VERTEBRATE TARGETS FOR THE BLACK HILLS ECOREGIONAL PLAN

28 June 2000

Gary P. Beauvais (Director), Wyoming Natural Diversity Database

==========

In 1999 the Midwest Science Division of The Nature Conservancy (TNC) initiated an ecoregional plan for the Black Hills of Wyoming and South Dakota. As with other ecoregional plans, a primary goal of this plan is to insure the viability of populations of rare taxa in the ecoregion. This necessitates (1) selecting target taxa, and (2) estimating the number, size, and distribution of minimally viable populations of each target taxon necessary for long-term persistence (i.e., quantifying the "conservation goals" for each target taxon).

This report discusses the vertebrate taxa selected as targets for the Black Hills ecoregion, and outlines the conservation goals for each. Note that certain aquatic vertebrates (e.g., lake chub, finescale dace) selected as targets are not discussed in this report; conservation status and goals for these species were assessed in a separate analysis by TNC.

Attachment 1 lists the primary and secondary vertebrate targets for the Black Hills.

Attachment 2 provides details on the status, habitat use, and conservation goals for each target. This information is presented in the below format:

> **Common name (Latin name) - primary or secondary target**
> Status: Conservation rank or other designation from Natural Heritage Programs and natural resource agencies. WY = Wyoming; SD = South Dakota; WGFD = Wyoming Game and Fish Department; USFS = U.S. Forest Service; USFWS = U. S. Fish and Wildlife Service.
> Justification as target: Reasons why the taxon was included on the targets list.
> Habitat: Description of the taxon's preferred or optimal habitat.
> Conservation goal: A brief description of the goal, including literature and other sources used to estimate population sizes and distributions. Note that the term "population" is used throughout this report to refer to both discrete populations and population segments. For most vertebrates, a minimal viable population is best expressed in terms of area of suitable habitat. Therefore, conservation goals are presented in terms of "patches" of appropriate habitat that should be encompassed by portfolio sites. Ideally, such patches should include known occurrences. However, because of a paucity of occurrence data for some taxa, some patches will have to encompass suitable habitat only, with the assumption that the target taxon is present within.

Minimum patch size: Estimated contiguous area of appropriate habitat necessary to support a population of 200 - 275 individuals (Groves et al. 2000). Usually based on estimates of population density and/ or home range size.

Minimum number of patches: Estimated number of patches required to ensure the long-term persistence of the taxon in the ecoregion. Based on the below matrix, which in turn is based on recommendations from Groves et al. (2000):

	Habitat specialization		
Distribution	Strong	Medium	Weak
Ecoregional endemic	**8-10 patches**	**6-8**	**6**
Regional endemic	**6-8**	**6**	**4**
Disjunct	**6**	**4**	**3**
Widespread	**3**	**3**	**3**
Peripheral	**3**	**3**	**3**

Distribution of patches: Spatial pattern of patches necessary to (1) encompass ecological variation in habitat, and (2) help de-couple patches from simultaneous disturbances. Patches are often explicitly specified for the Bear Lodge Mountains (abbreviated BLMO) because this montane subregion is disjunct from the other 4, contiguous montane subregions. The distributions outlined here should be strictly followed only when occurrence data is scarce. In some situations it may be more important to forego the suggested distribution in order to capture high-quality documented occurrences.

Minimum separation distance: Distance between the closest edges of adjacent patches necessary to de-couple patches from simultaneous disturbances. Disease and wildfire are considered the most pertinent disturbances in this context. For any given taxon, the separation distance necessary to prevent the dispersal of disease between patches is difficult to estimate. For mobile taxa (e.g., birds, bats), it is unlikely that such prevention is possible in this relatively small ecoregion. Because minimum patch size is generally scaled to mobility, the default separation distance is 3X the diameter of a minimum circular patch (or 3X the major axis of linear patches). To insure that patches are insulated from any single wildfire, at least 2 permanent streams are usually required in the inter-patch space.

ATTACHMENT 1. Primary and secondary vertebrate targets for the Black Hills ecoregion.

PRIMARY VERTEBRATE TARGETS

Black Hills redbelly snake (*Storeria occipitomaculata pahasapae*)

Northern flying squirrel (*Glaucomys sabrinus*)

Fringe-tailed myotis (*Myotis thysanodes pahasapensis*)

Townsend's big-eared bat (*Corynorhinus townsendii*)

American dipper (*Cinclus mexicanus*)

SECONDARY VERTEBRATE TARGETS

Smooth green snake (*Liochlorophis vernalis*)

Black-tailed prairie dog (*Cynomys ludovicianus*)

Black Hills red squirrel (*Tamiasciurus hudsonicus dakotensis)*

Black Hills red-backed vole (*Clethrionomys gapperi brevicaudus*)

Bear Lodge meadow jumping mouse (*Zapus hudsonius campestris*)

Northern goshawk (*Accipiter gentilis*)

Bald eagle (*Haliaeetus leucocephalus*)

American peregrine falcon (*Falco peregrinus anatum*)

Lewis' woodpecker (*Melanerpes lewis*)

Three-toed woodpecker (*Picoides tridactylus*)

Black-backed woodpecker (*Picoides arcticus*)

White-winged junco (*Junco hyemalis aikeni*)

McCown's longspur (*Calcarius mccownii*)

Chestnut-collared longspur (*Calcarius ornatus*)

ATTACHMENT 2. Conservation status and goals for vertebrate targets in the Black Hills ecoregion.

Black Hills redbelly snake (*Storeria occipitomaculata pahasapae*) - primary target
Status: G5T3 / S2 (WY) S3 (SD). USFS Region 2 Sensitive.
Justification as target: Taxon is endemic to the ecoregion. Population status is unknown, but probably rare. Some evidence suggests that mesic environments are preferred. Because snakes in this genus are specialized snail predators (Rossman and Myer 1990), the taxon may depend somewhat on the snails that are also listed as primary targets.
Habitat: Habitat use is poorly understood. Found in mountainous or hilly woodland and forest, valleys, upland meadows, and the edges of swamps and bogs. Hides under and in litter, understory vegetation, coarse woody debris, building foundations, and abandoned ant mounds. Generally associated with mesic situations and abundant ground cover (Baxter and Stone 1985, Biological and Conservation Database 2000b). Specialization for feeding on land snails (Rossman and Myer 1990) may require this taxon to frequent environments with high snail availability.
Conservation goal: An ecoregional endemic with moderate habitat and prey specialization; therefore 6-8 populations are required for long-term persistence. Because data on population densities and home range sizes are lacking, patch size is set equal to that of a similar taxon, the smooth green snake. Note that known dens/ hibernacula are very important, and should be encompassed by portfolio sites whenever possible.

Minimum patch size:	364 ha - 500 ha.
Minimum number of patches:	6 - 8.
Distribution of patches:	Each patch in a different subregion.
Minimum separation:	6.5 km - 7.6 km, with $\geq$ 2 permanent streams between closest patch edges.

Fringe-tailed myotis (*Myotis thysanodes pahasapensis*) - primary target
Status: G5T2 / S1B, S1N (WY) S2 (SD). WGFD SSC2. USFS Region 2 Sensitive.
Justification as target: At the species level, this taxon is rare with some indication of recent declines. The subspecies *M. t. pahasapensis* only occurs in the Black Hills and small portions of adjacent ecoregions. It is known to hibernate in the ecoregion, and therefore may not exchange many individuals with larger populations to the west. Like those of other bats, the local population is rather vulnerable because it likely depends on only a few day roosts, maternity roosts, and hibernacula, and is sensitive to disturbance of such structures.
Habitat: Uses a variety of habitats, including coniferous forest, woodlands, shrublands, grasslands, and deserts (Gerhart and Olson 1982, Clark and Stromberg 1987). Generally occurs below 7500 feet elevation in Wyoming. Roosts and nursery colonies are located in caves, abandoned mines, rock crevices, and occasionally old buildings (Wyoming Game and Fish Department 1996; B. Luce, Wyoming Game and Fish Department, personal communication).
Conservation goal: A regional endemic strongly associated with appropriate roosting substrate; therefore, 6-8 populations are required for long-term persistence. Because this taxon is strongly tied to roosting structures (i.e., caves, crevices, mine shafts) that are very local in nature and

difficult to associate with particular land cover types, patches selected for the conservation of this taxon should be centered on known roosts. Furthermore, patches should include a buffer of at least 100m around the roost, and also include some foraging habitat (typically ponds, streams, other wetlands) near the roost.

Minimum patch size:	Each patch should encompass roosting structure(s) plus surrounding area to encompass foraging habitat and provide a disturbance buffer; the size and shape of each patch should be determined on a case-by-case basis.
Minimum number of patches:	6 - 8.
Distribution of patches:	Defined by the distribution of known roosts/ occurrences.
Minimum separation:	Defined by the distribution of known roosts/ occurrences.

Townsend's big-eared bat (*Corynorhinus townsendii*) - primary target
Status: G4 / S1B, S2N (WY) S2S3 (SD). WGFD SSC2. USFS Region 2 and 4 Sensitive.
Justification as target: Large population declines have been recently documented range-wide. As with *M. t. pahasapensis*, the local population of *C. townsendii* is vulnerable because it likely depends on only a few day roosts, maternity roosts, and hibernacula, and is very sensitive to disturbance of such structures. Strongly associated with caves/ abandoned mine shafts.
Habitat: Most often found in desert shrublands and dry coniferous forests (Clark and Stromberg 1987), but may also occur in deciduous forests and mountain-foothills shrublands, Douglas-fir and ponderosa pine forests, and forest-dominated riparian up to 9000 feet (Humphrey and Kunz 1976; Worthington 1991; Wyoming Game and Fish Department 1992). Requires spacious caves for day roosts, maternity colonies, and hibernacula, and is frequently encountered in abandoned mines (Clark and Stromberg 1987; Clark et al.1989).
Conservation goal: A widespread taxon strongly associated with large caves and/ or mine shafts; therefore, 3 populations are required to insure long-term persistence. Because this taxon is strongly tied to roosting structures (i.e., caves and mine shafts) that are very local in nature and difficult to associate with particular land cover types, patches selected for the conservation of this taxon should be centered on known roosts. Furthermore, patches should include a buffer of at least 100m around the roost, and also include some foraging habitat (typically ponds, streams, other wetlands) near the roost.

Minimum patch size:	Each patch should encompass roosting structure(s) plus surrounding area to encompass foraging habitat and provide a disturbance buffer; the size and shape of each patch should be determined on a case-by-case basis.
Minimum number of patches:	3.
Distribution of patches:	Defined by the distribution of known roosts/ occurrences.
Minimum separation:	Defined by the distribution of known roosts/ occurrences.

Black Hills flying squirrel (*Glaucomys sabrinus*) - primary target
Status: G5T2Q / S2? (WY) S2 (SD).

Justification as target: The Black Hills population of *G. sabrinus* is likely a Pleistocene relict, and has been completely isolated from adjacent populations for several centuries. Such isolation increases conservation concern for the taxon because (1) it increases the probability of local extinction, and (2) it raises the possibility of genetic divergence (i.e., subspeciation). May prefer late-seral conifer stands, which are relatively rare in the ecoregion.
Habitat: Habitat use of the Black Hills population is not well understood; the below information is from populations in other areas. The taxon generally prefers coniferous and mixed forest, but will use deciduous upland and riparian forest as well. Optimal conditions are generally accepted as cool, moist, mature forest with abundant snags and large downed logs. Rosenberg and Anthony (1992) suggested that northern flying squirrels in western Oregon are habitat generalists with respect to seral stage (abundances were similar in late- and early-seral stands). Although cavities in large trees and snags are preferred den sites, dens have been documented in twig and leaf nests, underground burrows, and even artificial bird houses (Biological and Conservation Database 2000c).
Conservation goal: An ecoregional endemic specialized to forested habitats, possibly preferring mesic and late-seral stands; therefore, 6-8 populations are required for long term persistence. Patch size is based on a median recorded density of 3.0 individuals/ ha in forests of interior western North America (Witt 1992). Because this taxon is rather mobile relative to its small patch size, the separation distance was increased to 5X the diameter of a minimum circular patch to insulate against disease dispersal.

Minimum patch size:	67 ha - 92 ha.
Minimum number of patches:	6 - 8.
Distribution of patches:	At least 1 in each non-foothills subregion.
Minimum separation:	4.6 km - 5.6 km, with $\geq$ 2 permanent streams between closest patch edges.

American dipper (*Cinclus mexicanus*) - primary target
Status: G5 / S4? (WY) S1 (SD). South Dakota Threatened.
Justification as target: Because this taxon is non-migratory and strongly associated with montane streams, the ecoregional population is disjunct from adjacent populations. The South Dakota Heritage Program has documented steep declines in the ecoregional population in recent years (D. Backlund, South Dakota Heritage Program, personal communication).
Habitat: Taxon is specialized to swift flowing montane streams with relatively high production of aquatic insects; infrequently found along shorelines of montane lakes and ponds. Nests are placed directly over or immediately adjacent to the stream on overhanging rocks, cliff ledges, or underneath waterfalls or bridges (AOU 1983).
Conservation goal: Ecoregional occurrences are disjunct from the main range, and the taxon is specialized to high-gradient montane streams; therefore 4 populations are required for long term persistence. Density estimates from other areas average about 2200m of stream/ breeding pair; this suggests that an unreasonably large patch (220,000 - 302,000 m of stream) is necessary to support 200 - 275 individuals. Therefore, it is recommended that each of the 4 patches encompass as much stream as is practical in the context of other fine-filter and coarse-filter targets. Distributing patches by watershed will help de-couple populations from periodic flooding as well as other disturbances.

Minimum patch size:	See discussion above; a 50m buffer on either side of the stream should be included in each patch.
Minimum number of patches:	4.
Distribution of patches:	1 in BLMO; 1 each in 3 non-foothills subregions. Additionally, each of the 4 patches should fall within a unique ecoregional watershed.
Minimum separation:	Defined by distribution specifications.

Smooth green snake (*Liochlorophis vernalis*) - secondary target

Status: G5 / S2 (WY) S4 (SD).

Justification as target: Although secure globally, the distribution of this taxon is very patchy in western North America. The ecoregion supports a disjunct population that may be affiliated more strongly with eastern rather than western races.

Habitat: Habitat use is not well-understood. Existing information suggests rather general habitat use in foothills and montane zones. Heavy ground cover, including vegetation, litter, rocks, and coarse-woody debris, may be an important habitat element (Baxter and Stone 1985).

Conservation goal: Ecoregional occurrences are disjunct from the main range, and the taxon is somewhat general in habitat use; therefore 3 populations are required for long-term persistence. Because data on population densities and home range sizes are lacking, patch size is set to that used in the Wyoming Basins Ecoregional Plan (Beauvais 1999). This patch size was estimated from a general review of literature on snake life histories, and expert comments.

Minimum patch size:	364 ha - 500 ha.
Minimum number of patches:	3.
Distribution of patches:	1 in BLMO; 1 in a foothills subregion, 1 in a non-foothills subregion.
Minimum separation:	6.5 km - 7.6 km, with $\geq$ 2 permanent streams between closest patch edges.

Black-tailed prairie dog (*Cynomys ludovicianus*) - secondary target

Status: G4 / S2 (WY) S4 (SD). USFWS Candidate.

Justification as target: Although peripheral to the ecoregion, this taxon is included because of its massive historical range decline and immediate threats from deliberate eradication efforts. Also, some evidence suggests that black-tailed prairie dog colonies are high-quality habitat for several other rare-but-peripheral vertebrates such as swift fox, mountain plover, burrowing owl, and ferruginous hawk (see Wuerthner 1997). Thus, by addressing the needs of this one taxon, the ecoregional plan can efficiently address the needs of several other taxa. The USFWS recently decided that listing the black-tailed prairie dog under the U.S. Endangered Species Act was warranted, but postponed a final decision.

Habitat: In general this taxon occupies dry, flat, and open grasslands with low and relatively sparse vegetation, including areas overgrazed by cattle. Rangewide, all major grassland types (short, mixed, and tall) are used (Osborn 1942, Bonham and Lerwick 1976, Coppock et al. 1983a, 1983b). Grass-dominated patches within sage-steppe are also occupied. Graminoids

commonly found on colonies include *Agropyron* spp., *Stipa* spp., *Bouteloua gracilis*, and *Buchloe dactyloides* (O'Meilia et al. 1982, Coppock et al. 1983a, 1983b). Low and sparse vegetation is preferred; in landscapes with tall and dense vegetation, ungulate grazing or fire is usually required to prepare a site for colonization. After establishment, prairie dog foraging activities maintain low vegetation stature (Osborn 1942, Koford 1958). Fine to medium-textured soils such as silty clay loams, sandy clay loams, and loams are preferred (Merriam 1902, Thorp 1949, Koford 1958, Bonham and Lerwick 1976, Klatt and Hein 1978, Agnew et al. 1986), presumably because burrows tend to retain shape and strength better here than in coarser soils. However, sandy soils often support larger and coarser graminoids with lower forage quality; prairie dogs may avoid these forages and thus associated sandy areas.

Shallow slopes of less than 10% are preferred (Koford 1958, Hillman et al. 1979), presumably in part because such areas drain well and are only slightly prone to flooding. Of 86 colonies studied by Hillman et al. (1979), the majority were on floodplain terraces (35% of all towns) and rolling hills (35%), followed by flats (23%) and badlands (7%). Similarly, Koford (1958) observed a preference for sites adjacent to the Little Missouri River in North Dakota. All researchers found that soils were primarily fine to medium textured, thus it appears that landform (e.g., terrace vs. hilltop) affects choice of colony location less than do slope and soil texture.

Conservation goal: A widespread and peripheral taxon that occurs in grassland and shrub-steppe environments; 3 populations will likely ensure persistence of this plus other associated grassland taxa in the ecoregion. The Wyoming Game and Fish Department has estimated 2025 ha as the minimum size of a prairie dog complex that can support black-footed ferrets in the face of disease and other disturbances (B. Luce, Wyoming Game and Fish Department, personal communication). This was used as the minimum patch size here; note that a 2025 ha "complex" can include several occupied towns plus some unoccupied but appropriate intervening habitat. Because disease is an especially serious concern with prairie dogs, the separation distance was set at 5X the diameter of the minimum circular patch; note this is about 10X the average dispersal distance for individual black-tailed prairie dogs (Garrett and Franklin 1988).

Minimum patch size:	2025 ha.
Minimum number of patches:	3.
Distribution of patches:	1 in each foothills subregion.
Minimum separation:	26 km, with $\geq$ 2 permanent streams between closest patch edges.

Black Hills red squirrel (*Tamiasciurus hudsonicus dakotensis)* - secondary target
Status: G5T2Q / S3? (WY) S5 (SD).
Justification as target: Subspecies is endemic to the ecoregion, and is completely isolated from adjacent populations (Pleistocene relict). Morphologically, the taxon is uniquely adapted to the Black Hills environment (Lindsay 1987). The taxon appears to be relatively abundant and occurs in most conifer types in the ecoregion.
Habitat: This taxon is strongly associated with coniferous forest, especially those dominated by *Pinus contorta*, *Pseudotsuga menziesii*, *Abies* spp., and *Picea* spp. Ponderosa forests and woodlands are used occasionally, especially in the absence of Abert's squirrel (Ferner 1974).

The subspecies *T. h. dakotensis* is specially adapted to feeding on ponderosa pine cones (Lindsay 1987). Although occasionally seen in deciduous forest and woodland, especially in the Black Hills region, these types are poor quality habitat (Kemp and Keith 1970).
Conservation goal: An ecoregional endemic that occurs only in coniferous forest; therefore, 6-8 populations are required for long-term persistence. Patch size is based on a median recorded density of 2.6 individuals/ ha in western North America (Lane 1954, USDI Fish and Wildlife Service 1987). Because this taxon is rather mobile relative to its small patch size, the separation distance was increased to 5X the diameter of a minimum circular patch to insulate against disease dispersal; note this distance is over 10X the maximum recorded dispersal distance for individual red squirrels (Larsen and Boutin 1994).

Minimum patch size:	77 ha - 106 ha.
Minimum number of patches:	6 - 8.
Distribution of patches:	$\geq$ 1 in BLMO; $\geq$ 1 in 4 other subregions.
Minimum separation:	5.0 km - 5.8 km, with $\geq$ 2 permanent streams between closest patch edges.

Black Hills red-backed vole (*Clethrionomys gapperi brevicaudus*) - secondary target
Status: G5T3 / S3 (WY) S5 (SD).
Justification as target: Subspecies is endemic to the ecoregion, and is completely isolated from adjacent populations (Pleistocene relict). It is likely relatively abundant within most forest types in the ecoregion. Some evidence suggests mesic, late-seral stands with abundant coarse-woody debris are required for long-term population persistence.
Habitat: At a macrohabitat scale, this taxon strongly prefers forest to woodland, grassland, and shrub-dominated environments. In the western U.S., coniferous forest is primary habitat, with infrequent occurrences in upland and riparian deciduous types. Cool, mesic conifer stands with abundant coarse woody debris and other near-ground structures appear to be optimal habitat. Although found in conifer stands of various seral stages, including recently disturbed stands, it is generally accepted that *C. gapperi* prefers later seral stages (Pearson 1994, Beauvais 1997).
Conservation goal: An ecoregional endemic strongly associated with conifer forest, probably preferring mesic, late-seral stands; therefore 6-8 populations are required for long term persistence. Patch size is based on a median recorded density of 1.3 breeding females/ ha (Merritt and Merritt 1978).

Minimum patch size:	76 ha - 105 ha.
Minimum number of patches:	6 - 8.
Distribution of patches:	At least 1 in each non-foothills subregion.
Minimum separation:	3.0 km - 4.0 km, with $\geq$ 2 permanent streams between closest patch edges.

Bear Lodge meadow jumping mouse (*Zapus hudsonius campestris*) - secondary target
Status: G5T3 / S2 (WY) S5 (SD).

Justification as target: Subspecies is considered endemic to the ecoregion and surrounding areas. However, the degree of population isolation is uncertain; the Black Hills population may be contiguous with subspecies to the east and south.
Habitat: Habitat use by this particular subspecies is not well studied; the below information is drawn from studies of a related subspecies, *Z. h. preblei*. This taxon is strongly associated with heavy vegetation on the margins of streams and in other wet areas (e.g., marshes, springs, seeps). Although riparian environments in prairie and foothills zones are thought to be optimal, recent surveys in southeastern Wyoming suggest dense populations also occur along montane streams (Beauvais 1998; Wyoming Natural Diversity database unpublished data). Meadow jumping mice in Wyoming and Colorado use the entire floodplain of streams to a distance of about 100m from the stream channel; however, most activity occurs in dense and tall vegetation immediately adjacent to flowing water (Compton and Hugie 1993, Beauvais 1998, Grant 1999, Taylor 1999, Pague and Grunau 2000). Heavy herbaceous cover is vital, and high densities of meadow jumping mice have been recorded in areas with at least some woody (e.g., cottonwood, willow) overstory. Dry upland types such as ponderosa pine, juniper woodland, short grass prairie, and dry or irrigated croplands are not suitable (Merrill et al. 1996), although recent studies indicate that jumping mice undertake nocturnal foraging forays into such environments (T. Shenk, Colorado Division of Wildlife, personal communication). Also, hibernation probably occurs in uplands immediately adjacent to riparian corridors. When inactive in winter, meadow jumping mice occupy underground burrows in banks or hills; in summer, they rest under logs or clumps of vegetation.
Conservation goal: A regional endemic specialized to riparian environments; therefore 6 populations are required for long-term persistence. Recorded densities of *Z .hudsonius* vary widely, from about 7 individuals/ ha to 48 individuals/ ha (see Beauvais 2000); to be conservative, the patch size was based on the upper limit of the lower 1/3 of this range (i.e., 21 individuals/ ha). Observations of a closely related taxon, *Z. h. preblei*, suggest most activity occurs within 100m of a stream channel (T. Shenk, Colorado Division of Wildlife, personal communication; Pague and Grunau 2000). Therefore patches should be 200m wide and centered on permanent streams. Distributing patches by watershed will help de-couple populations from periodic floods as well as other disturbances.

Minimum patch size:	500 m - 700 m of stream, buffered by 100m on either side.
Minimum number of patches:	6.
Distribution of patches:	1 in BLMO; $\geq$ 1 each in 2 foothills subregions; $\geq$ 1 each in 2 non-foothills subregions. Additionally, each of the 6 patches should fall in a unique ecoregional watershed.
Minimum separation:	Defined by distribution specifications.

Northern goshawk (*Accipiter gentilis*) - secondary target
Status: G5 / S2S3B, S4N (WY) S3B, S2N (SD). WGFD SSC4. USFS Region 2 and 4 Sensitive.
Justification as target: Taxon is essentially non-migratory, and is strongly associated with conifer forest. However, it is likely that the Black Hills population regularly exchanges a few individuals with adjacent population segments. Mid- to late-seral conifer stands are preferred for nesting, and such stands are relatively rare in the ecoregion.

Habitat: Nesting occurs in a wide variety of forest types (e.g., deciduous, coniferous, and mixed). In the western U.S., nests are recorded most frequently in conifers (e.g., *Pinus* spp., *Abies* spp., *Pseudotsuga menziesii*, *Thuja* spp., *Picea* spp., *Larix* spp.; Reynolds et al. 1982, Hayward and Escano 1989, Bright-Smith and Mannan 1994, Squires and Ruggiero 1996). However, nests are also known from stands dominated by *Populus tremuloides*, *Betula papyrifera*, and even *Salix* spp. (McGowan 1975, Swem and Adams 1992, Younk and Bechard 1994, Squires and Reynolds 1997). The taxon typically nests in mid- to late seral stands (Hayward and Escano 1989, Reynolds et al. 1982, Speiser and Bosakowski 1987, Squires and Ruggiero 1996) and generally selects larger over smaller stands (Bosakowski and Speiser 1994, Woodbridge and Detrich 1994). Nests are usually constructed in the largest trees of dense, mature stands with high canopy closure (60-95 percent) and sparse ground cover, near the bottom of moderate slopes, and near water (Bull and Hohmann 1994, Hargis et al. 1994, Reynolds et al 1982, Siders and Kennedy 1994, Squires and Ruggiero 1996, Younk and Bechard 1994). Breeding goshawks forage in both heavily forested and relatively open habitats (Younk and Bechard 1992, Beier and Drennan 1997, Squires and Reynolds 1997).

Habitat requirements during the non-breeding season are poorly understood (Squires and Reynolds 1997). In general, goshawks winter at lower elevations and in landscapes with more open vegetation than during breeding season, although Widen (1989) found some preference for large tracts of mature forest during winter in Sweden.

Conservation goal: A widespread and mobile taxon that prefers breeding in mid- to late-seral conifer forest; therefore 3 populations are required for long-term persistence. Because this taxon has such large area requirements relative to the amount of suitable habitat in the ecoregion, each patch is intended to provide for only 50 breeding pairs. Although this may not be adequate for long-term persistence in the event of a large population decline, it is a more realistic goal for this ecoregion than the standard 100 breeding pairs per patch (i.e., 173,500 ha/ patch). In this context, patch size is based on a median reported nest spacing of about 3.8 km (Squires and Reynolds 1997). Also, a practical separation distance is difficult to determine for such a mobile taxon; the minimum diameter of 1 circular patch is used here.

Minimum patch size:	86,750 ha.
Minimum number of patches:	3.
Distribution of patches:	Majority of 1 in BLMO; majority of 1 in a foothills subregion; majority of 1 in a non-foothills subregion.
Minimum separation:	33 km, with $\geq$2 permanent streams between closest patch edges.

Bald eagle (*Haliaeetus leucocephalus*) - secondary target

Status: G4 / S2B, S3N (WY) S1B, S2N (SD). WGFD SSC2. South Dakota Endangered. USFWS Threatened.

Justification as target: The continental population is recovering from a recent crash; taxon will soon be de-listed from the U.S. Endangered Species Act. No breeding, and only small winter concentrations, occur in the ecoregion. Suitable habitat is available to accommodate larger and possibly more winter concentrations in the future.

Habitat: Rivers, lakes, and reservoirs with abundant fish and waterfowl are typical winter habitat; areas with reliable carrion and small mammals (especially lagomorphs) can also support wintering birds (Griffin et al. 1982). Communal winter roosts occur in coniferous or deciduous stands with large, accessible trees, and may be located several kilometers from foraging grounds.
Conservation goal: A widespread and very mobile taxon restricted to large water bodies and uplands with appropriate prey and carrion. There are very few documented occurrences (both historical and recent) in the ecoregion. Therefore, only 3 patches of suitable habitat are specified. Because suitable habitat is so limited, and because the number of wintering birds is likely determined more by prey/ carrion density rather than area of suitable habitat, it is recommended that each of the 3 patches encompass as much habitat as is practical in the context of other fine-filter and coarse-filter targets. Separation distance is a rough estimate based on taxon mobility.

Minimum patch size:	See discussion above.
Minimum number of patches:	3.
Distribution of patches:	There are 2 winter concentrations known in the ecoregion; 1 patch should be centered on each site. Cottonwood forests on major streams could support future concentrations as population expansion continues; the third site should encompass such habitat.
Minimum separation:	40 km.

American peregrine falcon (*Falco peregrinus anatum*) - secondary target
Status: G4T3 / S1B, S2N (WY) SXB, SZN (SD). WGFD SSC3. South Dakota Endangered.
Justification as target: The continental population is recovering from a recent crash; taxon was recently de-listed from the U.S. Endangered Species Act. Although breeding has not recently occurred in the ecoregion, some suitable habitat is available to accommodate population expansion.
Habitat: Nests are placed on ledges on large cliffs, buttes, and canyon sides, especially those with commanding views of valleys supporting high densities of passerines, shorebirds, and/ or waterfowl (AOU 1983, Palmer 1988). Rock faces with at least some southern exposure are usually selected at the latitude of the Black Hills. Occasionally found nesting on very tall buildings in urban areas.
Conservation goal: This is a widespread and very mobile taxon that breeds on large cliffs and canyon sides. There are very few documented occurrences (both historical and recent) in the ecoregion; therefore, only 3 patches of suitable habitat are specified. Furthermore, because suitable habitat is rare in the ecoregion and the taxon's area requirements are relatively large, each of the 3 patches should encompass as much habitat as is practical in the context of other fine-filter and coarse-filter targets. Although this may not ensure persistence in the ecoregion in the event of a large population decline, it is likely a more realistic goal than the standard 100 pairs/ patch (about 380,000 ha/ patch).

Minimum patch size:	See above discussion.
Minimum number of patches:	3.

Distribution of patches: Will be defined largely by the distribution of suitable canyon/ cliff habitat; each patch should encompass a different canyon or cliff set.
Minimum separation: Will be defined by the distribution of suitable habitat.

Lewis' woodpecker (*Melanerpes lewis*) - secondary target
Status: G5 / S2B, SZN (WY) S3B, S3N (SD). WGFD SSC3. USFS Region 2 Sensitive.
Justification as target: Although a relatively widespread breeder in western North America, recent data suggests a steady downward trend across most of its range. Appears to prefer burned conifer forest, which is relatively rare in the ecoregion.
Habitat: Breeds in open forest and woodland, often logged or burned, including oak, conifers (primarily *Pinus ponderosa*), riparian woodland and orchards, less commonly in pinyon-juniper (AOU 1983). Distribution closely matches that of open ponderosa pine forest in western North America; taxon is strongly associated with fire-maintained, late-seral ponderosa pine (Diem and Zeveloff 1980, Tobalske 1997, Saab and Dudley 1998). Some evidence suggests a preference for open ponderosa pine at higher elevations, and open riparian forests at lower elevations (Bock 1970, Tobalske 1997). Important habitat elements include an open tree canopy over a brushy understory, and abundant dead trees for nest cavities; dead and downed woody debris, perch sites, and abundant insects are also important (Linder and Anderson 1998, Saab and Dudley 1998).

Habitat quality of burned stands varies with age, size, and intensity of the burn, density of remaining snags, and geographic region. Lewis' woodpeckers are generally considered a species of older burns rather than new ones, and tend to move into stands several years post-fire as dead trees begin to fall and brush develops. Depending on site characteristics, appropriate conditions may develop anywhere from 2 - 30 years post fire (Bock 1970, Block and Brennan 1987, Caton 1996, Linder and Anderson 1998, Saab and Dudley 1998). On partially-logged burns in Idaho, nest sites were characterized by the presence of large and soft snags, and an average of 62 snags >23cm DBH/ ha (Saab and Dudley 1998). Unlike other woodpeckers, this taxon is not well-adapted for excavating cavities in hard wood. Although Lewis' woodpeckers will occasionally excavate a cavity in soft and/ or rotting wood, they more frequently nest in natural cavities, or in those excavated and abandoned by other species (Harrison 1979, Tobalske 1997).

Non-breeding habitat is variable; oak woodlands and nut and fruit orchards tend to be used more heavily in winter. An important habitat element in many wintering areas is the availability of storage sites for grains or mast, such as tree bark (e.g. bark of mature cottonwood trees), snags, or power poles with dessication cracks (Bock 1970, Tobalske 1997).
Conservation goal: A widespread and rather mobile taxon associated with conifer (especially burned) forest; therefore, 3 populations are required for long-term persistence. Patch size is based on a median reported breeding territory of 3.6 ha (Tobalske 1997).

Minimum patch size: 360 ha - 494 ha.
Minimum number of patches: 3.
Distribution of patches: 1 in BLMO; 1 in a foothills subregion, 1 in a non-foothills subregion.

Minimum separation: 6.4 km - 7.5 km, with ≥ 2 permanent streams between closest patch edges.

Three-toed woodpecker (*Picoides tridactylus*) - secondary target
Status: G5 / S3 (WY) S2 (SD). USFS Region 2 and 4 Sensitive.
Justification as target: Taxon is nonmigratory and strongly associated with conifer forest; there is likely only a small degree of connectivity between the Black Hills population and populations to the west and north. Some preference for spruce forest; recently burned conifer forest (relatively rare in the ecoregion) is preferred in some areas.
Habitat: Breeds in coniferous forest (primarily *Picea* spp.), less frequently in mixed forest. Optimal habitat includes stands with 1 - 2 snags/ ha, with snags occurring in clumps, measuring 31 - 41 cm DBH and 6 - 12 m tall, and with bark still present (Spahr et al. 1991). Cavity nests are typically placed in conifer or aspen snags, occasionally in live trees, and infrequently in utility poles.
Conservation goal: A widespread taxon with a high-degree of isolation in the ecoregion and a preference for recently burned or otherwise disturbed conifer stands; therefore, 4 populations are required for long-term persistence. Patch size is based on a reported density of 3 breeding pairs/ 100ha (Biological and Conservation Database 2000a).

Minimum patch size: 3334 ha - 4567 ha.
Minimum number of patches: 4.
Distribution of patches: 1 in BLMO; ≥ 1 in a foothills subregion, ≥ 1 in a non-foothills subregion.
Minimum separation : 19.6 km - 22.9 km, with ≥ 2 permanent streams between closest patch edges.

Black-backed woodpecker (*Picoides arcticus*) - secondary target
Status: G5 / S2 (WY) S3 (SD). WGFD SSC4. USFS Region 2 Sensitive.
Justification as target: Taxon is nonmigratory and strongly associated with conifer forest; there is likely only a small degree of connectivity between the Black Hills population and populations to the west and north. Tends to prefer recently burned conifer forest, which is relatively rare in the ecoregion.
Habitat: Breeds and winters in boreal and montane coniferous forests, especially areas with abundant snags (e.g., burns, bogs, blowdowns); less frequently in mixed forest and rarely in deciduous woodland (AOU 1983). Distribution closely tracks that of boreal and montane conifers; northern limits coincide with the limit of continuous conifer forest (Bock and Bock 1974). Strongly associated with recently burned conifers (Raphael and White 1984, Hutto 1995a, Hutto 1995b), including *Pinus* spp., *Picea* spp., *Abies* spp., *Larix* spp., and *Pseudotsuga menziesii* (Bock and Bock 1974, Yunick 1985, Goggans 1989, Villard and Beninger 1993, Villard 1994, Darveau et al. 1995). In Montana, the taxon was more abundant in montane pine and Douglas-fir than in subalpine spruce (Bock and Bock 1974). Hutto (1995b) found that the abundance of small trees in a burn was the best correlate of the taxon's abundance.

In contrast to Lewis' woodpeckers, black-backed woodpeckers appear to be species of recent burns, likely due to their heavy reliance on wood-boring insects (Blackford 1955, Kingery 1977, Apfelbaum and Haney 1981, Raphael et al. 1987, Villard and Scheick 1996). Hutto (1995b) suggested that a mosaic of recently burned stands is source habitat (i.e., reproduction exceeds mortality) and unburned forest is sink habitat that supports individuals exported from more suitable sites.

Nest holes are typically excavated in hard snags, partial snags, or live trees with dead heartwood; occasionally in stumps, fence posts, or utility poles. Nest cavity is usually 0.6 - 4.6 meters above ground in boles averaging 21-23 cm DBH, often near water (Evans and Conner 1979, McClelland et al. 1979, Raphael and White 1984, Saab and Dudley 1998).

Foraging is typically concentrated on ridges, and is focused equally on live and recently-dead trees averaging 31 cm DBH and 18 m in height with more than 40 percent of their needles intact (Bull et al. 1986). Snags and logs also used for foraging (Raphael and White 1984).
Conservation goal: A widespread taxon with a high-degree of isolation in the ecoregion and a preference for recently burned or otherwise disturbed conifer stands; therefore 4 populations are required for long-term persistence. Data on territory size and population density are lacking; therefore, patch size is based on information from a closely related target taxon, *P. tridactylus*.

Minimum patch size:	3334 m - 4567 m.
Minimum number of patches:	4.
Distribution of patches:	1 in BLMO; $\geq$ 1 in a foothills subregion, $\geq$ 1 in a non-foothills subregion.
Minimum separation :	19.6 km - 22.9 km, with $\geq$ 2 permanent streams between closest patch edges.

White-winged junco (*Junco hyemalis aikeni*) - secondary target
Status: G5T4 / S2B, S3N (WY) S5B, S5N (SD).
Justification as target: This subspecies breeds only in the ecoregion and small portions of surrounding ecoregions. However, the population appears relatively secure and is rather general in habitat use.
Habitat: Probably best described as a habitat generalist; foothills and montane zones are likely preferred over open grassland.
Conservation goal: A regional endemic with rather general habitat use; therefore, 4 populations are required for long-term persistence. Data on territory size and population density are lacking; therefore, patch size is based on information recorded for a closely related taxon, *J.phaeonotus* (median breeding territory 0.9 ha; Sullivan 1999).

Minimum patch size:	90 ha - 124 ha.
Minimum number of patches:	4.
Distribution of patches:	1 in BLMO; $\geq$1 in a foothills subregion, $\geq$1 a non-foothills subregion.
Minimum separation :	3.2 km - 3.8 km, with $\geq$ 2 permanent streams between closest patch edges.

McCown's longspur (*Calcarius mccownii*) - secondary target
Status: G5 / S3B, SZN (WY) SUB, SZN (SD).
Justification as target: A regional endemic that breeds in only a small portion of the northern and central Great Plains; recent data suggest population declines. Strongly associated with dry and open grassland.
Habitat: Breeding occurs in sparse short-grass prairie, especially areas that have been heavily grazed or recently burned. Both nesting and foraging usually occur in patches of bare or nearly-bare ground. Occasionally found in freshly plowed fields and stubble fields (American Ornithologists Union 1983, With 1994a). Nests are usually placed in scrapes on the ground at the base of shrubs, grass clumps, or cacti, or beside cattle dung. Nests beside shrubs may be subject to heavy predation by ground squirrels (With 1994b).
Conservation goal: A regional endemic that breeds only in flat, dry grassland; therefore, 6 populations are required for long-term persistence. Patch size is based on a median reported breeding territory of 1.0 ha (With 1994a).

Minimum patch size:	100 ha - 137 ha.
Minimum number of patches:	6.
Distribution of patches:	2 in each foothills subregion.
Minimum separation:	3.4 km - 4.0 km, with $\geq$ 2 permanent streams between closest patch edges.

Chestnut-collared longspur (*Calcarius ornatus*) - secondary target
Status: G5 / S2B, SZN (WY) S4B, SZN (SD).
Justification as target: A regional endemic that breeds in only a small portion of the northern Great Plains; recent data suggest population declines. Strongly associated with open grassland.
Habitat: Breeds in rolling mixed-grass and shortgrass uplands, and, in drier regions, moist lowlands (DuBois 1935, Fairfield 1968, Owens and Myers 1973, Stewart 1975, Wiens and Dyer 1975, Kantrud and Kologiski 1982). Prefers open prairie and avoids excessively shrubby areas (Arnold and Higgins 1986); however, scattered shrubs and other low perches often are used for singing (Harris 1944, Fairfield 1968, Creighton 1974). Also avoids areas with dense litter accumulations (Renken 1983, Berkey et al. 1993, Anstey et al. 1995). Prefers native grassland to heavily-grazed pastures and hay meadows (Fairfield 1968, Owens and Myres 1973, Maher 1974, Stewart 1975, Johnsgard 1980, Faanes 1983, Anstey et al. 1995, Davis and Duncan 1995). Cultivated fields, fallow fields, and stubble may support a few individuals if vegetation structure is suitable (Fairfield 1968, Owens and Myres 1973, Stewart 1975, Anstey et al. 1995). In North Dakota, densities were higher in cropland than in the tall, dense vegetation in Conservation Reserve Program fields (Johnson and Igl 1995). Preferred vegetation height is <20-30 cm (Fairfield 1968).

Within drier shortgrass habitats, chestnut-collared longspurs prefer wetter, taller, and more densely vegetated areas than McCown's longspurs and horned larks (DuBois 1937, Strong 1971, Creighton 1974, Kantrud and Kologiski 1982, Wershler et al. 1991). Low, moist areas and wet meadows are suitable habitat in arid and semi-arid regions (DuBois 1937, Giezentanner 1970,

Stewart 1975). In contrast, in wetter mixed-grass prairie, the taxon avoids tall and dense vegetation in favor of sparser uplands (Renken 1983, Renken and Dinsmore 1987, Berkey et al. 1993, Johnson and Schwartz 1993, Anstey et al. 1995).

Conservation goal: A regional endemic that breeds only in open grassland; therefore, 6 populations are required for long-term persistence. Patch size is based on a median reported breeding territory of 1.9 ha (Hill and Gould 1997).

Minimum patch size:	190 ha - 261 ha.
Minimum number of patches:	6.
Distribution of patches:	2 in each foothills subregion.
Minimum separation:	4.7 km - 5.5 km, with $\geq$ 2 permanent streams between closest patch edges.

LITERATURE CITED

Agnew, W., D. W. Uresk and R. M. Hansen. 1986. Flora and fauna associated with prairie dog colonies and adjacent ungrazed mixed-grass prairie in western South Dakota. Journal of Range Management 39:135-139.

American Ornithologists' Union (AOU), Committee on Classification and Nomenclature. 1983. Check-list of North American birds. Sixth Edition. American Ornithologists' Union / Allen Press Inc., Lawrence, Kansas.

Anstey, D.A., S. K. Davis, D. C. Duncan, and M. Skeel. 1995. Distribution and habitat requirements of eight grassland songbird species in southern Saskatchewan. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan.

Apfelbaum, S., and A. Haney. 1981. Bird populations before and after wild fire in a Great Lakes U.S.A. pine forest. Condor 83:347-354.

Arnold, T. W., and K. F. Higgins. 1986. Effects of shrub coverage on birds of North America mixed-grass prairies. Canadian Field-Naturalist 100:10-14.

Baxter, G. T. and M. D. Stone. 1985. Amphibians and reptiles of Wyoming. Second Edition. Wyoming Game and Fish Department, Cheyenne, Wyoming.

Beauvais, G. P. 1997. Mammals in fragmented forests in the Rocky Mountains: community structure, habitat selection, and individual fitness. Ph.D. dissertation, University of Wyoming, Laramie, Wyoming.

Beauvais, G. P. 1998. Survey's for Preble's meadow jumping mouse *(Zapus hudsonius preblei*) on F.E. Warren Air Force Base, Wyoming, September 1998. Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

Beauvais, G. P. 1999. Wyoming Basins ecoregional plan: description of targets, initial sites, and conservation goals for vertebrates. Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

Beauvais, G. P. 2000. Status report for rare vertebrates and plants in Laramie County, Wyoming. Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

Beier, P., and J. E. Drennan. 1997. Forest structure and prey abundance in foraging areas of northern goshawks. Ecological Applications 7:564-571.

Berkley, G., R. Crawford, S. Galipeau, D. Johnson, D. Lambeth, and R. Kreil. 1993. A review of wildlife management practices in North Dakota: effects on nongame bird populations and habitats. USDI Fish and Wildlife Service Report, Denver, Colorado.

Biological and Conservation Database. 2000a. Vertebrate characterization abstract - *Picoides tridactylus*.

Biological and Conservation Database. 2000b. Vertebrate characterization abstract - *Storeria occipitomaculata*.

Biological and Conservation Database. 2000c. Vertebrate characterization abstract - *Glaucomys sabrinus*.

Blackford, J. L. 1955. Woodpecker concentration in a burned forest. Condor 57:28-30.

Block, W. M., and L. A. Brennan. 1987. Characteristics of Lewis' Woodpecker habitat on the Modoc Plateau, California. Western Birds 18:209-212.

Bock, C. E. 1970. The ecology and behavior of the Lewis' woodpecker (*Asyndesmus lewis*). University of California Publication in Zoology No. 92.

Bock, C. E., and J. H. Bock. 1974. On the geographical ecology and evolution of the three-toed woodpeckers, *Picoides tridactylus* and *P. arcticus*. American Midland Naturalist 92:397-405.

Bonham, C. D. and A. Lerwick. 1976. Vegetation changes induced by prairie dogs on shortgrass range. Journal of Range Management 29:221-225.

Bosakowski, T., and R. Speiser. 1994. Macrohabitat selection by nesting northern goshawks: implications for managing eastern forests. Studies in Avian Biology 16:46-49

Bright-Smith, D. J., and R. W. Mannan. 1994. Habitat use by breeding male northern goshawks in northern Arizona. Studies in Avian Biology 16:58-65.

Bull, E. L. and J. E. Hohmann. 1994. Breeding biology of northern goshawks in northeastern Oregon. Studies in Avian Biology 16:103-105.

Bull, E. L., S. R. Peterson, and J. W. Thomas. 1986. Resource partitioning among woodpeckers in northeastern Oregon. USDA Forest Service Research Note PNW-444.

Caton, E. M. 1996. Cavity nesting birds in a post-fire habitat in northwestern Montana. Ph.D. dissertation, University of Montana, Missoula, Montana.

Clark, T. W. and M. R. Stromberg. 1987. Mammals in Wyoming. University Press of Kansas. Lawrence, Kansas.

Clark, T.W., A.H. Harvey, R.D. Dorn, D.L. Genter, and C. Groves (editors). 1989. Rare, Sensitive, and Threatened Species of the Greater Yellowstone Ecosystem. Northern Rockies Conservation Cooperative, Montana Natural Heritage Program, The Nature Conservancy, and Mountain West Environmental Services.

Compton, S. A. and R. D. Hugie. 1993. Status report on *Zapus hudsonius preblei*, a candidate Endangered Species. USDI Fish and Wildlife Service, Denver, Colorado.

Coppock, D. L., J. K. Detling, J. E. Ellis, and M. I. Dyer. 1983a. Plant-herbivore interactions in a North American mixed-grass prairie - Part I: Effects of black-tailed prairie dogs on intraseasonal aboveground plant biomass and nutrient dynamics and plant species diversity. Oecologia 56:1-9.

Coppock, D. L., J. E. Ellis, J. K. Detling, and M. I. Dyer. 1983b. Plant-herbivore interactions in a North American mixed-grass prairie - Part II: Responses of bison to modification of vegetation by prairie dogs. Oecologia 56:10-15.

Creighton, P.D. 1974. Habitat exploitation by an avian ground-foraging guild. Ph.D. dissertation, Colorado State University, Fort Collins, Colorado.

Darveau, M., P. Beauchesene, L. Belanger, J. Huot, and P. Larue. 1995. Riparian forest strips as habitat for breeding birds in boreal forest. Journal of Wildlife Management 59:67-78.

Davis, S. K., and D. C. Duncan. 1995. Grassland songbird abundance in native and crested wheatgrass pastures of southern Saskatchewan. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan.

Diem, K. L. and S. I. Zeveloff. 1980. Ponderosa pine bird communities. Pages 170-197 *in* R. M. DeGraff and N. G. Tilghman (editors). Workshop proceedings: management of western forests and grasslands for nongame birds. USDA Forest Service General Technical Report INT-86.

DuBois, A.D. 1935. Nests of Horned Larks and longspurs on a Montana prairie. Condor 37:56-72.

DuBois, A.D. 1937. The McCown Longspurs of a Montana prairie. Condor 39:233-238.

Evans, K. E. and R. N. Conner. 1979. Snag management. *In* R. M. DeGraff and K. E. Evans (editors). Management of North Central and Northeastern forests for nongame birds. USDA Forest Service Technical Report NC-51.

Faanes, C. 1983. Breeding birds of wooded draws in western North Dakota. Prairie Naturalist 15:173-187.

Fairfield, G.M. 1968. Chestnut-collared Longspur. Pages 1635-1652 *in* O.L. Austin, Jr. (editor). Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. Dover Publications, Inc., New York, New York.

Ferner, J. W. 1974. Habitat relationships of *Tamiasciurus hudsonicus* and *Sciurus aberti* in the Rocky Mountains. Southwestern Naturalist 18:470-473.

Garrett, M. G. and W. L. Franklin. 1988. Behavioral ecology of dispersal in the black-tailed prairie dog. Journal of Mammalogy 69:236-250.

Gerhart, W.A. and R.A. Olson. 1982. Handbook for evaluating the importance of Wyoming's riparian habitat to terrestrial wildlife. Wyoming Game and Fish Department, Cheyenne, Wyoming.

Giezentanner, J. B. 1970. Avian distribution and population fluctuations on the shortgrass prairie of north central Colorado. U.S. International Biological Program - Grassland Biome Technical Report No. 62.

Goggans, R. 1989. Black-backed woodpecker. Pages 88-89 in T.W. Clark, A. H. Harvey, R. D. Dorn, D. L. Genter, and C. Groves (editors). Rare, sensitive and threatened species of the greater Yellowstone ecosystem. Northern Rockies Conservation Cooperative / Montana Natural Heritage Program / The Nature Conservancy / Mountain West Environmental Services.

Grant, C. V. 1999. Technical summary of Preble's meadow jumping mouse survey of Colorado Interstate Gas Company's Medicine Bow Lateral natural gas pipeline. BioResources Inc., Logan, Utah.

Griffin, C. R., T. S. Baskett, and R. D. Sparrowe. 1982. Ecology of bald eagles wintering near a waterfowl concentration. USDI Fish and Wildlife Service Special Science Report No. 247:1-12.

Groves, C., L. Valutis, D. Vosick, B. Neely, K. Wheaton, J. Touval, and B. Runnels. 2000. Designing a geography of hope: a practitioner's handbook to ecoregional conservation planning. Volumes I and II. Second edition. The Nature Conservancy, Arlington, Virginia.

Hargis, C. D., C. McCarthy, and R. D. Perloff. 1994. Home ranges and habitats of northern goshawks in eastern California. Studies in Avian Biology 16:66-74.

Harris, R.D. 1944. The Chestnut-collared Longspur in Manitoba. Wilson Bulletin 56:105-115.

Harrison, H. H. 1979. A field guide to western birds' nests. Houghton Mifflin Company, Boston, Massachusetts.

Hayward, G. D., and R. E. Escano. 1989. Goshawk nest-site characteristics in western Montana and northern Idaho. Condor 91:476-479.

Hill, D. P. and L. K. Gould. 1997. Chestnut-collared longspur (*Calcarius ornatus*). No. 288 *in* A. Poole and F. Gill (editors). The birds of North America. The Academy of Natural Sciences, Philadelphia, Pennsylvania / The American Ornithologists Union, Washington, D.C.

Hillman, C. N., R. L. Linder, and R. B. Dahlgren. 1979. Prairie dog (*Cynomys ludovicianus*) distribution in areas inhabited by black-footed ferrets (*Mustela nigripes*). American Midland Naturalist 102:185-187.

Humphrey, S.R. and T.H. Kunz. 1976. Ecology of a pleistocene relict, the western big-eared bat (*Plecotus townsendii*), in the southern Great Plains. Journal of Mammalogy 57:470-494.

Hutto, R.L. 1995a. USFS Northern Region songbird monitoring program: distribution and habitat relationships. USDA Forest Service Northern Region internal report, Missoula, Montana.

Hutto, R.L. 1995b. Composition of bird communities following stand-replacement fires in northern Rocky Mountain (U.S.A.) conifer forests. Conservation Biology 9:1041-1058.

Johnsgard, P.A. 1980. A preliminary list of the birds of Nebraska and adjacent plains states. University of Nebraska Press, Lincoln, Nebraska.

Johnson, D.H., and L.D. Igl. 1995. Contributions of the Conservation Reserve Program to populations of breeding birds in North Dakota. Wilson Bulletin 107:709-718.

Johnson, D.H., and M.D. Schwartz. 1993. The Conservation Reserve Program and grassland birds. Conservation Biology 7:934-937.

Kantrud, H.A., and R.L. Kologiski. 1982. Effects of soils and grazing on breeding birds of uncultivated upland grasslands of the Northern Great Plains. USDI Fish and Wildlife Service Wildlife Research Report No. 15.

Kemp, G. A. and L. B. Keith. 1970. Dynamics and regulation of red squirrel (*Tamiasciurus hudsonicus*) populations. Ecology 51:763-779.

Kingery, H.E. 1977. The autumn migration, August 1- November 30, 1976: mountain west region. American Birds 31:203-207.

Klatt, L. E. and D. Hein. 1978. Vegetative differences among active and abandoned towns of black-tailed prairie dogs (*Cynomys ludovicianus*). Journal of Range Management 31:315-317.

Koford, C. B. 1958. Prairie dogs, whitefaces and blue gramma. Wildlife Monograph 3:6-78.

Layne, J. N. 1954. The biology of the red squirrel, *Tamiasciurus hudsonicus loquar* Bangs, in central New York. Ecological Monographs 24:227-267.

Linder, K. A. and S. H. Anderson. 1998. Nesting habitat of Lewis' woodpeckers in southeastern Wyoming. Journal of Field Ornithology 69:109-116.

Lindsay, S. L. 1987. Geographic size and non-size variation in Rocky Mountain *Tamiasciurus hudsonicus*: significance in relation to Allen's rule and vicariant biogeography. Journal of Mammalogy 68:39-48.

Maher, W. J. 1974. Matador Project: Birds II. Avifauna of the Matador area. Canadian Committee International Biological Program Technical Report 58. University of Saskatchewan, Saskatoon, Saskatchewan.

McClelland, B. R., S. S. Frissell, W. C. Fischer, and C. H. Halvorson. 1979. Habitat management for hole-nesting birds in forests of western larch and Douglas-fir. Journal of Forestry 77:480-483.

McGowan, J.D. 1975. Distribution, density and productivity of goshawks in interior Alaska. Alaska Department of Fish and Game, Juneau, Alaska.

Merriam, C. H. 1902. The prairie dog of the Great Plains. Pages 257-270 *in* Yearbook of the U.S. Department of Agriculture 1901. U.S. Government Printing Office, Washington D.C.

Merrill, E. H., T. W. Kohley, M. E. Herdendorf, W. A. Reiners, K. L. Driese, R. W. Marrs, and S. H. Anderson. 1996. The Wyoming Gap Analysis Project final report. Wyoming Cooperative Fish and Wildlife Research Unit. University of Wyoming, Laramie, Wyoming.

Merritt, J. F. and J. M. Merritt. 1978. Population ecology and energy relationships of *Clethrionomys gapperi* in a Colorado subalpine forest. Journal of Mammalogy 59:576-598.

Osborn, B. 1942. Prairie dogs in shinnery (oak scrub) savannah. Ecology 23:110-115.

Owens, R. A., and M. T. Myres. 1973. Effects of agriculture upon populations of native passerine birds of an Alberta fescue grassland. Canadian Journal of Zoology 51:697-713.

Pague, C. and L. Grunau. 2000. Factbook on the Preble's meadow jumping mouse (*Zapus hudsonius preblei*). Draft 9 January 2000. Preble's Meadow Jumping Mouse Science Team, Boulder, Colorado.

Palmer, R. S. 1988. Handbook of North American birds. Volume 4: Diurnal raptors [part 1]. Yale University Press, New Haven, Connecticut.

Pearson, D. E. 1994. Habitat use by the southern red-backed vole (*Clethrionomys gapperi*): response of an old-growth associated species to succession. MS thesis, University of Mantana, Missoula, Montana.

Raphael, M. G. and M. White. 1984. Use of snags by cavity-nesting birds in the Sierra Nevada. Wildlife Monographs 86:1-66.

Raphael, M.G., M.L. Morrison, and M.P. Yoder-Williams. 1987. Breeding bird populations during twenty-five years of postfire succession in the Sierra Nevada. Condor 89:614-626.

Renken, R. B. 1983. Breeding bird communities and bird-habitat associations on North Dakota waterfowl production areas of three habitat types. M.S. Thesis, Iowa State University, Ames, Iowa.

Renken, R. B., and J. J. Dinsmore. 1987. Nongame bird communities on managed grasslands in North Dakota. Canadian Field-Naturalist 101:551-557.

Reynolds, R. T., E. C. Meslow, and H. M. Wight. 1982. Nesting habits of coexisting *Accipiter* in Oregon. Journal of Wildlife Management 46:124-131.

Rosenberg, D. K. and R. G. Anthony. 1992. Characteristics of northern flying squirrel populations in young second- and old-growth forests in western Oregon. Canadian Journal of Zoology 70:161-166.

Rossman, D. A. and P. A. Myer. 1990. Behavioral and morphological adaptations for snail extraction on North American brown snakes (genus *Storeria*). Journal of Herpetology 24:434-438.

Saab, V. A. and J. G. Dudley. 1998. Responses of cavity-nesting birds to stand-replacement fire and salvage logging in ponderosa pine/Douglas-fir forests of southwestern Idaho. USDA Forest Service Research Paper RMRS-RP-11.

Siders, M. S. and P. L. Kennedy. 1994. Nesting habitat of *Accipiter* hawks: is body size a consistent predictor of nest habitat characteristics? Studies in Avian Biology 16:92-96.

Spahr, R., L. Armstrong, D. Atwood, and M. Rath. 1991. Threatened, endangered, and sensitive species of the Intermountain Region. USDA Forest Service, Ogden, Utah.

Speiser, R., and T. Bosakowski. 1987. Nest site selection by northern goshawks in northern New Jersey and southeastern New York. Condor 89:387-394.

Squires, J. R. and L. F. Ruggiero. 1996. Nest-site preference of northern goshawks in south-central Wyoming. Journal of Wildlife Management 60:170-177.

Squires, J. R. and R. T. Reynolds. 1997. Northern goshawk (*Accipiter gentilis*). No. 298 *in* A. Poole and F. Gill (editors). The birds of North America. The Academy of Natural Sciences, Philadelphia, Pennsylvania / The American Ornithologists Union, Washington, D.C.

Stewart, R.E. 1975. Breeding birds of North Dakota. Tri-College Center for Environmental Studies, Fargo, North Dakota.

Strong, M.A. 1971. Avian productivity on the shortgrass prairie of northcentral Colorado. M.S. thesis, Colorado State University, Fort Collins, Colorado.

Sullivan, K. A. 1999. Yellow-eyed junco (*Junco phaeonotus*). No. 464 *in* A. Poole and F. Gill (editors). The birds of North America. The Academy of Natural Sciences, Philadelphia, Pennsylvania / The American Ornithologists Union, Washington, D.C.

Swem, T. and M. Adams. 1992. A northern goshawk nest in the tundra biome. Journal of Raptor Research 26:102.

Taylor, R. C. 1999. Trapping report: Preble's meadow jumping mouse (*Zapus hudsonius preblei*) on True Ranch properties in southeastern Wyoming. True Ranches, Casper, Wyoming.

Thorp, J. 1949. Effects of certain animals that live in soils. Scientific Monthly 68:180-191.

Tobalske, B. W. 1997. Lewis' woodpecker (*Melanerpes lewis*). No. 284 *in* A. Poole and F. Gill (editors). The birds of North America. The Academy of Natural Sciences, Philadelphia, Pennsylvania / The American Ornithologists Union, Washington, D.C.

USDI Fish and Wildlife Service. 1987. Determination of endangered status for the Mount Graham red squirrel. Federal Register 52:20994-20999.

Villard, P. 1994. Foraging behavior of Black-backed and Three-toed woodpeckers during spring and summer in a Canadian boreal forest. Canadian Journal of Zoology 72:1957-1959.

Villard, P. and C. W. Benniger. 1993. Foraging behavior of male Black-backed and Hairy woodpeckers in a forest burn. Journal of Field Ornithology 64:71-76.

Villard, M. and J. Schieck. 1996. Immediate post-fire nesting by black-backed woodpeckers, *Picoides arcticus*, in Northern Alberta. Canadian Field-Naturalist 111:478-479.

Wershler, C., W.W. Smith, and C. Wallis. 1991. Status of the Baird's Sparrow in Alberta: 1987/ 1988 update with notes on other grassland sparrows and Sprague's Pipit. Pages 87-89 *in* G.L. Holroyd, G. Burns, and H.C. Smith (editors). Proceedings of the second endangered species and prairie conservation workshop. Natural History Occasional Paper 15. Provincial Museum of Alberta, Edmonton, Alberta.

Widen, P. 1989. The hunting habitat of goshawks *Accipiter gentilis* in boreal forests of central Sweden. Ibis 131:205-231.

Wiens, J.A., and M.I. Dyer. 1975. Rangeland avifaunas: their composition, energetics, and role in the ecosystem. Pages 146-182 *in* D.R. Smith (editor). Symposium on the management of forest and range habitats for nongame birds. USDA.Forest Service General Technical Report WO-1.

With, K. A. 1994a. McCown's longspur (*Calcarius mccownii*). No. 96 *in* A. Poole and F. Gill (editors). The birds of North America. The Academy of Natural Sciences, Philadelphia, Pennsylvania / The American Ornithologists Union, Washington, D.C.

With, K. A. 1994b. The hazards of nesting near shrubs for a grassland bird, the McCown's longspur. Condor 96:1009-1019.

Witt, J. W. 1992. Home range and density estimates for the northern flying squirrel, *Glaucomys sabrinus*, in western Oregon. Journal of Mammalogy 73: 921-929.

Woodbridge, B. and P. J. Detrich. 1994. Territory occupancy and habitat patch size of northern goshawks in the southern Cascades of California. Studies in Avian Biology 16:83-87.

Worthington, D.J. 1991. Abundance and Distribution of bats in the Pryor Mountains of south central Montana and north eastern Wyoming. Unpublished report, Div. of Biological Sciences, Univ. of Montana, Missoula, Montana.

Wuerthner, G. 1997. Viewpoint: the black-tailed prairie dog - headed for extinction? Journal of Range Management 50:459-466.

Wyoming Game and Fish Department. 1992. Endangered and nongame bird and mammal investigations. Nongame Program Biological Service Section Annual Completion Report, 15 April 1991 to 14 April 1992. Wyoming Game and Fish Department, Cheyenne, Wyoming.

Wyoming Game and Fish Department. 1996. Nongame Bird and Mammal Plan, a plan for inventories and management of nongame birds and mammals in Wyoming. Prepared by B. Oakleaf, A.O. Cerovski, and B. Luce, Nongame Program Biological Services Section, Wyoming Game and Fish Dept.

Younk, J. V. and M. J. Bechard. 1992. Effects of gold mining activity on northern goshawks breeding in Nevada'a Independence and Bull Run Mountains. Raptor Research Center, Boise State University, Boise, Idaho.

Younk, J. V. and M. J. Bechard. 1994. Breeding ecology of the northern goshawk in high-elevation aspen forests of northern Nevada. Studies in Avian Biology 16:119-121.

Yunick, R.P. 1985. A review of recent irruptions of the Black-backed Woodpecker and Three-toed Woodpecker in eastern North America. Journal of Field Ornithology 56:138-152.