Colorado Wildlife Science
Ecological Research, Management & Consulting

2017 North Star Nature Preserve Annual Wildlife Monitoring Report

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Submitted to—

Pitkin County Open Space & Trails
530 E. Main Street, 3rd Floor
Aspen, CO 81611

Submitted by—

Colorado Wildlife Science, LLC
0100 Elk Run Drive, Suite 128
Basalt, CO 81621

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List of Acronyms and Abbreviations

BCC	Bird of Conservation Concern
BCR	Bird Conservation Region
CBSD	Common Bird in Steep Decline
BLM	Bureau of Land Management
BLM	Bureau of Land Management
CNHP	Colorado Natural Heritage Program
CPW	Colorado Parks and Wildlife
CWS	Colorado Wildlife Science
DAU	Data Analysis Unit
ESA	Endangered Species Act
FE	Federal Endangered
FT	Federal Threatened
FQA	Floristic Quality Assessment
FSM	Forest Service Manual
FSS species	Forest Service Sensitive species
GMU	Game Management Unit
ILBT	Interagency Lynx Biology Team
IPaC	Information for Planning and Conservation database
MIS	Management Indicator Species
MSIM	Multi-Species Inventory and Monitoring
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
OAHP	Colorado Office of Archeology and Historic Preservation
OST	Pitkin County Open Space and Trails
R2S	USFS Region 2 Sensitive Species
RC	Regional Concern Species
RMBO	Rocky Mountain Bird Observatory
RFTA	Roaring Fork Transportation Authority
RS	Regional Stewardship Species
S	BLM Sensitive Species
SAM	Species Activity Mapping
SC	State Species of Concern
SGCN	Species of Greatest Conservation Needs
SE	State Endangered
ST	State Threatened
SC	State Species of Concern
TVES	Terrestrial Visual Encounter Survey
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WRNF	White River National Forest

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1.0 Introduction

This report documents the results of the 2017 annual wildlife monitoring activities conducted on the North Star Nature Preserve (North Star). For the purpose of this report, wildlife is defined as free-ranging terrestrial vertebrates. Specifically, the wildlife resources addressed in this report include non-chiropteran mammals and birds. The wildlife resources of North Star are listed and described including the results of numerous multi-taxa, mammal, nocturnal and diurnal raptor, and songbird field surveys. This report concludes with management and monitoring recommendations to be integrated into future adaptive management plans for North Star. Wildlife surveys were completed on North Star by Colorado Wildlife Science (CWS) over multiple visits from April through September 2017.

2.0 Existing Management

Currently, North Star is managed to balance recreational opportunities with ecological integrity. These two management foci are physically separated at North Star by the Roaring Fork River. On the west side of the river, the primary objective is management and protection of ecological processes and communities. The general public is not allowed on the west side except for a few permitted educational opportunities. The east side, however, is primarily devoted to a combination of passive recreation such as bird watching and wildlife viewing and active recreation such as paragliding, paddle boarding, tubing, and kayaking. Under the current management plan, fishing and hunting is not allowed at North Star. Dogs are restricted to the East Aspen Trail paralleling North Star's eastern perimeter.

3.0 Literature Review & Agency Consultation

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:

- U.S. Fish and Wildlife Service (USFWS) current list of federally protected species for Pitkin County (U.S. Fish and Wildlife Service 2017);
- Colorado Parks & Wildlife (CPW) Species Activity Mapping (SAM) (Colorado Parks & Wildlife 2017b);
- 2017 Colorado Natural Heritage Program (CNHP) conservation status data for sensitive wildlife species occurrences and Potential Conservation Areas (PCA) (CNHP 2017a);
- 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); and
- USFS Rocky Mountain Region Species Conservation Program Species Conservation Assessments (U. S. Department of Agriculture Forest Service 2006), and
- NatureServe Explorer (NatureServe 2017).

3.1 Colorado Parks & Wildlife Consultation

In addition to the CPW SAM data for the project area CPW District Wildlife Manager (DWM) Kurtis Tesch was consulted to review the project area and identify wildlife-related concerns.

3.2 Federally Listed Species

On December 13, 2017 a generalized area of interest including North Star was submitted to USFWS via the IPaC system (http://ecos.fws.gov/ipac/) requesting an official list of threatened, endangered, or candidate species that may occur on or within proximity of North Star and/or may be affected by management of the property. An official list was received and is attached as Appendix A and species protected under the Endangered Species Act (ESA) that may occur on or within proximity to North Star are listed below in Table 1. Only one federally protected species may occur on or adjacent to North Star: Canada lynx (*Lynx canadensis*). No designated critical habitat exists for any listed species within or adjacent to North Star. In addition, the State of Colorado list of State Endangered and Threatened species (including Species of Concern) (Colorado Parks & Wildlife 2017a) was reviewed. Seven species on that list could are known or could potentially occur on North Star: bald eagle (*Haliaeetus leucocephalus*), boreal 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*).

Table 1. Threatened, Endangered, and Proposed species known to occur or have the potential to occur at or be affected by management of North Star

Species	Status [1]	Typical Habitat [2]	Suitable Habitat Present at North Star
MAMMALS			
Canada Lynx *Lynx canadensis*	T	A, C, D, E	Yes
North American Wolverine *Gulo gulo luscus*	P	B, K	No
BIRDS			
Mexican Spotted Owl *Strix occidentalis lucida*	T	B, D	No
Yellow-billed Cuckoo *Coccyzus americanus*	T	C	No
FISH			
Colorado Pikeminnow *Ptychochelius lucius*	E	J	No
Razorback Sucker *Xyrauchen texanus*	E	J	No
Humpback Chub *Gila cypha*	E	J	No
Bonytail Chub *Gila elegans*	E	J	No

[1] Status: T=Threatened ; E=Endangered; P=Proposed

[2] Habitat Key: A=Aspen; B=Cliff/Rock/Scree; C=Cottonwood/Riparian; D=Conifer Forest; E=Headwaters/ Willow Riparian; F=Lakes/Rivers; G=Marsh/Wetlands/Beaver Complexes/Fens; H=Rangelands/Sage; I=Creek w/ Limestone drips; J=Colorado River; Green River, Lower Yampa & White Rivers; K=Above timberline; L=Mountain parks; M=Piñon Juniper

3.1.2.1 Federally Listed Species – Extirpated

Two of North America's top predators, gray wolves (*Canis lupus*) and grizzly bears (*Ursus arctos horribilis*), roamed the upper Roaring Fork Valley as recently as the 1940s and 1950s, respectively (Armstrong et al. 2011). Both wolves (Endangered) and grizzlies (Threatened) are listed under the federal Endangered Species Act. The anthropogenic extirpation of these apex predators has had unknown effects on the populations of the valley's other predators and former prey. Similarly, prior to reintroduction, Canada lynx were extirpated from most of Colorado by 1936 with rare trapping occurrences in 1972 and 1974 and some tracks in the late 1980s (McKelvey et al. 2000).

3.2.1 USFS & BLM Sensitive Species

The current USFS Region 2 Sensitive Species list is dated July 13, 2017 (R2 Supplement FSM 2600, Chapter 2670, Supplement No. 2600-2017-1). USFS Region 2 designated Sensitive birds and mammals having the potential to occur on at North Star are listed in Table 2. Those species shown in Table 2 as not having suitable habitat within the area of management influence are denoted as such.

Table 2. U. S. Forest Service, Rocky Mountain Region Sensitive Bird & Mammal Species that occur or have the potential to occur at North Star

Species	Agency	Suitable Habitat at North Star	Species Documented at North Star	Basic Habitat Description
BIRDS				
American Bittern *Botaurus lentiginosus*	USFS	No	No	Eastern plains and 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).
American Peregrine Falcon *Falco peregrinus anatum*	USFS BLM	No	No	Nest on steep precipitous cliffs; forages over forests & shrublands in proximity to cliffs. Primarily below 10,000 ft.
Bald Eagle ***Haliaeetus leucocephalus***	**USFS BLM**	**Yes**	**Yes – occasional in summer & during migration**	**In Central Colorado, primarily uses low elevation riparian habitat along the Colorado, Eagle, and White River drainages and their major tributaries. Roosts and nests in trees near open water.**
Black Swift *Cypseloides niger*	USFS BLM	No	No	Nests behind or next to waterfalls and wet cliffs. Forages over forests and open areas.
Black Tern *Chlidonias niger surinamensis*	USFS	No	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*	USFS	No	No	Coniferous forests. Does not occur in Colorado.
Boreal Owl *Aegolius funereus*	USFS BLM	No	No	Mature spruce/fir and mixed conifer forested areas with preference for wet situations (bogs or streams) for foraging.
Brewer's Sparrow *Spizella breweri*	USFS BLM	No	No	Higher quality sagebrush shrublands; may be found in alpine willow stands.
Burrowing Owl *Athene cunicularia*	USFS BLM	No	No	Open grasslands with available small mammal burrows.
Cassin's sparrow *Peucaea cassinii*	USFS	No	No	Heavily grazed eastern plains.
Chestnut-Collared Longspur *Calcarius ornatus*	USFS	No	No	Tallgrass prairie if northern plains.
Columbian Sharp-Tailed Grouse *Tympanachus phasianellus columbianus*	USFS BLM	No	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*	USFS BLM	No	No	Open grassy prairies and shrub steppe communities. Nests in trees or shrubs along streams or on steep slopes. Highly dependent on prairie dogs and jackrabbits as prey.

Table 2. U. S. Forest Service, Rocky Mountain Region Sensitive Bird & Mammal Species that occur or have the potential to occur at North Star				
Species	**Agency**	**Suitable Habitat at North Star**	**Species Documented at North Star**	**Basic Habitat Description**
Flammulated Owl *Psiloscops flammeolus*	USFS	No	No	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	USFS	No	No	Open grasslands of eastern plains.
Greater Prairie-Chicken *Tympanuchus cupido*	USFS	No	No	Sagebrush & grassland habitat in northeastern Colorado
Greater Sage-grouse *Centrocercus urophasianus*	USFS BLM	No	No	Large sagebrush shrublands in northwestern Colorado including Routt and northern Eagle County.
Harlequin Duck *Histrionicus histrionicus*	USFS	No	No	Relatively rapid streams of moderate size, typically surrounded by undisturbed forest. Extirpated in CO.
Lewis's Woodpecker ***Melanerpes lewis***	**USFS**	**Yes – but may be outside upper elevation limits**	**No**	**Open pine forests, burnt over areas with snags and stumps, riparian and rural cottonwoods, and pinyon-juniper woodlands.**
Loggerhead Shrike ***Lanius ludovicianus***	**USFS BLM**	**Yes**	**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*	USFS BLM	No	No	Forages predominately in grasslands, but also uses wet meadows and agricultural habitats including plowed and active crop fields.
McCown's Longspur *Rhynchophanes mccownii*	USFS	No	No	Shortgrass prairie.
Mountain Plover *Charadrius montanus*	USFS BLM	No	No	Grassland/cropland on eastern plains.
Northern Goshawk ***Accipiter gentilis***	**USFS BLM**	**Yes**	**Yes**	**Mature forest generalist. Often found in mixed conifer/aspen stands. Nests primarily in mature aspen and pine trees. Throughout WRNF nesting above 7,500 ft to 11,000 ft.**
Northern Harrier ***Circus cyaneus***	**USFS**	**Yes**	**No**	**Rare summer resident in mountain marshes and wetlands. In alpine tundra in fall migration. Uses shrublands for foraging. Documented in Garfield, Eagle, Pitkin, and Rio Blanco Counties, generally ranges up to 10,000 ft in summer.**
Olive-sided Flycatcher ***Contopus cooperi***	**USFS**	**Yes**	**Yes**	**Mature spruce/fir or Douglas-fir forests with preference for natural clearings, bogs, stream and lakeshores with water-killed trees, forest burns and logged areas with standing dead trees. Generally from 7,500 to11,000 ft.**
Purple Martin *Progne subis*	USFS	No - aspen stands small, declining	No	A, G, nesting in decadent aspen trees or snags from 8,000 to 9,000 ft. near streams or water. In Garfield, Eagle, Pitkin, Mesa, and Rio Blanco Counties.
Sagebrush Sparrow *Artemisiospiza nevadensis*	USFS BLM	No	No	Sagebrush shrublands, found in Garfield Co. & western Eagle Co.
Short-Eared Owl *Asio flammeus*	USFS	No	No	Grasslands, marshes, & agricultural areas on eastern plains and mountain parks.

Table 2. U. S. Forest Service, Rocky Mountain Region Sensitive Bird & Mammal Species that occur or have the potential to occur at North Star				
Species	**Agency**	**Suitable Habitat at North Star**	**Species Documented at North Star**	**Basic Habitat Description**
Trumpeter Swan *Cygnus buccinator*	USFS BLM	Yes	No	Shallow lake, marsh, & slough wetlands from Alaska east across western Canada to Ontario, Quebec, east to Nova Scotia & Newfoundland, & south to ID, MT, & ID. Occasional in Colo. & Utah. Obs. in Emma & Carbondale.
White-tailed Ptarmigan *Lagopus leucurus*	USFS	No	No	Alpine tundra, high-elevation willow thickets, krummholz, spruce-fir (winter).
MAMMALS				
American hog-nosed skunk *Conepatus leuconotus*	USFS	No	No	Canyons, mesas, and riparian valleys, with additional observations from grasslands through parts of Arizona, New Mexico, SE Colo.
American Marten ***Martes americana***	**USFS**	**Yes**	**Yes**	**Spruce/fir and mixed conifer forests with complex physical structure.**
Black-Tailed Prairie Dog *Cynomys ludovicianus*	USFS BLM	No	No	Historically inhabits the eastern third of Colorado below 6,000 ft.
Desert Bighorn Sheep *Ovis canadensis nelsoni*	USFS BLM	No	No	Rocky desert environments.
Fringed Myotis *Myotis thysanodes*	USFS BLM	No	No	Conifer, oak shrublands; caves, mines, building roosts, western WRNF including Rio Blanco, Garfield, and Mesa up to 7,500'.
Gunnison's prairie dog *Cynomys gunnisoni*	USFS BLM	No	No	Shortgrass & mid-grass prairie, grass-shrub habitats in low valleys, & mesic, high elevation sites on the Colorado Plateau in SE Utah, SW Colorado, northern Arizona, & NW, west-central, & central New Mexico.
Hoary Bat ***Lasiurus cinereus cinereus***	**USFS**	**Yes**	**No**	**Conifer & deciduous tree cavities or cliffs on edge of clearings up to 9,500 ft**
Kit Fox *Vulpes macrotis*	USFS BLM	No	No	Found in desert scrublands of western Colorado.
North American Wolverine *Gulo gulo luscus*	USFS	No	No	Occupy high elevations with deep, persistent, and reliable spring snow cover.
Pygmy Shrew ***Sorex hoyi montanus***	**USFS BLM**	**Yes**	**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***	**USFS**	**Yes**	**No**	**Riparian habitats that traverse a variety of other habitats. Mainly larger river systems.**
Rocky Mountain Bighorn Sheep *Ovis canadensis canadensis*	USFS	No	No	Rocky, steep, or rugged terrain for escape cover with open grass-dominated habitats nearby for foraging. Summer range at high elevation and winter range in valley bottoms or where snow depth is minimal.
Spotted Bat *Euderma maculatum*	USFS BLM	No	No	Cliff/Rock/Scree in arid Douglas-fir or Ponderosa Pine canyons associated with water, 6-8,000'.
Swift Fox *Vulpes velox*	USFS BLM	No	No	Grassland prairies of the Great Plains in a variety of habitats including shortgrass and mid-grass prairies, plowed fields and fencerows, and sagebrush.

Table 2. U. S. Forest Service, Rocky Mountain Region Sensitive Bird & Mammal Species that occur or have the potential to occur at North Star				
Species	**Agency**	**Suitable Habitat at North Star**	**Species Documented at North Star**	**Basic Habitat Description**
Townsend's Big-eared Bat *Corynorhinus townsendii townsendii*	**USFS BLM**	**Yes**	**No**	**Forages in semi-desert shrublands, pinyon-juniper woodlands and open montane forests. Rare to uncommon during summer. Roosts in caves, mines and mature forests. Generally not found above 10,500 ft.**
White-tailed Prairie Dog *Cynomys leucurus*	USFS BLM	No	No	Desert scrublands; most records are below 8,500 ft.
Wyoming Pocket Gopher *Thomomys clusius*	USFS	No	No	Dry, gravelly, shallow-soil ridge tops only in Sweetwater and Carbon counties in WY with some indication occurrences in northern CO.
AMPHIBIANS & REPTILES				
Black Hills Redbelly Snake *Storeria occipitomaculata pahasapae*	USFS	No	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*	**USFS BLM**	**Yes (non-breeding)**	**No**	**Subalpine forest habitats with marshes, wet meadows, streams, beaver ponds, and lakes, 7000-12,000 ft.**
Canyon treefrog *Hyla arenicolor*	BLM	No	No	Found in western desert and south eastern Colorado.
Columbia spotted frog *Rana luteiventris*	USFS	No	No	Coniferous or mixed forests, grasslands, & riparian areas of sage-juniper brushlands in AK through BC and western AB & WA, OR, ID, MT, WY, UT, & NV.
Desert Massasauga *Sistrurus catenatus edwardsii*	USFS BLM	No	No	Shortgrass prairie habitat with abundant sand sage, buffalograss, and blue grama in CO.
Great Basin spadefoot *Spea intermontana*	BLM	No	No	Found in western Colorado at elevation below 7,000 ft.
Longnose Leopard Lizard *Gambelia wislizenii*	BLM	No	No	Occurs in west-central Colorado and southwestern Colorado at elevations below 5,200 ft.
Milk Snake *Lampropeltis triangulum taylori*	BLM	No	No	Occurs throughout most of eastern, southern, and western Colorado at elevations primarily below 7,800 ft.
Midget Faded Rattlesnake *Crotalus oreganus concolor*	BLM	No	No	Occurs in desert and semi-desert habitats. Records for CO restricted to Garfield, Mesa, and San Miguel Counties.
Northern Leopard Frog *Lithobates pipiens*	**USFS BLM**	**Yes – but near upper elevational limit**	**No**	**Riparian and wetland areas, rarely above 8,500 ft.**
Plains Leopard Frog *Lithobates blairi*	USFS BLM	No	No	All types of water bodies & frequently wander far from water on the eastern plains.
Wood Frog *Lithobates sylvaticus*	USFS BLM	No	No	Sedge wetlands with adjoining grassy meadows, willow bogs, coniferous forests, and aspen in north-central CO.

Habitat Descriptions: A=Aspen, B=Cliff/Rock/Scree, C=Cottonwood/Riparian, D=Conifer Forest, E=Headwaters/Willow/Riparian, F=Lakes/Rivers, G=Marsh/Wetlands/Beaver Complexes/Fens, H=Rangelands/Sage, I=Creek w/ Limestone Drips, J=Colorado, Green, Lower Yampa, & White Rivers, K=Above Timberline, L=Mountain Parks, M=Pinyon/Juniper, N=Soils of Pierre, Niobrara, & Troublesome Formations

Sources for species occurrence and habitat association include the following: Adams (2003), Armstrong et al. (2011), Hammerson (1999), Kingery (1998), and unpublished information provided by FS staff (P. Nyland pers. comm. 2017) and Colorado Parks & Wildlife (CPW) staff (J. Logan pers. comm. 2017; K. Bakich pers. comm. 2017)

3.3 Colorado Natural Heritage Program Data

Review of the latest CNHP data (CNHP 2017b), in combination with the CNHP Roaring Fork Biological Inventory (Spackman et al. 1999) revealed 11 sensitive vertebrate species (global or state rank ≤ 3) recorded within proximity to North Star (Table 3).

Table 3. CNHP Element Occurrences Within Proximity to North Star

Common Name	Latin Name	Global Rank	State Rank
Bald Eagle	*Haliaeetus leucocephalus*	G5	S1B,S3N
Boreal Owl	*Aegolius funereus*	G5	S2
Boreal Toad	*Anaxyrus boreas boreas*	G4T1Q	S1
Canada Lynx	*Lynx canadensis*	G5	S1
Cooper's Hawk	*Accipiter cooperii*	G5	S3S4B,S4N
Great Blue Heron	*Ardea herodias*	G4	S3B
Northern Goshawk	*Accipiter gentilis*	G5	S3B
Northern Leopard Frog	*Lithobates pipiens*	G5	S3
Olive-sided Flycatcher[1]	*Contopus cooperi*	G4	S3S4B
Osprey	*Pandion haliaetus*	G5	S3B
Pygmy Shrew	*Sorex hoyi montanus*	G5T2T3	S2
River Otter	*Lontra canadensis*	G5	S3S4
Sharp-shinned Hawk	*Accipiter striatus*	G5	S3S4B,S4N
Sora	*Porzana carolina*	G5	S3S4B
Townsend's Big-eared Bat	*Plecotus townsendii*	G4	S2

3.4 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 4 that provides data on species abundance or estimated population sizes is the CWS authored Avian Monitoring Report.

Table 4. Reports Reviewed

Report	Author	Year	Description
North Star Nature Preserve 2015 Resource Management Plan (RMP)	Pitkin County	2015	Resource management plan establishing ecological values, management priorities & regulations.
Ecological Communities & Fluvial Geomorphology Baseline Report, North Star Nature Preserve	Golder Associates, Inc.	2015	Describes and evaluates the ecological communities and fluvial geomorphology for the North Star Nature Preserve.
OST Avian Monitoring Report: 2000-2008	CWS	2011	Reports results of point-transect monitoring & recommends Management Indicator Species for Filoha Meadows Nature Preserve, North Star & Seven Star Open Space.
Great Blue Herons	Charles Hopton	2014	Spreadsheet with monitoring data from 2000-2014.

[1] IUCN Conservation Status: Near Threatened

Table 4. Reports Reviewed

Report	Author	Year	Description
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.

3.5 Consultation Summary

At least 14 species classified as Federal or State Endangered or Threatened; BLM/USFS Sensitive; and/or with high (≤ 3) CNHP global or state rank have suitable habitat within the project area. Existing data on species occurrence at North Star is incomplete. The 2017 monitoring surveys were designed and implemented to close some of these data gaps.

4.0 Wildlife Monitoring

4.1 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 really 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 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 RMP. 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 results are again monitored and evaluated. This process is implemented on a regular cycle (e.g., every 5 years) to respond to changing recreation and ecological management needs and shifts in community values.

4.2 Monitoring Objectives

Specifically, the objectives of the 2017 monitoring effort were to:

1. Document spatial and temporal patterns of species composition and/or species richness for selected indicators and assess their interrelationships;
2. Assess the effects of human activity associated with North Star, the East of Aspen Trail, and the Roaring Fork River on wildlife;
3. Determine whether diversity, abundance, and community composition patterns of terrestrial vertebrates change over time; and

4. Determine the effectiveness of current management in balancing human use with preservation of biological diversity.

4.3 Monitoring Methods & Results

A variety of wildlife monitoring surveys were conducted. Survey techniques included Terrestrial Vertebrate 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 (Takata and Holroyd 1997, Bibby et al. 2000, Barnes and Belthoff 2008, Blakesley 2009); and avian point-transect surveys (CWS 2011). These methods and the results of the surveys are presented in Sections 3.2.4 through 3.2.9.

4.3.1 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 according to the MSIM protocols (Manley et al. 2006). TVES are general wildlife surveys designed to detect a variety of terrestrial species, especially mammals (e.g., ungulates, lagomorphs), 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 will be contained within a 200 m radius hexagonal area occupying approximately 10 ha (Fig. 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.

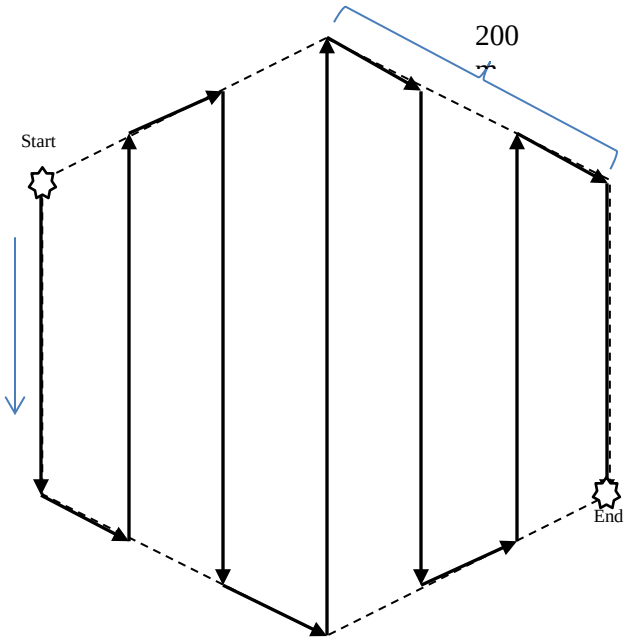

Figure 1. MSIM TVES hexagonal sampling unit (from Manley et al. 2006).

4.3.1.1 Survey Methods

Given the size and shape of North Star, two TVES hexagons were established in locations that provided the greatest representation of the major vegetation types (i.e., habitat) on the property (Map 1). Each corner and the center point of the TVES grid is permanently marked with wooden stakes or fiberglass rods and monumented via GPS. The TVES was conducted on July 1-2, 2014[2] between 0900 and 1400 hours. Two qualified observers searched within each TVES hexagon. Observers followed a transect that loops through the hexagon at ~50 m spacing (Fig. 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

[2] If deemed necessary, additional TVES could be conducted in fall and/or winter to establish migration and winter use of the property

line and perimeter of the hexagon and compass to walk the transect lines. All areas within 2 meters of either side of the transect line were surveyed.

4.3.1.2 Results

In 2017. the TVES at North Star resulted in 597 observations of 13 mammal species or sign of those species[3]. Sign was detected (e.g., scat, tracks, excavation, rubs, beds, dens) of the following mammals (in order of abundance): northern pocket gopher (*Thomomys talpoides*), Rocky Mountain elk (*Cervus elaphus nelsoni*), Rocky Mountain mule deer (*Odocoileus hemionus hemionus*), Microtine vole (*Microtus* sp.), American black bear (*Ursus americanus*), North American red squirrel (*Tamiasciurus hudsonicus*), moose (*Alces americanus*), least chipmunk (*Tamias minimus*), coyote (*Canis latrans*), North American beaver (*Castor canadensis*), golden-mantled ground squirrel (*Callospermophilus lateralis*), and North American deer mouse (*Peromyscus maniculatus*).

Vole presence was determined by the occurrence of trail castings or "eskers" (Photo 1) and/or dens (Halfpenny 1986, Elbroch 2003). Northern pocket gopher sign included mounds of dirt (Photo 2) 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 also detected via direct observation during the TVES: coyote, least chipmunk, Microtine vole (most likely montane vole [*M. montanus*]), mule deer (Photos 3, 4), and red squirrel.

The total detections of mammal species or sign of their occurrence was greater in 2017 than in 2014 but the relative abundance of those detections by species, except for northern pocket gophers, did not differ greatly. We recorded greater detections of northern pocket gophers, voles, mule deer, bears, moose (Photo 5), and least chipmunks in 2017 than in 2014 but fewer detections of elk, coyotes, beaver, and Wyoming ground squirrels. While no Wyoming ground squirrels were detected in 2017 (only 1 detection was recorded in 2014), American martens (Photo 15), deer mice (Photo 6) and moose were documented via TVES for the first time in 2017 (Photo 7).

Although the presence of many birds were detected during TVES, the only detections documented were those of raptors, Galliformes (e.g., grouse, turkeys, etc.), wading birds, waterfowl, or any occurrence of particular interest (e.g., rare, first detection, etc.). Such birds recorded during the TVES were: American coot (*Fulica americana*), Cooper's hawk (*Accipiter cooperii*), gadwall (*Anas strepera*), great blue heron (*Ardea herodias*; Photo 8), mallard (*Anas platyrhynchos)*, red-naped sapsucker (*Sphyrapicus nuchalis*), and spotted sandpiper (*Actitis macularius*).

4.3.2 Rare and Nocturnal Mammals

4.3.2.1 Survey Methods

Infrared cameras and associated scent stations were used to detect rare4 and nocturnal mammals. Survey locations were based on the general MSIM hexagonal survey design survey point locations. Five camera/scent stations were established at the south MSIM grid for a total of 5 stations (Map 2). This grid was selected since it more completely covered the variety of habitat types at North Star. Survey points were at the center of the hexagon and 400 m from the center at each of the cardinal directions. At each station, a motion sensitive monitoring camera was used to document species encounters. Bushnell® Trophy Cam brand cameras were set up to capture color photos during the day and infrared photos at

[3] It is important to note that this number does not represent the number of individual animals but, rather, the sign left by individual or multiple animals. It should be considered as an index of activity of mammals as a whole or of individual species at North Star.

[4] "Rare" in this case refers to animals that are uncommon across the landscape such as mountain lions and others that have large home ranges.

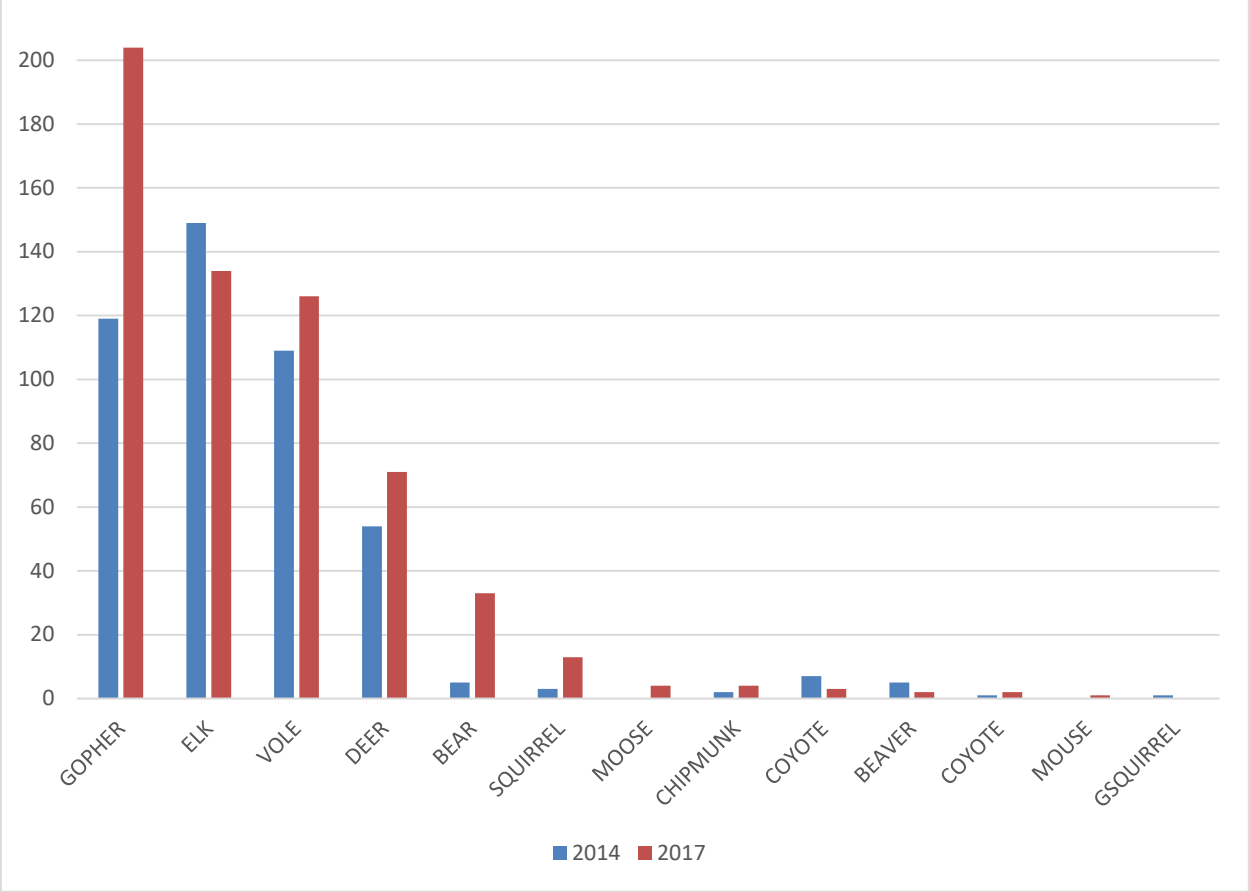

Figure 2. 2017 detections by mammal species[5] compared to 2014 results

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 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 (Photo 9) and to T-posts using EZ-Aim T Post Game Camera Mounts. Each camera was left in place for a total of 14 days.

Camera stations were baited and set to maximize detections of a variety of species. The primary bait was half a chicken 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; Carman's Superior Animal Lures Trails End® Lure, a lure for fox, coyotes and cats; and lanolin is used as a long-distance attractant. The lure mixture is 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 is placed within 4 m of the

[5] See Appendix C for species codes.

[6] When no tree was available, a T-post was used and left in place for future monitoring.

station on a substrate such as a tree branch. The mixture is applied on the setup day and is not reapplied or removed for the duration of the survey.

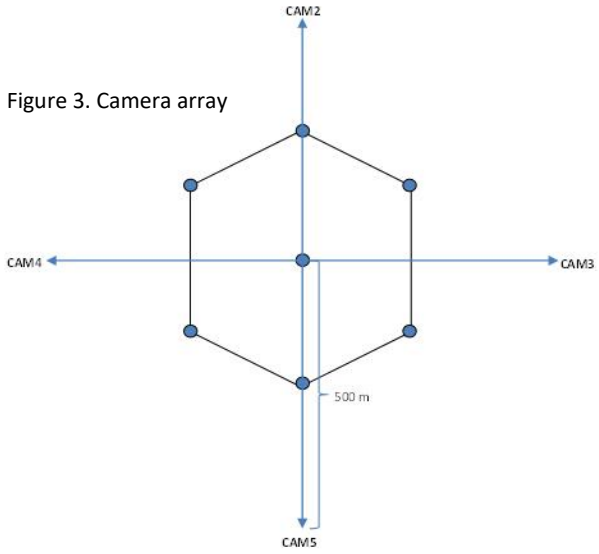

Figure 3. Camera array

4.3.2.2 Results

Over 2,500 photos were recorded by the 5 cameras placed at North Star. Wildlife species of interest were recorded at all locations. A total of 105 photographs of 8 mammal species and 6 bird species were recorded (Fig. 2). Of these, American black bear (Photo 10) was the most common species photographed (29.5%) followed by mule deer (26.7%; Photo 11), elk (12.4%), American marten (*Martes americana*; 7.6%), red squirrel (6.7%; Photo 12), moose (4.8%), coyotes (1.0%; Photo 13), and least chipmunk (1.0%) (See Appendix D for sample monitoring photos). Wild turkeys (*Meleagris gallopavo merriami*) were detected by the cameras 5 times (4.8%).Many of the photographs were triggered by wind moving vegetation and precipitation, rather than by wildlife.

Interestingly, 5 occurrences of wild turkeys (Photo 14) were documented. As discussed in the 2014 report by Golder (Golder Associates 2014) wild turkeys have been expanding their range in the Roaring Fork watershed and no turkey had been detected by formal surveys at North Star before 2014 with the image capture of 1 turkey. Given that 5 captures were documented in 2017, that trend seems to be continuing. American martens (Photo 15), North American moose (Photo 16), and a loggerhead shrike (Photo 17) were photo-documented for the first time in 2017. American martens were photo-documented 5 times and moose were photo-documented 8 times at North Star in 2017. Loggerhead shrikes are a predatory songbird that typically breeds in grasslands and other open habitats throughout much of North America but is experiencing substantial declines in distribution and population size. Although martens, moose, and shrikes have been observed on the property, none had been detected during formal surveys prior to 2017. Otherwise, all of the species detected were expected. A few mammals known to occur at North Star were not detected including bobcat (*Lynx rufus*), mountain lion (*Puma concolor*), long-tailed weasel (*Mustela frenata*) and short-tailed weasel (*M. erminea*). Given the duration of the survey, however, it is not surprising that these species which occur at relatively low densities were not confirmed by the cameras.

4.3.3 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, 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 carnivores.

4.3.3.1 Survey Methods

In 2017, nocturnal owl surveys (Map 1) were conducted at points established at regular intervals (350 m at North Star) spaced such that they maximized representation of the different cover types while minimizing the likelihood of detecting the same owl at multiple stations (Takats et al. 2001). Each point

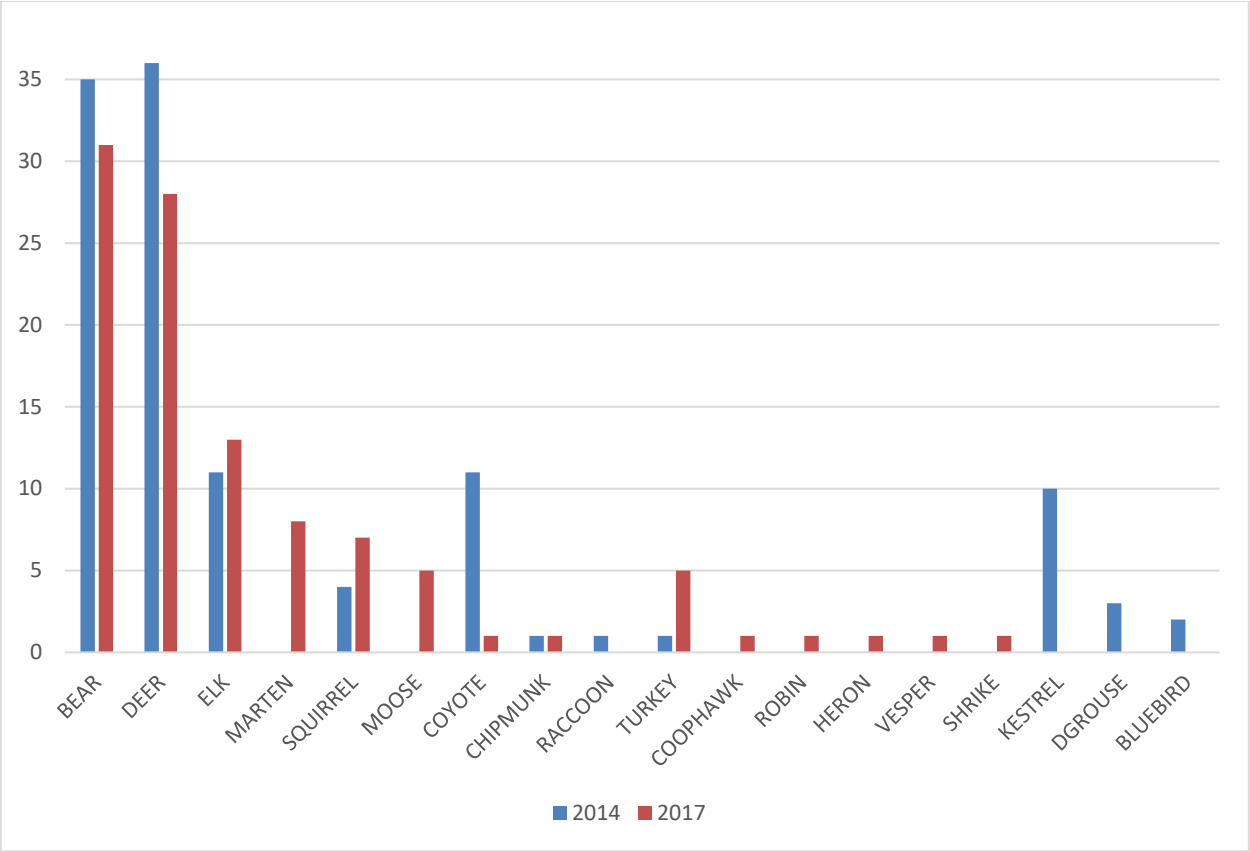

Figure 4. 2017 camera detections by mammal species[7] compared to 2014 results

was surveyed at the time of year when vocal activity of the majority of species is greatest (June 20). 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 person (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). At each station, the surveyor broadcast 3 times for 10 seconds in 3 directions, rotating 60˚ right or left (determined randomly) from the direction of travel, and then listen and search in all directions for owl responses for 30 seconds (Joy et al. 1994). The broadcast and observation procedures are then repeated two more times after rotating 120" from the previous broadcast.

The calls of all owl species that may occur in the AA 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 GIS (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 an mp3 player 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] See Appendix C for species codes.

4.3.3.2 Results

The 2017 nocturnal owl surveys at North Star resulted in the detection of 1 northern saw-whet owl (Aegolius acadicus). This owl, detected from calling point #5, was perched in a narrowleaf cottonwood approximately 185 m due east (94º) of the point (Map 3). A nest search was conducted the following day but none was found. Calls and sounds were documented from at least 8 other species including: coyotes, chorus frogs (Pseudacris triseriata), sora (Porzana carolina), Virginia rail (Rallus limicola), Wilson's snipe (Gallinago delicata), and mallards.

4.3.4 Avian Point Transects

The OST avian monitoring program 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, di Castri 1992). Birds can provide early warning of natural responses to environmental impacts (Noss 1990, Munn 1993, Woodley 1996b, Woodley 1996a). 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 helping to assure proper documentation of the potential effects of management actions on species of conservation concern.

4.3.4.1 Survey Methods

Avian surveys were conducted using point transects following the OST protocol 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). 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.

ArcGIS (ESRI 2008) was used to lay out a grid of systematic point count stations on properties to be added to the effort, each separated by at least 250 meters, within the boundary of a given property (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 (June 25). Surveys were begun 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. In addition, 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 and tree squirrels (i.e., red squirrels) are 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 annual or semi-annual reports, species richness and relative abundance is reported.

4.3.4.2 Results

In 2017, 288 individuals representing 41 species were detected which is fewer detections than any year from 2001-2008 except for 2004 (CWS 2011). Species abundance and species richness for each year was compiled by totaling the number of individuals and species detected. We calculated species richness (Chao 2) and species diversity (Shannon-Wiener Index or "Shannon Index"), using EstimateS 9.1

(Colwell 2016) to obtain the rarefaction curves and species richness estimators after randomizing the samples 100 times. The Chao 2 estimate of true species richness was chosen as the non-parametric estimator as it performs well on small samples (Colwell and Coddington 1994). Estimated species richness at North Star was 68.2 in 20178.

The Shannon diversity index measures the order (or disorder) within a community. The diversity index combines two quantifiable measures: the 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 richness and diversity) to 3.5 (high species evenness and diversity), though values beyond these limits may be encountered (Magurran 2004). The Shannon diversity index for the avian monitoring data collected in 2017 was 3.08.

In 2017, the 10 most abundant species represented 70.5% of the total individuals detected. Song sparrows, yellow warblers, Lincoln's sparrow and tree swallows were, respectively, the 4 most abundant species detected. Interestingly, red-winged blackbirds were the only thirteenth most abundant bird as compared to the most abundant 2001-2008 where it was either the most or second most abundant species detected (CWS 2011). The ratio of the number of detected individual species at North Star known to be habitat specialists or particularly sensitive to human activity (i.e., sensitive species; e.g., Cordilleran flycatcher, western tanager) 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-capped chickadee) was also calculated. The ratio favored the specialist/sensitive species with a ratio of 3.31:1. This is within the range of variation for this metric but below the mean (4.25:1) and median (4.44:1) as calculated for each year from 2001-2008 (CWS 2011).

Table 5. Relative abundance of ten most abundant bird species (2017)

Species	Relative Abundance
SOSP	12.2%
YWAR	10.8%
LISP	9.0%
TRES	9.0%
MALL	7.3%
FOSP	6.3%
WAVI	5.6%
AMRO	3.5%
HOWR	3.5%
RCKI	3.5%
10 Most Abundant Dominance	70.5%

4.3.4.3 Species of Concern

There are 21 bird species that were detected at North Star 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 6)

[8] For comparison, the average Chao 2 estimated species richness from 2001-2008 was 56.7 with a high of 69.82 in 2003 (CWS 2011).

4.3.5 Diurnal Raptor Surveys

Raptors, also known as birds of prey, are a group of birds composed of the orders Falconiformes (diurnal birds of prey) and Strigiformes (owls, nocturnal birds of prey). Due to differences in their behavior, raptors are split into diurnal and nocturnal (Section 3.23 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.

Table 6. List of bird species with special management designation detected on North Star in 2017

Species	USFS	USFWS	BLM	CPW	T&E	PIF
Band-tailed pigeon			S	SGCN		
Black-billed magpie					UCS	
Broad-tailed hummingbird						RS,UCS
Cooper's hawk						RS,UCS
Cordilleran flycatcher						RS,UCS
Green-tailed towhee	MIS					RS,UCS
Hairy woodpecker	MIS					
Lewis's woodpecker	R2S	BCC	S	SGCN		RC,RS,UCS
Lincoln's sparrow	MIS					
Loggerhead shrike	R2S	BCC	S			CBSD
Mountain bluebird	MIS					RC,RS
Mallard	MIS					
Northern flicker						CBSD,RS,UCS
Olive-sided flycatcher	R2S	BCC		SGCN		RC,TNC,UCC
Plumbeous vireo					RS	RS,UCS
Pine siskin					RC,RS	
Red-naped sapsucker	MIS	BCC				PS
Vesper sparrow	MIS					
Violet-green swallow						UCS
Virginia's warbler	MIS	BCC		SGCN	CC,RC,RS	RS,UCC,UCS
Warbling vireo	MIS					UCS
Wilson's warbler	MIS					CBSD

Special management designations: USFS=United States Forest Service, R2S=US Forest Service Region 2 Sensitive Species, MIS=Management Indicator Species; USFWS=U.S. Fish and Wildlife Service, BCC=Bird of Conservation Concern for Bird Conservation Regions (BCR) 16 & 18; BLM=Bureau of Land Management, S=BLM Sensitive Species in Colorado; CPW=Colorado Division of Parks & Wildlife, SGCN=Species of Greatest Conservation Need (Colorado Division of Wildlife 2005); FE=Federally Endangered Species, SE=State Endangered Species, FT=Federally Threatened Species, ST=State Endangered Species, SC=State Special Concern; PIF=Partners In Flight Species of Concern for Bird Conservation Region 16 (from the Species Assessment Database version 2017 found at http://rmbo.org/v3/avian/ExploretheData.aspx) CBSD = Common Bird in Steep Decline; RC = Regional Concern Species; RS = Regional Stewardship Species (PIF Science Committee 2012).

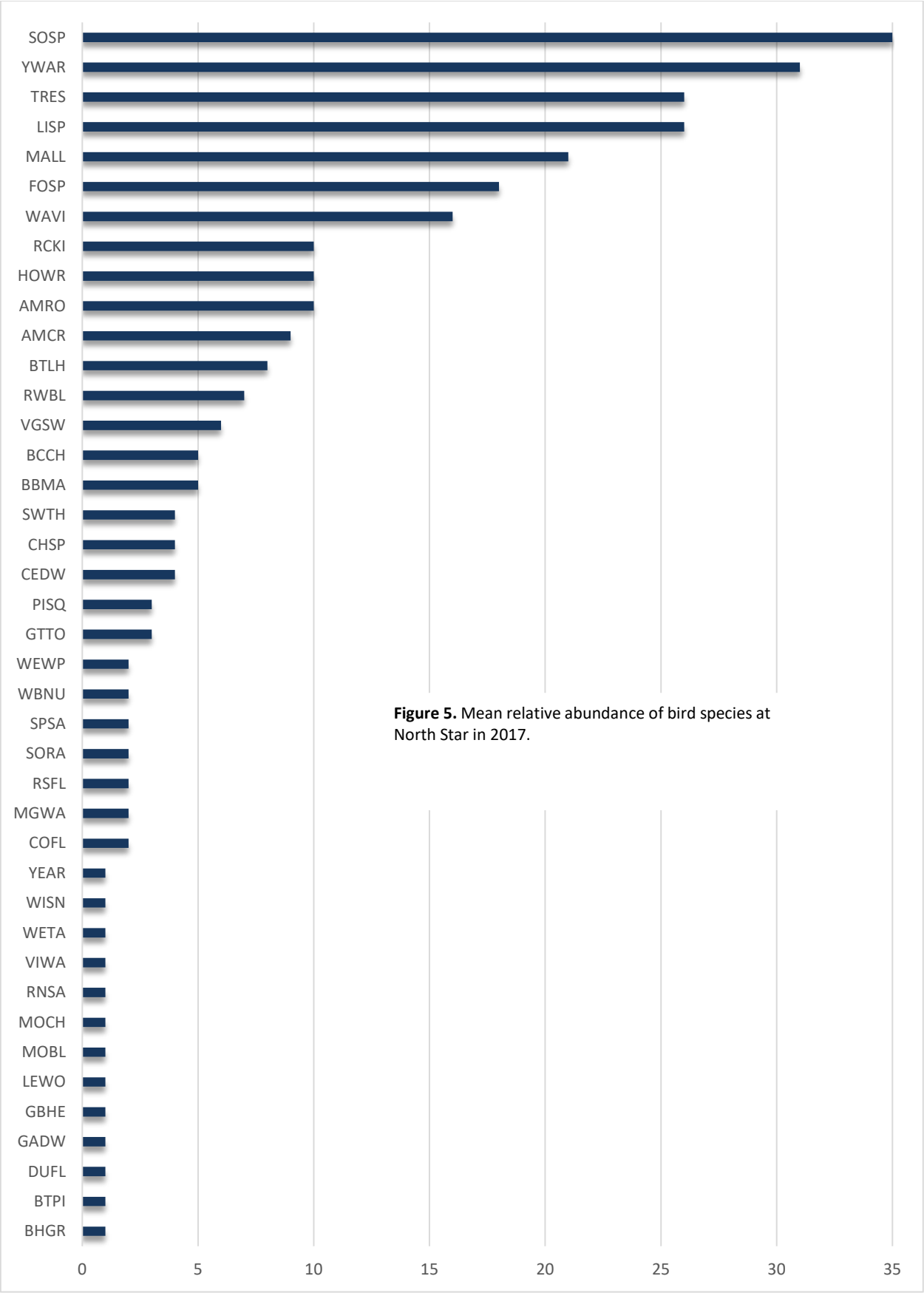

Figure 5. Mean relative abundance of bird species at North Star in 2017.

Some, such as red-tailed hawks, are readily observed if soaring over open fields. 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 playback surveys. Surveys were conducted during the early summer (July 8) to increase our chances 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).

4.3.5.1 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 150 m along a single 1,229 m transect along the toe of the slope leading to Richmond Ridge (Appendix B: Map 2). The survey was limited to this transect since it sufficiently covered the 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, and northern goshawk alarm calls, in that order, to avoid potential size-related inhibitory effects[9]. When a focal species was detected, the observer recorded 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).

4.3.5.2 Summary of Results

Four raptor species were detected during the broadcast surveys: American kestrel, Cooper's hawk, osprey, and red-tailed hawk. One female Cooper's hawk first via alarm calls and then direct observation (Photo 18). The female Cooper's hawk responded to the broadcast of the conspecific alarm call at point 7 by kekking (i.e., alarm call) from two locations then flying closer while calling. The hawk was observed again between points 7 and 8. A subsequent nest search in the vicinity of the observations following the completion of the broadcast survey resulted in discovery of the nest location (39.164794, -106.795786; Map 3; Photo 19). During the nest search, egg shells (Photo 20) were found below the nest tree indicating the presence of nestlings. Observation of the nest revealed the presence of 2 healthy nestlings.

A solitary red-tailed hawk of undetermined gender was at first detected by a vocalization at broadcast point 5 then by direct observation. The hawk circled 2 or 3 times in response to the broadcast northern goshawk alarm calls at approximately 25 feet above the ground and then flew west-northwest toward Richmond Ridge. A search was conducted in proximity to the detection and the historic red-tailed hawk nest (which is situated approximately 23 m southwest of the transect along a perpendicular bearing, approximately 40 m south-southwest of point 4, and approximately 125 m northwest of point 5). This nest search was unsuccessful and the historic nest is non-existent.

[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.

A solitary osprey was observed from broadcast point 5 as well. The osprey was flying in a straight line south-southeast approximately 80 feet above the ground.

4.3.6 Colonial Wading Birds

North Star is home to a colony of great blue herons (Photo 21). This heronry has existed at the south end of North Star for more than 25 years. Until 2006, it was located on the west side of the river in spruce trees (Photo 35). 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 (Photos 22, 36; Map 3). Although monitoring of the herons was not part of this monitoring effort, the herons have been monitored by Charlie Hopton of Aspen in cooperation with OST and the BCR Colony Watch program10 since 2000.

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
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

The heron nesting and productivity data indicates a substantial decrease in occupancy and production at the North Star heronry (Figure 6; Table 6). 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 with nestlings with zero fledged. Although the reduced productivity coincides with the exponential growth in

[10] For more information see http://rmbo.org/v3/avian/CitizenScience/ColonyWatch.aspx.

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). Further study is necessary to determine whether any management actions should or can be implemented to reverse this trend.

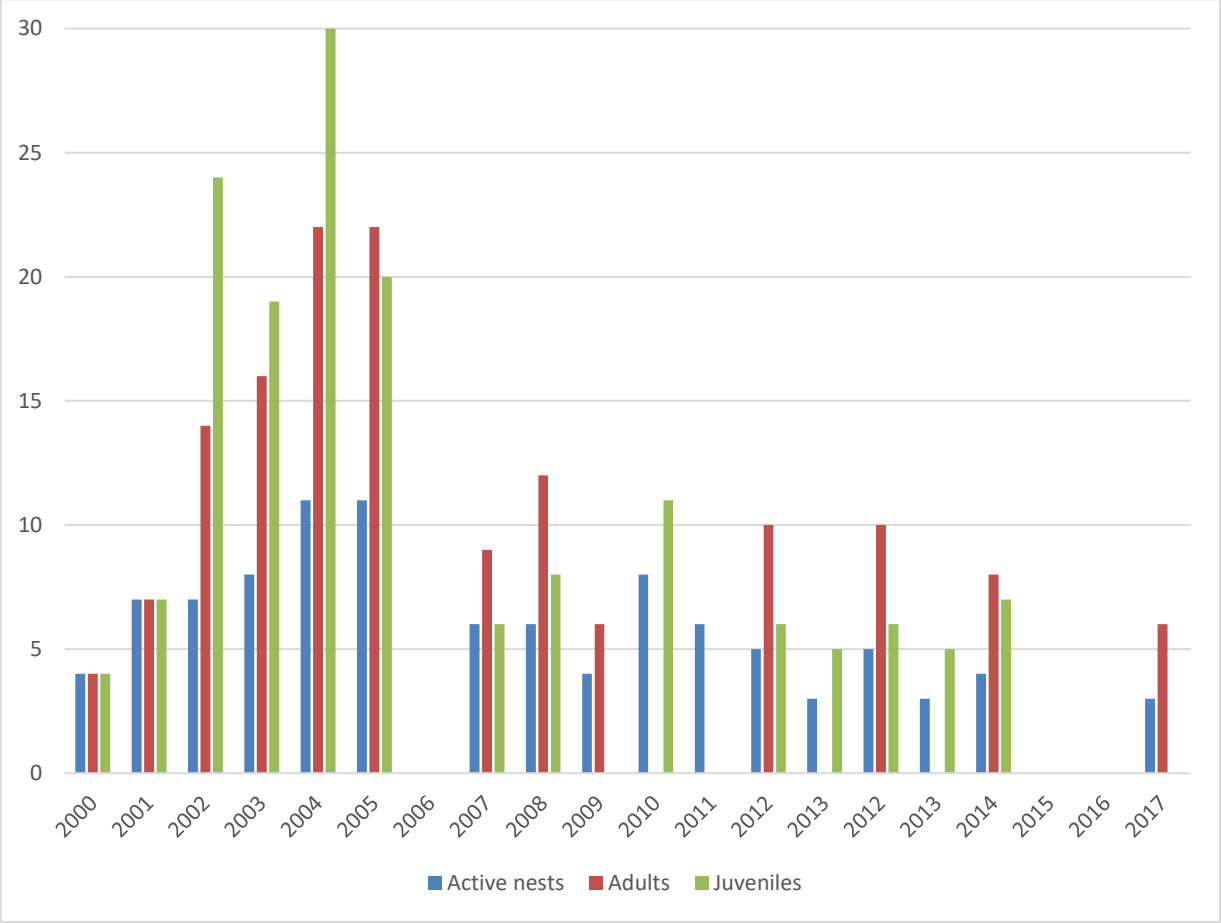

Figure 6. Great blue heron nesting and productivity data 2000-2017 (note: no data available for 2006, 2015, and 2016).

5.0 Conclusions

The scope and focus of the wildlife monitoring surveys were guided by OST and supported by past studies by OST, CWS, and other resource professionals. The following sections summarize each target group.

5.1 Mammals

The following conclusions can be made about mammals at North Star:

- Only 1 federally listed mammal species has the reasonable potential to occur on or around North Star: Canada lynx. No lynx or lynx sign has been identified at North Star during formal surveys through 2017.
- Five mammal species designated by a state or federal agency or of other conservation concern are known or have the reasonable potential to occur at North Star: American marten, hoary bat,

pygmy shrew, river otter, and Townsend's big-eared bat. These species were not documented at North Star via sign or direct observation during the 2017 surveys[11].

- North Star is heavily used by elk throughout the year. Elk cows use North Star in the summer for rearing habitat and as part of their general summer range (bulls to a lesser extent). Monitoring has confirmed that North Star is used by elk as rearing habitat. Although spotted calves were photo-documented at North Star, parturition has not been confirmed[12].

- North Star provides excellent summer mule deer habitat and a large number of mule deer continue to use North Star throughout the non-winter months.

- Northern pocket gophers and voles are abundant at North Star and are an important biotic component contributing to soil dynamics, infiltration, and plant ecology at North Star. Soil disturbance by these animals, however, also creates microsites where weeds can flourish.

- At least eleven mammalian predator species are known to use North Star as part of their home range but only American marten, black bears, coyotes, and martens were recorded by the 2017 surveys. American mink (*Neovison vison*), bobcats, short-tailed weasel, long-tailed weasel, mountain lions, red fox (*Vulpes vulpes*), and striped skunk (*Mephitis mephitis*) have not been observed or otherwise identified during formal surveys at North Star by CWS in 2014 (Golder Associates 2014) or 2017 but have been documented by a CWS biologist via direct observation or indirectly by means of tracks, scat, or other sign between 1998 and 2017.

- Abundant small mammals (i.e., leporids and rodents) of a variety of species provide an excellent prey base for both mammalian and avian predators. At least 6 small mammal species (American red squirrel, deer mouse, golden-mantled ground squirrel, least chipmunk, northern pocket gopher, vole spp.) were recorded during the 2017 surveys. Past small mammal surveys have found bushy-tailed woodrat (*Neotoma cinerea)*, long-tailed vole (*Microtus longicaudus*), montane vole, mountain cottontail, (*Sylvilagus nuttallii*), muskrat (*Ondatra zibethicus*), snowshoe hare (*Lepus americanus*), southern red-backed vole (*Myodes gapperi*), western jumping mouse (*Zapus princeps*), and Wyoming ground-squirrel (*Urocitellus elegans*) occurring at or on the periphery of North Star.

- The number of northern pocket gophers and voles (most likely montane voles) detected via the TVES increased substantially from 2014 to 2017 (Figure 2).

- North Star provides excellent moose habitat and moose were positively identified by direct observation, by tracks during TVES, and photo-documented by the camera traps in 2017. North Star is excellent moose habitat and the increased observations by both professionals and the public should be a warning that North Star is a likely human-moose conflict area.

- American black bears are abundant at North Star and the 2017 surveys indicate that North Star continues to be heavily used by sows with cubs and solitary males. At least 3 sows with 7 cubs were recorded using North Star during the same period in 2014. No less than 3 solitary bears were also documented by the monitoring cameras.

5.2 Birds

All birds were surveyed at North Star in 2017 via breeding season point transects, nocturnal bird surveys, and diurnal raptor surveys. Based on the results of those surveys, in combination with past efforts (e.g.,

[11] Bat surveys have not been conducted at North Star

[12] Parturition can be confirmed by the presence of birthing beds or direct observation of calving activity.

CWS 2011, Hopton 2014, Golder Associates 2014), the following conclusions can be made about North Star's avifauna:

- At least 86 bird species have been documented at North Star during the breeding season.
- Twenty-two species of conservation concern (Table 5) have been documented at North Star in 2017.
    - A single loggerhead shrike was captured by Camera 1 in 2017. This is the first shrike formally documented at North Star.
- North Star is home to a large number of bird species known to be sensitive to human activity. From 2000-2008 monitoring period, the ratio of sensitive species to generalist species increased at North Star (CWS 2011) but decreased in 2017. As river-based recreation at North Star continues to increase, this metric will be monitored to determine if there is a significant change in the trendline.
- Four species of diurnal raptor (American kestrel, Cooper's hawk, osprey, red-tailed hawk) were documented at North Star during the breeding season but only one active nest (Cooper's hawk) was located.
    - Although red-tailed hawks have nested at North Star as recently as 2013 and red-tailed hawks were observed in 2017, the historic nest no longer exists and no new nests were found.
- At least two owl species have been confirmed at North Star during the breeding season: great-horned owls and northern saw-whet owls. In 2017, however, only saw-whets were confirmed during surveys.
- Five wetland/wading birds (great blue heron, sora, spotted sandpiper, Virginia rail, Wilson's snipe) were identified at North Star in 2017. Killdeers have been observed in the past but not in 2017.
- At least seven species of waterfowl (American coot, Canada goose, cinnamon teal, gadwall, green-winged teal, mallard, and pied-billed grebe) likely breed at North Star. Only American coot, Canada goose, mallard, and gadwall, however, were documented during the 2017 surveys.

6.0 Ecological Setting & Habitat Types

One of the objectives of this study was to identify existing habitats at North Star. For the purposes of this study, habitat delineation was based on dominant existing vegetation and physical features. Seven major wildlife habitat types were identified on the property.

6.1 Open Water

Water is crucial for all fish and wildlife, and the high quality open water habitat at North Star provides essential habitat to many aquatic and terrestrial species, including important spawning and rearing habitat for trout, and breeding habitat for amphibians. In many locations, flow and hydrology have been impacted by barriers, culverts and diversions that have reduced water flow and interfere with fish movement and wildlife use. Channelization and development can restrict the natural ability of streams and riparian habitats to meander over time, limiting the quality and availability of these habitats, as well as affecting floodplain function. North Star's larger, cool spring-fed and run-off supported pools and river oxbows provide valuable water sources for numerous wildlife species and are important habitat for bats (foraging and drinking), waterfowl and shorebirds/wading birds (foraging and breeding), and amphibians (breeding; e.g., tiger salamander (Ambystoma tigrinum)). Open water areas provide nesting, feeding, and

resting habitat for migrating waterbirds (Foster 1986). North Star's oxbows, watercourses and adjacent open water areas are also important to furbearers such as muskrats, beaver, and mink.

6.2 Aspen Woodland

Aspen is a deciduous tree, and stands generally have high invertebrate prey diversity and densities. A suite of associated species, particularly songbirds, is entirely dependent on aspen. Aspen is important for birds in both migration and breeding seasons. It also provides fawning and calving habitat, hiding cover, and forage for mule deer and elk. Other wildlife that uses aspen include bats, black bear, beaver, rabbits, dusky grouse, and voles. Woodpeckers such as northern flickers and red-naped sapsuckers, create nesting cavities in aspen and secondary cavity nesters such as tree and violet-green swallows and mountain bluebirds nest in those cavities.

Although the aspen stands on North Star are relatively small, such small aspen patches are an important component of the landscape to many species of birds (Turchi et al. 1995). In fact, a study in northern Arizona found that aspen stands do not harbor separate populations, but rather are locations where the regional avifauna reaches high local density and richness and may be disproportionately important to birds in years of resource scarcity (Griffis-Kyle and Beier 2003).

6.3 Riparian Woodland & Shrubland

Riparian habitats at North Star are those adjacent to the river and streams, or that occur on the river's floodplain, terraces and oxbows. Riparian habitats are shaped and maintained through seasonal flooding, scour, and soil deposition. Floods replenish nutrients, recharge groundwater, and reset successional processes. Other riparian habitats at North Star also include the various springs, seeps, and intermittent streams occurring throughout the property.

In Colorado, the importance of riparian habitat to wildlife is inversely proportionate to its representation on the landscape (Miller et al. 2003). In the arid west it is estimated that riparian areas, which account for only 1% of the landscape, are used by greater than 70% of the state's wildlife species and that 27% of the breeding bird species depend on riparian habitats for their viability (Knopf et al. 1988, Howe 1996), and Colorado riparian habitat hosts a greater diversity of bird species than any other habitat (Kingery 1998).

Riparian habitats, such as those at North Star, also play an important function in providing for the habitat requirements of mule deer and elk (and moose). Deer, elk, and moose seek out riparian shrublands and wet meadows for their nutritious grasses and forbs (Foster 1986). North Star's broad riparian corridor provides mature trees and tall shrubs for thermal and screening cover, and drainage patterns promote pooling of water, growth of forbs, and a greater diversity of important shrubs. Small mammals such as montane voles, pocket gophers, deer mice, jumping mice, shrews (*Sorex* spp.), and mink use North Star's seasonally wet riparian woodlands.

6.4 Sagebrush

Sagebrush shrubland occupies relatively little acreage at North Star. It is likely, however, that this habitat type once occupied substantially greater acreage including most of the non-riparian upland outside the alluvial fans and below the toe of Richmond Ridge. Sagebrush supports a unique biodiversity that is at risk due to threats of urbanization, development, mineral exploration and extraction, grazing and agriculture. There is substantial concern regarding the decline of sagebrush habitat throughout the western United States. Fragmentation and degradation is causing a decline of habitat that is vital to numerous wildlife species ranging from insects to big game. Sagebrush habitats support a unique biodiversity. Several bird and mammal species are almost entirely dependent on sagebrush for survival (e.g., greater sage-grouse (extirpated from the Roaring Fork Watershed), sage sparrow (nearly extirpated from the Roaring Fork Watershed), and Brewer's sparrow). An additional 100 species of birds, 90 mammals, and 60 herpetofauna have a facultative association with sagebrush (Welch 2005). At least one

bird, 18 small mammals, and 3 native ungulates consume sagebrush in their diets. Over 240 insects as well as 70 spiders and other arachnid species are associated with sagebrush (Welch 2005).

6.5 Grassland

It is likely that the historic representation of upland grasslands at North Star is inversely proportional to that of sagebrush. In other words, the sagebrush shrublands at North Star were cleared by former landowners and converted to hayfields for agricultural purposes. These anthropogenic grasslands are dominated by smooth brome (*Bromus inermis*) and support the lowest species diversity of any habitat type on the property. That is not to say that they are not of value to wildlife, rather, this habitat type is simply less valuable than the other, naturally occurring habitat types.

The North Star grasslands provide highly palatable forage for elk, voles, jumping mice, and pocket gophers. In turn, the small mammals are important prey for coyotes, red fox, weasels, and raptors. The grasslands support high densities of grasshoppers and other insects which provide prey to songbirds and kestrels (Photo 23). North Star's grasslands provide excellent Wyoming ground squirrel habitat. Unfortunately, these colonial ground squirrels were eliminated from the property by previous owners and have yet to recolonize. Once that happens, American badgers (*Taxidea taxus*) will likely follow.

6.6 Herbaceous Wetlands

The herbaceous wetland habitat at North Star consists of those areas that are non-riparian and saturated by water during all or part of the year. Permanently saturated habitats include backwater sloughs, oxbows, and marshes, while seasonally saturated herbaceous habitats include seasonal ponds, vernal pools, and wet meadows. The marshes (including emergent marshes) at North Star occur in depressions (ponds), fringes around open water and along slow-flowing reaches of the river. Marshes are seasonally or continually flooded and have hydrophytic plants such as sedges, wetland grasses, and rushes; whereas wet meadows occur on gentle slopes where ground water exists (at least seasonally) near the surface but does not saturate the soil sufficiently to create wetland conditions. They are dominated by tufted hairgrass (*Deschampsia caespitosa*), fowl mannagrass (*Glyceria striata*), sedges (*Carex* spp.), reedgrass, rushes (*Juncus*), and other graminoids, as well as by various wildflowers.

Unfortunately, at least 50% of the original wetland area in Colorado has been lost to drainage, land-use development, and other human activities since colonial settlement (Dahl 1990). Wetlands provide important habitat for migrating and breeding waterfowl, shorebirds, waterbirds, songbirds, mammals, and amphibians (e.g., western chorus frog - *Pseudacris triseriata*). In addition to being critical for birds and many kinds of wildlife, floodplain wetlands, backwater sloughs, and swamps are important rearing habitats for juvenile trout. Of the 295 species of birds, 123 mammals, 47 reptiles, and 18 amphibians that inhabit Colorado at some time during the year, 125 (26%) can be classified as "wetland-dependent species"(Ringelman 1996). Within this category of "wetland wildlife", 98 species (78%) are migratory birds, 18 (14%) are amphibians, 6 (5%) are reptiles, 3 (1%) are mammals. CNHP has categorized 34% of these species (n=42; 29 migratory birds, 11 amphibians, 1 reptile, and 1 mammal) as "rare and imperiled" (CNHP 1996).

6.7 Mixed Conifer Forest

The mixed-conifer forests on the western side of North Star contain a range of species including Douglas-fir (*Pseudotsuga menziesii*), Engelmann spruce (*Picea engelmannii*), subalpine fir (A*bies lasiocarpa*), and aspen. The composition varies greatly depending largely on aspect. Due to the large number of fruit- and mast-bearing shrubs that occur within this habitat type, a relatively diverse assemblage of species can regularly be found in the mixed conifer at North Star. Deciduous fruit-bearing shrubs include shrubs that commonly dominate or co-dominate the understory are currants (*Ribes* spp.), thimbleberry (*Rubus parviflorus*), wortleberries (*Vaccinium* spp.), Oregon grape (*Mahonia repens*), and mountain lover (*Paxistima myrsinites*). Three USFS R2 Sensitive species have been recorded in North Star's mixed conifer forest: American marten, northern goshawks and olive-sided flycatchers. Other R2 Sensitive

species may occur including hoary bat (*Lasiurus cinereus*), pygmy shrew (*Sorex hoyi*), and Townsend's big-eared bat (*Corynorhinus townsendii pallescens*). In addition, black bears, bobcats, elk, red squirrels, least chipmunks, golden-mantled ground squirrels, southern-red-backed voles, and short-tailed weasels have all been recorded within North Star's mixed conifer forest.

7.0 Wildlife Management Indicator Species (MIS)

Avian MIS were recommended for North Star in the 2011 avian monitoring report (CWS 2011). These species remain appropriate today and are discussed below. In addition, mammalian MIS were added in 2014 (Golder Associates 2014) for consideration in future management of North Star. Only raw counts will be reported here. In 2017 avian species were monitored via the OST avian point transect protocol and mammals were monitored by the TVES and camera trap array components of the MSIM effort at North Star.

7.1 MIS - Aspen Forest or Woodland

Warbling Vireo (G5/S5B)

From 2001-2013, a median of 15.5 warbling vireos were documented at North Star. In 2017, 16 warbling vireos were identified during point transects. This is greater than the median and within the range of variability for that period. A high of 28 warbling vireos were documented in 2013 and a low of 10 were documented in 2007.

7.2 MIS - Riparian Shrublands

Lincoln's Sparrow (G5/S5BSZN)

The number of Lincoln's sparrows documented at North Star in 2017 (26) exceeded the median of 19 recorded from 2001-2013 and exceeded the count for every year except 2013 (41).

Song Sparrow (G5/S5)

Thirty-five song sparrows were documented at North Star in 2017. This exceeded the median of 26 recorded from 2001-2013 and exceeded the range of variability for that period. In 2001 and 2013, 34 song sparrows were recorded but only 12 were documented in 2011.

7.3 MIS – Emergent Wetlands

Red-Winged Blackbird (G5/S5)

It appears that the breeding population of red-winged blackbirds at North is declining (Figure 7). The red-winged blackbird is one of the most abundant species in North America with an estimated winter population of 190 million (Marshall et al. 2003). 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 in large part to the presence of human-commensal predators, such as domestic cats and raccoons (Vierling 2000).

Threats: Loss of emergent wetland habitats is the most significant threat. 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. Red-winged blackbirds are a common host for brown-headed cowbirds.

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 2001-2015 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. Although the linear trend of the raw data indicates a slight downward trend, only 32.6% of the variation in detections can be explained by the model. The remaining 67.4% can be explained by unknown variables or inherent variability.

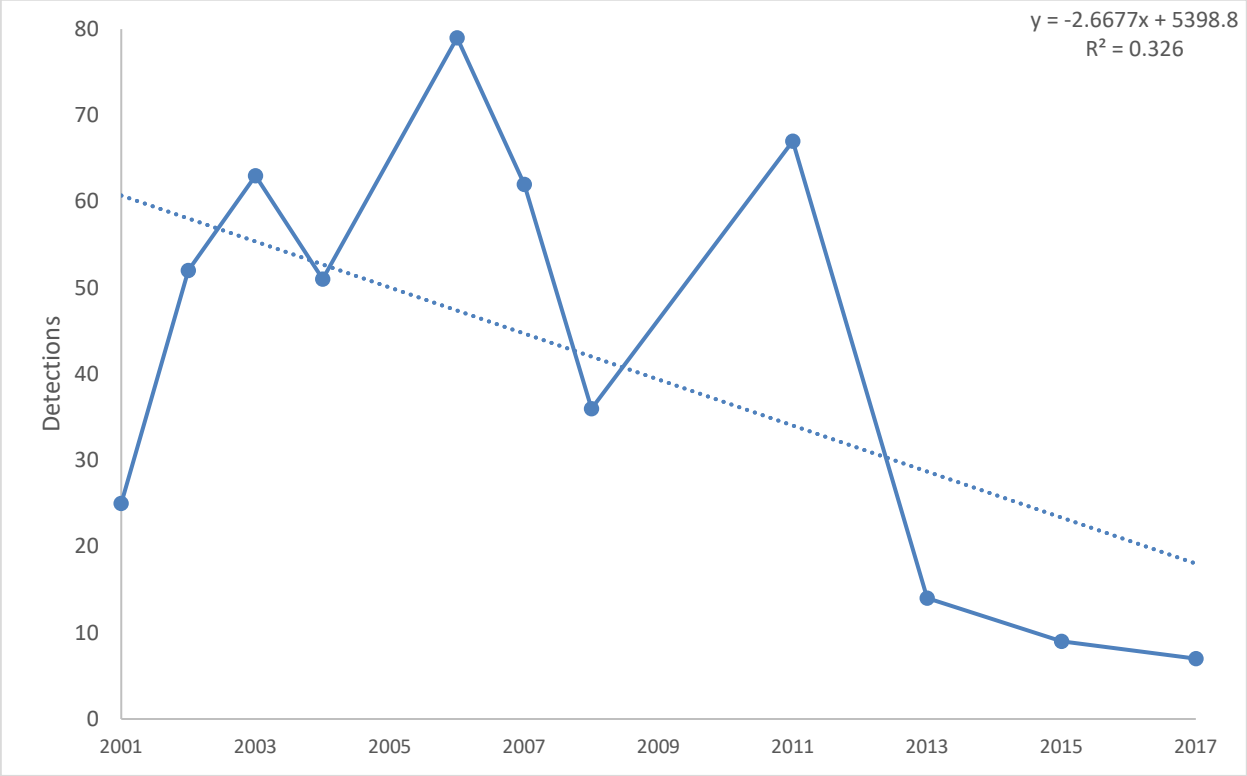

Figure 7. Red-winged blackbird detection trend 2001-2017 (note: no data available for 2009, 2010, 2012, 2014, and 2016).

7.4 MIS – Riparian Woodland

American Beaver (G5/S4)

No beaver specific surveys were conducted in 2017.

Yellow Warbler (G5/S5B)

The number of yellow warblers documented at North Star in 2017 (31) exceeded the median of 27 recorded from 2001-2013 and was within the range of variability for that period (n_{min} = 15; n_{max} = 35).

7.5 MIS – Broad-scale Riparian Specialist

Great Blue Heron (G5/S3B)

The greatest threats to heron colonies are from humans and eagles; these two factors have been cited in numerous cases of heronry abandonment. Many heron colonies are highly sensitive to human disturbance or to changes in their surroundings. Habitat fragmentation and loss from urban encroachment result in smaller colonies that have lower nest productivity. Human activities such as recreation, construction, and destruction of wetlands disrupt colonies. While herons are known to nest in urban areas, this is likely due to reduction in available habitat due to urban encroachment and also because humans and herons compete for the same resources – water, fish, trees, and fields. Depredation by eagles is considered the second

biggest threat to heron populations and often results in abandonment of nests or entire colonies. Herons are most sensitive to disturbance during the pre-nesting and early nesting phases.

Establishing a second nest after an initial failure is more likely to be successful if it is done early; if the herons do not make a second attempt to nest after moving a colony, an entire generation can be lost, which contributes to the overall decline in populations.

Production at North Star's great blue heron colony is clearly declining. Based on observation by CWS and Charlie Hopton (pers. comm.), it is believed that no young successfully fledged at North Star for the first time since at least 1995. An average of 10 young great blue herons successfully fledged at North Star since monitoring began in 2000. This decline has coincided with the rapid increase in river based recreation and observed golden eagle activity around the heronry (Charlie Hopton, pers. comm.). These two factors could be interacting synergistically resulting in the decline of the colony (Wershkul et al. 1976, Grubb 1979, Tremblay and Ellison 1979, Vos et al. 1985, Watts and Bradshaw 1994, Knight and Gutzwiller 1995, Reinhart 1999, Vennesland 2000). While the colony persists, its occupancy and production level are of concern. Further study is necessary to determine whether management has contributed to this decline.

7.6 MIS – Broad-scale Habitat Generalist

Rocky Mountain Elk

Elk were monitored via TVES and camera trap array components of the MSIM effort at North Star. One hundred thirty-four sets of elk tracks, pellet piles or other sign were detected during the TVES in 2017. This metric is comparable to the 149 detections in 2014. In addition, elk were detected by camera traps 13 times in 2017 as compared to 11 in 2014. Images of both bulls and cows were detected but no calves were detected in 2017.

8.0 General 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 (above) 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, raptor surveys, and great blue heron monitoring on a long-term basis to develop more comprehensive species lists, determine population trends, and evaluate the effects of management actions on MIS.

2. These surveys should be conducted at least every 3 years in order to produce data that will facilitate the adaptive management process in a cost-effective manner. 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).

3. Avian monitoring should be implemented every other year. From an effective monitoring perspective, every other year is really the largest interval that should be used. If done at greater intervals, say 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.

4. A more comprehensive study of the heronry should be conducted to determine whether management decisions are affecting occupancy and production.

5. A detailed investigation of the red-winged blackbird decline should be conducted to determine whether management decisions are impacting the population at North Star.

6. A species-specific beaver monitoring element should be added to the MSIM effort at North Star since beavers have been identified as a MIS.

7. Prior to implementation of major habitat or recreation development projects, targeted surveys should be conducted prior to implementation and for a few years following completion to determine effects on wildlife communities and MIS.

8. Interpretive displays should be added along the river to educate the river recreation community regarding North Star's ecological sensitivity.

9. Continue the closure of the west side of the river to the general public to maintain North Star as a nature preserve and as a buffer between human activity and adjacent WRNF lands.

10. Maintain the current dog prohibition.

11. Maintain waterfowl breeding, foraging, nesting, and loafing habitat; maintain forage opportunities for wading birds, and support red-winged blackbird breeding habitat.

12. Qualitatively monitor aspen recruitment at North Star to determine whether it is sufficient to maintain the important aspen woodland component.

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Appendix A. USFWS 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) 243-2778 Fax: (970) 245-6933
http://www.fws.gov/mountain-prairie/es/Colorado/
http://www.fws.gov/platteriver/

In Reply Refer To: December 13, 2017
Consultation Code: 06E24100-2018-SLI-0101
Event Code: 06E24100-2018-E-00191
Project Name: North Star Nature Preserve Wildlife Monitoring

Subject: List of threatened and endangered species that may occur in your proposed project location, and/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 ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system 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:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

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 Tracking Number 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
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds
- Wetlands

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) 243-2778

Project Summary

Consultation Code: 06E24100-2018-SLI-0101

Event Code: 06E24100-2018-E-00191

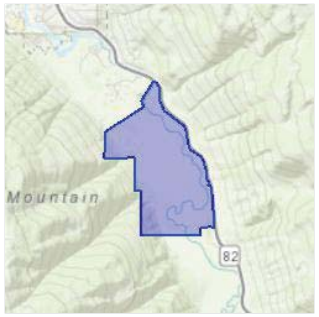
Project Name: North Star Nature Preserve Wildlife Monitoring

Project Type: LAND - MANAGEMENT PLANS

Project Description: This report documents the results of the 2017 annual wildlife monitoring activities conducted on the North Star Nature Preserve in Aspen, CO.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/39.169859535962395N106.79445121211197W



Counties: Pitkin, CO

Endangered Species Act Species

There is a total of 10 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. 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.

Mammals

NAME	STATUS
Canada Lynx *Lynx canadensis* Population: Contiguous U.S. DPS There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3652	Threatened
North American Wolverine *Gulo gulo luscus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5123	Proposed Threatened

Birds

NAME	STATUS
Mexican Spotted Owl *Strix occidentalis lucida* There is **final** critical habitat for this species. Your location is outside 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 **proposed** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

Fishes

NAME	STATUS
Bonytail Chub *Gila elegans* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1377	Endangered
Colorado Pikeminnow (=squawfish) *Ptychocheilus lucius* Population: Wherever found, except where listed as an experimental population There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3531	Endangered
Greenback Cutthroat Trout *Oncorhynchus clarki stomias* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2775	Threatened
Humpback Chub *Gila cypha* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3930	Endangered
Razorback Sucker *Xyrauchen texanus* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/530	Endangered

Flowering Plants

NAME	STATUS
Ute Ladies'-tresses *Spiranthes diluvialis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2159	Threatened

Critical habitats

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

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any activity that results in the take of migratory birds or eagles is prohibited unless authorized by the U.S. Fish and Wildlife Service[3]. There are no provisions for allowing the take of migratory birds that are unintentionally killed or injured. Any person or organization who plans or conducts activities that may result in the take of migratory birds is responsible for complying with the appropriate regulations and implementing appropriate conservation measures, as described below.

---

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or are known to have particular vulnerabilities in your project location. To learn more about the levels of concern for birds on your list, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your specific project area. To see maps of where birders and the general public have sighted birds in and around your project area, visit E-bird tools such as the E-bird data mapping tool (search for the scientific name of a bird on your list to see specific locations where that bird has been reported to occur within your project area over a certain time-frame) and the E-bird Explore Data Tool (perform a query to see a list of all birds sighted in your county or region and within a certain time-frame). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list can be found below.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC), but is of concern in this area either because of the Eagle Act, or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Mar 20 to Sep 15
Brown-capped Rosy-finch *Leucosticte australis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Jun 15 to Sep 15
Black Rosy-finch *Leucosticte atrata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9460	Breeds Jun 15 to Aug 31
Black Swift *Cypseloides niger* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8878	Breeds Jun 15 to Sep 10
Brewer's Sparrow *Spizella breweri* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9291	Breeds May 15 to Aug 10
Golden Eagle *Aquila chrysaetos* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/1680	Breeds Apr 1 to Aug 31
Lewis's Woodpecker *Melanerpes lewis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9408	Breeds Apr 20 to Sep 30
Olive-sided Flycatcher *Contopus cooperi* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3914	Breeds May 20 to Aug 31
Pinyon Jay *Gymnorhinus cyanocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9420	Breeds Feb 15 to Jul 15
Rufous Hummingbird *selasphorus rufus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8002	Breeds elsewhere
Willow Flycatcher *Empidonax traillii* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/3482	Breeds May 20 to Aug 31

Additional information can be found using the following links:

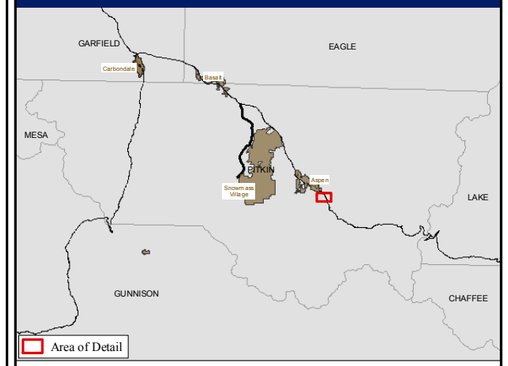
- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php

Appendix B. Maps

106°48'20"W
106°48'0"W
106°47'40"W
106°47'20"W
39°10'30"N
39°10'12"N
39°9'54"N
East of Aspen Trail
Roaring Fork River
JH Smith Interpretive Loop Trail
82
White River National Forest
White River National Forest
1
2
3
4
5
6
7
8
9

Pitkin County Open Space & Trails
Biological Baseline Surveys
North Star Nature Preserve

Map 1. Wildlife Surveys - TVES Transects & Nocturnal Bird Surveys



N

Legend:

- North Star Boundary
- 3 Nocturnal Bird Survey Point
- TVES Transect Leg
- Trail

0 250 500 1,000 Feet

1 in = 0.1 miles

Coordinate System: NAD83 State Plane Colorado Central

Project No 1400717

Date Prepared: 2014-10-15

Basemap Sources:

Aspen Pitkin GIS 2010 Orthophotos

Bing Maps

COLORADO WILDLIFE SCIENCE LLC

0100 Elk Run Dr, Ste 128, Basalt, CO 81621

970.927.4549

info@coloradowildlifescience.com

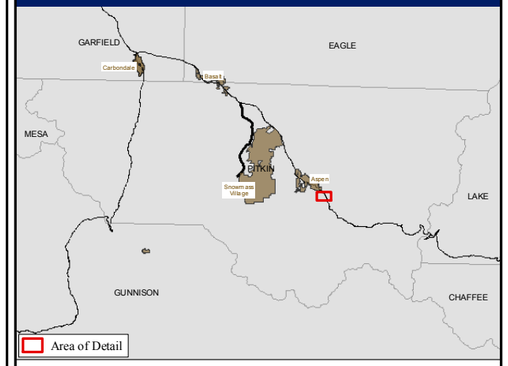
http://coloradowildlifescience.com

106°48'20"W
106°48'0"W
106°47'40"W
106°47'20"W
39°10'30"N
39°10'12"N
39°9'54"N

White River National Forest
White River National Forest
East of Aspen Trail
Roaring Fork River
JH Smith Interpretive Loop Trail
82

Pitkin County Open Space & Trails
Biological Baseline Surveys
North Star Nature Preserve

Map 2. Wildlife Surveys - Avian Point Transect, Nocturnal Bird Points & Diurnal Raptor Transect



N

Legend:
- North Star Boundary
- 3 — Avian Monitoring Point
- 3 — Nocturnal Bird Survey Point
- 3 — Diurnal Raptor Broadcast Point
- Diurnal Raptor Transect
- Trail

0 250 500 1,000 Feet
1 in = 0.1 miles

Coordinate System: NAD83 State Plane Colorado Central	Basemap Sources: Aspen Pitkin GIS 2010 Orthophotos; Bing Maps
Project No 1400717	
Date Prepared: 2014-10-15	

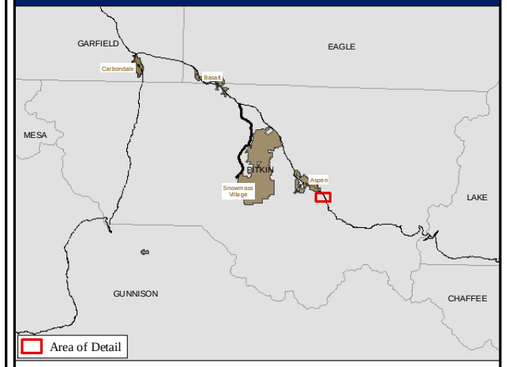
COLORADO WILDLIFE SCIENCE LLC
0100 Elk Run Dr, Ste 128, Basalt, CO 81621
970.927.4549
info@coloradowildlifescience.com
http://coloradowildlifescience.com

106°48'20"W
106°48'0"W
106°47'40"W
106°47'20"W
39°10'30"N
39°10'12"N
39°9'54"N
East of Aspen Trail
White River National Forest
82
RTHA Nest - Historic
RTHA - Observed
OSPR - Flyover
NSWO - Broadcast Response (nocturnal)
COHA - Observed
COHA - Nest
JH Smith Interpretive Loop Trail
106°48'20"W
106°48'0"W
106°47'40"W
106°47'20"W
106°47'0"W

Pitkin County Open Space & Trails Biological Baseline Surveys

North Star Nature Preserve

Map 3. Wildlife Surveys - Detections & Observations of Note; Heronry with Foraging Habitat



N

Legend:

- North Star Boundary
- Active Great Blue Heron Colony
- Great Blue Heron Important Off-river Foraging Area
- Recommended Great Blue Heron 200 m Quiet Zone
- Historic/Inactive Raptor Nest
- Cooper's Hawk - Observed
- Red-Tailed Hawk - Observed
- Saw-whet Owl - Broadcast Response
- Osprey - Observed
- Active Raptor Nest
- Trail

0 250 500 1,000 Feet

1 in = 0.1 miles

Coordinate System: NAD83 State Plane Colorado Central

Project No. 117-2017

Date Prepared: 2017-DEC-26

Basemap Sources:

Aspen Pitkin GIS
2014 Orthophotos

COLORADO WILDLIFE SCIENCE LLC
0100 Elk Run Dr, Ste 128, Basalt, CO 81621
970.927.4549
info@coloradowildlifescience.com
http://coloradowildlifescience.com

Appendix C. List of bird species detected during avian monitoring 2000-2017

Table 8. List of bird species detected at North Star during avian monitoring 2000-2017 with 4-letter codes

Common Name	Scientific Name	4-Letter Code
American coot	*Fulica americana*	AMCO
American crow	*Corvus brachyrynchos*	AMCR
American robin	*Turdus migratorius*	AMRO
Band-tailed pigeon	*Patagioenas fasciata*	BTPI
Bank swallow	*Riparia riparia*	BANS
Barn swallow	*Hirundo rustica*	BARS
Belted kingfisher	*Megaceryle alcyon*	BEKI
Brewer's blackbird	*Euphagus cyanocephalus*	BRBL
Black-billed magpie	*Pica hudsonia*	BBMA
Black-capped chickadee	*Poecile atricapillus*	BCCH
Black-headed grosbeak	*Pheucticus melanocephalus*	BHGR
Broad-tailed hummingbird	*Selasphorus platycercus*	BTLH
Brown creeper	*Certhia americana*	BRCR
Brown-headed cowbird	*Molothrus ater*	BHCO
Canada goose	*Branta canadensis*	CAGO
Cedar waxwing	*Bombycilla cedrorum*	CEDW
Chipping sparrow	*Spizella passerina*	CHSP
Cinnamon teal	*Anas cyanoptera*	CITE
Common raven	*Corvus corax*	CORA
Cooper's hawk	*Accipiter cooperi*	COHA
Cordilleran flycatcher	*Empidonax occidentalis*	COFL
Dark-eyed junco	*Junco hyemalis*	DEJU
Dusky flycatcher	*Empidonax oberholseri*	DUFL
Dusky grouse	*Dendragapus obscurus*	BGRU
Fox sparrow	*Passerella iliaca*	FOSP
Gadwall	*Anas strepera*	GADW
Golden eagle	*Aquila chrysaetos*	GOEA
Great blue heron	*Ardea herodias*	GBHE
Great-horned owl	*Bubo virginianus*	GHOW
Green-tailed towhee	*Pipilo chlorurus*	GTTO
Green-winged teal	*Anas crecca*	AGWT
Hairy woodpecker	*Picoides villosus*	HAWO
House finch	*Carpodacus mexicanus*	HOFI
House wren	*Troglodytes aedon*	HOWR
Killdeer	*Charadrius vociferous*	KILL
Lincoln's sparrow	*Melospiza lincolnii*	LISP
Loggerhead shrike	*Lanius ludovicianus*	LOSH
MacGillivray's warbler	*Geothlypis tolmiei*	MGWA
Mallard	*Anas platyrynchus*	MALL
Mountain bluebird	*Sialia currucoides*	MOBL
Mountain chickadee	*Poecile gambeli*	MOCH

Table 8. List of bird species detected at North Star during avian monitoring 2000-2017 with 4-letter codes		
Common Name	**Scientific Name**	**4-Letter Code**
Northern flicker	*Colaptes auratus*	RSFL
Northern goshawk	*Accipiter gentilis*	NOGO
Northern saw-whet owl	*Aegolius acadicus*	NSWO
Northern shrike	*Lanius excubitor*	NOSH
Olive-sided Flycatcher	*Contopus cooperi*	OSFL
Orange-crowned warbler	*Oreothlypis celata*	OCWA
Pied-billed grebe	*Podilymbus podiceps*	PBGR
Pine siskin	*Carduelis pinus*	PISI
Plumbeous vireo	*Vireo plumbeus*	PLVI
Red-naped sapsucker	*Sphyrapicus nuchalis*	RNSA
Red-tailed hawk	*Buteo jamaicensis*	RTHA
Red-winged blackbird	*Agelaius phoeniceus*	RWBL
Ring-necked duck	*Aythya collaris*	RNDU
Ruby-crowned kinglet	*Regulus calendula*	RCKI
Song sparrow	*Melospiza melodia*	SOSP
Sora	*Porzana carolina*	SORA
Spotted sandpiper	*Actitis macularia*	SPSA
Spotted towhee	*Pipilo maculatus*	SPTO
Steller's jay	*Cyanocitta stelleri*	STJA
Swainson’s thrush	*Catharus ustulatus*	SWTH
Tree swallow	*Tachycineta bicolor*	TRES
Vesper sparrow	*Pooecetes gramineu*	VESP
Violet-green swallow	*Tachycineta thalassina*	VGSW
Virginia rail	*Rallus limicola*	VIRA
Virginia's warbler	*Oreothlypis virginiae*	VIWA
Warbling vireo	*Vireo gilvus*	WAVI
Western kingbird	*Tyrannus verticalis*	WEKI
Western tanager	*Piranga ludoviciana*	WETA
Western wood-pewee	*Contopus sordidulus*	WEWP
White-breasted nuthatch	*Sitta carolinensis*	WBNU
White-crowned sparrow	*Zonotrichia leucophrys*	WCSP
Wild turkey	*Meleagris gallopavo merriami*	WITU
Willow flycatcher	*Empidonax traillii*	WIFL
Wilson’s warbler	*Cardellina pusilla*	WIWA
Wilson's snipe	*Gallinago delicata*	WISN
Yellow warbler	*Setophaga petechia*	YWAR
Yellow-rumped warbler	*Setophaga coronata*	AUWA

Appendix D. Photos

Photo 1. Vole esker

Photo 2. Northern pocket gopher castings

Photo 3. Mule deer bucks encountered at North Star

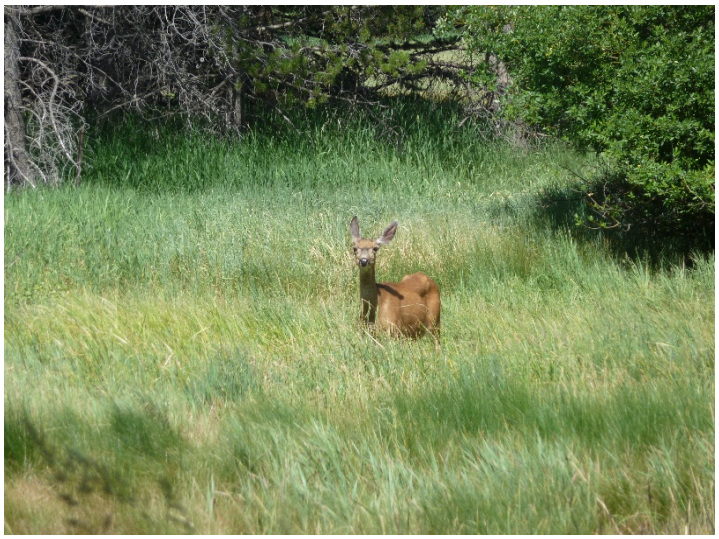


Photo 4. Mule deer doe

Photo 5. North American moose track found during TVES at North Star

Photo 6. Deer mouse observed at North Star during TVES

Photo 7. North American moose track observed during TVES

Photo 8. Great blue heron perched in a snag

Photo 9. Camera mounted on a fence post at North Star

Photo 10. Black bear sow at Camera 4. Note that the summer coat is coming in a different color than the winter coat thus the two-tone appearance.

Photo 11. Mule deer bucks in velvet at Camera 2

Photo 12. Red (or “pine”) squirrel at Camera station 4

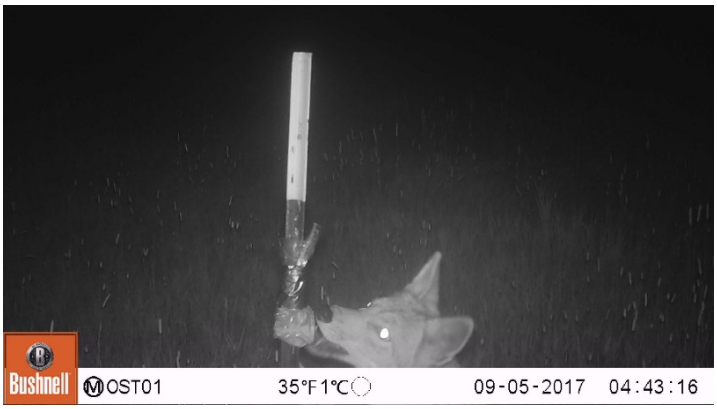


Photo 13. Coyote investigating the bait a Camera 1

Photo 14. Wild turkey hen at Camera 4. Note: the date stamp on the Bushnell cameras occasionally reset for no apparent reason

Photo 15. American marten at Camera 3

Photo 16. American moose at Camera 3

Photo 17. Loggerhead shrike at Camera 1


Photo 18. Cooper's hawk female that responded during broadcast survey


Photo 19. Cooper's hawk nest at North Star. Two nestlings are visible in the nest


Photo 20. Cooper's hawk egg shells found during broadcast survey which revealed the location of the nest.

Photo 21. Great blue heron a Camera 1. Note the bait & lure attached to the T-post.

Photo 22. Great blue heron adult and nestling in current heronry location at North Star.

Photo 23. American marten at Camera 3 at night.

Photo 24. Vesper sparrow at Camera 1

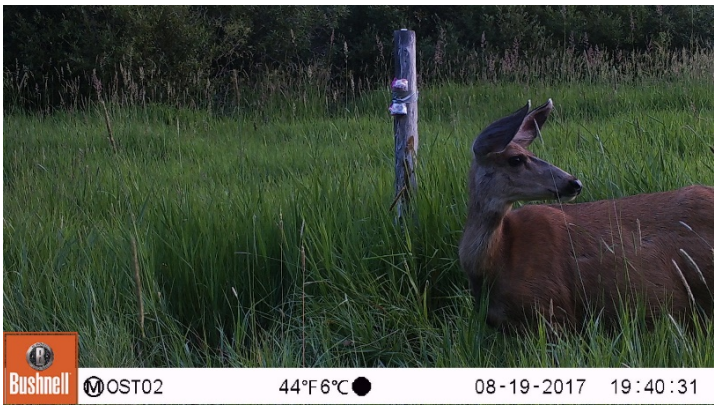


Photo 25. Mule deer doe at Camera 2.

Photo 26. Cow elk at Camera 3.

Photo 27. Moose calf at Camera 3

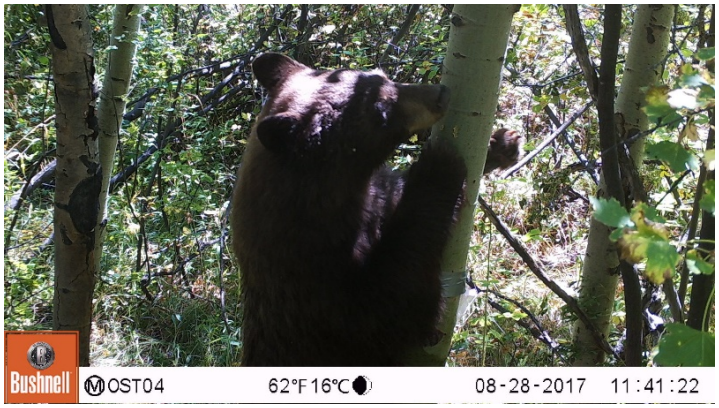


Photo 28. Black bear consuming bait at Camera 4.

Photo 29. Bull elk at Camera 4.

Photo 30. Mule deer fawn at Camera 4.

Photo 31. American robin at Camera 4.

Photo 32. Wet mule deer buck at Camera 5

Photo 33. Black bear occurrence for the TVES was often detected by means of indirect sign such as this log that was rolled over by a bear looking for grubs

Photo 34. Fox sparrow observed at North Star during point-transects

Photo 35. Old heronry location on the west side of the river

Photo 36. Current heronry location on the east side of the river

Appendix E. CPW Moose, Mule Deer & Elk Seasonal 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 2012

APPENDIX F. Coordinates of monitoring sites

Table 9. Avian monitoring station locations with ID number and UTM location

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 10. Diurnal raptor broadcast points

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 11. Nocturnal bird 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

Table 11. Nocturnal bird broadcast points		
8	39° 10' 15.03" N	106° 47' 31.17" W
9	39° 10' 32.27" N	106° 47' 46.33" W

Table 12. Monitoring camera stations		
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 13. TVES hexagon center points		
STATION	**LATITUDE**	**LONGITUDE**
1	39° 10' 0.09" N	106° 47' 44.07" W
2	39° 10' 14.99" N	106° 47' 43.17" W