crowned sparrow	*Zonotrichia leucophrys*	M-C								G5	S5	
White-faced ibis	*Plegadis chihi*	M-C	Tier 2				x			G5	S2B	
White-throated swift	*Aeronautes saxatalis*	B-C								G5	S5B	
Willow flycatcher	*Empidonax traillii*	M-C								G5	S4	
Wilson's snipe	*Gallinago delicata*	B-C								G5	S5	
Wilson's warbler	*Cardellina pusilla*	B-C								G5	S4B	
Yellow warbler	*Setophaga petechia*	B-C								G5	S5	
Yellow-rumped warbler	*Setophaga coronata*	B-C								G5	S5	
MAMMALS												
American badger	*Taxidea taxus*	P-H								G5	S4	
American beaver	*Castor canadensis*	Y-C								G5	S4	
American black bear	*Ursus americanus*	Y-C								G5	S5	
American ermine	*Mustela richardsonii*	P-H								G5	S4	

Common Name	*Species*	Occurrence at North Star	CPW State Wildlife Action Plan Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	NatureServe Global Status Rank	CNHP/NatureServe State Status Rank	Declining Trend
American water shrew	*Sorex palustis*	P-H								G5	S4	x
Bushy-tailed woodrat	*Neotoma cinerea*	Y-C								G5	S5	
Bobcat	*Lynx rufus*	Y-C								G5	S5	
Canada lynx	*Lynx canadensis*	L-H	Tier 1	LT	SE					G5	S1	
Coyote	*Canis latrans*	P-H								G5	S5	
Common muskrat	*Ondatra zibethicus*	Y-C								G5	S5	
Dwarf shrew	*Sorex nanus*	P-H								G4	S2	
Elk	*Cervus canadensis*	B-C								G5	S5	
Fringed myotis	*Myotis thysanodes*	P-H				x	x			G4	S3	x
Gray wolf	*Canis lupus*	Xr-H	Tier 2	LE	SE	x				G4G5	SXr	
Grizzly bear	*Ursus arctos*	X-H	Tier 2		SE					G4	SX	
Golden-mantled ground squirrel	*Callospermophilus lateralis*									G5	S5	
Hoary bat	*Lasiurus cinereus*	P-H	Tier 2			x	x			G5	S5B	
Least chipmunk	*Neotamias minimus*									G5	S5	
Little brown myotis	*Myotis lucifigus*	P-H	Tier 1	P			x			G3	S4	
Long-legged myotis	*Myotis volans*	P-H								G4	S5	
Long-eared myotis	*Myotis evotis*	P-H					x			G5	S4	
Long-tailed vole	*Microtus longicaudus*	Y-C								G5	S5	
Mountain lion	*Puma concolor*	P-H								G5	S4	
Montane vole	*Microtus montanus*	Y-C								G5	S5	
Mule deer	*Odocoileus hemionus hemionus*	B-C								G5	S4	
North American deermouse	*Peromyscus maniculatis*	Y-C								G5	S5	
North American porcupine	*Erethizon dorsatum*	P-H								G5	S5	
North American red squirrel	*Tamiasciurus hudsonicus*	Y-C								G5	S5	
Northern pocket gopher	*Thomomys talpoides*	Y-C								G5	S5	
Pacific marten	*Martes caurina*	Y-C	Tier 2			x				G4G5	S4	
Raccoon	*Procyon lotor*	Y-C								G5	S5	
Red fox	*Vulpes vulpes*	Y-C								G5	S5	
River otter	*Lontra canadensis*	P-H	Tier 2		ST	x	x			G5	S3S4	

Common Name	*Species*	Occurrence at North Star	CPW State Wildlife Action Plan Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	NatureServe Global Status Rank	CNHP/NatureServe State Status Rank	Declining Trend
Southern red-backed vole	*Clethrionomys gapperi*	Y-C	Tier 2							G5	S5	
Silver-haired bat	*Lasionycteris noctivagans*	P-H								G3G4	S3S4	x
Snowshoe hare	*Lepus americanus*	Y-C	Tier 2							G5	S5	
Striped skunk	*Mephitis mephitis*	Y-C								G5	S5	
Southern red-backed vole	*Clethrionomys gapperi*	Y-C	Tier 2							G5	S5	
Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	P-H	Tier 1		SC	x	x			G3G4T3T4	S2	
Western jumping mouse	*Zapus princeps*	Y-C								G5	S5	
Wyoming ground squirrel	*Urocitellus elegans*	P-H								G5	S5	
Yellow-bellied marmot	*Marmota flaviventris*	P-H								G5	S5	
REPTILES												
Western terrestrial garter snake	*Thamnophis elegans*	Y-C										