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RARE, SENSITIVE, AND THREATENED SPECIES OF THE GREATER YELLOWSTONE ECOSYSTEM

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RARE, SENSITIVE, AND THREATENED SPECIES OF THE GREATER YELLOWSTONE ECOSYSTEM

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PREFACE

This publication is a cooperative project of the Northern Rockies Conservation Cooperative; Robert D. Dorn of Mountain West Environmental Services; David L. Genter of the Montana Natural Heritage Program; and Craig Groves of the Natural Heritage Section, Nongame and Endangered Wildlife Program, Idaho Department of Fish and Game. Fifty-one experts from throughout the northern Rockies region and elsewhere contributed individual reports on the status of plant, invertebrate, and vertebrate species of concern in the Greater Yellowstone Ecosystem (GYE). Among the contributors are state and federal agency biologists, university professors, graduate students, and biologists working in nonprofit and private sector organizations. In addition to the chapters on plant and animal taxa, the publication includes a chapter on the designated and proposed Research Natural Areas in the GYE.

The plant section contains detailed accounts of 11 significant rare plant species and their conservation needs in the GYE. It also includes a list of 124 rare plant species known to occur in the GYE. This list includes information about these species' global and state Nature Conservancy Natural Heritage ranks, their status under the Endangered Species Act, and their listing as sensitive species by the Northern and Intermountain Regions of the U.S. Forest Service.

The invertebrate section is clearly only a beginning, covering only the mayflies and the butterflies. Both of these accounts provide an overview of these taxa and their conservation needs in the GYE. The mayfly chapter discusses the status of 12 mayfly families, several of which are still poorly known in the GYE. Detailed studies frequently discover new species and even new genera of mayflies. Butterflies are probably the best known of the insects in the GYE. The butterfly chapter discusses several butterfly species of special interest to conservationists, and contains a list of the 128 species of butterflies found in the Greater Yellowstone Ecosystem. We hope these accounts might serve as a model for a more complete compilation of information on the diversity of invertebrates of the Greater Yellowstone Ecosystem.

Each vertebrate species account consists of a description of the species, its range, its habitat, and its life history and ecology. The accounts focus particular attention on the species' conservation needs in the GYE. Key references for each species are provided. Distributional maps accompany the accounts for species whose ranges cover only a part of the GYE. Maps are not included for those species that are found throughout the GYE, for species whose distribution in the GYE is poorly known, or for those species where revealing the exact location of a population might further endanger it.

Vertebrate species were included in this compendium based on the following criteria:

The species is

- 1) listed as either threatened or endangered by the U.S. Fish and Wildlife Service, or is a candidate for one of these designations,
- 2) classed as a species of special concern or a comparable designation by state agencies,
- 3) identified as a sensitive species by the U.S. Forest Service,
- 4) classed as rare or status undetermined by The Nature Conservancy's Natural Heritage Programs, or
- 5) considered a candidate for one of the above designations by a recognized authority.

In addition, several species that do not meet these criteria are included, such as the short-horned lizard and the pileated woodpecker. The GYE is peripheral to the ranges of both these species, and their status in the GYE is unknown. Populations of peripheral species like these may require special management where they occur in the GYE. Research is needed to determine their status. The black bear, American marten, mountain lion, and bobcat are included either because reliable information on their status in the GYE is lacking or because the collaborators in this project believe they are sensitive species which should be carefully monitored. Many top carnivores are particularly sensitive to human disturbance and habitat alteration.

We hope that this publication will be a useful reference for managers, scientists, educators, and conservationists concerned with the Greater Yellowstone Ecosystem. For the first time, information about the rare and sensitive species of the GYE is compiled in one document. This compendium shows the number and diversity of species in the GYE that need management attention and points out numerous gaps in our knowledge of many species' life histories, ecological requirements, and status in the GYE. We hope this publication will lead to increased attention to basic research, inventory, monitoring, and conservation of the Greater Yellowstone Ecosystem's rare and sensitive flora and fauna, as well as its natural areas and communities.

ACKNOWLEDGMENTS

This publication is the result of many hours of work by biologists from throughout the Greater Yellowstone region and elsewhere. All of the contributors to this compendium took the time from their busy schedules to research and write the individual sections, volunteering their time and expertise. We are grateful to all of them.

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DEFINITIONS OF TERMS

U.S. Fish and Wildlife Service:

Endangered species: Any species in danger of extinction throughout all or a significant portion of its range.

Threatened species: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Candidate species: Species being considered for listing as endangered or threatened.

Category 1 (C1) candidate species: Taxa for which the Service currently has substantial biological information on hand to support the appropriateness of proposing to list as endangered or threatened.

Category 2 (C2) candidate species: Taxa for which information now in possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not currently available to support proposed rules. There are no current plans for listing these species unless additional information becomes available.

Category 3 (C3) candidate species: Taxa that were once being considered for listing as endangered or threatened, but are not currently receiving such consideration. Category 3 species fall into three groups:

3A: Taxa for which the U.S. Fish and Wildlife Service has persuasive evidence of extinction.

3B: Taxa that do not meet the Endangered Species Act's legal definition of "species."

3C: Taxa that are now considered to be more abundant or widespread than previously thought.

U.S. Forest Service:

The national forests of the GYE are in three Forest Service regions. Region 1 (Northern Region) has an official sensitive species list. Region 4's list (Intermountain Region) is in draft form. Region 2 (Rocky Mountain Region) is in the process of compiling a draft sensitive species list.

Sensitive species: Those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by:

- a. Significant current or predicted downward trends in population numbers or density.
- b. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Idaho:

Species of Special Concern: Native species which are either low in numbers, limited in distribution, or have suffered significant habitat losses. The list includes three categories of species:

- A) species which meet one or more of the criteria above and for which Idaho presently contains or formerly constituted a significant portion of their range (i.e. priority species),
- B) species which meet one or more of the criteria above but whose populations in Idaho are on the edge of a breeding range that falls largely outside the state (i.e. peripheral species), and
- C) species which may be rare in the state but for which there is little information on their population status, distribution, and/or habitat requirements (i.e. undetermined status species).

Montana:

Species of Special Concern: Animal species, plant species, and plant associations which are rare, endemic, disjunct, threatened, or endangered throughout their range or in Montana, vulnerable to extirpation from Montana, or in need of further research.

[Note: This definition and the list of Montana Species of Special Concern used in this publication are those developed by the Montana Natural Heritage Program. The Montana Department of Fish, Wildlife and Parks (FWP) has a separate list of **Species of Special Interest or Concern**, defined as "Species highlighted for data acquisition and subsequent management effort. These species may be of special interest or concern for a variety of reasons related to status, distribution or other concerns." The Montana FWP list can be found in the publication Vertebrate Species of Special Interest or Concern (Flath 1984).]

Wyoming:

Wyoming's species of special concern are given priority rankings based on their position within an evaluation matrix. Information about each species' breeding population status, distribution, status of essential habitat, and sensitivity to human disturbance is used to place the species in the matrix. Lower numbers indicate a greater need for special management attention.

Priority 1 species: These species need immediate attention and active management to insure that extirpation or a significant decline in the breeding population in Wyoming does not occur.

Priority 2 species: These are species in need of additional study to determine whether intensive management is warranted or whether low level management such as monitoring population trends and encouraging resource management planning to accommodate the species' needs would suffice. Until intensive management is proven to be needed, low level management will be implemented.

Priority 3 species: Knowledge of these species is so limited that they could not be adequately evaluated with the matrix. Wildlife in this category are species whose needs should be accommodated in resource management planning. However, intensive management programs to maintain or enhance populations do not appear warranted at present. They are species whose populations and habitat trends should be monitored to determine if low levels of management continue to be adequate.

The Nature Conservancy:

The Nature Conservancy uses a numerical ranking system to indicate a species' relative rarity and endangerment at the global (G), national (N), and state (S) levels. Species are ranked according to the following definitions:

1: Critically imperiled because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

2: Imperiled because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

3: Rare or uncommon (on the order of 21 to 100 occurrences).

4: Apparently secure, with many occurrences.

5: Demonstrably secure and essentially ineradicable under present conditions.

H: Of historical occurrence, i.e., formerly part of the established biota, with the expectation that it may be re-discovered.

U: Possibly in peril but status uncertain; need more information. This rank is used sparingly. Whenever possible, the most likely rank is assigned and a question mark added (e.g., S2?) to express uncertainty, or a range is used (e.g., S2S3) to delineate the limits (range) of uncertainty.

X: Believed to be extinct.

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INTRODUCTION

The region known as the "Greater Yellowstone Ecosystem" or the "GYE" has in the last decade become the focus of much scientific and public interest. This area, the high mountainous region including and surrounding Yellowstone National Park, encompasses pieces of three states (Fig. 1). It is crisscrossed with human-drawn boundaries that divide it into national parks, national forests, national wildlife refuges, state-owned lands, private lands, counties, and other subdivisions (Fig. 2). Yet despite the lines that dissect it on a map, this vast landscape is increasingly being viewed as a unit, as a distinct and definable biogeographical region. Its topography, geology, vegetation, and wildlife all distinguish it from the surrounding lands. Even the federal agencies that manage most of the GYE's lands now recognize the region as an entity, although some of them prefer to call it the "Greater Yellowstone Area."

The GYE is famous for its spectacular scenery, vast expanses of wilderness, and abundant wildlife. Some of the large showy animals that find refuge in the GYE, such as the elk, grizzly bear, and trumpeter swan, have been the focus of intensive study and management. But the GYE is home also to many other plant and animal species which have received little scientific attention and about which very little is known. A number of these lesser known or less abundant species are of concern to scientists and conservationists because of their rarity, their sensitivity to disturbance, or their requirements for habitat which is threatened in the GYE. This publication focuses on these rare, sensitive, and threatened species, both those that are well known and those that are not. It brings together information on each species' range, habitat, life history and ecology, and conservation needs in the GYE. It also highlights areas where information is lacking.

The species featured in this volume are of concern for a variety of reasons. Many are rare, with small or isolated populations. Small populations are usually more susceptible to extinction than larger populations. Small populations confined to limited habitat are vulnerable to habitat modification or loss. They may be severely reduced or eliminated by random events such as droughts, floods, or fires. Introduced predators and disease can be devastating. Genetic problems stemming from inbreeding and loss of genetic variability can arise when a population drops to very low numbers. Random fluctuations in population numbers or sex ratios are much more significant and potentially more harmful for small populations than for large ones. For all these reasons, small populations are of special concern to conservationists, scientists, and managers.

Many of the species featured in this compendium were once widely distributed but have become scarce because of habitat modification and human disturbances. The whooping crane, for example, historically ranged from the Arctic coast to central Mexico and from the Rocky Mountains east to the Atlantic coast. As its nesting grounds were drained and plowed by settlers, the whooping crane disappeared, until by 1937 only about 15 whooping cranes were known to survive. Although its numbers have increased since then to about 133 today, the whooping crane's status is still precarious and its range is very restricted. Other species are naturally rare. For example, Ross bentgrass has a very restricted distribution, growing only in the Upper Geyser Basin in Yellowstone National Park. Because of its low population size and isolation, it is vulnerable to extinction if its habitat is disrupted.

Some of the GYE's sensitive species were once widespread but were never found in high densities. Large carnivores such as the wolverine and the mountain lion are examples. As their habitat was modified by settlement and agriculture, these species became scarce or were extirpated from much of their historic range. Small populations of most of the native species of carnivores persist in the GYE, with the exception of the gray wolf, which was exterminated by the 1940s. Fishers were probably always very scarce in the GYE, and whether any fishers still occur there is unknown. Some of these species have very extensive home ranges, covering tens or hundreds of square miles. To ensure the continued existence of viable populations, large areas of habitat must be protected.

Several species are considered sensitive because they are intolerant of human activities during all or part of their life cycles. For example, white pelicans and common loons may desert their nests if they are disturbed during the breeding season. Townsend's big-eared bats may abandon their summer roosts or hibernacula if disturbed. Other less visible human activities have contributed to the decline of some of the species included in

Figure 1. Major rivers and mountain ranges of the Greater Yellowstone Ecosystem.

this publication. Bald eagles, peregrine falcons, white pelicans, and white-faced ibises have all been affected by pesticides. Many of the cutthroat trout populations in the GYE have been subjected to competition, predation, and hybridization resulting from introduction of exotic trouts.

Several of the species that are rare in the Yellowstone ecosystem are more common elsewhere, either because the GYE is located at the geographic edge of their range or because the habitat types they require are uncommon in the GYE. For example, nine species of butterflies reach the edges of their ranges in the GYE. The populations of these species in the GYE are likely to be small and scattered, and they may be susceptible to local extirpation if environmental conditions change. These peripheral species may be excellent environmental indicators.

Finally, some species included in this document are believed to be uncommon because they are hard to detect or have rarely been collected. For example, little is known about the status of the dwarf, pygmy, and Preble's shrews in the GYE. Rubber boas appear to be uncommon, but this may be due to their secretive habits. Boreal owls remained undetected in the Rocky Mountains until 1981 because of their nocturnal activity and winter courtship. Intensive efforts to census these species may show them to be more abundant than is now believed.

The Greater Yellowstone Ecosystem and its flora and fauna have been modified by humans, but human impacts have been minor relative to those affecting surrounding lands. Reintroducing the gray wolf would be an important step toward restoring the GYE's original complex of species. The existence of such a large area, with its biota still mostly intact, provides a rare opportunity to preserve not just individual species but the entire complex of interacting plant and animal communities. As Scott et al. (1988) point out, "It is easier and more cost-effective to protect intact, functioning ecosystems with their myriad species than to initiate emergency room conservation measures for one endangered species after another, or to wait until common species become endangered before acting to protect them." The Commission on Research and Resource Management Policy in the National Park System (1989:4) made a similar call for developing and using the ecosystem concept for large-scale landscape management, concluding that "Ecosystem management is the paradigm providing the soundest philosophical and technical basis for stewardship..." Protection and management of the Greater Yellowstone Ecosystem as a whole is needed not only to preserve the GYE's full complement of biological diversity, but also to maintain the integrity of the ecological processes that interconnect the biotic elements.

Ecosystem management and species preservation depend on a sound information base (see Clark and Harvey 1988). This publication is intended to contribute to ecosystem management by making easily available the existing knowledge about the Greater Yellowstone Ecosystem's most sensitive species. This is only a first step, one which we hope will encourage more comprehensive efforts. We hope that in addition to serving as a reference for scientists, educators, managers, and conservationists, this publication will encourage increased attention to the research, monitoring, and management actions that are needed to ensure these species' continued existence in the GYE. We hope too that it will increase appreciation of the GYE's rich store of biological diversity and the importance of conserving it.

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- Clark, T. W., and A. H. Harvey. 1988. Management of the Greater Yellowstone Ecosystem: an annotated bibliography. Northern Rockies Conservation Cooperative, Box 2705, Jackson, WY 83001. 52 pp.
- Scott, J. M., B. Csuti, K. Smith, J. E. Estes, and S. Caicco. 1988. Beyond endangered species: an integrated conservation strategy for the preservation of biological diversity. *Endangered Species Update* 5(10): 43-48.

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Figure 2. The Greater Yellowstone Ecosystem.

VASCULAR PLANTS

Introduction

Since the establishment of Yellowstone National Park in 1872, a number of studies on the vegetation of the Yellowstone region have been undertaken, starting with the Hayden and Jones surveys in the 1870s. Still, after over 100 years, parts of this area are completely unknown, botanically speaking. Large gaps exist in our knowledge of the Greater Yellowstone Ecosystem's flora. For example, one of the most significant bogs in the region in terms of phytogeography was not discovered by botanists until 1984. Five new species of vascular plants have been described from the GYE since 1982 and several more have been discovered but not yet described. This number of new species from such a small area is unheard of nowadays in North America.

Rare plant species are an important component of the GYE's flora. About 1700 species of vascular plants are known to occur in the Greater Yellowstone Ecosystem. The list of species that are rare amounts to 124, or about 7% of the total known vascular flora of the GYE. The disjunct boreal relics of the Beartooth Plateau, the endemic species of the Absaroka Mountains, and the rare plants restricted to thermal areas are good examples of significant components. In many cases, the basic ecological information that is needed to ensure these species' survival is lacking. How does grazing affect habitats which contain boreal relics? How will geothermal exploration and development affect Ross bentgrass (*Agrostis rossiae*), known only from a small area around Old Faithful, or *Eleocharis flavescens*, a species common in subtropical areas which has evolved a distinct variety in the Yellowstone area?

The Greater Yellowstone Ecosystem is the largest ecosystem left in the region which has been altered only to a moderate extent. An understanding of this ecosystem will help us to understand other ecosystems in the region which have been altered drastically from their pre-settlement conditions. Many questions about the Greater Yellowstone Ecosystem and its functions and processes remain to be answered. How does the pine bark beetle fit into the ecosystem? Why doesn't western tamarack extend farther south or blue spruce extend farther north? Why did the moose not enter the area until about 1870? Why is there a small California vegetation element in the ecosystem? Why is Great Basin vegetation "stranded" around Mammoth? Many more such questions could be asked. None have been satisfactorily answered because the broad historical picture is still not completely understood.

Much of the vegetation that shows us this history grows in fragile habitats which can easily be destroyed. For example, the phytogeographically significant bog that was discovered in 1984 contains a large number of disjunct boreal species. The bog had been altered in the past by the Forest Service for the purpose of "habitat improvement." The number of species that were eliminated from the area as a result of this "improvement" is unknown. How many other situations of alteration through ignorance have taken place? How do we prevent such alteration in the future?

Solution of many management problems in the GYE entails some form of regional management rather than independent management of individual parks or forests. This is sometimes done with animals but plants have been largely ignored. An area cannot be intelligently managed unless there is a thorough inventory of what is to be managed. An inventory should include not only vegetation, but geology, soils, and fauna as well. A first step in this direction should be a compilation of known information on vegetation of the Greater Yellowstone Ecosystem, particularly that vegetation which needs special management. Later studies should concentrate on the most critical vegetation, and intensive inventories should be undertaken to discover other significant vegetation in the ecosystem.

The rare plants of the GYE are divided into two groups in this document. Table 1 is a list of all the rare plants known to occur in the Greater Yellowstone Ecosystem. Eleven species that are especially significant

have detailed write-ups. Many more could have been included in this category had space allowed. The Natural Heritage ranking system of The Nature Conservancy has been used to provide a general guide to the relative significance of each of these species. Ranks are assigned to species of concern based on their rarity and degree of endangerment. The rank consists of two parts: a global (G) rank and a state (S) rank. Values range from 1 (most rare or threatened) to 5 (common and no threats). Other symbols used in the ranking include:

- T - subspecific or varietal rank (added to global rank of the full species),
- U - status in state unknown,
- H - taxon documented in state by historical record(s) only.

The following are examples of Heritage ranks for Wyoming plants:

- Big sagebrush, G5S5 = common globally and in Wyoming,
- Pinyon pine, G5S2 = common globally but rare in Wyoming,
- Uinta greenthread, G1S1 = rare globally and in Wyoming.

Federal Status categories are as follows:

C1 - taxa for which the U.S. Fish and Wildlife Service currently has on file substantial information on biological vulnerability and threats to support the appropriateness of proposing to list them as endangered or threatened species,

C2 - taxa for which information now in possession of the U. S. Fish & Wildlife Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threat(s) are not currently known or on file to support the immediate preparation of rules,

3C - taxa that have proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat.

Table 1 also shows which of the rare plant species in the GYE are listed as sensitive species by the Northern Region (R1) and the Intermountain Region (R4) of the U.S. Forest Service. The Northern Region lists sensitive plants by state, which are indicated in the table. The Rocky Mountain Region (R2) does not yet have a formal sensitive plant species list.

I thank the state Heritage program botanists for providing Heritage ranks for the species of concern: Steve Caicco and Robert Moseley of Idaho, Steve Shelly of Montana, and Hollis Marriott of Wyoming. Hollis also provided detailed write-ups for six of the rare species and assisted with computer conversions.

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Tweedy's Sand Verbena
Abronia aminophila Greene

DESCRIPTION: Sprawling perennial with stems to 30 cm long; leaves opposite, petioles mostly as long as or longer than blades, blades 2-35 mm long, entire; involucral bracts 3-5 mm long; calyx of 5 united white sepals (salverform), about 10 mm long; corolla none; fruit ribbed; flowers in late July and early August.

RANGE: Shore of Yellowstone Lake and one other location in Sublette County, Wyoming.

HABITAT: Sandy places with cool night-time temperatures at 7400-7700 ft (2250-2350 m).

CONSERVATION NEEDS: This species is known from only two locations. Because both populations are very small, it probably should be a candidate for threatened status. It needs additional study to learn more about its habitat requirements and basic biology.

NOTES: In the past, there was some question on the validity of this species, but now it appears to be a valid entity. The characteristics used by Galloway to distinguish it are not adequate, however.

REFERENCES:

Galloway, L. A. 1975. Systematics of the North American desert species of *Abronia* and *Tripterocalyx* (Nyctaginaceae). *Brittonia* 27:328-347.

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Ross Bentgrass
Agrostis rossiae Vasey

DESCRIPTION: Annual grass, branched at base, to 2 dm high; leaf blades mostly toward base of plant, 1-2.5 cm long, 0.5-2 mm wide, the sheaths somewhat inflated; panicle usually contracted, 2-6 cm long, the branches scabrous, purplish, and spikelet-bearing mostly above middle, with some short and some long branches at lowest node; spikelets 2-2.5 mm long; lemma about 1.5 mm long, awnless; palea minute; flowers April to June.

RANGE: Upper Geyser Basin in Yellowstone National Park.

HABITAT: Marl around hot springs and geysers at about 7400 ft (2250 m).

CONSERVATION NEEDS: This species is subject to wide fluctuations in population size due to changing thermal activity. Because the population size is very low, any human activities that might affect its habitat could easily result in its extinction. Threatening activities include development of visitor facilities such as boardwalks, roads, and trails, and thermal energy research outside the Park. An active monitoring program for the population is needed, especially to determine what specific factors cause the population size to fluctuate so widely. Grazing and trampling by large ungulates should also not be overlooked.

NOTES: Although listed only as a Category 2 plant by the U. S. Fish and Wildlife Service, this species is probably the most vulnerable to extinction in Wyoming at the present time.

REFERENCES:

- Dorn, R. D. & J. L. Dorn. 1980. Illustrated guide to special interest vascular plants of Wyoming. U. S. Fish & Wildlife Service & U. S. Bureau of Land Management. 67 pp.
Swallen, J. R. 1948. *Agrostis variabilis* Rydb. a valid species. Leaflet. W. Bot. 5:123-124.

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Bog Bearberry
Arctous rubra (Rehd. & Wils.) Nakai

DESCRIPTION: Trailing shrub; branchlets glabrous; leaves alternate, petioled, deciduous, oblanceolate to obovate, 1-4.5 cm long, crenate-serrate, veiny; flowers 2 or 3 from terminal buds, appearing with the new leaves; corolla urn-shaped, greenish-white, about 5 mm long; ovary superior; berry red and juicy; flowers in June and July.

RANGE: Clark's Fork Valley, Park County, Wyoming; also known from Alaska, Canada, and Asia.

HABITAT: Calcareous bog at about 6600 ft (2010 m).

CONSERVATION NEEDS: The Wyoming occurrence is the only one known in the contiguous 48 states. The bog it occurs in is extremely significant in that it also contains a large number of disjunct boreal species. Some of these are: *Primula egaliksensis*, *Salix myrtillofolia* (only known location in 48 contiguous states), *Scirpus punilus*, *Carex livida*, *Carex scirpoidea* var. *scirpiformis*, *Carex microglochin*, *Carex limosa*, *Kobresia simpliciuscula*, *Eriophorum viridicarinarum*, and *Orchis rotundifolia*. The bog has been disturbed by humans in the past. Future disturbance should not be allowed. The importance of this bog cannot be overemphasized, despite past disturbances. A thorough evaluation is needed for this site along with the development of specific management plans to prevent further degradation.

NOTES: The Forest Service was responsible for past disturbance of this site which should have been recognized as unique. The site was not irreparably damaged, however, so future management should actively seek to right the past mistakes.

REFERENCES:

- Collins, E. I., ed. 1985. Wyoming natural areas needs workshop proceedings. The Nature Conservancy, Arlington, VA. 166 pp.
- Evert, E. F. 1985. Some notable collections for 1984. Wyoming Native Plant Society Newsletter 4(3):4.
- Evert, E. F., R. D. Dorn, R. L. Hartman, & R. W. Lichvar. 1986. Noteworthy collections. Madrono 33:313-315.

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Shultz's Milkvetch
Astragalus shultziorum Barneby

DESCRIPTION: Dwarf perennial herb, prostrate or nearly so; stems slender, diffuse, of subterranean origin, sometimes rooting adventitiously; leaf-bearing stems to 7 cm long; stems and leaves with fine inconspicuous hairs; leaves pinnately compound with 9-15 leaflets; stipules connate; flower stalks initially ascending slightly, but generally becoming prostrate with maturity; flowers (1) 2-3 (5), 11-12 mm long, white-cream, often with lavender striations; legumes sessile, unilocular, bluntly trigonous (triangular in cross-section), with a conspicuous attenuate beak, 10-12 mm long.

RANGE: WYOMING: Lincoln Co., Salt River Range southeast of Afton; Teton Co., southern half Teton Range.

HABITAT: Rocky calcareous sites (not on bare rock however), 9300-10500 ft (2835-3200 m).

CONSERVATION NEEDS: Additional survey directed at Shultz's milkvetch is needed to determine whether or not the species is sufficiently rare and/or threatened to be considered Sensitive. At this time, the species appears to be common where it occurs, but of restricted distribution. Survey of potential habitat in the Teton, Salt River and Wyoming Ranges may show that the species is widespread enough that special management is not needed. Of concern is the fact that reproduction in populations in the Salt River Range appears to be significantly lower (as evidenced by flower/fruit production) than in the Teton Range.

NOTES: Questions have been raised concerning the taxonomic status of *Astragalus shultziorum*--in particular, its relationship to *A. molybdenus*. The latter species also has a restricted distribution (central Colorado, one site in northwest Montana), and appears to prefer calcareous habitats. The two taxa have been separated based mainly on fruit morphology and ovule number. However, opinions thus far have been based on relatively little reproductive material, and additional study is needed.

Astragalus shultziorum is a Category 2 candidate for Federal listing.

REFERENCES:

- Barneby, R. C. 1981. A new alpine *Astragalus* (Leguminosae) from western Wyoming. *Brittonia* 33:156-158.
- Isely, D. 1986. Leguminosae of the United States. *Astragalus* L. IV. Species Summary F-M. *Iowa State J. of Research* 61:239.

AUTHOR: Hollis Marriott, Wyoming Natural Diversity Database, The Nature Conservancy, 3165 University Station, Laramie, WY 82071.

Yellow Springbeauty

Claytonia lanceolata Pursh var. *flava* (A. Nels.) C. L. Hitchc.

DESCRIPTION: Perennial herb from fleshy corm to 2 cm in diameter; stems and leaves somewhat succulent; basal leaves narrowly oblanceolate, 5-15 mm wide, to 15 cm long; stems 1-5 from each corm, 7-25 cm long; stems leaves 2, narrowly lanceolate, 2-7 cm long; racemes with 3-12 flowers; flowers deep yellow or white (see **NOTES** below), about 1-1.5 cm across; flowers May-June (July in heavy snow years).

RANGE: WYOMING: Fremont Co., southern Absaroka Mountains northeast of Dubois. MONTANA: Deer Lodge Co., southwest of Anaconda; Jefferson Co., southeast of Deer Lodge; Beaverhead Co., Pioneer Mountains; Gallatin Co., Hebgen Lake; Silver Bow Co., Highland Mountains. IDAHO: Fremont Co., Henry's Lake.

HABITAT: Moist mountain meadows, 5500-10,000 ft (1675-3050 m).

CONSERVATION NEEDS: The yellow springbeauty is known only from seven widely scattered sites. One of these sites, at Henry's Lake, Idaho, is being destroyed by construction of a housing subdivision begun in 1988. Because of the very limited range of the taxon, disturbance could significantly impact its global population. *Claytonia lanceolata* var. *flava* should be designated Sensitive by Region 2 of the US Forest Service (it is currently listed as Sensitive in Regions 1 and 4). Surveys are needed to map site boundaries, and site data should be incorporated into agency planning to act as flags in screening potential projects. Monitoring programs should be established to track population trends, and to alert managing agencies to problems. The type locality at Henry's Lake is the least viable of all known populations and it is not expected to persist at the site. The downward trend in this population probably began in 1923 when a dam was constructed on Henry's Lake, flooding considerable amounts of lakeshore habitat. Ongoing development of the remaining habitat will probably cause the extirpation of *Claytonia lanceolata* var. *flava* in Idaho. This site should be targeted by appropriate conservation groups for protection (possibly including transplanting).

NOTES: Populations of *Claytonia lanceolata* var. *flava* often include white-flowered individuals that are very similar to the yellow-flowered plants, aside from flower color. Chromosome counts for individuals of the two color forms at the Wyoming site show them to both be diploids. Electrophoretic analysis shows no detectable differences between the two forms, and only slight differences among populations. In addition, the var. *flava* populations appear to be quite different from the common, widespread white-flowered springbeauty, electrophoretically and in vegetative morphology.

Claytonia lanceolata var. *flava* is currently a Category 2 candidate for Federal listing. Status surveys have been completed for all known populations of *C. lanceolata* var. *flava* in Idaho, Montana, and Wyoming. The Wyoming Natural Diversity Database has recommended maintaining C2 status until more information is available concerning taxonomy.

REFERENCES:

- Davis, R. J. 1966. The North American perennial species of *Claytonia*. Brittonia 18:285-303.
- Hitchcock, C. L. 1964. pp. 229-230 in C. L. Hitchcock et al., Vascular Plants of the Pacific Northwest. Part 2. Seattle: Univ. of Washington Press.
- Marriott, H. J. 1986. Status report for *Claytonia lanceolata* var. *flava*. Prepared for the U.S. Fish and Wildlife Service, Helena, MT, by The Nature Conservancy.
- Moseley, R. K. 1989. Report on the conservation status of *Claytonia lanceolata* var. *flava* in Idaho. Status report prepared by the Idaho Natural Heritage Program for the U.S. Fish and Wildlife Service, Region 1, Boise, ID. 20 pp. plus appendices.
- Nelson, A. 1900. New plants from Wyoming. Bull. Torrey Club 27:258-274.
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Shelly, J. S. 1989b. Update to the report on the conservation status of *Claytonia lanceolata* var. *flava*, a candidate threatened taxon. Unpublished report on file at Montana Natural Heritage Program, Helena, MT. 39 pp.

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Wyoming Tansymustard
Descurainia torulosa Rollins

DESCRIPTION: Biennial, or possibly short-lived perennial herb, to 15 cm tall, with well-developed taproot; finely hairy throughout with minute branched hairs; stems several to numerous, procumbent (growing close to ground at base); leaves mostly basal, pinnately lobed (primary lobes simple or with a few subsidiary lobes), to 3 cm long; stem leaves few, similar to basal leaves; flowers minute, with whitish petals to 1.5 mm long; fruiting pedicels erect, appressed to rachis; siliques erect, appressed to rachis, curved outward or nearly straight, linear, torulose (constricted slightly between seeds), 8-12(15) mm long, ca. 1 mm in diameter; flowers and fruits July-August (?).

RANGE: WYOMING: Fremont Co., Absaroka Mountains; Sweetwater Co., Pine Butte southeast of Rock Springs.

HABITAT: Absaroka Mountains: volcanic scree and talus at base of cliffs, 10,000-11,400 ft (3050-3475 m); Pine Butte: sandstone talus at base of north-facing cliffs, 8300 ft (2530 m).

CONSERVATION NEEDS: For *Descurainia torulosa*, the greatest conservation need is information. No studies directed at the species have been done, and little is known about its biology and potential threats. It is small, inconspicuous, and grows on relatively inaccessible sites; thorough inventory may show the tansymustard to be more common. If the species is rare, Sensitive designation may be warranted, and site data should be incorporated into agency planning to act as flags in screening potential projects. In addition, a monitoring program should be established to track population trends, and to alert managers to problems.

NOTES: *Descurainia torulosa* is a Category 2 candidate for Federal listing. Region 4 of the U.S. Forest Service lists it as Sensitive.

REFERENCES:

Rollins, R. C. 1983. Studies in the Cruciferae of western North America. J. Arnold Arbor. 64:499-500.

AUTHOR: Hollis Marriott, Wyoming Natural Diversity Database, The Nature Conservancy, 3165 University Station, Laramie, WY 82071.

Comb-hair Draba
Draba pectinipila Rollins

DESCRIPTION: Caespitose perennial herb to 15 cm high; leaves mostly basal, the blades linear to linear-oblongate, 3-12 mm long, 0.7-1.5 mm wide, pubescent with doubly pectinate hairs, petioles ciliate with simple or forked hairs; scapes with doubly pectinate hairs; pedicels pubescent; sepals 2-3.5 mm long; petals yellow, mostly 3-5 mm long; fruits oblong-oblongate to lanceolate, 5-8 mm long, flattened parallel to septum, with doubly pectinate hairs on valve surfaces; styles 0.3-0.7 mm long; seeds 3-5 per locule; flowers in July and August.

RANGE: WYOMING: Clay and Beartooth Buttes, Park County; also known from Colorado and British Columbia.

HABITAT: Rocky alpine slopes and cliffs of limestone at 9800-10000 ft (2990-3050 m).

CONSERVATION NEEDS: The species is quite rare, but because of its habitat, is under no immediate threats. With it are a number of rare species such as *Draba porsildii*, *Parrya nudicaulis*, and *Erigeron humilis*. This is the only alpine limestone on the Beartooth Plateau and the reason for these plants being here. The entire limestone area of Clay and Beartooth Buttes should be preserved as an ecosystem with important biogeographical characteristics.

NOTES: Developments such as roads and trails should be avoided on the two buttes except around the existing fire lookout and existing road.

REFERENCES:

- Collins, E. I., ed. 1985. Wyoming natural areas needs workshop proceedings. The Nature Conservancy, Arlington, VA. 166 pp.
- Dorn, R. D. 1978. A new species of *Draba* (Cruciferae) from Wyoming and Utah. Madrono 25:101-103.
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- Rollins, R. C. 1953. *Draba* on Clay Butte, Wyoming. Rhodora 55:229-235.

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North Fork Lomatium
Lomatium attenuatum Evert

DESCRIPTION: Perennial herb to 25 cm tall, with a long, thick taproot; leaves few, green, ovate in outline, 2-11 cm long and 1.5-10 cm wide, finely divided into linear or oblanceolate segments; flower/fruit stalks 1-3 (4), elongating and exceeding the leaves in fruit; involucre generally absent, involucre absent or more often of 1-6 linear-lanceolate inconspicuous bractlets; flowers yellow, minute, in a relatively tight umbel; in fruit, as the rays elongate and less than half the ovaries mature, the umbel appears much larger and open; fruit glossy, 5-8 mm long, 3-5 mm wide, with wings to 0.75 mm wide. *Lomatium attenuatum* can be most easily distinguished from *Cymopterus terebinthinus*, with which it sometimes grows, by the celery odor of the crushed leaves (leaves of the cymopterus smell of anise). It can be separated from *Lomatium cous* most easily by the shape of the bractlets in the involucre. In *L. cous*, the bractlets are broad and rounded, and often connected in part. Flowers and fruits mid-May through mid-July.

RANGE: WYOMING: Park Co., Absaroka Mountains, North Fork Shoshone River drainage.

HABITAT: Level to steeply sloping sites on sparsely-vegetated volcanic soil, and occasionally limestone; 5200-10500 ft (1585-3200 m).

CONSERVATION NEEDS: The North Fork lomatium is common within its limited range, and no threats are known at this time.

NOTES: *Lomatium attenuatum* is a Category 2 candidate for Federal listing.

REFERENCES:

Evert, E. F. 1983. A new species of *Lomatium* (Umbelliferae) from Wyoming. Madrono 30:143-146.
Marriott, H. J. 1988. (Unpublished) Sensitive plant species survey, Shoshone National Forest. Summary report. Prepared for Shoshone NF, Cody, WY.

AUTHOR: Hollis Marriott, Wyoming Natural Diversity Database, The Nature Conservancy, 3165 University Station, Laramie, WY 82071.

Absaroka Beardtongue
Penstemon absarokensis Evert

DESCRIPTION: Perennial herb from a ropy underground caudex with numerous fibrous roots; stems several, to 18 cm tall; leaves entire, somewhat succulent, narrowly to broadly ovate, 2.5-7(9) cm long, 7-20(25) mm wide, slightly glossy, often purple when young; inflorescence leafy, somewhat one-sided, with 2-8 flowers; flowers with purplish-blue tubes and bright blue mouths; sepals with prominently erose (ragged) margins and elongated tips exceeding the basal portions in length. The relatively broad, succulent leaves and distinctive sepals are most useful for separating the Absaroka beardtongue from the other members of the genus with which it occurs. Flowers mid-May through mid-July.

RANGE: WYOMING: Park Co., Absaroka Mountains, drainages of North and South Forks Shoshone River; Fremont Co., northwest Wind River Basin.

HABITAT: Level to steeply-sloping sites on very sparsely vegetated volcanic soil; occasionally on river gravels; 6300-10000 ft (1920-3050 m).

CONSERVATION NEEDS: *Penstemon absarokensis* is common within its limited range, and no threats are known at this time. Additional populations may be discovered within or near the known range of the species in the South Fork drainage. No populations have been found north of the North Fork drainage, nor south of the South Fork drainage.

NOTES: *Penstemon absarokensis* is a Category 2 candidate for Federal listing.

REFERENCES:

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- Marriott, H. J. 1988. (Unpublished) Sensitive plant species survey, Shoshone National Forest. Summary report. Prepared for Shoshone NF, Cody, WY.

AUTHOR: Hollis Marriott, Wyoming Natural Diversity Database, The Nature Conservancy, 3165 University Station, Laramie, WY 82071.

Icegrass

Phippsia algida (Phipps) R. Br.

DESCRIPTION: Densely tufted perennial grass, 10 cm or less high; leaf blades 1-2.5 mm wide; spikelets in a narrow panicle, 1 flowered; glumes unequal, minute; lemma about 1.5 mm long, 3 nerved; palea slightly shorter than lemma; flowers July and August.

RANGE: WYOMING: Park County, Beartooth Plateau; Fremont County, Wind River Mountains;
MONTANA: Carbon County, Beartooth Plateau; also known from Colorado, Alaska, Canada, and Asia.

HABITAT: Wet alpine gravel below melting snowfields at 9800-10800 ft (2990-3290 m).

CONSERVATION NEEDS: This species is one member of an unusual ecosystem that contains a number of disjunct boreal species including *Koenigia islandica*, *Juncus triglumis*, *Kobresia macrocarpa*, and *Salix barrattiana*. The area needs to be managed to exclude livestock grazing and off-road vehicle use so that the ecosystem is not irreparably damaged. A complete inventory and establishment of boundary lines is the primary need at present.

NOTES: An old jeep trail passes through the area which still may be open to public travel. The trail itself is not a threat but people tend to stray from the trail, especially under wet conditions.

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Shoshonea
Shoshonea pulvinata Evert

DESCRIPTION: Low mat-forming perennial herb, 2-8 cm tall; mats to 45 cm across, rich green; leaves 5-25 mm long, 3-20 mm wide, pinnately divided with 2-5 pairs of leaflets; flowers minute, yellow, in compact umbels 0.75-1.5 cm wide (enlarging in fruit); fruit oblong, sometimes slightly compressed, 2-4 mm long, 1.5-3 mm wide, with somewhat prominent ribs; flowers mid May-mid July. The leaves and distinctive green mats of shoshonea are recognizable throughout the growing season.

RANGE: WYOMING: Park Co., east flank Absaroka Mountains west and northwest of Cody; Fremont Co., Owl Creek Mountains. MONTANA: Carbon Co., Pryor Mountains, east flank Beartooth Mountains.

HABITAT: Level to gently-sloping sites on calcareous rocky soils and outcrops, with other low forbs, vegetation generally quite sparse; 5800-9000 ft (1770-2740 m).

CONSERVATION NEEDS: No threats to the species are presently known. The shoshonea grows in abundance on relatively inaccessible, harsh sites. Its worldwide distribution, however, appears to be sufficiently limited that protection of populations should be taken into consideration should development be proposed in areas of shoshonea habitat. Additional survey is needed in the Owl Creek Mountains (BLM and Wind River Reservation lands).

NOTES: *Shoshonea pulvinata* is a Category 2 candidate for Federal listing. The Montana Natural Heritage Program and the Wyoming Natural Diversity Database have recommended maintaining C2 status until rangewide surveys are completed.

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TABLE 1. RARE PLANTS KNOWN TO OCCUR IN THE GREATER YELLOWSTONE ECOSYSTEM

Taxon	Federal Status	USFS Regional Lists	The Nature Conservancy Heritage Program Rank			
			Global	Idaho	Montana	Wyoming
<i>Abies concolor</i>			G5			S1
<i>Abronia ammophila</i>			G1			S1
<i>Adiantum pedatum</i>			G5	S5		S1
<i>Agoseris "lackschewitzii"</i>			G2	S2	S1	
<i>Agrostis rossiae</i>	C2		G1			S1
<i>Antennaria aromatica</i>	C2		G3G4		S3	S2
<i>Antennaria flagellaris</i>			G4	S4		S2
<i>Arctous rubra</i>			G4G5			S1
<i>Arenaria stricta</i> var. <i>dawsonensis</i>			G5			S1
<i>Astragalus ceramicus</i> var. <i>apus</i>			G4T3	S3	S1	
<i>Astragalus gilviflorus</i>			G4	S1		
<i>Astragalus paysonii</i>	3C	R1 (ID)	G3	S1		S2
<i>Astragalus shultziorum</i> (<i>molybdenus</i>)	C2		G1			S1
<i>Astragalus terminalis</i>			G3G4	S?	S2	S1
<i>Botrychium ascendens</i>			G?			S1
<i>Botrychium lanceolatum</i>			G5			S1
<i>Botrychium lunaria</i> var. <i>onondagense</i>			G5T3	S1		S1
<i>Botrychium simplex</i> var. <i>compositum</i>			G5T?			S1
<i>Calamagrostis koelerioides</i>			G5			S1
<i>Carex buxbaumii</i>			G5	S1?		
<i>Carex capitata</i>			G5			S1
<i>Carex concinna</i>			G4G5			S1
<i>Carex cusickii</i>			G?	S5		S1
<i>Carex parryana</i> ssp. <i>idaho</i>	3C	R1 (MT)	G2	S1?	S1	
<i>Carex incurviformis</i>			G?		S1	S2
<i>Carex leptalea</i>			G5			S2
<i>Carex limosa</i>			G5	S3		S1
<i>Carex livida</i>		R1 (MT)	G5	S1	S1	S1
<i>Carex multicosata</i>			G5	S4	S1	
<i>Carex occidentalis</i>			G4		SU	S1
<i>Carex scirpoidea</i> var. <i>scirpiformis</i>			G5T5			S1
<i>Carex subnigricans</i>			G?	S4		S1
<i>Castilleja exilis</i>			G5		SU	S1
<i>Castilleja pulchella</i>			G3?	S1		
<i>Chrysothamnus parryi</i> ssp. <i>montanus</i>			G5T1	S1		
<i>Cirsium foliosum</i>			G5			S1
<i>Claytonia lanceolata</i> var. <i>flava</i>	C2	R1 (MT) R4	G5T1	S1	S1	S1
<i>Collomia debilis</i> var. <i>debilis</i>			G4T?			S2
<i>Collomia tenella</i>			G4?			S1
<i>Cryptogramma stelleri</i>			G5			S1
<i>Cymopterus evertii</i>	C2		G3			S3
<i>Descurainia torulosa</i>	C2	R4	G1			S1

Taxon	Federal Status	USFS Regional Lists	The Nature Conservancy Heritage Program Rank			
			Global	Idaho	Montana	Wyoming
<i>Draba borealis</i>			G4			S1
<i>Draba crassa</i>			G?			S1
<i>Draba glabella</i>			G4G5			S1
<i>Draba pectinipila</i>	3C		G1			S1
<i>Draba porsildii</i>	3C		G3		S1	S1
<i>Elymus flavescens</i>			G4G5	S4	S1	
<i>Epipactis gigantea</i>		R1 (MT)	G5	S2	S1	S1
<i>Erigeron coulteri</i>			G5			?
<i>Erigeron flabellifolius</i>			G3G4		S2	S2
<i>Eriophorum scheuchzeri</i>			G5			S1
<i>Gayophytum humile</i>			G?			S1
<i>Gentianella propinqua</i>			G4	S1		
<i>Haplopappus carthamoides</i> var. <i>subsquarrosus</i>			G?T1			S1
<i>Hesperochiron pumilus</i>			G?			S2
<i>Heterocodon rariflorum</i>			G5		S1	S1
<i>Hieracium scouleri</i>			G4G5			S1
<i>Horkelia fusca</i>			G?			S1
<i>Isoetes occidentalis</i>			G?			S1
<i>Juncus filiformis</i>			G5			S1
<i>Juncus triglumis</i>			G5		S2	
<i>Juncus vaseyi</i>			G5			S1
<i>Kelloggia galioides</i>			G5		S1	S1
<i>Kobresia macrocarpa</i>		R1 (MT)	G5		S1	S2
<i>Kobresia simpliciuscula</i>			G5	SH	S1	S1
<i>Koenigia islandica</i>			G4		S2	S1
<i>Lemna valdiviana</i>			G5			S1
<i>Lesquerella carinata</i>	3C	R1 (MT)	G4	S4	S1	S1
<i>Lesquerella fremontii</i>	3C		G2			S2
<i>Lesquerella multiceps</i>			G?			S1
<i>Lesquerella paysonii</i>			G4	S1		
<i>Lomatium attenuatum</i>	C2		G3			S3
<i>Lonicera caerulea</i>			G?			S1
<i>Lysichiton americanus</i>			G5	S5	S5	S1
<i>Monardella odoratissima</i>			G4G5			S1
<i>Myriophyllum quitense</i>			G?			S1
<i>Myriophyllum verticillatum</i>			G5			S1
<i>Najas guadalupensis</i>			G5		S1	S1
<i>Ophioglossum vulgatum</i>			G5		S1	S1
<i>Orchis rotundifolia</i>		R1 (MT)	G5		S2	S1
<i>Oxalis violacea</i>			G5?			S1
<i>Paeonia brownii</i>			G5	S5		S1
<i>Parrya nudicaulis</i>			G2G4			S1
<i>Pellaea glabella</i>			G5			S1
<i>Penstemon absarokensis</i>	C2		G3			S3
<i>Perideridia bolanderi</i>			G5			S1
<i>Phippsia algida</i>			G4		S1	S1
<i>Polemonium foliosissimum</i> var. <i>alpinum</i>			G5T5			S1
<i>Polygala verticillata</i>			G5			S1
<i>Polystichum scopulinum</i>			G5	S4	S1	S1
<i>Porterella carnosula</i>			G?			S2
<i>Potamogeton obtusifolius</i>		R1 (MT)	G5		S1S2	S1
<i>Potentilla uniflora</i>			G?		S1	S1

Taxon	Federal Status	USFS Regional Lists	The Nature Conservancy Heritage Program Rank			
			Global	Idaho	Montana	Wyoming
<i>Primula alcalina</i>	C2	R4	G2	S1	SU	
<i>Primula egalikensis</i>			G?			S1
<i>Puccinellia fernaldii</i>			G?			S1
<i>Ranunculus flabellaris</i>			G5			S1
<i>Ranunculus gelidus</i>			G4		S1	
<i>Ranunculus occidentalis</i> var. <i>dissectus</i>			G5T?			S1
<i>Rubus acaulis</i>			G5			S1
<i>Salix barrattiana</i>		R1 (MT)	G5		S1	S1
<i>Salix glauca</i>			G4	S1		
<i>Salix monochroma</i>			G?			S1
<i>Salix myrtillofolia</i>			G?			S1
<i>Sanicula graveolens</i>			G4			S1
<i>Saxifraga cernua</i>			G4	S2		
<i>Saxifraga serpyllifolia</i> var. <i>chrysantha</i>			G?		S1	S1
<i>Scirpus pumilus</i>			G?			S1
<i>Scolochloa festucacea</i>			G5			S1
<i>Selaginella selaginoides</i>			G5		S1	S1
<i>Senecio atratus</i>			G?			S2
<i>Senecio fuscatus</i>			G4		S2	S2
<i>Shoshonea pulvinata</i>	C2	R1 (MT)	G2G3		S1	S2
<i>Spirodela polyrhiza</i>			G5			S1
<i>Stipa webberi</i>			G4	S2		
<i>Telesonix heucheriformis</i>			G4	S1		
<i>Tillaea aquatica</i>			G5			S1
<i>Townsendia condensata</i> var. <i>condensata</i>			G5T5	S5	S1	S2
<i>Townsendia condensata</i> var. <i>anomala</i>			G5T1			S1
<i>Townsendia florifer</i>			G4G5	S5	S1	S1
<i>Townsendia leptotes</i>			G4	S4	SU	S1
<i>Trautvetteria caroliniensis</i>			G4G5	S5		S1
<i>Viola renifolia</i>		R1 (MT)	G5		S1	S1

INVERTEBRATES

Introduction

A complete census of invertebrate species in the Greater Yellowstone Ecosystem does not exist. The number can only be estimated until more faunal studies have been conducted, but it is probably in the tens of thousands. Every rigorous collection of an invertebrate group turns up new species and even new genera. Because of this, it is impossible to say what species of invertebrates are most threatened or endangered in the GYE.

Arthropoda is by far the largest invertebrate phylum in the Greater Yellowstone Ecosystem. The largest arthropod class, Insecta, is dominated by four orders: Coleoptera (beetles), Diptera (flies), Hymenoptera (ants, wasps, and bees), and Lepidoptera (butterflies, skippers, and moths). These orders contain 90-95% of an estimated 12,000 insect species found in the GYE. The remaining 5% of the insect species in the GYE are distributed among 19-23 other orders. The following two sections provide an overview of the GYE's mayflies (Ephemeroptera), a small insect order that is relatively poorly known, and butterflies, a small Lepidopteran superfamily, which is probably the best studied insect group in the GYE. These accounts, which cover only a tiny fraction of the GYE's insects, illustrate the diversity of invertebrate life found in the ecosystem. Other arthropod classes in the GYE include Crustacea (copepods, freshwater shrimp, and pill bugs), Myriapoda (millipedes and centipedes), and Arachnida (scorpions, pseudoscorpions, daddy longlegs, ticks, mites, and spiders).

There are probably a few dozen species each of Annelida (segmented worms) and Mollusca (snails, slugs, bivalves) in the GYE. These two phyla are better represented in marine environments than in terrestrial or fresh water environments. Other invertebrate phyla represented in the GYE include Porifera (sponges), Coelenterata (hydras), Platyhelminthes (flatworms), Nemertinea (ribbonworms), Nematoda (roundworms), Nematomorpha (horsehair worms), Rotifera (rotifers), Gastrotricha, Bryozoa, and Tardigrada (water bears). Some of these phyla, such as the Nematoda, may comprise thousands of species in the GYE, while others are represented by only a few species. None have been comprehensively studied.

Invertebrates are overlooked and understudied in part because of their small size. Many are more secretive than vertebrates and many are ephemeral--adults may live only a few days. In many groups, juveniles differ in form from adults and cannot be identified to species. Even adults of many species cannot be readily identified because invertebrate taxonomy is one or even two centuries behind vertebrate taxonomy. But despite the relative lack of scientific attention that they have received, invertebrates play an indispensable ecological role in the GYE.

Invertebrates are important links in aquatic and terrestrial food webs. They also play a critical role in recycling of organic compounds. Bacteria are the ultimate decomposers, breaking up complex organic molecules into smaller ones which are the required nutrients of living organisms. But bacteria alone cannot decompose plant and animal bodies without the activity of insects, which mine and tunnel dead plant and animal remains. The interactions of invertebrates, bacteria, and soil microflora release nutrients from organic material to replenish the soil. Soil invertebrates such as earthworms also help to aerate the soil by burrowing through it.

Invertebrates can be extremely sensitive indicators of environmental change. For example, many aquatic insect species are very sensitive to changes in water temperature, pH, salinity, oxygen content, or pollutants. The presence or absence of certain species of mayflies, caddisflies, stoneflies, or midges has often been used to indicate water quality. As a result of their small size, invertebrates can take advantage of a vast diversity of microhabitats. Invertebrates fill countless highly specialized ecological niches. Because of their habitat specificity, habitat modification can have dramatic effects on invertebrate diversity and abundance. Almost all documented instances of extinction of invertebrate species have been due to elimination of their habitat by human activity.

An enormous amount of taxonomic and ecological research remains to be done on the invertebrate fauna of the GYE. Habitat modification may be affecting species that have not even been discovered yet. Preserving intact ecosystems is the most effective means of ensuring that invertebrate diversity is not inadvertently lost.

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Ephemeroptera

INTRODUCTION: The Ephemeroptera or mayflies constitute a small order of insects with aquatic nymphs and short-lived terrestrial adults. The adults have non-folding wings, a feature shared among living insects only with the order Odonata (dragonflies and damselflies). Mayflies are unique in having two winged stages, the sexually immature subimago (or dun) and the sexually mature imago (or spinner).

Mayfly communities in the Greater Yellowstone Ecosystem are generally composed of relatively few species when compared to stoneflies, caddisflies and aquatic true flies. Many mayfly species are very abundant insects and they form important links in aquatic food webs. Most species are primary consumers feeding directly on accumulated organic detritus or on algae. Mayflies occur in all types of water from large lakes and rivers to small, even temporary ponds and streams. Many species are very sensitive to pollution and are quickly lost from impacted lakes and streams. Mayflies are extremely fragile insects and relatively difficult to identify to species. They are not a favorite among collectors and are rather poorly known. Detailed studies frequently describe new species.

CONSERVATION NEEDS: While mayflies are relatively poor colonizers compared to other winged insects, they have high fecundity and may be expected to recolonize areas of temporary and local disturbance. Long-term and global threats such as climate modification, acid rain and pesticide accumulation are likely to have more serious effects on mayflies.

Species favoring ponds and headwater streams are generally sufficiently widespread to be globally safe. Species of large rivers are of greater concern as large rivers are few in number and generally degraded by the accumulated effects of pollution and impoundments. Some large river mayflies are very rare and poorly known. Some are likely now extinct. The larger rivers of the GYE represent some of the largest natural flowing streams in the United States, and their preservation deserves special efforts. Unfortunately, Yellowstone area rivers are not large enough to contain some of these specialized species.

Some mayfly species are restricted to areas near the source of springs, occasionally only a single spring. Some of these species represent relict populations of a once more widespread species and others represent island populations that resulted from a rare colonization event and rapid selection to the new environment. Springs, especially large ones and those with unusual properties, can be expected to contain rare or local and even endemic invertebrate species and deserve protection. This is especially true in non-glaciated areas. The introduction of exotic species, particularly fish, poses one of the greatest risks to spring inhabitants.

Family Baetidae

INTRODUCTION: The family Baetidae includes some very common and important species as well as many that are very poorly known. Many species are very small and can be identified only when both the mature nymph and the male imago are available to an expert. The fauna of the Yellowstone area is poorly known.

The classification of genera and species of the family Baetidae has long been unsatisfactory and is subjected to rather frequent changes. The following species list incorporates some recent changes, but is highly tentative due primarily to a lack of collecting. The lesser known species are usually found in larger rivers and only during the summer months.

SPECIES LIST:

? indicates possible occurrence within the Greater Yellowstone Ecosystem.

* indicates type locality within the Greater Yellowstone Ecosystem.

<i>Acentrella turbida</i> (McDunnough)	<i>Fallceon quilleri</i> (Dodds)
<i>A. insignificans</i> (McDunnough)	<i>Diphetor hageni</i> Eaton
<i>Baetis bicaudatus</i> Dodds	<i>Centroptilum</i> spp.
<i>B. tricaudatus</i> Dodds	<i>Cloeon</i> spp.
* <i>B. thermophilos</i> McDunnough	<i>Callibaetis</i> spp.
<i>Pseudocloeon edmundsi</i> ¹ (Jensen)	

¹ The name of this species (both genus and species) will likely be changed in the near future.

CONSERVATION NEEDS: The status of *Baetis thermophilos* and the species of *Centroptilum* and *Cloeon* in the Greater Yellowstone Ecosystem is unknown. *Baetis thermophilos* was described from adults taken at Old Faithful and is unknown as nymphs. *Callibaetis* is taxonomically poorly known, but the species are found mostly in ponds and are likely widespread and secure as are the remaining, better known species.

Family Ephemerellidae

INTRODUCTION: The family Ephemerellidae or spiny crawlers is represented in the Greater Yellowstone Ecosystem by 16 species with three additional species considered possible. Two species were originally described from collections taken within Yellowstone National Park. New species and even new genera continue to be described in this family mostly from high mountain streams in the western states and provinces. Close examination of collections made from high mountain streams and specialized habitats in the GYE may contain additional surprises.

Until 1980 the family was considered to contain a single genus, *Ephemerella*, mostly because of the uniformity of the adults. The nymphs are far from uniform, and are generally identifiable to species. The species have diverse feeding patterns compared to other mayfly families, with herbivores, shredders, scrapers, carnivores and collectors all represented. The species of this family also have diverse life cycles and temperature and microhabitat preferences. Frequently, many species occur at the same site. One or more species are expected in all area streams not subject to excessive pollution or dewatering. Because the nymphs are both highly specialized and identifiable to species, they make excellent indicator species compared with members of other mayfly families. Changes in the densities and zonation of these species over time can usually be clearly interpreted in terms of environmental change (siltation, nutrient enrichment, temperature, etc.).

SPECIES LIST:

? indicates possible occurrence within the Greater Yellowstone Ecosystem.

* indicates type locality within the Greater Yellowstone Ecosystem.

<i>Attenella margarita</i> (Needham)	<i>Ephemerella alleni</i> Jensen & Edmunds
<i>Caudatella edmundsi</i> (Allen)	<i>E. aurivillii</i> (Bengtsson)
* <i>C. heterocaudata</i> (McDunnough)	<i>E. inermis</i> Eaton
<i>C. hystrix</i> (Traver)	<i>E. infrequens</i> McDunnough
? <i>Caurinella idahoensis</i> Allen	* <i>E. lacustris</i> Allen & Edmunds
<i>Drunella coloradensis</i> (Dodds)	? <i>Serratella micheneri</i> (Traver)
<i>D. doddsi</i> (Needham)	<i>S. tibialis</i> (McDunnough)
<i>D. flavilinea</i> (McDunnough)	<i>Timpanoga hecuba hecuba</i> (Eaton)
<i>D. grandis ingens</i> (McDunnough)	
? <i>D. pelosa</i> (Mayo)	
<i>D. spinifera</i> (Needham)	

CONSERVATION NEEDS: With the possible exception of *Caurinella idahoensis*, all these species are thought to be secure from local threats because of their geographic range. Several species are of special interest. *Caudatella edmundsi* was previously known only from a few localities in western Oregon. This distinctive species is restricted to narrow stretches of a few undisturbed mountain streams and small rivers with an abundance of submerged bryophytes. *Caurinella idahoensis* was named as a new genus and species in 1984 based on a single female nymph collected near Lolo Pass in Idaho and may follow the continental divide into the Greater Yellowstone Ecosystem. *Drunella pelosa* was called one of the rarest species in the family by Allen and Edmunds in their 1965 review. It was then known only from a handful of nymphs collected in California, Oregon and Washington. It has recently been taken in northwest Montana and may extend into the GYE. *Ephemerella alleni* occupies a narrow geographic range extending from Yellowstone National Park to northwest Montana and adjacent Idaho. It occurs only in high mountain streams and appears to be entirely parthenogenetic (the eggs develop without fertilization). *Ephemerella lacustris* was originally described from Yellowstone Lake and may occur only there, although it has been reported elsewhere. *Serratella micheneri* may occur in the GYE. It is known from north-central Wyoming and has been taken in south-central Montana. It occurs also in all the Pacific coast states, but has not been collected in between.

Family Heptageniidae

INTRODUCTION: Heptageniids are not as well known as the Ephemerellidae. Twenty-three species are known or likely from the Yellowstone area, but several more species may be present. Species of this family are generally identifiable only with adult males, but some species may be also be identified from nymphs.

The species are rather characteristic of different combinations of temperature and current velocities and may be useful indicators of changing temperature and flow regimens if specific recognition is achieved. Some species have very short life cycles occurring only during the summer season. Most are general feeders, consuming the loose accumulation of detritus and diatoms that cover stream substrates. Some large river species, so far unknown from the Yellowstone area, are carnivorous. Carnivorous mayflies species are in general very rare and known only from the deep water of large rivers.

SPECIES LIST:

? indicates possible occurrence within the Greater Yellowstone Ecosystem.

* indicates type locality within the Greater Yellowstone Ecosystem.

? <i>Aneperous rusticus</i> McDunnough	<i>Heptagenia adequata</i> McDunnough
<i>Cinygma integrum</i> Eaton	? <i>H. elegantula</i> (Eaton)
<i>Cinygmula gartrelli</i> McDunnough	<i>H. solitaria</i> McDunnough
<i>C. kootenai</i> McDunnough	* <i>Nixe (Akkarion) criddlei</i> (McDunnough)
<i>C. par</i> (Eaton)	<i>N. (A.) simplicioides</i> (McDunnough)
<i>C. ramaleyi</i> (Dodds)	* <i>Rhithrogena futilis</i> McDunnough
<i>C. reticulata</i> McDunnough	<i>R. hageni</i> Eaton
<i>C. tarda</i> (McDunnough)	<i>R. morrisoni</i> (Banks)
<i>Epeorus (Iron) albertae</i> (McDunnough)	<i>R. robusta</i> Dodds
<i>E. (I.) deceptivus</i> (McDunnough)	<i>R. undulata</i> Banks
<i>E. (I.) longimanus</i> (Eaton)	? <i>Stenonema terminatum</i> (Walsh)
<i>E. (Ironopsis) grandis</i> (McDunnough)	

CONSERVATION NEEDS: *Aneperous rusticus* is a rare, carnivorous species occurring in large rivers in Saskatchewan and Utah and may occur near Yellowstone National Park. It may have been lost from the Missouri River system. *Cinygma integrum* is an uncommon species restricted to high streams where it occurs almost exclusively on submerged wood. *Heptagenia adequata* is a poorly known species occurring in some of the larger rivers in the Yellowstone area.

Family Siphonuridae

INTRODUCTION: Siphonurids are rather poorly known everywhere. About a dozen species are known from the Yellowstone area. Species of this family are frequently not identifiable with certainty even when both adult males and mature nymphs are available. The western species of *Ameletus* are in particular need of taxonomic revision. Most species are active swimmers occurring in areas of little current. Adults of many species are very rarely collected.

SPECIES LIST:

? indicates possible occurrence within the Greater Yellowstone Ecosystem.

* indicates type locality within the Greater Yellowstone Ecosystem.

<i>Ameletus</i> 10+ species	<i>Siphonurus autumnalis</i> McDunnough
? <i>Analetris eximia</i> Edmunds	<i>S. columbianus</i> McDunnough
? <i>Parameletus columbiae</i> McDunnough	<i>S. occidentalis</i> Eaton

CONSERVATION NEEDS: The status of the *Ameletus* species must await a taxonomic review of the genus. Many species occur in the Yellowstone area. Each species is characteristic of different stream reaches and different habitats.

Analetris eximia is a rare, primitive carnivorous mayfly occurring in large rivers during the summer season. It is known only from the Green River system upstream of Flaming Gorge Reservoir and from the Saskatchewan River. It appears to have been eliminated from all Missouri drainage rivers though it must have once occurred there. It is threatened where it occurs due to dam construction and pollution. *Siphonurus autumnalis* is a little known species occurring in some of the larger, undisturbed rivers of the Yellowstone area.

Family Leptophlebiidae

INTRODUCTION: Leptophlebiids are most diverse in tropical areas where they occur in streams, lakes and ponds. Leptophlebiids prefer rather reduced current where they feed on accumulated organic debris. At least six species occur within the Yellowstone area. Each species is characteristic of different longitudinal zones within stream systems. They have highly seasonal life cycles.

SPECIES LIST:

? indicates possible occurrence within the Greater Yellowstone Ecosystem.

* indicates type locality within the Greater Yellowstone Ecosystem.

<i>Paraleptophlebia debilis</i> (Walker)	? <i>Choroterpes albiannulata</i> McDunnough
<i>P. heteronea</i> (McDunnough)	<i>Leptophlebia gravastella</i> (Eaton)
<i>P. bicornuta</i> (McDunnough)	? <i>Traverella albertana</i> (McDunnough)
<i>P. memorialis</i> (Eaton)	
<i>P. vaciva</i> (Eaton)	

CONSERVATION NEEDS: All of these species are relatively well known and widely distributed.

Smaller Families

Family Ametropodidae: This family is presently unknown from the Yellowstone area, but *Ametropus ammophilus* Allen and Edmunds occurs in northwest Montana and *A. albrighti* Traver occurs to the south in Wyoming. Both species occur in large, sandy rivers and occupy rather narrow geographic ranges.

Family Oligoneuridae: No members of the family are reported from the Yellowstone area, but *Lachlania powelli* Edmunds and *Isonychia campestris* McDunnough occur nearby. Both occur in warm, large rivers.

Family Polymitarciidae: The widespread *Ephoron album* Say may occur in some larger rivers of the Yellowstone area.

Family Leptohyphidae: The widespread *Tricorythodes minutus* Traver occurs abundantly in the larger rivers of the Yellowstone area. Some specimens taken from the Yellowstone area do not seem referable to that species and need further study.

Family Caenidae: *Caenis youngi* Roemhild occurs in some lakes of the GYE. This species was described in 1984 and so far is known only from the Yellowstone area.

Family Ephemeridae: A single widespread species, *Ephemera simulans* Walker, occurs in some larger rivers and lakes of the Yellowstone area.

Family Baetiscidae: No members of this interesting family are known from the Yellowstone area, but two species, *Baetisca laurentina* McDunnough and *B. lacustris* McDunnough, approach it from the east. The first of these two species also occurs in the Hudson Bay drainage to the north. They are expected in larger rivers or along the shorelines of lakes.

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Butterflies of the Greater Yellowstone Ecosystem

Butterflies are insects belonging to five families in the order Lepidoptera which are classified together as one superfamily, Papilionoidea. Several characteristics of their appearance and biology differentiate them from the other lepidopteran subgroups, skippers and moths. Because of their abundance, diurnal habits, and often brilliant coloration they have been the objects of considerable study by both amateur and professional biologists for many years. As a consequence they are probably the best known insect group, and many details are known about their systematics, ecology, behavior, population dynamics, and distribution.

In addition to being conspicuous members of the fauna of the Greater Yellowstone Ecosystem, butterflies are useful indicators of environmental conditions. For example, they are highly sensitive to pesticides and may be used as indicator species to assess the effects of spraying programs on non-target species. Since temperature influences all stages of their life histories, butterflies are likely to play important roles in monitoring the biological effects of climate change. Finally, because they have been collected for many years, historical records of butterfly distributions will be valuable for estimating rates of colonization and extinction under changing patterns of land use.

Table 1 lists the 128 species of butterflies which are found in the Greater Yellowstone Ecosystem. This represents slightly more than 30% of the butterfly species recorded from North America north of Mexico (Scott 1986). About 70% of the species found in the Ecosystem occur in Yellowstone National Park (Bowser, unpublished check list for YNP; Ferris and Brown 1981).

About 16% of the species in the GYE may be of special interest to conservationists. First, five species, *Papilio polyxenes*, *Chlosyne nycteis*, *Phyciodes tharos*, *Boloria napaea*, and *Boloria improba*, occur in the Ecosystem as disjunct populations, well isolated from the rest of their ranges (Scott 1986). These populations are more likely to go extinct than those located within the main body of their ranges because of the reduced probabilities of immigration to supplement low population sizes when they occur.

Next, the GYE is located at the geographic edges of the ranges of nine other species: *Colias interior*, *Colias meadii*, *Euchloe olympia*, *Polygonia progne (oreas)*, *Phyciodes mylitta*, *Boloria epithore*, *Apodemia mormo*, *Satyrrium acadica*, and *Euphilotes battoides* (Scott 1986). These species are likely to occur in the Greater Yellowstone area only as small, highly scattered populations which may be particularly prone to extinction under changing environmental conditions (see Brussard 1984 for a detailed discussion of the biology of marginal populations).

Two migratory species, *Phoebis sennae* and *Euptoieta claudia*, are common south of the GYE and occasionally migrate this far north. Another species, *Nathalis iole*, has not yet been recorded from the GYE, but has similar migratory habits. If occurrences of *P. sennae* or *E. claudia* become more common or if *N. iole* begins to show up on a regular basis, it is possible that these events are signaling the onset of warmer climatic conditions.

Finally, three species, *Coenonympha haydenii*, *Euphydryas gillettii*, and *Boloria kriemhild* are northern Rocky Mountain endemics. These species are particularly interesting since the area where all three of these species' ranges are coincident provides a reasonable approximation of the boundary of the Greater Yellowstone Ecosystem. Although *C. haydenii* and *B. kriemhild* are locally quite common, *E. gillettii* is rare, and its populations appear to be declining. Williams (1988) visited 29 localities where *E. gillettii* had been collected in the past and found extant populations at only 13 of them.

Part of this decline may be attributable to fire suppression. The species' larval foodplant, *Lonicera involucrata*, will grow wherever sufficient moisture is available. However, the caterpillars can only complete their development on *Lonicera* plants that are growing in direct sunlight. These rather precise habitat requirements are most often met where moist mountain meadows meet lodgepole or spruce/fir forests. In the absence of fire, however, the forest begins to encroach upon the meadow, shading the *Lonicera* and eliminating the warm habitat necessary for the butterfly (Williams 1981, 1988). Thus, *E. gillettii* may be an excellent "management indicator species" for the Greater Yellowstone Ecosystem.

TABLE 1. Butterfly species found in the Greater Yellowstone Ecosystem. Taxonomic arrangement follows Scott (1986); records are taken from Ferris and Brown (1981) and an unpublished check list compiled for Yellowstone National Park (YNP) by Gillian Bowser. Records denoted by "o" are unconfirmed.

	GYE	YNP
I. PAPILIONIDAE		
<u>Papilioninae: Swallowtails</u>		
Papilio machaon (bairdii)	x	x
P. zelicaon	x	x
P. polyxenes	x	x
P. indra	x	
P. glaucus (rutulus)	x	x
P. eurymedon	x	x
P. multicaudata	x	x
<u>Parnassiinae: Parnassians</u>		
Parnassius phoebus	x	x
P. clodius	x	x
II. PIERIDAE		
<u>Coliadinae: Sulfurs</u>		
Colias meadii	x	x
C. alexandra	x	x
C. eurytheme	x	x
C. philodice	x	x
C. interior	x	
C. pelidne	x	x
C. scudder (gigantea)	x	x
Phoebis sennae	x	
<u>Pierinae: Whites</u>		
Anthocharis sara	x	x
A. stella	x	x
Euchloe hyantis	x	
E. ausonia	x	x
E. olympia	x	
Pieris rapae	x	x
P. napi	x	x
P. chloridice (beckerii)	x	x
P. protodice	x	x
P. callidice (occidentalis)	x	x
P. sisymbrii	x	x
Neophasia menapia	x	

III. NYMPHALIDAE	GYE	YNP
<u>Danainae: Milkweed Butterflies</u>		
Danaus plexippus	x	x
<u>Satyrinae: Satyrs</u>		
Coenonympha tullia	x	x
C. haydenii	x	x
Cercyonis pegala	x	x
C. meadii	x	
C. sthenele	x	x
C. oetus	x	x
Erebia magdalena	x	x
E. theano	x	x
E. epipsodea	x	x
E. callias	x	x
Neominois ridingsii	x	
Oeneis chryxus	x	x
O. bore (taygete)	x	
O. uhleri	x	x
O. jutta	x	x
O. melissa	x	
O. polyxenes	x	
<u>Nymphalinae: Brush-Footed Butterflies</u>		
<u>Nymphalini: Nymphs</u>		
Limenitis archippus	x	
L. weidemeyerii	x	x
Vanessa atalanta	x	x
V. cardui	x	x
V. virginiensis	x	
V. carye (anabella)	x	x
Polygonia satyrus	x	x
P. gracilis (zephyrus)	x	x
P. progne (oreas)	o	
P. faunus	x	x
Nymphalis milberti	x	x
N. californica	x	x
N. vau-album	x	x
N. antiopa	x	x
Euphydryas chalcedona (anicia)	x	x
E. editha	x	x
E. gillettii	x	x
Chlosyne gorgone	x	
C. nycteis	x	
C. palla	x	x
C. gabbi (acastus, nycteis)	x	
Phyciodes mylitta	x	
P. pallida	x	x
P. tharos	x	x
P. campestris (pratensis)	x	x

	GYE	YNP
<u>Argynnini: Fritillaries</u>		
Boloria napaea	x	
B. eunomia	x	
B. selene	x	x
B. titania	x	x
B. kriemhild	x	x
B. epithore	o	o
B. frigga	x	
B. improba	x	
B. freija	x	x
Speyeria aphrodite	x	x
S. cybele	x	x
S. mormonia	x	x
S. hydaspe	x	x
S. callippe	x	x
S. atlantis	x	x
S. egleis	x	
S. zerene	x	x
S. coronis	x	x
S. edwardsii	x	
Euptoieta claudia	x	

IV. LYCAENIDAE

Riodininae: Metalmarks

Apodemia mormo	x	
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Lycaeninae: Hairstreaks, Coppers, and Blues

Theclini: Hairstreaks

Harkenclenus titus	x	
Satyrrium acadica	x	
S. californica	x	
S. sylvinus	x	
S. saepium	x	
S. behrii	x	
S. fuliginosum	x	
Callophrys eryphon	x	x
C. polios	x	
C. augustus (augustinus)	x	
C. gryneus (siva)	x	
C. spinetorum	x	x
C. affinis	x	x
C. sheridanii	x	x
Strymon melinus	x	

	GYE	YNP
<u>Lycaenini: Coppers</u>		
<i>Lycaena phleas</i>	x	x
<i>L. cupreus</i> (snowi)	x	x
<i>L. mariposa</i>	x	x
<i>L. nivalis</i>	x	x
<i>L. helloides</i>	x	x
<i>L. heteronea</i>	x	x
<i>L. rubidus</i>	x	x
<i>L. xanthoides</i> (editha)	x	x
<u>Polyommataini: Blues</u>		
<i>Everes amyntula</i>	x	x
<i>Celastrina argiolus</i>	x	
<i>Glaucopsyche lygdamus</i>	x	x
<i>G. piasus</i>	x	x
<i>Euphilotes battoides</i>	o	o
<i>E. enoptes</i>	x	
<i>Plebejus glandon</i> (franklinii)	x	x
<i>P. idas</i> (argyrognomon)	x	x
<i>P. melissa</i>	x	x
<i>P. saepiolus</i>	x	x
<i>P. icarioides</i>	x	x
<i>P. shasta</i>	x	x
<i>P. acmon</i>	x	x

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FISHES

Rare and Sensitive Fishes of the Greater Yellowstone Ecosystem

Waters of the Greater Yellowstone Ecosystem harbor some of the most prized fisheries in the world. Each year, millions of dollars pour into the economies of local communities from recreational fishing in the waters of the Yellowstone area. Just the mention of rivers such as the Madison, Snake, Yellowstone, or Henrys Fork will elicit countless stories and fond memories from many veteran fishing enthusiasts. These are highly productive waters that literally draw their life from the earth over which they flow. Geothermal flows moderate the cold runoff waters and provide a rich nutrient source for aquatic life.

While some of the fish described here are of great sport interest, this is by no means a treatise on their angling merit. The accounts that follow describe six of the GYE's fish species that are of great concern. Common to all is the question of whether they will remain viable components of this highly prized and intensively managed fishery. The endangered Kendall Warm Springs dace evolved in a limited stretch of water that probably has remained fairly constant in flow and temperature for hundreds of years. It now faces an uncertain future in the face of livestock grazing and geothermal development. Fluvial Arctic grayling may be a past memory before we are even able to document and fully understand the demise of this formerly wide-ranging native. Likely causes for its decline include the introduction of exotic trouts and the competition/predation that ensued. It is ironic that grayling seem to fare well in lacustrine habitat, even in the presence of other trouts. Their pre-settlement distribution was largely restricted to riverine habitat; rarely were they found in lakes.

Cutthroat trout of the GYE experience the same pressures as elsewhere: vulnerability to over-exploitation, habitat degradation, competition with exotic species, and perhaps worst of all, the insidious process of genetic introgression. In many cases it is only a matter of time before a given population is lost through hybridization with trout already in the drainage. Short of building stream barriers (short-term) or rehabilitating streams (expensive and often impractical), there is little that can be done in most cases where non-native salmonids have become established. Yellowstone National Park is the last stronghold for the Yellowstone cutthroat trout. Even with thriving populations in the upper Yellowstone River system, threats arise such as illegally planted populations of brook trout in the drainage. The westslope cutthroat trout presents additional challenges due to its high genetic divergence between populations. In order to avoid the loss of most of the genetic diversity within this species, numerous populations need to be protected across its range.

Habitat degradation and fragmentation (yes, it happens in fluvial systems too), along with widespread fish plants and over-exploitation, necessitate very active management to maintain the last stocks of pure-strain Bonneville cutthroat trout. Currently, this species is a candidate for federal listing under the Endangered Species Act. Unfortunately, if efforts fail to recover this fish, its fate may be tied to constant artificial propagation.

This could be the future of any of the species described in the following pages. Fortunately, this need not be the case. The authors of the salmonid accounts herein are among the best coldwater fisheries biologists in the country. They, and their colleagues in the Northern Rockies, are responsible for some of the most progressive fish management and conservation in practice. Geneticists have been recruited to study the extent of introgression in wild populations, and to develop strategies for maintaining genetic variability within and among populations. Symposia have been held to address issues of conservation and management of native salmonids. Yellowstone National Park has an aggressive fisheries management program that strives to maintain native fisheries while attempting to restore viable fisheries, such as the fluvial grayling. If each of the three neighboring states were able to commit sufficient resources to devise and implement management programs for

native fisheries, it would go a long way toward assuring long-term conservation of these and other fishes of special concern.

In reading the accounts, it may be concluded that native trout management and conservation is difficult if not frustrating. Cutthroat trout readily hybridize with one of the most popular and widely planted fish in the west, the rainbow trout. Two other popular and widely planted non-native sport fish, the brown and brook trout, are aggressive competitors and predators of cutthroat trout and grayling.

Rarely do professional biologists encounter such a vexing dilemma: whether to manage for popular non-native sport species which are the monetary backbone of any (state) fisheries program or to conserve aboriginal fisheries such as cutthroat trout, grayling, and whitefish. Clearly, we are beyond restoring our native fisheries everywhere. It is not practical nor would it be acceptable to most of the public. But is there middle ground where a sport fishery thrives along with effective conservation programs for native fisheries? What about "non-game" fish -- do we wait until they become so imperilled as to warrant protection under the nation's most powerful environmental law, the Endangered Species Act?

The Greater Yellowstone Area offers opportunities for developing sound fisheries conservation programs. Several of the salmonids treated here are highly regarded and valuable sport fishes. Couple this with the great potential for winning public support for conservation in the GYE. Turning "America's playground" into an American classroom may be overly simplistic but it certainly has raised public awareness of the grizzly bear and wolf. The species accounts that follow provide basic information on the status and needs of some of the area's most imperilled fisheries. The conservation of fish is also compatible with the appropriate management of other organisms and communities. Virtually all natural values of aquatic systems benefit from wise fisheries management. The evolutionary wealth of these species is an important part of these values.

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Yellowstone Cutthroat Trout

Oncorhynchus (formerly *Salmo*) *clarki bouvieri*

DESCRIPTION: The Yellowstone cutthroat trout is usually yellow-brown and dark olive-green or steel-grey on the back; sides are generally lighter. The belly ranges from yellow to beige or off-white. A reddish cast along the middle of the side typically becomes darker from the caudal fin toward the head, and the operculum varies from rose to scarlet red. Large round, black spots are profuse on the caudal, adipose, and dorsal fins; spots on the back and sides are noticeably less numerous anteriorly. The head, which lacks spots, is short and relatively blunt, and the lower jaw is long, typically reaching past the rear margin of the eye. Small teeth on the tongue (basibranchial teeth) are always present. A red slash on each side of the lower jaw is characteristic. Lateral line scales vary from 150-200, usually 165-180. There are 10-11 dorsal fin rays and 10-11 anal fin rays.

RANGE: The historic range of the Yellowstone cutthroat trout included the Yellowstone River drainage in Montana and Wyoming and portions of the Snake River drainage in Wyoming, Idaho, Nevada, Utah, and perhaps Washington. The original range of the Yellowstone subspecies circumscribed the range of the fine-spotted Snake River cutthroat trout, and overlapped the range of the coastal cutthroat trout. Introductions of non-native fishes, environmental degradation, and angler harvest severely reduced the historic range, and the Yellowstone cutthroat trout is currently most abundant within the GYE. Stocking activities expanded the original range, but these transplants have never restored the Yellowstone cutthroat trout to historic numbers.

HABITAT: Although the Yellowstone cutthroat trout is often considered a "headwater" fish, the native habitat is diverse. Historically, elevational range extended from about 900 ft (275 m) to at least 8,500 ft (2,590 m). Populations are found in waters ranging in size from small beaver impoundments to large lakes. Although historically common in large western rivers such as the Yellowstone River and the Snake River above Shoshone Falls, Idaho, this species is currently limited to the headwaters of these rivers. Yellowstone cutthroat trout are adapted to colder water; water temperatures between 40°F (4.5°C) and 60°F (15.5°C) appear to be optimum for the species. Populations, however, have been known to exist in waters heated geothermally to at least 81°F (27°C) in Yellowstone National Park.

LIFE HISTORY AND ECOLOGY: Yellowstone cutthroat trout spawn over a 7-month period, depending on latitude, altitude, water temperature, and runoff conditions. In the GYE, spawning can occur from the latter part of April through early August. Yellowstone cutthroat trout, whether resident in lakes or streams, spawn in streams. Spawning populations are comprised of individuals age-3 and older (primarily ages-4 to -7). Angler harvest can greatly affect the age composition, and the mean age of spawners is lower in heavily exploited stocks.

Older and larger spawners migrate first in the spring. Age, length, weight, and condition factor of individual spawners decline as the spawning season progresses. Spawners in tributaries to Yellowstone Lake spend between 6 and 25 days instream. Males generally migrate earlier than females and remain in the stream longer. Although past research indicated high post-spawning mortality (48%), the average instream mortality during a recent 5-year study in a Yellowstone Lake tributary was approximately 13%. Spawning occurs where optimum-size gravel (0.5-3.4 in [12-85 mm]) and suitable water temperatures (42-65°F [5.5-15.5°C]) are found. A typical female of approximately 16 in (400 mm) from Yellowstone Lake will deposit about 1,300 eggs (1,073 eggs/lb or 2,633 eggs/kg). Egg mortality estimates in natural redds have ranged between 12 and 42%; surviving eggs typically hatch in 25-30 days, and juveniles emerge about 2 weeks later.

Most Yellowstone cutthroat trout inhabiting lakes are planktivorous prior to maturity. In Yellowstone Lake mature fish are generally associated with the shallower portions of the littoral zone where they feed on crustaceans and insects. Few Yellowstone cutthroat trout are piscivorous. Stream populations appear to depend most heavily on aquatic insects.

Growth rates in Yellowstone cutthroat trout are highly variable depending on the stock and environmental conditions. In Yellowstone Lake, most Yellowstone cutthroat trout over 12 in (300 mm) are mature, and individuals below 10 in (250 mm) are generally immature. In alpine and subalpine lakes and streams, harsh

conditions result in long-lived, slow-growing populations that mature at 4-5 in (100-130 mm). In slow-growing, unfished populations maximum life expectancy may extend to 11 years.

CONSERVATION NEEDS: Although increased emphasis has been placed on the protection of genetically unaltered populations of Yellowstone cutthroat trout in recent years, the threat of hybridization with rainbow trout or other cutthroat trout subspecies is critical. Stocks of the indigenous Yellowstone cutthroat trout display adaptations to different environments that have resulted in ecotypes displaying characters as variable as those commonly found between subspecies or even species of trout. A registry of ecotypic varieties of cutthroat trout would help preserve genetic variation for its practical, scientific, and aesthetic value.

Tramplng and over-grazing of riparian habitats, and stream dewatering, due mostly to irrigation demands, have greatly reduced the available habitat for Yellowstone cutthroat trout. Preserving adequate instream flows and altering livestock grazing strategies are integral to the perpetuation of native and introduced wild populations of the Yellowstone subspecies. High catchability of the Yellowstone cutthroat trout makes the subspecies an important and popular recreational resource; this vulnerability, however, can easily lead to overharvest. If angler harvest is limiting, special regulations such as number and size limits can provide protection necessary to sustain fish populations. Special regulations should be incorporated into any program to restore or introduce populations of Yellowstone cutthroat trout to their former abundance.

The Yellowstone cutthroat trout is classified by Region 1 of the U.S. Forest Service as a sensitive species on the Gallatin and Custer National Forests. It is a species of special concern in Idaho and Montana.

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Fine-Spotted Snake River Cutthroat Trout

Oncorhynchus (formerly *Salmo*) *clarki* subsp.

DESCRIPTION: The fine-spotted Snake River cutthroat trout is distinguished from other cutthroat subspecies by its unique spotting pattern. The spots are fine and profuse, concentrated on the posterior part of the body and above the lateral line. In all other characters, including electrophoretically analyzed proteins, the fine-spotted cutthroat trout is similar to the Yellowstone cutthroat trout, *O. c. bouvieri*. Its color is predominantly yellowish-brown or sometimes silvery, and mature fish may have faint rosy tints. The lower fins can become orange or red. The general maximum size in the Snake River is about 18 in (450 mm) and 2.2 lbs (1 kg), although an occasional fish may be much larger. When stocked into lakes with rich food resources, the fine-spotted cutthroat trout has been known to attain weights to at least 11 lbs (5 kg). Variations among individuals in lateral series scale counts, pyloric caeca, vertebrae, and basibranchial teeth indicate that the subspecies is not homogeneous throughout its range, but consists of many discrete reproductively isolated stocks. Hybridization with other trouts also accounts for some of this variability.

The fine-spotted cutthroat trout has not yet been formally described as a subspecies, although it is widely recognized as a distinct taxon by its common name.

RANGE: Both the Yellowstone and the fine-spotted cutthroat trout are indigenous to the upper Snake River drainage above Shoshone Falls, Idaho, although the two forms are rarely found together in the same habitat. Due to habitat alterations in the upper Snake River, such as the construction of Palisades Reservoir and stocking of non-native trouts, the precise original distribution of the two forms in the upper Snake River drainage is not known. In the very headwaters of the Snake, in Heart Lake, and in tributary streams southward to the Gros Ventre River, the Yellowstone cutthroat is the native trout. The original range of the fine-spotted cutthroat probably included the main Snake River downstream to Shoshone Falls and tributary streams from the Gros Ventre River downstream to Palisades Reservoir. In tributary streams below Palisades Reservoir, such as the Henrys Fork, Teton River, Portneuf River, and Goose Creek, the Yellowstone cutthroat is native.

The fine-spotted cutthroat's present distribution is the Snake River from above Jackson Lake (where they are stocked) to Palisades Reservoir and in all tributaries from the Gros Ventre to the Salt River. The first three tributaries of the Snake below Jackson Lake (Pacific Creek, Buffalo Fork, and Spread Creek) are inhabited by Yellowstone cutthroat. In the Gros Ventre drainage, Yellowstone cutthroat are found in the headwater tributaries and fine-spotted cutthroat in the rest of the drainage. The fine-spotted cutthroat trout is intensively propagated in fish hatcheries and is widely distributed outside its native range, especially in Wyoming and Colorado.

HABITAT: The fine-spotted cutthroat trout seems particularly adapted to big river environments with swift currents. For spawning it uses cold spring-fed tributaries less than 12 in (30 cm) deep, with clean, relatively silt-free gravel bottoms. Gravel of 1-2.5 in (2.5-6.4 cm) is preferred. The fine-spotted cutthroat adapts well to lakes and reservoirs, but is less successful in small streams.

LIFE HISTORY AND ECOLOGY: The fine-spotted cutthroat exhibits two basic migratory-spawning patterns: resident in small streams, and migratory between main rivers and tributary streams. The migratory trout usually move into tributary streams in March. Spawning takes place from early to late spring, with peak spawning occurring in April and May. Certain spring-fed tributaries appear to be of great importance for successful reproduction. The majority of spawning fish are in age classes 3 and 4. The average female produces about 2,300 eggs. Post-spawning mortality is as high as 55%.

Egg mortality is about 11-12% in optimum spawning conditions where the gravel is free of silt. About half of the fingerlings drift down to the main rivers in January and February; the others migrate to the main rivers at age-1 or 1+. The fine-spotted cutthroat feeds primarily on aquatic and terrestrial insects, on both the bottom and the surface. Larger size classes also feed on small fish such as Paiute and mottled sculpins.

CONSERVATION NEEDS: Although the fine-spotted cutthroat trout, because of widespread stocking outside its original range, is probably more abundant now than it has ever been, the maintenance of abundant populations in its native range is dependent on the quality of the spawning habitat. The Wyoming Game and

Fish Department and other management agencies are working to maintain and improve spawning tributaries, many of which have been subjected to degradation from erosion, siltation, and irrigation diversions. Levees along the Snake River prevent flood waters from flushing sediment from the spawning gravels, and agricultural practices can contribute to increased silt deposition. The levees also promote erosion of islands and channelization of the Snake River, which greatly decreases the habitat value of the river for cutthroat trout.

All fine-spotted cutthroat trout stocks have probably been exposed to hybridization with Yellowstone cutthroats and rainbow trout, but despite this they have maintained their distinctive spotting pattern. How the fine-spotted cutthroat and Yellowstone cutthroat have maintained their distinctions instead of freely hybridizing is not known.

The fine-spotted cutthroat trout is a Category 2 candidate for listing under the Endangered Species Act. It is a species of special concern in Idaho. Region 4 of the U.S. Forest Service lists it as a sensitive species (draft list).

NOTES: Because of the great significance of the fine-spotted Snake River cutthroat trout as the basis for the sport fishery in the Jackson Hole area, considerable attention has been devoted to this trout by the Wyoming Department of Game and Fish.

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Westslope Cutthroat Trout

Oncorhynchus (formerly *Salmo*) *clarki lewisi*

DESCRIPTION: The westslope cutthroat trout differs from other cutthroat in its body coloration and spotting. It has a silver body with yellowish tints and the typical cutthroat red slash. It has orange, pink, or red colors on its sides and stomach region. The colors are most intense on mature males. The spots, which are small and irregularly shaped, are found most heavily on the tail and back. Spots are few or absent from the sides and stomach below the lateral line. Adults do not retain parr marks. Maximum size is about 18-20 in (460-510 mm) and about 3 lbs (1.4 kg). The lateral series scales are usually 150-200 or more, pyloric caeca are 25-50, and vertebrae are typically 60-61.

RANGE: The westslope cutthroat's natural range included the entire upper Missouri River drainage to below Great Falls in Montana; the Salmon, Clearwater, and Spokane drainages in Idaho; and the Clark Fork and Kootenai river drainages in Idaho, Montana, and British Columbia. Westslope cutthroat trout have declined dramatically throughout the historic range, although populations in Idaho have fared slightly better than those in Montana. In Idaho, where westslope cutthroat historically inhabited 10,000 miles of streams (40% of the state's total streams), 11% of the historic range still supports strong populations and 36% supports viable populations. In Montana, westslope cutthroat trout persist in 27% of the historic range. Range reduction has resulted primarily from habitat losses and overharvest.

The westslope cutthroat's range in the Greater Yellowstone Ecosystem has always been limited to the headwaters of the Gallatin and Madison rivers. Today the westslope cutthroat in the GYE is found only in Bacon Rind, Fan, and Cougar creeks, in the upper Madison River and the Gibbon River below Gibbon Falls, and possibly in Grayling Creek and the tributaries of the upper Gallatin River.

HABITAT: The westslope cutthroat uses mountain streams, mainstem river systems, and large natural lakes (Pend Oreille, Priest, Coeur d'Alene, and Kootenai lakes) for some or all of its life history. Adults prefer large pools and low velocity areas of rivers and near shore environments in lakes. Niche partitioning is evident in streams where steelhead are present. Westslope cutthroat trout in the GYE do not inhabit lakes.

LIFE HISTORY AND ECOLOGY: There are three life histories displayed by the westslope cutthroat trout: migratory between lakes and streams, migratory between main rivers and tributaries, and resident or non-migratory. The migratory fish (from either rivers or lakes) spawn in tributary streams, often traveling up to 200 mi (322 km), but more commonly 25-50 mi (40-80 km). Spawning occurs from April to July depending on elevation and spring runoff.

The juveniles of migratory fish spend 2-3 years in tributary streams, emigrating to the mainstem or lake when they reach a length of 6-8 in (15-20 cm). Sexual maturity occurs at 4-6 years with a typical size of 14-16 in (35-40 cm). Westslope cutthroat trout seldom exceed 20 in (51 cm), with a maximum age of 7 years.

Resident (non-migratory) stocks of westslope cutthroat trout spend their entire life in small streams. These fish mature at 8-10 in (20-25 cm), seldom exceeding 10-12 in (25-30 cm). The importance of these resident stocks to the migratory population is unknown.

The westslope cutthroat trout feeds primarily on insects (both aquatic and terrestrial), seldom turning to a fish diet. This may be the primary reason for its size limitations relative to other cutthroat trouts. Juveniles in lake environments feed on zooplankton but prefer insects when available.

Westslope cutthroat do not coexist well with introduced rainbow and brook trout. Hybridization with rainbow trout and competition with brook trout have eliminated the westslope cutthroat in many areas in Idaho and Montana.

CONSERVATION NEEDS: The westslope cutthroat trout shows a very high level of genetic divergence among local populations. Therefore, to avoid loss of genetic diversity it is essential to ensure the continued existence of many populations throughout its range. Local westslope cutthroat populations, however, face a variety of threats.

Hybridization with other cutthroat trout subspecies and rainbow trout is a widespread problem. For example, none of the populations of westslope cutthroat trout in Yellowstone National Park are genetically pure. All show some degree of hybridization with Yellowstone cutthroat trout or other trouts. In Montana,

genetically pure populations persist in only 2.5% of the historic range, and in Idaho, pure populations persist in less than 4% of the historic range. Hybridization can lead to the loss of locally adapted populations and the homogenization of distinct strains of trout. Introduced salmonids including kokanee salmon, brook trout, and lake trout have also affected wild populations of westslope cutthroat trout through competition and predation.

The westslope cutthroat is very sensitive to angler harvest. Restricted harvest or catch-and-release fishing has been necessary in Idaho and Montana to maintain wild populations, even in the wilderness areas. Because it is primarily an insectivore displaying aggressive feeding habits, it may be the most vulnerable trout to harvest. Without severe harvest restrictions or catch-and-release regulation, it is doubtful that wild populations of westslope cutthroat trout can be maintained with increasing fishing pressure.

Westslope cutthroat have also been affected by loss of habitat. Road construction and logging have released sediment and altered stream channels, reducing their production and capacity. Grazing can degrade riparian environments. Toxic mining waste in the Coeur d'Alene River and Panther Creek in Idaho and the Clark Fork River in Montana has eliminated westslope cutthroat trout from large stretches of river. Most remaining strong populations of westslope cutthroat trout are associated with wilderness and roadless areas.

Regions 1 and 4 (draft list) of the U.S. Forest Service list the westslope cutthroat trout as a sensitive species. It is a species of special concern in Idaho and Montana.

NOTES: Recent investigations suggest that the genetic differences between the westslope cutthroat trout and other cutthroat trouts may warrant designation as a separate species.

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Bonneville Cutthroat Trout

Oncorhynchus (formerly *Salmo*) *clarki utah*

DESCRIPTION: The Bonneville cutthroat trout is similar to the Yellowstone cutthroat trout (*O. c. bouvieri*), differing mainly in the spotting pattern with larger, more evenly distributed spots on the sides of the body. The cutthroat trout of the Snake Valley region tend to have more spots. The Bonneville cutthroat is one of the more somber hued cutthroats and does not develop the brilliant colors of some cutthroat subspecies. Some populations within the Bonneville basin, however, do display brilliant reddish-orange spawning colors. The scale counts range from 133-183 in the lateral series and 33-46 above the lateral line. Gillrakers range from 16-24, vertebrae 61-62, pyloric caeca 25-54, basibranchial teeth 1-50, with the teeth being present in at least 90% of the populations.

Specimens sampled within the Bonneville basin range from 2-9.3 in (58-237 mm) and weigh 0.14 oz-0.3 lbs (4 -135 g). The largest individuals are up to 13 in (330 mm) and 0.8 lbs (366 g). The cutthroat trout of the Snake Valley region are slightly larger and heavier. Historically, the biggest stream specimens from the Bear River, Wyoming, reached a maximum size of 17-18 in (425-450 mm). Lake populations in Utah Lake attained a size in excess of 15.5 lbs (7 kg) and 30 in (760 mm) in length. The cutthroat trout of Bear Lake on the Utah-Idaho border represent a genotype of the original lacustrine stock of the Bonneville cutthroat from ancient Lake Bonneville and weigh up to 18 lbs (5.6 kg).

RANGE: The Bonneville cutthroat trout historically ranged within Lake Bonneville, the largest of the ancient lakes of the Great Basin. The lake occupied 19,750 mi² (51,152 km²) in central and northern Utah, eastern Nevada, southeastern Idaho, and southwestern Wyoming. The drying of Lake Bonneville segregated populations of the cutthroat into isolated geographic areas within the Bonneville basin. Since white settlers moved into the basin, loss of habitat through water diversions, overgrazing, land development, and hybridization with exotic species has accounted for the widespread loss of the species. At one time the fish was presumed extinct, but through efforts of fisheries scientists and agencies, pure-strain remnant populations have been found and reintroductions are being made to extend the range of the species. Today, only 41 populations, primarily limited to small headwater streams, are known to be genetically pure. This includes 39 stream populations in four states (ID, NV, UT, and WY) occurring in about 181 mi (302 km) of streams, and two lake populations. The Bonneville cutthroat within the GYE occurs only in the Thomas Fork and Smith's Fork drainages of the Bear River system within the Bonneville basin in southwestern Wyoming and southeastern Idaho.

HABITAT: The Bonneville cutthroat trout prefers streams characterized by clear, cool water, a silt-

Figure 3. Distribution of the Bonneville cutthroat trout in the Greater Yellowstone Ecosystem.

free rocky substrate with a riffle, run, pool environment; a 1:1 pool to riffle ratio with areas of slow, deep water; well vegetated streambanks for canopy, shade, and undercut bank stability; abundant instream cover; and relatively stable streambanks, flow regimes, and temperatures (55°F [13°C] summer with a maximum of 70°F [22°C]). Streambank and instream cover is recognized as one of the most essential components of the cutthroat's habitat. The Bonneville cutthroat today is generally not abundant in the streams it occupies because of degraded aquatic-riparian habitats resulting from human activities and livestock grazing.

LIFE HISTORY AND ECOLOGY: Spawning usually occurs in the spring during April to June. Spawning is usually noted first in lower stream reaches and progresses upstream. Where spawning fish were measured in Utah, the majority of age-2 males (5.2 in [134 mm] in total length) were mature, while females were not mature until age-3 (5.7 in [147 mm]). An age-3 female may have up to 176 eggs.

The cutthroat's food source is predominantly aquatic insects and terrestrial insects that drop into the water. In some cases where streambank vegetation provides canopy cover into the stream, terrestrial insects make up more than 50% of the diet. As the fish grow to maturity, they may also feed on smaller fish species.

Hybridization with other trouts results in the loss of the cutthroat's genetic purity. Where pure populations exist today they are either geographically isolated from other cutthroats or are protected by the placement of barrier falls that prevent the upstream movement of exotic species. One exception to this is the GYE cutthroat population in the Thomas Fork and Smith's Fork drainages of the Bear River system, where the native cutthroat is dominant over the nonnative trout. No evidence of hybridization has been detected.

Bonneville cutthroat populations can be affected by drought. Fifty percent or more of the population of small streams can be lost due to flow reductions or intermittent status. Flood flows can also account for the partial or total elimination of stream populations, especially in habitats which are in poor condition.

CONSERVATION NEEDS: The Bonneville cutthroat is susceptible to local extinction as a result of such activities as livestock grazing, timber harvest, road construction, water diversions, pollutants (sediments and chemical), angling over-exploitation, and hybridization with non-native trouts. Aquatic-riparian areas and stream courses need to be managed carefully in order to maintain viable habitat for the Bonneville cutthroat. Stream habitat improvement methods should be applied in conjunction with other management actions to arrest the species' decline in poor habitat conditions. In those streams where non-native salmonids have been introduced, intensive fisheries management is needed to maintain the genetic integrity of the remaining pure populations of Bonneville cutthroat and to increase the number of pure-strain populations. In small streams where it is native, the Bonneville cutthroat consistently attains a greater size than do brook or rainbow trout. It is therefore more appealing to the angler as a native fishery. But it is very susceptible to angling pressure and can be reduced and/or eliminated through over-exploitation, thereby necessitating restrictive angling regulations.

Wildlife agencies in Utah, Nevada, Idaho, and Wyoming are developing management plans for the Bonneville cutthroat. The U.S. Forest Service and the Bureau of Land Management (BLM) are working to improve aquatic-riparian habitat conditions for the cutthroat in cooperation with the states. The U.S. Fish and Wildlife Service, which lists the Bonneville cutthroat as a Category 2 candidate for listing under the Endangered Species Act, is monitoring its recovery. The Bonneville cutthroat is listed as a species of special concern by Idaho and Wyoming and as a sensitive species by Region 4 of the Forest Service (draft list).

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Arctic Grayling
Thymallus arcticus

DESCRIPTION: The Arctic grayling, a relatively small member of the trout family, attains a maximum size of about 6 lbs (2.7 kg), but few specimens exceed 2.5 lbs (1.1 kg). The average length is 12-15 in (305-380 mm). This species is easily distinguished from the other salmonids by its large dorsal fin which has a base as long or longer than the fish's head. The iridescent orange, green, and blue colors on the dorsal fin are striking and also distinctive; however, these colors are more vivid in males than in females. The mouths of grayling extend to under the eye (not beyond or anterior to the eye), and their jaws bear small teeth, further differentiating this species from other salmonids.

RANGE: The Arctic grayling has a holarctic distribution. In North America its historic range included Alaska, western Canada, northern Michigan, and the upper Missouri River system of Montana and Yellowstone National Park. Grayling populations in the latter two locations were widely but intermittently distributed in streams of the Missouri River drainage above the Great Falls, Montana.

The ranges of river-dwelling grayling in Alaska and Canada are still quite extensive, but those of populations in the contiguous U. S. have been severely reduced. Fluvial grayling in Michigan and Yellowstone Park are now extinct, despite efforts to reintroduce fish into those areas. In Montana, only one stream population still persists, in the upper Big Hole River. In contrast, lake-dwelling grayling (many from planted stock) are abundant and secure in numerous locations in Yellowstone National Park, Montana, Wyoming outside the Park, Idaho, and other western states.

HABITAT: Fluvial grayling typically inhabit large and medium-sized streams with cold (<68°F [20°C]) clear water, although in Alaska bogs also are used. Grayling prefer streams with an abundance of pools, low velocities and gradients, and abundant aquatic vegetation. Most of the streams used by grayling have sand and/or gravel bottoms.

LIFE HISTORY AND

ECOLOGY: Grayling spawn in streams from April to mid-June. Males establish and defend spawning territories. The actual spawning act occurs during daylight hours, often in the afternoon when water temperatures are highest. Spawning substrates are usually sand and gravel. No redd (nest) is built, although their adhesive eggs may be covered by bottom materials stirred up by the spawning act. Hatching can occur from 8-27 days after spawning, depending on water temperatures. After hatching, the larvae remain in the substrate for 3-4 days before emerging.

Figure 4. Distribution of the Arctic grayling in the Greater Yellowstone Ecosystem. Each dot represents one or more lakes containing Arctic grayling.

Young grayling first feed on zooplankton, then switch to a diet largely composed of aquatic insect larvae and terrestrial insects. Growth rates vary with the quantity and quality of available food and water temperatures. The most rapid growth rate in Montana fish appears to be about 8,11,13,15, and 16 inches (20.3, 27.9, 33.0, 38.1, and 40.6 cm) at ages 1-6, respectively.

In Montana and Yellowstone National Park populations, individuals sometimes attain sexual maturity at age-2 but usually at age-3. In more northerly populations, a few fish become mature at age-4, but most do not mature before age-6. Mature grayling often live to a maximum estimated age of about 12 years, although 7 years appears to be about the oldest in Montana fish. Habitat alterations and competition with introduced species appear to be responsible for the reduction and elimination of fluvial grayling populations. However, lake-dwelling grayling appear to be able to coexist with introduced fish species.

CONSERVATION NEEDS: The fluvial Arctic grayling seems to be headed for extinction in its present habitat in Montana. The first conservation need is to establish a breeding population of this stock in a new, secure location. Next, streams in Yellowstone National Park and Montana having the suitable physical characteristics and only native fishes should be identified. Then, introductions of grayling from the captive fluvial stock should be made into the selected streams.

The Montana arctic grayling is a Category 2 candidate for listing under the Endangered Species Act. Region 1 of the U.S. Forest Service lists it as a sensitive species on the Beaverhead National Forest. Montana lists it as a species of special concern.

NOTES: A cooperative research project (between the Montana Natural Heritage Program, the U.S. Forest Service, the Montana Department of Fish, Wildlife and Parks, the Montana Cooperative Fisheries Research Unit, and the Bureau of Land Management) on the Big Hole River grayling is in its third year. Valuable new data have been collected on fish movements, spawning habitat areas, and microhabitat use by adults and fry. Additional information is needed on competitive interactions between grayling and exotic salmonids and the effects of predation on grayling.

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Kendall Warm Springs Dace
Rhinichthys osculus thermalis

DESCRIPTION: The Kendall Warm Springs dace is a small member of the minnow family, currently identified as a subspecies of the speckled dace (*R. osculus*). Kendall Warm Springs dace adults range in size from 0.9-2.1 in (23-54 mm). Breeding males are a bright purple color, and females a dull olive green. The Kendall Warm Springs dace can be distinguished from the Green River speckled dace (*R. o. yarrowi*) by its smaller body size, larger head and fins, and fewer scales and fin rays.

RANGE: The Kendall Warm Springs dace is restricted to the Kendall Warm Springs, located on the Bridger-Teton National Forest, in the upper Green River Basin. The springs area and a short outlet stream comprise the total range of this subspecies.

HABITAT: The Kendall Warm Springs are located at an elevation of 7,840 ft (2390 m) and consist of numerous seeps and springs scattered along the north face of a small limestone ridge. Consolidated flow from the springs travels southwest for a distance of 984 ft (300 m), and then cascades over a travertine embankment into the Green River. The Kendall Warm Springs are thermal springs that flow from a limestone formation. The springs originate at near 85°F (29.4°C), and the outfall temperature drops as low as 78°F (25.6°C) in the winter. Water from the springs is well mineralized, slightly alkaline, and moderately high in total dissolved solids and specific conductance. Aquatic vegetation surrounds the main channel and is often heavy in the pools. Monkeyflower (*Mimulus* sp.) and moss are the dominant aquatic plant species found in the upper areas. Sago pondweed (*Potamogeton pectinatus*), moss (*Drepanocladus aduncus polycarpus*), and stonewort (*Chara contraria*) are the most common plants found in the lower areas.

LIFE HISTORY AND

ECOLOGY: Kendall Warm Springs dace are the only fish known to occur in the Kendall Warm Springs. They appear to be well dispersed throughout the available habitat. Adult dace may occur in the main current, but most remain in the pools or quiet eddies where plant growth or other debris breaks the current. Distribution of fry suggests that spawning is widespread and occurs several times a year. Nursery areas used by fry are in still water pockets in dense mats of aquatic vegetation, away from the main flow. Dace generally occur in small schools, possibly due to space limitations or behavioral preference. Plant growth provides the primary escape cover for the Kendall Warm Springs dace. Typical danger avoidance reactions include a skittering flight to the nearest clump of plants, or fleeing to the deeper, turbulent areas in the main current. Although specific food habit studies have not been

Figure 5. Distribution of the Kendall Warm Springs Dace.

conducted, it is assumed that Kendall Warm Springs dace food habits are similar to those of other speckled dace, which are apparently omnivorous and opportunistic feeders.

CONSERVATION NEEDS: In the past, the Kendall Warm Springs dace's habitat was threatened by cattle grazing and water pollution from the use of soaps for bathing and washing clothing. Another threat was removal of the dace for use as sport fish bait. Because of these threats, the Kendall Warm Springs dace was listed as an endangered species in 1970. Actions taken by resource management agencies since that time have reduced many of the threats to the fish and its habitat.

These conservation measures included prohibitions on the seining or trapping of Kendall Warm Springs dace and on bathing and wading in the springs. Other actions included interpretive signing, withdrawal of the area from mineral entry, fencing the springs to exclude grazing, setting up barricades to eliminate unauthorized vehicle use, and establishment of parking areas. The area has been designated as "essential" habitat for the dace, and a recovery plan has been developed. Questions remain as to whether geothermal exploration and development in nearby areas may affect the aquifer feeding the Kendall Warm Springs.

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AMPHIBIANS AND REPTILES

A Preliminary Survey of the Distribution of Amphibians and Reptiles in Yellowstone National Park

Although Yellowstone is our oldest national park and many aspects of its natural history have been intensively studied, we know relatively little about the amphibians and reptiles that dwell there. This chapter briefly describes our present knowledge of the distribution and abundance of amphibians and reptiles within Yellowstone National Park. Four sources of data were used in this preliminary study: specimen records from 14 national and regional museum collections; Yellowstone National Park files (observation records and back-country lake surveys); personal field observations; and published accounts (Carpenter 1953, Turner 1955, Mueller 1967, Algard 1968, Varley and Schullery 1983, Baxter and Stone 1985). After summarizing this information, we discuss future research needs and opportunities concerning the amphibians and reptiles of Yellowstone.

SPECIES OCCURRENCE: Four species of amphibians (one salamander and three anuran species) and six species of reptiles (one lizard and five snake species) are known to occur in Yellowstone National Park (Table 1). This number of species is low in comparison with other areas of the United States, presumably because of the cool, dry conditions that place developmental, physiological, and behavioral constraints on these ectothermic animals.

TABLE 1. Amphibians and reptiles known to occur in Yellowstone National Park. Following the common names of each species are the numbers of museum specimens and reliable field observations, respectively.

Species	Records / Observations
AMPHIBIANS	
Blotched Tiger Salamander (<i>Ambystoma tigrinum melanostictum</i>)	11 / 41
Boreal Toad (<i>Bufo boreas boreas</i>)	23 / 9
Boreal Chorus Frog (<i>Pseudacris triseriata maculata</i>)	13 / 7
Spotted Frog (<i>Rana pretiosa</i>)	256 / 7
REPTILES	
Northern Sagebrush Lizard (<i>Sceloporus graciosus graciosus</i>)	6 / 14
Rubber Boa (<i>Charina bottae</i>)	0 / 17
Wandering Garter Snake (<i>Thamnophis elegans vagrans</i>)	17 / 7
Valley Garter Snake (<i>Thamnophis sirtalis fitchi</i>)	1 / 0
Bull Snake (<i>Pituophis melanoleucus sayi</i>)	1 / 7
Prairie Rattlesnake (<i>Crotalus viridis viridis</i>)	1 / 20

Five other species of amphibians and reptiles occur near Yellowstone National Park but their presence within the park is currently unconfirmed. Northern leopard frogs (*Rana pipiens*), Great Basin spadefoot toads (*Scaphiopus intermontanus*), short-horned lizards (*Phrynosoma douglassi*), and racers (*Coluber constrictor*) may reach the Park and are definitely found within the Greater Yellowstone Ecosystem. Painted turtles (*Chrysemys picta*) may occur within the far northern portion of the Greater Yellowstone Ecosystem (Stebbins 1985). Three painted turtles have been observed in the Park but they were probably introduced (Turner). The Plains spadefoot toad (*Scaphiopus bombifrons*) may reach the eastern boundary of Greater Yellowstone (Baxter and Stone 1985). Bullfrogs (*Rana catesbeiana*) have been introduced in the extreme eastern portion of Greater Yellowstone, near Dubois, Wyoming (Baxter and Stone 1985).

DISTRIBUTION: All of the species occurring in Yellowstone National Park are widely distributed, some ranging throughout the West and others throughout the entire United States. Surprisingly little is known, however, about the detailed distribution of amphibians and reptiles within the Park itself. There are less than 350 museum specimens from Yellowstone National Park and even fewer field observations that have been reliably recorded (Table 1). Furthermore, the majority of collecting sites are near roads and over 60% of the records are for a single species, the spotted frog. The small size and uneven nature of this data set preclude meaningful analyses of the distribution of many of the species but several tentative generalizations can be made. Tiger salamanders, boreal toads, chorus frogs, spotted frogs, and wandering garter snakes appear to be widely distributed within the Park. There are too few observations of rubber boas to be certain of their distribution but we believe that future sampling will show this species is also widespread throughout the Park. Three species have limited distributions in Yellowstone Park. Sagebrush lizards appear to be limited mainly to thermal areas, but they may be found at lower elevations along the lower Yellowstone River as well (Mueller 1967, Algard 1968). Bull snakes and prairie rattlesnakes are primarily limited to lower elevations in the extreme northern part of the Park. The valley garter snake (*Thamnophis sirtalis fitchi*) occurs in the southwestern corner of the Park along the Bechler River. It also has been collected along the Snake River just south of the Park boundary. The red-sided garter snake (*Thamnophis sirtalis parietalis*) was reliably observed in the northern part of the Park along the Gardner River in the 1920s and may still be present.

RELATIVE ABUNDANCE: On the basis of the number of museum specimens and field observations, we can speculate about the relative abundances of amphibians and reptiles in Yellowstone. Although there are few species of amphibians and reptiles, most of them are locally common in some portions of the Park. Tiger salamanders may be very abundant locally. Before breeding in the spring or following transformation in late summer, salamanders migrating to or from ponds may number in the thousands (Turner 1955, Varley and Schullery 1983). Chorus frogs and spotted frogs also may be abundant locally in the spring when they congregate to breed (Carpenter 1953, Turner 1955). Boreal toads, sagebrush lizards, wandering garter snakes, bull snakes, and rattlesnakes may be common in their respective habitats. Although rubber boas appear to be uncommon, they are largely fossorial and nocturnal so their apparent scarcity may be partly due to their secretive habits. We recently confirmed the occurrence of the valley garter snake in the park but cannot yet determine its abundance.

RESEARCH PRIORITIES: The most striking finding of our survey is the lack of data concerning the amphibians and reptiles in Yellowstone. This situation is probably due to several factors, such as the remoteness of much of the Park, restrictions on collecting, the short activity season for amphibians and reptiles, and the Park's other natural features which have attracted more attention from scientists.

We believe that future research should focus on a systematic sampling program with a greater number, diversity, and range of localities. We feel that sampling efforts should be concentrated on the following regions: (1) where the six major rivers leave the Park (potential dispersal corridors); (2) backcountry areas (selected to distribute sampling efforts more evenly); (3) thermal areas; (4) high elevations (selected to determine altitudinal limits); and (5) burned and unburned areas (to indicate the impact of fire on amphibian and reptile populations). Observations by Park employees, researchers, and visitors can provide an important source of data for clarifying distribution patterns and for directing future collecting efforts. We strongly encourage anyone with information on sightings of amphibians or reptiles within Greater Yellowstone to contact us. Ideally the information would include a description of the animal, when and where it was seen, the prevailing environmental conditions, and

any behavioral observations. Once the distribution patterns have been documented adequately, we can examine the basis of these patterns by correlating them with environmental features (such as thermal areas and vegetation zones) and historical events (introductions of exotic species, fires, etc.).

Special attention should be paid to the distribution and abundance of amphibians in the Greater Yellowstone Ecosystem because populations of several species of toads and frogs have been declining recently in the western United States (Corn and Fogleman 1984, Baxter and Stone 1985, Hayes and Jennings 1986). To determine the magnitude of this problem, we need to compare information on past and current amphibian distributions and abundances in a wide variety of locations. Studies of amphibian populations within Yellowstone National Park may be revealing because there are baseline data for comparisons (Turner 1958, 1960, and Park surveys of tiger salamander distributions). Furthermore, the relatively undisturbed nature of much of the Park may prove useful in testing hypotheses concerning the causes of declines in amphibian populations (pollution, droughts, disease, predation, etc.).

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Short-Horned Lizard
Phrynosoma douglassi

DESCRIPTION: The short-horned lizard is one of the smallest members of this wide-ranging genus, with a maximum snout-vent length of only 3.75 in (95 mm). Its tail is short compared to most of the other species. As the common name indicates, it has short head spines as well as small chin shields. These short stubby horns and a single row of fringe scales on each side of the body distinguish this species from other horned lizards. The head spines are about as broad at their base as they are long. The dorsal body color varies from slate gray to buff, brownish, reddish or even yellowish, allowing the lizard to blend into the substrate. Dorsally there are two rows of dark brown or black blotches arranged transversely; usually these are light-edged posteriorly. Each side of the neck has a dark blotch just behind the head and there are usually scattered light-colored flecks on the dorsal surfaces. Ventrally it is white to yellowish with varying amounts of gray suffusion or dark spotting, especially on the throat and belly. The males are slightly smaller than the females and have enlarged post anal scales as well as a broader tail base, especially during the breeding season.

RANGE: The distribution of this species extends farther north than any other member of the genus and it is found at very high elevations in the southern part of its range. The five subspecies found in the United States occur from the Arizona, New Mexico and Texas borders with Mexico northward to the southern edge of Canada and from eastern Oregon and Washington eastward to the central Great Plains. The eastern short-horned lizard (*P. d. brevirostre*) is the form most likely to occur in the eastern part of the Greater Yellowstone Ecosystem, but the pigmy horned lizard (*P. d. douglassi*) and the Salt Lake horned lizard (*P. d. dorsatum*) approach it from the west and southwest respectively.

HABITAT: The short-horned lizard is more cold tolerant than the other species of horned lizards. It is found mainly in the Great Basin and adjoining areas and the short grass prairie country east of the Rockies. It has been found as high as 10,400 ft elevation (3,170 m) in Arizona but seems to prefer the sagebrush desert and the semiarid short grass prairie areas where patches of loose soil or sand are available for burrowing. The general area may be rocky, hardpan or sandy but is always well drained and supports an abundant ant population.

LIFE HISTORY AND ECOLOGY: The short-horned lizard is almost exclusively insectivorous with ants being reported in high proportions in the diet. Grasshoppers, beetles, insect larvae and spiders commonly appear in the gut. This lizard is not easily maintained in captivity and this may be due to the difficulty of supplying ants in sufficient quantities. Like all lizards in this area, it hibernates during the winter months. Emergence in the spring normally follows the disappearance of snow. Males and young of the year seem to emerge a few days before the females. Following emergence, courting and copulation occur, probably in June in the Greater Yellowstone Ecosystem. The eggs are retained in the oviduct of the female for the full period of development. Females have been reported to have as many as 31 eggs in the ovaries with an average of about 16-17. Usually 3-15 young are produced in late summer or early fall about 2 months after fertilization. The young measure about 0.5-0.9 in (12-22 mm) snout-vent length. Brood sizes appear to decrease and individual sizes to increase from south to north through the species' range. The young are enclosed in a transparent sac which is ruptured at birth. The young have a tendency to burrow in the loose soil almost immediately. Sexual maturity is reached at the end of about 2 years when males attain a length of about 1.6 in (40 mm) and females 1.8 in (45 mm) snout-vent length.

There is some variation in activity patterns among different members of this species. Females and subadults seem to be more active and are seen more frequently after the breeding season, but males are more active before the breeding season. During the summer when temperatures are high, there seem to be two periods of daily activity, one in the morning from about 0800-1100 and a second period of lesser activity from 1600-1800 hours, after the peak daily temperature has been reached. The midday heat is usually avoided by burrowing in the substrate or moving to the shade at the base of sagebrush or other woody plants. The cool parts of the evening, night, and morning are spent under the soil surface. Short-horned lizards bask for short periods upon emergence in the morning.

There is evidence that these animals establish and maintain home ranges. Territoriality has not been demonstrated, although females are said to occupy feeding territories. Some evidence of homing has also been shown.

Short-horned lizards are preyed upon by other lizards and snakes, and to a lesser extent by several species of birds, chipmunks, and ground squirrels.

CONSERVATION NEEDS: Two habits exhibited by short-horned lizards make them vulnerable to activity of off-road vehicle enthusiasts. Horned lizards have evolved the habit of "freezing" rather than running when disturbed. Their color pattern permits them to blend readily into the substrate on which they occur. Also, this species burrows into loose soil or sand to escape the high midday temperatures as well as the cool temperatures at night. According to studies in California, considerable numbers are destroyed by the tires of off-road vehicles.

NOTES: Distributional literature indicates that the short-horned lizard occurs only in appropriate habitat at the edges of the Greater Yellowstone Ecosystem. This species is successful throughout most of its range but may need special consideration in the marginal habitat in which it occurs in the GYE.

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BIRDS

Introduction

Bird species in this section were selected based upon their listing as threatened or endangered species under the federal Endangered Species Act, U.S. Forest Service and Bureau of Land Management sensitive species, state species of concern, and on information contained in the databases of the Montana and Idaho Natural Heritage Programs. Of the twenty species considered here, five have questionable breeding status in the GYE (merlin, mountain plover, upland sandpiper, pileated woodpecker, and pygmy nuthatch). Arguably, at least six other species not considered in this publication (white-tailed ptarmigan, Caspian tern, common tern, rufous hummingbird, Townsend's warbler, and white-winged crossbill) are either rare or their breeding status in the ecosystem is unknown.

Three bird species in the GYE-- the bald eagle, peregrine falcon, and whooping crane--are federally listed as endangered species, and considerable resources are committed to their conservation and recovery. The bald eagle and peregrine falcon are on their way to recovery in the GYE and elsewhere; the status of the whooping crane, however, remains precarious. Additionally, the U.S. Fish and Wildlife Service has recently been petitioned to add the GYE's trumpeter swan population to the list of threatened and endangered species.

With the exception of the pileated woodpecker, the remaining birds considered in this section are species of special concern in at least one of the GYE states. The status of several of these species has been or is currently being determined through surveys conducted by state nongame or natural heritage programs. These surveys, however, may not necessarily have included part or all of the GYE, particularly Grand Teton and Yellowstone National Parks. In addition, the status of many rare species, such as the owls and woodpeckers, remains essentially unknown in the GYE.

The GYE has been no exception to the litany of threats to biological diversity worldwide. Human disturbance, pesticides, and habitat loss, particularly through clear cutting of forests and agricultural conversions, have been responsible for major impacts to the avian community. The water birds and raptors are all susceptible to nesting failure caused by human disturbance. White pelicans, white-faced ibis, and the falcons (peregrine and merlin) have suffered from pesticide problems at one time or another. Timber management practices in the GYE have likely resulted in habitat losses for owl, woodpecker, and nuthatch species. On the brighter side, the fires of 1988 probably increased foraging and nesting habitat and made prey more available for both woodpeckers and owls.

Surveys to determine population status, distribution, and habitat use are needed for several species including the upland sandpiper, harlequin duck, merlin, woodpeckers, and pygmy nuthatch. For other species, site-specific management plans to protect critical habitat from human disturbance are badly needed. More generalized management plans are needed for most species. Although such plans may exist for a species in one part of the GYE, they may be lacking or inconsistent in other portions of the ecosystem.

Many of the bird species considered in these accounts are high profile species observed by many visitors to the GYE. Indeed, their presence is a main attraction for many tourists. If these and other rare avian species are to persist as viable inhabitants of the GYE, greater emphasis must be placed on coordinated research, surveys, monitoring, and habitat protection and management by the public land management agencies within the ecosystem.

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Common Loon

Gavia immer

DESCRIPTION: The common loon is a large diving bird, weighing from 7-9 lbs (3.2-4.1 kg). Body length ranges from 28-36 in (71-92 cm), with wingspans to 58 in (147 cm). During the summer breeding season, both males and females have a black head, red eye, and a straight, heavy black bill. There are two striped "necklaces" of white feathers on the otherwise black neck. The breast and underparts are white. The back is checkered black and white, and is a distinctive field mark. Winter adult and all juvenile plumages are very similar. Head, neck and upperparts are dark gray to dark brown; cheeks, throat, and underparts are white. Loons fly rapidly, with the head held slightly lower than the body, and the feet trailing behind. Loons are well adapted to diving, and are rarely, if ever, seen on land, except to nest. On the water, they ride low, sometimes with only their head above the surface.

Common loons give four distinctive calls, three of which are heard on summer breeding lakes. The wail, a long almost mournful cry, is reminiscent of coyote or wolf howls. The tremolo (the so-called "laugh of the loon") is a high pitched, rapid, five-beat call, frequently given at the approach of humans in canoes or on shore. The yodel, given only by males during territorial confrontations, starts slowly with a single ascending note, and ends with a variable number of repeated high pitched, short notes.

RANGE: In North America, the common loon's historical breeding range covered sub-arctic Alaska, eastward through sub-arctic Canada to Newfoundland, south to northern California, Iowa, Pennsylvania, and the New England states. Unregulated harvesting led to severe population declines by the 1920s, especially in the northeast. Since then, chemical contamination and oil spills on wintering grounds, coupled with increased human habitation and activity on the breeding lakes, have further reduced the loon's breeding range. Currently, Maine, New Hampshire, Vermont, Michigan, Wisconsin, Minnesota, and Montana have significant populations of nesting loons. Smaller "island" populations exist in Massachusetts, North Dakota, Washington state, and in the Greater Yellowstone Ecosystem. In the GYE, loons nest on several lakes in the southwestern section of Yellowstone National Park, and on a few lakes throughout the rest of the Park, in Grand Teton National Park, and on the Targhee National Forest.

Common loons winter on coastal waters of the Atlantic and Pacific Oceans, Gulf of Mexico, Sea of Cortez, and on the Great Lakes. Loons from the intermountain west probably winter along the coasts of California and Oregon.

HABITAT: Common loons prefer large, clear lakes with at least partially forested shorelines. Lakes must be large enough (generally >10 acres [4 ha]) to provide the long runway loons need to get airborne, and deep enough to prevent freezing solid, thus sustaining the fish prey populations. Loons' territories contain an area of shallow water with emergent vegetation, and a secluded spot along the shore that is protected from wave action. Islands are often preferred for nesting. Lakes with large amounts of human activity, large fluctuations in water level, turbid water, entirely barren shorelines, or no protected bays are typically avoided, except during short feeding trips from the nesting lake or as migratory stopovers.

LIFE HISTORY AND ECOLOGY: During the winter, common loons forage alone during the day, and flock into rafts of up to 100 individuals at night. This rafting behavior continues during migration, but by the time the loons arrive at their nesting lakes, they are entirely territorial. Staging lakes on migratory pathways provide important feeding grounds and are used by hundreds of loons at a time. Twin Lakes Reservoir, near Preston, Idaho, may be a staging area for the entire Rocky Mountain population. Loons begin courtship during migration, but may not pair up then. On nesting lakes, loon pairs exhibit little courtship behavior, and it appears that lake qualities, not the presence of mates, draw loons to particular lakes. After arrival, intrasexual territoriality may be the mechanism by which pair formation is accomplished. Nest site selection and copulation begin soon after the pair arrives, usually in early May. Copulation normally occurs on land.

Loons build primitive nests of mud and vegetation, taken from the immediate vicinity of the nest. Some nests are unmodified scrapes in the ground, whereas others are more complex platforms of mud, moss and other vegetation. Some nests are well hidden by live vegetation; others are quite exposed. All nests are built no more than 3-6 ft (1-2 m) from water's edge. One or two large olive-brown eggs with dark brown spots are laid one day apart. Both sexes incubate the eggs during the 29-day incubation period. Nest predation by raccoons,

skunks, gulls and other animals, and nest washout due to wave action are common causes of egg loss. Loons may renest if they lose an egg, but not if they lose a chick.

During the nesting and early chick rearing stages, the loon parents are strongly territorial, aggressively driving other loons and waterbirds from their territory. Territory size is highly variable. On smaller lakes, territories usually encompass the whole lake. On larger lakes, loons defend a variable space from 10-500 ac (4-200 ha). Chick rearing lasts approximately 11 weeks. In situations where both eggs hatch successfully, intraclutch competition may lead to the death of one of the chicks. Both parents will carry the chicks on their backs. Both adults feed the chicks live prey, not regurgitant, from hatching until fledging. Adult care gradually decreases throughout the summer, as chicks learn to forage for themselves. All told, breeding and chick rearing takes about 16 weeks. This limits the loon's ability to renest, as the chicks must be mature enough to fly before ice formation, sometimes as early as late September. Juvenile loons will stay on coastal waters for 3 years, until they reach sexual maturity.

Loons are sight predators, and consequently are most active during the day. Loons feed primarily on fish. They are known to nest on fishless lakes, however, either shifting their diets to larval and adult amphibians, crayfish, leeches, and aquatic insects, or flying to nearby lakes to fish.

CONSERVATION NEEDS: Loons are sensitive to human disturbances on nesting or staging lakes. Boating can cause nest abandonment and egg loss, due to disturbance and boat wakes. Water level fluctuations on reservoirs can flood nests, or can put the nest too far above the lower water level. Many unoccupied lakes in the GYE appear to be ideal loon nesting lakes, except for high levels of human disturbance. On currently occupied nesting lakes in the GYE, human disturbance is minimal since the lakes are remote. Measures to limit such disturbances in the future will insure the lakes will continue to be available to nesting pairs. Lakes should be posted with informational signs in the early spring if loons are found to be nesting, and boating restrictions should be strictly enforced.

The small loon population in the GYE nests at a higher elevation than any other in North America. This means a very short ice-free season for nesting loons. With the long chick rearing period, timing is critical; renesting is rarely successful. Any slight change in human disturbance levels or nest predator populations could eradicate loons in the GYE. Special management may be required to ensure that this population persists in the GYE. The common loon is a species of special concern in Idaho (Category A, draft list) and Montana, and a Priority 1 species in Wyoming. Regions 1 and 4 (draft list) of the U.S. Forest Service list it as a sensitive species.

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American White Pelican

Pelecanus erythrorhynchos

DESCRIPTION: The American white pelican is one of the largest North American birds. Body length ranges from 54-70 in (137-170 cm), wingspan is up to 9.5 ft (290 cm), and weight is 10-17 lbs (4.5-7.7 kg), although 30 lbs (13.6 kg) has been reported. Females are slightly smaller than males. The white pelican is easily recognized by its large white body, its long flat bill and its distensible pouch used for capturing fish. The primaries and secondaries are black, extending almost to the body. The feet are webbed and are yellow to bright orange in color. Early in the breeding season the adults have an orange bill and feet, a flat 1.5 in (4 cm) high keratinized plate or "horn" half way down the upper mandible, a pale yellow patch on the breast and pale yellow plumes on the back of the head. Around the time of hatching the horn is shed and the head loses the plumes, gaining a variable amount of gray or black feathers. In winter the entire head is white and the bill and feet are more pale yellow. Juveniles are all white, but tend to be dusky with gray bills.

White pelicans are silent except at their breeding colonies, where they emit low grunting sounds. They are graceful fliers, holding the head back and using slow, strong wingbeats with occasional gliding. They often fly in flocks of 20 or more birds, using vee or line formations, and soaring on thermals during long distance flights.

RANGE: In the Greater Yellowstone Ecosystem pelicans have a breeding colony on the Molly Islands in the southeast arm of Yellowstone Lake. Historically, white pelicans bred from British Columbia east to southwestern Ontario, and from southern California to Nevada, Utah, central Colorado and east to southcentral Wisconsin. There have also been non-migratory colonies on the Gulf Coast of Texas and in Mexico. Loss of suitable breeding habitat and human persecution reduced the number of colonies west of the Rockies from at least 23 to 8 and has had similar effects elsewhere. Populations and colonies appear to be stable now, and new colonies are occasionally formed, such as at Pathfinder Reservoir near Casper, Wyoming, in 1984 and at Minidoka National Wildlife Refuge in Idaho in 1989.

White pelicans sometimes wander during fall dispersal and migration and have been reported in nearly every state and province. In winter they generally use coastal waters in the West from southern California to Panama and in the East from Panama to Florida. For the last several years a few have wintered on the Snake River in eastern Idaho.

HABITAT: White pelicans nest colonially on islands or peninsulas that are free from mammalian predators and human disturbance. Nesting colonies are usually located on flat, open ground near water. White pelicans are extremely mobile and are opportunistic feeders. Colonies may be located 50 mi (80 km) or more from the nearest food source, and the pelicans may travel over 375 mi (600 km) round-trip to forage. Pelicans may be found on any body of water where fish are available within 3 ft (1 m) of the surface, including rivers, lakes, reservoirs, and potholes. They often forage in shallow water, but will also use deeper water if there are fish near the surface or there are diving birds in the area (e.g., cormorants) from which they can steal fish.

LIFE HISTORY AND ECOLOGY: White pelicans are social birds year round. Nesting colonies are usually formed on traditional island sites in April and May. Pair formation occurs at the colony. Nest initiation is influenced by climate and occurs between late March and late June, but most nests are started by mid-May. Nests are made close to the water, often next to objects such as large rocks or driftwood, and are about 2 ft (0.6 m) apart. Nest materials are anything within reach of the nest (e.g., sticks, rocks, bones) or nothing at all. Females normally lay two eggs, one each about 5 and 7 days after nest site selection. One island may contain many subcolonies, each initiated at a different time. Most nests in a subcolony are initiated at the same time. Males and females share incubation duties, and switch places every 72 hours. The eggs within a colony hatch synchronously after 31-32 days incubation, although eggs within a nest usually hatch 2 days apart. Normally only one young per nest survives the 3-4 week nestling period. The larger (older) chick continually pecks its younger sibling, causing death by starvation and/or injury. About 4 weeks after hatching, the young begin to form creches and eventually remain in these groups overnight while both parents are foraging. The young fledge 12-13 weeks after hatching, and disperse from the colony before migrating south for the winter. They reach sexual maturity after 3-4 years.

White pelicans do not plunge-dive like the brown pelican, but rather feed at the surface. They feed most heavily at night through mid-morning, and loaf or travel much of the day. They are opportunistic feeders and rely mostly on rough fish such as carp, chub, minnows, and suckers, although they will eat game fish, crayfish, and salamanders if available. They capture fish up to 24 in (61 cm) long and eat an estimated 4 lbs (1.8 kg) daily. Pelicans often forage solitarily in areas where there are fish near the surface, but they will also forage in cooperative groups of 5-30 or more.

CONSERVATION NEEDS: Pelican breeding colonies are in a precarious position. Entire colonies will abandon with little provocation, and there is no evidence that they have the ability to renest. It is urged that breeding colonies not be approached within at least 0.25 mile (0.4 km) until late in the breeding season (late July), if not longer. Ample foraging areas within range of the colony also need to be maintained. Populations seem to have stabilized recently, but known colonies should be monitored on a yearly basis, preferably by airplane. Pesticides have caused egg shell thinning in some areas. The significance of this is not fully known, but should be monitored. The American white pelican is listed as a species of special concern in Idaho (Category A, draft list) and Montana, and as a Priority 1 species in Wyoming.

NOTES: The Yellowstone Lake colony suffered outright destruction before 1932, when it became off limits to humans. It continued to be highly disturbed (often unintentionally) until 1960, when motorboats were prohibited from much of the southeast arm of the lake. Since then the colony has been fairly stable. There were 401 nests in 1988. The biggest threat now appears to be possible flooding of the islands, which are only 5-10 ft (2-3 m) above water level. These pelicans commonly feed in Idaho on Henrys Lake and at Island Park Reservoir, as well as throughout Yellowstone and Grand Teton National Parks. This is the only colony known in which game fish (cutthroat trout) make up a substantial portion of the diet.

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White-faced Ibis

Plegadis chihi

DESCRIPTION: The white-faced ibis, a medium-sized relative of the heron, flies with its head and neck straight out. The 6-7 in (15-18 cm) decurved bill is distinctive and not easily confused with any other local bird. The white-faced ibis is 19-20 in (48-51 cm) in length with a wingspan of 37-39 in (94-99 cm). Adults are a uniform bronze-brown, but the remarkable iridescence of the wings and back can appear silver, purple, or entirely black depending on the angle. The white feathers bordering the face in adults separate this species from the closely related glossy ibis (*P. falcinellus*) of the eastern U.S. The face is bare and reddish in front of the white trim. The legs and feet are also reddish in breeding birds. Nestlings have a strange black and white banded bill which turns black at fledging. Juveniles have a finely streaked greyish head and lack the white facial markings of the adult.

Ibis fly with a strong, steady wingbeat and glide only when coming down to land. They often fly in flocks of 10-50 birds, either in vee formation or long lines. Their flight appears purposeful and rapid. Their only vocalization is an unmusical double grunt, sounding like "greh-greh," which can frequently be heard around the breeding colonies.

RANGE: Historically the white-faced ibis nested from California and eastern Oregon through northern Utah, Colorado, Nebraska, and Minnesota, with local populations in south Louisiana, Texas, and Mexico. Today it nests in isolated colonies from Oregon to Kansas, southeast to the Texas and Louisiana coasts. White-faced ibis are only peripherally found in the Greater Yellowstone Ecosystem, but because of their mobility and habit of shifting entire breeding colonies when conditions deteriorate, they might be observed anywhere. White-faced ibis have been seen in 21 of the 47 latilong blocks in Montana and they are known to breed in four. In Wyoming they have been observed in 25 of 28 latilongs, but there have been only five authenticated breeding colonies, which show intermittent use. The closest to the GYE was in a bulrush marsh south of Cokeville, near the Idaho state line. There are at least six large nesting colonies of ibis in Idaho, several of which are near the GYE. Grays Lake National Wildlife Refuge (NWR) has recently experienced a buildup of ibis. They are thought to have nested on the eastern side of the refuge since at least 1987. These birds may have moved up from the large colony at Bear River NWR, near Montpelier. Large nesting colonies are also found at Market Lake Wildlife Management Area (WMA) near Roberts, Mud Lake WMA near Terreton, and at Camas NWR near Hamer, Idaho. Over 4,000 were counted on the eastern edge of American Falls Reservoir on the Snake River in southern Idaho throughout the summers of 1987 and 1988. Band returns indicate that these ibis winter in western Mexico.

HABITAT: Ibis forage in flooded fields and at the receding edges of irrigation reservoirs. Water seems to be a requirement for a suitable feeding site, and in eastern Idaho the widespread use of flood irrigation has increased foraging habitat for ibis. They are versatile in their nesting requirements, and can either nest in emergent rushes or build a stick nest in small willows. They need a degree of isolation provided by marshes or small islands for both the nesting colonies and the social night roosts. Long lines or vees of ibis fly 5-25 mi (48-40 km) in the early morning and at dusk between nesting colonies or night roosts and feeding areas.

LIFE HISTORY AND ECOLOGY: White-faced ibis nest in large colonies which range in size from 30-50 nests in new colonies to over 1,500 nests in established colonies. Nest initiation seems to be synchronous within subgroups of ibis. Within large colonies there are often subcolonies of 20-30 nests, with all nests at a similar stage. Clutch size is usually three to four (range two to seven). The incubation period is 21-22 days. Only two young usually fledge. The young are semi-altricial and fledge at 28+ days. White-faced ibis first breed at 2 years of age.

Ibis return north in late March or early April, and depart en masse for their wintering grounds in western Mexico in early September. Ibis are highly social year round, with little aggressive interaction in their feeding groups or at the nesting colonies. Ibis nest in association with snowy egrets (*Egretta thula*), black-crowned night-herons (*Nycticorax nycticorax*), and Franklin's gulls (*Larus pipixcan*), with the latter two species being responsible for some predation on ibis chicks or eggs.

Ibis are probing, non-visual feeders and feed in large groups. The main food source along reservoir edges is mud dwelling midge larvae (*Chironomus* spp.) that are exposed by the receding waters. In flooded pastures, ibis eat earthworms and snails.

CONSERVATION NEEDS: Ibis populations should be closely monitored. Because their wintering grounds are in Mexico, there is a constant threat of pesticides, especially DDT and possibly dieldrin. In eastern Idaho, the hay and potato farmers use considerable quantities of organophosphate insecticides. These toxins cause a reduction of an essential brain enzyme, cholinesterase, and can cause immediate death when ingested. Pesticides have also caused breeding failures due to thin-shelled eggs in some white-faced ibis colonies.

White-faced ibis are sensitive to human disturbance, especially around their breeding colonies. Their numbers should be monitored and their nesting colonies should be left as undisturbed as possible. When young ibis are disturbed at their breeding colonies, such as during banding operations, they often attempt to swim off. As a result, they can become hypothermic. Fluctuating water levels can also be harmful to ibis colonies during the nesting season, as a rise in water level can flood nests in hardstem bulrush, the most frequently used nesting habitat. A drop in water level can allow predator access to nests.

There have been population increases in Idaho in recent years, but at the same time large colonies in the Salt Lake area and eastern California have been abandoned. The GYE is on the edge of their range, but there is always the possibility of a range expansion.

The white-faced ibis in the Great Basin is a Category 2 candidate for listing under the Endangered Species Act. It is a species of special concern in Montana and a Priority 1 species in Wyoming.

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Trumpeter Swan

Cygnus buccinator

DESCRIPTION: The trumpeter swan is the largest of the world's waterfowl species. Adult plumage is all white, commonly stained with rust from iron-rich waters and sediments. On the adult's black bill, a salmon-colored "grinning streak" frequently marks the lower mandible edge. Cygnet (first-year swan) plumage is gray with a pink bill which gradually darkens to black. Trumpeters lack the yellow patch below the eye which is characteristic of the smaller tundra swan (*Cygnus columbianus*). Females weigh 16-22.4 lbs (7.3-10.2 kg) and have a wing standard chord of 23.8-25 in (60-64 cm). Males weigh 20-27.5 lbs (9.1-12.5 kg), with a wing standard chord of 21.5-26.8 in (55-68 cm). Adults usually measure greater than 2 in (5 cm) from the tip of the bill to the front edge of the nostril; tundra swans measure less than 2 in (5 cm).

The trumpeter's distinctive brassy call arises from an extra loop of the trachea in the sternum. The call's horn-like quality contrasts markedly with the high-pitched barking "wow-wow-wow" of the tundra swan.

RANGE: Historically, trumpeters nested across most of North America. Flocks migrated south to ice-free freshwater and coastal wintering areas. The commercial swanskin trade, coupled with sport hunting and habitat destruction, reduced the species to near extinction by 1920. Remnant flocks survived only in the most remote portions of Alaska, Alberta, and the Greater Yellowstone Ecosystem. Stringent protection and restoration efforts increased swan numbers and distribution. Currently the Pacific Coast population summers in Alaska and British Columbia, and migrates south to winter along the coast from Alaska to northern Oregon. The Rocky Mountain population nests in Alberta, British Columbia, Yukon, Northwest Territories, Saskatchewan and the Greater Yellowstone region. The slaughter of the swans destroyed most of their traditional migration patterns to southerly winter habitats. As a result, virtually all Rocky Mountain trumpeters, regardless of their summer range, now winter in the Greater Yellowstone Ecosystem.

Recovery efforts have reintroduced trumpeters into Oregon, Washington, Nevada, the midwestern U.S. and eastern Canada.

HABITAT: Most nesting occurs on marshes, lakes, and beaver ponds, although oxbows or slow-moving backwaters of rivers may occasionally be used. Trumpeters prefer stable, quiet, and shallow waters where small islands, muskrat houses, or dense emergent vegetation provide nesting and loafing sites. Nutrient-rich waters, with dense aquatic plant and invertebrate growth, provide the best habitat. During the mid-summer molt, nonbreeding subadult trumpeters frequently gather in flocks of 20-100 on larger lakes or reservoirs.

Winter habitat must provide extensive beds of aquatic plants that remain ice-free. Pacific Coast trumpeters use both estuaries and freshwater habitats, and increasingly feed in pastures and croplands in recent years. In the GYE, cold temperatures and ice restrict trumpeters to sites where geothermal waters, springs, or outflow from dams maintain ice-free areas. Trumpeters feed most efficiently in shallow, slow moving waters. They prefer open sites with few trees or shrubs to obscure their vision.

LIFE HISTORY AND ECOLOGY: Trumpeters most often form pair bonds during their second or third years, and first nest when they are 4 or 5 years old. Most pairs remain together year-round and bond for life. The highly territorial pairs begin to build nests in late April or early May. Clutches usually contain two to seven eggs. Hatching occurs in June after an incubation period of about 33 days. Cygnets can fly by late September, but remain with their parents throughout their first winter. After separating from their parents during the following spring, siblings may remain together into their third year. Family bonds are strong; subadult siblings may reunite with their parents after nesting ends or during subsequent winters.

Wild trumpeters can live at least 25 years, although most succumb much earlier to collisions with fences or powerlines, lead poisoning, shooting, or winter emaciation. High cygnet mortality prior to fledging appears related to the poor condition of nesting females following severe winters and/or late, cold springs. Even after fledging, cygnets suffer nearly 50% mortality during the subsequent year as they explore their environment. Survival rates improve as young swans gradually learn movement patterns and food sources from their parents.

CONSERVATION NEEDS: The trumpeter swan is a long-lived, social bird that is highly dependent upon family bonds and traditional patterns of resource use. Traditional migration patterns and knowledge of important winter and spring habitats were lost as the species neared extinction. Although recovery efforts have

increased swan numbers, historic migratory paths have not yet been restored. As a result, virtually all the breeding trumpeters of Canada and the Greater Yellowstone Ecosystem share the same high elevation winter habitat in the GYE. Increasing numbers of wintering swans, concentrating on this limited, harsh winter habitat are vulnerable to catastrophic losses. Reduced flows during drought, heavy ice formation, unusually severe winter weather, disease, or environmental pollution could destroy a large portion of the Rocky Mountain trumpeters during a single winter. The swans' vulnerability was demonstrated during the winter of 1988-1989, when low water flows in the Henrys Fork of the Snake River, combined with unusually low temperatures, caused the river channels to freeze and resulted in the death of about 100 swans.

Management efforts currently focus on ensuring adequate stream flows, protecting and enhancing nesting and wintering habitat, and restoring southward migration to lower elevation habitats. Efforts to disperse trumpeters southward along the Snake River, into the Grays Lake National Wildlife Refuge, and along the Salt River began in 1988.

The trumpeter swan is a species of special concern in Idaho (Category A, draft list) and Montana, and a Priority 1 species in Wyoming. Region 1 of the U.S. Forest Service lists it as a sensitive species on the Beaverhead, Gallatin, and Custer National Forests. Region 4 (draft list) also lists it as a sensitive species. In March 1989 the Idaho Chapter of The Wildlife Society petitioned the U.S. Fish and Wildlife Service to add the GYE trumpeter population to the threatened species list.

NOTES: The Trumpeter Swan Society (3800 County Road 24, Maple Plain, MN 55359) is a nonprofit organization dedicated to the restoration of the trumpeter swan in the U.S. and Canada. For over 20 years this group has coordinated waterfowl propagators, researchers, managers, and interested citizens in recovery efforts.

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Harlequin Duck

Histrionicus histrionicus

DESCRIPTION: The harlequin duck is a member of the tribe Mergini (sea ducks). *Histrionicus* is a monotypic genus with characteristics intermediate between the eiders (*Somateria* spp.) and the scoters (*Melanitta* spp.). Harlequins are small ducks. Males and females weigh an average of 21 and 19 oz (602 and 539 gm) respectively and measure 16.2 and 15.4 in (41 and 39 cm) in total length.

The nuptial plumage of a male harlequin is a variety of contrasting colors. The blue-gray background varies, with the older drakes being more brightly blue and yearlings more grayish. The sides of the body are rusty red. In front of the eye is a white crescent, posterior to the eye is a white circle and a white slash. A reddish-brown streak runs the length of the crown. Two white slashes radiate from the back around to the breast and several white bars are present on the wing. One white spot can be seen on each side of the rump. The female harlequin is cryptically colored. The body is medium brown with a lighter, almost white color to the belly. The head has a distinct white spot behind the eye and another white patch in front of the eye which varies in its degree of visibility. The beak, feet and legs of both sexes are bluish gray. The eclipse plumage of the drake resembles the hen except that the white in the wing remains. Females have no distinct speculum. The tail of both sexes has longer feathers in the center than at the outer edges and is occasionally held up while swimming.

RANGE: The harlequin duck breeds only in select locations throughout the Greater Yellowstone Ecosystem. Their North American breeding distribution extends from southern Alaska southward through the Rocky Mountains to northwestern Wyoming and through the coastal and Cascade ranges into northern California. Breeding also occurs in Newfoundland, Greenland and Iceland.

HABITAT: Harlequins breed along remote mountain streams away from concentrated human activities. The physical features of nesting habitat include very low gradient stream sections with dense shrubs lining the banks, braided channels, swift currents and water rich in aquatic insect fauna. Harlequins will use turbulent stream sections for security and feeding activities. The presence of harlequin ducks on a particular stream is an indicator of high water quality.

LIFE HISTORY AND ECOLOGY: Harlequins begin arriving in the GYE during the last week of April. Breeding pairs and bachelor drakes arrive on the breeding grounds through the middle of May and unpaired hens arrive in early June. Harlequins found in the GYE rarely occur in flocks of more than six birds. In Grand Teton National Park (GTNP), more than 50% of the females identified on the summer range are unsuccessful or non-breeding hens. By mid-July, the majority of the drakes and non-breeding hens depart the breeding grounds and return to the West coast to undergo the post-breeding season molt.

Pair bonds are generally formed on the winter range prior to migration. While on their breeding streams, paired drakes defend a small area of approximately 6.5 ft (2 m) radius around their mate. Bachelor drakes attempt to court almost any hen that they encounter during May. Pairs will avoid other pairs without confrontation, allowing home ranges to overlap extensively in some locations. Once incubation begins the pair bonds are broken. Drakes may remain for about a week in nearby communal loafing areas before leaving the breeding grounds for the coast.

Clutch sizes range from three to eight downy young. The chicks are hatched from late June to early August depending on the elevation and the timing of the spring snow melt. The young are flightless for approximately 6 weeks and depart the summer range shortly after attaining flight skills.

Harlequins show a rather high degree of homing to the breeding grounds. In GTNP, 50% of marked adults returned to the same stream in successive years. However, only one of eight marked hens with broods returned to raise a clutch of chicks 2 years in a row.

While on the breeding grounds, harlequins feed primarily on four orders of benthic aquatic insects (stoneflies, mayflies, caddisflies and dipterans). They will occasionally take filamentous algae and sculpins.

CONSERVATION NEEDS: Much remains to be learned about harlequin ducks breeding in the GYE. In order to evaluate the conservation needs of this species, further research should be conducted. Grand Teton National Park is the only part of the GYE where baseline data have been collected. Intensive surveys are needed

to quantify the presence of harlequins throughout the GYE. Critical information which has yet to be collected includes identification of the wintering grounds, length of generation time, annual variation in birth and death rates, and quantification of occupied habitat.

An estimated maximum of 50 adult harlequins and 50-55 young of the year potentially could occupy GTNP during the breeding season. Productivity of young appears to be lowered in areas with heavy human recreation. Because of the scarcity of known breeding locations on the national forests and the susceptibility to human disturbances in the national parks, the harlequin duck should be studied and managed as a highly sensitive species. Trail construction and maintenance along known breeding streams should be avoided during the first 7-10 days after the chicks hatch, since they are especially susceptible to disturbance during this time.

The harlequin duck is a migratory gamebird with no open season. Regions 1 and 4 (draft list) of the U.S. Forest Service list it as a sensitive species. It is a species of special concern in Idaho (Category A, draft list) and Montana.

NOTES: A pair of harlequin ducks commands a high price among aviculturists (~\$1000.00). This species is becoming more popular in waterfowl collections around North America. Collection of wild birds in the GYE should be strictly limited.

The Montana and Idaho Natural Heritage Programs are conducting research and general surveys of harlequin ducks in the GYE. Harlequin duck sightings should be reported to their offices or to a local National Park Service or U.S. Forest Service office.

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Ferruginous Hawk

Buteo regalis

DESCRIPTION: The ferruginous hawk is the largest North American buteo. Though plumages are similar, females can be distinguished from males by their larger size. Light and dark color morphs occur in the GYE, but the dark morph comprises less than 4% of the population observed in the Centennial Valley.

Females have wing chord lengths of 16.8-17.7 in (43-45 cm) and tail lengths of 9.4-9.9 in (24-25 cm). They average 2.7 lbs (1.2 kg) in weight. Males have wing chord lengths of 16.6-17.3 in (42-44 cm) and tail lengths of 9.1-9.7 in (23-25 cm). Their average weight is 2.3 lbs (1.0 kg). For both sexes, body lengths range from 19.7-26 in (50-66 cm) and wingspreads from 52.8-59.9 in (134-152 cm).

Ferruginous hawks have large heads with pale yellow eyes. The gape and feet are bright yellow. Wings are long and tapered. Legs are feathered. Light morph adults have dark brown/black backs with rufous colored feather edges. The dorsal surface of the wings exhibits the same pattern. The tail is generally white throughout, though a rusty wash is often present on the dorsal side. The entire under surface of the wings, body and tail is white and the rufous colored leg feathers form a noticeable vee in flight.

Light morph immature birds look very similar to light morph adults but lack the rusty appearance. A rufous bib is present during their first summer but this fades by fall. Leg feathers of immature birds are light and do not contrast with the white belly until the second year. The rare dark morph appears all dark except for the trailing edge of the underwing and the tail.

RANGE: The ferruginous hawk, a bird of the arid West, has the most restricted range of any North American buteo. It is found from Washington north to southern Alberta, Saskatchewan and Manitoba, east to the Dakotas, Nebraska, Kansas, Oklahoma and Texas, south to New Mexico and Arizona and west to California and Oregon. Loss of habitat to agricultural practices and disturbance has reduced much of the breeding range of this species.

Within the GYE, it is a common breeder only in the Centennial Valley of Montana where it makes up approximately 30% of the summer raptor community. A fall concentration of buteos occurs in the Henrys Lake area of Idaho, during which ferruginous hawks are the second most common buteo sighted. Ferruginous hawks leave the GYE in September and return in late March and early April. Some migrate as far south as central Mexico.

HABITAT: The ferruginous hawk is a bird of undisturbed western grasslands, arid shrublands and badlands. In the Centennial

Figure 6. Breeding range of the ferruginous hawk in the Greater Yellowstone Ecosystem.

Valley the ferruginous hawk is closely associated with these habitat types on the valley floor.

Seventy percent of the active ferruginous hawk nests located in the Centennial Valley were in willows along streams. Active nests were also found in lone Douglas firs, on rock outcrops, on the ground and on manmade structures. All nests were located within 1.2 mi (2 km) of the valley floor and afforded a commanding view of foraging sites. Ferruginous hawks hunt mainly in open country which in the GYE is characterized by low growing grasses and sagebrush.

LIFE HISTORY AND ECOLOGY: Ferruginous hawks become sexually mature at 2 years of age. Nest construction occurs in April. The nests of ferruginous hawks are very large compared to other buteo nests. In the Centennial Valley the bases of nests are usually about 3.3 ft (1 m) in diameter and about 1.6 ft (0.5 m) high. One ground nest reached 5.6 ft (1.7 m) in height. Nests are constructed of sagebrush and willow branches. The bowl is lined with shrub bark with cow dung a common component. Both sexes provide the necessary nest materials, but the female constructs the nest.

Eggs are laid in April and incubation, performed by both sexes, lasts 28-36 days. Normally, three to four eggs are laid, but one to six have been noted. Eggs are oval in shape and white with varying degrees of brown blotches. The nestling period lasts 40-46 days. Very young nestlings are brooded almost exclusively by the female while the male provides food. In the Centennial Valley the average number of young raised to fledging per active nest was 2.2. Young fledge during the third week of July.

Recently fledged birds suffer mortality from exposure, starvation, predation and accidents. Radio telemetry data from the Centennial Valley indicate that fledged birds leave parental home ranges after approximately 1 month.

In the Centennial Valley the main prey item is ground squirrels, with pocket gophers, mice, voles, small birds and insects also taken. Hunting activity is concentrated in the early morning and late afternoon hours. Ferruginous hawks hunt mainly from low flights or perches.

CONSERVATION NEEDS: The ferruginous hawk is very sensitive to human disturbance and will readily abandon a nest site during the pre-egg laying period and incubation, even if disturbed only once. Severe overgrazing in the Centennial Valley could affect ferruginous hawk nest site selection by causing a decline in the regeneration of willow. Agricultural activities not only present a threat to nest success but often reduce the prey base available to ferruginous hawks. This particular raptor requires large tracts of relatively undisturbed range-land, areas normally associated with low-level grazing.

The ferruginous hawk is a Category 2 candidate for listing under the Endangered Species Act. It is a species of special concern in Idaho (Category A, draft list) and Montana, and a Priority 3 species in Wyoming. Regions 1 and 4 (draft list) of the U.S. Forest Service list it as a sensitive species.

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Bald Eagle

Haliaeetus leucocephalus

DESCRIPTION: The bald eagle is a large, powerful diurnal raptor classified as a fish or sea eagle. Like most raptors, female bald eagles are larger than males. Average wingspan of adult female bald eagles breeding in the GYE is 80.3 in (204 cm) and average weight is 11.5 lbs (5.2 kg). Adult males have wingspans averaging 75.6 in (192 cm) and an average weight of 9 lbs (4.1 kg). Bald eagle body lengths range from 31-37 in (79-94 cm). Bald eagles that breed in the GYE are 3% to 8% smaller and weigh up to 13% less than migrant adults from more northern latitudes. Size dimorphism between immature and adult eagles is often as pronounced as that between males and females. Immatures (eagles less than 4 years old) generally have longer tails and wider wings but weigh less than adults.

Adult bald eagles have white heads and tails and very dark brown to charcoal black wings and bodies, and bright yellow bills, feet and lower legs. Adult males often appear darker than females in body color.

Three to four immature plumage classes have been identified. Immatures 6 months to 2 years old are most often misidentified, as they bear little resemblance to adults. Their head, breast, scapular region, underwings and tail are heavily brown and white speckled.

RANGE: The bald eagle is the only member of the genus *Haliaeetus* to occur in the New World. Its range is restricted to North America. The historic breeding range of the bald eagle included virtually every U.S. state and Canadian province plus portions of northern and eastern Mexico. During the 1960s, bald eagle populations were depressed primarily by the effects of DDT. Breeding range shrank to include only remote, forested portions of the continent, mostly in Canada. Since the banning of DDT in 1973, bald eagle range has expanded and populations have rebounded.

Exponential increases in the number of occupied nest sites and coincident productivity have occurred in the GYE, and bald eagles now occur on all major rivers and lakes in the ecosystem. Three population units are recognized within the GYE based on elevation, nesting phenology, nesting substrate and food habits: the Yellowstone Unit (eagles nesting on the Yellowstone Plateau), the Snake Unit (along the Snake River and its tributaries in Wyoming and eastern Idaho), and the Continental Unit (in the headwaters of the Madison and Red Rock Rivers in southwestern Montana and northwestern Wyoming and the upper Henrys Fork in eastern Idaho).

Approximately 70 occupied nest sites have been documented, and up to 100 migrants may winter in the GYE.

Figure 7. Primary bald eagle habitat in the Greater Yellowstone Ecosystem. Light shading represents areas important to nesting adults. Dark shading represents areas important during summer to juveniles, immatures, and subadults produced in the GYE.

HABITAT: Bald eagles are creatures of aquatic environments. In the GYE, they occupy riparian or lacustrine habitat as breeders but occasionally exploit upland areas for food. Nest sites are distributed around the periphery of lakes and reservoirs and linearly along forested corridors of major rivers, usually within 0.9 mi (1.5 km) of shore. Bald eagles choose older large-diameter trees of a variety of species in which to nest, most often in the taller trees of a large stand.

On rivers, eagles concentrate on runs and pools which provide foraging opportunities year round. Riffles are important seasonally as selected prey fishes use them for spawning and feeding. On lakes and reservoirs in the GYE, eagles use shallow areas, gently sloping shorelines and wetlands.

LIFE HISTORY AND ECOLOGY: Documented age of first breeding in GYE bald eagles is 6 and 7 years old. Nest building and repair occur in every season in well-established pairs but are most intense in fall, late winter and early spring. Both males and females build the stick nests, and nests used over many years may attain a size of 6.5 ft (2 m) high by 5 ft (1.5 m) wide. Egg laying occurs from late February in lower elevations along the Snake River to early April in Yellowstone National Park. Clutch size commonly consists of one to three eggs. Incubation spans 31 to 35 days. Eggs hatch from late March to May, and the nestling period lasts 11 to 14 weeks. Both sexes (but predominantly the female) incubate, brood and feed young. Fledglings are dependent on adults for up to 8 weeks. Virtually all juvenile eagles produced in the GYE leave the ecosystem by November.

Banding and radio-telemetry studies indicate most GYE eagles less than 1 year old migrate west to northern California and southcentral and western Oregon where they spend their first winter. Most return to the GYE by late April. During spring, summer and fall, radio-tagged 1-, 2-, and 3-year-olds produced in the GYE traveled extensively throughout the ecosystem using many widely separated areas in one year. Survival rate of bald eagles radio-tagged as nestlings (n=19) was at least 68% to 1 year. Survival to 2 years was at least 42%. Actual survival rates are probably higher, since some apparent mortality is due to failure of radio transmitters rather than eagle deaths.

Breeding bald eagles are resident in their home range year round in most of the GYE, but some nesting in Yellowstone National Park and immediate high altitude environs may move altitudinally to lower elevations of the GYE in winter. Home ranges of adults nesting along the Snake River include an average of 6.8 mi (11 km) of river, but only about 3.7 mi (6 km) are key use areas. Density of eagle pairs is higher along river sections that are more braided and sinuous. Several eagle pairs include both riparian and lacustrine habitat within their range.

Important prey species for bald eagles in the GYE include fishes (suckers, trout, whitefish, chubs), birds (many species of waterfowl, some passerines and game birds), and mammals (elk, deer, antelope and moose carrion, and ground squirrels, beaver, and hares).

Adult foraging activity is usually most intense during early morning with a second peak of activity in late evening. Foraging activity of immatures is evenly distributed throughout the day but focused on lakes and reservoirs rather than rivers.

CONSERVATION NEEDS: The U.S. Fish and Wildlife Service lists the bald eagle as endangered in all the conterminous United States except Minnesota, Wisconsin, Michigan, Oregon, and Washington, where it is listed as threatened. All seven national forests in the GYE use the bald eagle as a Management Indicator Species. The Greater Yellowstone Ecosystem Bald Eagle Working Group's management objective for the GYE bald eagle population is to maintain 62 breeding pairs with an 85% annual occupancy rate (53 occupied nests), producing 1.0 young per occupied territory per year based on a 5-year running average. As of 1989, the mean number of territories was 63.5, with an occupancy rate of 88% (55.8 occupied nests) and 1.05 young produced per occupied territory. Management objectives also call for preventing threats to bald eagle habitat (such as logging, private land subdivision, or campground development) in 62 nesting territories.

Although the GYE bald eagle population is increasing, continuing human activity and loss of habitat due to housing developments, gravel pits, roads, and recreational facilities is reducing long-term carrying capacity of the GYE. Human disturbance causes reduced nest attentiveness and, under extreme cases, abandonment. Excessive recreational use of rivers and lakes may be affecting adult attentiveness and feeding of young and may be eliminating foraging opportunities for all age classes. Current and increased use may affect productivity and occupancy of existing territories. Environmental contaminants may be affecting bald eagles in the GYE. All eagles tested in the GYE (n=75) had detectable levels of at least two heavy metals in their blood, and many were

at or above levels considered toxic. Monitoring of contaminant levels should continue. The cumulative effects of all anthropogenic disturbances should be investigated. Monitoring of population size and productivity should continue.

Implementation of the 1983 bald eagle management plan for the GYE is needed throughout the ecosystem. Site- and habitat-specific management plans for bald eagle territories throughout the GYE should be given management priority. Management plans for habitat required by subadult and non-breeding eagles are also needed.

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Peregrine Falcon

Falco peregrinus

DESCRIPTION: The most distinguishing feature of the peregrine falcon is the black helmet, nape and moustache stripe or wedge below the eye. Adult peregrines are crow-sized, with dark gray back and tail, and tan to white breast streaked with brown. The cere and feet are yellow in adult birds and the eyes are dark brown. The plumage of both sexes is similar. Female peregrines are one-third larger than males, weighing 1.6-2.1 lbs (719-952 g). The female's body length is 16-18 in (42-46 cm) and wingspread is 40-46 in (102-116 cm). Males weigh 1-1.5 lbs (453-685 g). The male's body length is 14-16 in (37-41 cm) and wingspread is 37-43 in (94-100 cm).

During their first year young peregrines have a dark brown back, tail, and helmet with a heavily streaked breast. Fleishy parts on immature birds range from pale blue to greenish yellow.

The peregrine falcon is the same size as the lighter colored and more common prairie falcon. In flight prairie falcons have contrasting dark brown axillaries or patches under the wings which peregrines lack.

RANGE: The word "peregrine" means wanderer and the bird breeds on every continent except Antarctica. Use of chlorinated hydrocarbons such as DDT contributed to a dramatic decline in peregrine numbers in the northern hemisphere. Peregrines which consumed contaminated prey concentrated DDT in their bodies, with the result that their eggs were too thin-shelled to support the weight of incubating birds. By 1960 peregrines were extinct east of the Mississippi River. The U.S. Fish and Wildlife Service placed the peregrine on the endangered species list in 1969 and began to plan for the species' recovery.

In the northern Rocky Mountain states, which include the GYE, breeding peregrine falcons were gone by 1970. Thirty-two historical nest locations are known within the Greater Yellowstone Ecosystem.

Reintroduction efforts began in the GYE in 1980. Releases of peregrines have been concentrated in the GYE to encourage interaction among potential breeders and to establish a viable breeding population in a minimum of time. Managers expect to reach the GYE recovery goal of 30 breeding peregrine pairs by 1990.

HABITAT: The peregrine falcon lives in open country near rivers, marshes and coasts. Historically, Rocky Mountain peregrines nested in a variety of habitats. Mountain cliffs and river gorges are typical nest locations for peregrines in the Greater Yellowstone Ecosystem. Eyries are found on dominant cliffs at heights greater than 200 ft (60 m). Peregrines occasionally nest on man-made structures including bridges, buildings and release towers.

LIFE HISTORY AND ECOLOGY: Peregrine falcons generally breed at 2 or 3 years of age. The male establishes and defends a territory beginning in mid- to late March. If his mate from the previous breeding season returns to the territory, pair bonds are reformed. If she does not return he will court other females. Peregrines do not build stick nests--they lay their three to four eggs in a gravel or sand depression.

During the 33- to 34-day incubation period the female does most of the incubating while the male wards off intruders and provides food for the female. The semi-altricial young are raised by both parents and stay in the nest until they are about 6 weeks old. Parental care continues for several weeks after the young birds leave the nest.

The migration patterns of Greater Yellowstone Ecosystem peregrine falcons are not well understood. Birds breeding in the GYE may winter in Mexico or Central America or near large western rivers or waterfowl refuges. Some may remain in their breeding territories throughout the year if there is an adequate winter food source.

Small birds, including swallows and shorebirds, make up the bulk of the peregrine's diet. The peregrine is an expert and agile bird hunter and has been clocked at speeds exceeding 200 mi (322 km) per hour in stoops or dives after prey. Although peregrines have been recorded hunting up to 18 mi (28.9 km) away from their nests, a 10-mile (16 km) hunting radius is more common.

CONSERVATION NEEDS: In the United States DDT use was banned in 1972. The ban, combined with reintroduction and management efforts, has allowed reestablishment of the peregrine throughout much of its historical range. Resource management agencies, conservation groups, businesses and private citizens have worked cooperatively in this successful recovery program.

In 1984 two pairs of peregrines nested and successfully fledged young for the first time since 1970 in the Greater Yellowstone Ecosystem. Eleven pairs of peregrines were known to be defending territories in 1988 in the Greater Yellowstone Ecosystem, and 17 young were fledged. In 1989, 19 pairs were defending territories, and 22 young were fledged (pers. comm., Ed Levine). Population monitoring in the GYE could reveal several more breeding pairs of peregrines. Peregrine populations in the GYE continue to be exposed to pesticides in countries where they or their prey migrate. Continued management of wild peregrine populations may be necessary to sustain breeding populations affected by chemical use. Reproductive trends and pesticide residue levels must be monitored in recovering populations.

The effects of the 1988 fires on the GYE peregrine population cannot be predicted with certainty, but the fires may benefit the peregrines by improving prey availability and foraging habitat. The peregrine falcon is listed as an endangered species by the U.S. Fish and Wildlife Service. It is used as a Management Indicator Species by the Gallatin, Beaverhead, Custer, and Bridger-Teton National Forests.

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Merlin

Falco columbarius

DESCRIPTION: The merlin is a small falcon noted for rapid flight and enduring tail-chases of small birds. Merlins are 9-12 in (24-30 cm) long with a wing span of up to 27 in (68 cm), lack distinctive mustache marks and have a banded tail in which the light bands are noticeably narrower than the dark bands. Adult males have bluish backs, whereas immature and female merlins have brown backs.

Three subspecies are generally recognized. *Falco columbarius richardsonii*, the Richardson's merlin, is very pale with the male having a powder blue back and the female tending toward light to medium brown. The tail is banded with whitish bands. The taiga merlin, *F. c. columbarius*, of the northern boreal forests is darker than the prairie form, has a faint mustache and buffy (female) or bluish (male) bands on the tail. The black merlin, *F. c. suckleyi*, of the Pacific coast is the darkest of the three forms with a back tending to dark brown or almost black and a tail in which banding is faint. Immature birds tend to resemble females but have a darker brown back.

Regardless of age or subspecies, the merlin's small size, long, pointed wings and longish, banded tail are all good field marks for the species. However, it may be confused by the novice with the slightly smaller American kestrel (*F. sparverius*) which lacks the merlin's banded tail and possesses distinctive mustache marks, or the sharp-shinned hawk (*Accipiter striatus*) which has short, rounded wings and tail bands of equal width.

RANGE: Merlins are found nesting in the northern latitudes of North America from coast to coast. The Richardson's merlin occurs in the central and northern Great Plains south to central Wyoming, and west to eastern Idaho. The taiga merlin nests in the boreal forests of Canada and Alaska to the northern conterminous United States. The black merlin is found nesting primarily along the coast of British Columbia.

Merlins winter from the north-central United States to South America. Many Richardson's merlins remain within their breeding range in or near towns where they feed on passerine birds attracted to feedlots and backyard bird feeders.

There have been no verified merlin nests reported in recent years in the Greater Yellowstone Ecosystem although there have been occasional sightings of birds during the breeding season, and a nest has been reported just outside the eastern boundary of the GYE (B. Oakleaf, Wyoming Game and Fish Dept., pers. comm.). Some merlins winter in and around the GYE and they migrate through the area during the spring and fall.

HABITAT: Like all long-wings (falcons), merlins are best adapted to open country. Typically, nest sites are found in abandoned corvid or raptor nests which are in close proximity to meadow, cool desert or prairie habitat. Black and taiga merlins tend to winter in almost any habitat encountered on their winter range, but Richardson's merlins often remain in prairie parklands during the winter.

LIFE HISTORY AND ECOLOGY: Merlins generally take up breeding territories in April and begin egg-laying in May. Since, like all North American falcons, merlins do not build their own nests, the nest site chosen is usually a stick nest of another bird. It is not uncommon, however, for taiga merlins near the Arctic treeline to nest in a scrape on the ground, and Richardson's merlins have occasionally been observed to nest in tree cavities and on cliffs. The female usually lays four to five cream-colored eggs covered with rust-colored splotches, which hatch after about 30 days. The male does most or all of the hunting during early brood-rearing while the female tends to the young and defends the nest area, often with great vigor. Most of the prey brought to the nest are small birds. Young fledglings spend the latter portion of their flightless youth moving around on branches of the nest tree, and approximately a month after hatching they are ready to fly. After the young fledge they often remain together as a family group for up to 5 weeks.

CONSERVATION NEEDS: Merlins have suffered some ill effects from pesticide contamination, and in certain locations population declines have been noted in the past, especially for the Richardson's merlin. Pesticides can also have deleterious effects on prey populations and should be used and monitored carefully. There has been an increase in merlin numbers in some Canadian cities with humans "creating" good merlin habitat by planting ornamental trees which attract and enhance merlin prey populations and which provide nest sites for large birds like crows and, eventually, merlins.

Surveys are needed to determine the merlin's status and distribution in the GYE. The merlin is listed as a species of special concern in Idaho (Category B, draft list) and Montana, and a Priority 2 species in Wyoming. Wyoming lists it as the raptor most in need of additional inventory work in the state.

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Whooping Crane

Grus americana

DESCRIPTION: The whooping crane is the tallest bird in North America; males standing erect approach 4.9 ft (1.5 m). Sexes look alike but males usually are slightly larger. Weights of captive adults average 16 lbs (7.3 kg) and 14.1 lbs (6.4 kg) for males and females, respectively. Adult plumage is snow white except for black primaries, black or grayish alulae, and a dark gray-black triangular shaped patch on the nape. The crown and malar region on the head is carmine and covered with sparse black bristly feathers. The bill is dark olive-gray with the base pink or rose colored; the iris is yellow. Legs and feet are black except for the ventral surfaces of the toes which range from salmon to a pinkish-yellow color.

Plumage of juveniles is a mottled mixture of white and cinnamon/rust colored feathers and varies considerably between individuals. Feather replacement continues until adult plumage is attained between 12-15 months of age. Eye color of juveniles is a light blue-gray but slowly changes to the yellow adult color during the first winter.

RANGE: The whooping crane is found only in North America. The historic range during the past 250 years extended from the Arctic coast south to central Mexico, and from the Rocky Mountain region (Utah) eastward to the Atlantic coast. Only one wild nesting population of about 133 whooping cranes exists today. Current range is very restricted to a nesting area in northern Alberta and southern Northwest Territories, Canada (mainly Wood Buffalo National Park), and the major wintering site on the Texas coast near Corpus Christi (mainly Aransas National Wildlife Refuge). The migration route includes much of the Great Plains region of North America between northern Canada and the Texas coast. A major fall stopover area is in southern Saskatchewan. Historic records show whoopers present in western Wyoming including the Greater Yellowstone Ecosystem and vicinity (1906, 1912, 1914, 1915 or 1916, 1930), Star Valley (1934, 1935), Idaho (Bear River, 1832) and Utah (Great Salt Lake, 1880s).

All whoopers currently summering in the GYE and vicinity are a result of the cross-fostering experiment initiated at Grays Lake National Wildlife Refuge, Idaho, in 1975. Eggs produced by the wild flock nesting in Canada and the captive flock in Maryland (Patuxent Wildlife Research Center) are placed in sandhill crane nests at Grays Lake. The sandhill cranes become foster parents to the whooping crane chicks. Major summer sites in the GYE and vicinity include Yellowstone National Park, Grand Teton National Park, Grays Lake, Island Park and Teton Basin in Idaho, Upper Green River Basin, Wyoming, and the Centennial Valley, Montana.

HABITAT: Whooping cranes in the GYE primarily use shallow wetlands, wet meadows and adjacent upland sites for their daily activities. Preferred sites have minimal human disturbance. During September, whoopers join their sandhill crane cousins and gather in favored staging areas mainly at Grays Lake, Island Park, and Teton Basin, Idaho, and the Upper Green River Basin, Wyoming.

LIFE HISTORY AND ECOLOGY: Whooping cranes occur in the GYE and vicinity mainly between April and mid-October. They are omnivorous feeders, taking both vegetal and animal foods, including plant tubers, leaves and berries, cultivated grain crops such as barley and wheat, a variety of invertebrates and small fish, frogs, birds and mammals. Whoopers are monogamous and normally pair for life but will re-mate following loss of a mate. First nesting can occur anytime after age 3. Whooping cranes nest in May and June. The normal clutch is two eggs (sometimes one, rarely three) which require 29-30 days' incubation by both sexes. Young are precocial but are fed by parents. Young fledge between 78-90 days and families remain together through March-April of the following year. Adults return to the same summer territories for life unless the habitat becomes unsuitable.

CONSERVATION NEEDS: Cranes can tolerate little human disturbance, especially during nesting, brood rearing, and during the flightless molt (May-mid-August). Slight human disturbance is often sufficient to cause adults to desert nests. Cranes especially suffer from illegal shooting, powerline collisions, collisions or entanglement in barbed wire fences, and diseases, especially avian tuberculosis. When planning new powerline construction, wetlands and immediate adjacent areas frequented by cranes and trumpeter swans should be avoided.

The whooping crane is a federally listed endangered species and is one of the most highly endangered animals in North America. In addition to the cross-fostering program at Grays Lake, the whooping crane

recovery effort focuses on maintaining and increasing the wild nesting flock and breeding whooping cranes in captivity. A potential release site in Florida is being studied for a planned release of captive-bred whoopers in the mid-1990s.

NOTES: To date, no whooping cranes cross-fostered by sandhill cranes at Grays Lake have successfully paired and nested. Excessive mortality of adults, very limited number of females (currently four in the population), wide summer distribution of females, and possible problems with imprinting have hindered pair formation. A 6-year male and female stayed together at Grays Lake in summer 1989. A number of matings occurred in May and the birds may establish a permanent pair bond.

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Mountain Plover

Charadrius montanus

DESCRIPTION: The mountain plover is a medium-sized member of the plover family. Sexes are similar in size and plumage. The mountain plover weighs about 4 oz (110 g) and measures about 9 in (22 cm) long. Its wingspread is about 17.5-18.5 in (44.5-47 cm). Plumage is a nondescript bay color, darker above and lighter below. During the breeding season, a nearly black head cap is set off by a white eye stripe and a bright white patch on the forehead. In flight, a white wing stripe and dark tail band with white border are good field marks.

RANGE: The original breeding range of the mountain plover included the shortgrass prairies of the Great Plains from the Canadian border south to New Mexico and Texas. Range restriction and population declines have been noted during this century. Causes of this decline were believed to be market hunting on winter ranges, and loss of breeding and wintering habitat due to agricultural development. Today the mountain plover breeds throughout most of its original range but only in isolated areas. Nesting mountain plovers have been recorded in the Chapman Bench area north of Cody. The mountain plover is transitory through the Greater Yellowstone Ecosystem in Wyoming and Montana. They would be expected to use any shortgrass areas in the GYE during migration. Winter range includes parts of Texas, California, and Mexico.

HABITAT: The mountain plover is a bird characteristic of shortgrass prairies. It prefers grassy areas devoid of shrubs with vegetative height under 4 in (10 cm). Frequently, short grass habitats modified by grazing ungulates, prairie dogs, or fire are selected over surrounding areas for nesting. In some areas this species may actually benefit from intensive livestock grazing. Mountain plovers prefer sites with broad level topography, but they also nest in mountain foothill areas of Montana around livestock watering sites located on gently sloping benches. Wintering habitat is poorly defined.

LIFE HISTORY AND ECOLOGY: The mountain plover arrives at its northern breeding ranges in mid-April. Courtship displays and mating follow in May. In late May, the female lays a clutch of three eggs for the male to incubate. The female then lays an additional three eggs in another nest which she incubates. Mountain plover nests are shallow depressions in the soil lined with pieces of lichen, dried cattle manure, and plant litter. Nesting plovers may feign injury to distract predators from a nest site. They are also reported to fly at the faces of ungulates to prevent nest trampling. Eggs hatch at 4 weeks. The young are downy and cryptically colored. Plover chicks leave the nest shortly after hatching and follow their parent, learning to forage for themselves. Mountain plovers feed almost exclusively on insects, with beetles, grasshoppers and ants forming the bulk of the diet. Birds begin to flock by early August and leave the breeding areas by mid- to late August.

CONSERVATION NEEDS: Maintenance of nesting habitat is crucial for the survival of mountain plovers. Winter range habitat may also be a limiting factor. The mountain plover was listed as a Category 2 candidate species for listing under the Endangered Species Act by the U.S. Fish and Wildlife Service in 1973 due to reports of declining numbers and habitat. Montana lists the bird as a species of special concern.

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Long-Billed Curlew

Numenius americanus

DESCRIPTION: Long-billed curlews are the largest shorebird indigenous to North America. Adults have long, decurved bills which range from 4.5-8.6 in (11.3-21.9 cm) in length. Body length is 21-26 in (53-66 cm) and wingspread is 36-40 in (91-102 cm). Adults weigh about 1.75-2 lbs (794-907 g). Females tend to be larger than males, especially in bill length, and to have lower-pitched calls. Adult plumages are mottled brown with a distinctive cinnamon coloration, especially to the underwing coverts and axillaries; the crown is streaked and lacks any stripes. Long-billed curlews can be difficult to sex on the basis of size or plumage. When seen in profile, however, the length of an adult female's bill is usually more than three times the diameter of her head, whereas the male's bill length is usually about two head diameters.

RANGE: Long-billed curlews breed from the southern interior of British Columbia and the prairies of Alberta and Saskatchewan, south to Utah and Texas. These birds are relatively short-distance migrants. Some winter in the West, from the Central Valley of California, south along the Pacific coast and through the Imperial and Colorado River valleys, and along the Gulf of California. Others winter in the East, from South Carolina to Florida and along the Gulf Coast from Louisiana and Texas south at least as far as Honduras.

Scattered breeding pairs of long-billed curlews can be found in those parts of the GYE where suitable habitat exists, including the National Elk Refuge, Grand Teton National Park, Grays Lake National Wildlife Refuge, Teton Valley, Idaho, Henrys Lake Flats, and the Centennial Valley. Other important nesting habitat for long-billed curlews is found in the Chapman Bench area north of Cody and in the upper Green River drainage north and west of Pinedale.

HABITAT: Long-billed curlews select open habitats year round. During the breeding season, they frequent prairies and grasslands, as well as plowed fields, meadows, and pastures. Whereas long-billed curlews use developed lands for feeding, they have not been reported to nest in agricultural areas. Height of the vegetation, which rarely exceeds 11.8 in (30 cm), appears to be more important than its composition, probably because tall, dense vegetation interferes with the birds' foraging abilities. Because reproductive success is better in years when the vegetation on their nesting territories is not too tall, intensive grazing and fires can be effective management tools when used at the proper time of year. On their winter range, some long-billed curlews use grasslands and fields, while others seem to prefer intertidal and estuarine habitats along the coast.

LIFE HISTORY AND ECOLOGY: Long-billed curlews arrive on their upland breeding grounds during the latter half of March and early to mid-April. Arrival in the GYE is probably during April given the later phenology. Males arrive first and disperse over suitable habitat to establish nesting territories. These territories are relatively large (29.7-49.4 ac, 12-20 ha) and normally are used by both members of a pair for feeding and nesting. Males without mates advertise their status to available females by performing conspicuous flight displays around the perimeter of their territory. Females with previous breeding experience in an area may return with or soon after their mates. Courtship behaviors among these experienced pairs are much reduced, and they may begin nesting within 7-10 days of arrival. Four eggs are laid in a grass-lined depression on the ground. Incubation lasts 28-29 days and is shared by both sexes. Females tend to incubate during the day, and males at night.

Parental care of the highly precocial chicks consists primarily of vigilance and defense against potential predators. Anti-predator behaviors range from mild escape reactions to intense mobbing and attack. Adults engage in mobbing behavior from late in incubation until their chicks are 3-4 weeks old. Females tend to mob and/or attack only when their own chicks are threatened. Males not only defend their own chicks in this manner, but they also will assist neighbors with mobbing efforts.

Young chicks are brooded during inclement weather. Parents appear to keep their brood together and to direct its general movements. Fledging occurs when the chicks are 38-42 days old. Females usually depart the breeding grounds in late June or early July, before their chicks have fledged. If the chicks are nearly fledged at this time, males may depart with their mates; otherwise the males will remain to care for younger chicks. After fledging, juveniles and any remaining males gather into flocks and search for swarms of grasshoppers. These staging flocks may be seen in irrigated fields or pastures during the heat of the day. By the end of August most long-billed curlews have migrated from their breeding grounds.

Juvenile birds remain on the wintering grounds until they are almost 2 years old. Both sexes may undertake a northward migration at age 2, but they probably do not attempt to breed. Females may begin breeding at age 3, but males may not acquire a territory and mate until age 4 or 5.

The long-billed curlew's diet consists primarily of small invertebrates including earthworms, spiders, beetles, caterpillars, and grasshoppers. Curlews wintering in estuarine habitats feed on crustaceans, mollusks, and small amphibians.

CONSERVATION NEEDS: First, the breeding grounds of these birds have been fragmented and drastically reduced in the last century. Despite evidence that some populations have been increasing and expanding in recent years, too much nesting habitat has already been lost, and remaining areas must be protected. Some curlew nesting habitat in the GYE has been lost to agricultural development.

Second, despite treaties and laws, adult long-billed curlews are still shot needlessly in some areas. This tends to occur in late May or June when human visitors carrying firearms find long-billed curlews to be tempting targets. At this time, adult curlews may be easily shot while trying to protect their young.

Long-billed curlews have evolved conservative reproductive tactics characterized by long-term monogamous pair-bonding, and low reproductive effort. These adaptations, no doubt, enhance individual longevity and the ability to capitalize on optimum breeding conditions whenever they might occur. At the same time they underscore the importance of protecting both the adult birds and the quality of their nesting habitat. The long-billed curlew is a Category 2 candidate for listing under the Endangered Species Act. It is a species of special concern in Montana and a Priority 3 species in Wyoming.

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Upland Sandpiper

Bartramia longicauda

DESCRIPTION: The upland sandpiper, formerly known as the upland plover, is a prairie shorebird that is most closely related to the curlews, and the only member of the genus *Bartramia*. Adults stand 11-12.5 in (28-32 cm) tall and look alike. Males weigh 4.7-5.9 oz (132-166 g) and females weigh 4.7-6.2 oz (132-175 g). They have a delicate profile with a small head, long neck, large, dark eyes, and a relatively short bill that is slightly decurved at the tip. Black feathers edged in buff create a brown scale-like pattern on their back and wings. The neck and chest are pale buff streaked with black, and the belly is white. Upland sandpipers have a blackish crown, with a white line above the lore that merges with a white eye ring. The bill is black above and light yellow below. They have a long tail that extends well beyond the folded wing-tips, and long, yellowish-gray legs. The precocial young are mottled with brown, black, and white above, and white below. Upland sandpipers perch on fenceposts, rocks, or stumps, and often hold their wings aloft on landing. They are very vocal and utter three or four different calls. Unlike most shorebirds, they are seldom seen near water.

RANGE: The breeding range of the upland sandpiper extends across northwestern Alaska, the Yukon, and British Columbia south to Oregon, and southeast through the Great Plains and the Lake States to West Virginia and Maryland. They winter in southern South America on the pampas of Argentina and Uruguay. There are no records of upland sandpipers nesting in the GYE, although reliable observations have been made by U.S. Forest Service personnel during the nesting season on the Targhee National Forest.

HABITAT: The breeding habitat of upland sandpipers is native grasslands, particularly mixed and tall-grass prairie. In North Dakota, the center of their geographic breeding range, 183 of 199 nests were found in grasslands, mostly native prairie. Upland sandpipers also nest in wet meadows, hayfields, small grain fields, retired croplands, and mowed or burned railroad or highway right-of-ways. Flocks of upland sandpipers stop to feed in upland pastures, dry meadows, and grasslands on their long-distance migration to relatively similar habitat on the pampas of South America.

LIFE HISTORY AND ECOLOGY: Upland sandpipers, often already paired, return to their breeding grounds in mid-April to early May, and 2-3 weeks later, begin to nest. Courtship behavior includes two distinctive aerial displays performed by both sexes. One is called "sky circling," where a sandpiper slowly circles high above the prairie and utters a long, penetrating whistle, and then dives abruptly back to the ground. The other is the "flutter stroke," where a bird flies horizontally 15-20 ft (4.5-6 m) above the ground with a series of rapid wing strokes followed by a long glide.

Both the male and female participate in the construction of the nest, which is a depression in the ground, often hidden in a tuft of grass and lined with dried grasses. The female usually lays four buff to creamy white eggs that are spotted with reddish brown on the rounded end. For about 24 days (range 21-28 days), both sexes take turns incubating the eggs. After hatching, usually a single adult (often the male) attends the downy young until they are able to fly at about 32-34 days of age. The adults and fledged young gather into flocks in mid- to late July.

Upland sandpipers eat primarily terrestrial insects, such as adult beetles, beetle and lepidopteran larvae, ants, moths, centipedes, and spiders, as well as snails, earthworms, seeds, and waste grain. Grasshoppers, crickets, and weevils make up almost half their diet.

CONSERVATION NEEDS: Upland sandpiper populations seriously declined in the late 1800s due to excessive hunting for the commercial meat market. Market hunters shot thousands of "prairie pigeons" and packed them in barrels to ship to the cities.

Upland sandpipers are sensitive to prairie grassland conversion and overgrazing. The decrease in the extent of native prairie grasslands has greatly reduced the geographic range of upland sandpipers. They are on a number of state endangered species lists (Illinois and Ontario), and were on the National Audubon Society's Blue-List (an early warning system for species experiencing population or range reductions) from 1975-1986. Idaho lists the upland sandpiper as a species of special concern (Category A, draft list), and Wyoming lists it as a Priority 2 species. There is general concern that populations are declining, especially in the eastern portion of their range. Surveys should be done to determine the status of the upland plover in the GYE.

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Burrowing Owl

Athene cunicularia

DESCRIPTION: The burrowing owl is a small, brown, long-legged owl of the open plain. It is a crepuscular forager but is also active during the daytime. It is heavily spotted on the back and barred on the front with males usually lighter brown than females during breeding season. Juveniles are buffy below with little barring. This species has a white chin stripe, round head without ear tufts and a relatively short tail.

The burrowing owl is the only North American owl which does not exhibit size dimorphism. Males and females are similar in size and weight. Body lengths vary from 9-11 in (23-28 cm), wing spans are 6.7 in (169 mm) for males and 6.5 in (166 mm) for females, and weights fluctuate between 5.3 and 5.6 oz (150 and 160 g) for both sexes.

When agitated, the burrowing owl bobs up and down and gives a rapid "check-check" alarm call. At night a soft "co-hoo" similar to a mourning dove's coo is heard. If the owl nest is disturbed, the young owls inside emit a call for protection remarkably similar to the sound of a rattlesnake. Burrowing owls are most often seen perching outside the entrances to their underground nests, either on the ground or on a small shrub.

RANGE: The burrowing owl's range throughout the Greater Yellowstone Ecosystem is limited to open tall grass/sagebrush prairies. In rural areas around the GYE where open plain habitat predominates, the burrowing owl is found in isolated colonies. Historically, this owl ranged throughout the lower 48 states and Canada from the open seaside prairies of the East to the deserts of the Southwest. Loss of habitat and prospective nest sites has extirpated the burrowing owl from most of its range, including the midwestern U.S. and Canada. It is still somewhat common west of the Mississippi, becoming more abundant in the arid deserts and prairies of Alberta, Idaho, Oregon and Washington. It is also found in the southern states from California to Texas and as far south as central Mexico. Some success has been achieved in reintroducing owls in British Columbia.

Burrowing owls are migratory in the northern expanse of their range above 37° latitude. The northern population of owls appears in mid-March and migrates in September or October, apparently leap-frogging over the southern non-migratory populations. Their winter range is currently unknown.

HABITAT: The burrowing owl is heavily dependent upon the excavating activity of ground-dwelling mammals for nesting sites (i.e., skunks, badgers, prairie dogs, ground squirrels). Soil types in which these owls nest vary greatly;

Figure 8. Burrowing owl distribution in the Greater Yellowstone Ecosystem. Dark shading represents areas where owls are common residents and nest yearly. Medium shading represents areas where owls nest frequently (1-5 years). Light shading represents areas where owls nest occasionally or rarely (>5 years).

substrata preferred by burrowing mammals, however, dictates the owls' presence in the west. Only in Florida, where a small disjunct population exists, do they prefer to excavate their own burrows. Occasionally owls nest in lava outcrops in southeast Idaho.

In optimum sites, vegetation seldom exceeds 3.3 ft (1 m) in height, especially within the GYE. Burrowing owls rarely reside where trees and tall shrubs exist, probably because these tend to reduce the owls' visibility for predators and prey. In addition to burrowing mammals, the owls' habitat must support populations of small rodents such as montane voles and deer mice, which the owls use as a food source. Grasshoppers, carrion and scarab beetles, and Jerusalem crickets are also a major part of the owls' diet in mid- to late summer when temperatures become very warm.

LIFE HISTORY AND ECOLOGY: The burrowing owl is a colonial nester living in loose groups of two pairs or more. Nests may be solitary or as close as 32.8 ft (10 m) apart. Nests are generally characterized as a 5.9-7.9 in (15-20 cm) diameter abandoned burrow sloping downward to a nesting chamber located anywhere from 3.3-16.4 ft (1-5 m) back from the entrance. The mouth of an active burrow is commonly scattered with debris such as cow and horse manure and rodent carcasses.

Mating and egg laying occur in early April, each nest having an average of 10 eggs per nest in Idaho. The incubation period lasts approximately 26 days with the eggs beginning to hatch around the first week in May. Young are born semi-altricial and range in number from 1 to 12 with a mean of 6 young per nest. The owlets remain below ground for 20 to 30 days and leave the nest shortly thereafter. During incubation the male parent is solely responsible for food retrieval while the female remains with the eggs. After hatching, the female's hunting role increases to supply food for the rapidly growing young. In mid- to late summer the young disperse. Adulthood is attained the year following hatching.

Burrowing owls forage for food at dusk and into the twilight and return to the hunt in early morning. Foraging strategies early in the season include hovering over potential prey such as voles or mice and dropping down quickly to trap the animals in their talons. Perching on fence posts or shrubs and waiting for prey movement is another well-practiced method. In mid- to late summer when temperatures increase, the owls' diet shifts to insects because of their increased availability and ease of capture.

Major predators include badgers, weasels, mink, and coyote. The owls are most vulnerable during the incubation and fledging stages when they reside below ground. Domestic cats and dogs also pose possible threats to young. Home ranges, based upon recent telemetry studies, are approximately 0.8 mi² (2 km²) around the nest burrow. This range is seldom circular; boundaries are irregularly shaped based upon the habitat and the proximity to other owls or predators.

CONSERVATION NEEDS: The burrowing owl is an excellent environmental indicator because its existence hinges upon a multitude of complex ecological factors. Not only is this raptor dependent on small rodents and insects for food, but its nesting site selection is limited to those areas which exhibit burrowing mammal activity. Removal of such animals, which quite often are considered pests, effectively eradicates the burrowing owl. Over recent years, the owl's numbers have been declining steadily in the West. Much of the burrowing owl's habitat, although not affected by grazing, is being destroyed by farming. Farming practices which leave dirt berms at the edge of cultivated fields would be beneficial as would the use of artificial nest burrows (ANB) if burrowing mammals have been exterminated.

Until recently, little was known about this owl and its underground habits. The development of ANB in recent years has shed light on much of the breeding biology of this unique owl. Although more information is needed, proper management of this raptor is beginning to take shape. Surveys are needed to determine the current status of the burrowing owl in the GYE. The burrowing owl is a species of special concern in Montana and a Priority 2 species in Wyoming.

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Great Gray Owl

Strix nebulosa

DESCRIPTION: The great gray owl is the largest owl in North America. This species is easily recognized by its large size, large rounded head without ear tufts, mottled gray plumage, and enormous pale gray facial disks surrounding yellow eyes.

Females have body lengths of 21-26 in (54-67 cm) and weights of 2.3-2.9 lbs (1030-1310 g). Males have body lengths of 18-24 in (47-62 cm) and weights of 1.7-2.4 lbs (763-1080 g).

RANGE: In North America the great gray owl occurs from the boreal forests of Alaska, east to Ontario, south to northern Minnesota and Wisconsin, northwestern Wyoming, western Montana, northern Utah, Idaho, and through the Sierra Nevadas in California. In the Greater Yellowstone Ecosystem, it occurs primarily in the lodgepole pine/Douglas fir/aspen zone at elevations up to 9,850 ft (3,000 m).

HABITAT: The great gray owl is found in coniferous and hardwood forests. These owls forage along the edges of meadows, clearcuts, and in open forests. They do not build nests but use existing platforms such as old stick nests built by northern goshawks (*Accipiter gentilis*) or red-tailed hawks (*Buteo jamaicensis*). They may also nest on platforms formed by dwarf mistletoe brooms, on the flat top of a broken-off tree, or on artificial platforms. The fires of 1988 probably increased foraging habitat for great gray owls in the GYE, although effects on nesting habitat are unknown.

LIFE HISTORY AND ECOLOGY: Great gray owls are not commonly seen throughout most of their range. They are seldom seen in the GYE, although several nests have been located. The female starts incubating eggs as early as April and as late as June, and one to five young are raised. The female incubates the eggs and broods the young while the male provides all or most of the food. The young owls leave the nest after 3-4 weeks but, unable to fly for 1-2 more weeks, they climb small leaning trees and perch out of reach of mammalian predators. Both adults care for the young for several weeks after they leave the nest, then the male continues to feed the young for up to 3 months, until they are able to hunt for themselves.

They forage primarily on voles (*Microtus* spp.) and pocket gophers (*Thomomys talpoides*) throughout the year. In some areas they migrate to lower elevations in the winter to avoid deep snow which reduces the availability of prey. If prey is scarce in the spring, the owls may not breed.

Radio telemetry has shown that juvenile mortality is high in the first year of life. Most great grays do not nest until they are 3 or

Figure 9. Locations of great gray owl pairs in the Greater Yellowstone Ecosystem (based on Franklin's 1988 study in Idaho and Wyoming). Each dot represents one or more pairs.

4 years old. Once they start nesting, great gray owls typically keep the same mate and nest in the same general vicinity year after year.

CONSERVATION NEEDS: Intensive timber management may be detrimental to great gray owls if nest sites or roost trees needed by fledged young are eliminated. Many suitable nest trees are harvested during timber sales, including trees with mistletoe which are undesirable from a silvicultural standpoint. Broken-topped dead trees are often cut for firewood. Fortunately, great gray owls readily nest on artificial platforms that can be supplied in forest stands, particularly in areas historically used by great gray owls.

Surveys are needed in the GYE to locate great gray owl nesting territories. This is particularly important in those areas which are being logged. Surveys by the Idaho Department of Fish and Game for great gray owls on the Targhee National Forest suggest that they may be declining there.

The great gray owl is a species of special concern in Idaho (Category C, draft list) and Montana.

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Boreal Owl

Aegolius funereus

DESCRIPTION: The boreal owl is a small, 9 in (23 cm) chocolate brown owl of high elevation forests. White wing spots, tail bars, and a white and brown mottled breast highlight its plumage. A white facial disk outlines the boreal owl's head, which is further distinguished by a light-colored bill and white head spots. Juvenile boreal owls are solid dark brown, except for some wing spots and white semi-circles outlining the inner facial disk. The adult's head spots, pale bill, dark brown color and relatively large size distinguish it from the congeneric saw-whet owl. Juvenile saw-whet owls are distinguished from juvenile boreal owls by their dark bill and a dark bib on a rusty breast. As the most dimorphic of all owl species, boreal owl sexes differ substantially in size. Males average 4.1 oz (117 g) and females 5.7 oz (163 g).

RANGE: The boreal owl's distribution is circumboreal, extending across the northern regions of North America, Europe and Asia. Prior to 1981, the owl's North American range was believed limited to Canada and Alaska. Since then, however, breeding populations have been documented throughout the northern Rocky Mountains in eastern Washington, Idaho, Montana, Wyoming and Colorado. Other sightings are documented in the Washington Cascades and northern New Mexico. Undoubtedly, the species also inhabits Utah and Oregon and possibly California. As elsewhere, almost nothing is known about the boreal owl's distribution in the GYE. One dead boreal owl was found on the west side of the Teton Range in November 1986. Calling birds were heard near Henrys Lake in 1987 and 1988, in the Lionhead area in April 1988, and from the west side of Teton Pass in April 1985, February 1988, and March 1989. Boreal owls have been heard calling from 24 locations in Grand Teton National Park (some of these calls may have been from the same territories and do not necessarily represent 24 pairs).

Juveniles were photographed in 1984 in Grand Teton National Park, and one nest site was located in the park in 1989. Courtship was observed at this site, but the nest failed. Boreal owls probably occur throughout the spruce-fir forests of the region.

HABITAT: The overriding common factor of boreal owl habitat throughout its range is spruce-fir zone forests (i.e., high elevation). The exact species, age, and size composition of forests used by the owls varies with location and the owls' activity. Mature forests are necessary for nesting because the owls require large nesting cavities (3 in [7.6 cm] diameter opening and 15 in [38.1 cm] diameter tree at cavity), but the owls frequently use pole stands for hunting. They will also use openings where perches are available (e.g., forest edges), especially in spring when snow cover is still present under the forest canopy but openings have melted. Preliminary evidence suggests that boreal owls seek cool

Figure 10. Locations of boreal owl sighting or calls. Some dots represent more than one record.

forest stands in spruce-fir forest for summer roost sites. Small mammal abundance may also be greatest in these stands. Because spruce-fir forests contain few cavities, however, forest types with abundant cavities within or adjacent to spruce-fir forests may be ideal habitat. For example, small patches of large aspen may be extremely important, and ponderosa pine stands on warm, dry microsites within the spruce-fir zone in central Idaho support a large population. The one nest found in Grand Teton National Park was in an aspen.

LIFE HISTORY AND ECOLOGY: Boreal owls remained undetected in the Rocky Mountains until recently because of their nocturnal activity and winter courtship. Males call from potential nest sites (often from the cavity itself) between early February and late April with the peak in March. Their call closely resembles that of a winnowing snipe, consisting of a series of staccato notes that quickly crescendo to a peak that is briefly maintained. The short calling period is almost the only time to locate boreal owls. (Some people have reported a fall calling period, but it is doubtful the birds are calling from breeding sites at that time). Breeding efforts vary widely from year to year, presumably in response to small mammal populations. Males defend a small area around the nest site, but otherwise home ranges overlap extensively. In central Idaho, home ranges varied from 828-7,413 ac (335-3,000 ha) but are most commonly over 2,471 ac (1,000 ha). Habitat quality, particularly small mammal abundance and the relative distance between high quality foraging areas and potential nest cavities, are major determining factors in home range size and owl movements.

Females begin occupying the nest 1-2 weeks prior to egg laying in early April to mid-May. Time of egg laying varies from year to year but seems consistent within an area and year. Two to four eggs are normal in central Idaho. With abundant prey, however, clutch size may be much larger. Clutches of seven are common in Scandinavia. The male provides the female with some prey during courtship and provides all prey from the beginning of nest occupancy through the third week of brooding when the female leaves the nest. After leaving the nest, most females no longer play a role in raising the young. They may, in fact, move large distances away. Juveniles fledge at about 30 days, having achieved adult weight. Their feather development, however, is still incomplete. Males continue to feed the young until they are independent.

Although boreal owls will opportunistically capture prey during the day and will actively hunt in daylight if bad weather has hampered nocturnal foraging, they are primarily nocturnal birds. The peak of their activity occurs within 2 hours of sunset and sunrise. During the day, they generally roost next to the bole of a tree making only a few short flights, usually to prey cached nearby. Winter roosts show little pattern, but summer roosts usually occur in cool microsites. Often the owls' activity shifts to higher elevations in the summer, in part to avoid heat stress.

Boreal owls prey primarily on small mammals, especially the red-backed vole, which makes up 25-50% of their diet. They are opportunistic hunters, and their summer diet is varied, including insects, jumping mice, chipmunks, birds, pocket gophers, shrews, deer mice and voles. Red-backed voles, however, continue to form the bulk of the diet. Females occasionally capture flying squirrels.

CONSERVATION NEEDS: Mature spruce-fir stands appear important to boreal owls but the exact size required to meet their needs is unknown at this time. Retaining and replacing snags is an obvious need because of the owl's requirement for large nesting cavities. Management for abundant small mammal populations in high elevation conifer forest will also enhance boreal owl populations.

The 1988 fires could have mixed impacts on boreal owls. Where large areas of lodgepole pine burned, nest site availability will not be affected much. If large areas of old spruce-fir forest burned, however, the owls could face some long-term loss of nesting and roosting habitat. If the fires stimulate aspen regeneration, the long-term effect on the owls should be positive since aspen is an important cavity tree for boreal owl nesting. Boreal owls need many low perches to hunt effectively. Where hot overstory fires burned, foraging habitat will decrease as these low perches and snags fall. The fires' effects on the owls' prey base will be mixed, depending on fire intensity and time since the burn. The net effect of the fires on the boreal owl will probably be neutral or slightly negative.

Regions 1 and 4 (draft list) of the U.S. Forest Service list the boreal owl as a sensitive species. It is a species of special concern in Idaho (Category A, draft list) and Montana.

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Pileated Woodpecker

Dryocopus pileatus

DESCRIPTION: The pileated woodpecker is the largest woodpecker in North America. It is easily recognized by its bright red crest and black plumage with white under the wings and on portions of the head and neck. The male has an entire red crest and mustache while the female has a partial red crest and a black mustache.

This species is 16-19.5 in (41-50 cm) in length with a wing span of 28-30 in (71-76 cm). The pileated woodpecker is adapted in several ways to excavate in wood. The beak is chisel-shaped, and a spongy, elastic tissue between the beak and skull acts as a shock absorber against the driving blows on wood. The feet are zygodactyl--two toes pointing forward and two pointing backward--permitting the bird to cling to vertical surfaces. The tail, with its stiff rectrices, acts as a prop.

RANGE: The pileated woodpecker is widespread in the East, rare in the Rocky Mountain states, and uncommon in the Canadian taiga, the coastal forests down to central California, the Sierra Nevada, and the Cascades of Oregon and Washington. In the GYE, several unconfirmed sightings of pileated woodpeckers have been reported, but no nests have been found. Sightings include one in Grand Teton National Park, two in Yellowstone National Park, and two on the west slope of the Teton Range in Targhee National Forest. Foraging cavities believed to have been made by pileated woodpeckers were found in lodgepole pine on the Teton Basin District of Targhee National Forest in July 1988.

HABITAT: This woodpecker occurs in mature stands of coniferous and deciduous forests, particularly forests with a high density of dead, standing, and downed trees. It is almost exclusively a forest bird preferring dense stands. The numerous dead trees left by the Yellowstone fires of 1988 will probably benefit pileated woodpeckers in the GYE.

LIFE HISTORY AND ECOLOGY: The pileated woodpecker is a year-round resident. Each spring a pair excavates a new nest cavity, usually in a dead tree at least 20 in (50 cm) in diameter at breast height and at least 30 ft (9 m) high. A large tree is needed because the cavity is typically 10 in (25 cm) wide and up to 24 in (61 cm) deep, and excavated at heights of 20-60 ft (6-18 m). Usually two to four eggs are laid, and one to four young are raised. The young woodpeckers are capable of short flights when they leave the cavity in late June or early July. They remain with the adults until fall. The following spring, 1-year-old birds usually breed.

In addition to nesting in cavities, pileated woodpeckers roost in cavities at night and during adverse weather. There is a need for large diameter dead trees to supply sites for both nest and roost cavities. Vacated cavities are used by a host of secondary cavity nesters.

The woodpeckers feed primarily on carpenter ants (*Camponotus* spp.), although bark beetles and wood-boring beetles are also consumed. These prey items are found primarily in dead or dying wood.

CONSERVATION NEEDS: The pileated woodpecker is likely to be affected by intensive timber management because it depends on large diameter dead trees for nesting, roosting, and foraging. Large diameter live trees become scarce as rotations are shortened, and dead standing and downed trees are cut for firewood. The pileated woodpecker is an "indicator species" of mature forests on many national forests in the Northwest. Populations of pileated woodpeckers are being monitored in these areas to detect changes in their populations over time. The distribution and abundance of the pileated woodpecker within the GYE need to be determined.

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Black-backed Woodpecker

Picoides arcticus

DESCRIPTION: The black-backed woodpecker has three toes on each foot, glossy black plumage, and a striking yellow cap on the male and most juveniles. The call note, a single metallic-sounding *kyik*, and the drum, long and moderate in tempo, are distinctive. Both are given frequently during the breeding season.

The male black-backed woodpecker is about 9.5 in (24 cm) in length and weighs approximately 3 oz (80 gm). Female woodpeckers are slightly smaller and weigh approximately 0.3 oz (10 gm) less than males.

RANGE: The range of the black-backed woodpecker is limited to North America, where it occurs in northern coniferous forests. It is rare throughout its range, but it may become locally common. It occurs from central Alaska and Canada south to the Cascades of Washington and Oregon and the Sierras of California, northern and central Idaho, northwestern Wyoming, the northern Great Lakes states, northern New England, and Newfoundland.

HABITAT: The black-backed woodpecker is a montane forest species. It has been associated with pine (*Pinus* spp.), typically lodgepole (*Pinus contorta*) or jack pine (*Pinus banksiana*), and may be found in tamarack (*Larix* spp.) bogs of the Northeast. Foraging occurs in areas with concentrations of dead or decaying trees and logs. The black-backed woodpecker is often found foraging in recently burned forests. In the GYE, it is strongly associated with burned forests. Nest cavities are excavated in heartrot in live or dead trees. Night roosts, during the breeding season, are in mistletoe clumps or indentations in a tree trunk, such as a deep scar or a western gall rust canker. Use of cavities for roosting has not been observed, but roosting habits during winter have not been documented.

LIFE HISTORY AND ECOLOGY: The black-backed woodpecker is resident, although temporary range extensions and population irruptions have occurred with outbreaks of wood-boring insects. Pair bonding, courtship and territorial drumming begin about early to mid-April. Nest cavities are generally being excavated by early May. The adults share excavation, incubation and caring for young. Incubation of two to five eggs begins in late May and lasts about 11 days. Young fledge about 24 days after hatching. They fledge at adult weight, are capable of flight although tail feathers are incomplete, and continue to be fed by adults for about 2 weeks. No information is available on dispersal of young. Home ranges for three birds during the breeding season were estimated, using radio-telemetry, as 800, 300 and 175 ac (325, 120, and 70 ha) in lodgepole pine habitat on the Deschutes National Forest in Oregon. Home ranges of members of a pair apparently overlap only near the nest.

The black-backed woodpecker feeds primarily on wood-boring insects, particularly larvae and pupae of bark beetles (*Dendroctonus* and *Ips* spp.). An individual woodpecker may remain on a tree or log for several hours, systematically flaking bark from the tree or excavating in soft, decayed wood.

The black-backed woodpecker is preyed on by large avian predators such as goshawks (*Accipiter gentilis*) and great horned owls (*Bubo virginianus*). Eggs and young hatchlings may be preyed on by tree squirrels (*Tamiasciurus* spp.).

CONSERVATION NEEDS: The black-backed woodpecker may be susceptible to local extirpation due to timber harvest and conversion of mature and overmature forest stands to young, vigorous stands with low densities of dead or decayed trees. Information is needed on population density, patterns of dispersal by young, home range sizes and habitat during the winter, and home ranges of breeding pairs. Until more information is available on this species, large tracts of unlogged, decadent habitat should be identified and managed for black-backed woodpeckers. In intensively managed forests, black-backed woodpecker populations should be monitored.

Surveys of black-backed woodpeckers are needed in the GYE. The large burned areas left by the fires of 1988 will be beneficial to black-backed woodpeckers in the short term. The fires provide an excellent opportunity to study the response of this species to extensive areas of burned forest.

Wyoming lists the black-backed woodpecker as a Priority 3 species.

NOTES: Nest cavities of the black-backed woodpecker are often conspicuous because they are excavated at low heights, typically 3-16 ft (1-5 m) from the ground, and because the woodpeckers remove bark from around the cavity, thereby exposing the yellow cambium. The reason for this bark removal is unknown.

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Three-toed Woodpecker

Picoides tridactylus

DESCRIPTION: The three-toed woodpecker is an inconspicuous, little-known woodpecker, with three toes on each foot, black and white barring at the sides and down the center of the back, and a yellow cap on the male and most juveniles. The Rocky Mountain form, *dorsalis*, which occurs in the Greater Yellowstone Ecosystem, has very little barring on the back. It is distinguished from the hairy woodpecker by the barred sides and from the black-backed woodpecker by the barred or white stripe down the center of the back, a large post-ocular stripe, and browner, less glossy plumage. The call note, a single sharp *pik*, and the drum, short in duration and slow in tempo, are distinctive, although both are given infrequently.

The male three-toed woodpecker is about 8.75 in (22 cm) in length and weighs approximately 2 oz (70 gm). Females are slightly smaller and weigh approximately 0.3 oz (10 gm) less than males.

RANGE: The three-toed woodpecker, relatively uncommon throughout its range, is circumboreally distributed. It occurs from Scandinavia to Siberia in Eurasia, south locally to southern Europe and western China, and in North America from northwestern Alaska to Newfoundland, south locally to southeastern Oregon, northern New England, and in the Rocky Mountains to south-central New Mexico.

HABITAT: The three-toed woodpecker is a montane forest species, typically found above 4,000 ft (1,219 m) elevation. Its range is sympatric with spruce (*Picea* spp.), and in the United States, it is frequently found in spruce-tamarack (*Larix* spp.) bogs and lodgepole pine- (*Pinus contorta*) dominated forest stands. Foraging occurs in areas with abundant dead and decayed trees that are infested with wood-boring insects. Three-toed woodpeckers are frequently found foraging in newly burned areas; thus they should respond well to the 1988 fires in the GYE. Nest cavities are excavated in trees with heartrot, typically recently dead trees. Night roosts, during the breeding season, are in cavities in very decayed, broken-topped dead trees. Roosting habitat during winter has not been documented.

LIFE HISTORY AND ECOLOGY: The three-toed woodpecker is mostly resident, although movement during winter has been documented in several populations. Pair bonding, courtship and territorial drumming begin in mid- to late April. Nest cavities are being excavated by mid-May. The adults share excavation, incubation and caring for young. Incubation of two to five eggs begins in early June and lasts about 11 days. Young fledge about 22 days after hatching. They fledge at adult weight, are capable of flight although tail feathers are incomplete, and continue to be fed by adults for about 2 weeks. No information on dispersal of young is available. Home ranges for three birds during the breeding season were estimated, using radio-telemetry, as 750, 350 and 130 ac (300, 140, and 50 ha) in mixed conifer-lodgepole pine habitat on the Deschutes National Forest, Oregon. Home ranges of members of a pair apparently overlap only near the nest.

The three-toed woodpecker feeds primarily by flaking bark from a tree to prey on wood-boring insects underneath, particularly larvae and pupae of bark beetles (*Dendroctonus* and *Ips* spp.). An individual woodpecker may forage on one tree for several hours. This propensity for foraging by flaking, rather than excavating, explains the species' association with tree species that have scaly bark, such as spruce and lodgepole pine. Concentrations and temporary range extensions of the three-toed woodpecker have occurred with concentrations of wood-boring insects, but the species is apparently less irruptive than the black-backed woodpecker.

The three-toed woodpecker is preyed on by large avian predators such as goshawks (*Accipiter gentilis*) and great horned owls (*Bubo virginianus*). Eggs and young hatchlings may be preyed on by tree squirrels (*Tamiasciurus* spp.).

CONSERVATION NEEDS: Large tracts of decadent forest stands may be required to support individual three-toed woodpeckers. This species may be susceptible to local extirpation by forest management that leaves inadequate numbers of dead or decayed trees. Information is needed on population density, patterns of dispersal by young, home range sizes and habitat during the winter, and home ranges of breeding pairs. Until more information is available on this species, large tracts of unlogged, decadent habitat should be identified and managed for three-toed woodpeckers. In intensively managed forests, three-toed woodpecker populations should be monitored.

Surveys of three-toed woodpeckers are needed in the GYE. The large burned areas left by the fires of 1988 will probably be beneficial to three-toed woodpeckers in the short term. The fires provide an excellent opportunity to study the response of this species to extensive areas of burned forest.

The three-toed woodpecker is listed as a sensitive species (draft list) by Region 4 of the U.S. Forest Service. Idaho lists it as a species of special concern (Category C, draft list).

NOTES: This species is often unnoticed because of its sedentary habits, infrequent vocalizations, and mottled plumage which blends into the forest shadows. Typically, it is located by listening for the quiet sounds of foraging. When nest cavities are being excavated, it may be located by its responsiveness to play-back recordings of the species-specific drum.

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Pygmy Nuthatch

Sitta pygmaea

DESCRIPTION: The pygmy nuthatch is the smallest of the nuthatch species, weighing only 0.4 oz (10.6 g), on average. It is 9.5-11.5 cm (3.75-4.5 in) in length. It is sexually monomorphic, having white undersides, a blue-gray back, a brownish cap, and a black eye stripe. In contrast, white-breasted and red-breasted nuthatches have black caps and a white line over the eye.

RANGE: Its disjunct geographic distribution mostly coincides with the distribution of ponderosa pine (*Pinus ponderosa*) throughout the West, and south through most of Mexico. There are no known breeding records from the Greater Yellowstone Ecosystem, although pygmy nuthatches may breed in mixed ponderosa forest in the part of the Custer National Forest that is included within the GYE. Local nonbreeding movements into and out of the area may be common.

HABITAT: As implied above, the pygmy nuthatch appears to be restricted primarily to ponderosa pine habitat, especially older (mature to old-growth) stands that are fairly open (<70% canopy coverage). Pygmy nuthatches have also been found nesting in other pine species on the Pacific coast and in pinyon-juniper woodlands in Arizona.

LIFE HISTORY AND ECOLOGY: Pygmy nuthatches are year-round residents that eat primarily bark and leaf beetles, but occasionally eat seeds as well. They tend to restrict their searching activities to canopy branches rather than tree boles.

This highly vocal species occurs in social groups year round. In winter, individuals occur in groups of about eight, on average, and are frequently found foraging in mixed-species flocks with other resident insectivores. During the breeding season, pygmy nuthatches are known to be communal nesters, where one to three "helpers" (usually yearling males) may assist at the nest. In early April, both sexes begin to excavate a nest cavity in a large (usually >20 in [>50 cm] dbh) dead or decaying ponderosa pine snag at an average height of more than 20 ft (6 m). The female lays six to eight white, spotted eggs and incubates them for 2 weeks. Both sexes (and possibly some helpers) feed the young for about 3 more weeks before the young fledge. Each breeding pair occupies a territory of about 4.9 ac (2 ha) in size. During the nonbreeding season, however, more than 150 individuals have been reported roosting in the same cavity.

CONSERVATION NEEDS: Within its restricted habitat range, the pygmy nuthatch uses relatively large snags for nesting and roosting. The health of nuthatch populations may, therefore, hinge upon the availability of old-growth ponderosa pine. Biologists have documented that populations of nuthatches drop significantly after timber harvesting if snags are removed. They recommend that ponderosa pine forests be cut so that a minimum of three to five large (>19 in [48.3 cm] dbh) snags per acre are left standing. The distribution of the pygmy nuthatch in the GYE needs to be determined.

The pygmy nuthatch is a species of special concern in Idaho (Category C, draft list).

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MAMMALS

Introduction

Accounts of mammal species in this section were selected based upon their listing as threatened or endangered species under the federal Endangered Species Act, U.S. Forest Service and Bureau of Land Management sensitive species, state species of concern, and on information contained in the databases of the Montana and Idaho Natural Heritage Programs. Of the eighteen species considered here, two are listed under the Endangered Species Act-- the grizzly bear as a threatened species and the gray wolf as an endangered species. With the exception of the black bear, American marten, mountain lion, and bobcat, all of the remaining mammals are listed as a state species of concern by at least one state in the GYE.

Seven species of shrews and bats thought to be rare in the GYE are included in this section. Both of these groups of mammals are difficult to study, and consequently limited research has been conducted on them in the GYE and elsewhere. Little specific information is available on their population status, distribution, and habitat use within the GYE. Bats are sensitive to human disturbance at roost and maternity sites. Studies have demonstrated that forest-dwelling bats do not use large openings (>80 ac) caused by clearcuts. Many bat species require mature trees for roosting and a heterogeneous distribution of seral habitat types for foraging. In this regard, the fires of 1988 probably had some positive benefits for bat species in the GYE.

During the early 1900s, predator control was widely practiced in the GYE, particularly in Yellowstone National Park. Not surprisingly, carnivorous mammals represent over one half of the mammals considered in this section. Seven of the ten species of carnivores are furbearers, each of which is legally harvested in at least one of the three GYE states. Some, like the black bear and bobcat, can be found throughout the ecosystem. The status of others, such as the wolverine, fisher, and lynx, is unknown, and their populations appear to be small.

Of the two endangered species, the grizzly bear has received the most attention. Sizeable efforts by state and federal agencies aimed towards the conservation and recovery of this species in the GYE appear to be paying off. In 1988 an increase was observed in the grizzly bear population for the first time in 13 years. The gray wolf, on the other hand, has been absent from the GYE since the 1940s. Public and agency support for reintroducing wolves to the GYE appears to be gaining momentum.

For most of the carnivorous mammals, overharvest and habitat loss are the two most important factors in their conservation. Marten, fisher, lynx, and bobcat are all easily trapped and susceptible to overharvest. Two of the four mustelid species, marten and fisher, prefer mature and old growth forest types. Thus, timber management practices can have significant impacts on these furbearers.

Perhaps the single most important factor linking all of the carnivores together is their need for relatively large tracts of undisturbed habitat. Wolverines, for example, have average home range sizes of approximately 150 mi² (389 km²). More than any other animals in the GYE, these carnivores need effective and coordinated ecosystem management over sizeable acreages of habitat if viable populations of these species are to persist.

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Dwarf Shrew

Sorex nanus

DESCRIPTION: The dwarf shrew is the smallest mammal in North America and one of the smallest in the world. It has a long, pointed snout, almost pin-sized eyes, and small rounded ears. Hair coloration varies from medium to dark brown, particularly along the back, to smoky gray on the underside. The tail is slightly bicolored, being lighter below.

Total body and tail lengths are 3.3-4 in (82-105 mm) and 1-1.75 in (27-45 mm), respectively. The most notable characteristic of this species is its light weight which ranges from 0.06-0.11 oz (1.8-3.2 g). Both sexes appear similar in color and size.

Dwarf shrews, like other species in the same genus, are difficult to identify without careful consideration of skull characteristics. Often a knowledge of the habitat at the site of collection is also required.

RANGE: Within the Greater Yellowstone Ecosystem the dwarf shrew has been collected only from a few sites on the Beartooth Plateau, between 8,000 and 10,900 ft (2,438-3,322 m) in elevation, and at one site in Grand Teton National Park (elevation 10,500 ft [3,200 m]). This species, though normally associated with a montane habitat, has been collected throughout the Colorado Plateau and the Great Basin of New Mexico. Historically it was distributed eastward into Kansas and southward into southern New Mexico, but within recent times it has been isolated into islands of coniferous forest habitat. It is very likely that this species ranges more extensively throughout the GYE than is now known, as considerable habitat exists.

HABITAT: Though a few specimens of the dwarf shrew have been collected as low as 2,400 ft (732 m) in elevation near the Black Hills, this species is more commonly found in subalpine and alpine habitats. A majority of specimens have been taken in rocky outcroppings. The dwarf shrew has also been found in arid habitats throughout Colorado and New Mexico. It is apparent that a wide tolerance of habitat types exists.

LIFE HISTORY AND

ECOLOGY: The breeding biology of the dwarf shrew is not well understood. Based upon relatively few observations, breeding is thought to occur between June and August, with young being born any time from July to early September. This species, like other closely related members of the same genus, probably has a gestation of 20-23 days. Evidence suggests that females experience a post-partum estrus and thus that more than one litter may be produced in a season. An average litter size extrapolated from embryo counts is 6.5. Though juvenile females are not

Figure 11. Locations where dwarf shrews have been collected. The dot near the northeast corner of Yellowstone National Park represents 3 records.

thought to reach sexual maturity their first summer, some juvenile males may.

Dwarf shrews are thought to be active year-round and, owing to their extremely small size, must forage constantly. Insects and soft-bodied spiders are most likely their preferred food items although, given such a range in habitats used, many other small invertebrates must surely be taken. This species is often sympatric with other soricid species (*S. cinereus*, *S. merriami*, *S. monticolus*, and *S. hoyi*), though the extent of competition is unknown.

CONSERVATION NEEDS: Only 37 specimens of the dwarf shrew have been collected in the GYE since the first one was taken in 1954. All of these specimens were obtained at relatively high elevations (8,000 ft [2,438 m] and above) with 36 of 37 found in the alpine tundra. The last, and most recently collected, specimen was taken in a marshy, wooded habitat. Though this species is not considered to be abundant throughout any of its range, the numbers obtained in the GYE probably indicate that it is not as rare as once thought. Selective pit-fall trapping will be required to adequately census this species in other GYE localities. The dwarf shrew is a species of special concern in Montana and a Priority 2 species in Wyoming. The unique nature of this smallest of North American mammals warrants further study.

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Pygmy Shrew

Sorex hoyi

DESCRIPTION: The pygmy shrew vies with the dwarf shrew (*Sorex nanus*) as North America's smallest mammal. It has an elongated snout, greatly reduced eyes and small, rounded ears. A total body length of approximately 2.6-4 in (67-98 mm), tail length of 1-1.3 in (25-34 mm) and weight of 0.08-0.21 oz (2.2-6 g) help explain why this animal is rarely seen. Though its coloration may vary slightly over its entire range, it is most commonly brown to grayish-brown on top, becoming lighter gray on the sides and belly. There is no discernible size or color distinction between the sexes.

RANGE: There are no reported records of the pygmy shrew from the GYE. Its current distribution extends from Alaska across the Canadian provinces to New England, and as far southeastward as Alabama and Georgia. Recently its southwestern range has been extended to Beaverhead Co., Montana, approximately 100 mi (160 km) northwest of the GYE. With this extension and an isolated population existing along the border between Wyoming and Colorado, it is highly probable that the pygmy shrew exists in the GYE.

HABITAT: Pygmy shrews in Montana, Idaho, Wyoming, and Colorado have been collected in widely diverse habitats ranging from alpine bogs of the boreal region to dry, coniferous forest stands at lower elevations. They have also been taken in riparian habitats in the zone between alder thickets and sagebrush, as well as in other lowland marshes.

LIFE HISTORY AND ECOLOGY: Because of its rarity, many life history facts for the pygmy shrew are unknown. Pregnant females have been collected in the months of June, July and August, and recent evidence suggests that more than one litter may be produced in a summer. The duration of gestation is unknown, although it is probably similar to other members of this genus (20-23 days). Nest sites are most commonly found in old, decaying logs. Litter size probably averages five. The young grow rapidly, attaining adult size by the following winter, and sexual maturity is assumed to be reached at 9-11 months of age. Pygmy shrews are active throughout the year. Their extremely high metabolic rate requires that they forage day and night. Being primarily insectivorous, they feed on an abundant array of arthropods and worms common in leaf litter and decaying vegetation. Stomach analyses in one study showed that ants made up over 45% of the identifiable prey items; however, by volume, larval ants, beetles, moths and spiders were most important.

CONSERVATION NEEDS: It is difficult to assess the conservation needs of the pygmy shrew in the GYE because its status here is unknown. Though it is not considered abundant in any locality it presently inhabits, this may be due, in part, to a lack of collection efforts. Because this species is one of the most evolutionarily primitive placental mammals in the world and one of the world's smallest mammals, efforts should be made to elucidate its status in the GYE. The pygmy shrew is a species of special concern in Idaho (Category C, draft list) and a Priority 2 species in Wyoming.

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Preble's Shrew

Sorex preblei

DESCRIPTION: Preble's shrew is another one of the extremely small soricids comparable to *S. hoyi* and *S. nanus* in size. As with other small shrews in this genus, distinguishing characteristics include a long, narrow snout, very small eyes and small rounded ears. The type specimen, collected in the winter, was brownish gray with slightly gray sides and a smoky gray belly. Summer pelage is somewhat darker brown above with smoky gray coloration on the underside. The tail is distinctly bicolored.

No discernible size differences exist between males and females of this species. Total body length ranges from 3-3.75 in (77-95 mm), tail length is 1.2-1.5 in (30-38 mm), and weight ranges from 0.07-0.11 oz (2.1-3.2 g).

This species is difficult to distinguish from two other sympatric species, the masked shrew (*Sorex cinereus*) and Hayden's shrew (*Sorex haydeni*). Preble's shrew is consistently smaller than masked shrews from the same site, but it is very difficult to separate from Hayden's shrew. A detailed analysis of skull morphology is required for positive identification, and as with all shrews, is usually referred to experts working on these groups.

RANGE: There are only two reported records for Preble's shrew in the Greater Yellowstone Ecosystem. One specimen was collected at the Lamar Ranger Station in 1964, and more recently a single specimen was obtained near Hebgen Lake in the Gallatin National Forest. Additional records of this species are few but demonstrate a distribution which extends across Montana, westward through central Idaho and the extreme southeastern corner of Washington into southcentral Oregon, with southern extensions into California, Nevada, Utah, and southern Wyoming.

HABITAT: Preble's shrew is primarily associated with arid and semi-arid sagebrush-grassland habitats. A few collection sites have been within openings in subalpine coniferous forests. Altitudinal variation has ranged from approximately 3,000-8,300 ft (914-2,529 m).

LIFE HISTORY AND

ECOLOGY: There are only 35 specimens of Preble's shrew recorded in the literature, and of these, fewer than half have been identified as to sex and/or general age category. Available data are so incomplete that no picture can be developed concerning this species' breeding biology. Often specimens have been in such poor shape when collected that only the skull was saved. It is quite possible that many more Preble's shrews have been collected but were incorrectly identified as a subspecies of *Sorex cinereus*, or possibly as *Sorex haydeni*.

Due to their overall similarity to other closely related

Figure 12. Locations where Preble's shrews have been collected.

species, the general life history of Preble's shrew is most likely similar as well. A spring to summer breeding period and a lifespan of approximately 14-16 months would be anticipated. As with other soricids, this species is most surely insectivorous, feeding on the abundant arthropods within the leaf litter.

CONSERVATION NEEDS: With so few records of this species, not only within the GYE but throughout its entire range, it is clear that serious efforts should be made to census the population. This species appears to be more restricted in its habitat preferences than other soricid species found within the GYE and thus may be more susceptible to disturbances. When additional specimens are collected every effort should be made to fully describe their reproductive status, stomach contents, and habitat associations. The Preble's shrew is a Category 2 candidate for listing as threatened or endangered under the Endangered Species Act. It is listed as a species of special concern in Idaho (Category C, draft list) and Montana, and as a Priority 3 species in Wyoming.

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Fringed Myotis

Myotis thysanodes

DESCRIPTION: The fringed bat is a rather large myotis with long ears (0.7 in or 18 mm). Pelage is light brown on the back and slightly lighter on the ventral side. The edge of the uropatagium (interfemoral membrane) has a conspicuous dorsal fringe of short stiff hairs. The wing span is approximately 11 in (280 mm). The ears and membranes are very dark. Weight is approximately 0.2 oz (6 g).

This species is often confused with the long-eared myotis (*M. evotis*). The fringed bat can be distinguished by its shorter ear, longer forearm, and heavily fringed uropatagium.

RANGE: The fringed bat is found in montane habitats over much of western North America, from British Columbia south to southern Mexico. The species is irregular and local in distribution and is generally uncommon at the edge of its range. The fringed bat is poorly collected in the GYE. Its known distribution includes southwest Montana, adjacent Wyoming and possibly southeastern-most Idaho.

HABITAT: This species prefers dry coniferous forests, juniper and desert scrub of the Southwest. It usually is found at elevations of 4,000-8,000 ft (1,200-2,400 m). Fringed bats will roost in rock crevices, caves, mines and buildings. This species will also use buildings as night roosts. The winter range and habitat are unknown.

LIFE HISTORY AND ECOLOGY: Fringed bats are highly gregarious, often occurring in large nursery colonies. Male bats are rarely found in these maternity colonies, although males of this species often form colonies during the summer. Nothing is known of its habits in winter. Two studies on food habits indicate this species eats beetles, moths, crickets and harvestmen. The flight of fringed bats is slow and highly maneuverable. They are capable of hovering flight and use it to glean insects from vegetation as well as for aerial capture among branches.

Many aspects of this species' biology are poorly known, including reproduction. A single young is born in late spring after a 50-60 day gestation. Mating takes place in autumn and sperm is stored until ovulation in the spring. The young are relatively precocial at birth, and are capable of flight in 17 days. At 3 weeks old the juveniles are similar in size and color to adults.

CONSERVATION NEEDS: The fringed bat has a restricted distribution in the GYE. Its distribution and status in the GYE need study. Fringed bats are easily captured, especially at cave entrances and roost sites. Identification and protection of roost sites and hibernacula are necessary to maintain the species. Excess disturbance or over-collecting of colonies by spelunkers or biologists should be avoided. The fringed bat is a species of special concern in Idaho (Category C, draft list) and Montana, and a Priority 3 species in Wyoming.

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California Myotis

Myotis californicus

DESCRIPTION: This is a small, pale-colored bat. The ears are semi-transparent and the pelage is yellowish-brown. The hind foot is small, about 0.3 in (8 mm), and wingspan is about 9 in (230 mm). Total length is about 3 in (80 mm) and weight is about 0.15 oz (4.2 g). The only other myotis in the GYE that is as small as this species is the small-footed myotis (*M. ciliolabrum*). California myotis lack the dark ears, facial mask, and burnished tips of hair of the small-footed myotis. Nevertheless, these two species are often confused.

RANGE: The California myotis is found over a wide area of western North America. It is found in valleys and lowland forests from northern British Columbia south into the arid Southwest to central Mexico. Locally the species is known from scattered sites in southwestern Montana. It was recently collected east of the Continental Divide in Montana. This species is at the edge of its eastern range in the GYE, where it is quite rare. Its distribution within the GYE is poorly documented, but it may be restricted to the lower valleys of the north and west.

HABITAT: California myotis prefer drier forested and shrubland habitat in lowland valleys and mountains. They are often found in association with rock outcrops and cliffs but will also roost in trees under loose bark. These bats often use manmade structures as night roosts, resting and digesting their first meal shortly after dark. Mines and caves are also used as roosts but most in the GYE are too cool for summer habitation. The California myotis uses these cooler caves as hibernacula. The winter ecology and distribution of this species is poorly known.

LIFE HISTORY AND ECOLOGY: The California myotis is less gregarious than other western myotis. They may be found alone or in small groups and small maternity colonies during the summer. Even in hibernation they gather in small numbers. Mating occurs in October or November, at the onset of hibernation. Ovulation occurs in the spring and a single young is born in June.

The California myotis emerges shortly after sunset and forages on concentrations of insects located with echolocation. Its slow maneuverable flight allows it to capture numerous insects in a short period. It hunts near vegetation or over water, usually within 6.5-10 ft (2-3 m) of the ground. Insects of the orders Diptera and Tricoptera are more prevalent in its diet than are Lepidoptera.

CONSERVATION NEEDS: The California myotis is most vulnerable at roost sites and hibernacula. Human caused mortality or disturbance could reduce or extirpate the species locally. Hibernacula and significant maternity roosts should be identified and protected. The California myotis is a species of special concern in Idaho (Category C, draft list) and Montana, and a Priority 3 species in Wyoming.

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Spotted Bat

Euderma maculatum

DESCRIPTION: The spotted bat is the most striking of North American bats. Enormous pink ears and three large white spots on the black dorsal surface distinguish this species from all others. The ventral pelage is whitish. The wing and patagial membranes are pinkish-red to gray-brown. Morphology of the sexes is identical. The wingspan for adults is approximately 10 in (250 mm), body length 4.5 in (115 mm), length of ear 1.6 in (42 mm), and average weight is 0.5 oz (14 g).

RANGE: The spotted bat is known from the northeastern portion of the GYE in Montana and Wyoming. It occurs in scattered localities in western North America and is one of the rarest species in the U.S. Recent discoveries in British Columbia have greatly expanded its known and potential range from the arid southwest.

HABITAT: The spotted bat has been found in a variety of habitats including open ponderosa pine, desert scrub, piñon-juniper, and rough arid terrain. It forages over open forests and fields in drier ponderosa pine forests. Its day roosts are situated in high cliffs, particularly fractured sedimentary surfaces.

LIFE HISTORY AND ECOLOGY: Spotted bats are territorial and space themselves along regular foraging routes in suitable habitat. The food habits are poorly known, but previous studies have shown that spotted bats prey almost exclusively on moths. They emerge well after dark and typically forage quite high, at or above tree tops, usually 30-50 ft (10-15 m) above the ground. Spotted bats possess an atypically low-frequency echolocation call that is effective for fast flight feeding on tympanate moths (those that can detect ultra-sonic sounds). The calls are also audible to humans and readily detectable by trained ears. Spotted bats are thought to migrate south for the winter hibernation, but information on seasonal movements and winter activity is very limited.

CONSERVATION NEEDS: Spotted bats may be limited by suitable roosting habitat. They are invariably found in remote, undisturbed settings, although their tolerance to disturbance is unknown. The greatest identified threat is disturbance or destruction of roosting habitat. The fractured sedimentary cliff faces used for day roosts are especially vulnerable to earth movements or seismic activity. Very little is known of specific habitat requirements for foraging areas. The species is in need of additional study and occupied habitats need to be identified and protected. The spotted bat is a Category 2 candidate for listing as a threatened species under the Endangered Species Act. The U.S. Forest Service lists it as a sensitive species in Region 4 (draft list) and on the Custer National Forest in Region 1. It is a species of special concern in Idaho (Category C, draft list) and Montana, and a Priority 3 species in Wyoming.

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Townsend's Big-Eared Bat

Plecotus townsendii

DESCRIPTION: Townsend's or western big-eared bat is a medium sized bat with extraordinarily large ears. Pelage color is variable, but in the GYE the bases of the ventral hair are slate gray, with brown-buff at the tips. The hair is long and very soft. The flight membranes and ears are light brown. Two glandular lumps are evident on either side of the nose. Total length is approximately 4.1 in (105 mm), wingspan is 9.9-10.6 in (250-270 mm), ear length is 1.4 in (35 mm), and the tragus is about 0.6 in (15 mm). Adult weight ranges from 0.25-0.46 oz (7-13 g). Females are slightly larger than males.

RANGE: *Plecotus townsendii* is found throughout much of western North America, from British Columbia to central Mexico, and as far east as western South Dakota and Texas. Isolated relict populations are known from the south central and Appalachian states. This species is nowhere abundant and is uncommon to rare over much of its wide range. Although its status is poorly known, studies in Idaho, Oregon and Washington have documented a precipitous decline in the species. Western big-eared bats are known from several locations in Yellowstone and Grand Teton Parks and from the Custer and Gallatin National Forests in Montana.

HABITAT: This species occupies moist forests as well as arid savannah and shrub-steppe. It has been found foraging over sagebrush-grasslands, riparian areas, open pine forests, and arid scrub within the GYE. *Plecotus* is very dependent on rocky outcrops, caves and old mines for roosting habitat. These bats will occasionally take shelter in buildings but do not tolerate a hot, dry roost environment for long periods. Males are solitary or occur in small groups while females form maternity colonies in suitable warmer caves. Hibernation occurs in local caves that range from 42.8°-53.6°F (6°-12°C).

LIFE HISTORY AND ECOLOGY: The western big-eared bat forages well after dark and is rarely seen. Like the spotted bat, this species selectively forages for nocturnal moths and occasional flies and beetles. The large ears and low frequency echolocation calls allow this bat to effectively feed on Lepidoptera 0.2-0.3 in (5-8 mm) in size. They are adept aerial foragers with a characteristic slow flight that is highly maneuverable. Mating occurs in the fall and winter at the hibernaculum. Ovulation occurs in early spring and after a variable gestation of 55-100 days (temperature dependent), a single young is born in June. Young weigh about 0.09 oz (2.5 g) at birth and are able to fly within 3 weeks.

CONSERVATION NEEDS: Several studies in Idaho, Oregon, Washington and California have demonstrated that *Plecotus* is very sensitive to human disturbance. Summer roosts and hibernacula are particularly vulnerable to disturbance which leads to abandonment and increased mortality. The disturbance often is not malefic or readily apparent. Simple repeated visitation by cavers may be significant. Local extinctions can result in areas with limited roost habitat or excessive disturbance. The low reproductive rate and limited roosting habitat require that western big-eared bats and their habitats receive full protection.

Few roost sites and hibernacula have been identified in the Greater Yellowstone Ecosystem. Other than a few specimen records, little is known about the species in the GYE. *Plecotus* is in need of comprehensive inventory in the ecosystem. Hibernacula and maternity roosts need to be identified and given full protection.

The western big-eared bat is a Category 2 candidate for listing as a threatened species under the Endangered Species Act. Region 4 of the U.S. Forest Service lists it as a sensitive species (draft list), and Region 1 lists it as sensitive in Montana and Idaho. It is listed as a species of special concern in Idaho (Category C, draft list) and Montana, and as a Priority 3 species in Wyoming.

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Uinta Chipmunk

Tamias umbrinus

DESCRIPTION: The Uinta chipmunk is somewhat larger than other chipmunks in the GYE, with generally darker and duller pelage. Its outermost dorsal stripe, dark and prominent in other species, is obscure to absent, and it is grayish on its hips. Its total length is 8.5-9.75 in (216-243 mm), tail length is 3.75-4.5 in (95-111 mm), and weight is 1.9-2.8 oz (55-80 g).

RANGE: The Uinta chipmunk is found in western mountains as far south as northern Arizona. Its population, as recorded by mammalogists, is broken into discontinuous populations, but because of the difficulty of identifying the species, its distribution is probably poorly documented. In the GYE it has been recorded in Yellowstone National Park, especially in the northeast corner, and at Togwotee Pass east of Grand Teton National Park. It has also been found in the Big Hole Mountains in Bonneville County, Idaho, and south of the GYE near Bloomington Lake on the Caribou National Forest in Bear Lake County, Idaho.

HABITAT: This species appears to favor higher elevations (about 8,000 ft [2,438 m]). On the Beartooth Plateau it is considered a subalpine species and it seems commonly associated with spruce-fir forests. In Arizona it is associated with dense shrub cover and dense forest understory of conifer seedlings with many deadfalls.

LIFE HISTORY AND ECOLOGY: The Uinta chipmunk hibernates in the GYE, but it probably arouses occasionally and eats some of the food (seeds and berries) it stores in its burrow. It has been reported to emerge infrequently from its hibernation burrow during winter on warm, snow-free days. Like other chipmunk species, Uinta chipmunks mate shortly after emergence from hibernation. Gestation is about 30 days and litter size is four to five. Females have only one litter per year in the GYE. There is no evidence that Uinta chipmunks are territorial, but when observed feeding on campers' scraps in Colorado, they appeared to exhibit a dominance hierarchy.

Uinta chipmunks feed primarily on plant material such as seeds, berries, buds, and fungi, but they also eat insects, bird eggs and carrion. They tend to be more arboreal than other chipmunks, climbing in conifers and shrubs to obtain buds on branch tips and berries. Their nest burrows, a short tunnel terminating in a nest chamber, have been found under rocks and exposed roots of conifers.

CONSERVATION NEEDS: Significant life history and ecological information is lacking for this species. Because of their patchy distribution, logging and wildfire could impact local populations. Specific conservation needs for this species can only be identified after more research elucidates its natural history. The Uinta chipmunk is a species of special concern in Idaho (Category B, draft list) and Montana.

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Gray Wolf

Canis lupus

DESCRIPTION: The gray wolf is the largest wild member of the dog family with long legs, deep narrow chest, and blocky head. Adult males typically weigh 90-110 lbs (40-50 kg) and measure 5-6.5 ft (1.6-2.1 m) in total length, whereas adult females weigh 70-90 lbs (32-40 kg) and measure 4.5-6.0 ft (1.5-1.9 m) in total length. Coloration varies from creamy white to mottled patterns of gray to coal black. The gray wolf may be distinguished from the coyote (*C. latrans*) by its larger body size, longer legs, larger feet, larger rostrum, and proportionately smaller brain case.

RANGE: Historically, the gray wolf occurred throughout most of North America north of 20° N latitude. Intensive persecution and loss of habitat, however, has extirpated the gray wolf from 99% of its former range in the contiguous United States. The gray wolf was native to the Greater Yellowstone Ecosystem, but intensive control both inside and outside Yellowstone National Park eliminated resident animals by the 1940s.

HABITAT: Wolves are found in varied habitat, including grasslands, sagebrush steppes, coniferous and mixed forests, and alpine areas. They are associated with an ungulate prey base that includes deer, elk, moose, and bison.

LIFE HISTORY AND ECOLOGY: The ecological role of the wolf is as the preeminent predator of the large ungulates. No other carnivore--not the coyote or mountain lion or grizzly bear--exerts the same kind of evolutionary pressure. Wolves prey upon ungulates throughout the year. They may supplement their diet with beaver and smaller rodents during the summer, but in most cases these prey do not appear to be necessary or sufficient to support wolves. Wolves are opportunistic predators, often preying on the young, the old, and those weakened by disease or infirmities. A wolf consumes about 8-12 lbs (3.5-5.5 kg) of meat per day, or the equivalent of about six to nine adult elk per year. Most wolves living near livestock areas where wild prey are available do not prey upon livestock. Wolf depredations are not as widespread or as serious as generally believed. Studies in Minnesota and western Canada have shown that on average, wolves kill about one of every 1,000 livestock grazed. Wolves and grizzly bears co-exist in much of their remaining range in Alaska and western Canada. There have been no recorded cases of healthy wild wolves attacking a person in North America.

Wolves occur in relatively low densities of one wolf per 30-100 mi² (75-250 km²). The basic population unit is the pack: a cohesive group of typically 2-16 animals. Most packs include a pair of breeding adults ("alpha" or dominant), other nonbreeding adults and/or yearlings that may be offspring from previous years, and pups of the year. Packs occupy territories of 50-300 mi² (125-750 km²). Wolves advertise their occupation of a territory with two complementary behaviors: howling and scent-marking. Howling serves as a long-distance but short-duration advertisement whereas scent-marking functions as a site-specific but long-duration notice.

Breeding commonly occurs in February and, following a 63-day gestation, a litter of four to seven pups is born in a ground burrow or in a den in the rocks. After about 6-8 weeks, the wolf family moves the pups from the natal den to areas called *rendezvous sites*. Typically, these are small meadows with forest and surface water nearby. The pups grow rapidly and are ready to accompany the older animals by early fall. Most wolves become sexually mature at 2 years.

CONSERVATION NEEDS: The gray wolf in the Northern Rocky Mountains is listed federally as an endangered species. Montana lists it as endangered and a species of special concern. Idaho lists it as a threatened and endangered species. The approved Recovery Plan calls for translocating wolves to Yellowstone National Park. Public surveys reveal strong support among park visitors and moderate support among Wyoming residents for restoring this missing link in the Greater Yellowstone Ecosystem. An environmental analysis of a restoration proposal is needed.

NOTES: A briefing booklet "Wolf Recovery in the Northern Rocky Mountains" published by the National Audubon Society provides excellent background. The gray wolf is a management indicator species on the Beaverhead, Shoshone, and Custer National Forests.

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Black Bear

Ursus americanus

DESCRIPTION: The black bear is one of two bear species in the Greater Yellowstone Ecosystem. It is a large, stocky animal with small eyes, small rounded erect ears, a short tail, long legs and plantigrade feet. The head is elongated with a flat brow, giving a flat facial profile. The snout is typically long and brown, ending with a characteristic pig-like nose. Hair is shaggy and uneven, and may be dark black, brown, cinnamon, or almost blond. Body weight of individual bears varies greatly throughout the year. They weigh less in spring and early summer, and gain weight rapidly during late summer and fall. Average weights for adult females range from 88-150 lbs (40-70 kg) and adult males from 130-300 lbs (60-140 kg).

The black bear differs from the grizzly bear (the only other member of the bear family in the GYE) in its smaller body profile, less dished facial profile, less prominent shoulder hump, front feet with a more rounded or kidney-shaped pad, and shorter, more curved claws.

RANGE: The black bear ranges throughout most mixed forest types in the GYE. The black bear is native only to North America, from Alaska to Mexico and in all of the United States. Currently, it is found throughout Canada, approximately 23 of the United States and two or three states in Mexico. Much of the decline of the black bear's range is a result of change in land use patterns.

HABITAT: The black bear is primarily a forest animal. It uses a variety of habitats, concentrating most heavily where a mosaic of community types is available, ranging through mixed spruce-fir and deciduous forest, open meadows, avalanche chutes, wet meadows and riparian areas.

LIFE HISTORY AND ECOLOGY: Adult black bears are solitary except during the breeding season and periods of raising young. Mating generally occurs in June and July. Promiscuity does occur but its frequency is unknown. Implantation of the blastocyst is delayed approximately 7-8 months, and fetal development occurs during the last 6-8 weeks. Young are born in winter dens in late January or early February and emerge in late March to early May. Cubs stay with their mother throughout the summer and fall and den as a family group the second winter. Young then generally disperse as yearlings. Females become sexually mature at 3-5 years.

Throughout their range in the GYE, black bears consume primarily grasses and forbs in the spring and summer. Whitebark pine nuts, serviceberries, elderberries and colonial insects such as ants and beetles are consumed later in the fall. Black bears have been found to dig for roots occasionally. Rotten logs ripped open and claw marks on aspen tree trunks are common signs of their presence in the GYE.

An individual's home range will vary throughout the season as it responds to changing food resources. Generally, the home range of an adult male is three to eight times larger than that of an adult female. Individuals' home ranges overlap, but little is known as to the extent of inter- and intraspecific interactions.

Black bears are most often crepuscular. Individuals habituated to campsites and roadsides may become diurnal or nocturnal. Black bears use "day-bed" sites in protective forest habitats during inactive periods. They are generally shy and secretive toward humans, and less aggressive than the grizzly bear.

CONSERVATION NEEDS: Timber harvesting, mining, and commercial development are encroaching on black bear habitat in the Greater Yellowstone Ecosystem. A complete, broad scale assessment of the status of black bear populations in the GYE is needed. Unfortunately, very little black bear research is being conducted in the GYE. Further research efforts are needed to identify and mitigate "problem bear factories"--areas where black bears become habituated to humans. Increased money is being spent to relocate problem black bears in the GYE, but no data exist to document how effective this program is toward providing a long-term solution.

Black bear population fluctuations are dependent on seasonal food productivity. Management suggestions to enhance and improve food production and habitat for black bears are as follows: broadcast burn slash to promote rapid shrub growth; minimize scarification practices; coordinate logging activities with seasonal movement patterns; leave mature stands of timber for escape cover, primarily for cubs; and create a diverse mosaic of uneven-age timber stands by harvesting only small areas. The 1988 forest fires in the GYE will enhance black bear habitat within 5-10 years.

Black bears are very adaptable animals with relatively small home ranges. With adequate monitoring of populations, integration of information about black bears among all land-use agencies within the GYE, and improvement of habitat quality resulting from large scale forest fires, it is doubtful the black bear will become a threatened species in the future.

The black bear is classified as a game species with regulated hunting seasons in Idaho, Montana, and Idaho.

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Grizzly Bear

Ursus arctos horribilis

DESCRIPTION: The grizzly bear is a large, heavy-bodied carnivore. Adult females weigh 290-320 lbs (132-145 kg) and adult males weigh 400-490 lbs (182-223 kg) in the Yellowstone area. Adults vary from 6-9 ft (1.8-2.7 m) long and are 3-4 ft (1.0-1.2 m) at the shoulder. The grizzly often has a hump of muscle at the shoulder and silver-tipped pelage, but these characteristics vary and are not evident in all individuals. The fur is usually brown but can range from black to almost silver-white. Some animals show a distinctive girth band of darker fur just behind the shoulder and dark fur on the front legs in contrast with a lighter overall color. The feet are plantigrade with long claws on the front feet.

RANGE: The grizzly historically inhabited western North America from central Mexico to the Arctic Ocean. It now inhabits six separate areas in the conterminous United States, which together cover less than 1% of its historic U.S. range. It ranges throughout the Yellowstone ecosystem. The grizzly probably reached its lowest numbers in the lower 48 states in the 1920s and 1930s because of intensive persecution due to perceived conflicts with the domestic livestock industry. The species is declining in parts of Canada and Alaska because of habitat loss and excessive mortality. Perhaps 50-60,000 remain in North America.

HABITAT: The grizzly is an adaptive species, occupying dry desert (historically), coniferous forest, coastal rainforest, dry and wet meadows, alpine and subalpine regions, and arctic tundra. Optimum grizzly habitat has a variety of aspects, elevations, and vegetative communities. The grizzly does well in early seral stage areas producing graminoids, forbs with tuberous roots, and fruit-bearing shrubs. In southern areas of its range, such as the Yellowstone ecosystem, areas where whitebark pine nuts are available are preferred feeding sites. Areas producing animal prey such as ungulates or fish are also frequented, especially in Yellowstone.

LIFE HISTORY AND

ECOLOGY: Grizzlies breed in June and early July. Males and females consort for up to 2 weeks, during which time repeated mating may occur. A female may breed with several different males during one season, but males in the presence of an estrus female will defend her from other males. Females first breed between 4-6 years of age (rarely at age 3), while males first breed between age 5-9. Young are born in the den in late January and weigh less than 1 lb (0.45 kg) at birth. Young remain with their mother usually for two full summers and den with her during intervening winters.

Figure 13. Grizzly bear recovery zone. The recovery zone is the area within which grizzly bear habitat will be managed and recovery criteria for the species (such as number of females with cubs, distribution of females with cubs, annual mortality, and habitat effectiveness) will be measured.

Females breed every 3 years and will come into estrus sooner if young are lost before weaning. Litter size averages two but can be one to three.

Home ranges are large, often covering hundreds of square miles. Adult male ranges are usually two to three times as large as female ranges. Home ranges overlap extensively between all sex and age classes, and individuals do not defend territories. Because food habits vary by season, general seasonal ranges can be predicted based on food availability. Avoidance of adult males by other bears, however, results in movements and use patterns that are not strictly related to resource availability.

Grizzly bears hibernate from approximately November to April. During hibernation, the bear's metabolism changes to allow it to use stored fats and conserve water so that it does not eat, drink, urinate, or defecate for up to 5 months at a time. Males tend to enter the den later and leave earlier than females.

Grizzlies are opportunistic omnivores, consuming 80-90% vegetation. When animal foods are available these are often preferred and make up the majority of the diet. In the Yellowstone ecosystem, major foods include winter-killed or weakened ungulates (especially elk), elk calves, spawning cutthroat trout, whitebark pine nuts (*Pinus albicaulis*), certain grasses, sedges, and tubers, and rodents. Where garbage or game meat are available, grizzly bears will often seek them out, leading to "habituation" or the lessening of fear and avoidance of people, and "food conditioning," the eventual preference for human-related foods. Bears that develop these behavioral characteristics often become dangerous to people and usually have to be removed.

CONSERVATION NEEDS: The GYE grizzly population has been isolated from other populations for about 60 years. The current population estimate for the GYE is a minimum of 170-180 bears. The population trend is increasing as of 1988 for the first time since 1975. Although reproduction is at an all time high, efforts to carefully manage the grizzly and its habitat in the Yellowstone ecosystem must continue. Management is complicated by the many human demands on grizzly habitat in the Yellowstone ecosystem. Continued efforts are needed to eliminate available human foods in bear range and to convince the public that garbage kills bears. This is especially necessary on the private lands in the ecosystem which comprise only 1% of the grizzly bear habitat, yet contribute more than 50% of the bear/human conflicts on average.

Because the grizzly is listed as a threatened species in the conterminous United States, it is protected by the Endangered Species Act. A coordinated grizzly recovery effort is underway in all six occupied areas south of Canada. Recovery will require attainment of population goals based on numbers of females seen with cubs annually, adequate distribution of females with young, a limit on the annual number of human-induced mortalities, and adoption of an interagency conservation plan to assure that the habitat necessary for survival of the grizzly in the GYE will be available in the future. The revised Grizzly Bear Recovery Plan will call for regularly moving bears into the isolated GYE population to prevent the loss of genetic diversity through inbreeding. Reproduction and survival of the all-important adult female part of the population will be monitored. These monitoring systems will reveal any decrease in reproduction, allowing timely response by the management agencies. Application of the Cumulative Effects Model, now in the final stages of development, will allow agencies to assess the impacts of all management decisions on the future of the grizzly.

The grizzly is arguably the single most important symbol of wildlife management success or failure in the Yellowstone ecosystem. The status of the population has improved since the 1970s and continued careful management can assure its survival as a wild animal in the Yellowstone ecosystem.

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American Marten

Martes americana

DESCRIPTION: The marten is a lean, medium-sized member of the weasel family, with short limbs and a long, bushy tail. The lustrous fur, prized by trappers, varies from yellow to rich brown to almost black. An irregular, yellowish to bright orange throat patch is distinctive.

Females have head and body lengths of 12.5-15.75 in (320-400 mm), tail lengths of 7-7.75 in (180-200 mm), and weights of 0.63-0.88 lbs (280-850 g). Males have head and body lengths of 14-17.75 in (360-450 mm), tail lengths of 7.75-9 in (200-230 mm), and weights of 1-2.75 lbs (470-1250 g).

Martens have semi-retractable claws and the soles are densely furred in winter. Both sexes have anal and abdominal glands for scent marking. The American marten differs from the only other North American member of the genus, the fisher (*M. pennanti*), in its smaller size, lighter pelage, and presence of an orange rather than white bib.

RANGE: The marten ranges through most forested areas in the Greater Yellowstone Ecosystem. The marten historically ranged from Alaska across most of Canada, New England, the Alleghenies, the Great Lakes region, the Rocky Mountains south to New Mexico, the Sierra Nevadas, and the Cascades. Loss of habitat and overtrapping extirpated the species from many southeastern areas, including southern Ontario, Quebec, Prince Edward Island, New England, and the Great Lakes states. But some reinvasion of former range and several reintroductions are now again expanding the marten's range.

HABITAT: The marten is a species of the northern forests. Optimum habitat is mature old-growth spruce-fir communities with 30+% canopy cover, a well established understory of fallen logs and stumps, and lush shrub and forb vegetation. Mixed coniferous and deciduous forests may also be used. Martens tend to avoid large openings, such as clearcuts, but they will use riparian areas, meadows, forest edges, and rocky alpine areas.

LIFE HISTORY AND ECOLOGY: The marten is a solitary creature except during the breeding season and raising of young. Mating generally occurs in July and August. Implantation of the blastocyst is delayed 6-8 months, and after an active pregnancy of about 27 days, one to five young are born in mid-March to late April. The altricial young, raised solely by the mother, grow rapidly. They achieve adult length (though not adult weight) at 3 months and disperse in late summer or early fall. Sexual maturity is achieved at 1 or sometimes 2 years.

Martens are active throughout the year, with highest activity levels in morning, evening, and night. Despite their arboreal agility, they hunt mostly on the ground. While foraging, they cross and recross their own tracks in a bound or gallop. Martens rest or den in hollow trees and stumps, in ground burrows or rock piles, in excavations under tree roots, in natural snow caves, or in squirrel middens.

They eat a wide variety of foods, primarily small mammals--voles, tree squirrels, snowshoe hares, flying squirrels, chipmunks, mice, and shrews. They also eat birds and eggs, amphibians and reptiles, earthworms and insects, fruits and berries, and carrion. Marten populations are regulated largely by food availability throughout the year. Martens may compete with fishers and mink for food, and a few larger predators may prey on martens.

Radio telemetry has demonstrated home ranges of 4-8 mi² (10-20 km²) for males and 1-2 mi² (3-6 km²) for females. Home ranges of adult males overlap those of two to six females, although there is intrasexual intolerance.

CONSERVATION NEEDS: The marten is susceptible to local extinction from overtrapping and timber harvests. Where the 1988 fires destroyed old-aged lodgepole pine and spruce-fir forest, marten habitat was largely eliminated. Martens are classed as "indicator species" on Beaverhead, Bridger-Teton, Shoshone, and Gallatin National Forests in the GYE. Estimates of population viability need to be made and suitable, interconnected habitat capable of supporting viable populations identified and managed for martens. Adequate monitoring of populations under an "adaptive management" procedure is needed. With appropriate management, the marten can be assured a healthy role in the GYE.

NOTES: An estimated 250+ martens are trapped each year in the GYE. Martens figure prominently in the historic North American fur trade, second only to beavers in the monetary return to traders. They remain commercially important, especially in Canada. A biologically accurate childrens' book by Denise Casey (1988) introduces the marten to young people.

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Fisher

Martes pennanti

DESCRIPTION: The fisher, a member of the weasel family (Mustelidae), is about the size of a large house cat. Like many mustelids, fishers have long bodies, relatively short legs, and a long bushy tail. The highly sought and valuable fur is dark brown to black, often with variable patches of white in the chest and genital areas. Females have darker, silkier fur than males, which tend to have a coarser and more grizzled pelage.

Fishers are sexually dimorphic, with adult males averaging slightly less than twice the size of adult females. In Idaho, males averaged 11.5 lbs (5,227 g) [range: 7.0-15.5 lbs (3,182-7,045 g)], whereas females averaged 6.26 lbs (2,845 g) [range: 4.8-9.0 lbs (2,182-4,091 g)]. Total body length of males ranged from 36.6-40.7 in (931-1,033 mm) and averaged 39.1 in (994 mm). Female fishers had total body lengths of 33.6-39.0 in (853-890 mm) and averaged 35.0 in (893 mm). Both sexes have anal glands which are used for scent marking, especially during the breeding season.

RANGE: Historically, the fisher ranged across most of Canada, New England, along the southern fringe of the Great Lakes, the Rocky Mountains south to south-central Wyoming, the Cascades, and the Sierra Nevada Mountains. Loss of habitat through timber harvest and wild fires, and overtrapping has extirpated the fisher throughout much of its southern range, including Illinois, Indiana, Ohio, Pennsylvania, Virginia, and West Virginia.

Fishers may exist in very low numbers within the northern half of the Greater Yellowstone Ecosystem in Wyoming, but they have been extirpated from Montana portions of the GYE, and they were never known to occur in the Idaho portion of the GYE.

HABITAT: The fisher is a species of the northern forest. In western North America, optimum habitat appears to be mature to old-growth coniferous forest in the summer, and young to mature coniferous forest in the winter. Fishers avoid non-forested openings lacking overhead cover (i.e., grasslands, meadows, and clear-cuts) and seem to prefer areas with at least 70% canopy cover. The degree of stand isolation is more highly correlated (negatively) with the occurrence of fishers than is any other habitat measure. Fisher presence has also been shown to be positively associated with stand size. Thus, fishers seem to prefer large areas of about 250 acres of suitable habitat which is interconnected with other large areas of suitable habitat. Fishers select forested riparian areas all year, but especially in the summer. A dense understory of young conifers, shrubs, and herbaceous cover seems to be particularly important in summer. Large diameter hollow logs and brush piles provide critical denning sites in winter.

LIFE HISTORY AND ECOLOGY: The fisher is a solitary animal except during the brief 1-2 week breeding season, which occurs from late March to late April. Females are sexually mature and most often breed at 1 year of age. Males are also thought to be sexually mature at 1 year of age, but are not believed to be effective breeders until 2 years old. Breeding occurs approximately 6-8 days following parturition (early March to mid-April). Implantation of the blastocyst is delayed for about 10 months. The period of active pregnancy is believed to be about 30 days. Fishers produce an average of 3 young per litter. The altricial young are born in a tree den, and are raised solely by the mother. Growth occurs rapidly, allowing the mother and kits to leave the den by the end of the ninth week. At approximately 5.5 months old, kits approach the size of adults. The young usually disperse by the end of September.

Fishers may be active at any time of the day or night, but are usually most active during early morning and early evening. Activity bouts are dependent on weather, snow conditions, and appetite. Generally one to three activity periods, lasting 2-5 hours each, occur within a 24-hour period. Summer resting sites are typically from 20-60 ft (6-18 m) high in a tree, and usually in a clump of "witches broom." In winter, resting sites are almost always in a hollow log, or less commonly, within a snow-covered brush pile. Although fishers are somewhat arboreal, they are virtually 100% terrestrial while hunting and traveling.

Fishers are opportunistic predators and their diet depends on prey availability. Predominant foods are snowshoe hares, porcupines, grouse, tree squirrels, flying squirrels, voles, shrews, and carrion. To a lesser extent, fishers may eat other birds, eggs, reptiles, amphibians, insects, and various fruits and nuts. The fisher's ability to prey on porcupines, and possibly control porcupine populations, has resulted in many fisher

reintroduction projects in commercial forest areas across the United States. Fishers may compete with marten for food. Mountain lions and possibly black bears have been known to kill fishers in Idaho.

Radio telemetry studies in Idaho indicate home range sizes of approximately 10-15 mi² (26-39 km²) and 10-25 mi² (26-65 km²) for females and males, respectively. There is little overlap of home ranges of animals of the same sex, but male and female home ranges commonly overlap. Males appear to abandon their defense of home ranges during the breeding season while in pursuit of females in estrus.

CONSERVATION NEEDS: Fishers are very secretive and rarely observed by humans. This partially explains the lack of information currently available on fisher ecology. Estimates of population viability and causes of mortality need to be made. Fishers are well known for being easily trapped, and for frequently being caught in sets for other furbearers, especially marten, coyote, and fox. A small increase in mortality above natural levels is all that is necessary to cause local extinction. In areas where fishers are scarce, their population can be seriously affected by trapping--even by incidental take.

Timber harvesting results in forest fragmentation, reducing the size of patches of suitable habitat and isolating suitable patches from each other. Fishers are highly sensitive to forest fragmentation, avoiding either forested areas that are reduced in size below 250 ac (100 ha), or larger areas that are isolated from other suitable habitat. Further information on fisher habitat requirements is needed for populations in western North America. Data-driven habitat management policies must be implemented to ensure that suitable habitat is maintained to support a viable population of fishers in the GYE and other occupied areas.

The fisher is a species of special concern in Idaho (Category A, draft list) and Montana, and a Priority 3 species in Wyoming. Region 4 of the U.S. Forest Service lists it as a sensitive species (draft list).

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Wolverine

Gulo gulo

DESCRIPTION: The wolverine is the largest member of the terrestrial weasel group Mustelidae. Unlike the long, slender form of most mustelids, this species has the general appearance of a cub bear with a bushy tail. It is compact and strongly built, with short, thick skeletal structures and heavy musculature, and has a broad head, a short stout neck, and relatively short legs.

Adult head-body length ranges from 25.6-41 in (650-1000 mm), tail length ranges from 6.7-10 in (170-260 mm), and body weight ranges from 31-61 lbs (14-27.5 kg) for males and from 15-31 lbs (7-14 kg) for females. Females generally average 10% less in length and about 30% less in weight than males.

Wolverines have disproportionately large feet adapted for deep-snow travel, digging and climbing. Five toes are present with strong semiretractable claws that are curved and 0.8-1.5 in (20-38 mm) long. Dense, stiff hair is present around the pads and between the toes during winter. Both sexes of wolverines engage in extensive marking behavior using anal and ventral scenting glands and by chewing or scratching bushes and trees.

RANGE: The wolverine's range is circumboreal, extending across northern North America, Eurasia, and Scandinavia. Historically its range in North America extended from Alaska and northern Canada south to the northern tier of the United States, with a southward extension along the Rocky Mountains to Arizona and New Mexico. Today the wolverine's range covers Alaska, most of Canada, and parts of the northwestern United States.

The historic range of the wolverine included the Greater Yellowstone Ecosystem. The GYE population was near extinction by the early 1900s following the period of extensive exploration, settlement, and fur trade, which began about 1840. The GYE wolverine population has not shown a comparable level of recovery and/or expansion as that exhibited by the Bob Marshall/Glacier Park population, which is probably at or near historic densities in the better habitats. Wolverines are considered to be scarce or rare in the GYE. The GYE probably has a small population, but the actual status and range remain uncertain. Occasional observations have been reported and tracks have been documented in recent decades.

HABITAT: The wolverine primarily inhabits the coniferous forest zones, generally at the higher altitudes during summer and at mid- to lower elevations during winter. Large parks, meadows and clear cuts are generally avoided except for an occasional direct crossing. Wolverines prefer to hunt around small meadows, timbered thickets, cliffs, riparian areas, and ecotonal areas. Den sites are usually selected under logjams, uprooted trees, caves, or snow tunnels, usually in a well-forested area.

LIFE HISTORY AND ECOLOGY: Wolverines lead a solitary life except for a few days during breeding season and the rearing of the young by the female. They do not mate for life and the males are seldom associated with the females or the young during the rearing period. Mating periods vary but generally occur from late spring through early fall. Delayed implantation of the blastocyst postpones active pregnancy until the following December or January when a 30-40 day gestation period begins. Litters of usually two or three young are born from February through April. Young wolverines develop and mature quite rapidly, often attaining adult size and weight by early winter. Sexual maturity is usually reached at 2 years of age. Juvenile mortality and poor or irregular breeding success apparently contribute directly to a relatively low reproductive output in wolverine populations, and wolverines are a naturally low density species throughout their holarctic range.

Wolverines are primarily nocturnal, and they remain active throughout the year, even during the most severe winter weather. They are very active animals and can sustain a loping gait for hours. Wolverines hunt in tree wells, rock piles, cliffs, streambeds and big game wintering areas in a random, linear coverage of large areas. Research has shown that the wolverines have very large home ranges of about 150 mi² and that extensive travel is normal, especially for males. Aggressive defense of territories is essentially nonexistent. Extensive scenting and marking behavior, however, appears to be a social mechanism to maintain individual spacing.

The wolverine is generally an opportunistic carnivore, consuming a wide variety of food items that may include fruits, berries, insects, and fish when the more preferred small mammals, birds, and carrion are not available. Wolverines are best described as scavenging predators with a tendency to cache surplus food items.

They are well adapted for this lifestyle with powerful jaws, strong teeth, and overall great strength, which enable them to feed on large bones and frozen meat. Wolverines can kill animals many times their own size, especially when deep snow or special circumstances hinder the prey; actual first-order predation on large mammals, however, accounts for a small percentage of the overall diet. Man is the only significant predator on wolverines.

CONSERVATION NEEDS: Historic events indicate that the wolverine is vulnerable to regional extirpation from intense trapping and poisoning activities (even for other species) and by habitat degradation from logging, mining, road construction and development. Surveys of population occurrence and viability should be made in many of the areas of reported sightings and suitable habitat. It is likely that successful restocking programs could be implemented in some of the most suitable areas. Given protection from man-caused mortality and habitat loss, the wolverine should continue to expand present ranges and reoccupy suitable historic areas. It is likely that a "hands off" management policy will prove the most practical.

The wolverine is a Category 2 candidate for listing under the Endangered Species Act. It has been classified as a protected species in Idaho since 1965. It is a species of special concern in Idaho (Category A, draft list) and Montana, and a Priority 3 species in Wyoming. Region 4 (draft list) of the Forest Service lists the wolverine as a sensitive species, and Region 1 lists it as sensitive in Idaho. It was reclassified from an unprotected predator to a furbearer in Montana in 1976. Since 1976 a small legal harvest has been maintained in Montana by conservative seasons and trapper limits. Adjacent GYE jurisdictions provide total protection.

NOTES: About 8-15 wolverines are legally harvested annually in Montana. Pelts are used primarily as full trophy mounts or for parka trim. This level of harvest is not biologically significant to the Montana population's welfare.

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River Otter

Lutra canadensis

DESCRIPTION: The river otter is one of the most aquatic members of the weasel family. The long, streamlined body has a muscular, dorso-ventrally flattened flexible tail that is wide at the base and tapers towards the tip. The short, powerful legs, which provide the main propulsion in water, are equipped with large webbed feet. Each foot has five toes with well-developed nonretractable claws. The heel pad of both hind feet has four small, rough protuberances that give the otter traction on slippery surfaces.

The otter's flat, blunt head is characterized by a black, almost bulbous nose and a short muzzle. Slightly protruding eyes, small ears, and the nose are situated high on the head, allowing the otter to swim low in the water. The ears and valvular nostrils close off when the otter submerges. Its long, stiff, and highly sensitive whiskers aid in locating prey when visibility is poor.

The otter's coat consists of short, dense, soft underfur protected by longer, stiffer, glossy guard hairs. Air trapped within the fur acts as insulation when the otter dives. Otter pelts range in color from a rich, dark brown (almost black) to a pale chestnut on the upper parts, and a light brown mixed with varying amounts of gray on the ventral surface.

Size and weight among river otters from different regions vary considerably, but in all cases males are larger than females. In general, adults measure 35.5-51.2 in (900-1300 mm) in length, with the tail accounting for approximately a third of the total. Weights range from 11 to nearly 31 lbs (5 to nearly 14 kg), with females weighing 10-29% less than males. Maximum size and weight are reached at about 2-4 years of age.

RANGE: The river otter's range includes many of the lakes and streams of the Greater Yellowstone Ecosystem. Prior to about 1800, river otters occupied virtually all major waterways of the United States and Canada. Human encroachment, destruction of habitat, and overharvest eliminated otters from portions of their range, especially marginal areas. Present distribution spans the entire North American continent from east to west and southern Florida to northern Alaska. Reintroduction programs in as many as 10 states are helping to restore otters to portions of their former range.

HABITAT: River otters have adapted to a variety of aquatic habitats. They are found in both marine and freshwater environments ranging from coastal islands to high mountain lakes and streams. Otters are most abundant in food-rich coastal areas, including estuaries, coastal marshes, and the lower portions of streams, and in lowland marshes and swamps interconnected by meandering streams and small lakes. They also thrive in the tributaries of major nonpolluted drainages with limited human impact. They are scarce in heavily populated areas, particularly if there is much pollution. Good riparian habitat is an important element in otter habitat. With adequate undisturbed habitat, otters can tolerate human presence.

In the GYE and other temperate regions of North America, otters may be forced to vacate high elevation streams and lakes during winter and move down into the valleys as the waters freeze and snow accumulates.

LIFE HISTORY AND ECOLOGY: River otters normally reach sexual maturity at age 2, although males may not successfully breed until they are 5-7 years old. Breeding spans a period of up to 3 months and occurs from March to May in temperate regions. Copulation normally takes place in the water. The fertilized egg develops for about 2 weeks, but does not implant on the wall of the uterus for about 9 months. Implantation occurs in late January or early February in the GYE, approximately 50-60 days before birth.

Prior to giving birth, the female normally retreats to a small tributary stream, pond, or lake with adequate food, shelter, and seclusion. River otters do not excavate their own dens. Instead, they use the burrows of other animals such as the beaver, or natural shelters in close proximity to water. Females generally produce a litter each year. Birth occurs in March or April, about 11-12 months after successful copulation. Litter size is generally two or three. Blind, toothless, and helpless at birth, the pups grow rapidly and venture outside the den at about 2 months of age. The family group (female and her young) remains in the natal area at least until the pups are about 3 months old. There is no evidence that adult male otters participate in rearing the young. Otter pups are weaned at about 4 months of age. Young otters are able to survive on their own by the age of 6 months, but the family generally remains together for at least 7-8 months (late autumn) or until just prior to the birth of a new litter. Siblings may remain together until the age of 12-13 months, when dispersal occurs.

River otters in captivity have been known to live up to 25 years. However, in the wild a 15-year-old otter would be considered old.

The size and shape of an otter's home range vary considerably with drainage patterns and relief. Males generally have larger home ranges than females. In the mountainous West, home ranges probably vary in length from 19-48 mi (31-78 km) of waterway during the year.

Fish are the otter's most important prey, with slow-swimming species predominating because they are easiest to catch. The fast-swimming trout and other salmonids generally occur less frequently in the otter's diet unless nothing else is available. Crayfish are an important part of the otter's diet in regions where they occur. Otters occasionally supplement their fish diet with muskrats and other mammals, frogs, snakes, turtles, aquatic insects, and birds such as waterfowl.

River otters are more social than most mustelids. The family, consisting of an adult female and her juvenile offspring, is the basic social group. Temporary social groups may also occur, consisting of more than one family, a family and nonbreeding otter other than an adult male, subadult groups of either sex, and bachelor groups.

A study that recorded the types of behavior exhibited by otters during 294 observation periods indicated that otters spend the majority of their time foraging and feeding (62%). Play behavior accounted for only 6% of the observations, indicating that unusual playfulness among captive and tame otters does not appear to be nearly as prevalent among wild, free-ranging otters.

CONSERVATION NEEDS: While factors responsible for the decline of otter populations throughout North America vary considerably, habitat loss has probably contributed the most. Overharvest may have been important in reducing or eliminating otters from many areas. Today, properly controlled harvests and closed seasons have reversed the trend and allowed otter populations to slowly recover in areas where they were extirpated.

The river otter is classified as a Priority 3 species in Wyoming, as a furbearer with a closed season in Idaho, and as a furbearer with a regulated season in Montana. Management options include harvest regulations, habitat protection and enhancement, monitoring programs, and reintroduction and population augmentation. If afforded proper protection and management, the river otter will continue to be a part of the GYE.

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Mountain Lion

Felis concolor

DESCRIPTION: The mountain lion is a large slender cat with muscular limbs. Each foot has four toes with retractable claws. The tail is long and cylindrical. The head is blocky with medium rounded ears. The fur is short and tawny in color. Male lions weigh between 120 and 145 lbs (55-65 kg) with total length between 7.2 and 7.5 ft (2.2-2.3 m). Females weigh between 75 and 100 lbs (35-45 kg) with total length between 6.6 and 6.9 ft (2.0-2.1 m).

RANGE: The mountain lion once ranged extensively throughout most of North and South America. With the conversion of native habitat to agriculture, the lion's range has been severely reduced and populations have become isolated. Lions are presently most common in the western United States and Canada with isolated populations and incidental sightings reported in the central and eastern states. Lions can be found sporadically throughout the Greater Yellowstone Ecosystem but are not considered abundant. Most sightings are within Yellowstone National Park in the northeastern corner.

HABITAT: Mountain lions inhabit a variety of habitat types. In the West, they are most commonly found in mountainous rocky areas although they will also frequent low lying rocky areas. The most important component of the habitat is adequate rocky terrain.

LIFE HISTORY AND ECOLOGY: The mountain lion is a solitary species except during the breeding season and raising of young. Lions are polygamous and mating can occur throughout the year. Gestation is 82-96 days and the average litter size is 2.4-3.0 kittens. Kittens weigh approximately 14 oz (400 g) at birth, but they grow rapidly to nearly 9 lbs (4 kg) by weaning age of 1-2 months. Young mountain lions stay with their mother until age 1.5-2 years and reach sexual maturity at 2-3 years.

Lions exhibit a crepuscular activity cycle, spending the daytime hours resting in the sun or shade. Preliminary data indicate that lions will exhibit periods of relatively sedentary behavior followed by extensive movements. Presumably they spend several days at or near a kill and then travel within the home range until they make another kill.

Mountain lions feed primarily on large ungulate species and occasionally on smaller mammals. In the western U.S., the main prey species is the mule deer (*Odocoileus hemionus*) but they also feed on elk (*Cervus elaphus*) and livestock. The main prey selected seems a function of abundance. Lions stalk their prey and once close enough will attack with a quick bound. They usually aim for the back of the animal and attempt to kill the prey with a bite at the base of the skull. After making a kill, the lion will feed until satiated and then cache the remaining carcass for later use.

Home ranges vary extensively among mountain lions. Total home ranges as large as 113 mi² (293 km²) and as small as 25 mi² (64 km²) have been recorded. Seasonally, lions move extensively from summer range to winter range. Winter ranges usually center on winter congregations of their main prey.

CONSERVATION NEEDS: Lions are susceptible to local extinctions due to habitat destruction and/or overharvest. Lions within the national parks are safe from hunting but may move out of the parks during the winter to areas where they can be hunted. A current study on mountain lion movements being conducted in Yellowstone National Park should indicate how many lions move out of the park and become exposed to possible hunting.

NOTES: Lions are not numerous in the GYE and likely will remain at low numbers. Their numbers seem limited more by restricted stalking habitat than lack of prey or hunting pressure.

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Lynx

Felis lynx

DESCRIPTION: The lynx is a medium-sized cat with a short, black-tipped tail. Lynx are gray with indistinct brown mottling. They have conspicuous ear tufts and jowl "whiskers." Their feet are big and heavily furred; hair covers the pads in winter. Claws are retractile and do not show in the track. Lynx have a unique appearance when standing because their hind legs are longer than their front legs which places the rump slightly above the shoulders.

Males are slightly larger than females. Head and body length is 26-38 in (66-97 cm), tail length is about 4 in (10 cm), and adult weight is 15-35 lbs (7-16 kg). Lynx tracks are about the size of mountain lion (*Felis concolor*) tracks. However, the stride of a lynx (< 18 in [45 cm]) is much shorter than that of a lion (> 30 in [75 cm]).

The only other short-tailed cat in North America is the bobcat (*Felis rufus*). The dorsal side of a bobcat's tail usually has two or three transverse black stripes and the tip is white. In contrast, the tip of a lynx's tail is encircled with black and the black is not in a striped pattern. Bobcat feet (< 2 in [5 cm] in diameter) are noticeably smaller than those of lynx (> 3 in [8 cm] in diameter) and a bobcat's foot pads are naked in winter. Ear tufts are less prominent on bobcats than on lynx, but the difference is not marked.

RANGE: Lynx occur throughout the forests of Alaska and Canada and extend into the United States around the Great Lakes and in mountainous areas. Encroachment upon their habitat by man and heavy trapping pressure, especially when pelt prices are high, have eliminated the lynx from some areas. Recolonization is common. Lynx are scarce in the GYE. However, reports of sightings and a few harvested lynx have been recorded over the past 100 years (J.D. Varley, Yellowstone National Park, pers. comm.). Specific information on status and distribution of lynx in the GYE is not available. It is possible that the limited reports are of transient animals, but it is more probable that a small population persists in the GYE.

HABITAT: The lynx is primarily an occupant of the boreal forest but also lives in montane forests. Preferred habitat in GYE would be dense lodgepole pine forests for hunting snowshoe hares and higher elevation spruce-fir forests for denning. Willow flats and aspen forests with dense shrub understories would also be used.

LIFE HISTORY AND ECOLOGY: Lynx lead solitary lives except when rearing young and during a short breeding period in February-March. Following a gestation of about 62 days, one to five young are born. Kittens are furred and heavily spotted at birth but their eyes do not open for about 10 days. Young reach adult size at 6-8 months and may become sexually mature at 1 year. Young stay with their mothers until they are 9-11 months old. Maximum longevity is about 15 years.

Lynx are most active from shortly before dark to shortly after dawn but are sometimes active during daylight hours. They usually bed for the day in, or on the edge of, dense to moderate cover. Young are born in dens, debris piles, caves, or other natural shelters.

The lynx feeds primarily upon snowshoe hares, especially during winter. Lynx also eat other small to medium-sized animals and occasionally larger animals and carrion. Lynx populations exhibit cyclic fluctuations with an interval of 8-11 (average 10) years. The lynx is cyclic because its primary prey is cyclic. Few, if any, young are successfully reared during the 2-4 year period when hare populations are at the lowest ebb. Lynx travel extensively during these lean years. Lynx numbers in the GYE should fluctuate less markedly than boreal populations because the prey base is more diverse and less cyclic in the GYE. The 1988 fires may have a negative effect on lynx numbers by reducing snowshoe hare habitat in dense coniferous forest stands.

Home range size of lynx in the GYE is unknown. Data from other areas suggest a size of 5-20 mi² (12-50 km²). Home ranges of 37 mi² (60 km²) for males and 20 mi² (33 km²) for females were reported in Washington.

The wolf, mountain lion, and possibly coyote are the only natural enemies of the lynx. Losses of lynx to these other predators are likely insignificant. Lynx are probably mildly cannibalistic, as are other cats. Humans and starvation are the main factors regulating lynx numbers.

CONSERVATION NEEDS: Data on status and distribution of the lynx in the GYE are clearly needed before any reasonable conservation effort is proposed. Lynx are easily trapped and populations could be suppressed or eliminated by heavy trapping. However, the large protected area supplied by Yellowstone National Park should prevent extirpation of the species in the GYE. The lynx is a Category 2 candidate for listing under the Endangered Species Act. Region 4 of the U.S. Forest Service lists it as a sensitive species (draft list). It is a species of special concern in Idaho (Category B, draft list) and Montana, and a Priority 3 species in Wyoming.

NOTE: Bobcats are easily mistaken for lynx, especially by untrained observers. Bobcat pelts are often called bay lynx or lynx-cat in the fur trade. Therefore, reports of sightings and even pelts should be viewed with caution.

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Bobcat

Felis rufus

DESCRIPTION: Bobcats are medium-sized members of the cat family. Their fur, which is often extremely valuable in the fur market, ranges from reddish-brown with indistinct markings, to light buff with very pronounced dark spotting. Both the bobcat and the lynx (*Felis lynx*) are characterized by a short, stubby tail. The bobcat's tail is black only on top at the end, whereas the lynx's tail is completely black at the tip. The bobcat has shorter ear tufts and smaller feet than the lynx.

Males weigh 18-35 lbs (8-16 kg) and are 28-46 in (71-117 cm) long from head to tail. Females are smaller than males, averaging 12-25 lbs (5.5-11 kg) in weight and 24-41 in (61-104 cm) in length. Bobcats are seldom seen, even though they may commonly occur in a region. Their crepuscular and nocturnal activity patterns, as well as their use of thick cover, allow them to remain largely undetected except for their tracks in the mud or snow.

RANGE: Bobcats are found in the more rugged habitats throughout the Greater Yellowstone Ecosystem. Within North America, bobcats are the most abundant and widespread of the wild cats and occur across the lower 48 states except for parts of the midwest. Their range extends from southern Mexico north to approximately the Canadian border.

HABITAT: Bobcats occur in a variety of habitats within their range from arid deserts to moist coniferous forests. They are found where there is sufficient cover, such as extensive rocky areas and thick vegetation, to provide concealment for them to stalk and ambush their prey. Bobcats avoid large open areas and extensive plains.

LIFE HISTORY AND ECOLOGY: Bobcats spend their life alone, except for mother-offspring groups and during the breeding season. Bobcats maintain a strict social organization. Adults maintain individual ranges that are exclusive of others of the same sex. Males' ranges are usually larger than females' and one male often overlaps several females' ranges. Sizes of male ranges, determined by radio-telemetry, are from 0.75-55 mi² (2-140 km²). Female ranges are 0.25-24 mi² (1-61 km²) in size.

The peak breeding season is from late January through early March. One male will mate with several females. The gestation period is thought to be about 62 days. Most young are born in April and May. There are usually two to three kittens per litter, with up to five possible. Kittens are kept at dens in rock piles, log jams, or caves until they are 4-5 months old. They are raised solely by their mother. At about 5 months, kittens begin to follow their mother on her hunting forays, where they learn to hunt on their own. Kittens become self-sufficient at 8-10 months but may still associate with their mother until almost 12 months of age. Kittens disperse at 9-15 months of age and travel widely (up to 125 mi [200 km]) in search of an unoccupied range to claim for their own. Some females become sexually mature by their first breeding period (9 months of age). Most males become sexually mature between 1-2 years of age. In the wild, most bobcats live 2-5 years, with some individuals reaching 15 years.

Bobcats are very efficient hunters, and stalk their prey using available cover for concealment. Bobcats hunt during crepuscular or nocturnal hours when their prey are most active. The diet is composed of small mammals (cottontail rabbits, jackrabbits, voles, mice, red squirrels) and birds (wrens, sparrows, and forest grouse). Although bobcats are capable of killing deer, in most regions bobcats are not significant predators of game species.

CONSERVATION NEEDS: The large demand for bobcat fur has created high pelt prices (up to \$500) and caused locally heavy harvest pressure on bobcat populations. Better information on the impact of harvesting on bobcat populations is needed. Methods to monitor bobcat population sizes and trends are also needed.

NOTES: Bobcats are legally harvested in all states of the Greater Yellowstone Ecosystem. They are one of the most commercially important furbearers within the ecosystem because of their high pelt prices.

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RESEARCH NATURAL AREAS

I. Introduction

Natural area preservation in the Greater Yellowstone Ecosystem dates back to 1952, when Forest Service Chief Edward Cliff signed the designation order establishing Cliff Lake Research Natural Area on the Beaverhead National Forest. Natural area establishment was sporadic for the next 30 years, until the advent of comprehensive land management planning undertaken by the Forest Service and Bureau of Land Management (BLM) in the 1980s. Regulations governing the federal planning process required the Forest Service and BLM to consider the establishment of special management or natural areas to protect and maintain significant biological features. As a result, the Forest Service and BLM have established nine natural areas in the GYE and proposed 27 more for protection (see Figure 14). In many cases, identification and establishment of these areas was done in cooperation with organizations such as the Idaho Natural Areas Coordinating Committee, The Nature Conservancy and state Natural Heritage Programs.

Two types of special management area designations have been used by federal agencies in the GYE to preserve and maintain biotic communities in a natural state: Research Natural Area (RNA) and Special Interest Area (SIA).

Research Natural Area -- A RNA is a physical or biological unit in which current natural conditions are maintained insofar as possible. These conditions are achieved by allowing natural and physical processes to prevail without human intervention (Federal Committee on Ecological Reserves 1977). Federal land management agencies have been developing a comprehensive national system of RNAs since 1927. To date, the Forest Service, National Park Service and BLM have designated RNAs in the GYE. Principal goals of the RNA system are:

1. The long-term preservation of a representative array of all significant natural ecosystems as sources of baseline data, against which the effects of human activities in similar environments can be measured.
2. To provide sites for education and research on natural processes in undisturbed ecosystems. Only nondestructive research methods are allowed.
3. To provide gene pool reserves for a full array of plant and animal species, including both common and rare, within naturally functioning environments.

RNAs differ from areas in the National Wilderness Preservation System in several ways, one of the primary being that RNAs are administratively designated. Another is that livestock grazing is allowed in Wilderness, while it is prohibited in RNAs. RNAs are also smaller, generally between 300 and 1,000 acres, allowing for a more detailed inventory of the area's biological and scientific importance and a reasonable area of focus for interdisciplinary research programs on naturally-functioning ecosystems (e.g., Bormann and Likens 1979). RNAs must also be sufficiently accessible for periodic visits for measurement of study plots and instruments. Recreational use of RNAs is limited or subordinate to the scientific and educational objectives for the areas. They are important settings, however, for activities emphasizing environmental learning (Hendee et al. 1978). RNAs may be established in Wilderness, enhancing the scientific and educational objectives of the National Wilderness Preservation System. Several proposed RNAs in the GYE occur around the perimeter of designated or proposed wilderness areas.

Special Interest Areas -- The SIA is an administrative designation exclusive to the Forest Service, with the objective being to protect and manage special recreation areas with unique physical and biological

characteristics. The four categories of SIAs highlight different features and include the Geological Area, Paleontological Area, Zoological Area and Botanical Area. Only the Botanical Area category has been used in the GYE. Research and education are not the primary purposes of SIAs, but recreational and other uses are allowed as long as they do not disturb the feature(s) which SIA designation was intended to protect. Although SIAs generally do not provide as great a level of protection as RNAs, Botanical Areas are treated as equivalents to RNAs in the GYE.

Inherent to the task of preserving biotic communities in natural areas is the process of classifying the landscape into elements to insure that no communities are lost. One of the primary objectives of natural area conferences convened in Idaho (Wellner and Johnson 1974), Montana (Loop and Bird 1986) and Wyoming (Collins 1985) was to identify those elements of biological diversity requiring representation in a natural area system. Classification protocols established at these conferences were used to assess community conservation needs in the GYE.

Figure 14. Locations of proposed and established Research Natural Areas and Botanical Areas in the Greater Yellowstone Ecosystem.

II. Natural Areas in the Greater Yellowstone Ecosystem

Following are brief descriptions of the physical and biological attributes of 39 established and proposed natural areas in the GYE.

Beaverhead National Forest - Montana

There are two established RNAs on the Beaverhead National Forest, both within the GYE. One additional RNA within the Greater Yellowstone portion of the Beaverhead Forest is currently recommended for establishment in the Final Forest Plan (USDA Forest Service 1986a).

Cave Mountain RNA (proposed)

Primary Feature: Relict subalpine grassland.

Cave Mountain pRNA encompasses five plateau-like summits, all over 9500 feet, around Cave Mountain in the Gravelly Range, 30 miles south of Ennis, Montana. The 1,300-acre site is surrounded by steep escarpments of massive limestone formations containing numerous marine fossils. Rock glaciers lie at the foot of the escarpments and there are at least two caves in the area. Mining claims blanket the pRNA and U.S. Steel Corp. has applied for patent on part of the area.

Vegetation of the pRNA is predominantly subalpine grasslands of Idaho fescue, tufted hairgrass and sedges. Approximately ten percent of the area is mixed whitebark pine and lodgepole pine. A substantial stand of rough fescue (*Festuca scabrella*) is present in the area, reported to be the southernmost location in Montana for this species. Other features include near-alpine cushion-plant communities, a cold spring and soil frost features. Although the general vicinity surrounding Cave Mountain was grazed by sheep from the turn of the century until 1969, Cave Mountain was used only lightly due to steepness of surrounding terrain and lack of water. Grasslands present on Cave Mountain are believed to be relics of high altitude grasslands that once occurred along the crest of the Gravelly Range. The area still contains a loess cap high in volcanic ash 4 to 6 inches deep. This cap may have been present on much of the Gravelly Range but was lost with heavy grazing use, probably by bison and domestic livestock.

Reference: Johnson and Pfister 1982.

Cliff Lake RNA

Primary Features: Grasslands and shrublands with high species diversity.

Established in 1952, Cliff Lake RNA occupies a high, undulating bench, which rises abruptly 500 to 600 feet above the west side of Cliff Lake, 24 miles northwest of West Yellowstone, Montana. This 2,291-acre RNA overlies volcanic rocks of Tertiary age. No permanent water exists on the bench, but several ephemeral streams traverse the area. Cliff Lake RNA was grazed lightly by sheep prior to 1950, but effects were minimal due to lack of water on the plateau.

Grasslands, dominated by Idaho fescue, and shrublands, dominated by mountain big sagebrush, are the outstanding features of the RNA. These communities have unusually high species diversity, with over 20 graminoids, 50 forbs, and six shrubs. Slightly more than half the area is covered by coniferous forest, comprised of 100-year-old lodgepole pine and 200-year-old Douglas-fir stands. Small stands of aspen, with a grass-forb understory, add diversity to the RNA.

References: Johnson and Pfister 1982; USDA Forest Service 1952.

Cottonwood Creek RNA

Primary Features: Xeric to mesic low elevation grassland and forest communities.

Established in 1972, Cottonwood Creek RNA lies on the east side of the Ruby River valley, between the Snowcrest and Gravelly ranges, 22 miles southwest of Ennis, Montana. Lying on a 7,000-foot, east-west trending ridge, the 128-acre RNA has been fenced and excluded from grazing since 1938. Geologically, it rests on tilted, interbedded sandstones and shales. Differential weathering has resulted in sandstone ridges and eroded shale depressions. A portion of a landslide is included in the RNA.

The steep, dry south-facing slope has thin soils with areas of erosion pavement, supporting the Idaho fescue/bluebunch wheatgrass habitat type. In addition, small areas of scattered Douglas-fir and Rocky Mountain juniper occur along the draws on the south-facing ridge. The north-facing slope is typified by deep soils that support the mountain big sagebrush/bluebunch wheatgrass habitat type.

References: Johnson and Pfister 1982; USDA Forest Service 1972.

Bridger-Teton National Forest - Wyoming

The Bridger-Teton National Forest has no established RNAs. The Draft Forest Plan (USDA Forest Service 1986b) identified ten general areas that warranted further inventory for suitable RNAs. Subsequent field investigations of the candidate areas in 1987, by Joel Tuhy of The Nature Conservancy, working under a contract with the Forest Service, identified six specific sites suitable for RNA establishment. The final Forest Plan (USDA Forest Service 1989) endorsed the establishment of four of these areas: Afton Front, Horse Creek, Osborn Mountain, and Swift Creek. Final acreages are not yet known.

Afton Front RNA (proposed)

Primary Features: Low elevation shrub-steppe and forest communities.

Afton Front pRNA encompasses the upper portions of Blaney and Anderson canyons along the west slope of the Salt River Range, 1 mile northeast of Afton, Wyoming. The pRNA contains dissected topography, with high vertical relief and predominantly north, south and west aspects. Neither canyon contains a perennial stream. Surface rocks are all sedimentary, ranging in age from Permian through Jurassic, including various layers of limestone, dolomite, sandstone and shale.

Afton Front pRNA is an outstanding example of a mosaic of contrasting north- and south-slope plant communities. South-facing slopes support several types of xeric grasslands and shrublands. Small stands of bigtooth maple are also scattered on these slopes, mostly in narrow draws. North-facing slopes are mostly occupied by xeric forests of Douglas-fir, with subalpine fir predominating at higher elevations. Aspen stands occur in the wider, lower canyon bottoms, and are also widely scattered on higher slopes.

Reference: Tuhy 1987a.

Horse Creek RNA (proposed)

Primary Features: High diversity of alpine, coniferous forest, aspen, riparian, forbland, grassland and shrubland communities.

Horse Creek pRNA encompasses the head of Horse Creek on the western slope of the Gros Ventre Range, approximately 10 miles southeast of Jackson, Wyoming. Much of the area is relatively steep, although benchlike landforms exist at the higher elevations. Surficial geology of the area ranges in age from Precambrian through Quaternary and includes igneous, metamorphic and sedimentary rock. The high degree of landform and

geological diversity, combined with almost 4800 feet of relief, result in tremendous habitat and, hence, biotic diversity within the pRNA.

The lower and middle parts of the pRNA support mesic forests of Douglas-fir on north-facing slopes, and a mosaic of drier forests, shrublands and forblands on south-facing slopes. The upper part of the basin contains a diverse assemblage of coniferous forests, aspen stands, forb meadows, and narrow riparian corridors. Known plant communities in the RNA include two alpine habitat elements, 14 coniferous forest habitat types, two aspen community types, six riparian community types, five tall forb community types, one grassland community and three upland shrub communities.

References: Collins 1985, Tuhy 1987b, Youngblood 1980.

North Ditch Creek RNA (proposed)

Primary Features: Mesic forest communities.

North Ditch Creek pRNA encompasses two small basins in the North Fork of Ditch Creek drainage, which drains the west slope of the Mount Leidy Highlands, approximately 6 miles south of Moran, Wyoming. Slope gradients range from gentle to very steep and all aspects are represented. Vertical relief in the proposed area is about 1200 feet. Surface rocks are all sedimentary, ranging in age from Cretaceous to lower Tertiary, and including various layers of shale, sandstone, conglomerate and coal.

The majority of the pRNA is forested, with Douglas-fir, lodgepole pine, Engelmann spruce and subalpine fir comprising much of the forest cover, occurring in six habitat types. Three tall-forb and two sagebrush communities occur on sites where topographic and/or soil factors are unfavorable for conifers.

Reference: Tuhy 1987c.

Osborn Mountain RNA (proposed)

Primary Features: Diverse and well-developed alpine communities; rare plants.

Osborn Mountain rises 4000 feet above the east side of the Green River valley in the northern Wind River Range, approximately 16 miles southwest of Dubois, Wyoming. The pRNA lies almost entirely above upper timberline on the sprawling, plateau-like top of Osborn Mountain. The plateau slopes gently upward from west to east, with the highest point on the eastern side of the plateau in excess of 11,920 feet. The main mass of the pRNA is formed from metamorphic and/or intrusive igneous rocks that comprise the core of the Wind River Range. The high ridge in the southwestern portion of the area is a remnant cap of sedimentary strata, including limestone and sandstone, that once covered the whole region.

Osborn Mountain pRNA contains a broad spectrum of alpine habitats, each with a distinctive flora and assemblage of communities. These habitats include cliffs and ledges, talus and scree, fellfield and felsenmeer, meadow and turf, and standing and running water. Six plant species of limited distribution in Wyoming occur in a peat-sedge bog in the pRNA: *Carex bipartita*, *C. incurviformis*, *Juncus biglumis*, *Phippsia algida*, *Potentilla rubricaulis* and *Saxifraga chrysantha*. The diversity of geological substrates in the area, combined with a diversity of habitats, makes Osborn Mountain an outstanding pRNA for alpine elements.

References: Collins 1985, Tuhy 1987d.

Soda Fork RNA (proposed)

Primary Features: High diversity of coniferous forest and riparian communities.

Soda Fork pRNA, located in the Washakie Range, about 17 miles northeast of Moran, Wyoming, spans the large and wide Soda Fork canyon, a tributary of the Buffalo Fork River. The pRNA encompasses many

landforms, including both wide and narrow valley bottoms, gently-sloping toeslopes and benches, moderate to very steep mid-elevation slopes, gently-sloping and undulating upper basins and very steep slopes and cliffs at the highest elevations. Surficial geology in the area consists of Tertiary volcanics, mostly alternating layers of lava and ash, and Paleozoic carbonates. Topographic and geological diversity, combined with vertical relief of over 3200 feet, result in high habitat and, hence, biotic diversity.

The sides of the Soda Fork canyon are covered with coniferous forest, including eight habitat types. Present cover of the forest is predominantly Engelmann spruce and subalpine fir at all but the highest elevations. Lodgepole pine stands occur on lower- and mid-elevation benches and gentle slopes. Whitebark pine codominates with subalpine fir in upper elevation forests. Interspersed with forest communities, especially on gentler slopes, are four tall-forb communities and one sagebrush habitat type. The wide valley bottom of Soda Fork supports an intricate and diverse mosaic of ten riparian community types. Alpine habitats occur at the highest elevations on Soda and Terrace mountains.

Reference: Tuhy 1987e.

Swift Creek RNA (proposed)

Primary Features: Tall-forb, Engelmann spruce and riparian communities.

Swift Creek pRNA lies along the west side of the crest of the Salt River Range, about 7 miles east of Afton, Wyoming. In addition to including a portion of the main Swift Creek drainage, the pRNA also includes four smaller tributary drainages. Topography is moderate to very steep, with the gradient of Swift Creek also being relatively steep as it flows through both V- and U-shaped valley segments. Surficial geology of the pRNA is comprised of Paleozoic and Mesozoic sediments, including limestone, dolomite, sandstone and shale.

Slopes along the lower part of Swift Creek canyon are largely covered by coniferous forest communities, with Douglas-fir, and to a lesser extent subalpine fir and lodgepole pine, being the predominant cover types. Scattered within these forests are several tall-forb communities. The canyon bottom supports a narrow riparian zone dominated by spruce, tall willows and red-osier dogwood. The upper part of the drainage supports lush and diverse tall-forb communities, along with patches of conifers and aspen. Many of the conifer patches on the sideslopes are stunted because of harsh microclimate and avalanches. The highest elevations along the crest are rocky and sparsely vegetated with krummholz, alpine ledges and talus. The pRNA is known to contain one rare plant, *Astragalus shultziorum*, while two others are known from the vicinity.

Reference: Tuhy 1987f

Caribou National Forest - Idaho

There are two established RNAs on the Caribou National Forest portion of the GYE. The Final Forest Plan (USDA Forest Service 1985a) recommends consideration of one additional RNA within the GYE.

Elk Valley RNA (proposed)

Primary Features: Alkaline, middle elevation wetland system.

Elk Valley pRNA is located in the Gannett Hills, 18 miles northeast of Montpelier, Idaho. The 200-acre pRNA, occurring at approximately 7500 feet in altitude, encompasses a diverse wetland system in the broad valley of upper Spring Creek. The wetland is underlain by the Preuss Redbeds, which contain salt beds that were deposited in a shallow marine basin during the Jurassic.

The vegetation mosaic of the Elk Valley wetland includes sedge, rush and willow dominated communities which are known to occur throughout the interior of western North America. What makes Elk Valley unique,

however, is that many of these communities are normally found at much lower elevations, adjacent to salt desert shrub or more arid portions of the sagebrush-steppe. In addition, these types are characterized by the presence of a large number of plant species generally recognized as indicators of alkalinity. Studies of aquatic communities in the pRNA reveal an unusually diverse crustacean fauna. Also, an aquatic insect occurring at Elk Valley has not previously been reported for Idaho. In years of normal precipitation, cattle are excluded from the wetland due to high water. During drought years, however, cattle wander into the middle of the valley to graze. The Caribou Forest considers this conflict significant enough to rule out the establishment of Elk Valley as a RNA to protect this unique juxtaposition of wetland and aquatic communities.

References: Caicco 1986; Savage 1979.

Horse Creek RNA

Primary Features: Seral lodgepole pine stands in subalpine fir habitat types.

Established in 1989, Horse Creek RNA is located along the eastern slope of the Webster Range, 12 miles northwest of Afton, Wyoming. The 330-acre RNA encompasses a short, steep drainage that flows north into Horse Creek. It is underlain by a Mesozoic sedimentary formation, comprised of limestone, siltstone and sandstone.

Vegetation of Horse Creek RNA is comprised of a diverse assemblage of six subalpine fir habitat types. Lodgepole pine is the major cover type of the area, although mountain pine beetle infestations have thinned the stands to a considerable degree. Aspen communities occur throughout the area.

Meade Peak RNA

Primary Features: High elevation forest and nonforest communities.

Established in 1988, Meade Peak RNA is located on Snowdrift Mountain in the central Preuss Range, approximately 12 miles north of Montpelier, Idaho. Meade Peak is the highest point in the Preuss Range at 9,957 feet, with the RNA encompassing 305 acres around the summit. Paleozoic formations comprise the geologic substrates of the RNA, including limestone, sandstone, shale, dolomite and quartzite.

Meade Peak RNA is a subalpine parkland with much of the peak covered by a sagebrush-grass-forb community. Douglas-fir, limber pine, Engelmann spruce and subalpine fir occur singly or in small stands. Scattered Douglas-fir and limber pine grow on the rugged and scenic cliffs on the southwest slope of the peak. Scree and rock outcrop communities at the highest elevations contain elements of the Rocky Mountain alpine flora.

Reference: Wellner and Moseley 1987a.

Custer National Forest - Montana

There are no established or proposed RNAs in the Greater Yellowstone portion of the Custer National Forest (Beartooth Ranger District). The Final Forest Plan (USDA Forest Service 1986c) identifies five alpine and high elevation wetland habitat elements for which no suitable RNA candidates have been found. These elements occur only in the Greater Yellowstone portion of the Custer National Forest.

Gallatin National Forest - Montana

There are no established RNAs on the Gallatin National Forest. The Forest Service's Northern Regional Office assigned terrestrial and aquatic community targets as the Forest's objectives for identifying candidate RNAs in the Forest Plan. Nine areas, all within the Greater Yellowstone Ecosystem, are included in the Final Forest Plan (USDA Forest Service 1986d) that largely fulfill these assigned targets.

Black Butte RNA (proposed)

Primary Features: Mosaic of Idaho fescue, subalpine fir and subalpine fir-whitebark pine communities.

Black Butte pRNA is located on the west side of the Gallatin River, adjacent to Yellowstone National Park, 23 miles north of West Yellowstone, Montana. Approximately 500 acres in size, the pRNA encompasses a small hydrologic basin that flows northward into the Gallatin River. The pRNA is underlain by Paleozoic sediments.

Much of the vegetation of Black Butte pRNA is comprised of relatively xeric subalpine fir habitat types. Engelmann spruce, lodgepole pine, and Douglas-fir are major seral tree species. The subalpine fir-whitebark pine/grouse whortleberry habitat type occupies protected sites, saddles and northerly aspects at higher elevations. Forb-rich stands of the Idaho fescue/Richardson's needlegrass habitat type occur along ridgetops and some of the drier slopes.

East Fork Mill Creek RNA (proposed)

Primary Features: Mosaic of Engelmann spruce, Douglas-fir and subalpine fir communities.

East Fork Mill Creek pRNA is located along the west slope of the Absaroka Range, 22 miles north of Gardiner, Montana. Approximately 800 acres in size, the pRNA encompasses a hydrologic basin that flows northward into the East Fork of Mill Creek. The pRNA is underlain by Paleozoic sediments.

Communities at lower elevations in the pRNA consist of Engelmann spruce and Douglas-fir habitat types with understories dominated by ninebark. Several subalpine fir habitat types occupy the middle elevations, while the xeric Douglas-fir/elk sedge habitat type occurs on the ridges. Limber pine is present in ridgeline forest stands.

Mount Ellis RNA (proposed)

Primary Features: Mosaic of Douglas-fir, Engelmann spruce, subalpine fir and forbland communities, including the rare subalpine fir/beargrass habitat type.

Mount Ellis pRNA is located at the northern end of the Gallatin Range, 5 miles south of Bozeman, Montana. Approximately 1000 acres in size, the pRNA encompasses the upper drainage of an unnamed tributary of Bear Canyon. The basin contains a gentle gradient stream and is underlain by Paleozoic and Mesozoic sediments.

Dense stands of lodgepole pine dominate the gentle topography at the head of the drainage and along the stream. Where slopes steepen, mature stands of subalpine fir and Douglas-fir assume dominance. Moist, forb-rich meadows occur in openings throughout the area. A small marsh, lying just below the watershed divide, adds to the diversity of the area. Of special interest is the presence of the subalpine fir/beargrass habitat type in the upper portion of the drainage. This habitat type, reflective of a maritime climate, is rare within the Greater Yellowstone Ecosystem.

Reference: Arno 1979.

Obsidian Sands RNA (proposed)

Primary Features: Lodgepole pine/bitterbrush community on volcanic alluvium.

Obsidian Sands pRNA is located 3 miles northwest of West Yellowstone, Montana, adjacent to Hebgen Lake in the Madison River valley. It encompasses about 300 acres of nearly level obsidian sands, derived from alluvial outwash. This substrate is very well drained, with no permanent surface water. Droughty conditions, combined with intense cold air pooling in this high elevation valley, create a harsh environment for plant growth.

Obsidian Sands pRNA is uniformly covered with the lodgepole pine/bitterbrush habitat type. Stands are moderately open with numerous age classes of self-replacing lodgepole pine. The undergrowth is sparse, with bitterbrush the most prominent species.

Palace Butte RNA (proposed)

Primary Features: Forbland and forest communities; subalpine aquatic communities.

Palace Butte pRNA is located in the northern Gallatin Range, 16 miles south of Bozeman, Montana. Approximately 800 acres in size, the pRNA encompasses a glaciated, subalpine basin in the Hyalite Creek drainage. Excellent examples of undisturbed aquatic communities occur here, including two low productivity lakes with and without fish, temporary ponds, moderate to steep gradient stream segments and waterfalls. Tertiary volcanics underlie the pRNA.

Forest vegetation consists of several subalpine fir and subalpine fir-whitebark pine habitat types, generally supporting stands of lodgepole pine and Engelmann spruce. Much of the vegetation of Palace Butte pRNA, however, consists of extensive and diverse forbland communities.

Passage Creek RNA (proposed)

Primary Features: Subalpine fir and Idaho fescue communities.

Passage Creek pRNA is located on the west slope of the Absaroka Range, 18 miles northeast of Gardiner, Montana. Approximately 1000 acres in size, the pRNA encompasses a small hydrologic basin underlain by Tertiary volcanics. The basin contains a small, moderate gradient stream that flows northeast into Passage Creek.

Much of the vegetation of Passage Creek pRNA consists of subalpine fir habitat types supporting mature stands of lodgepole pine, subalpine fir, Engelmann spruce and Douglas-fir. Moist subalpine meadows, dominated by a mixture of grasses, sedges and forbs, interrupt the forest cover on the ridges at the head of the drainage. These meadows represent the Idaho fescue/bearded wheatgrass habitat type.

Pioneer Lakes RNA (proposed)

Primary Features: Numerous aquatic communities; subalpine fir and Engelmann spruce communities.

Pioneer Lakes pRNA is located along the west slope of the Gallatin Range, 20 miles southwest of Bozeman, Montana. Approximately 400 acres in size, the pRNA encompasses a hydrologic basin that flows south into the Gallatin River. The pRNA is underlain by Tertiary volcanics. Numerous aquatic communities occur in the area, including streams of low and steep gradients, average production lakes with fish, and permanent ponds.

The exposed ridge at the north end of the pRNA supports sagebrush-steppe and mixed shrub communities. Forest communities are represented by open stands or scattered individuals of mixed species, including subalpine fir, limber pine, lodgepole pine, aspen, Douglas-fir and Engelmann spruce. These occur in four subalpine fir and one Engelmann spruce habitat types.

Sliding Mountain RNA (proposed)

Primary Features: Limber pine, Douglas-fir, subalpine fir and Engelmann spruce communities.

Sliding Mountain pRNA is located along the west slope of the Absaroka Range, 10 miles north of Gardiner, Montana. Approximately 1200 acres in size, the pRNA encompasses a narrow hydrologic basin that flows north into Sixmile Creek. The pRNA is underlain by Tertiary volcanics and crystalline metamorphics. A small, moderate to steep gradient stream traverses the area.

Vegetation of Sliding Mountain pRNA consists of a diverse assemblage of xeric to mesic forest habitat types. The xeric extreme is represented by both low and high elevation habitat types; limber pine/Idaho fescue and Douglas-fir/ninebark at the lower elevations and subalpine fir-whitebark pine/grouse whortleberry at the higher elevations. Along the stream and on protected slopes occur several mesic subalpine fir and Engelmann spruce habitat types, with the subalpine fir/Sitka alder community being the wettest.

Wheeler Ridge RNA (proposed)

Primary Features: Extensive and well-developed whitebark pine communities.

Wheeler Ridge pRNA is located in the northern Gallatin Range, approximately 14 miles south of Bozeman, Montana. It encompasses an entire section (640 acres) on a high elevation ridge, surrounded in a checkerboard pattern by Burlington Northern timberland. Wheeler Ridge is a relatively wide ridge that runs in a north-south direction through the center of the pRNA. Cirques occur to the east and west of the ridge, in which slump topography and active avalanche chutes are present. Geology of the pRNA consists of Tertiary volcanics, mostly breccias and lavas, overlying Paleozoic sediments, comprised of quartzite, shale and limestone.

The most outstanding feature of Wheeler Ridge pRNA is its extensive, old-growth stand of whitebark pine. Whitebark pine in this stand are larger and taller than the average whitebark pine found in the Gallatin National Forest. Subalpine fir is a co-dominant throughout most of the pRNA, while lodgepole pine is a major forest component at lower elevations. Although 90% of the proposed RNA is forested, plant species diversity in the forested communities is low. In contrast, floristic diversity of wet meadows on the cirque floors is greater, making them important components of the site.

References: Johnson 1980; Johnson and Pfister 1982.

Idaho Falls District - Bureau of Land Management - Idaho

The Medicine Lodge Resource Management Plan (USDI BLM 1985) established four RNAs in the Greater Yellowstone portion of the Idaho Falls District.

Game Creek RNA

Primary Features: Diverse assemblage of upland shrub-steppe and coniferous and deciduous forest communities; well-developed riparian zone.

Game Creek RNA encompasses a 375-acre section of the lower Game Creek valley, at the base of the west slope of the Teton Range, ten miles south of Driggs, Idaho. It lies on the Idaho - Wyoming border, adjacent to the Targhee National Forest. The RNA is underlain by sedimentary rocks, including limestone, sandstone and quartzite.

Because Game Creek RNA spans the valley, it includes both south- and north-facing aspects, which results in a diversity of upland communities. Included are mountain big sagebrush, Douglas-fir, subalpine fir and aspen communities. Along the Game Creek floodplain, Engelmann spruce and red-osier dogwood communities comprise the well-developed riparian zone.

Pine Creek Island RNA

Primary Features: Narrowleaf cottonwood floodplain communities.

Three small islands in the South Fork of the Snake River were designated as RNAs in the Medicine Lodge Plan. Each RNA is located along a different segment of the river, which together include the range of diversity of narrowleaf cottonwood communities along the South Fork between the Palisades Dam and its confluence with

the Henrys Fork. Pine Creek Island RNA, 25 acres in size, lies in the middle section, located downstream from Connant Landing, 7 miles northwest of Swan Valley, Idaho.

Vegetation of the RNA is comprised of mature narrowleaf cottonwood communities, with willow-, silverberry- (*Elaeagnus commutata*) or grass-dominated understories.

Reid Canal Island RNA

Primary Features: Narrowleaf cottonwood floodplain communities.

Reid Canal Island was one of three small islands in the South Fork of the Snake River that were designated as RNAs to include a diversity of narrowleaf cottonwood communities (see Pine Creek Island RNA). Reid Canal Island RNA, 22 acres in size, is located along the lower river segment, near the Reid Canal diversion, 5 miles north of Ririe, Idaho.

Vegetation of the RNA is comprised solely of the mature narrowleaf cottonwood/silverberry community, containing a diverse shrub understory.

Squaw Creek Island RNA

Primary Features: Narrowleaf cottonwood floodplain communities.

Squaw Creek Island was one of three small islands in the South Fork of the Snake River that were designated as RNAs to include a diversity of narrowleaf cottonwood communities (see Pine Creek Island RNA). Squaw Creek Island RNA, 25 acres in size, is located on the upper river segment, near the mouth of Squaw Creek, 2 miles south of Swan Valley, Idaho.

Much of the vegetation of Squaw Creek Island RNA is comprised of mature narrowleaf cottonwood communities, with willow-, silverberry- (*Elaeagnus commutata*) or grass-dominated understories. A mixed shrub community, comprised of alder, willow and red-osier dogwood, also occurs on the island.

Shoshone National Forest - Wyoming

The Shoshone National Forest has two established Botanical Areas and no established RNAs. The Final Forest Plan (USDA Forest Service 1986e) identified four additional areas as being suitable as RNAs. The Forest has since decided to designate all four as Botanical Areas.

Bald Ridge Botanical Area (proposed)

Primary Features: Limber pine woodland; high plant species diversity.

Bald Ridge pBotanical Area is located east of the Clarks Fork of the Yellowstone River canyon, 23 miles northwest of Cody, Wyoming. Approximately 200 acres in size, the area encompasses a prominent, 8,000-foot ridge aligned in a north-south direction. It is underlain by several calcareous rock formations.

The east-facing slopes of Bald Ridge pBotanical Area have extensive, open-growth limber pine stands, occurring in 10- to 20-acre patches. Graminoids dominate the understory and the intervening grassland communities. The overall diversity of plant species on the ridge, however, is unusually high. The westerly aspects support a mixed stand of limber pine, Engelmann spruce, and some Douglas-fir in various stages of secondary succession.

References: O. Scott 1985.

Pat O'Hara Creek Botanical Area (proposed)

Primary Features: Douglas-fir/mountain ninebark habitat type; high shrub diversity.

Pat O'Hara Creek pBotanical Area includes approximately 300 acres on the south side of Dry Fork of Pat O'Hara Creek, 16 miles northwest of Cody, Wyoming. The pBotanical Area spans about 800 feet in elevation on the relatively gentle, north-facing toe slopes of Pat O'Hara Mountain. It is underlain by several calcareous rock formations.

Pat O'Hara Creek pBotanical Area contains two unusual features: 1) Douglas-fir/mountain ninebark habitat type, a rare association in the GYE, where it is at the northwestern limit of its range, and 2) greatest understory shrub diversity on the Shoshone National Forest. The area is covered mostly by mature (ca. 200 years old) Douglas-fir stands. Limber pine is a constant but low density component of these forests.

Picketts Knob Botanical Area (proposed)

Primary Feature: Whitebark Pine stands.

Picketts Knob pBotanical Area is located in the upper Wind River drainage, 18 miles northwest of Dubois, Wyoming. Approximately 300 acres in size, it encompasses a broad, north-south-oriented ridge between Du Noir Creek and Middle Fork of Long Creek. The pBotanical Area is underlain by Tertiary volcanics and is easily protected due to steep escarpments surrounding most of the area.

Two habitat types occur in Picketts Knob pBotanical Area, one whitebark pine and one subalpine fir. Whitebark pine is the predominant cover type, with various amounts of subalpine fir, Engelmann spruce and lodgepole pine occurring in the stands.

Sawtooth Peatbed Botanical Area

Primary Feature: Southernmost fen-palsa in North America.

Sawtooth Peatbed Botanical Area, established in 1987, protects and highlights a unique ecosystem for the conterminous United States, that is, a fen-palsa (an elevated peatbed overlying permafrost). Sawtooth fen-palsa represents the southernmost occurrence of a palsa in North America. It is unique due to its size, southern location, and isolation from commonly occurring palsas in northern Canada and Alaska. Situated in the bottom of a broad, northwest-trending valley, this 160-acre area is located in the Beartooth Mountains, approximately 32 miles northwest of Cody, Wyoming, at an altitude of 9700 feet.

The fen-palsa is composed of an approximately 20-acre graminoid palsa surrounded by a sedge fen that grades into subalpine wet meadow. The palsa is raised 3 to 6 feet above the surrounding fen and wet meadow. Permafrost occurs at a depth of 15 to 18 inches below its surface and is believed to extend through the peat deposit into the underlying granite. The surface of the palsa appears to be exposed enough so as to be blown free of snow during the winter. It is characterized by uneven thermokarst topography. The palsa is practically devoid of vegetative cover. The surrounding fen is dominated by *Carex scopulorum*, *C. praeceptorum*, *C. illota*, and *C. aquatilis*.

References: Collins et al. 1984; Pierce 1961.

Swamp Lake Botanical Area

Primary Features: Unique wetland communities; many rare plants.

The Swamp Lake Botanical Area was established in 1987, to protect and maintain the large number of unique and unusual plant species and plant communities that occur in this wetland in the Clark's Fork of the

Yellowstone River valley, 34 miles northwest of Cody, Wyoming. The 344-acre area lies at the foot of Cathedral Cliffs, where extensive upwelling of warm, alkaline (pH 8.0-8.4) groundwater occurs. These springs drain an aquifer flowing under extensive Paleozoic carbonates found to the south. Bedrock underlying the wetland complex consists of impervious Precambrian granitic rocks.

Three wetland communities or habitats have been described at Swamp Lake, each with several rare plant species. A swamp forest community comprises the uppermost unit of the wetland complex and is dominated by white spruce. Seven rare species occur in this community, where some are locally dominant. In their only occurrence in the coterminous United States, *Arctous rubra* and *Salix myrtillofolia* are found in scattered colonies in this community. A sedge-shrub community, dominated by *Carex rostrata*, occurs in areas between the swamp forest and open water. Two species of limited distribution in Wyoming occur here. The marl flats and open water community comprises the most interesting and unique unit of the wetland complex. Sedges dominate on the saturated floating deposits of marl and peat. No less than ten rare species occur in this community, four of which occur nowhere else in Wyoming.

References: Collins 1985; Johnston 1987.

Twin Lakes Botanical Area (proposed)

Primary Feature: Alpine vegetation and associated cryopedogenic features.

Located approximately 36 miles northwest of Cody, Wyoming, Twin Lakes pBotanical Area is one of the best-studied alpine areas in the Rocky Mountains. The 722-acre area encompasses a broad, northerly-facing cirque in the upper Rock Creek drainage, surrounded by rolling uplands of the Beartooth Plateau. Twin Lakes pBotanical Area is underlain by Precambrian crystalline rocks, primarily folded gneiss and migmatites.

Twin Lakes contains outstanding examples of the full spectrum of alpine habitats, frost features and an unusually rich assemblage of arctic-alpine plant species. Included are extensive areas of alpine cushion plant, alpine turf, alpine meadow, and alpine bog vegetation. Cryopedogenic features include snowbeds, non-sorted circles and stripes, sorted circles and stripes, frost hummocks, frost boils, and solifluction terraces.

References: Collins 1985; Evert 1982, 1984; Johnson 1962; Johnson and Billings 1962.

Targhee National Forest - Idaho and Wyoming

There is one established RNA on the Targhee National Forest portion of the GYE. Seven candidate RNAs within the GYE are included in the Targhee Forest Plan (USDA Forest Service 1985b). Six are still considered viable candidates and are moving through the establishment process. The seventh, Fogg Butte, was not considered viable due to conflicts with cattle grazing.

Burns Canyon RNA (proposed)

Primary Features: Diverse assemblage of deciduous-hardwood forest, coniferous forest and shrub-steppe communities on structurally complex sedimentary formations.

Burns Canyon pRNA is located along the southern side of the Big Hole Mountains, approximately 31 miles northeast of Idaho Falls, Idaho. The 490-acre pRNA spans Burns Canyon, a major tributary along the middle section of the South Fork of the Snake River. Occurring in a highly faulted section of the Overthrust Belt, Burns Canyon includes numerous sedimentary formations, including quartzite, sandstone, shale and limestone. A large landslide deposit, occurring along one of the faults, adds significant landform diversity to the area.

Vegetation of the pRNA differs on either side of Burns Canyon. A deciduous-hardwood forest covers the south-facing canyon slope, with aspen and bigtooth maple being the dominant trees. Mountain-mahogany and

sagebrush communities also occur on the slope. Coniferous forest covers the north-facing slope, with Douglas-fir and subalpine fir habitat types represented. Lodgepole pine, shrub and tall forb communities, largely successional to Douglas-fir and subalpine fir habitat types, are widespread cover types on the north-facing slope.

Reference: Wellner and Moseley 1986a.

Moose Creek Plateau RNA (proposed)

Primary Features: Xeric, high elevation forests on relatively recent volcanic substrate.

Moose Creek Plateau pRNA, approximately 400 acres in size, is located along the Continental Divide adjacent to Yellowstone National Park, 14 miles northeast of Island Park, Idaho. This rolling, high elevation plateau is uniformly underlain by rhyolites of the third and youngest volcanic cycle in the Yellowstone region. The substrate is very porous and no perennial water exists in the RNA, although vernal ponds and intermittent streams are present.

In August 1988, the entire pRNA was burned by the North Fork Fire. Burn intensity ranged from moderate to high severity. Permanent monitoring plots were established in 1989, to monitor vegetative succession. Prior to the fire, vegetation of the pRNA was comprised of xeric, high elevation forest communities, with lodgepole pine being the dominant species. The lodgepole pine, however, was heavily infested with mountain pine beetle and was declining, causing a shift in dominance to the climax species, whitebark pine and subalpine fir. Plant species diversity on the Plateau is very low. This pRNA is notable because of the presence of the whitebark pine/Ross' sedge habitat type, a rare community in Idaho, with Moose Creek being its only occurrence in a RNA or pRNA in the state.

Reference: Wellner and Moseley 1987b.

Rock Lake RNA (proposed)

Primary Features: Undisturbed lake and wetlands on relatively recent volcanic substrate.

Rock Lake pRNA lies in the Falls River Basin, Wyoming, near the southern boundary of Yellowstone National Park, 25 miles east of Ashton, Idaho. The region is characterized by a series of flat upland benches interrupted by numerous, shallow wetland basins, which drain slowly to the southwest. The pRNA is uniformly underlain by Falls River Basalt, extruded during the third and youngest volcanic cycle in the Yellowstone region.

Final boundaries for this pRNA have yet to be drawn, but it will include open water, graminoid wetland and upland forest communities. Wetland communities generally form concentric zones around open water habitats, with water lily (*Nuphar polysepalum*), grass-leaved potamogeton (*Potamogeton gramineus*), and softstem bulrush (*Scirpus validus*) forming the most hydric community, followed by several sedge-dominated communities. Transition from wetland to upland coniferous forest is usually abrupt and occurs where there is a slight rise in topography. In several areas, however, aspen stands occur in this transition area, some with large-diameter individuals. The forested benches are flat and contain several communities dominated by lodgepole pine. Trumpeter swans were nesting on Rock Lake in 1986.

Sheep Falls RNA (proposed)

Primary Features: Large waterfall and associated communities.

The Sheep Falls area was chosen as a candidate area primarily to fill the need for a large waterfall and associated spray-zone communities within the RNA system. Although preliminary field work indicates that Sheep Falls may fill this need, other major falls in the Island Park area need to be inventoried so that the least altered example can be included in the system.

Sheep Falls pRNA, approximately 100 acres in size, straddles the Henrys Fork of the Snake River as it flows through a shallow but steep-walled canyon, 10 miles north of Ashton, Idaho. Relatively flat, broad river terraces below the canyon rim constitute the majority of the pRNA. Sheep Falls, a long, cascading rapid, is located at the downstream boundary of the pRNA.

Lodgepole pine is the major tree cover in the pRNA with small inclusions of a sagebrush-grass community. There is little riparian vegetation in the area due to the basalt palisades immediately adjacent to the river.

Targhee Creek RNA (proposed)

Primary Feature: Aquatic and terrestrial alpine communities; rare plants.

Targhee Creek pRNA is located in the Henrys Lake Mountains, along the Continental Divide, 21 miles north of Island Park, Idaho. The 2600-acre pRNA encompasses two small basins at the head of Targhee Creek. The two basins are underlain by geologic substrates with significantly different chemical and physical properties: mica schist in one and limestone in the other. Paternoster lakes occur in the limestone/dolomite basin.

Targhee Creek pRNA contains the most diverse alpine flora of any area in Idaho, including eight rare species. Alpine vegetation is also extremely diverse and well-developed on ridges around the perimeter of the pRNA. At timberline, tree islands of whitebark pine and subalpine fir occur on the plateaus, while krummholz subalpine fir is well-developed on the ridges. Extensive whitebark pine woodlands interspersed with forb meadows occur in the limestone basin, while dense, closed-canopy whitebark pine forests occur in the mica schist basin. Several small lakes and numerous wet meadows, in both the subalpine and alpine zones, occur in the limestone basin. Lower elevations of the RNA contain forests climax to subalpine fir, with grass-forb openings occurring on drier slopes.

Reference: Wellner and Moseley 1987c.

Thurmon Creek RNA (proposed)

Primary Features: Five large cold springs; spring creeks; wetland vegetation.

Thurmon Creek pRNA encompasses 607 acres on the southeastern slope of Thurmon Ridge, five miles southwest of Island Park, Idaho. Thurmon Ridge lies at the edge of the Henrys Fork Caldera, an eruptive center formed during the second volcanic cycle in the Yellowstone region. Five springs emanate from the base of the ridge in the pRNA, aligned on a fault that runs along the caldera margin.

Protection of the cold springs, surrounding slope, and resulting creeks is the primary importance of Thurmon Creek pRNA. Baseline data on several biotic and physical parameters were collected for the aquatic system in the pRNA by University of Idaho researchers. Surrounding vegetation consists of a complex mosaic of coniferous forest, deciduous forest, shrub and graminoid communities.

References: Rabe and Saunders 1983; Saunders 1980; Wellner and Moseley 1986b.

Willow Creek RNA

Primary Features: Unique combination of bigtooth maple, limber pine and Rocky Mountain juniper; extensive aspen communities.

Established in 1988, Willow Creek RNA encompasses an 810-acre portion of the southern slope of Big Bend Ridge, a remnant segment of a volcanic caldera, 5 miles north of Ashton, Idaho. Numerous parallel drainages, with no permanent water, dissect the RNA. Willow Creek RNA is divided into two units, with each unit being underlain by rhyolite from different volcanic flows and having very different physiography. The eastern unit is a sequence of rounded ridges separated by wide valleys with little exposed bedrock, while the western unit contains

sharply-defined benches dissected by steep canyons with considerable exposed bedrock. Rhyolite underlying the western unit is approximately half the age as that underlying the eastern.

Vegetation of Willow Creek RNA dramatically reflects the differences in substrate. The eastern unit contains Douglas-fir and aspen communities on relatively deep soils. The western unit, in contrast, contains mostly scabland vegetation consisting of limber pine, bigtooth maple and mountain big sagebrush communities with little soil development.

Reference: Wellner and Moseley 1987d.

Yellowstone National Park

The National Park Service has designated one RNA in the GYE.

Yellowstone National Park RNA

Sometime during the mid-1960s, the National Park Service designated Yellowstone National Park, in its entirety, as a RNA. At about 2 million acres in size, it is the largest RNA in the federal system. While fulfilling the research and educational objectives of RNAs, as do most national parks, it is atypical in many respects, including its large size and the disturbed nature of many portions of the park.

Reference: Federal Committee on Ecological Reserves 1977.

III. Summary of Community Conservation Needs in the Greater Yellowstone Ecosystem

Table 1 presents GYE community elements described in the literature and their representation or absence within proposed or established natural areas. Four major gaps in the natural area system are apparent from the table: (1) Riparian communities GYE-wide; (2) Aspen communities GYE-wide; (3) Many low elevation shrub-steppe and steppe communities GYE-wide; and (4) Forest communities found primarily on the Shoshone National Forest portion of the GYE.

Lack of suitable areas containing undisturbed examples of riparian, aspen and low elevation nonforest communities is a problem that is not unique to the GYE. This problem has plagued natural areas workers throughout western North America, as these communities represent the preferred location of many development activities, including roads, recreational facilities, housing, and especially livestock grazing. Fogg Butte on the Targhee National Forest is an example of an unresolvable conflict between natural area preservation and livestock grazing. The paucity of forest and low elevation nonforest communities from the Shoshone National Forest reflects the low priority given until recently to natural areas in Region 2, whose RNA program has consistently lagged behind other Forest Service regions.

An important omission from the community elements listed in Table 1 is unique situations. Rare communities or species assemblages have generally not been identified in community classification research. In certain instances, ecologists and taxonomists have recognized unique situations and recommended them for protection (i.e., Cave Mountain pRNA and Swamp Lake Botanical Area). As our ecological knowledge of the GYE increases and we are better able to identify unique communities, these situations should be protected in natural areas wherever they occur.

TABLE 1. Summary and status of communities within the Greater Yellowstone Ecosystem -- their distribution within the GYE and representation within existing and proposed RNAs and Botanical Areas.

Community Element ¹	Distribution of Communities within the GYE ²	Representation of Communities in Established and Proposed RNAs and Botanical Areas ³		
		Idaho	Montana	Wyoming
FOREST COMMUNITIES ⁴				
<i>Abies lasiocarpa</i> /				
<i>Acer glabrum</i> ht	IW	2,4,10	xxxxxxxxxx	1,2,6
<i>Actaea rubra</i> ht	IW	none	xxxxxxxxxx	2,3
<i>Alnus sinuata</i> ht	M	xxxxxxxxxx	11	xxxxxxxxxx
<i>Arnica cordifolia</i> ht	IMW	7	4,6	none
<i>Arnica latifolia</i> ht	IW	none	xxxxxxxxxx	2,3,5
<i>Berberis repens</i> ht	IW	10	xxxxxxxxxx	5
<i>Calamagrostis canadensis</i> ht	IMW	5	8,10,12	none
<i>Calamagrostis rubescens</i> ht	IMW	2,8	4,6,9	none
<i>Carex geyeri</i> ht	IMW	none	10	5
* <i>Carex rossii</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
<i>Clematis pseudoalpina</i> ht	M	xxxxxxxxxx	5,6	xxxxxxxxxx
<i>Galium triflorum</i> ht	M	xxxxxxxxxx	5,6,8,11	xxxxxxxxxx
<i>Juniperus communis</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	5
<i>Linnaea borealis</i> ht	IMW	none	4,5,9,10,11	none
* <i>Luzula hitchcockii</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Menziesia ferruginea</i> ht	MW	xxxxxxxxxx	none	none
<i>Osmorhiza chilensis</i> ht	IW	2	xxxxxxxxxx	2,6
* <i>Pedicularis racemosa</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
<i>Physocarpus malvaceus</i> ht	IW	2,4	xxxxxxxxxx	1,2,6
<i>Ribes montigenum</i> ht	IMW	3,7	none	2,3,6
<i>Spiraea betulifolia</i> ht	IW	8	xxxxxxxxxx	none
<i>Streptopus amplexifolius</i> ht	IW	none	xxxxxxxxxx	3
<i>Symphoricarpos albus</i> ht	IW	none	xxxxxxxxxx	2
<i>Thalictrum occidentale</i> ht	IMW	7	none	5,13
* <i>Vaccinium caespitosum</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
<i>Vaccinium globulare</i> ht	IMW	2,4,7	5,6,8,9,11,12	2,3,5,6
<i>Vaccinium scoparium</i> ht	IMW	2,5,6,7	2,8,9,10,12	2,5,7
<i>Xerophyllum tenax</i> ht	M	xxxxxxxxxx	6	xxxxxxxxxx
<i>Abies lasiocarpa</i> - <i>Pinus albicaulis</i> /				
<i>Vaccinium scoparium</i> ht	M	xxxxxxxxxx	4,8,9,11,12	xxxxxxxxxx
<i>Picea engelmannii</i> /				
* <i>Arnica cordifolia</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Calamagrostis canadensis</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Caltha leptosepala</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Carex disperma</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
<i>Cornus stolonifera</i> ct	IW	10	xxxxxxxxxx	2,6
<i>Equisetum arvense</i> ht	IMW	10	none	3,5
<i>Galium triflorum</i> ht	MW	xxxxxxxxxx	9,11	2,6
* <i>Hypnum revolutum</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Juniperus communis</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
<i>Linnaea borealis</i> ht	MW	xxxxxxxxxx	2,10	none
<i>Physocarpus malvaceus</i> ht	MW	xxxxxxxxxx	5,9,11	none
* <i>Ribes montigenum</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Smilacina stellata</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
* <i>Vaccinium scoparium</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none

Community Element	Distribution of Communities within the GYE	Representation of Communities in Established and Proposed RNAs and Botanical Areas		
		Idaho	Montana	Wyoming
<i>Pinus albicaulis</i> /				
<i>Abies lasiocarpa</i> ht	M	xxxxxxxxxx	12	xxxxxxxxxx
* <i>Carex geyeri</i> ht	MW	xxxxxxxxxx	none	none
<i>Carex rossii</i> ht	IW	5	xxxxxxxxxx	none
* <i>Festuca idahoensis</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Juniperus communis</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
<i>Vaccinium scoparium</i> ht	IMW	7	none	2,7
<i>Pinus contorta</i> /				
* <i>Arnica cordifolia</i> ct	IW	none	xxxxxxxxxx	none
* <i>Carex geyeri</i> ct	IW	none	xxxxxxxxxx	none
* <i>Carex rossii</i> ct	IW	none	xxxxxxxxxx	none
<i>Calamagrostis rubescens</i> ct	IMW	8	none	13
* <i>Juniperus communis</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Linnaea borealis</i> ct	MW	xxxxxxxxxx	none	none
<i>Purshia tridentata</i> ht	M	xxxxxxxxxx	7	xxxxxxxxxx
* <i>Shepherdia canadensis</i> ct	IW	none	xxxxxxxxxx	none
<i>Spiraea betulifolia</i> ct	IW	8	xxxxxxxxxx	13
* <i>Vaccinium caespitosum</i> ct	M	xxxxxxxxxx	none	xxxxxxxxxx
<i>Vaccinium globulare</i> ct	IW	none	xxxxxxxxxx	13
<i>Vaccinium scoparium</i> ct	IMW	8	none	none
<i>Pinus flexilis</i> /				
* <i>Agropyron spicatum</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
* <i>Cercocarpus ledifolius</i> ht	I	none	xxxxxxxxxx	xxxxxxxxxx
<i>Festuca idahoensis</i> ht	MW	xxxxxxxxxx	11	none
<i>Hesperochloa kingii</i> ht	IW	3	xxxxxxxxxx	3,7
* <i>Juniperus communis</i> ht	MW	xxxxxxxxxx	none	none
<i>Populus angustifolia</i> /				
<i>Cornus stolonifera</i> ct	I	11,12,13	xxxxxxxxxx	xxxxxxxxxx
* <i>Poa pratensis</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
<i>Populus tremuloides</i> - <i>Abies lasiocarpa</i> /				
* <i>Arnica cordifolia</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Berberis repens</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Ligusticum filicinum</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Pedicularis racemosa</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Prunus virginiana</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Rudbeckia occidentalis</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Shepherdia canadensis</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Symphoricarpos oreophilus</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
<i>Populus tremuloides</i> - <i>Pinus contorta</i> /				
<i>Calamagrostis rubescens</i> ct	IW	2	xxxxxxxxxx	13
<i>Populus tremuloides</i> - <i>Pseudotsuga menziesii</i> /				
<i>Amelanchier alnifolia</i> ct	I	4	xxxxxxxxxx	xxxxxxxxxx
* <i>Calamagrostis rubescens</i> ct	IW	none	xxxxxxxxxx	none
* <i>Spiraea betulifolia</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Symphoricarpos oreophilus</i> ct	IW	none	xxxxxxxxxx	none

Community Element	Distribution of Communities within the GYE	Representation of Communities in Established and Proposed RNAs and Botanical Areas		
		Idaho	Montana	Wyoming
<i>Populus tremuloides</i> /				
* <i>Amelanchier alnifolia</i> - <i>Calamagrostis rubescens</i> ct	IW	none	xxxxxxxxxx	none
* <i>Amelanchier alnifolia</i> - <i>Pachistima myrsinites</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
<i>Amelanchier alnifolia</i> - <i>Spiraea betulifolia</i> ct	IW	8	xxxxxxxxxx	none
<i>Amelanchier alnifolia</i> - <i>Symphoricarpos oreophilus</i> ct	IW	9	xxxxxxxxxx	none
* <i>Artemisia tridentata</i> - <i>Festuca idahoensis</i> ct	IW	none	xxxxxxxxxx	none
* <i>Arnica cordifolia</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Astragalus miser</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Berberis repens</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Calamagrostis rubescens</i> ct	IMW	none	none	none
* <i>Calamagrostis rubescens</i> - <i>Poa pratensis</i> ct	IW	none	xxxxxxxxxx	none
* <i>Equisetum arvense</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Geranium viscosissimum</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
* <i>Juniperus communis</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
<i>Ligusticum filicinum</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	2
<i>Pachistima myrsinites</i> - <i>Calamagrostis rubescens</i> ct	I	10	xxxxxxxxxx	xxxxxxxxxx
* <i>Pachistima myrsinites</i> - <i>Geranium viscosissimum</i> ct	IW	none	xxxxxxxxxx	none
* <i>Poa pratensis</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
* <i>Ranunculus alismaefolius</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
<i>Rudbeckia occidentalis</i> ct	IW	none	xxxxxxxxxx	2
* <i>Shepherdia canadensis</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
<i>Spiraea betulifolia</i> - <i>Calamagrostis rubescens</i> ct	IW	9	xxxxxxxxxx	none
* <i>Symphoricarpos oreophilus</i> ct	M	xxxxxxxxxx	none	xxxxxxxxxx
<i>Symphoricarpos oreophilus</i> - <i>Calamagrostis rubescens</i> ct	IW	8	xxxxxxxxxx	none
* <i>Symphoricarpos oreophilus</i> - <i>Poa pratensis</i> ct	IW	none	xxxxxxxxxx	none
* <i>Symphoricarpos oreophilus</i> - <i>Rudbeckia occidentalis</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
* <i>Thalictrum fendleri</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Wyethia amplexicaulis</i> ct	IW	none	xxxxxxxxxx	none
<i>Pseudotsuga menziesii</i> /				
<i>Acer glabrum</i> ht	IW	4,9,10	xxxxxxxxxx	none
* <i>Agropyron spicatum</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
<i>Arnica cordifolia</i> ht	IMW	3	none	none
<i>Berberis repens</i> ht	IW	3,10	xxxxxxxxxx	none
<i>Calamagrostis rubescens</i> ht	IMW	6,9	2,3,5,6	none
* <i>Carex geyeri</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
* <i>Cercocarpus ledifolius</i> ht	IW	none	xxxxxxxxxx	none
* <i>Festuca idahoensis</i> ht	MW	xxxxxxxxxx	none	none
<i>Juniperus communis</i> ht	IMW	3	none	none

Community Element	Distribution of Communities within the GYE	Representation of Communities in Established and Proposed RNAs and Botanical Areas		
		Idaho	Montana	Wyoming
<i>Linnaea borealis</i> ht	M	xxxxxxxxxx	5	xxxxxxxxxx
<i>Osmorhiza chilensis</i> ht	I	9	xxxxxxxxxx	xxxxxxxxxx
<i>Physocarpus malvaceus</i> ht	IMW	4	5,8,11	1,2
<i>Physocarpus monogynus</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	8
<i>Spiraea betulifolia</i> ht	IMW	6	none	none
<i>Symphoricarpos albus</i> ht	IMW	none	2,6	none
<i>Symphoricarpos oreophilus</i> ht	IMW	9	2	none
* <i>Vaccinium globulare</i> ht	IM	none	none	xxxxxxxxxx

SHRUBLAND COMMUNITIES⁵

<i>Alnus incana</i> / <i>Ribes hudsonianum</i> ct	IW	4,12	xxxxxxxxxx	2
<i>Artemisia arbuscula</i> ssp. <i>arbuscula</i> / * <i>Agropyron spicatum</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
* <i>Festuca idahoensis</i> ht	MW	xxxxxxxxxx	none	none
<i>Artemisia arbuscula</i> ssp. <i>thermopola</i> / * <i>Festuca idahoensis</i> ht	I	none	xxxxxxxxxx	xxxxxxxxxx
<i>Artemisia cana</i> / * <i>Agropyron caninum</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
<i>Festuca idahoensis</i> ht	IMW	none	none	5
<i>Artemisia longiloba</i> / * <i>Agropyron smithii</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Agropyron spicatum</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Festuca idahoensis</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
<i>Artemisia nova</i> / * <i>Agropyron spicatum</i> ht	IMW	none	none	none
* <i>Festuca idahoensis</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / * <i>Agropyron spicatum</i> ht	IW	none	xxxxxxxxxx	none
<i>Artemisia tridentata</i> ssp. <i>spiciformis</i> / * <i>Bromus carinatus</i> ht	I	none	xxxxxxxxxx	xxxxxxxxxx
* <i>Carex geyeri</i> ht	I	none	xxxxxxxxxx	xxxxxxxxxx
Mountain forb ht	W	xxxxxxxxxx	xxxxxxxxxx	1,2,3,5,6
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i> / <i>Agropyron spicatum</i> ht	IMW	3,4,9	3,10	1,2,3
* <i>Agropyron spicatum</i> - <i>Geum triflorum</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
<i>Festuca idahoensis</i> ht	IMW	6,7,8	2	none
<i>Festuca idahoensis</i> - <i>Geum triflorum</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none

Community Element	Distribution of Communities within the GYE	Representation of Communities in Established and Proposed RNAs and Botanical Areas		
		Idaho	Montana	Wyoming
* <i>Stipa comata</i> - <i>Geum triflorum</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Symphoricarpos oreophilus</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Symphoricarpos oreophilus</i> - <i>Agropyron spicatum</i> ct	IW	none	xxxxxxxxxx	none
<i>Symphoricarpos oreophilus</i> - <i>Carex geyeri</i> ct	I	10	xxxxxxxxxx	xxxxxxxxxx
* <i>Symphoricarpos oreophilus</i> - <i>Festuca idahoensis</i> ct	IW	none	xxxxxxxxxx	none
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> /				
* <i>Agropyron spicatum</i> ht	IMW	none	none	none
* <i>Festuca idahoensis</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
<i>Artemisia tripartita</i> /				
* <i>Agropyron spicatum</i> ht	I	none	xxxxxxxxxx	xxxxxxxxxx
* <i>Festuca idahoensis</i> ht	MW	xxxxxxxxxx	none	none
<i>Cercocarpus ledifolius</i> /				
<i>Agropyron spicatum</i> ht	IM	4	none	xxxxxxxxxx
<i>Cornus stolonifera</i> /				
<i>Heracleum lanatum</i> ct	IW	4,10	xxxxxxxxxx	2
* <i>Galium triflorum</i> ct	IW	none	xxxxxxxxxx	none
<i>Potentilla fruticosa</i> /				
* <i>Deschampsia cespitosa</i> ct	IMW	none	none	none
* <i>Festuca idahoensis</i> ct	IMW	none	none	none
* <i>Purshia tridentata</i> / <i>Festuca idahoensis</i> ht	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Rhamnus alnifolia</i> ct	IW	none	xxxxxxxxxx	none
<i>Rhus trilobata</i> /				
* <i>Agropyron spicatum</i> ht	MW	xxxxxxxxxx	none	none
* <i>Festuca idahoensis</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
<i>Salix boothii</i> /				
* <i>Calamagrostis canadensis</i> ct	IW	none	xxxxxxxxxx	none
* <i>Carex nebraskensis</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
<i>Carex rostrata</i> ct	IW	1	xxxxxxxxxx	5
* <i>Equisetum arvense</i> ct	IW	none	xxxxxxxxxx	none
* <i>Poa palustris</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
<i>Smilacina stellata</i> ct	IW	none	xxxxxxxxxx	2,5,6
<i>Salix exigua</i> / <i>Equisetum arvense</i> ct	IW	none	xxxxxxxxxx	2
<i>Salix geyeriana</i> /				
* <i>Calamagrostis canadensis</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
* <i>Carex rostrata</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
* mesic forb ct	IW	none	xxxxxxxxxx	none
* <i>Salix lutea</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
* <i>Salix planifolia</i> ct	IW	none	xxxxxxxxxx	none

Community Element	Distribution of Communities within the GYE	Representation of Communities in Established and Proposed RNAs and Botanical Areas		
		Idaho	Montana	Wyoming
<i>Salix wolfii</i> /				
* <i>Calamagrostis canadensis</i> ct	I	none	xxxxxxxxxx	xxxxxxxxxx
<i>Carex aquatilis</i> ct	IW	none	xxxxxxxxxx	5
* <i>Carex nebraskensis</i> ct	IW	none	xxxxxxxxxx	none
<i>Carex rostrata</i> ct	IW	none	xxxxxxxxxx	5
* <i>Deschampsia cespitosa</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
Mesic forb ct	IW	none	xxxxxxxxxx	5
<i>Sarcobatus vermiculatus</i> /				
* <i>Agropyron smithii</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
* <i>Elymus cinereus</i> ht	MW	xxxxxxxxxx	none	none

GRASSLAND AND GRAMINOID COMMUNITIES⁶

<i>Agropyron spicatum</i> /				
* <i>Agropyron smithii</i> ht	MW	xxxxxxxxxx	none	none
* <i>Bouteloua gracilis</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
* <i>Koeleria pyramidata</i> ct	M	xxxxxxxxxx	none	xxxxxxxxxx
* <i>Poa sandbergii</i> ht	MW	xxxxxxxxxx	none	none
<i>Carex aquatilis</i> ct	IW	1,8	xxxxxxxxxx	none
<i>Carex lanuginosa</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	13
* <i>Carex microptera</i> ct	IW	none	xxxxxxxxxx	none
<i>Carex nebraskensis</i> ct	IW	none	xxxxxxxxxx	13
<i>Carex praegracilis</i> ct	IW	1	xxxxxxxxxx	none
<i>Carex rostrata</i> ct	IW	1,8	xxxxxxxxxx	13
* <i>Carex simulata</i> ct	W	xxxxxxxxxx	xxxxxxxxxx	none
* <i>Deschampsia cespitosa</i> / <i>Carex</i> spp. ht	MW	xxxxxxxxxx	none	none
<i>Festuca idahoensis</i> /				
<i>Agropyron caninum</i> ht	MW	xxxxxxxxxx	2,9	none
<i>Agropyron smithii</i> ht	MW	xxxxxxxxxx	none	7
<i>Agropyron spicatum</i> ht	MW	xxxxxxxxxx	3	7
* <i>Carex filifolia</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx
<i>Deschampsia cespitosa</i> ht	MW	xxxxxxxxxx	1	none
<i>Stipa richardsonii</i> ht	M	xxxxxxxxxx	4	xxxxxxxxxx
<i>Juncus balticus</i> ct	IW	1	xxxxxxxxxx	13
<i>Scirpus validus</i> ct	IW	1	xxxxxxxxxx	13
* <i>Stipa comata</i> / <i>Bouteloua gracilis</i> ht	M	xxxxxxxxxx	none	xxxxxxxxxx

Community Element	Distribution of Communities within the GYE	Representation of Communities in Established and Proposed RNAs and Botanical Areas		
		Idaho	Montana	Wyoming
FORBLAND COMMUNITIES ⁷				
<i>Agastache urticifolia</i> - <i>Viguiera multiflora</i> ct	W	xxxxxxxxxxx	xxxxxxxxxxx	1,2,3,6
<i>Arnica longifolia</i> ct	IMW	none	none	2,5,6
* <i>Artemisia ludoviciana</i> - <i>Valeriana edulis</i> ct	W	xxxxxxxxxxx	xxxxxxxxxxx	none
* <i>Caltha leptosepala</i> ct	W	xxxxxxxxxxx	xxxxxxxxxxx	none
* <i>Balsamorhiza macrophylla</i> ct	W	xxxxxxxxxxx	xxxxxxxxxxx	none
<i>Balsamorhiza sagittata</i> - <i>Helianthella uniflora</i> ct	IW	none	xxxxxxxxxxx	2,3,5,6
* <i>Epilobium angustifolium</i> ct	W	xxxxxxxxxxx	xxxxxxxxxxx	none
* <i>Helenium hoopesii</i> ct	W	xxxxxxxxxxx	xxxxxxxxxxx	none
<i>Heracleum lanatum</i> - <i>Rudbeckia occidentalis</i> ct	MW	xxxxxxxxxxx	none	2,6
<i>Ligusticum filicinum</i> - <i>Delphinium occidentale</i> ct	W	xxxxxxxxxxx	xxxxxxxxxxx	2,3,5,6
<i>Lupinus argenteus</i> - <i>Fragaria virginiana</i> ct	W	xxxxxxxxxxx	xxxxxxxxxxx	5
<i>Mertensia ciliata</i> ct	IMW	none	none	6
* <i>Solidago canadensis</i> ct	W	xxxxxxxxxxx	xxxxxxxxxxx	none
* <i>Veratrum californicum</i> ct	IW	none	xxxxxxxxxxx	none
* <i>Wyethia amplexicaulis</i> ct	IW	none	xxxxxxxxxxx	none
ALPINE HABITAT ELEMENTS ⁸				
Cliff and Ledge	IMW	3,7	none	2,4,5,12
Fellfield and Felsenmeer	IMW	3,7	none	2,4,5,6,12
Meadow and Turf	IMW	7	none	4,12
Standing and Running Water	IMW	7	none	4,12

¹ * denotes a community unknown from an existing or proposed RNA or Botanical Area.

² I = Idaho; M = Montana; W = Wyoming.

³ Numbers in appropriate state columns correspond to the following existing or proposed RNAs and Botanical Areas (none = not represented; XXXXXXXXXXXX = element not found in state):

IDAHO

Caribou NF

1. Elk Valley pRNA
2. Horse Creek RNA
3. Meade Peak RNA

Targhee NF

4. Burns Canyon pRNA
5. Moose Creek Plateau pRNA
6. Sheep Falls pRNA
7. Targhee Creek pRNA
8. Thurmon Creek pRNA
9. Willow Creek pRNA

Idaho Falls BLM

10. Game Creek RNA
11. Pine Creek Island RNA
12. Reid Canal Island RNA
13. Squaw Creek Island RNA

MONTANA

Beaverhead NF

1. Cave Mountain pRNA
2. Cliff Lake RNA
3. Cottonwood Creek RNA

Gallatin NF

4. Black Butte pRNA
5. East Fork Mill Creek pRNA
6. Mount Ellis pRNA
7. Obsidian Sands pRNA
8. Palace Butte pRNA
9. Passage Creek pRNA
10. Pioneer Lakes pRNA
11. Sliding Mountain pRNA
12. Wheeler Ridge pRNA

WYOMING

Bridger-Teton NF

1. Afton Front pRNA
2. Horse Creek pRNA
3. North Ditch Creek pRNA
4. Osborn Mountain pRNA
5. Soda Fork pRNA
6. Swift Creek pRNA

Shoshone NF

7. Bald Ridge pBotanical Area
8. Pat O'Hara Creek pBotanical Area
9. Picketts Knob pBotanical Area
10. Sawtooth Peatbed pBotanical Area
11. Swamp Lake Botanical Area
12. Twin Lakes pBotanical Area

Targhee NF

13. Rock Lake pRNA

⁴ Forest community elements follow: Mueggler and Campbell 1982; Pfister et al. 1977; Steele et al. 1983; Youngblood and Mueggler 1981; Youngblood et al. 1985.

⁵ Shrubland community elements follow: Bramble-Brodahl 1978; Hironaka et al. 1983; Mueggler and Stewart 1980; Tweit and Houston 1980; Youngblood et al. 1985.

⁶ Grassland and graminoid community elements follow: Mueggler and Stewart 1980; Tweit and Houston 1980; Youngblood et al. 1985.

⁷ Forbland community elements follow: Gregory 1983.

⁸ Alpine habitat elements follow: R. Scott 1985.

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