2 Subbasin Biological Resources

This section of the assessment describes the environmental conditions and fish and wildlife populations in the Upper Snake province. A key element is information on the current and potential conditions within each of the 22 watersheds.

This assessment reflects the complex of environmental linkages and does not focus on a single species. The challenge is to consider the numerous roles of each species in the environment and the consequences of the elimination of or decrease in one habitat and/or species on other habitats and species. This assessment adopts an approach developed by the Interactive Biodiversity Information System (IBIS 2003) for evaluating the ecological functions of species.

This assessment focuses on nine habitats and their associated focal species (Figure 2-1 and Table 2-1). Although the discussions are separate, we recognize the hierarchical relationships between focal habitats, focal vegetation species, and focal wildlife species that depend, either directly or indirectly, on the focal vegetation species.

Both the aquatic and terrestrial resources sections describe the physical and biological features of a focal habitat. Focal habitats describe a combination of unique vegetative characteristics, dominant plant species, or successional stages with important ecological ties to fish and wildlife (e.g., old growth). Focal habitats may also be composed of specific environmental elements integral to the viability of fish and wildlife populations (e.g., snags, caves). The technical teams used one or more of the following criteria to identify and select focal habitats and species in this assessment:

- Comparatively high fish and/or wildlife density
- Comparatively high fish and/or wildlife species diversity
- Important fish and/or wildlife breeding habitat
- Important fish and/or wildlife seasonal ranges
- Important fish and/or wildlife population or habitat linkage areas
- Rareness
- High vulnerability to habitat alteration
- Unique or dependent species

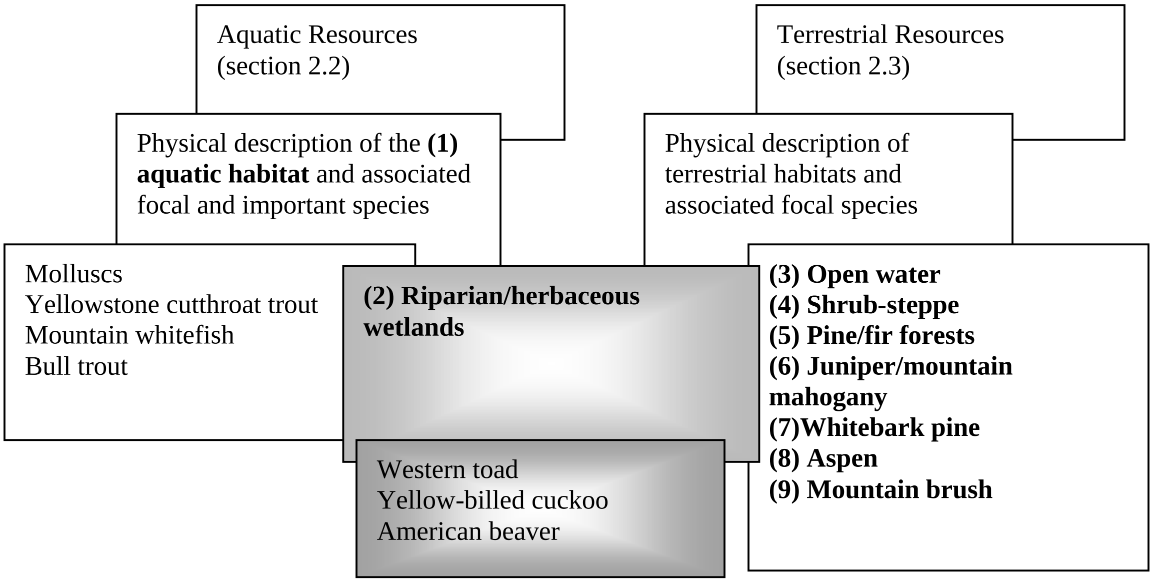

Figure 2-1. Organization of the nine focal habitats for the Upper Snake province. Note that the riparian/herbaceous wetlands habitat is the link between the aquatic and terrestrial resources. The American beaver is especially important to aquatic and riparian/herbaceous wetland habitats because it creates and maintains waterways and affects hydrography.

The selection of the terrestrial focal habitats acknowledged the complexity and high variety of habitats found within the Upper Snake province. For example, classifications of wildlife habitats and land cover are closely related. Land cover is the physical observation of the surface of the ground relating to soils, rock, waterbodies, vegetation and various forms of human development. These same features form the basis for the description of wildlife habitats, though often habitats have more specific definitions relating to key biological functions or species. Typically, land cover classifications are devised for rapid assessment of large areas using remote sensing techniques, whereas habitat classifications rely on more detailed field observations and tend to have a more restricted geographical scope. For terrestrial habitats, vegetation types are crucial, and in general, the condition of habitats is described by reference to the component vegetation types and botanical composition of the vegetation plots (although it was noted that elevation can sometimes confuse the issue). Therefore, we considered land and vegetation classification systems of cover types and structural stages when identifying focal habitats.

Table 2-1. Focal habitats and species associated with the focal habitats in the Upper Snake province.

Focal Habitat	Focal Species	Species' Key Roles in Maintaining Ecological Conditions
Aquatic	Molluscs	Detritivore; grazes along the mud surfaces, ingesting diatoms or small plant debris. May act as first alert regarding pollutants long before the pollutants are seen in other organisms.
	Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*)	Insectivorous and piscivorous at larger sizes. Provides food base for piscivorous birds and mammals.
	Mountain whitefish (*Prosopium williamsoni*)	Insectivorous. Provides food base for piscivorous birds and mammals.
	Bull trout (*Salvelinus confluentus*)	Top aquatic predator. Spawns in very cold headwater areas.
Riparian/herbaceous wetlands	Western toad (*Bufo boreas boreas*)	Feeds in water on decomposing benthic substrate and aids in physical transfer of substances for nutrient cycling (C, N, P). Uses burrows dug by other species (secondary burrow user). Physically affects (improves) soil structure and aeration (typically by digging).
	Yellow-billed cuckoo (*Coccyzus americanus*)	Prey for secondary or tertiary consumer (primary or secondary predator). Interspecies nest parasite. Controls or depresses insect population peaks.
	American beaver (*Castor canadensis*) (the only species that actively creates waterways)	Prey for primary or secondary predator. Primary burrow excavator (fossorial or underground burrows). Creates trails (possibly used by other species). Aids in physical transfer of substances for nutrient cycling (carbon, nitrogen, phosphorus, etc.). Physically affects (improves) soil structure and aeration (typically by digging). Impounds water by creating diversions or dams; creates ponds or wetlands by building physical barriers. Creates standing dead trees (snags).
Open water (lakes)	Trumpeter swan (*Cygnus buccinator*)	Prey for secondary or tertiary consumer (primary or secondary predator). Primary creation of ground structures (possibly used by other organisms).
	Western grebe (*Aechmophorus occidentalis*)	Disperses vascular plants, insects, and other invertebrates. Primary creation of aquatic structures (possibly used by other organisms).
	American white pelican (*Pelecanus erythrorhynchos*)	Piscivorous (fish eater). Primary creation of aerial structures (possibly used by other organisms).
	American avocet	Prey for secondary or tertiary consumer (primary or secondary predator). Disperses insects and other invertebrates.
	Common loon (*Gavia immer*)	Piscivorous (fish eater). Disperses vascular plants, insects, and other invertebrates.

Focal Habitat	Focal Species	Species' Key Roles in Maintaining Ecological Conditions
Shrub-steppe	Sagebrush (*Artemisia* spp.)	Provides food, cover, and nesting substrate, especially for sage-steppe obligates. Sometimes protects other native forbs and grasses from overgrazing (when in the interface). Determines which other kinds of vegetation will occur. Stabilizes soil; tolerates drought.
	Northern sagebrush lizard (*Sceloporus graciosus graciosus*)	Prey for secondary or tertiary consumer (primary or secondary predator). Physically affects (improves) soil structure and aeration (typically by digging).
	Greater sage grouse (*Centrocercus urophasianus*)	Prey for secondary or tertiary consumer (primary or secondary predator). Disperses seeds.
	Sage sparrow (*Amphispiza belli*)	Prey for secondary or tertiary consumer (primary or secondary predator). Common interspecific nest host. Disperses seeds/fruits (through ingestion or caching).
Pine/fir forest (dry, mature)	Great gray owl (*Strix nebulosa*)	Uses aerial structures created by other species. Controls terrestrial vertebrate populations (through predation).
	Black-backed woodpecker (*Picoides arcticus*)	Primary cavity excavator in snags or live trees. Controls or depresses insect population peaks. Physically fragments downed, standing wood.
	Boreal owl (*Aegolius funereus*)	Vertebrate eater (consumer or predator of herbivorous vertebrates). Secondary cavity user.
	Northern goshawk (*Accipiter gentilis*)	Controls terrestrial vertebrate populations (through predation or displacement). Primary creation of aerial structures (possibly used by other organisms).
Juniper/mountain mahogany	Mountain mahogany (*Cercocarpus ledifolius*)	Big game cover and forage, especially during winter. Very palatable to bighorn sheep. Some stabilization properties; helps to stabilize soil in disturbed areas such as roadcuts and mine spoils. Tolerant of heat and drought.
Whitebark pine	Whitebark pine (*Pinus albicaulis*)	Provides forage for bears and other species. Survives where tree growth is limited. Provides hiding and thermal cover for wildlife.
	Clark's nutcracker (*Nucifraga columbiana*) (keystone species in whitebark pine regeneration)	Prey for secondary or tertiary consumer (primary or secondary predator). Disperses seeds/fruits (through ingestion or caching).
Aspen	Quaking aspen (*Populus tremuloides*)	Provides important breeding/nesting, foraging, cover, and resting habitat for a variety of birds and mammals. Has a high food value. Important for certain cavity nesters. Important mid-seral species.
Mountain brush	Antelope bitterbrush (*Purshia tridentata*)	An important browse for wildlife and livestock. Supports several insect populations. Provides cover for birds and rodents.

Focal Habitat	Focal Species	Species' Key Roles in Maintaining Ecological Conditions
	Green-tailed towhee (*Pipilo chlorurus*)	Prey for secondary or tertiary consumer (primary or secondary predator).
	Mule deer (*Odocoileus hemionus*) (migrates to juniper/mountain mahogany habitat in winter)	Herbivory on trees, shrubs, grasses, and forbs that may alter vegetation structure and composition. Major prey species for carnivores. Creates trails (possibly used by other species); uses trails created by other species.
	Rocky Mountain elk (*Cervus elaphus nelsoni*) (migrates to juniper/mountain mahogany habitat in winter)	Prey for secondary or tertiary consumer (primary or secondary predator). Herbivory on trees or shrubs that may alter vegetation structure and composition. Transportation of viable seeds, spores, plants, or animals. Disperses fungi. Physically fragments down wood. Creates trails (possibly used by other species); uses trails created by other species.

Focal species either have special ecological, cultural, or legal status, or can be used to evaluate the health of the ecosystem and effectiveness of management actions. The following selection criteria were used in the focal species identification:

- Federal/state classification
- Cultural/economic significance
- Critical ecological function
- Indicator of environmental health
- Locally significant or rare
- Guild representative
- Habitat obligate
- Managed species
- Relationship to salmon
- Data availability

One aquatic species, bull trout (*Salvelinus confluentus*), and four terrestrial species in the Upper Snake province are listed as threatened under the Endangered Species Act of 1973 (ESA)[1] (Table 2-2). Two snail species, the Utah valvata snail (*Valvata utahensis*) and the Snake River physa snail (*Physa natricina*), are listed as endangered. Species listed under the ESA, but not included as focal species for the priority habitats, are included in the assessment (see section 2.3.9) as they affect future management actions or projects.

[1] The term ''threatened species'' means any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. The term ''endangered species'' means any species that is in danger of extinction throughout all or a significant portion of its range.

Table 2-2. Species listed under the Endangered Species Act in the Upper Snake province.

Species	Status	Date	Protective Regulations
Aquatic			
Utah valvata snail (*Valvata utahensis*)	endangered	December 14, 1992	57 FR 59244
Snake River physa snail (*Physa natricina*)	endangered	December 14, 1992	57 FR 59244
Bull trout (*Salvelinus confluentus*)	threatened	November 1, 1999	64 FR 58910
Terrestrial Species			
Bald eagle (*Haliaeetus leucocephalus*)	endangered threatened	March 11, 1967 July 12, 1995	32 FR 4001 60 FR 35999
Wolf (*Canis lupus*)	threatened (experimental population)[2]	March 11, 1967 November 18, 1994 November 22, 1994	32 FR 4001 59 FR 60252 59 FR 60266
Canada lynx (*Lynx canadensis*) (see section 2.3.9.3)	threatened	March 24, 2000	65 FR 16051
Grizzly bear (*Ursus arctos horribilis*)	endangered threatened	March 11, 1967 July 28, 1975	32 FR 4001 40 FR 31734

[2] The Endangered Species Act Amendments of 1982, Pub. L. 97-304, made significant changes to the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), including the creation of section 10(j), which provides for the designation of specific animals as “experimental.” Under section 10(j), a listed species reintroduced outside of its current range, but within its historic range, may be designated, at the discretion of the Secretary of the Interior (Secretary), as “experimental.” This designation increases the U.S. Fish and Wildlife Service’s flexibility and discretion in managing reintroduced endangered species because such experimental animals may be treated as threatened species. The act requires that animals used to form an experimental population be separated geographically from nonexperimental populations of the same species.

Two primary information sources used in this assessment include the Interior Columbia Basin Ecosystem Management Project (ICBEMP)[3] data set, and the Geographic Approach to Planning (GAP)[4] data set. The ICBEMP data set supplied information on the potential (i.e., historic) vegetation coverage, while the GAP II data set supplied information on current coverage. With any remotely derived information, such as that of the GAP data set, there is a certain degree of uncertainty. In GAP, spatial and spectral resolutions, temporal constraints, cloud cover, and geometric correction accentuated uncertainty. For this assessment, the most important habitats are the aquatic, riparian, and herbaceous wetlands. However, GAP II did not assess riparian areas (see Appendix 2-1). Since riparian habitats are a focal habitat, as well as the critical overlap of terrestrial and aquatic environments, obtaining reliable information on the quantity and quality of the riparian and herbaceous wetlands in the Upper Snake province is of foremost importance.

[3] More than 300 different geographic information system (GIS) data layers or themes were compiled or created in support of the ICBEMP assessment. In addition, numerous databases were created. The U.S. Forest Service's Pacific Northwest Research Station serves as custodian of the project data. These data are available for download from the ICBEMP web site, which is maintained by the Interior Columbia Basin Ecosystem Management Project of the U.S. Department of Agriculture, Forest Service and U.S. Department of the Interior, Bureau of Land Management.

[4] GAP analysis is a rapid conservation evaluation method for assessing the current status of biodiversity at large spatial scales. It uses geographic information systems (GIS) to identify habitats. By identifying their habitats, GAP analysis gives land managers, planners, scientists, and policy makers the information they need to make better-informed decisions when identifying priority areas for conservation.

2.1 Key Ecological Functions of Fish and Wildlife Species

2.1.1 Overview

2.1.1.1 Key Ecological Functions and Environmental Correlates

Understanding ecological roles of fish, wildlife, and plant species is important in understanding the consequences of changes and management on ecosystems. As suggested by Figure 2-1, many species perform several functions in their environments. Further, a specific function in the environment might be occupied by several species. This concept, called functional redundancy, is defined as the total number of wildlife species performing a specific ecologic function. Functional redundancy is just one of many community patterns used to describe ecological systems. Other ecological functions, or community patterns, in wildlife communities include total functional diversity, functional richness, functional webs, functional profiles, and functional homologies (Marcot and Vander Heyden 2001).

In this assessment, key ecological functions (KEFs) and key environmental correlates (KECs) (IBIS 2003) were used to describe and compare wildlife species and their associations with each other and their environment (Appendix 2-2). The KEFs of species refer to the major ecological roles that species play in their ecosystem and the resulting influences on diversity, productivity, and eventually sustainability of resource use and production (Marcot and Vander Heyden 2001). KEFs are defined for each species using a standardized classification system (see Appendix 2-2). One limitation to using this system is that the relative impacts or importance of different functions are excluded. Another major limitation to this process is that there has been little research done to quantify the rates of KEFs (i.e., tonnage of soil worked by burrowing and digging animals per acre per year).

Key environmental correlates (KECs) refer to environmental influences on the distribution and abundance of organisms. KECs are also denoted for each species using a standard classification system that includes categories for vegetation habitat elements, nonvegetation, terrestrial elements, aquatic bodies and substrates, and anthropogenic structures. As with KEFs, one major limitation of KEC information is that it is represented as simple categorical relations with species rather than as quantified correlations (i.e., specific amounts, levels or rates of each KEC and corresponding population densities or trends of each species).

2.1.1.2 Functional Specialists and Generalists

In the Upper Snake province, the frequency of species by number of KEF categories is roughly characterized by a distribution right skewed frequency (Figure 2-2). The species with many KEF categories tend to be functional generalists: they perform many functions. Species with fewer KEF categories are functional specialists, performing only a few functions within their ecosystems. We identified 60 functional specialist species in the Upper Snake province (Appendix 2-2). The only focal species identified as functional specialist was the boreal owl (*Aegolius funereus*). Nine species were identified that performed only one KEF in the Upper Snake province (Figure 2-2): the black swift (*Cypseloides niger*), common nighthawk (*Chordeiles minor*), common poorwill (*Phalaenoptilus nuttallii*), harlequin duck (*Histrionicus histrionicus*), merlin (*Falco columbarius*), rough-legged hawk (*Buteo lagopus*), turkey vulture (*Cathartes aura*), and ringneck snake (*Diadophis punctatus*) (Appendix 2-2). Only one species performs 14 ecological functions: the black bear (*Ursus americanus*). The majority of the species in the Upper Snake province perform between two and seven KEFs (Figure 2-2).

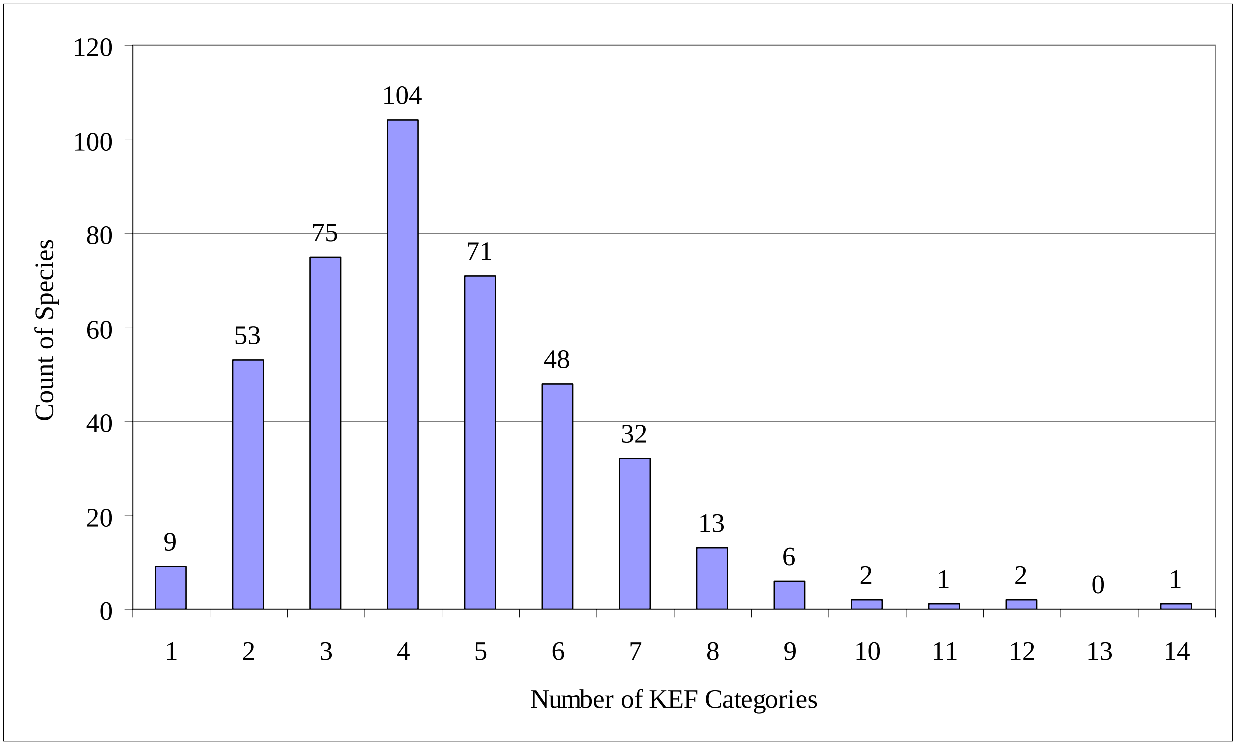

Figure 2-2. Frequency histogram showing the number of vertebrate wildlife species by number of categories of key ecological functions (KEFs) that they perform in the Upper Snake province (IBIS 2003).

2.1.1.3 Functional Richness

We also determined the functional richness in the Upper Snake province by taking the total number of KEF categories in a community (IBIS 2003). The wildlife habitats in the Upper Snake province appear more or less equally functionally rich, with between 37 and 46 species per wildlife habitat (Appendix 2-2). The most functionally rich communities are the riparian and herbaceous wetland areas. Forested habitats are also slightly greater in the functional richness than shrub-steppe or grassland habitats.

2.1.1.4 Trophic Levels

Evaluation of KEFs can also be used to depict general trophic structures of communities and identify species that aid in the physical transfer of substances for nutrient cycling. In the Upper Snake province, 222 wildlife species (55%) are categorized as primary consumers, 370 (92%) as secondary consumers (primary predators), and 7 (<1%) species as tertiary consumers (secondary predators) (Figure 2-3). Bird species appear to play a proportionally greater role across the trophic levels. Other minor trophic categories include carrion feeders (<1%, mostly birds and mammals), cannibalistic feeders (<1%, amphibians and mammals), and coprophagous feeders (feces eaters) (<1%, all mammals).

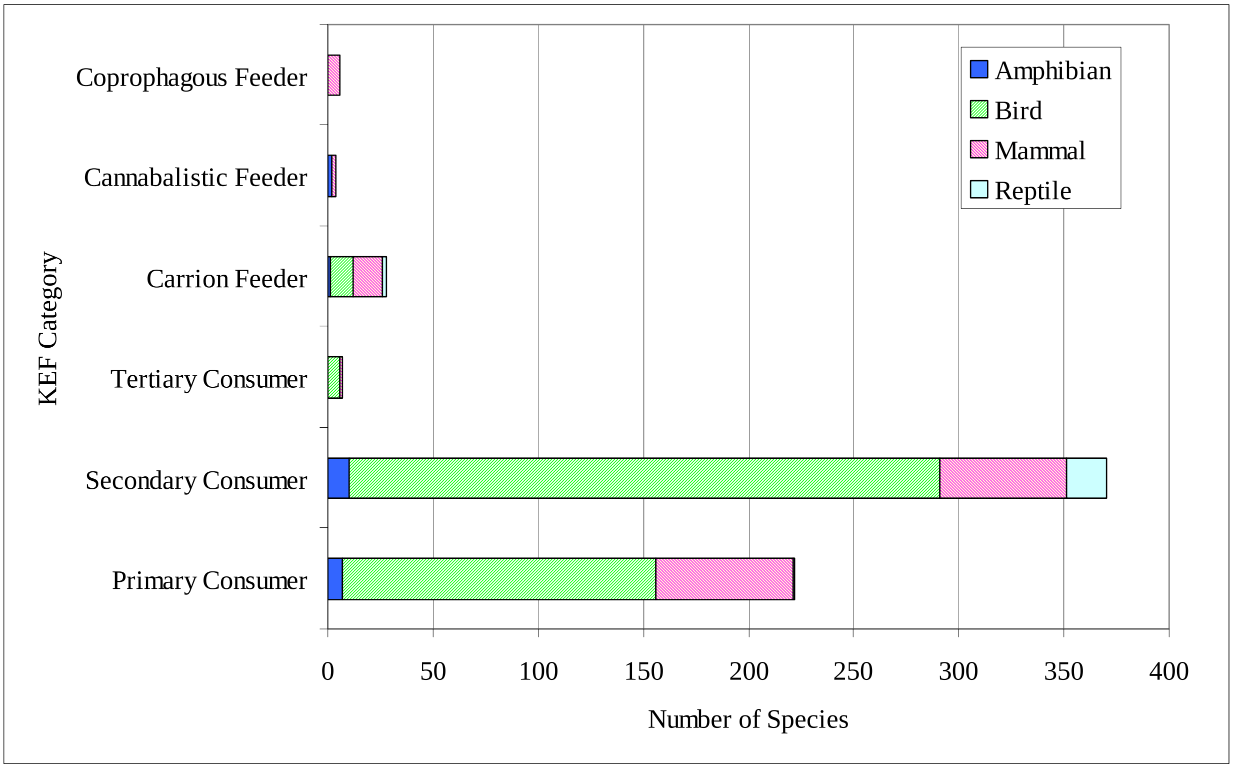

Figure 2-3. Trophic level functions of wildlife in the Upper Snake province (IBIS 2003).

We also evaluated 27 categories of organismal relationships within wildlife communities (Appendix 2-2). Five species of birds serve as pollination vectors for plants (Fig4ure 2-4). Among terrestrial vertebrates, mammals are the sole dispersers of fungi and lichens, and both birds and mammals disperse seeds and fruits. Fourteen bird species and one mammalian species act as primary cavity excavators, serving 31 bird and 7 mammalian secondary cavity-using species. Birds and mammals create roosting, denning, and nesting structures in aerial, ground, and aquatic environments that other amphibian, reptile, bird, and mammal species also use (Figure 2-4).

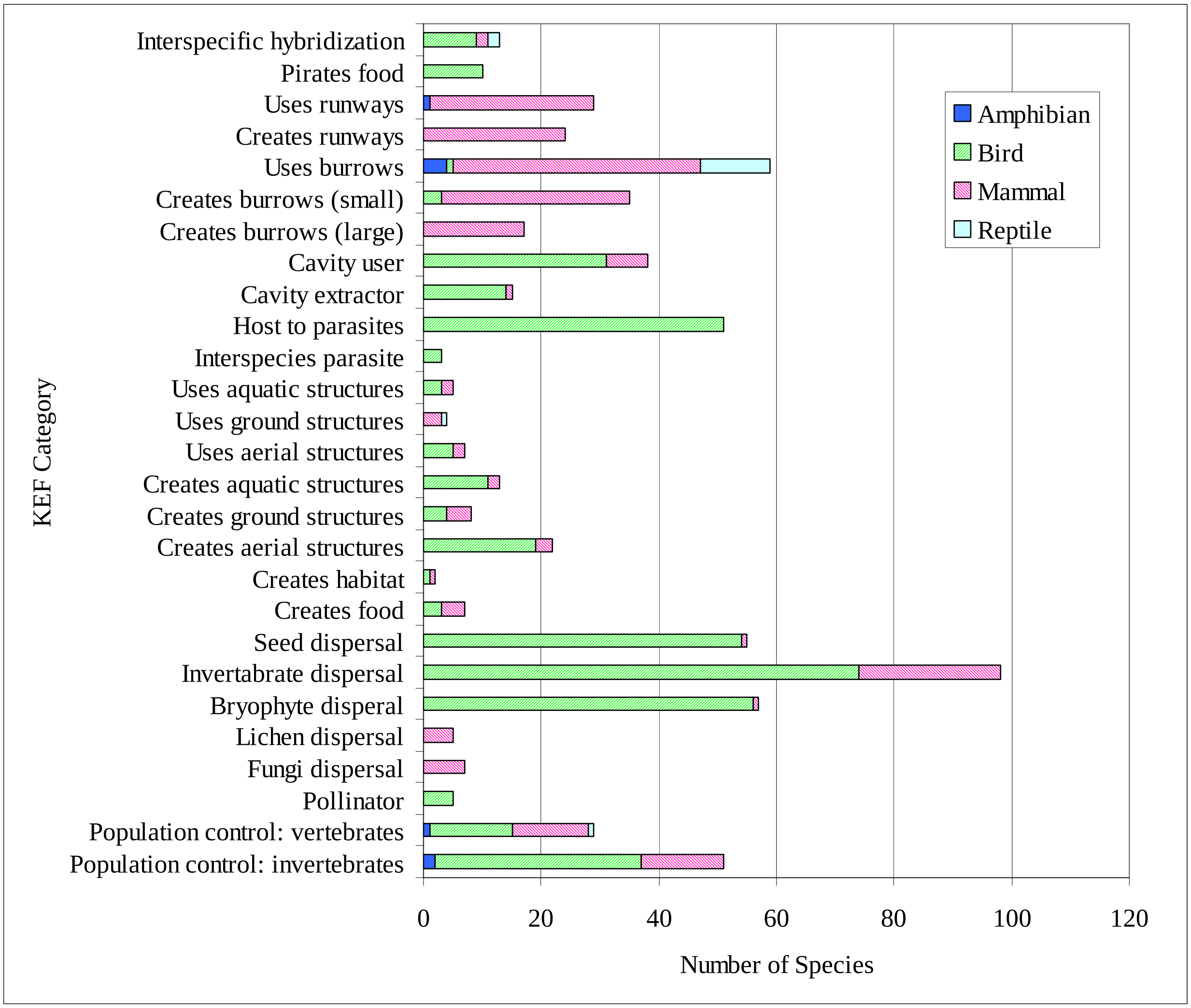

Figure 2-4. Organismal functional relations of wildlife in the Upper Snake province (see appendix (IBIS 2003).

2.1.1.5 Total Functional Diversity

Total functional diversity is functional richness weighted by functional redundancy (Brown 1995). The change in total functional diversity (TFD) in the Upper Snake province from the historic to current conditions (circa 1850 to 2000) suggests that large scale decreases have occurred and significant decreases in total functional diversity have occurred in the Lower Henrys, Teton, Idaho Falls, Willow, Palisades, American Falls, Portneuf, Blackfoot, Raft, LakeWalcott, Upper Snake–Rock, and Goose watersheds (Figure 2-5). However, some areas within these same watersheds and others have significantly increased in total functional diversity (Figure 2-5). Increases in total functional diversity might be explained changes in habitats due to either natural or anthropogenic causes. The analysis of functional richness for different habitats demonstrated that riparian or forested habitats had greater functional richness than other habitats like grasslands or shrub-steppe. Areas in the Upper Snake province with increased total functional diversity may originate from areas that were once grasslands or shrub-steppe that have now converted to forested or open water types. In addition, increases in total functional diversity might be explained by animals leaving areas of high anthropogenic disturbance to find refuge in protected or wilderness areas and relatively intact watersheds. To escape human or natural disturbances occurring in preferred environments, species might occupy habitats that they do not normally prefer. Finally, we must consider the potential for unknown shortcomings in the IBIS model in our analysis.

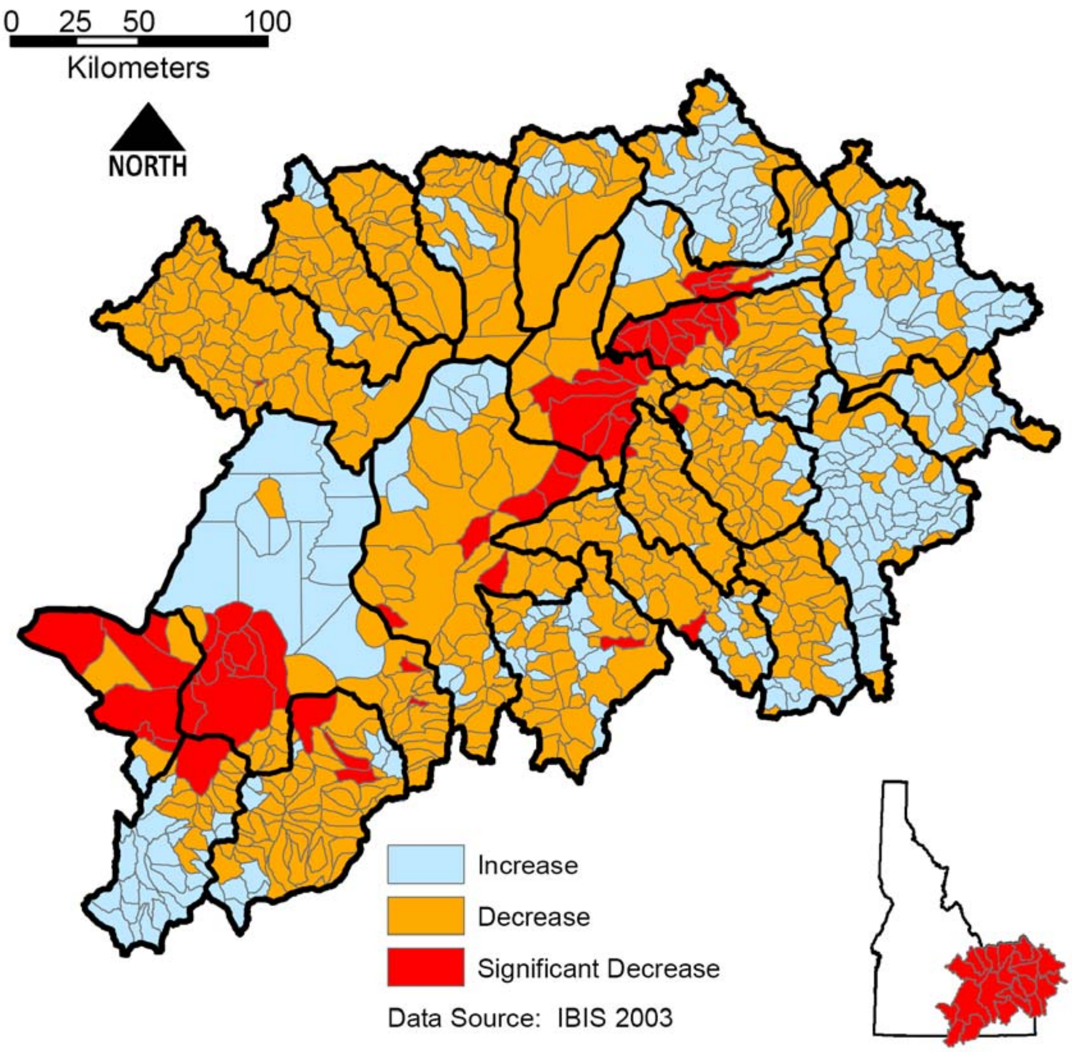

Figure 2-5. Change in total functional diversity from historic to current (circa 1850 to 2000) conditions in the Upper Snake province (IBIS 2003).

2.1.1.6 Functional Profiles

Marcot and Vander Heyden (2001) hypothesize that functional redundancy imparts resilience because increases in functional redundancy are often correlated to increases in the functional resilience (or resistance for that function). Functional profiles also show the degree of functional redundancy across communities. For instance, an analysis of the functional profile identifies the level of redundancy of a particular KEF. Communities that are functionally homologous have similar functional profiles and patterns of functional redundancy, even if the species performing the functions differ. Functionally homologous communities can be expected to operate in similar ecological ways. Currently, there is not enough information to determine which communities are functionally homologous in the Upper Snake province. Information on species and habitats need to be collected over time to make these types of determinations.

To illustrate the functional profiles in the Upper Snake province, we compared the number of KEF categories among the focal habitats (Figure 2-6 and Figure 2-7). Overall, riparian/herbaceous wetland habitats appear to have the greatest number of species performing the greatest number of ecological functions. There are a few exceptions: there are more tertiary consumers in the pine/fir forests (Figure 2-6), more mammals dispersing fungi and lichens in the pine/fir forests, and more species making and using burrows and ground structures in the shrub-steppe habitat than there are in riparian/herbaceous wetlands (Figure 2-7).

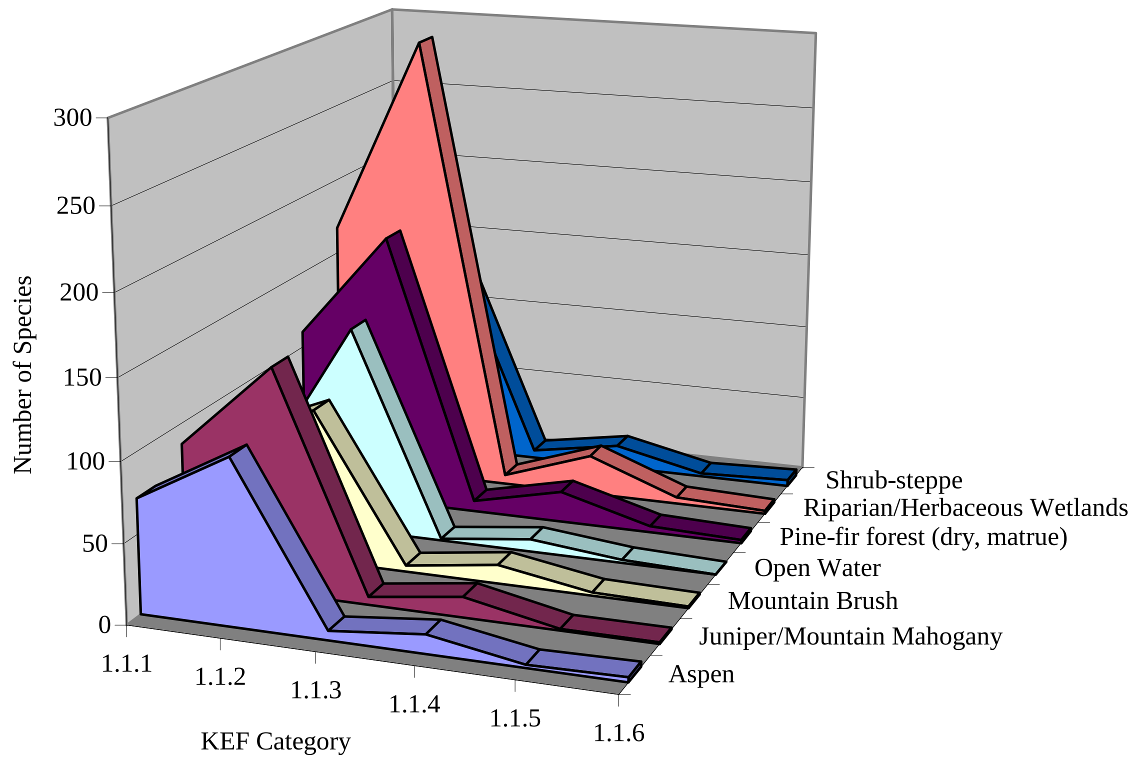

Figure 2-6. Degree of functional redundancy in trophic levels for seven focal habitats in the Upper Snake province (IBIS 2003) (see Appendix 2-2 for KEF category definitions).

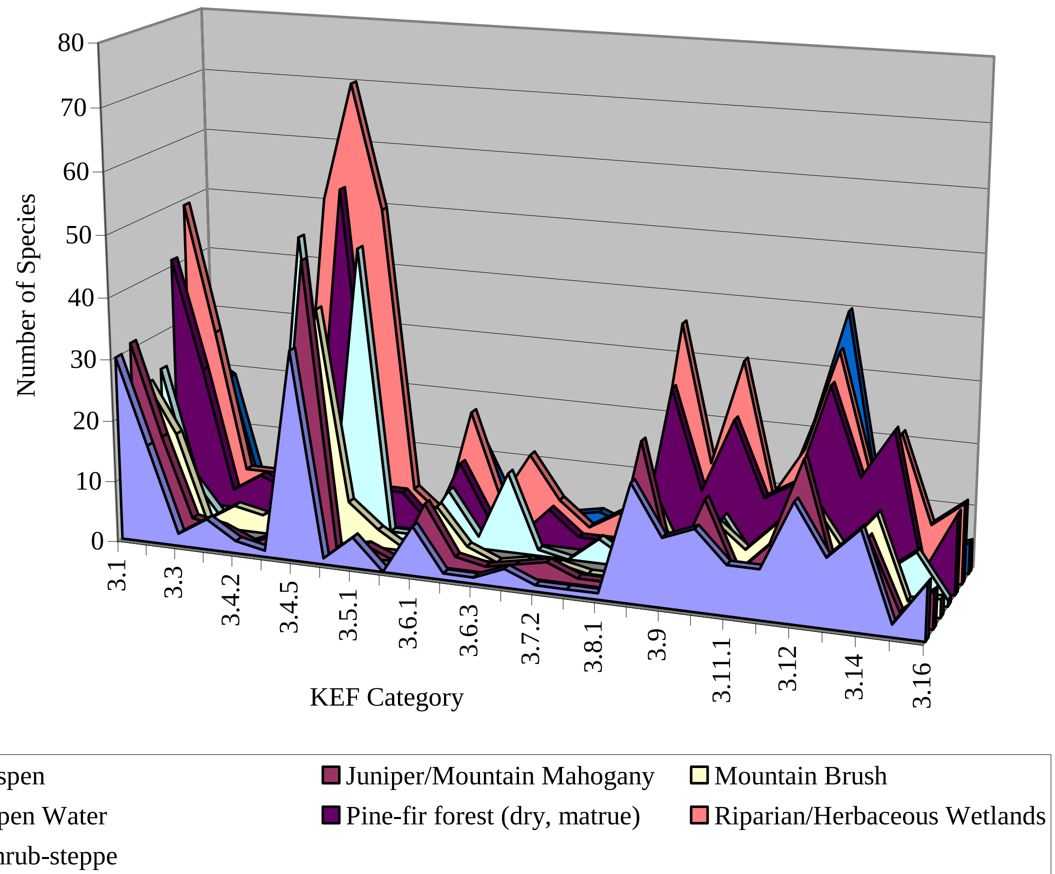

Figure 2-7. Degree of functional redundancy in organismal relationships for seven focal habitats in the Upper Snake province (IBIS 2003) (see Appendix 2-2 for KEF category definitions).

The findings from comparing functional profiles for focal habitats suggest riparian and herbaceous wetlands are a functionally resilient habitat, while aspen and juniper/mountain mahogany habitats are less functionally resilient. The functional profiles also show which ecological functions or roles are performed by many species or only a few species for each focal habitat. For instance, many species disperse seeds and fruits in all focal habitats (KEF category 3.4.5) (Figure 2-7), implying a redundancy for this ecological function. In contrast, for some habitats, very few species act as pollinators (KEF category 3.3) or disperse lichens (KEF category 3.4.2) (Figure 2-7).

2.1.1.7 Critical Functional Link Species

An ecological function that is represented by very few species; by species that are scarce or declining; or by species that, if extirpated, would mean loss of the function to the system are termed “imperiled functions.” Loss of imperiled functions serves to degrade ecosystem integrity, even seldom performed but critical ecological functions that maintain ecosystems. Reductions or extirpations of species that perform critical functional links may have ripple effects in the ecosystem, causing unexpected or undue changes in biodiversity, biotic processes, and the functional web of a community.

By definition, if the species is the only one that performs a particular ecological function within a community, then it is a critical functional link species. For instance, the black-chinned (*Archilochus alexandri*) and rufous (*Selasphorus rufus*) hummingbirds are two species that act as pollination vectors for a variety of habitats. These species are critical functional link species for shrub-steppe and grasslands habitats (Appendix 2-2).

Focal species that perform critical functional roles in certain habitats are the American beaver (*Castor canadensis*) and Rocky Mountain elk (*Cervus elaphus nelsoni*) (Appendix 2-2). The beaver is also a critical functional link species for several habitats because it is the only species that functions to impound water by creating diversions or dams. The elk is the only species to create small ponds or increase herbaceous wetlands through wallowing in shrublands and shrub-steppe.

2.1.2 Focal Species

We summarized KEFs and KECs for each of the wildlife species identified as a focal species in the Upper Snake province (Figure 2-8 and Figure 2-9, respectively). Wildlife species that have high KEF counts are considered to be generalists in their environment, while species that have low KEF counts are considered specialists (Figure 2-8). Species that have high KEC counts are considered to be robust because they can more easily adapt to changes in their environment than species with low KEC counts can (Figure 2-9). Of the focal species for the Upper Snake province, the Rocky Mountain elk, beaver, and mule deer appear to be the more resilient to changes in their environment because they have high KEF and KEC counts. The focal species most susceptible to changes in their environment are the boreal owl, sagebrush lizard, and black-backed woodpecker (*Picoides arcticus*). For instance, the black-backed woodpecker is dependent on fire landscapes and other large-scale forest disturbances and so fire suppression and post-fire savage logging are detrimental to the species and have reduced its habitat.

Other species with relatively low KEF counts are the great gray owl (*Strix nebulosa*) and American white pelican (*Pelecanus erythrorhynchos*), but these species also have relatively high KEC counts (Figure 2-8 and Figure 2-9). Such counts mean that these species are functional specialists but that they are also capable of adapting to changes in their environment. Both the great gray owl and American white pelican are capable of migrating to different areas to find preferred forage. So, although they may be functional specialists, they move from one area to another to find forage. The American avocet is also a functional specialist because it eats primarily invertebrates. But the avocet utilizes both the aquatic and terrestrial environments, increasing its ability to find adequate forage.

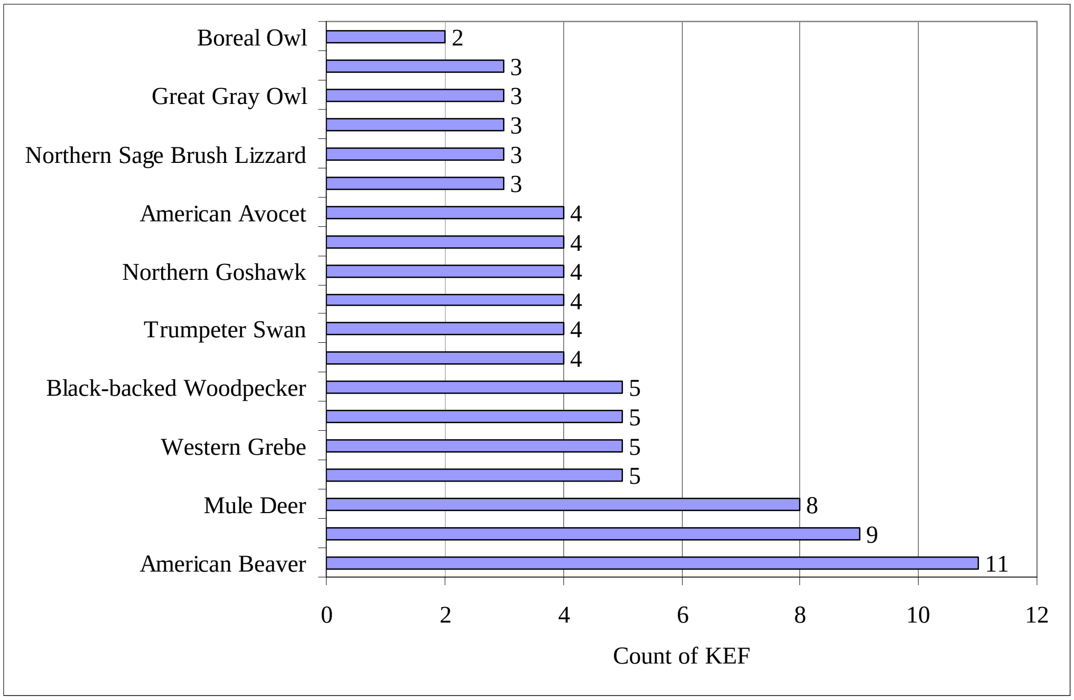

Figure 2-8. Counts of key ecological functions (KEFs) for focal wildlife species in the Upper Snake province (IBIS 2003).

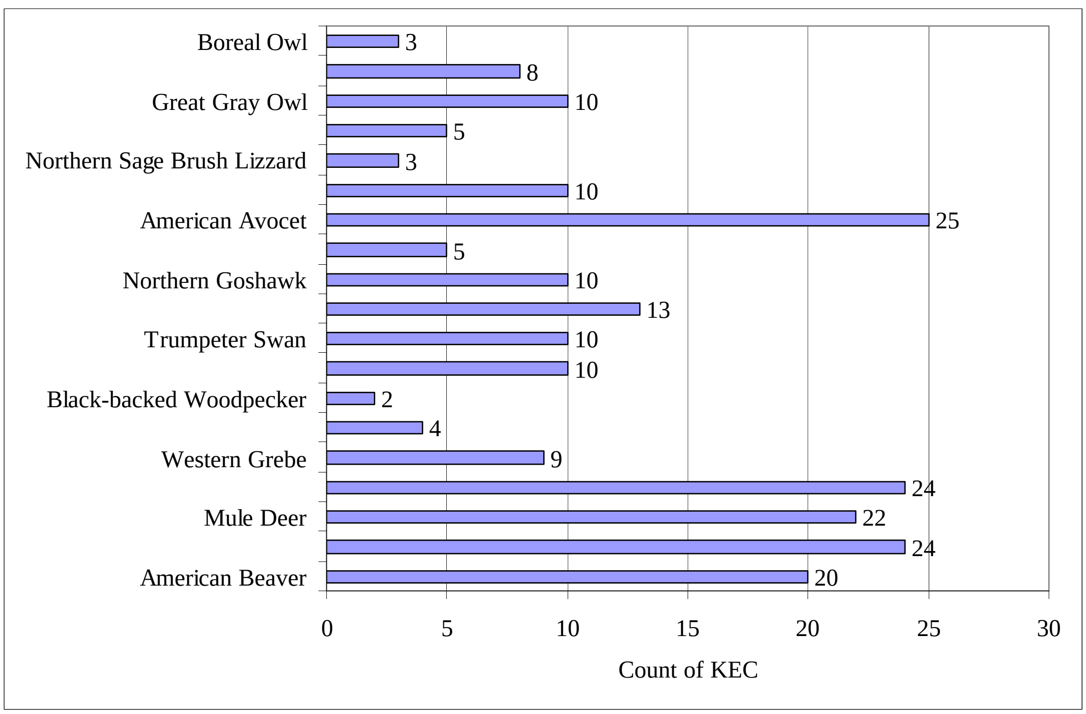

Figure 2-9. Counts of key environmental correlates (KECs) for focal wildlife species in the Upper Snake province (IBIS 2003).

To evaluate how the ecological functions and roles of wildlife and fish species might overlap, we assessed the wildlife focal species for direct associations with aquatic environments (Figure 2-10). Two hundred sixteen species in the Upper Snake province have direct associations with the aquatic environment (Appendix 2-2). Of the focal species, 8 birds, 3 mammals, and the western toad (*Bufo boreas boreas*) were found to have direct associations with the aquatic environment. KEC counts for these species reveal that the American avocet, American beaver, elk, mule deer, and western toad would be better adapted to changes in their environment, while the trumpeter swan (*Cygnus buccinator*), common loon (*Gavia immer*), and western grebe (*Aechmophorus occidentalis*) would be less adaptable to changes in their aquatic environments. Overall, the avocet and beaver seem able to use both aquatic and terrestrial habitats equally, whereas the trumpeter swan relies more on the aquatic environment than the terrestrial (Figure 2-10).

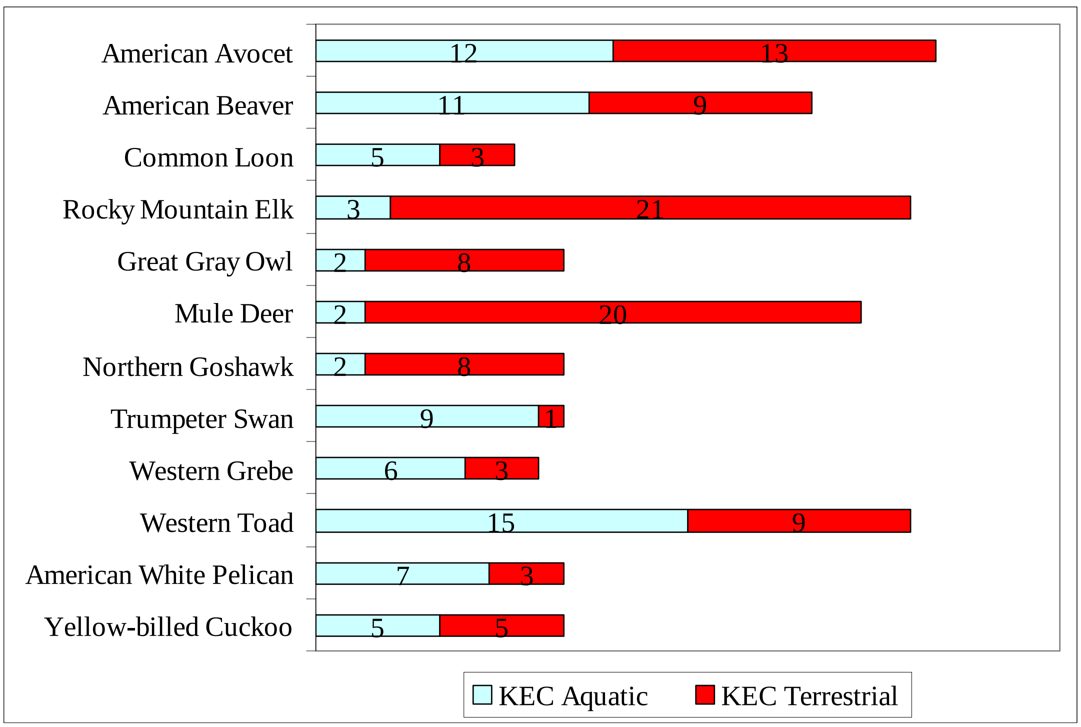

Figure 2-10. Terrestrial focal species associated with aquatic environments in the Upper Snake province and their respective key environmental correlate (KEC) counts (IBIS 2003).

Using the IBIS data set and known species distribution in the Upper Snake province, we determined the percentage change in total functional diversity for each of the focal species in their respective focal habitats (Figure 2-11). Even though species are capable of occupying the entire area of a particular focal habitat, they often occupy only a certain percentage of it. So, over the total area for a focal habitat, some areas show increases in the total functional diversity, while other areas show decreases. The same approach can be applied to understanding the changes in total functional diversity for each of the focal habitats in the Upper Snake province (Figure 2-12).

Decreases in total functional diversity in both focal species and focal habitats suggest an overall decline in habitat quality and quantity (Figure 2-11 and Figure 2-12). Focal habitats appearing to be in critical need of mitigative action to increase their total functional diversity in the Upper Snake province include the juniper/mountain mahogany, whitebark pine, and open water habitats. Each of these habitats has declined in total functional diversity by at least 81%. Open water habitats and riparian/herbaceous wetlands in the Upper Snake province have declined significantly in total functional diversity by 23 and 9%, respectively (Figure 2-12). Consequently, there are declines in the total functional diversity for all the open water and riparian/herbaceous wetland focal species, except for the common loon. One possible explanation for this finding may be that the differences between manmade and natural reservoirs benefit the common loon.

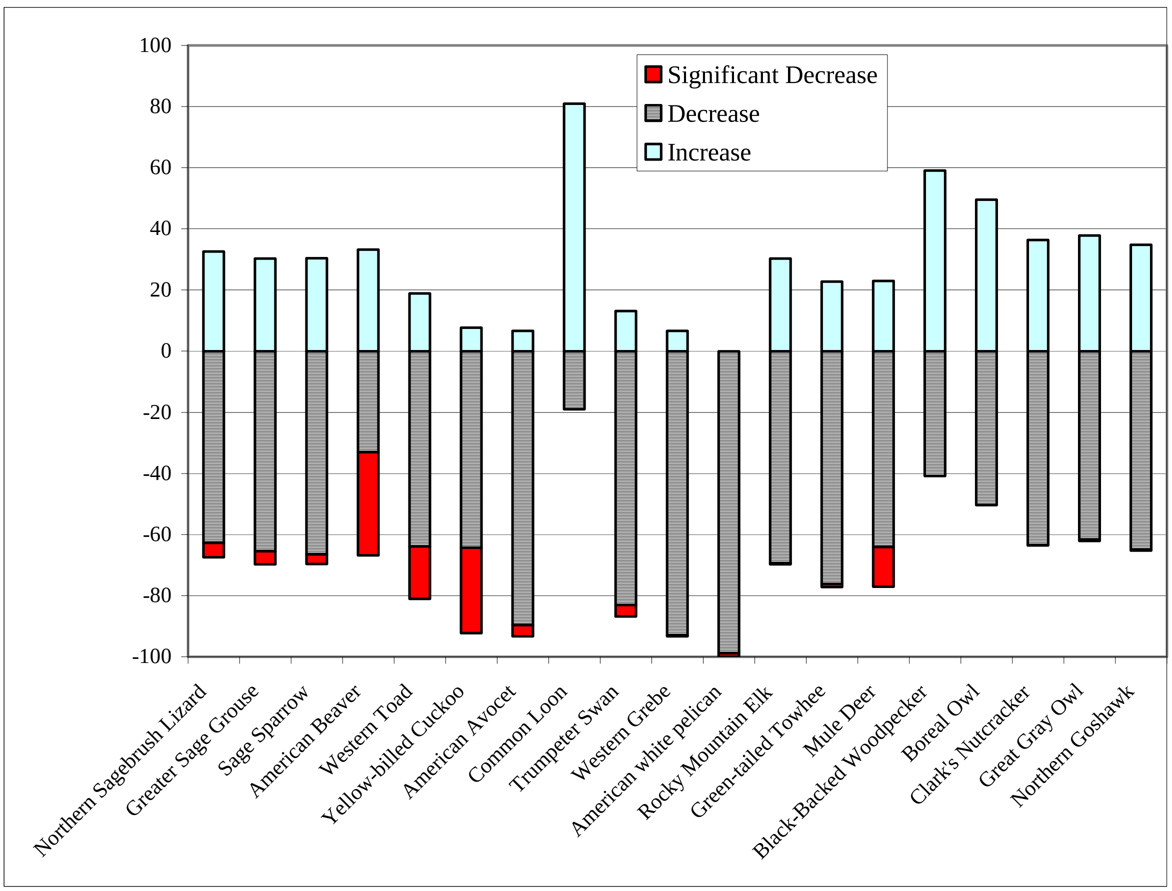

Figure 2-11. The percentage change in total functional diversity (TFD) for each focal species in its respective habitat in the Upper Snake province.

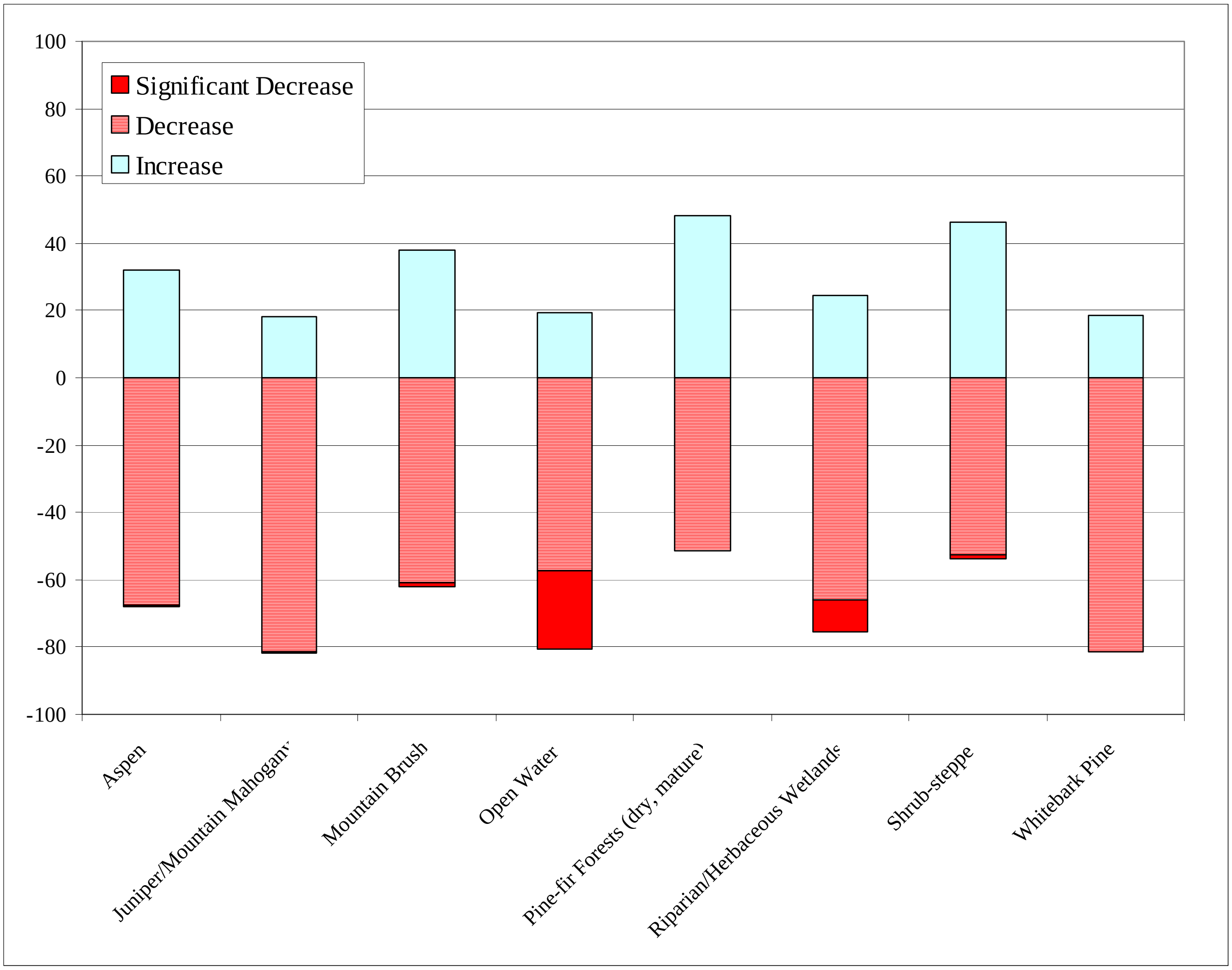

Figure 2-12. The percentage change in total functional diversity (TFD) for each of the focal habitats in the Upper Snake province.

2.2 Aquatic Resources

2.2.1 Focal Species

Focal species (Table 2-3) for the aquatic portion of this assessment were chosen according to guidelines provided by the Northwest Power and Conservation Council (NPPC 2001). These guidelines suggested inclusion of species that met the following criteria in order of importance: 1) designation as a federal endangered or threatened species, 2) ecological significance, 3) cultural significance, and 4) local significance. Further direction from the Independent Science Review Panel was to use no more than five focal species for the assessment. Based on the above guidelines, the following focal species were chosen: 1) Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*) because the species is widespread throughout the subbasin, it is a species about which the most information is known, and it is also socially and ecologically important; 2) bull trout because it is the only federally listed fish species in the subbasin; and 3) mountain whitefish because it is the only native salmonid in the Big Lost River drainage and because this population is genetically more distinct from other Snake River mountain whitefish populations than the Yellowstone cutthroat trout is distinct from westslope cutthroat trout (Bart Gamett, U.S. Forest Service, personal communication). The fisheries technical teams considered other native fish species that were not chosen as focal species but that were considered important in the subbasin. A short discussion of important species is included in this assessment.

The watershed was chosen as the organizational unit for focal species discussions. The watershed is thought to be the appropriate unit to consider when dealing with aquatic species because the condition of an aquatic ecosystem is dependent on the land and water management in the watershed (Doppelt *et al*. 1993). Bull trout population delineations were identified by the U.S. Fish and Wildlife Service (USFWS 2002).

Table 2-3. Focal, important, and nonnative species in the Upper Snake province identified by the fisheries technical teams.

Focal Species	Important Species	Nonnative Species
Yellowstone cutthroat trout	Speckled dace	Rainbow trout
Bull trout	Longnose dace	Brook trout
Mountain whitefish	Leopard dace	Brown trout
Utah valvata snail	Peamouth chub	
Snake River physa snail	Leatherside chub	
	Chiselmouth chub	
	Utah chub	
	Tui chub	
	Shorthead sculpin	
	Mottled sculpin	
	Torrent sculpin	
	California floater	
	Margeterifera spp.	

2.2.1.1 Yellowstone Cutthroat Trout (Oncorhynchus clarkii bouvieri)

Two forms of the Yellowstone cutthroat trout have been identified but not differentiated genetically (May *et al.* 2003). These are the large-spotted form that was dominant in most of the upper Yellowstone River basin and the Snake River basin from Palisades Reservoir downstream to Shoshone Falls and the fine-spotted form that was dominant in portions of four watersheds in the upper Snake River basin. This assessment will treat both forms as Yellowstone cutthroat trout.

2.2.1.1.1 Conservation Status

In August 1998, Yellowstone cutthroat trout were petitioned for listing under the ESA; however, the U.S. Fish and Wildlife Service concluded that the petition did not contain sufficient or substantial information to indicate that listing was unwarranted at this time (USFWS 2001). The Yellowstone cutthroat trout are a state and federally recognized species of special concern.

All state and federal agencies that manage Yellowstone cutthroat trout consider this subspecies to be a game fish. Therefore, all

Yellowstone cutthroat trout populations have sport fish value and are managed as such by the various states and National Parks in which they occur, regardless of their genetic status. Many Yellowstone cutthroat trout are managed as “conservation populations,” with additional management emphasis placed on preserving the genetic makeup and/or other important attributes of these populations (May *et al.* 2003).

Meyer and Lamansky (2003) identified factors affecting the distribution and biomass of Yellowstone cutthroat trout in the upper Snake. They determined that the occurrence of nonnative salmonids might pose the largest threat to long-term cutthroat trout persistence in the upper Snake River basin. They suggest that management actions developed to restore or protect cutthroat trout populations in the upper Snake River basin should focus on controlling the threat posed by nonnative salmonids (see more about current status by river drainage and on recommendations for future research and management actions in Meyer and Lamansky (2003). Evidence provided by Rieman and McIntyre (1993) and Young (1995) indicate that the declines in distribution and abundance of native salmonids throughout North America, including areas in the Rocky Mountains, have been attributed to introductions of nonnative species introductions, habitat degradation, and overharvest. In general, populations of native salmonids that persist in western North America tend to be located in high-elevation, steep-gradient reaches that are relatively unproductive (Gresswell 1995, Rieman and McIntyre 1995, Young 1995).

2.2.1.1.2 Life History

Yellowstone cutthroat trout that inhabit larger rivers migrate to smaller streams to spawn (fluvial life history). High spring flows and movement of silt and gravels are thought to limit successful spawning in mainstem rivers, therefore making tributary spawning habitat important for the long-term persistence of the species. Adult migration into spawning tributaries from the South Fork Snake River started as early as mid-February and continued as late as August for Wyoming tributaries and began in late April or early May, peaked in June, and continued through July on an Idaho tributary. Sex ratios are approximately 1:1 (Kiefling 1978). In populations upstream of Palisades Reservoir, spawning was initiated at age 3 and 4, with the oldest fish observed being age 7 (Kiefling 1978). For Yellowstone cutthroat trout populations in Idaho, maturation occurred at age 2 (29%), 3 (49%), or 4 (13%), with only three fish being over age 7 (<1%) and the oldest Yellowstone cutthroat trout being age 10 (Meyer *et al*. 2003a). Downstream migration of fry was documented in winter for tributary streams in Wyoming. Yellowstone cutthroat trout ranged in size from 2 to 7 kg, while some hybrids reached up to approximately 15 kg (Varley and Gresswell 1988). Yellowstone cutthroat trout also inhabit small streams, adopting a resident life history of spawning and rearing in the same stream.

The diet of the Yellowstone cutthroat trout is primarily aquatic and terrestrial insects, but the fish are opportunistic and larger individuals will feed upon small fish and mammals such as mice and voles (Kiefling 1978). The maximum age of Yellowstone cutthroat trout is variable and greatly influenced by environmental factors (Behnke 1992). In Yellowstone Lake, the average maximum age for Yellowstone cutthroat trout is about 7, but fish of 8 and 9 years of age have appeared in spawning runs. Protective regulations in some areas have greatly reduced mortality from angling (Gresswell and Varley 1988). The Yellowstone subspecies did not co-evolve with rainbow trout or redband trout, and sympatric populations of native Yellowstone cutthroat trout fish and introduced rainbow trout (*Onchorhyncus mykiss*) (Behnke 1992). In areas where rainbow trout or other cutthroat subspecies have been stocked, introgression may be documented.

2.2.1.1.3 Population Trends and Distribution

Today, Yellowstone cutthroat trout persists in some Snake River tributaries between Shoshone Falls and Palisades Reservoir, but the species has been replaced by nonnative trout in other areas (Behnke 1992). As an example of this distribution, Behnke (1992) notes that the rainbow trout is now the dominant trout in the Henrys Fork. Special angling regulations have proved effective in increasing the abundance and proportion of older fish (5–7 years old) in Yellowstone cutthroat trout populations (Thurow *et al*. 1988).

Historical Range

The known historical range of Yellowstone cutthroat trout is shown in Figure 2-13 (May *et al*. 2003). That range includes the upper portions of the Yellowstone River drainage within Montana and Wyoming and the upper Snake River drainage in Idaho, Wyoming, Nevada, and Utah. Behnke (1992) considers the Yellowstone cutthroat trout as the original native trout to the entire Snake River system, including the upper Yellowstone River drainage. Behnke also concludes that "Yellowstone cutthroat trout had a much greater distribution before redband trout invaded the middle Columbia River basin in the late-glacial period." Using Behnke's statement as a starting point, May *et al*. (2003) assessed all streams within any 4th field HUC that was within the area that Behnke identified as being potentially part of the historically occupied habitat. In this multi-state assessment of Yellowstone cutthroat trout, May *et al*. (2003) also identified stream segments that should be excluded from historical range based on evidence for exclusion. Such evidence included 1) geological barriers above which there was no evidence that Yellowstone cutthroat trout inhabited waters; 2) tectonic events that would have made regions uninhabitable or caused ancient populations to go extinct and not be recolonized prior to 1800; and 3) habitat judged as unsuitable based primarily on thermal regime, stream channel gradient, and minimal stream flow (May *et al.* 2003).

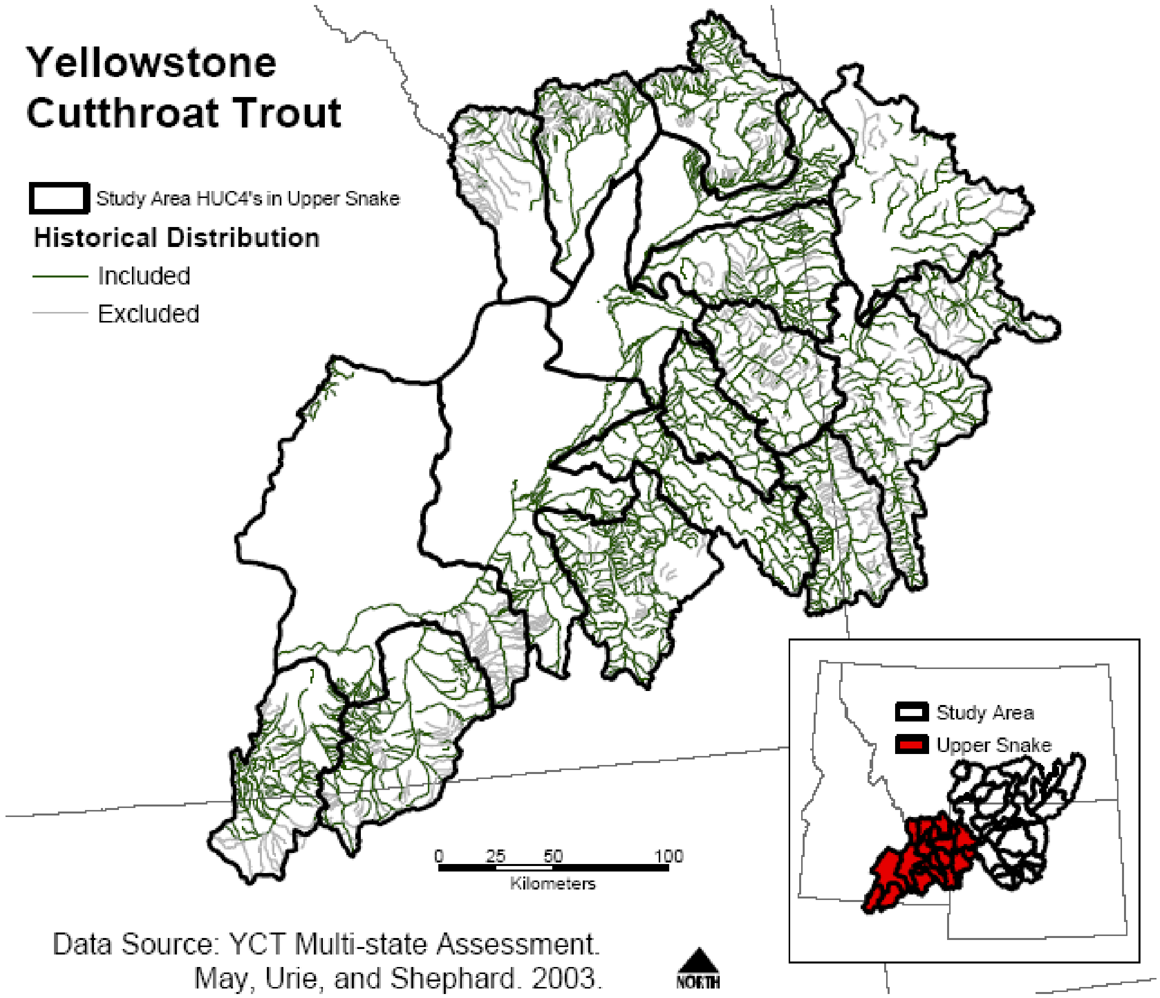

Figure 2-13. Historical range of Yellowstone cutthroat trout in the Upper Snake province (May *et al*. 2003).

In the upper Snake River drainage, Yellowstone cutthroat trout persist in Heart Lake and other waters above Jackson Lake (Behnke 1992). From Shoshone Falls to Palisades Reservoir, the Yellowstone cutthroat trout persists in some Snake River tributaries but has been replaced in others. In some areas, Yellowstone cutthroat trout have largely been replaced by brook, brown, and rainbow trout and by hybrid rainbow × cutthroat trout populations.

May *et al*. (2003) found that historically occupied habitat included stream segments occupied by both large-spotted and fine-spotted forms of Yellowstone cutthroat trout, and in some cases both forms were present. Based on a StreamNet 1:100,000-scale hydrography layer, May *et al*. (2003) reported that there are approximately 6,269 miles of historic Yellowstone cutthroat trout range in Idaho (36% of total occupied historic lotic habitat [circa 1800] occupied by Yellowstone cutthroat trout in Montana, Idaho, Wyoming, Nevada, and Utah).

Current Distribution

May *et al*. (2003) identified the current distribution of Yellowstone cutthroat trout by assessing all stream segments within the historical range, not including stocking by artificial propagation. They evaluated all waters that supported Yellowstone cutthroat trout and appeared on the StreamNet hydrography layer, regardless of level of introgression. In their multi-state assessment of Yellowstone cutthroat trout, May *et al.* (2003) also ranked the abundance of Yellowstone cutthroat trout inhabiting each stream segment. The most recent assessment indicates that Yellowstone cutthroat trout currently occupy over 2,100 miles of the historically occupied habitats found in Idaho (35% of historical).

Meyer and Lamansky (2003), in their study of 773 stream reaches throughout the upper Snake River basin in Idaho, found that in general, Yellowstone cutthroat trout presence at a specific site within a drainage was associated with a higher percentage of public property, higher elevation, more gravel and less fine substrate, and more upright riparian vegetation. However, there was much variation among drainages in the direction and magnitude of the relationships between stream characteristics and Yellowstone cutthroat trout occurrence and biomass, as well as variation in model strength. Meyer and Lamansky's report (2003) presents probably the most detailed records of the current distribution and occurrence of Yellowstone cutthroat trout by watershed in Idaho. Information below is from IDFG (2001) or Meyer and Lamansky (2003), unless otherwise noted.

Population status—A substantial amount of survey data on Yellowstone cutthroat trout exists in the Upper Snake province. However, using data to make comparisons between areas at a larger scale when the sampling scheme was not defined for that purpose can be problematic due to the nonrandom distribution of sampling points and the varying sample methods and sampling effort that are frequently employed. For that reason, we are focusing this assessment using data collected by Meyer and Lamansky (2003) where available and supplemented with data from the Wyoming Game and Fish Department and Utah Division of Natural Resources. We assessed population status by normalizing the Yellowstone cutthroat trout density estimates available throughout the three subbasins and calculating a mean and standard deviation. Population strength was defined as follows: 1) normal densities were within ½ standard deviation of the mean, 2) low densities were less than ½ standard deviation of the mean, and 3) high densities were greater than ½ standard deviation from the mean.

Hybridization and introgression from rainbow trout—Rainbow trout hybridization and introgression was evaluated on samples collected by Meyer and Lamansky (2003) using genetic and phenotype-based procedures. For the purposes of this assessment, populations were grouped into the following four categories: 'core populations', 'conservation populations', 'mixed populations', and 'hybrid populations'. Core populations were identified as populations in which no rainbow trout introgression was observed (1 diagnostic mtDNA marker and 3 diagnostic co-dominant nDNA markers), or, in the absence of genetic information, populations in which no hybrids were phenotypically identified. Conservation populations were identified as populations in which 1-10% rainbow trout introgression was observed, or in which 1-10% of the samples were phenotypically identified as hybrids. Mixed populations were those that were genetically identified with 10-20% rainbow trout introgression, or in which 10-20% of the individuals sampled were phenotypically identified as hybrids. Finally, populations that were genetically identified with greater than 20% rainbow trout introgression, or in which greater than 20% of the individuals sampled were phenotypically identified as hybrids, were classified as 'hybrid' populations.

With regards to the accuracy of phenotypic versus genetic identifications: 1) genetic data corroborated our visual determination that hybridization was absent at 43 of 59 sites; 2) at the 7 sites where we visually failed to discern genetically-detected hybridization, the percent of rainbow trout alleles in the population were low (< 1 %) at all but two locations; and 3) where we detected hybridization both visually and genetically (9 sites), levels of hybridization were similar between methods (correlation coefficient r = 0.80; Meyer *et al*. IDFG unpublished data).

Genetic Variation of Yellowstone Cutthroat Trout in Idaho—Genetic results from a mtDNA RFLP screen on 40 Yellowstone cutthroat populations (>1000 samples), from across their range in Idaho, indicate that Yellowstone cutthroat trout populations are highly structured at the drainage level (IDFG, unpublished data). An analysis of molecular variance indicates that a substantial portion of the total genetic variation (>46%) is partitioned between the major drainages (ex. Raft, Portnuef, Blackfoot, Willow Creek, S.F. Snake, etc.). This data suggests that the conservation of genetic diversity of Yellowstone cutthroat trout in Idaho will at least require the maintenance of healthy populations within each of the major drainages and provides a starting point for describing and prioritizing conservation management units for the subspecies.

Closed Basin Subbasin

Medicine Lodge and Beaver–Camas Watersheds— Several designated core and conservation cutthroat populations are present (Figure 2-14), and the middle Dry and Moose creeks populations appear to be isolated from rainbow and brook trout. Additionally, Yellowstone cutthroat trout is believed to be the only native salmonid to use these watersheds. Yellowstone cutthroat trout are found in many streams throughout the various drainages, but rainbow trout are the predominant fish throughout the drainages. Of the 50 sites that were sampled for fish and habitat in the Closed Basin subbasin, 14 were fishless. Yellowstone cutthroat trout were found in 10 of the remaining 36 sites but occurred without nonnative salmonids in only 2 locations (Table 2-4). In the Beaver–Camas watershed, populations of wild rainbow trout and brook trout (*Salvelinus fontinalis*) exist in most streams in the headwater areas. Several designated core and conservation cutthroat populations are present (Figure 2-14), and the middle Dry and Moose creeks populations are isolated from rainbow and brook trout. Several Yellowstone cutthroat trout populations were defined as hybrids. Brown trout (*Salmo trutta*) have been released into Camas Creek, and Lahontan Cutthroat trout are released into Mud Lake. For the Closed Basin subbasin, Yellowstone cutthroat trout distribution was too restricted for meaningful conclusions to be drawn about factors related to occurrence.

Table 2-4. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the Beaver–Camas (BCM) and Medicine Lodge (MDL) watersheds within the Closed Basin subbasin. Density of rainbow trout (RBT) < 100 mm is listed as an index of further introgression risk.

Stream Name (watershed)	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
East Fork Rattlesnake Creek (BCM)	Core		1			
Middle Dry Creek (BCM)	Core	1				
Moose Creek (BCM)	Core			1		
Cold Creek (MDL)	Absent				1	
Fritz Creek (MDL)	Core			1		
Fritz Creek (MDL)	Hybrid			1		
Horse Creek (MDL)	Absent				1	
Indian Creek (MDL)	Absent				2	Normal–1
Irving Creek (MDL)	Absent				2	Normal–1
	Core			1		
Warm Creek (MDL)	Absent				2	Normal–1
Webber Creek (MDL)	Hybrid			1		
West Fork Indian Creek (MDL)	Conservation		1			
	Hybrid			2		Normal–1

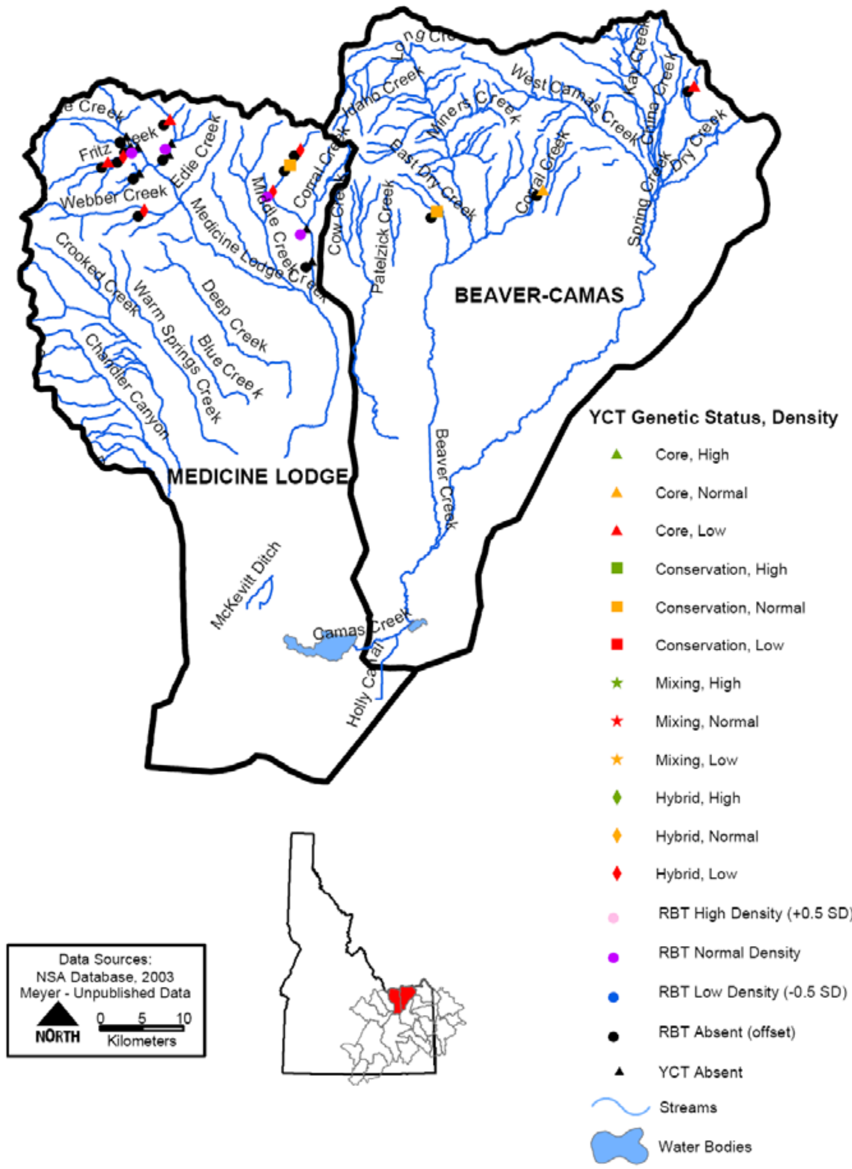

Figure 2-14. Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the Beaver–Camas and Medicine Lodge watersheds. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Upper Snake Subbasin

Henrys Fork of the Snake River (Upper Henrys Fork and Lower Henrys Fork Watersheds)—The Henrys Fork supports a small fraction of the Yellowstone cutthroat that it did prior to the 1900s. During the 1800s, the Yellowstone cutthroat population was prolific enough to support numerous commercial fishing operations in the late part of the century (including Henrys Lake). The exploitation of these fish may have contributed to their decline; however, it is more likely that concurrent aggressive stocking programs using rainbow trout and brook trout had more to do with the loss of Yellowstone cutthroat trout throughout the drainage (Van Kirk and Gamblin 2000). In 1958 and again in 1966, the entire drainage above the Island Park Dam was treated with pesticides to remove nongame fish. The cutthroat populations that still existed prior to that time were largely eliminated downstream to Mesa Falls. Following the treatments, the drainage was restocked with rainbow trout. In addition to the effects of exploitation, exotic fish stocking, and chemical treatments, habitat degradation and fragmentation likely played a role in the loss of cutthroat populations. Currently, Yellowstone cutthroat trout are considered rare in the mainstem Henrys Fork.

In the Henrys Fork drainage, sampling was conducted at 69 sites, with Yellowstone cutthroat trout occurring at 12 sites and nonnative salmonids present at 8 of those 12 sites. Within the Upper Henrys watershed, four Yellowstone cutthroat trout core populations were identified (Table 2-5). The majority of these populations were tributaries to Henrys Lake (Figure 2-15). Howard, Duck, Tyghee, and Timber creeks are known to provide spawning habitat for Yellowstone cutthroat trout from Henrys Lake. The mainstem Henrys Fork is dominated by rainbow trout from Island Park Dam downstream to Mesa Falls, with rainbow trout and brown trout dominant from Mesa Falls downstream. From Henrys Lake Outlet to Island Park Dam, a remnant Yellowstone cutthroat trout population is present, and Yellowstone cutthroat trout are stocked in this stretch. Warm River is dominated by rainbow trout and brown trout. Efforts to reestablish Yellowstone cutthroat trout in portions of the drainage began in 1999 with the chemical treatment and restocking of Golden Lake and its tributaries.

In the Lower Henrys watershed, six core populations and one conservation population were identified in tributaries to the Falls River (Table 2-6 and Figure 2-16), which is the largest tributary to the Henrys Fork. Rainbow trout are dominant in the Falls River, with cutthroat and rainbow cutthroat hybrids incidental. Distribution was too restricted within the drainage for meaningful conclusions to be drawn about factors related to cutthroat trout occurrence.

Table 2-5. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the Upper Henrys watershed in the Upper Snake subbasin. Density of rainbow trout (RBT) < 100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Canyon Creek	Absent				1	
Duck Creek	Core			1		
Howard Creek	Core			1		
Sheridan Creek	Absent				3	Normal–1
Snow Creek	Absent				1	
Twin Creek	Absent				1	
	Hybrid			1		
Tygee Creek	Core		2			
West Fork Hotel Creek	Absent				1	
Wyoming Creek	Absent				1	

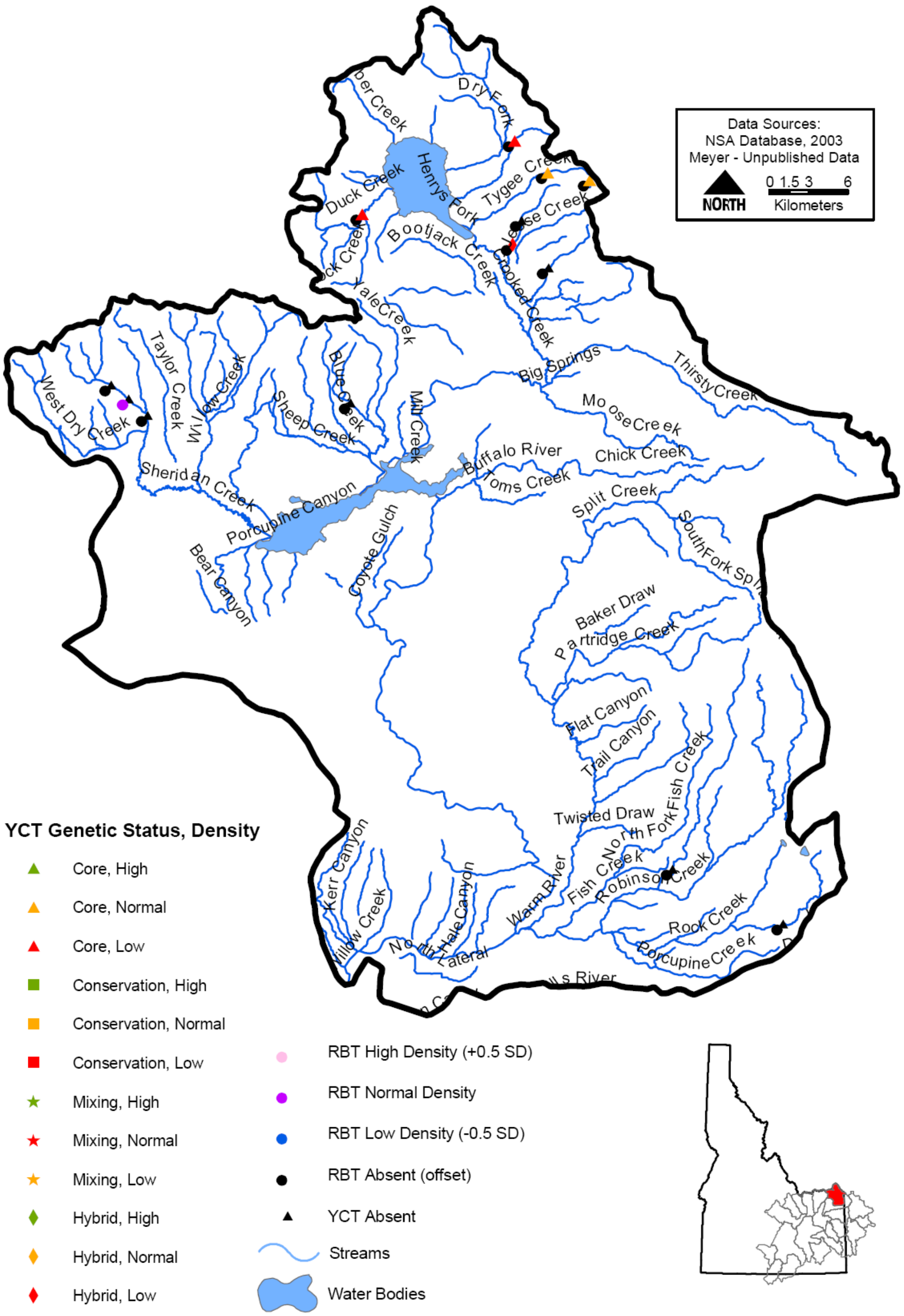

Figure 2-15. Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the Upper Henrys watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Table 2-6. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the Lower Henrys watershed in the Upper Snake subbasin. Density of rainbow trout (RBT) < 100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Calf Creek	Core		1			
Cascade Creek	Absent				1	Normal–1
Conant Creek	Absent				2	Normal–1
	Core			1		
Coyote Creek	Core			1		
Jackass Creek	Core		1			
North Boone Creek	Core			1		
South Boone Creek	Core			1		
Squirrel Creek	Absent				1	
	Conservation		1			
Unnamed tributary to Boundary Creek	Absent				1	Normal–1

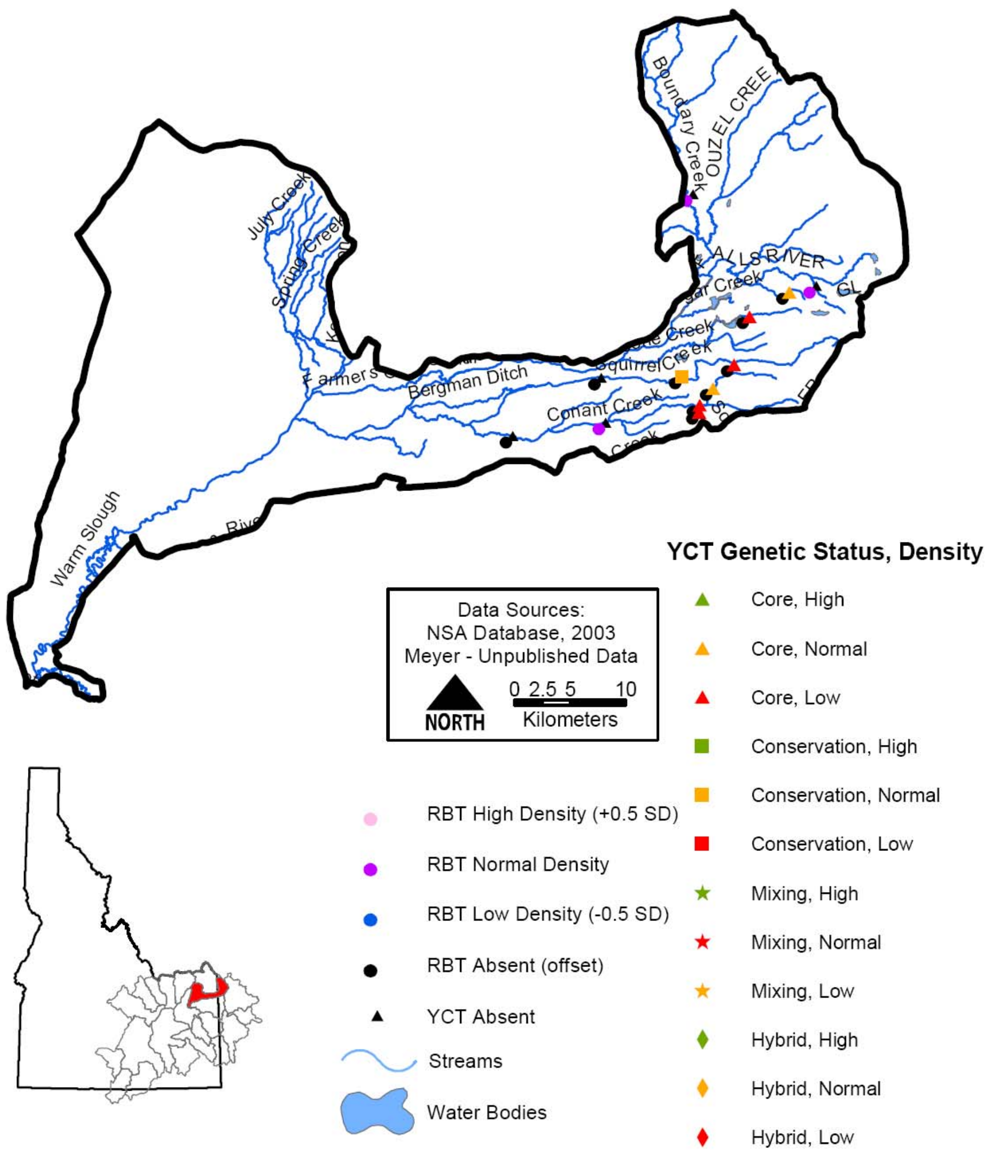

Figure 2-16. Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the Lower Henrys watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Teton Watershed—The Teton River was historically viewed as a stronghold of Yellowstone cutthroat trout. But recent surveys show severe population declines in the mainstem, with rainbow trout as the dominant trout there. Yellowstone cutthroat trout core and conservation populations were relatively widespread in tributaries in the Teton watershed (Figure 2-17), with Yellowstone cutthroat trout present in 59% of sites containing perennial streamflow. Of the populations identified, 35 were classified as core, 3 as conservation, and 1 as hybrid (Table 2-7). Nearly all sites containing Yellowstone cutthroat trout also contained brook trout. In fact, brook trout were more widespread, existing in 75% of sites containing perennial streamflow and all sites but five that contained fish of any species. Populations of Yellowstone cutthroat trout in the main Teton River have suffered substantial declines in recent years.

Occurrence of Yellowstone cutthroat trout in the Teton watershed was associated with lower elevations and a lower percentage of fine substrate, and the trout were more likely to occur where nonnative salmonids were present (Table 2-18 and Table 2-19). However, none of these relationships was strong, and the inclusion of these variables in the logistic regression model relating stream conditions to cutthroat trout distribution explained only 17% of the variation in occurrence (Table 2-19).

Table 2-7. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the Teton watershed in the Upper Snake subbasin. Density of rainbow trout (RBT) <100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Canyon Creek	Absent				1	
	Conservation		1			
	Core		3			
Fish Creek	Core		2			
Game Creek	Core			1		
Garner Canyon	Core		1	1		
Horseshoe Creek	Conservation			1		
Little Pine Creek	Core		1			
Mahogany Creek	Core			1		
Mike Harris Creek	Core	1		1		
Moose Creek	Core			1		
North Fork Horseshoe Creek	Core	1	1			
North Fork Mahogany Creek	Core		1			
North Fork Packsaddle Creek	Conservation	1				
	Core	1				
North Leigh Creek	Core		1	1		
North Moody Creek	Core		2			
Sob Canyon	Core			2		
South Fork Badger Creek	Core	3				
South Fork Canyon Creek	Core		2			
South Fork Horseshoe Creek	Core			1		
South Fork Mahogany Creek	Core			2		
South Moody Creek	Core			2		
State Creek	Core			1		
Trail Creek	Core			1		
Warm Creek	Absent				1	
	Hybrid			1		Normal–1

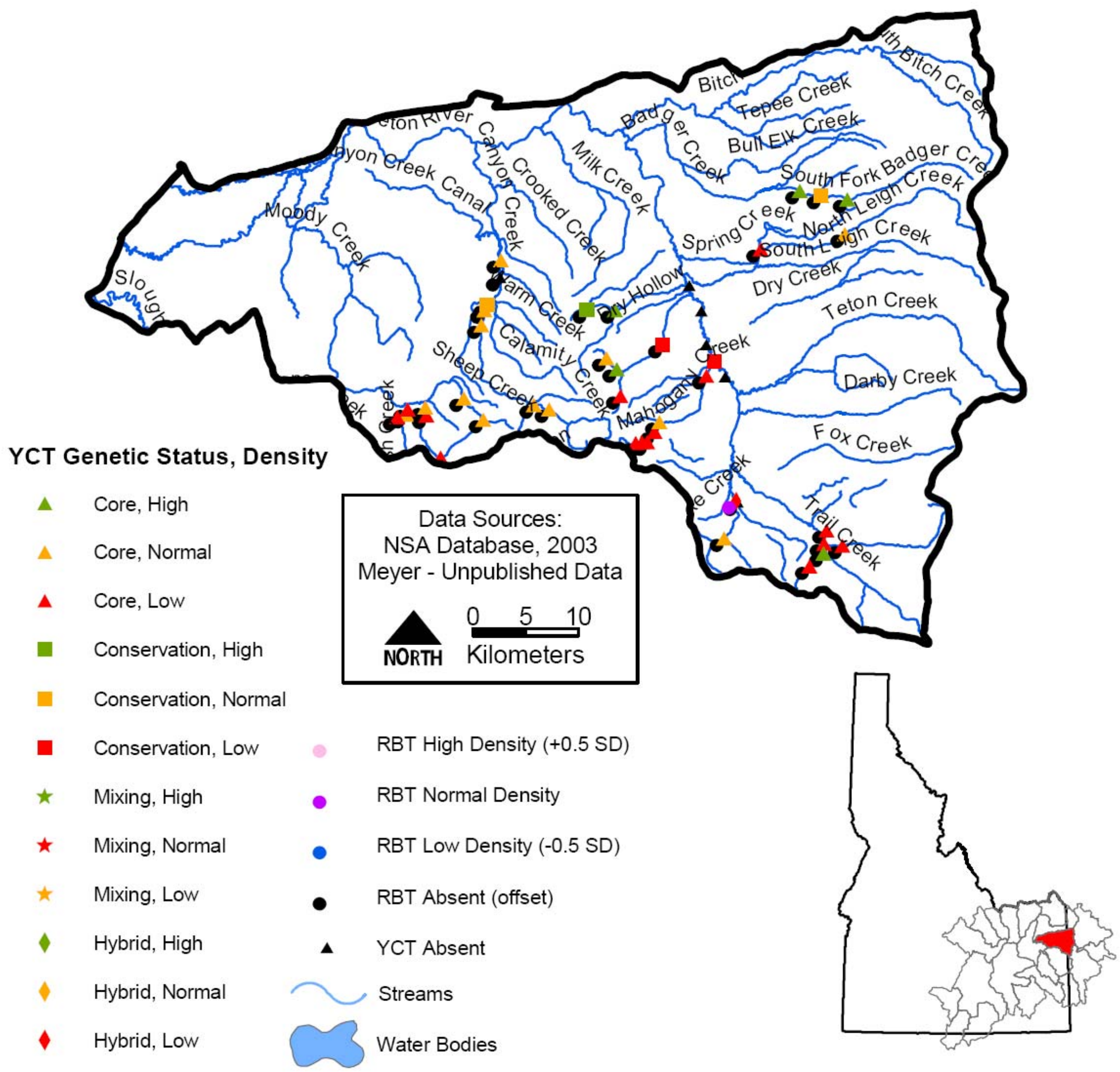

Figure 2-17. Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the Teton watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Idaho Falls Watershed—No core or conservation populations of Yellowstone cutthroat trout are known to occur in this watershed, though Yellowstone cutthroat trout are known to be present in low numbers within the main Snake River in the Idaho Falls watershed.

Willow Watershed—The Willow Creek drainage was unique in the Upper Snake subbasin because all (21) of the Yellowstone cutthroat trout populations identified were considered core populations, and no rainbow trout or hybrids were identified in the watershed (Table 2-8 and Figure 2-18). Yellowstone cutthroat trout were sympatric with brook trout in three sites in the watershed. Cutthroat trout were more likely to be present in higher order, wider streams with more gravel substrate; public landownership also increased the likelihood of cutthroat trout presence (Table 2-18 and Table 2-19). These variables explained 58% of the variation in cutthroat trout occurrence in the logistic regression model for this drainage. Most (71%) of the Yellowstone cutthroat trout populations in the Willow watershed were low density relative to other Yellowstone cutthroat trout populations within the species' Idaho range (Table 2-8).

Table 2-8. Introgression and status of Yellowstone cutthroat trout (YCT) populations sampled in the Willow watershed in the Upper Snake subbasin. Density of rainbow trout (RBT) <100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Birch Creek	Core			1		
Brockman Creek	Core			1		
Corral Creek	Core		1	1		
Lava Creek, NF	Core			1		
	Core			1		
Lyons Creek	Core			2		
Mill Creek	Core			2		
Sawmill Creek	Core			1		
Sellars Creek	Core	1		3		
South Fork Sellars Creek	Core	2	1			
Tex Creek	Core			1		
Willow Creek	Core		1	1		

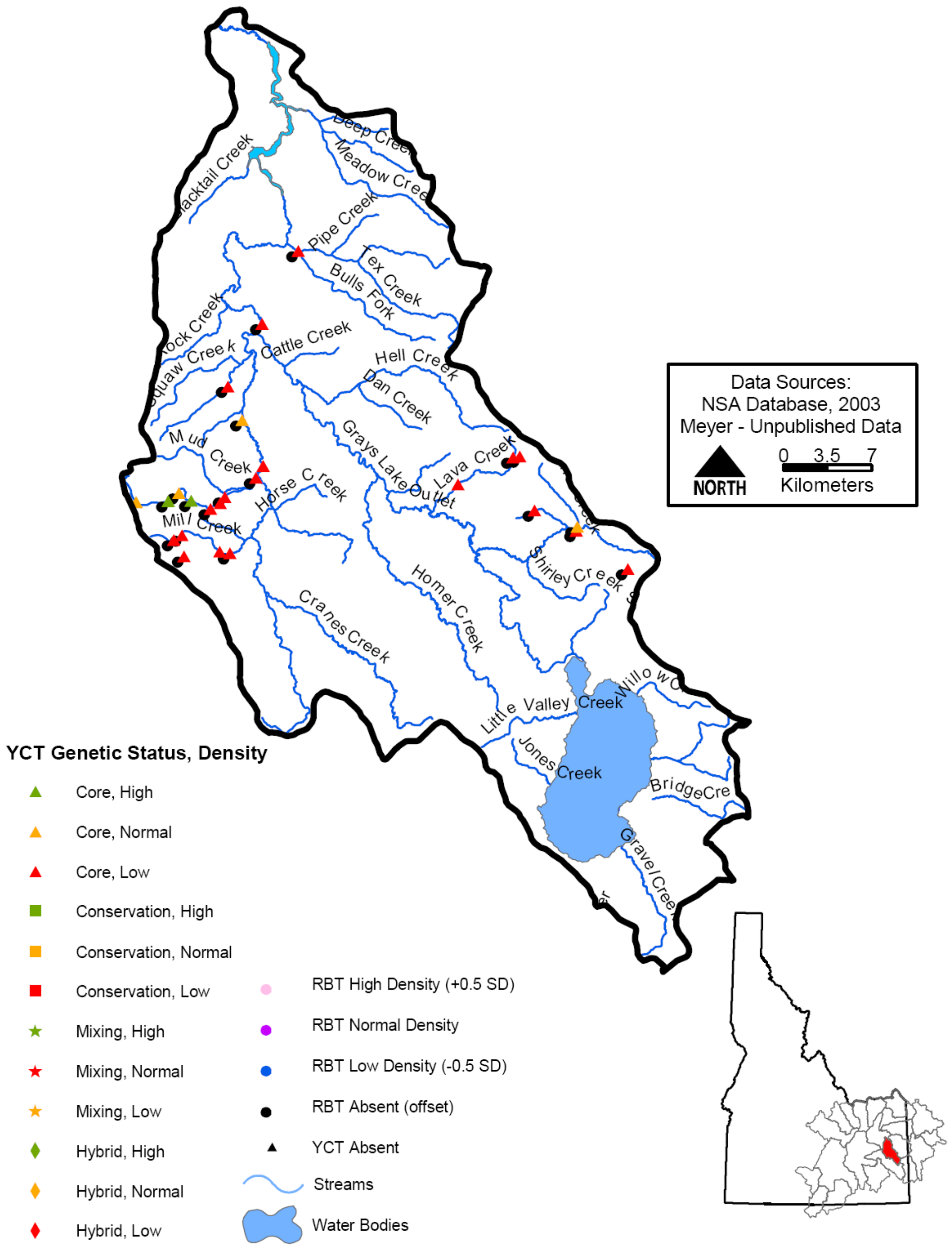

Figure 2-18. Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the Willow watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Blackfoot Watershed—In the Blackfoot watershed, Yellowstone cutthroat trout were found in 64% of study sites, while nonnative salmonids occurred in 23 sites, including 19 in sympatry with cutthroat trout (Figure 2-19). Above Blackfoot Reservoir, 79% of sites where fish were present contained Yellowstone cutthroat trout, but 55% also contained either rainbow trout or brook trout. Downstream of Blackfoot Reservoir, 59 and 26% of sites contained cutthroat trout and nonnative trout, respectively. In the Blackfoot watershed, 27 populations were classified as core, 11 as conservation, 4 as mixed, and 2 as hybrid (Table 2-9). An adfluvial population of Yellowstone cutthroat trout exists in the Blackfoot watershed associated with Blackfoot Reservoir. A weir is operated yearly on the Blackfoot River to limit rainbow trout spawning in the upper Blackfoot River. Cutthroat trout were more likely to occur in higher-gradient, wider, headwater locations on public land and with higher amounts of gravel, cobble, and boulder substrate and less fine sediment substrate (Table 2-18 and Table 2-19). These variables explained 51% of the variation in cutthroat trout occurrence in the logistic regression model developed for this drainage (Table 2-19).

Table 2-9. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the Blackfoot watershed in the Upper Snake subbasin. Density of rainbow trout (RBT) <100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Angus Creek	Core			1		
Bacon Creek	Core		1	1		
Blackfoot River	Conservation			1		
	Core		1			
	Hybrid			1		
	Mixing		1	1		
Browns Canyon	Core	1	1			
Brush Creek	Conservation		1			
	Core		1			
Chippy Creek	Core			1		
Diamond Creek	Conservation	5				
	Core			2		
	Mixing	1				
Horse Creek	Core	1	1			
Kendall Creek	Core		1			
Lanes Creek	Core		1			
Miner Creek	Conservation	1				
	Core	1		1		
Poison Creek	Conservation	1				
	Core	2				
Rawlins Creek	Core		1	1		
	Mixing	1				

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Sheep Creek	Core	1	2			
South Fork Canyon Creek	Core			1		
Timber Creek	Hybrid			1		
Timothy Creek	Conservation		2			
	Core		1			
Wolverine Creek	Core	2				

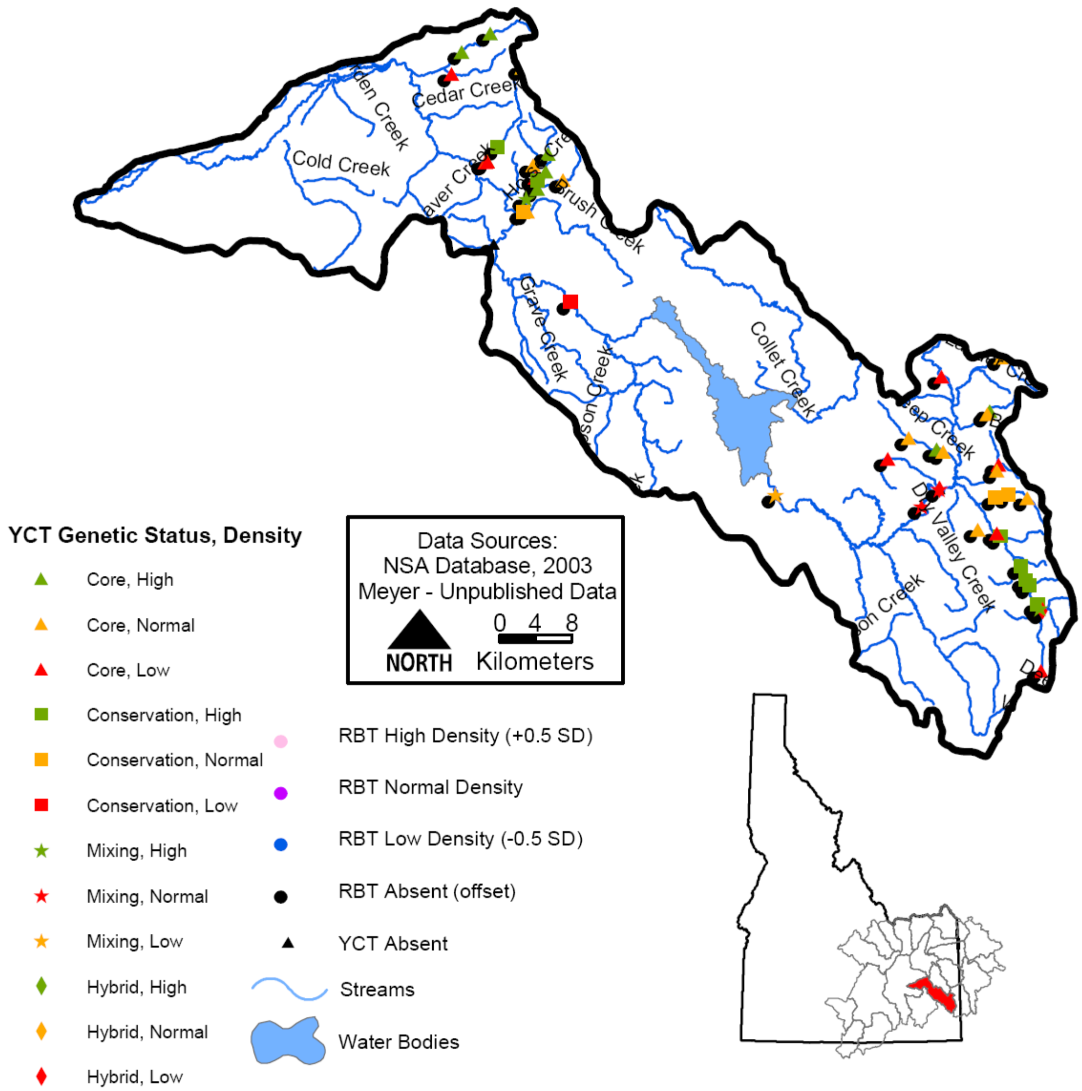

Figure 2-19. Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the Blackfoot watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Portneuf Watershed—In the Portneuf watershed (outside of the Fort Hall Indian Reservation boundary), Yellowstone cutthroat trout were present in 65% of sites sampled (Figure 2-20). Nonnative salmonids occurred at 26 locations, 21 of which were in sympatry with cutthroat trout. In the Portneuf watershed, 27 populations were classified as core, 8 as conservation, 4 as mixed, and 9 as hybrid (Table 2-10). Sites with cutthroat trout tended to be wider and lower in elevation and tended to have more upright vegetation than sites without cutthroat trout. Cutthroat trout presence was also associated with public landownership, a higher percentage of cobble-boulder substrate, and higher stream order (Table 2-18 and Table 2-19). Using these variables in a logistic regression model, 63% of the variation in cutthroat trout occurrence was explained (Table 2-19).

Table 2-10. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the Portneuf watershed in the Upper Snake subbasin. Density of rainbow trout (RBT) <100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Bell Marsh Creek	Core		1	2		
Big Springs Creek	Conservation	1				
East Bob Smith Creek	Core		2			
Gibson Jack Creek	Core		1			
Gibson Jack Creek	Hybrid			2		Normal–1
Goodenough Creek	Core		1	1		
Harkness Creek	Core			1		
Inman Creek	Core		2	1		
Marsh Creek	Core			1		
Middle Fork Toponce Creek	Conservation		2			
	Hybrid		2			Normal–1
Mink Creek	Mixing		1			
North Fork Pebble Creek	Core		1			
North Fork Rapid Creek	Core	1	1			
Pebble Creek	Conservation	2				Normal–1
	Core	1				
Portneuf River	Hybrid			2		
Rapid Creek	Mixing	1		1		
Right Hand Fork Marsh Creek	Core			1		
Robbers Roost Creek	Core		1	1		
South Fork Toponce Creek	Conservation	2				
	Core		1			
	Hybrid			1		
	Mixing			1		
Toponce Creek	Core			1		
	Hybrid			1		

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Walker Creek	Core			2		
Webb Creek	Conservation		1			
	Core			1		
	Hybrid			1		
West Fork Mink Creek	Core		1	1		

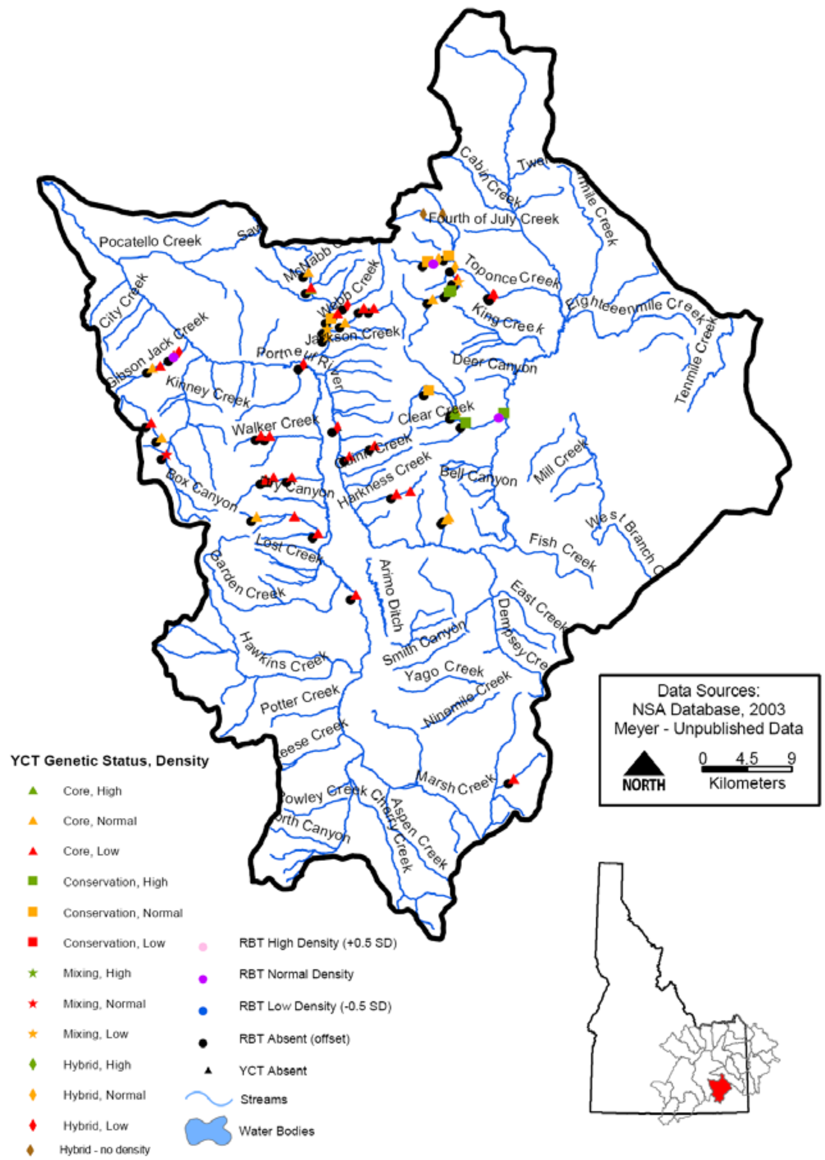

Figure 2-20. **Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the Portneuf watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.**

American Falls Watershed—The American Falls watershed was historically Yellowstone cutthroat trout habitat. Currently, rainbow trout is the dominant trout in this watershed. Three populations (outside of reservation boundaries) were identified as core populations (Table 2-11 and Figure 2-21).

Table 2-11. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the American Falls watershed in the Upper Snake subbasin. Density of rainbow trout (RBT) < 100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Crystal Creek	Core		1			
Midnight Creek	Core	2				

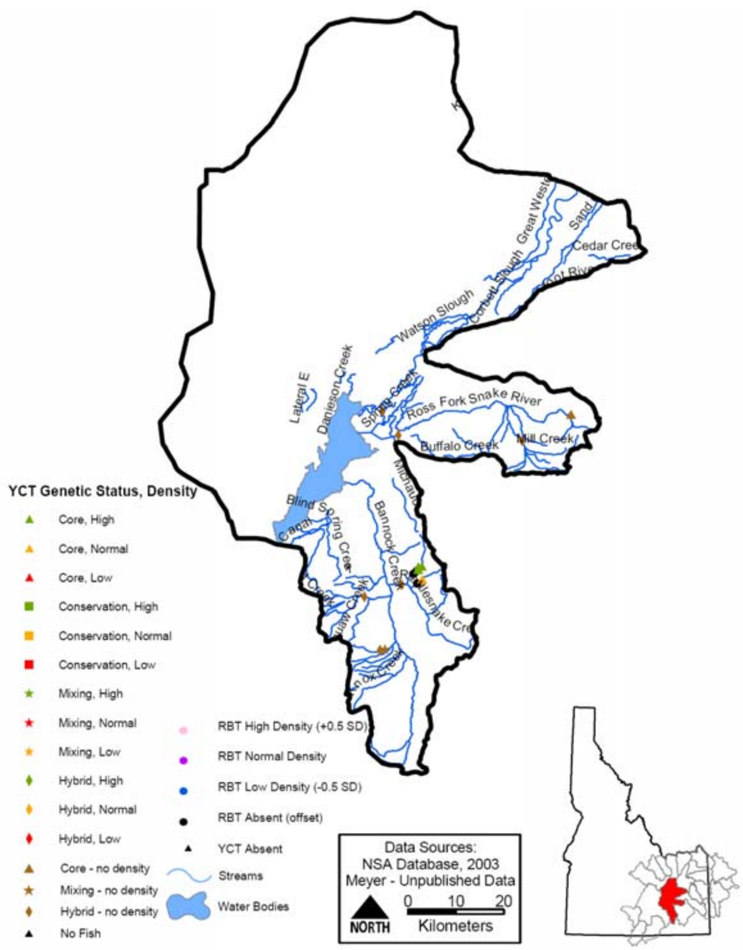

Figure 2-21. Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the American Falls watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Lake Walcott Watershed—Waters within the Lake Walcott watershed were historically Yellowstone cutthroat trout habitat. Currently, rainbow trout are the dominant salmonid in the drainage, and only one hybrid population of Yellowstone cutthroat trout was identified (Table 2-12 and Figure 2-22).

Table 2-12. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the American Falls watershed in the Upper Snake subbasin. Density of rainbow trout (RBT) <100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
East Fork Rock Creek	Hybrid			1		Normal–1

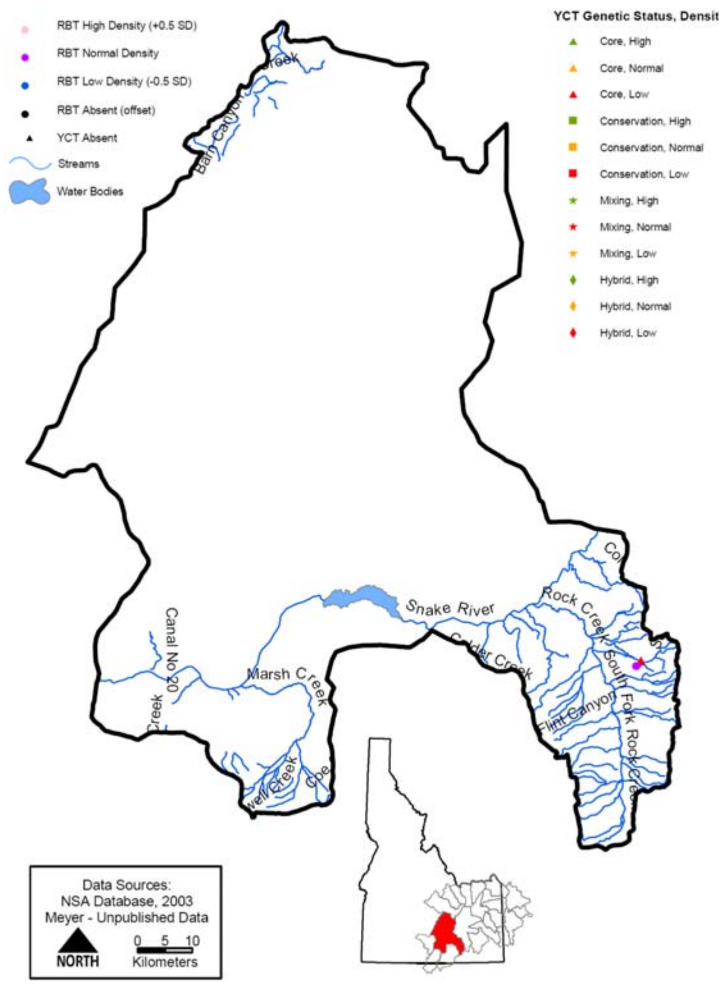

Figure 2-22. Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the Lake Walcott watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Raft Watershed—Yellowstone cutthroat trout were present in 61% of sites sampled in the Raft watershed (Figure 2-23). Nonnative salmonids occurred in 39 sites and were in sympatry with cutthroat trout at 22 locations. In the Raft watershed, 32 populations were classified as core, 1 as conservation, and 5 as hybrid (Table 2-13). Higher elevations, more upright vegetation, and unstable banks were positively related and stream gradient and fine substrate were negatively related to cutthroat trout occurrence (Table 2-18 and Table 2-19), but these variables explained only 35% of the variation in cutthroat trout occurrence in the logistic regression model (Table 2-19).

Table 2-13. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the Raft watershed in the Upper Snake subbasin. Density of rainbow trout (RBT) < 100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Almo Creek	Core		1			
Basin Creek	Core		2	1		
Cassia Creek	Core	1		2		
	Hybrid			2		
Clear Creek	Absent				2	Normal–2
	Core		1			
Clyde Creek	Conservation		1			
	Core		2			
Cottonwood Creek	Core		1			
	Hybrid		1			
Cross Creek	Core			1		
Dry Creek	Core			2		
Edwards Creek	Core		1			
Eightmile Canyon	Core	1				
Fall Creek	Absent				1	High–1
Flat Canyon Creek	Core		1	1		
George Creek	Core	1				
George Creek	Hybrid		1	1		Normal–1
Grape Creek	Core		1			
Green Creek	Core			1		
Johnson Creek	Core		1	1		
Lake Fork	Absent				2	High–1
Left Fork Johnson Creek	Core	1				
Mahogany Creek	Core		1			
New Canyon Creek	Core		2			
North Fork Sublett Creek	Absent				2	Normal–2

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Rosevere Fork of Clear Creek	Absent				1	Normal–1
Sawmill Canyon Fork of One Mile Creek	Core		1			
Sixmile Creek	Absent				1	
South Fork Sublett Creek	Absent				1	
South Junction Creek	Core			2		
Stinson Creek	Core	1				
Wildcat Creek	Core			1		

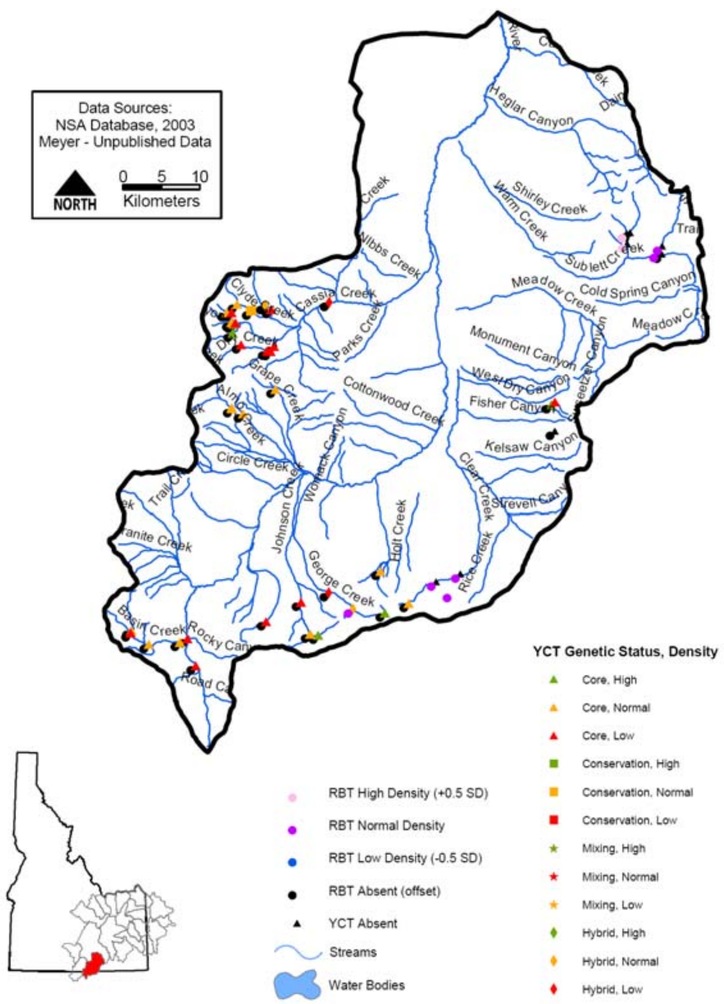

Figure 2-23. Distribution of sampling locations for Yellowstone cutthroat trout in the Raft watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Goose Watershed—In the Goose watershed, Yellowstone cutthroat trout occurred in 47% of sites sampled (Figure 2-24). Nonnative salmonids occurred at 24 sites, 7 of which also contained cutthroat trout. In the Goose watershed, 21 populations were classified as core, 1 as conservation, and 3 as hybrid (Table 2-14). Cutthroat trout were more often found in wider, higher-elevation streams with public landownership, more stream shading, and more upright vegetation but with lower gradients and lower levels of gravel substrate (Table 2-18 and Table 2-19). The inclusion of these variables in a logistic regression model explained 68% of the variation in cutthroat trout occurrence (Table 2-19).

Table 2-14. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the Goose watershed in the Upper Snake subbasin. Density of rainbow trout (RBT) < 100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Big Cottonwood Creek	Core	5	1	2		
	Hybrid			1		
Birch Creek	Absent				1	
Cold Creek	Absent				1	
Ecklund Creek	Core	1	2			
Goose Creek	Core		2	4		
	Hybrid			1		
Little Cottonwood Creek	Absent				1	
Sawmill Creek	Core	2	1			
Squaw Creek	Absent				3	
Thoroughbred Creek	Core			1		
Trapper Creek	Absent				4	High–1, Low–1
Trout Creek	Conservation		1			
	Hybrid			1		
Willow Creek	Absent				1	Normal–1

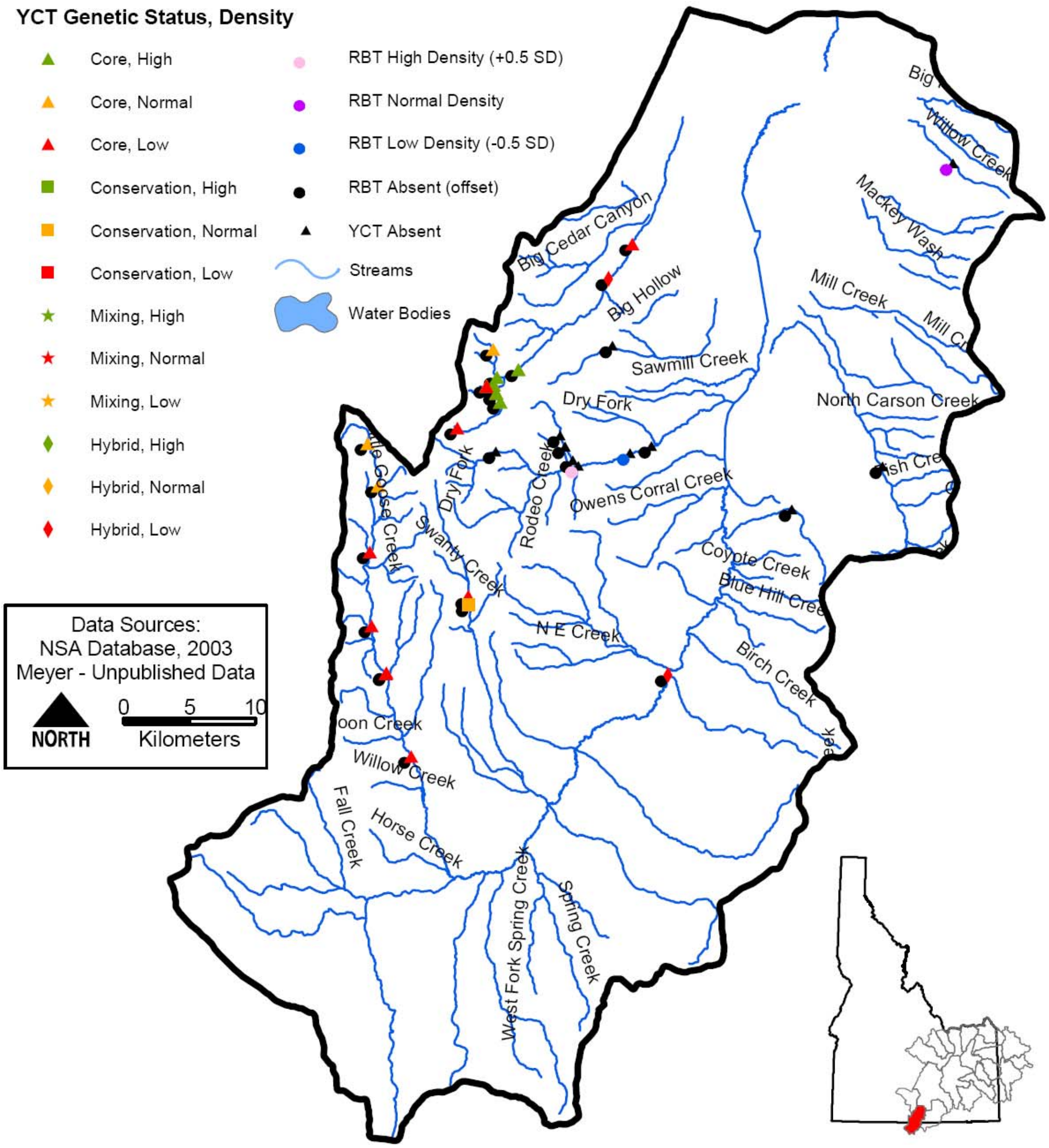

Figure 2-24. Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the Goose watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Upper Snake–Rock Watershed—In the Upper Snake–Rock watershed, 3 populations were classified as core (Table 2-15 and Figure 2-25).

Table 2-15. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the Upper Snake–Rock watershed in the Upper Snake subbasin. Density of rainbow trout (RBT) < 100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Dry Creek	Core		1			
East Fork Dry Creek	Core			2		

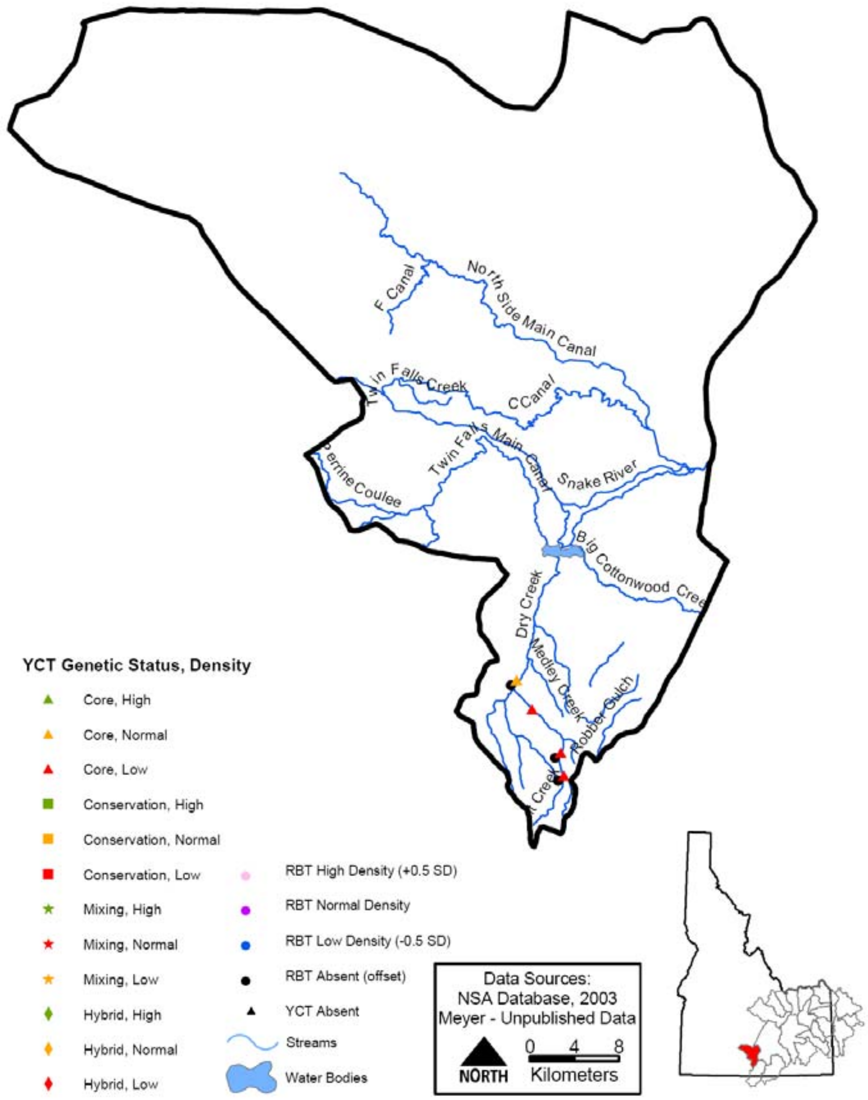

Figure 2-25. Distribution of sampling locations with known introgression status of Yellowstone cutthroat trout (YCT) in the Upper Snake–Rock watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Snake Headwaters Subbasin

Palisades Watershed—Yellowstone cutthroat trout occurred in 91% of sites sampled. Nonnative salmonids were detected in 23 sites, 15 of which contained rainbow trout or hybrids. In this watershed, 71 populations were classified as core populations (Table 2-16 and Figure 2-26). Distribution was too pervasive within the drainage for meaningful conclusions to be drawn about factors related to cutthroat trout occurrence.

Table 2-16. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the Palisades watershed in the Snake Headwaters subbasin. Density of rainbow trout (RBT) < 100 mm is listed as an index of further introgression risk.

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Barnes Creek	Core		2			
Bear Creek	Core	1	2	1		
Big Elk Creek	Core	1	1			
Bilk Creek	Core			1		
Bitters Creek	Core			2		
Black Canyon	Core		1			
Burns Canyon	Conservation		1			
	Mixing	1				Normal–1
Camp Creek	Core		1			
City Creek	Core			2		
Clear Creek	Core		1	1		
Comb Creek	Core		1			
Corral Canyon	Core		2			
Corral Creek	Core			1		
Deadman Canyon	Core		1			
Dry Canyon	Core			1		
East Fork Palisades Creek	Core	2	1			
Elk Creek	Core	1	2			
Elk Flat Fork	Core			2		
Fall Creek	Core	1	1			
Fish Creek	Core	1	1	1		
Garden Creek	Core		2	1		
Iowa Creek	Core	1	2			
Jensen Creek	Core	1				
McCoy Creek	Core	2	1			
North Fork Palisades Creek	Core	2		1		
North Fork Pine Creek	Conservation	1				
	Core	1		1		
North Fork Rainey Creek	Core	1	1			

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Palisades Creek	Core	3				
Pine Creek	Conservation	3				
	Core	1				
Pole Creek	Core			2		
Pritchard Creek	Absent				1	
	Hybrid			2		
Rainey Creek	Conservation		1			
	Core		2			
South Fork Rainey Creek	Conservation		1			
	Core		2			
Spring Creek	Core			1		
Table Rock Canyon	Core			1		
Trout Creek	Core			1		
Unknown tributary to McCoy Creek	Core			1		
Unknown tributary to North Fork Bear Creek	Core		1	1		
West Pine Creek	Conservation		1			
	Core		1			
Williams Creek	Core		1			

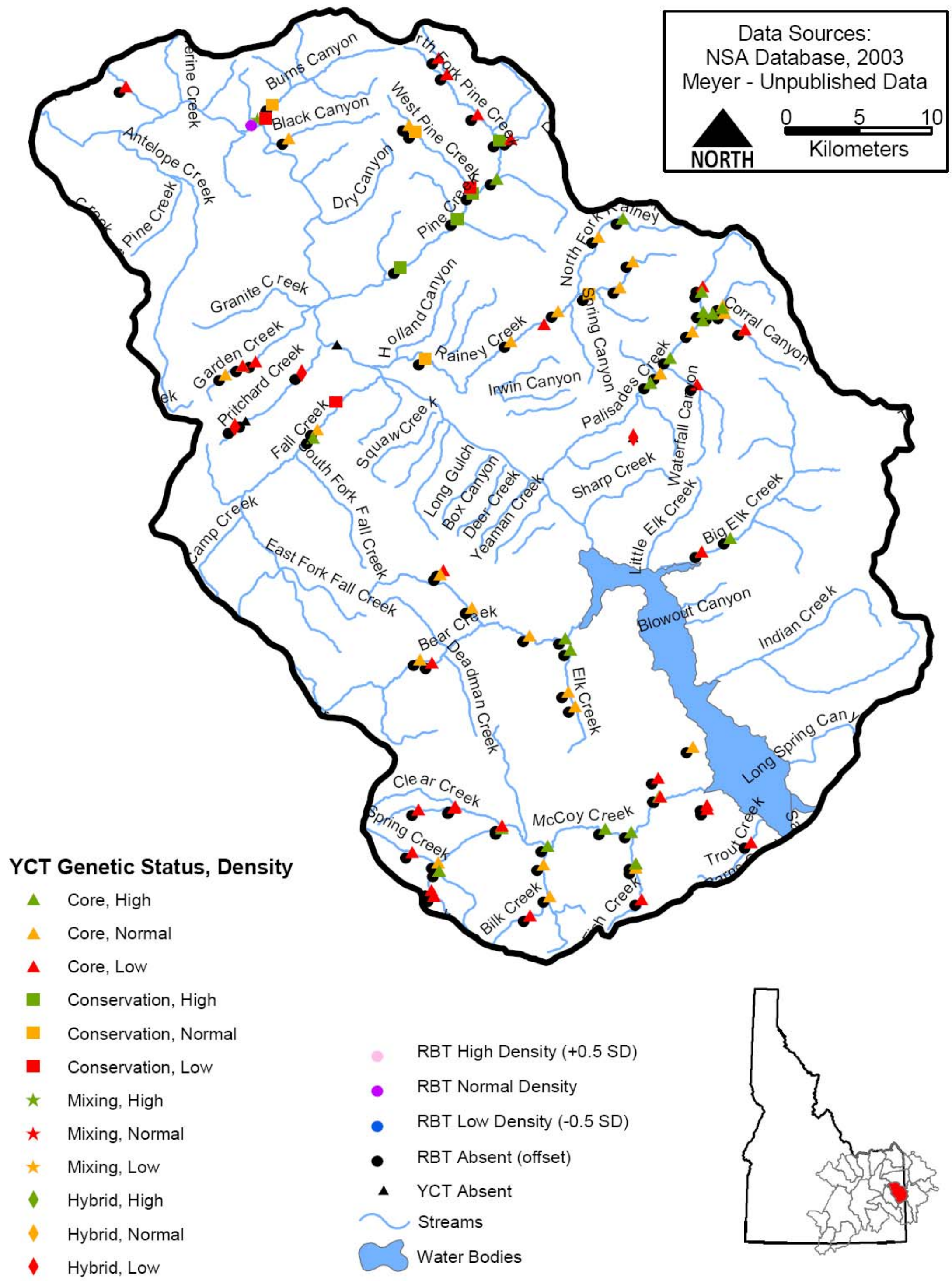

Figure 2-26. Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the Palisades watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Salt Watershed—Information on Yellowstone cutthroat trout populations in the Salt watershed was supplemented with data from D. Isaak (2001). In the Salt watershed, Yellowstone cutthroat trout were widely distributed (Figure 2-x), and 107 populations were classified as core, with 1 classified as a mixed population (Table 2-17).

Table 2-17. Introgression and population status of Yellowstone cutthroat trout (YCT) for sampling locations in the Salt watershed in the Snake Headwaters subbasin. Density of rainbow trout (RBT) < 100 mm is listed as an index of further introgression risk (Dan Isaak, unpublished data).

Stream Name	Introgression Status	YCT Density				RBT Density
		High	Normal	Low	None	
Bear Canyon	Core	1				
Boulder Creek	Core	1	1			
Burns Creek	Core			2		
Cottonwood Creek	Core	2	3	1		
Crow Creek	Core	1	1	5		
Deer Creek	Core	1		4		
Dry Creek	Core			9		
Fish Creek	Core		2			
Horse Creek	Core	1	2	2		
Jackknife Creek	Core	1	7	3		
Nom Creek	Core			1		
North Fork Willow Creek	Core			1		
Rock Creek	Core		1	1		
Sage Creek	Core		1	3		
Salt River	Core	1	2	5		
South Fork Tincup Creek	Core	3				
	Mixing			1		
Spring Creek	Core	3	3	1		
Squaw Creek	Core	1	2			
Stump Creek	Core	1	2	5		
Timber Creek	Core		1			
Tincup Creek	Core	1	8	2		
Trail Creek	Core		1			
Wagner Creek	Core			1		
White Dugway Creek	Core			3		
Willow Creek	Core	1	2			

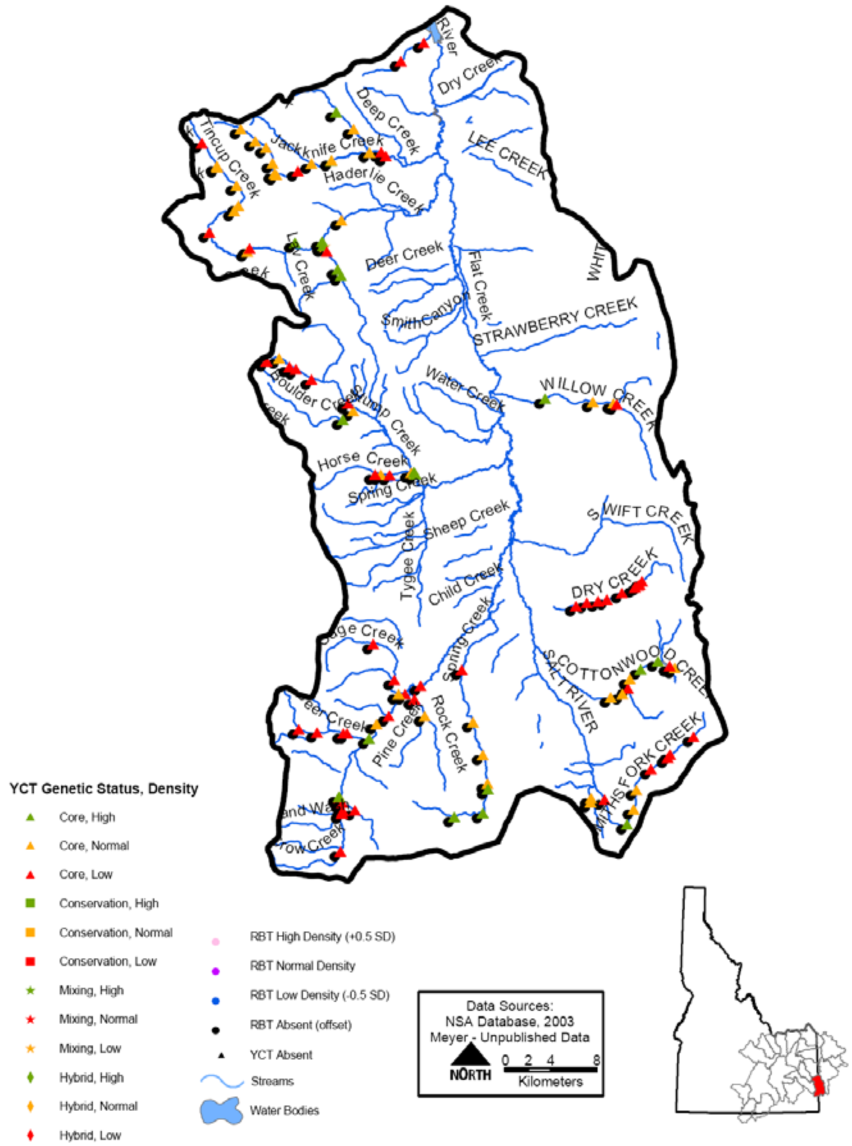

Figure 2-27. Distribution of sampling locations for Yellowstone cutthroat trout (YCT) in the Salt watershed. Rainbow trout (RBT) density < 100 mm is plotted as an index of further introgression risk.

Greys–Hoback Watershed—Yellowstone cutthroat trout are considered common and abundant in the Hoback River basin (WGFD 2004). No rainbow trout or hybrids are known to be present in this watershed.

Gros Ventre Watershed—Yellowstone cutthroat trout are considered abundant in the Gros Ventre River, while rainbow trout are considered common and hybrids are considered rare (WGFD 2004).

Snake Headwaters Watershed—In the Snake Headwaters watershed, Yellowstone cutthroat trout are considered abundant, while rainbow trout are considered rare and hybrids were not classified (WGFD 2004).

Table 2-18. Mean values of stream characteristics in study sites with and without Yellowstone cutthroat trout within several river drainages in the Upper Snake subbasin, Idaho. Bold italics within each river drainage indicate variables that were subsequently included in logistic regression models (Meyer and Lamansky 2003).

	Teton River (n = 64)		Willow Creek (n = 32)		Blackfoot River (n = 61)		Portneuf River (n = 63)		Raft River (n = 64)		Goose Creek (n = 57)	
Variables	Absent	Present	Absent	Present	Absent	Present	Absent	Present	Absent	Present	Absent	Present
n	26	38	12	20	22	39	22	41	25	39	30	27
Stream order	1.6	1.9	***1.3***	***2.2***	***2.6***	***2.0***	***1.5***	***1.9***	2.0	2.0	1.9	2.3
Dominant riparian vegetation rating	3.2	3.2	2.7	2.7	2.3	2.6	***2.6***	***3.4***	***2.5***	***2.9***	***2.7***	***3.6***
Gradient (%)	3.8	3.0	3.5	2.2	***1.5***	***1.9***	3.1	3.7	***4.0***	***3.9***	***5.3***	***3.1***
Stream width (m)	2.4	3.2	***1.5***	***2.2***	***2.7***	***2.7***	***1.8***	***2.8***	2.1	2.3	***1.9***	***2.7***
Fines substrate rating	***2.1***	***1.9***	3.5	3.4	***3.9***	***2.3***	3.0	1.6	***2.3***	***1.7***	1.8	2.1
Gravel substrate rating	2.8	2.6	***1.5***	***2.1***	***1.5***	***2.7***	2.3	2.6	***2.8***	***3.1***	***3.2***	***3.0***
Coble/Boulder substrate rating	1.3	1.5	0.6	0.6	***0.7***	***0.9***	***0.5***	***1.8***	1.1	1.6	1.3	1.5
Stream shading rating	1.8	1.5	2.0	1.7	1.2	1.4	2.7	2.7	1.9	2.3	***2.0***	***2.6***
Bank stability rating	0.6	0.7	***0.5***	***1.5***	2.2	1.2	1.0	1.1	1.3	1.3	1.3	0.9
% Private property	27	29	***75***	***45***	***36***	***33***	***50***	***32***	24	33	***27***	***4***
% Exotic salmonids present	***58***	***87***	17	15	18	49	23	51	68	56	57	26
Elevation (m)	***6607***	***6432***	6364	6349	6129	6370	***5552***	***5458***	***5860***	***6263***	***5582***	***6277***

Table 2-19. Summary of variables included in logistic regression models relating stream characteristics to the occurrence of Yellowstone cutthroat trout in the Upper Snake subbasin, Idaho. Up and down arrows indicate direct or indirect relationships between stream attributes and cutthroat trout presence, respectively (Meyer and Lamansky 2003).

	Teton River	Willow Creek	Blackfoot River	Portneuf River	Raft River	Goose Creek
Variables in model	Exotic salmonids ↑	Land ownership ↑	Stream order ↓	Elevation ↓	Gradient ↓	Elevation ↑
	Elevation ↓	Unstable banks ↑	Land ownership ↑	Land ownership ↑	Fines substrate ↓	Gradient ↓
	Fines substrate ↓	Stream order ↑	Fines substrate ↓	Cobble/boulder substrate ↑	Elevation ↑	Riparian vegetation ↑
		Gravel substrate ↑	Gradient ↑	Stream width ↑	Riparian vegetation ↑	Gravel substrate ↓
		Stream width ↑	Stream width ↑	Stream order ↑	Unstable banks ↑	Stream shading ↑
			Cobble/boulder substrate ↑	Riparian vegetation ↑		Stream width ↑
			Gravel substrate ↑			Land ownership ↑
Model output						
AIC	82.8	26.9	52.5	39.2	69.9	30
n	64	32	61	63	64	56
R^2	0.17	0.58	0.51	0.63	0.35	0.68

Artificial Propagation

Between 1899 and 1957, Yellowstone cutthroat trout eggs were collected at Yellowstone Lake (Gresswell and Varley 1988). Today, hatchery propagation of Yellowstone cutthroat trout is carried out in Idaho (Henrys Lake stock, Henrys Lake Fish Hatchery), Wyoming (South Paintrock Creek stock, U.S. Fish and Wildlife Service National Fish Hatchery at Jackson, WY), and Montana (McBride Lake stock) (Behnke 1992).

2.2.1.2 Bull Trout (Salvelinus confluentus)

2.2.1.2.1 Conservation Status

Bull trout (*Salvelinus confluentus*, [Suckley, 1858]) were listed under the ESA as threatened on November 1, 1999 (64 FR 58910). Earlier rulemakings had listed distinct population segments of bull trout as threatened in the Columbia, Klamath, and Jarbidge river basins (63 FR 31647, 63 FR 42747, 64 FR 17100). The Bull Trout Recovery Team developed a draft recovery plan that provided a framework for implementing recovery actions for the species. This draft recovery plan was also used as the principal basis for identifying critical habitat for species. The proposed designation of critical habitat was published on November 29, 2002 (67 FR 71236) and includes streams within the Upper Snake province.

2.2.1.2.2 Life History

Bull trout exhibit a number of life history strategies. They spawn more than once (i.e., iteroparious life history), and some may spawn in alternate years. Stream-resident bull trout complete their entire life cycle in the tributary streams where they spawn and rear. Migratory bull trout spawn in tributary streams where juvenile fish usually rear from one to four years before migrating to either a larger river (i.e., fluvial) or lake (i.e., adfluvial) where they spend their adult life, returning to the tributary stream to spawn (Fraley and Shepard 1989). Resident and migratory forms may be found together, and either form can produce resident or migratory offspring (Rieman and McIntyre 1993).

The size and age of bull trout are variable depending on life history strategy. Resident bull trout tend to be small, averaging 20 cm (8 inches) long and rarely exceeding 30 cm (12 inches). Adults that migrate to larger downstream rivers average about 40 cm and often exceed 61 cm (24 inches) (Goetz 1989). Maximum sizes are reached in large lakes and reservoirs, where adults can grow to over 69 cm (27 inches) long and 10 kg (22 lbs.) in weight (McPhail and Baxter 1996). Under appropriate conditions, bull trout regularly live to 10 years and, under exceptional circumstances, reach ages in excess of 20 years (Fraley and Shepard 1989, McPhail and Baxter 1996). Bull trout normally reach sexual maturity in 4 to 7 years.

The preferred spawning habitat of bull trout consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989). Bull trout typically spawn from August to November during periods of decreasing water temperatures (Swanberg 1997). However, migratory forms are known to begin spawning migrations as early as April and to move upstream as far as 250 km to spawning areas (Fraley and Shepard 1989, Swanberg 1997).

Depending on water temperature, egg incubation is normally 100 to 145 days (Pratt 1992). Water temperatures of 1.2 to 5.4 °C (34.2–41.4 ºF) have been reported for incubation, with an optimum (i.e., best embryo survivorship) temperature reported to be from 2 to 4 °C (36–39 ºF) (Fraley and Shepard 1989, McPhail and Baxter 1996).

Juveniles remain in the substrate after hatching, and the time from egg deposition to emergence of fry can exceed 200 days. During the relatively long incubation period in the gravel, bull trout eggs are especially vulnerable to fine sediments and water quality degradation (Fraley and Shepard 1989). Increases in fine sediment appear to reduce egg survival and emergence (Pratt 1992). High juvenile densities have been reported in areas characterized by a diverse cobble substrate and a low percentage of fine sediments (Shepard *et al.* 1984).

Bull trout are opportunistic feeders, with food habits that are primarily a function of size and life history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro-zooplankton, and small fish (Donald and Alger 1993, McPhail and Baxter 1996). Adult migratory bull trout feed almost exclusively on other fish (Rieman and McIntyre 1993).

2.2.1.2.3 Population Trends and Distribution

Information on distribution and abundance was taken from the Bull Trout Recovery Plan, Little Lost River Chapter (USFWS2002) as it contains the most comprehensive information on populations of bull trout available at the time of the assessment. Bull trout distribution within the recovery unit is based largely on presence-absence surveys and basinwide surveys that used electrofishing and snorkeling techniques. Surveys conducted from 1992 through 1999 indicate that bull trout have a wide, but fragmented, distribution in the Little Lost River watershed (Figure 2-28). Bull trout occupy approximately 164 km (101.9 miles) of streams and are the only salmonid present in approximately 32 km (19.8 miles) of streams (Gamett 1999). Bull trout occur in the following streams: the upper reach of Badger Creek, upper reach of Big Creek, lower reach of Bunting Canyon Creek, lower reach of Camp Creek, Firebox Creek, Hawley Creek, Iron Creek, Jackson Creek, middle and upper reaches of the mainstem Little Lost River (including Sawmill Creek), Mill Creek, Quigley Creek, Redrock Creek, Smithie Fork, an unnamed tributary to Smithie Fork, Summit Creek, Timber Creek, Squaw Creek (Sawmill Canyon), North Fork Squaw Creek, lower reach of Slide Creek, upper reach of Warm Creek, Wet Creek (except for the middle section), and Williams Creek.

Bull trout were previously observed in some reaches and streams where they were not detected in recent surveys (1992 through 1999). Bull trout were found in the lower reach of the Little Lost River near Howe in 1983 (Corsi *et al*. 1986), which was prior to annual dewatering of the reach that began in 1985, indicating that bull trout probably occupied all reaches of the river. Bull trout were not found in the reach in 1987 (Corsi and Elle 1989) or more recently (Gamett 1999). Bull trout were reported from Big Springs Creek in 1977 (Gamett 1999), lower Squaw Creek (Wet Creek drainage) in 1987 (Corsi and Elle 1989), and Dry Creek during the 1920s and 1960s (Gamett 1999). However, bull trout were not collected in these streams during surveys conducted in the 1990s (Gamett 1999). Because bull trout may exhibit a patchy distribution within a stream, detecting them may be difficult, even with relatively intensive sampling efforts (Gamett 1999).

Abundance of bull trout (expressed as density, or the number of individuals per kilometer of stream) has declined in some areas of the Little Lost River and its tributaries. In the reach of the Little Lost River from the confluence of Summit Creek upstream to the National Forest boundary, bull trout density declined 91% between 1984 and 1993 (Table 2-20) (Gamett 1999). In the reach of the river between the National Forest boundary upstream to the confluence of Smithie Fork, bull trout density declined 62% between 1987 and 1995. Bull trout densities were higher in later surveys of both reaches (Table 2-20), a finding that suggests that bull trout declines were probably related to low water levels and associated high temperatures due to drought, degraded habitat conditions downstream of Warm Creek, and angler harvest.

Bull trout abundance has declined in other tributaries of the Little Lost River watershed. According to personal communications with local residents, relatively large bull trout (300 to 500 mm [11.8–19.7 inches]) were caught by anglers during the 1940s through the 1960s in Big Creek, a tributary in the Wet Creek drainage (Gamett 1999). Bull trout were also reported in 2 of 7 years of creel census data collected from 1969 through 1979 (6 and 16% of all species in 1974 and 1977, respectively). In 1978, brook trout were introduced in Big Creek.

Table 2-20. Estimated densities (individuals per stream kilometer) of rainbow trout, brook trout, bull trout, and all species combined for two reaches of the Little Lost River from surveys conducted in the 1980s and 1990s (Garnett 1999).

Sample Date	Rainbow Trout	Brook Trout	Bull Trout	Species Combined
Little Lost River—Summit Creek upstream to National Forest boundary				
October 1984	713	27	45	245
July 1985	83	32	61	176
July 1986	123	21	45	189
July 1987	150	52	24	226
August 1993	203	20	4	227
July 1997	208	16	21	245
Little Lost River–National Forest boundary upstream to Smithie Fork Creek				
July 1987	423	90	162	675
August–September 1995	499	33	62	594
July 1997	366	74	87	527

Gamett (1999) noted that five sites were sampled in Big Creek during 1992 through 1997, and bull trout were collected at two sites. At these two sites, 2% and 6% of all trout collected were bull trout (2 bull trout and an apparent hybrid at one site; 7 apparent hybrids at the other), whereas 38% and 77% of all trout were brook trout. In 1999, no bull trout were collected at two other sites (USFS 1999). Presumed declines of bull trout in Big Creek are probably associated with brook trout interactions, and similar declines are probably occurring in Mill Creek and lower Squaw Creek (Sawmill Canyon). Sampling in Wet Creek during 2001 suggests that adult bull trout have undergone substantial declines in abundance.

Both resident and migratory (fluvial) bull trout exist in the Little Lost River Recovery Unit. Bull trout in the Little Lost River below Iron Creek road are fluvial and migrate to headwater streams to spawn. The smallest bull trout captured in the Little Lost River downstream of Iron Creek Road (10 sampling sites) was 151 mm (5.1 inches) in total length (Gamett 1999). In 1987, Corsi and Elle (1989) found that age 1 and age 2 bull trout in the

Little Lost River watershed were 99 mm (3.4 inches) and 155 mm (5.3 inches) long, respectively. Data collected downstream of the National Forest boundary (Corsi *et al*. 1986, Corsi and Elle 1986, Elle *et al*. 1987, Corsi and Elle 1989) indicate a lack of small bull trout in the Little Lost River downstream of this point. This lack of young-of-the-year and age 1 bull trout in this area of the Little Lost River indicates that bull trout are spawning and rearing elsewhere.

The primary spawning areas for fluvial bull trout appear to be tributary streams in Sawmill Canyon. Bull trout over 300 mm (11.8 inches) long were observed in many streams of Sawmill Canyon during the spawning period in July, August, and September (Corsi and Elle 1989, Gamett 1999), indicating that these fish may be migratory. If so, fluvial bull trout may be migrating over 30 km (18.6 miles) to spawn, and historically, bull trout may have migrated the length of the Little Lost River, over 80 km (49.7 miles). High densities of young bull trout in Smithie Fork, the Little Lost River upstream of Smithie Fork, and Firebox Creek suggest that these streams are the most important spawning and rearing tributaries for fluvial bull trout. In 1995, bull trout densities (fish > 70 mm [2.8 inches]) were 30.3 fish per 100 square meters (2.8 fish/100 ft^2) in Smithie Fork and 20.4 fish per 100 square meters (1.9 fish/100 ft^2) in the Little Lost River upstream of Smithie Fork (Gamett 1999).

Relatively large bull trout have been observed in Wet Creek and in Big Creek, a tributary of Wet Creek, suggesting that these fish were fluvial (Gamett 1999). Bull trout up to 430 mm (16.9 inches) long have been recorded by electrofishing and creel surveys in Big Creek. Relatively large fish, up to 635 mm (25.0 inches) long and 3.9 kg (8.6 pounds) in weight and that appeared to be bull trout × brook trout hybrids, have been collected by electrofishing and angling in and around a beaver pond near the head of Big Creek. In July 1996, snorkelers observed bull trout over 300 mm (11.8 inches) long in Wet Creek in the beaver ponds immediately below Hilts Creek. The large size of these fish in relation to the size of Little Lost/Wet Creek suggests that they were fluvial fish that migrated into these areas to spawn. For both Big Creek and Wet Creek, bull trout were probably migrating from lower Wet Creek and possibly from the Little Lost River. Length frequency data suggest that bull trout in Wet Creek above the falls that are located 0.8 km (0.5 miles) above Hilts Creek are resident fish. The old diversion structure, falls, and cascades at this point are probably a barrier to upstream fish movement.

There is insufficient data to determine whether migratory bull trout occur in Mill Creek, Quigley Creek, Squaw Creek (Sawmill Canyon), Slide Creek, North Fork Squaw Creek, Warm Creek, or Badger Creek (Garnett 1999). Data on length frequency and length at sexual maturity suggest that bull trout in upper Squaw Creek (Sawmill Canyon) are resident fish. It is likely that fluvial bull trout from the Little Lost River historically used all of these streams for spawning and rearing. However, the bull trout currently found in these streams may be only remnants of a former fluvial population that has reverted to residency. In addition, resident fish may be sympatric with fluvial fish in streams such as Smithie Fork (Gamett 1999).

In the past, fluvial bull trout probably migrated into Williams Creek, but bull trout there now are residents (Gamett 1999). Since the late 1800s, Williams Creek has been permanently diverted for irrigation, and flow does not reach the Little Lost River. Therefore, bull trout inhabiting Williams Creek are completely isolated from fish in other portions of the Little Lost River watershed.

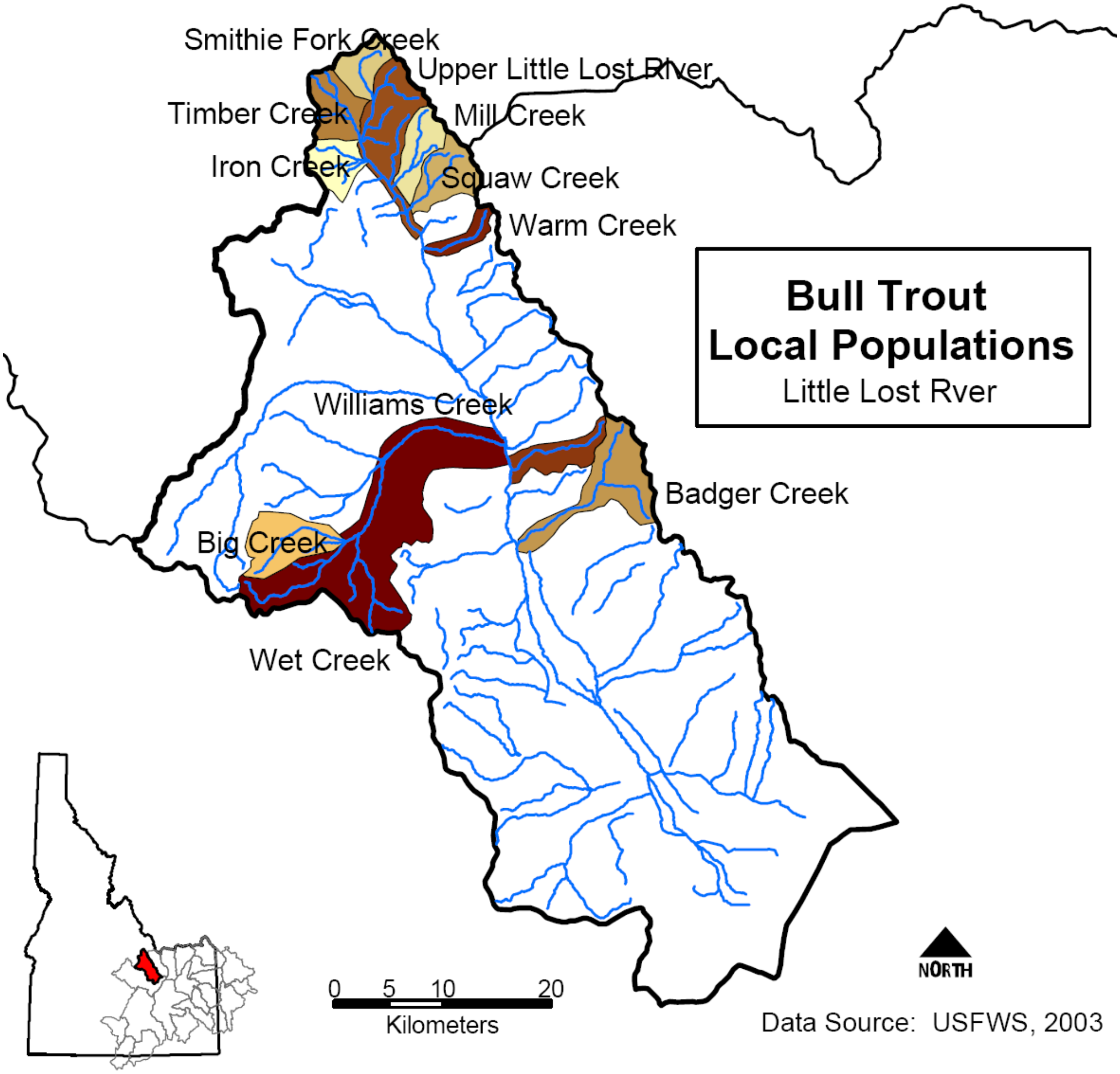

Figure 2-28. Bull trout populations in the Little Lost River watershed in the Closed Basin subbasin of the Upper Snake province.

2.2.1.3 Mountain Whitefish (*Prosopium williamsoni*)

2.2.1.3.1 Conservation Status

The mountain whitefish is widely distributed throughout the western United States and considered abundant throughout all major river drainages in Idaho (Simpson and Wallace 1982).

2.2.1.3.2 Life History

The preferred habitat of mountain whitefish is cold mountain streams (Simpson and Wallace 1982), where they are found predominantly in riffle areas during summer and deep pools during winter (Wydoski and Whitney 1979). Mountain whitefish mature at about 3 years of age. They are fall spawners, typically spawning in riffle areas during late October or early November when water temperatures range between 40 and 45 °F; in some instances, spawning is known to occur along gravel shores in lakes or reservoirs. Eggs are adhesive and stick to the substrate following spawning. Hatching occurs in March (Simpson and Wallace 1982).

Mountain whitefish spend much of their time near the bottom of streams and feed mainly on aquatic insect larvae (AFS 2000). Mountain whitefish also feed on terrestrial insects on the surface and on fish eggs (Simpson and Wallace 1982). Although growth is variable, most mountain whitefish in Idaho are typically 3 to 4 inches at the end of their first year and 6 to 7 inches after 2 years (Simpson and Wallace 1982).

2.2.1.3.3 Population Trends and Distribution

A native fish species, the mountain whitefish is probably the most widely distributed native fish species of the *Salmonidae* family found in Idaho. The species has persisted without population augmentation or special management. In many areas, mountain whitefish provide an important winter fishery because they feed more actively than most salmonids during this period.

Mountain whitefish in the Big Lost River watershed, a hydrologically isolated stream basin, are believed to have originated from the upper Snake River sometime during the last several million years. Previous work has shown that this population is genetically distinct from other mountain whitefish populations and may constitute an endemic subspecies. A study by Gamett *et al*. (2004) indicated that there has been a substantial decline in the distribution of mountain whitefish in the drainage. It is estimated that prior to the arrival of European settlers in the late 1860s, mountain whitefish occupied approximately 300 km of stream in the Big Lost River watershed. However, it appears that the fish now occupy only about 80 km of stream, indicating that distribution has decreased to approximately 27% of historic levels. Furthermore, in areas that are still occupied by the species, there appears to have been large declines in abundance. Major factors contributing to the declines appear to be dewatered streams, habitat fragmentation, flow alteration, habitat alteration, and drought.

2.2.1.4 Molluscs

The Snake River upstream from Shoshone Falls provides habitat for the two Snake River snails listed as threatened on January 13, 1993: the Utah valvata snail (*Valvata utahensis*) and Snake River physa snail (*Physa natricina*) (Figure 2-29). The Snake River physa snail can be regarded as riparian associates and are heavily affected by management of terrestrial riparian zones. The Utah valvata snail is generally a lake-dwelling species and exists in reservoirs and stream reaches with fine sediments. Most mollusc species that we considered for focal species status prefer relatively undisturbed cool and shaded streams, lakes, springs, seeps, or other permanent water habitats.

The Snake River ecosystem has undergone significant transformation from a primarily free-flowing, cold-water system to a slower-moving, warmer system. The habitat requirements for mollusc species generally include cold, clean, well oxygenated, flowing water of low turbidity. The Snake River molluscs are vulnerable to continued adverse habitat modification and deteriorating water quality from one or more of the following: hydroelectric development, load-following (the practice of artificially raising and lowering river levels to meet short-term electrical needs by hydroelectric projects) effects of hydroelectric project operations, water withdrawal and diversions, water pollution, inadequate regulatory mechanisms, and the possible adverse effects of invasive exotic species (such as the New Zealand mudsnail).

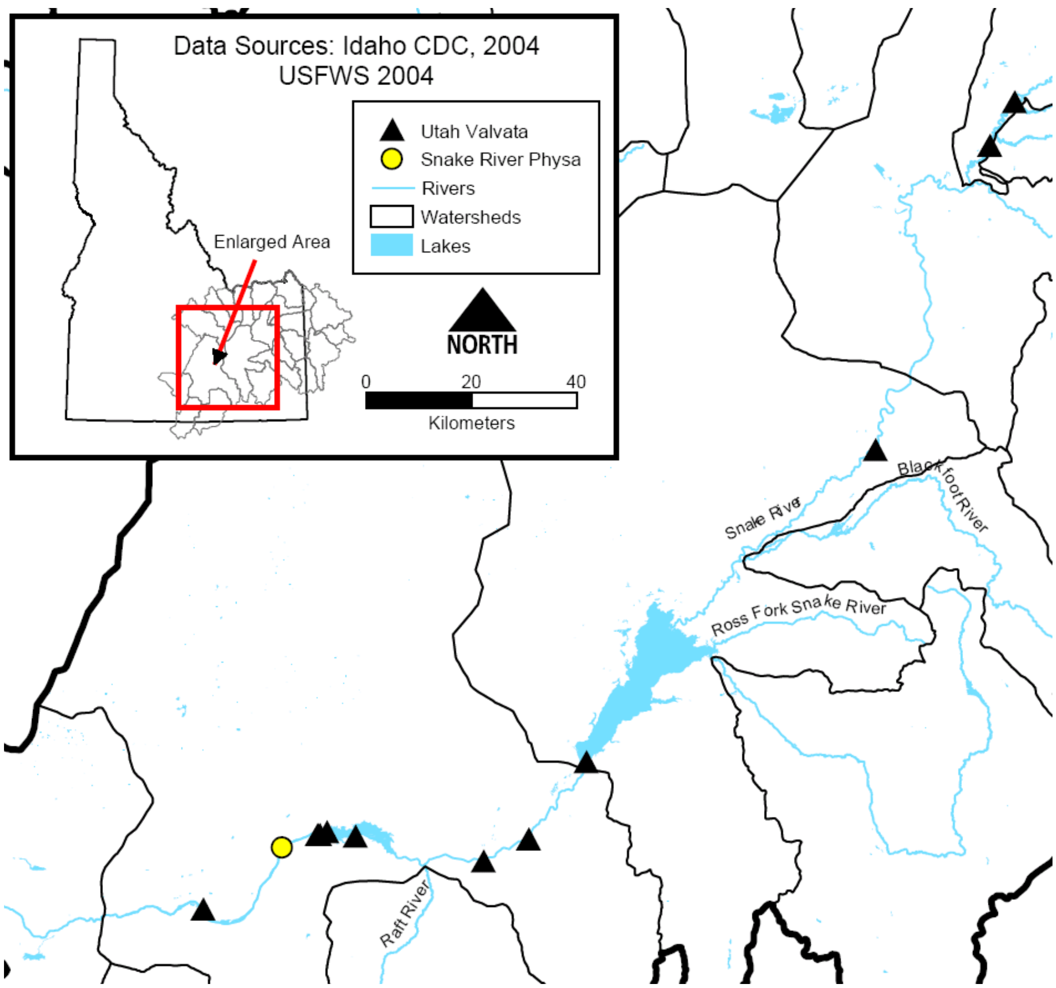

Figure 2-29. General locations where focal mollusc species are present in the Upper Snake province (IDCDC 2004). There are no distribution records for either the Idaho springsnail or the California floater. What does color difference mean? There is no legend.

The Snake River aquatic species recovery plan (USFWS 1995) identifies specific recovery areas and short-term recovery goals that will provide downlisting/delisting criteria for each of the five listed snail species. Actions needed to initiate recovery include:

- Ensure water quality standards for coldwater biota and habitat conditions so that viable, self-reproducing snail colonies are established in free-flowing mainstem and coldwater spring habitats within specified geographic ranges, or recovery areas, for each of the 5 species.

- Develop and implement habitat management plans that include conservation measures to protect coldwater spring habitats occupied by Banbury Springs limpet, *Lanx*, Bliss Rapids snail, and Utah valvata snail from further habitat degradation.

- Stabilize the Snake River Plain aquifer to protect discharge at levels necessary to conserve the listed species' coldwater spring habitats.

- Evaluate the effects of nonnative flora and fauna on listed species in the Snake River from C.J. Strike Dam to American Falls Dam.

2.2.1.4.1 Utah Valvata Snail (*Valvata utahensis*)

The Utah valvata snail, also known as the desert valvata, inhabits areas between sand, silt, and mud grains in shallow shoreline waters, pools adjacent to rapids, perennial flowing waters associated with large spring complexes, and reservoir habitats. The species avoids areas with heavy currents or rapids. This snail generally requires flowing water that is cold, clean, and well oxygenated. The snail prefers well-oxygenated areas of limestone mud or mud-sand substrate among beds of submergent aquatic vegetation. It is absent from pure gravel-boulder substrate.

The Utah valvata is primarily a detritivore, grazing along the mud surface ingesting diatoms or small plant debris. Common plant associates are *Chara*, *Elodea*, *Myriophyllum*, *Ceratophyllum*, and *Potamogeton* spp. (Frest and Johannes 1995). Other mollusc associates include *Physella gyrina*, *Valvata humeralis*, and *Fluminicola* spp. (Frest and Johannes 1995).

Free flowing, coldwater environments required by the Utah valvata snail have been altered by reservoir development, river diversions, and habitat modification. Water quality has deteriorated in the Snake River due to altered natural flow and pollution. Water quality and habitat conditions in the mainstem Snake River must be improved to begin to recover the snail. Additional studies are needed to address the temperature, substrate, and flow requirements.

The species historically occurred in the middle Snake River from about Weiser to American Falls. The species also occurred at sites in southeastern Idaho and at Utah Lake, Utah. The species appears to have been extirpated from most of its historical range.

In the mid-1990s, the Utah valvata snail was located in the upper Snake River, and in 2001, the species was found in the Big Wood River. It appears to be very abundant in the Snake River near the Payne boat ramp (D. Gustafson, personal communication, 2001), occurring with *Valvata humeralis* and *Fluminicola* spp. At the boat ramp, the river is lake-like and has few of its normal insects left. Further downstream at the Twin Bridges site at Blackfoot, *Valvata* and *Fluminicola* drop out and *Physella* and *Stagnicola* are abundant (D. Gustafson, personal communication, 2001). The species currently exists in disjunct populations from the

Thousand Springs complex upstream to Rexberg, Idaho, in the Henrys Fork of the Snake River, including Lake Walcott (reservoir) and American Falls Reservoir.

2.2.1.4.2 Snake River Physa Snail (*Physa natricina*)

The Snake River physa snail occurs on the undersides of gravel to boulder-size substrate in swift current in the mainstem Snake River. Living specimens have been found on boulders in the deepest accessible part of the river at the margins of rapids. Because of the rarity of this species and the difficulty sampling the habitat in which it resides, not much is known about the snail's life history or distribution.

The snail is known to be associated with gravel-boulder substrate that is basalt derived and a few macrophytes or epiphytic algae (Frest and Johannes 1995). Other freshwater snails that associate with the Snake River physa snail include *Fluminicola* spp., *Taylorconcha serpenticola*, and *Vorticifex effusus* (Frest and Johannes 1995).

Taylor (1982) believed that much of the habitat for this species was deep water beyond the range of routine sampling. The modern historic range in the Snake River extends from Grandview upstream through the Hagerman reach (RM 573) (Taylor 1982). Currently, two populations (or colonies) are believed to remain in the Hagerman and King Hill reaches, with possibly a third colony immediately downstream of Minidoka Dam. However, recent surveys have failed to collect these snails in the Hagerman reach, including the type locality of the species.

2.2.2 Important Species

2.2.2.1 Speckled Dace (Rhinichthys osculus)

A bottom dweller, the speckled dace inhabits shallow, rocky, headwater streams with relatively swift flow, sometimes in areas with considerable aquatic vegetation (Sublette *et al*. 1990). The species has a relatively low tolerance for elevated temperatures and reduced oxygen (Lowe *et al*. 1967, Sublette *et al*. 1990).

This species feeds principally on benthic insects but also takes algae, other aquatic invertebrates, and detritus (Scott and Crossman 1973).

Spawning usually occurs once a year from June through August in animals older than 2 years (Cannings and Ptolemy 1998). During reproductive periods, males develop a red spawning dress similar to that of the leopard dace (*Rhinichthys falcatus).* Breeding occurs in riffles with a clean gravel substrate, and males clean and prepare the gravel with their mouths prior to spawning. During breeding, many males accompany a single female; she deposits adhesive eggs into prepared substrate.

2.2.2.2 Longnose Dace (Rhinichthys cataractae)

The longnose dace seeks the interstices between stones in gravel-rock substrates of riffle areas of streams or the surge zone or deeper water of lakes (Sublette *et al*. 1990). Longnose dace occupy perennial mainstream and tributary habitat at higher elevations (Bestgen and Platania 1990). The longnose dace feeds on the bottom, principally on chironomids, mayflies, and simuliids, but it also takes algae and plant material. In Montana, Gerald (1966) found that size influenced diet, with dace up to 49 mm long taking mostly algae, the 50- to 69-mm fish preferring Chironomidae, and the 70- to 100-mm class taking Chironomidae and Baetidae equally.

Spawning occurs from early spring to early summer in riffles with a water velocity of 45 to 60 cm per second or on wave-swept shores over a coarse substrate with crevices into which eggs are deposited. Eggs are demersal and adhesive. According to McPhail and Lindsey (1970), the incubation period is from 7 to 10 days at 15.6 ºC.

2.2.2.3 Leopard Dace (*Rhinichthys falcatus*)

The leopard dace averages 7 to 10 cm (about 3 inches) long and is creamy in color, somewhat darker on the back, with many large irregularly shaped spots.

The species prefers rivers with a cobble or stone bottom and relatively warm, productive waters. When the leopard dace occurs in the same river systems as the longnose dace, the two species have quite different current-flow preferences: the leopard dace prefers slow-moving currents, probably less than 0.5 meters per second, and the longnose dace prefers more rapid water (Scott and Crossman 1973).

Yearling leopard dace are commonly found in shallow cobble habitat near current. The dace uses very different habitat for nursery areas than it uses for adult habitat. The sun warms the shallow nursery zone in summer. This warmth probably adds to the productivity and metabolic activity of young dace in these habitats.

Little information is known about female reproduction. Beyond observations of dace seeking refuge under rocks, no information is available on their behavior since they have not been observed in open water. Stomach contents saved from collected specimens appear to contain mostly remains of insect larvae. Stomach contents have not been identified completely, but algae are not seen as a major component in the food habits of the species. Predation and competition by sympatric prickly sculpin (*Cottus asper*), torrent sculpin (*C. rhotheus*), or rainbow trout (*Oncorhynchus mykiss*) may affect dace abundance, although hiding under rocks could provide the species with protection from predation.

2.2.2.4 Peamouth Chub (*Mylocheilus caurinus*)

The peamouth chub is endemic to western North America and the sole member of the genus *Mylocheilus* (Bailey *et al.* 1970). Peamouth chub are commonly found in the weedy shallows of rivers and lakes. They grow to a maximum of about 35 cm.

Spawning takes place in the inlets, outlets, and gravel shallows of lakes during May and June once waters reach about 12 ºC (Wydoski and Whitney 1979). During spawning, peamouth chub aggregate in schools. Then females broadcast release large numbers of sticky, greenish eggs that hatch in 7 to 8 days depending on water temperatures. Male and female peamouth chub are dimorphic during the breeding season, with the ripe males developing tubercles on the head, pectoral, and pelvic fins. Breeding males also develop a dark lateral stripe flanked with tinges of red and exhibit a dark green dorsal surface. Ripe females are less colorful than the males are and lack well-developed lateral stripes.

Like many cyprinids, peamouth chub hybridize easily with other family members, and in 1856, a specimen was described from the lower Columbia River as a new species, *Cheonda cooperi* (Carl *et al*. 1967). Nearly 100 years later, a similar specimen was found in Flathead Lake, Montana, and correctly identified as a hybrid between the redside shiner and peamouth chub (Weisel 1954). A similar case of hybridization has been noted for northern squawfish (*Ptychocheilus oregonesis*) and peamouth chub (Scott and Crossman 1973).

2.2.2.5 Leatherside Chub (*Gila copei*)

The leatherside chub is a small minnow native to streams and rivers of the southeastern portion of the Lake Bonneville basin. It was once common throughout its native range, but currently, the species has suffered substantial decreases in population levels. Consequently, the leatherside chub is listed as a species of special concern in the State of Idaho. The species is rare, and there is little information on its population status, distribution, and/or habitat requirements.

Leatherside chub live up to 8 years, and adults reach a maximum length of 150 mm. The body is bluish above and silvery below, and males have bright orange-red coloration on the axils of the paired fins. The skin has a leathery texture with very small scales (75–85 in the lateral line), and the anal and dorsal fins have 8 fin rays. The leatherside chub tends to inhabit rocky, flowing pools and sometimes riffles of creeks and small rivers. This chub probably spawns in midsummer. It may serve as forage for other fishes.

The leatherside chub is present in the Upper Snake province in the Goose Creek drainage, Trapper Creek, and the top end of the Salt River.

Although Simpson and Wallace (1982) listed this species as native to the upper South Fork Snake River in Idaho, it is possible that the species was introduced because it was not collected from the upper Snake until the 1930s. In their list of fishes found in Idaho, Wydoski and Whitney (1979) seemed to suggest that this species was introduced into the Snake River drainage and Lake Bonneville basin in Idaho. However, Sigler and Sigler (1987) listed it as native to the eastern Lake Bonneville basin that includes Idaho.

2.2.2.6 Chiselmouth Chub (*Acrocheilus alutaceus*)

The average length of the adult chiselmouth is 6 to 7 inches (15–18 cm). The head of the fish is blunt, and the eyes are relatively large. The lower lip is covered with a hard cartilaginous sheath with an almost straight cutting edge, rather like a chisel, giving the fish the ability to scrape algae from rocks. The overall coloration of the chiselmouth chub is a rather drab, dark brown, with lighter sides covered in many small black dots.

The species seems to prefer faster water of warm streams but is also found in backwaters of larger rivers and in small kettle lakes and large lakes. Although spawning has not been observed, it occurs in streams. Biology and critical habitat requirements are still largely unknown.

Although the species' range is confined and its distribution spotty, the fish is found in numerous localities and a variety of waterbody types, and it has no obvious threats (Cannings and Ptolemy 1998). Young chiselmouth feed mainly on insects, while adults feed largely on diatoms that they scrape from rocks or other substrate with their lower chisel-like jaw. Spawning usually occurs in late June to early July when water warms up. During spawning, eggs have been found on the open bottom and buried among boulders (Scott and Crossman 1973). Maturity occurs at age 3 or 4 years, and the fish may live to 6 years (Cannings and Ptolemy 1998).

2.2.2.7 Utah Chub (*Gila atraria*)

The Utah chub is found in the upper Snake River system in Wyoming and Idaho, as well as in the Lake Bonneville basin (including Great Salt Lake drainage and Sevier River system) in southeastern Idaho and Utah. The species occurs in lakes, quiet pools of headwaters, creeks, and small to medium-sized rivers, and it is often found in vegetation over mud or sand.

2.2.2.8 Tui Chub (*Gila bicolor*)

The tui chub is widely distributed throughout the hydrographic Great Basin Region in much of the area formerly occupied by Lake Lahontan and other pluvial lakes during the Pleistocene (Grayson 1993). The disappearance of these lakes isolated various populations, and some became more differentiated than others; 13 subspecies have been recognized (Smith 1979).

The species prefers to inhabit lakes and quiet, vegetated, mud- or sand-bottomed pools of headwaters, creeks, and small to large rivers. Distinct subspecies are *G. b. snyderi* (protected) in Owens River, California; *G. b. mohavensis* (protected) in Mojave River, California; *G. b. bicolor* in the Klamath River system in Oregon and California; *G. b. obesa*, a stream- and spring-inhabiting form in the Lake Lahontan basin; and *G. b. pectinifer*, a lake-inhabiting form, also in the Lake Lahontan basin, Nevada.

Tui chubs are small fish, rarely exceeding 6.7 inches (170 mm) standard length (tip of snout to end of vertebral column) but occasionally reaching 8.7 inches (220 mm) and possibly 10 inches (254 mm). The body is stocky, with a large, slightly concave head, and short rounded fins. Larger fish may develop a pronounced hump behind the head. Both sexes exhibit similar size and outward appearance.

Tui chubs initiate spawning when water temperatures approach 64 ºF (18 ºC) and continue to some degree while water temperatures range from 63 to 79 ºF (17–26 ºC). Spawning occurs through the spring (with some indication of fall spawning) and involves groups of chubs releasing eggs over vegetation to which the eggs become attached. The adhesive eggs are about 0.04 inches (1 mm) in diameter and hatch in 6 to 8 days at temperatures of 64 to 68 ºF (18–20 ºC). Hatchlings spend about 12 hours on the bottom and then swim to the surface. Young fish, or fry, then form small schools in shallow areas of their habitat.

Little is known about the feeding habits of the tui chub.

2.2.2.9 Shorthead Sculpin (*Cottus confuses*)

The shorthead sculpin is found in several seemingly disjunction areas in the Pacific Northwest (Wydoski and Whitney 1979, Page and Burr 1991). The distribution of shorthead sculpin in the Upper Snake province is uncertain because of the difficulty in distinguishing this species from the mottled sculpin.

Shorthead sculpins inhabit cold, fast riffles in streams with gravel and rubble (Brown 1971, Wydoski and Whitney 1979) but are sometimes in slower water (Peden and Hughes 1984). In some localities, this species is more abundant in headwaters of drainages than other sculpin species (Maughan and Saul 1979, Wydoski and Whitney 1979); elsewhere, the pattern is the opposite (Hughes and Peden 1984). Water temperatures in summer are somewhat cooler than for other sculpin species (45.5–60.8 ºF [7.5–16 ºC]) (Wydoski and Whitney 1979, Roberts 1988); mean summer temperature for occupied streams in northwestern Montana was 45 ºF (7 ºC) (Gangemi 1992).

2.2.2.10 Mottled Sculpin (*Cottus bairdi*)

The mottled sculpin is a bottom dweller, living between and beneath rocks in riffles of cool streams or, occasionally, in lakes. Spawning in this polygynous species occurs in spring when water temperatures are 5.6 to 16.7 ºC (42–62 ºF), with females mating preferentially with larger males that exhibit distinct territoriality (Savage 1963). Mating success depends to some extent on the size of the rock covering the nesting burrow (Downhower and Brown 1980). Eggs are laid in nests under rubble or among gravel or under objects and adhere to the undersurface of the nest cover. They hatch in 20 days at water temperatures of 55 to 59 ºF (13–15 ºC).

The mottled sculpin is a benthic feeder, feeding at night from underneath or between rocks, taking mostly chironomid larvae, as well as amphipods, other insects, invertebrates, and some plant material. It feeds on trout eggs rarely and may take young trout on occasion (Bailey 1952, Zarbock 1952). Prime feeding time is in late evening, extending into the night. The lateral line is used extensively for locating prey (Hoekstra and Janssen 1985). Sculpins are cannibalistic, and large males may eat small females; therefore, the female has to be a certain size during mate selection to avoid being devoured (Downhower *et al*. 1983).

2.2.2.11 Torrent Sculpin (*Cottus rhotheus*)

Life history information for the torrent sculpin is limited, as it is for most sculpin species. Little information exists on home range size and dispersal. Pre-spawning upstream movements (January–March) and post-spawning downstream movements (April–June) have been reported in Washington (Thomas 1973); distances of these movements were not determined and may be relatively small.

Sexual maturity is reached at 2 years of age (Northcote 1954, Brown 1971, Wydoski and Whitney 1979), at about 5.5 cm standard length. Adults can live at least six years and reach 15.2 cm (Wydoski and Whitney 1979). Torrent sculpins (n = 119) collected from Libby Creek, Montana, in October fell into two size groupings of five total age classes (Gangemi 1992): group 1 = 3.5 to 5.1 cm and group 2 = 7.1 to 10.8 cm. The larger individuals were probably 5 years old (Wydoski and Whitney 1979).

Spawning occurs in April and May, according to Northcote (1954) and Wydoski and Whitney (1979), but Thomas (1973) noted egglaying only in April during four years. Eggs are laid on the undersides of rocks. Fecundity is positively related to female size and varies among localities (Wydoski and Whitney 1979). First fry are found in August (Northcote 1954, Brown 1971).

Torrent sculpins eat a large variety of prey; larger organisms can be consumed because torrent sculpins have large mouths (Scott and Crossman 1973, Wydoski and Whitney 1979, Lee *et al*. 1980). Five insect orders, fingernail clams, crustaceans, and two fish species were in the diet in British Columbia (Northcote 1954). Several species of salmonids and other game fishes feed on this sculpin (Brown 1971, Wydoski and Whitney 1979). At least three species of parasites have been reported in torrent sculpins (Hoffman 1967).

2.2.2.12 Western Pearlshell (*Margeterifera falcate*)

The western pearlshell is a freshwater bivalve mussel and a member of the Unionoida, an order of bivalve molluscs. Unrelated to true clams or mussels, the western pearlshell appears to be derived from the marine trigonioideans, a once diverse fossil group that is represented today by only a few species. These species belong to two families. The Margaritiferidae are few in number and limited in distribution, with only five taxa in North America. The other family, the Unionidae, has perhaps 300 species.

The western pearlshell is a filter feeder and essentially an immobile animal, expect during its larval stage. It acquires oxygen and food across its extensive gill surface and releases metabolic waste into the surrounding water. Because North American species lack true siphons, or tubes for water intake and release, most species are confined to burrowing only as deep as the posterior edge of the shell, rendering them susceptible to predators, desiccation, and temperature extremes. Nevertheless, many species live 20 to 30 years, some up to 140 years (Bauer 1987). The *Margeterifera* larvae, called glochidia, are parasitic and depend on the blood of a host to meet oxygen and nutrient needs. The glochidia attach themselves to the gills of a host fish. The fate of the glochidia host also limits and determines the distribution of the species. Host fish for the *Margeterifera* glochidia include Chinook salmon, rainbow trout, brown trout, brook trout, speckled dace, Lahontan redside, and Tahoe sucker (Clark 1981).

Natural predators of metamorphosed mussels consist of fishes, birds, muskrats, and raccoons. Muskrats ate up to 37,000 mussels in a year in an Alberta lake (Hanson *et al*. 1989, Convey *et al.* 1989). Other important predators are sturgeon.

Historically, the western pearlshell ranged from southern Alaska to central California and eastward to western Montana, western Wyoming, and northern Utah (Taylor 1981). Currently, the status of the interior populations needs further investigation (Frest and Johannes 1995). The species is extinct in the Okanogan River, and populations persist locally in parts of the Coeur d’Alene system, including the Coeur d’Alene River and St. Maries River.

As filter feeders on microscopic food items, freshwater mussels are very susceptible to smothering by silt and other sediments in the water (Ellis 1936) and to harm from pollutants carried by these sediments. Siltation may also result in reduced dissolved oxygen and increased organic material (Ellis 1936, Harman 1974). At sublethal levels, silt interferes with feeding and metabolism in general (Aldridge *et al*. 1987). Susceptibility to silt differs from species to species (Marking and Bills 1980). Although effects of pesticides vary from species to species, sublethal levels of polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT), Malathion, Rotenone, and other toxic compounds generally inhibit respiratory efficiency and accumulate in the tissues (Jacobson *et al.* 1993). Mussels are more sensitive to pesticides than many other animals tested. They may act as first alerts to pollutants long before effects are seen in other organisms. More research is needed to determine lethal and sublethal levels.

2.2.2.13 California Floater (Pisidium ultramontanum)

A large freshwater mussel in the family Unionidae, the California floater was used as a food source by Native Americans. This species is most commonly found in large streams and lakes, only in relatively slow current. The snail is also found in coldwater springs or reservoirs in relatively stable, oxygenated mud-to-fines gravel beds. The California floater is a low-elevation species.

Very little is known regarding the floater’s life history. It is a filter feeder, like all unionaceans. The host fishes for the glochidial stage of this bivalve are unknown.

Historically, the California floater occurred in the lower Willamette and Columbia rivers. The species also occurred in larger, slow streams of northern California to as far south as the northern San Joaquin Valley. The species range also included the Wahkiakum, Cowlitz, Clark, Skamania, and Klickitat coasts in Washington; Clatsop, Columbia, Multnomah, Hood River, and Wasco coasts in Oregon; and Siskiyou, Shasta, Lassen, Modoc and Tehama coasts in California.

Taylor (1981) reports that this species is probably eradicated over much of its original range. Frest and Johannes (1995) report that the species appears to be extinct or nearly extinct in Utah and Nevada and is very limited in distribution in Arizona. No living specimens were found between 1988 and 1990 in the Willamette and lower Columbia rivers. The species is extinct in the upper Sacramento River but still survives in the Fall River, Pit River, and Shasta coast in California. The Snake River populations are much circumscribed but may be the best populations extant (Frest 1992). In the Snake River, the species is often found immediately upstream or downstream of rapids.

2.2.3 Nonnative Species Descriptions

Rainbow trout are native to Idaho in the Snake River downstream of Shoshone Falls. Naturally reproducing populations occur throughout the Upper Snake province as a result of introductions. Rainbow trout can pose a substantial risk to the long-term persistence of Yellowstone cutthroat trout through hybridization and introgression.

The brook trout is native to eastern North America. It was introduced in Idaho in the 1800s and has been introduced throughout the Upper Snake province. Brook trout can be locally abundant, but abundance varies significantly throughout the subbasin (Levin *et al*. 2002). Brook trout may displace native salmonids, prey on juveniles, and hybridize with bull trout.

The brown trout is native to Europe and western Asia and was introduced into North America in 1883. It can be found in most waters in Canada, except for Prince Edward Island and Manitoba. Introductions or invasions of brown trout and brook trout have led to displacement of cutthroat trout throughout the western United States (Behnke 1992).

2.3 Terrestrial Resources

The distribution and abundance of fish and wildlife depend on the distribution and types of vegetation cover, as well as on other parameters including geomorphology and climate. Many wildlife species demonstrate close relationships with and, at times, dependence upon certain vegetation complexes. For example, the interaction between whitebark pine and the Clark’s nutcracker (*Nucifraga columbiana*) results from coevolution and is mutualistic (Tomback 1982). Clark’s nutcrackers have evolved a sublingual throat pouch in which to carry pine seeds to sites where they cache them (Bock *et al*. 1973). Seed dispersal by this nutcracker has resulted in ring tree cluster growths and altered the whitebark pine’s genetic population structure in comparison to wind-dispersed pines (Furnier *et al*. 1987, Schuster and Mitton 1991, Carsey and Tomback 1994, Tomback and Schuster 1994). Ecological relationships like that of the whitebark pine and Clark’s nutcracker—between vegetation cover and wildlife species—within habitats are sometimes complex and difficult to quantify or qualify but are important to consider when attempting to protect, restore, or recover species and habitats.

The terrestrial assessment team identified nine focal habitats for the Upper Snake province (Table 2-1). Using the criteria from Section 2.0, as a starting point the technical team initial discussions were based primarily upon a list of 24 habitat classifications derived from the IBIS database. Focal habitat discussions evolved over the course of four meetings as both upper and lower technical teams settled upon habitat classification questions that incorporated multiple species benefits as well as addressing high conservation priorities.

Appendix 2-3 includes detailed descriptions of all the focal habitats. Historical records of habitats in the Upper Snake province suggest that much of the province was shrub-steppe, with aspen forests dominating in the eastern watersheds (Figure 2-30). Current records of habitats suggest that aspen forests have declined and become fragmented from historic times and appear to have almost disappeared or been replaced with old, dry pine/fir forests (Figure 2-31). The shrub-steppe focal habitat still appears to occupy the greatest amount of area in the province, while the open water habitat occupies the least (Table 2-21). Riparian/herbaceous wetlands, mountain brush, whitebark pine, and juniper/mountain mahogany habitats are scarce throughout the province, appearing only in fragmented allotments (Table 2-21 and Figure 2-31).

We estimated changes in the focal habitats from historical conditions in the Upper Snake province (Table 2-22). The data suggest that the areas for all focal habitats have declined, with the exception of shrub-steppe and mountain brush habitats. The mountain brush habitat appears to have increased in area in both the Upper Snake and Closed Basin subbasins (Table 2-22). Although riparian/herbaceous wetlands make up the most important focal habitat, the riparian/herbaceous wetland habitats have not been assessed in the GAP II dataset (Appendix 2-1). Therefore, it is impossible to quantify the percentage of change between historical and current conditions for this habitat. However, anecdotal information overwhelmingly suggests that riparian/herbaceous wetland habitats have declined from historical conditions.

Table 2-21. Percentage representation of the current terrestrial focal habitats, by major watershed, for the Upper Snake province (GAP II) (see Table 1-1 for watershed code definitions).

Snake Headwaters Subbasin	Percentage (%) of major hydrologic unit (watershed)				
	GHB	GVT	PAL	SAL	SHW
Riparian/herbaceous wetlands	3	2	2	1	5
Open water???		<1	2	<1	6
Shrub-steppe	12	6	14	8	6
Pine/fir forest	51	33	19	17	65
Juniper/mountain mahogany			<1		
Whitebark pine			<1	<1	3
Aspen	5	1	20	12	1
Mountain brush			<1	<1	
Other	29	15	12	14	67

Upper Snake Subbasin	Percentage (%) of major hydrologic unit (watershed)											
	AMF	BFT	GSE	IFA	LHF	PTF	RFT	TET	UHF	USR	LWT	WIL
Riparian/herbaceous wetlands	3	4	<1	1	3	2	2	3	8	<1	1	11
Open water	2	2	<1	<1	<1	<1	<1	<1	2	<1	3	<1
Shrub-steppe	44	88	112	22	11	71	74	4	14	5	178	35
Pine/fir forest	1	7	3	<1	26	7	3	22	51	<1	3	2
Juniper/mountain mahogany	<1	<1	12	<1	<1	1	14	<1	<1	<1	3	<1
Whitebark pine		<1			1			<1	<1		<1	<1
Aspen	1	15	2	1	9	8	4	17	16	<1	2	24
Mountain brush	<1	2	<1	4	15	2	<1	<1	<1	<1	<1	<1
Other	47	24	44	72	34	27	72	52	22	22	192	25

Closed Basin Subbasin	Percentage (%) of major hydrologic unit (watershed)				
	BCM	BCK	BLR	LLR	MDL
Riparian/herbaceous wetlands	2	<1	3	1	<1
Open water	<1	<1	<1	<1	<1
Shrub-steppe	53	64	59	53	54
Pine/fir forest	13	10	10	13	8
Juniper/mountain mahogany	<1	<1	<1	<1	<1
Whitebark pine	<1	8	8	9	3
Aspen	4	<1	<1	<1	<1
Mountain brush	4	2	1	3	1
Other	24	15	19	21	33

Table 2-22. Percentage changes in area (km²) from historical to current for the focal habitats in the three subbasins of the Upper Snake province using ICBMP Historic and GAP II vegetation classifications (see Table 1-1 for watershed code definitions). (See Appendix 2-1 for data limitations. For instance, there is no reliable information on the current distribution of riparian/herbaceous wetland area in the Upper Snake province.)

Snake Headwaters Subbasin	**Percentage (%) of major hydrologic unit (watershed)**				
	GHB	**GVT**	**PAL**	**SAL**	**SHW**
Riparian/herbaceous wetlands	?	?	?	?	?
Open water			2,168		–15
Shrub-steppe	2,603	3,087	1,929	2,359	1,143
Pine/fir forest	142	58	–35	–31	68
Juniper/mountain mahogany	–100				
Whitebark pine	–100	–100	–81	–100	–91
Aspen	–92	–94	–38	–48	–98
Mountain brush			589		
Other	1,164	939	66	930	514

Upper Snake Subbasin	**Percentage (%) of major hydrologic unit (watershed)**											
	AMF	**BFT**	**GSE**	**IFA**	**LHF**	**PTF**	**RFT**	**TET**	**UHF**	**USR**	**LWT**	**WIL**
Riparian/herbaceous wetlands	?	?	?	?	?	?	?	?	?	?	?	?
Open water		519							275			
Shrub-steppe	–52	–3	–27	–76	–74%	–13	–45	–89	602	–81	–51	41
Pine/fir forest	75	16	341	-92	143	–3	5	123	67		407	–83
Juniper/mountain mahogany	–46	–72	14	–62	-97	–14	–37		–99	–7%	–66	–14
Whitebark pine		–91			–91	–100		–99	–99			
Aspen	–66	–63	–58	–76	–63	–69	–29	–31	–64		–67	–41
Mountain brush	165	–44	–14	1,208	9,218	119	–65	–95	0	369	–55	552
Other	21,487	3,060	1,354	4,667	567	4,606	2,098	7,517	107	23,865	11,930	136

Closed Basin Subbasin	**Percentage (%) of major hydrologic unit (watershed)**				
	BCM	**BCK**	**BLR**	**LLR**	**MDL**
Riparian/herbaceous wetlands	?	?	?	?	?
Open water					835
Shrub-steppe	2	–6	–5	–18	39
Pine/fir forest	43	–11	–50	–2	–53
Juniper/mountain mahogany	–100	706	–97	–87	–100

Closed Basin Subbasin	Percentage (%) of major hydrologic unit (watershed)				
	BCM	BCK	BLR	LLR	MDL
Whitebark pine	–98	12	–5	74	–65
Aspen	–50	–83	–26	–69	–98
Mountain brush		5,530	6,569	3,771	379
Other	67%	107	180	110	252

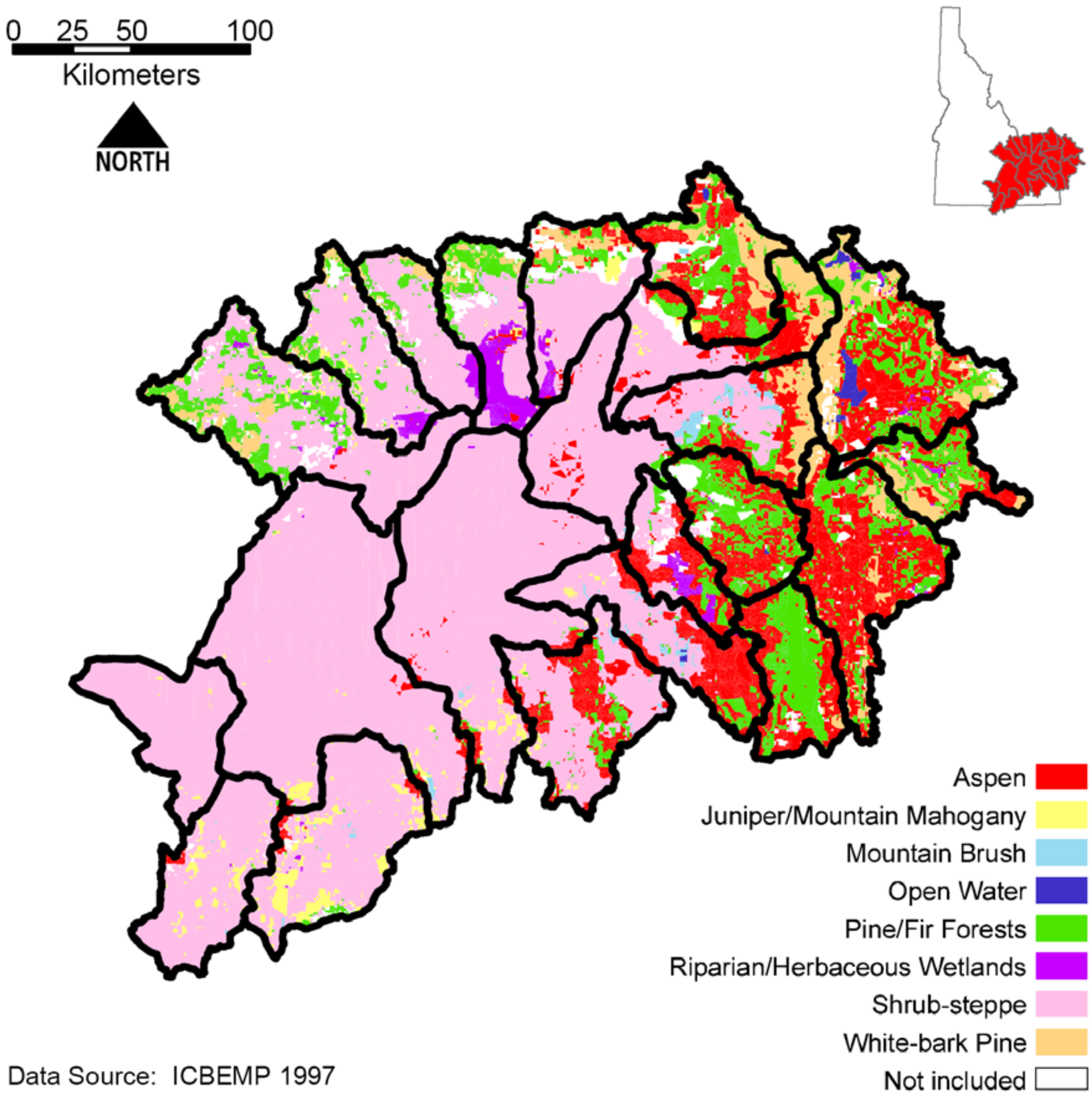

Figure 2-30. Historical occurrences of the focal habitats in the Upper Snake province.

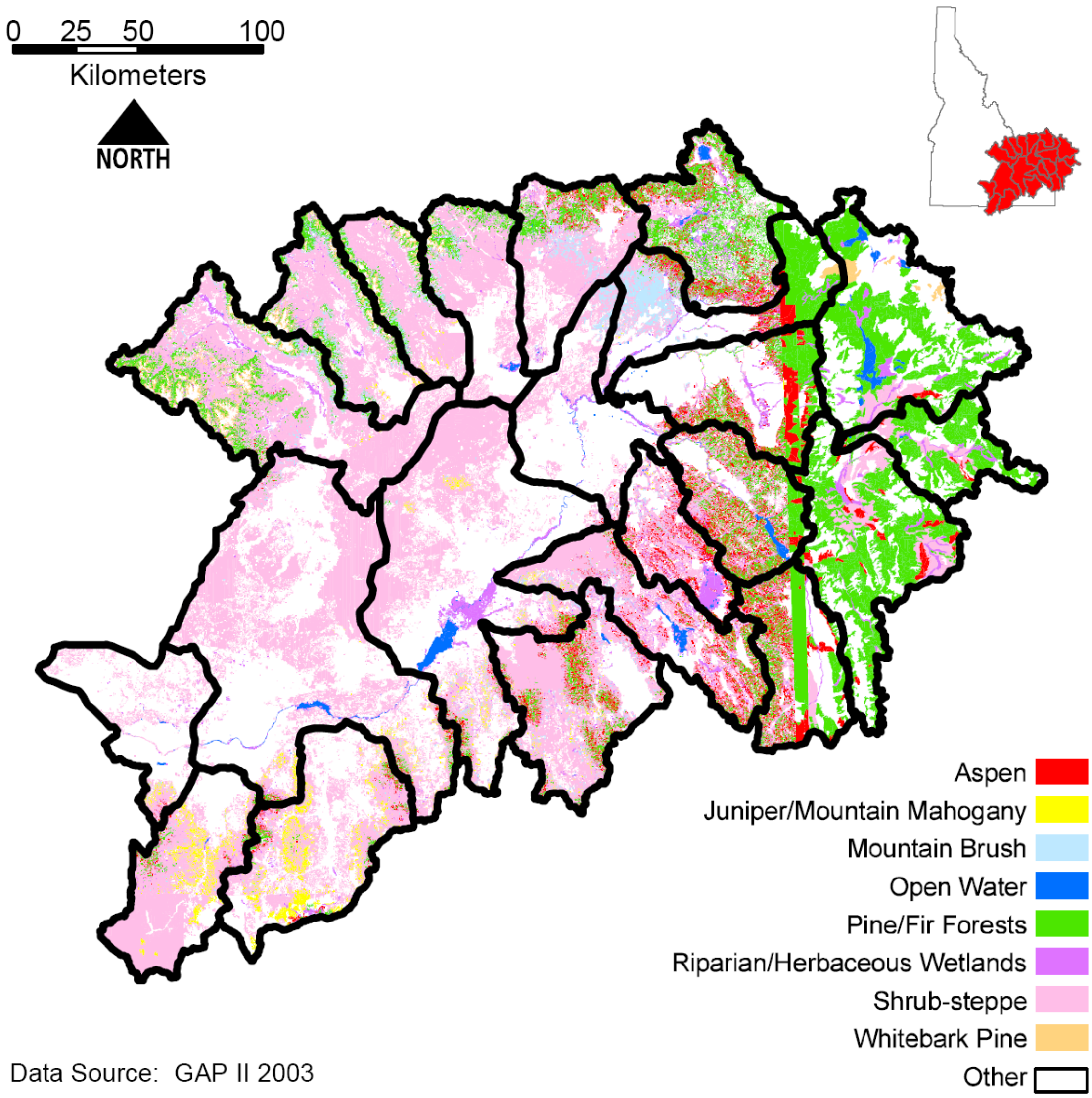

Figure 2-31. Current occurrences of the focal habitats in the Upper Snake province.

2.3.1 Riparian/Herbaceous Wetlands

By virtue of its high productivity, diversity, continuity, and critical contributions to both aquatic and upland ecosystems, riparian/herbaceous wetland habitat provides a rich and vital resource to the fish and wildlife resources in the Upper Snake province (Figure 2-32). Riparian areas contain elements of both aquatic and terrestrial ecosystems that mutually influence each other and occur as transitions between aquatic and upland habitats (WDFW 2003). Riparian habitat forms natural corridors that are important travel routes between foraging areas, breeding areas, and seasonal ranges, and that provide protected dispersal routes for young (WDFW 2003).

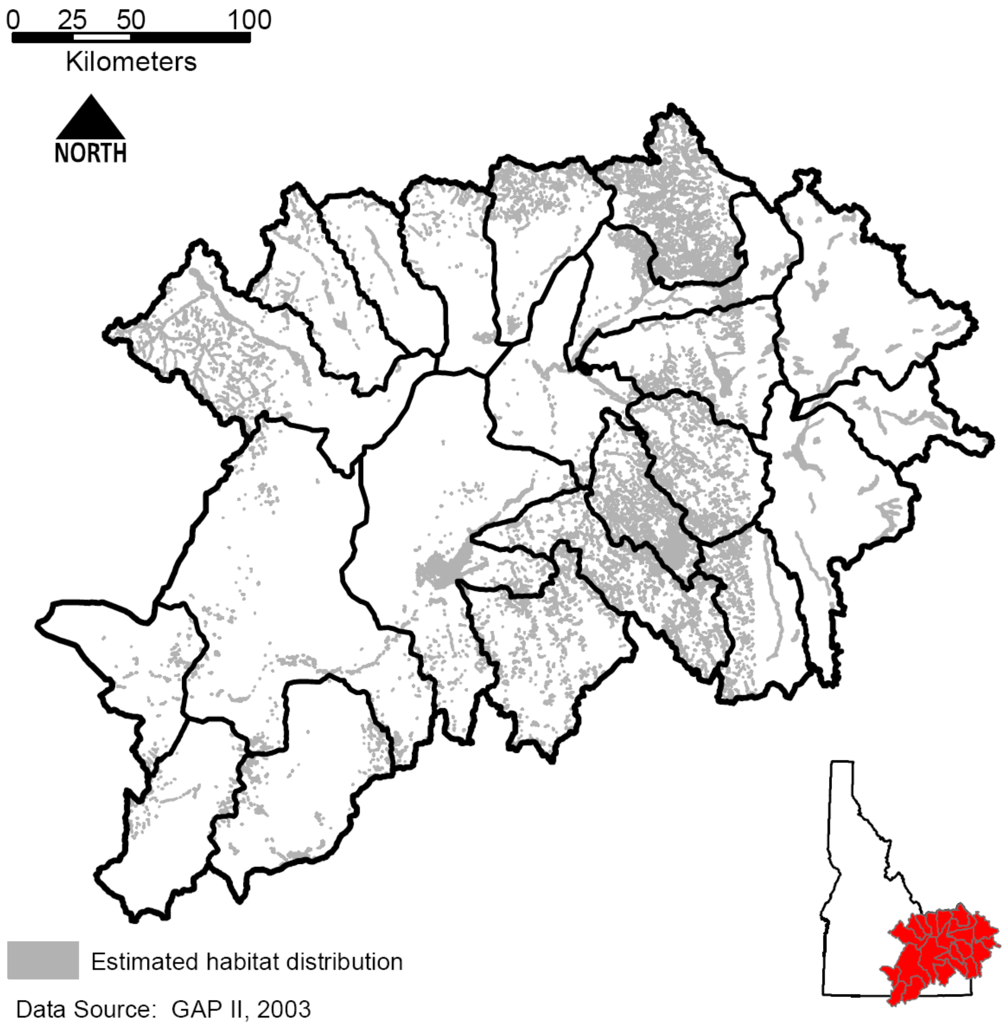

Figure 2-32. Estimated distribution of riparian/herbaceous wetlands in the Upper Snake province.

Riparian habitat is limited geographically, however, and is vulnerable to loss and degradation through human activities and land uses. Since the arrival of settlers in the early 1800s, from 50 to 90% of riparian habitat in Idaho has been lost or extensively modified (Saab and Groves 1992). Protecting riparian habitat may yield the greatest gains for fish and wildlife across the landscape while involving the least amount of area (WDFW 2003). Forested riparian habitat has an abundance of snags that are critical to cavity-nesting birds and mammals and to many insectivorous birds. Downed logs are common and provide cover and resting habitat for amphibians, reptiles, and small mammals. Intact riparian habitat has well-developed vegetation, usually with multiple canopy layers. Each layer consists of unique habitat niches that together support a diversity of bird and mammal species (WDFW 2003).

Wetlands are one of the more valuable habitats to humankind. The value of nonwildlife functions in wetlands may exceed the value of the wildlife functions. Fifty-six percent of the wetlands in Idaho have been lost in the past 200 years (Dahl 1990).

Wetlands are among the most important habitats for birds, supporting a large number of bird species and individuals, including many high-priority species (IDPIF 2000).

2.3.1.1 Focal Species

The western toad, yellow-billed cuckoo (*Coccyzus americanus*), and American beaver are focal species for the riparian/herbaceous wetland habitats (Table 2-23). Cottonwood/willow riparian forest is a dynamic community; dependent upon periodic flooding to provide substrate and nutrients and to cycle the community back to earlier successional stages.

The western toad is an indicator of the health of the riparian/herbaceous wetland habitats, primarily because it feeds in water on decomposing benthic substrate and aids in physical transfer of substances for nutrient cycling. The toad functions in both the aquatic and terrestrial environments (Figure 2-10) but requires water for breeding (Verner and Boss 1980). Interestingly, all breeding members of a local population tend to lay their eggs in the same location, which is used repeatedly from year to year.

The yellow-billed cuckoo is a migratory bird that has evolved to increase its reproductive success by laying eggs in other (host) species' nests. The yellow-billed cuckoo also acts as an indicator species for riparian habitat quality because it eats insects in the riparian vegetation (Table 2-23).

Beaver activity can be beneficial to some wildlife species and also improve fish habitat (Gard 1961, Johnson 1989, Van Deelen 1991). Waterfowl often benefit from the increased edge, diversity, and invertebrate communities created by beaver activity (Van Deelen 1991). Occupied beaver-influenced sites produce more waterfowl because of improved water stability and increased brood-rearing cover. Also, beaver ponds provide habitat for invertebrate populations, which are prey for amphibians, birds, and fish.

Table 2-23. Status and life history information for vertebrate focal species selected for riparian/herbaceous wetland habitats in the Upper Snake province. See Appendix H for detailed life history and biological information for each of the focal species.

Focal Species	Western Toad	Yellow-billed Cuckoo	American Beaver
Conservation Status	Protected nongame species in Idaho	Protected nongame species in Idaho	State game species in Idaho
Population Status	Not rare and apparently secure, but with cause for long-term concern. Fairly common winter resident in Idaho.	Critically imperiled because of extreme rarity or because some factor of its biology makes it especially vulnerable to extinction	Demonstrably widespread, abundant. and secure
Age at First Reproduction	Males 3 years; females probably 4 or 5 years	Little information available; most likely both sexes breed at about 1 year (first spring following birth).	Between 2 and 3 years of age

Focal Species	Western Toad	Yellow-billed Cuckoo	American Beaver
Frequency of Reproduction	Iteroparous; eggs are laid in open water from February to July, with peak activity occurring in April. Males breed every year; females breed at less regular intervals.	Iteroparous; eggs laid once a year	Iteroparous; only the colony's dominant female breeds, producing one litter a year.
Number of Offspring/ Fecundity	Eggs are laid in gelatinous strings of 13 to 52 eggs per inch, in masses of up to 16,500 per clutch. Metamorphosis is usually completed within 30–45 days.	Females lay 1–5 eggs, with 2–3 eggs being usual.	Average litter size varies from 2–3 kits.
Life span/ Longevity	Maximum age of at least 9 years; females of at least 10–11 years have been reported.	At least 4 years; very little information available	Up to 11 years in the wild and 15–21 years in captivity
Predators	Preyed upon by fish, amphibians, reptiles, birds, and mammals. Mortality is greatest during the larval and juvenile stages but is slight thereafter.	Eggs and nestlings are taken by avian predators, mammals, and snakes. Raptors are an important cause of mortality in adults, especially during migration or upon arrival to wintering grounds following migration.	Few natural predators; however, in certain areas, beavers may face predation pressure from wolves, coyotes, lynx, fishers, wolverines, and occasionally bears. Minks, otters, hawks, and owls periodically prey on kits. Humans kill beaver for fur.
Diet	Bees, beetles, ants, and arachnids. Other foods include crayfish, sowbugs, grasshoppers, trichopterans, lepidopterans, and dipterans.	Primarily large insects like caterpillars, katydids, cicadas, grasshoppers, and crickets	Appears to prefer herbaceous vegetation to woody vegetation during all seasons if it is available
Trophic Relationships	Heterotrophic consumer, primary consumer, aquatic herbivore, secondary consumer (consumer or predator of herbivorous vertebrates); feeds in water on decomposing benthic substrate; eats terrestrial invertebrates and aquatic macroinvertebrates	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore), prey for secondary or tertiary consumer (primary or secondary predator); eats terrestrial invertebrates	Heterotrophic consumer, primary consumer (aquatic herbivore and foliovore [leaf eater]), bark/cambium/bole feeder, browser (leaf, stem eater)

2.3.2 Open Water

Open water habitat in the Upper Snake province (Figure 2-33), also known as lacustrine habitat, is characterized by 1) high diversity of fish and wildlife species, 2) important fish and wildlife breeding habitat, 3) important fish and wildlife seasonal ranges, 4) important fish and wildlife movement corridors, 5) high vulnerability to habitat alteration, and 6) unique or dependent species. Lacustrine wetlands are associated with lakes and large ponds. The margins or fringes of lakes and large ponds support wetlands that are maintained by lake levels. The open lake includes both the inshore and offshore waters of the lakes and reservoirs. The inshore waters begin at the offshore edge of the coastal wetlands and extend lakeward to the point where vertical thermal stratification can be measured in summer (Dodge and Kavetsky 1995). Fish are the dominant fauna of the open lake. During the summer, coldwater fishes including trout and whitefish occupy the deeper, colder offshore waters, while coolwater and warmwater fishes inhabit the shallower, warmer, inshore waters (IDPIF 2000). In areas without human disturbance, large numbers of waterfowl may use open water sites for molting. Open water sites often support large waterfowl concentrations during spring and fall staging and migration. Drawdowns in mid and late summer, a period of high irrigation demand, expose mudflats that provide feeding sites for migrating shorebirds (IDPIF 2000). Lacustrine open water wetlands are used for irrigation storage, fishing, and water sports.

In Idaho, all of the larger lakes and many of the smaller ones have dams that maintain lake levels. Lake levels may be stabilized or manipulated at any time of the year for recreation, power, and irrigation. Altered hydrological regimes often reduce wetland habitat or convert it to a different type. Fluctuating levels in response to power or irrigation demands on some reservoirs have created steep eroding banks on islands and lake shores with little emergent habitat (IDPIF 2000). American Falls Reservoir, located in the Upper Snake subbasin, is the second largest reservoir in the state and provides shallow feeding areas for waterfowl and mudflats for migrating shorebirds. This site also contains some excellent bottomland cottonwood forests, mostly on the Fort Hall Indian Reservation. The avifauna in the area is among the most diverse in Idaho. American Falls Reservoir supports a population of breeding and wintering trumpeter swans, a wintering population of bald eagles, and a significant breeding population of colonial waterbirds. The reservoir also supports thousands of ducks, geese, and shorebirds during the spring and fall migrations and is a fall staging area for migrating sandhill cranes. Perhaps the most significant conservation issue for American Falls Reservoir is the occasional outbreak of avian botulism resulting from the annual irrigation drawdown.

Figure 2-33. Estimated distribution of open water habitats in the Upper Snake province.

2.3.2.1 Focal Species

The focal species for open water habitats in the Upper Snake province include the western grebe, American white pelican, trumpeter swan, American avocet (*Recurvirostra americana*), and common loon (Table 2-24). Open water habitats that support populations of grebes, loons, or white pelicans most likely have high water quality and support healthy fish populations because all three of these focal species consume a lot of fish. The also eating fish, the avocet eats primarily aquatic invertebrates. The avocet feeds by thrusting its bill underwater and swinging it from side to side along the bottom to stir up aquatic insects (Hamilton 1975). Because the avocet eats mostly aquatic invertebrates, this species is also an indictor of open water habitat quality.

The trumpeter swan is categorized as a species of special concern in Idaho and Montana and as a priority 1 species in Wyoming. Trumpeter swans eat the roots, stems, leaves, and/or seeds of a variety of aquatic vegetation, and they occasionally eat insects. Trumpeter swans are also sensitive to human activities on their breeding grounds. Intrusions by humans at nesting wetlands have caused temporary and permanent nest abandonment, as well as movements from breeding and staging areas.

Table 2-24. Status and life history information for vertebrate focal species selected for open water habitat in the Upper Snake province. See Appendix H for detailed life history and biological information for each of the focal species.

Focal Species	Western Grebe	American White Pelican	Trumpeter Swan	American Avocet	Common Loon
Conservation Status	Protected nongame species in Idaho	Protected nongame species in Idaho	Species of special concern in Idaho	Protected nongame species in Idaho	Protected nongame species in Idaho
Population Status	Not rare and apparently secure, but with cause for long-term concern	Critically imperiled because of extreme rarity	Critically imperiled because of extreme rarity	Demonstrably widespread, abundant, and secure in Idaho	Critically imperiled because of extreme rarity in Idaho
Age at First Reproduction	Probably breeds in first year	3 years	Forms pair bonds when 2 or 3 years old and first nests when 4 or 5 years old	Usually breeds at 2 years old, but some individuals breed in first year	No data, but thought to be no earlier than 4 years; may be as late as 7 years
Frequency of Reproduction	Iteroparous; one clutch per season is normal, but replacement clutches are common.	Iteroparous; one clutch per season	Iteroparous; eggs laid once a year	Iteroparous; eggs laid once a year	Iteroparous; eggs laid once a year. Clutches are replaced if eggs are lost.
Number of Offspring/ Fecundity	Mean clutch size is 2–3 chicks.	One offspring per clutch is the norm, even if 2 chicks hatch.	Female lays 5–6 eggs.	Female lays 2–4 eggs, usually 4.	Clutch size is generally 2 eggs, rarely 3.
Life span/ Longevity	Up to 14 years, but most banded birds have been recovered at minimum ages of 6–7 years.	Maximum reported life span is 26 years.	Up to 35 years in captivity but usually not more than 12 years in the wild	At least 9 years, but probably much longer	No data, but survival is assumed to be similar to that of the Artic loon (25–30 years). At least 9 years.
Predators	Bald eagles and mink; raccoons will take nesting adults and eggs. Eggs are consumed by common ravens and pecked or eaten by coots and Forster's terns, especially after human disturbance. Chicks are also vulnerable to predation by bass and pike.	Adults are rarely preyed upon. Eggs and young rarely taken at undisturbed colonies, unless low water makes them accessible to coyotes. Scavenging gulls are the main predator at disturbed colonies.	Except for humans, few natural enemies after flying age is reached. Young are susceptible to predation from birds of prey and mammals.	Predators of adults include the peregrine falcon, prairie falcon, great horned owl, and northern harrier. Falcons, harriers, and mink are known to prey on young. Predators of eggs are gulls, ravens, badgers, striped skunks, long-tailed weasels, coyotes, raccoons, red fox, and gopher snakes.	Very few predators of adults. Nest predators include American crows, ravens, gulls, striped skunks, raccoons, minks and weasels. Young chicks are taken by northern pike, muskellunge, snapping turtles, bald eagles, and gulls.

Focal Species	Western Grebe	American White Pelican	Trumpeter Swan	American Avocet	Common Loon
Diet	Fish are the main food items, reportedly composing 81–100% of the diet.	Small schooling fish; also larger sluggish bottom feeders, salamanders, and crayfish	Roots, stems, leaves, and/or seeds of a variety of aquatic vegetation; occasionally insects	Primarily aquatic invertebrates; also terrestrial invertebrates, small fish, and seeds	Live fish, other aquatic vertebrates, some invertebrates, and occasionally vegetation
Trophic Relationships	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore); piscivorous (fish eater); eats terrestrial invertebrates and aquatic macroinvertebrates	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore), vertebrate eater (consumer or predator of herbivorous vertebrates); piscivorous (fish eater)	Heterotrophic consumer; primary consumer (herbivore), foliovore (leaf-eater), aquatic herbivore, spermivore (seed-eater), grazer (grass, forb eater), secondary consumer (primary predator or primary carnivore); eats terrestrial invertebrates and aquatic macroinvertebrates	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore), vertebrate eater (consumer or predator of herbivorous vertebrates); eats terrestrial invertebrates and aquatic macroinvertebrates	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore), vertebrate eater (consumer or predator of herbivorous vertebrates); eats aquatic macroinvertebrates; piscivorous (fish eater)

2.3.3 Shrub-steppe

Shrub-steppe habitat is found throughout the Upper Snake province (Figure 2-34). Shrubland birds show the most consistent population declines over the last 30 years of any group of bird species (Paige and Ritter 1999). Researchers suggest that shrub-steppe habitat be given the highest conservation priority based on trends in bird populations (Saab and Rich 1997). Still, comparatively high wildlife density and species diversity characterize shrub-steppe habitat. Approximately 100 bird and 70 mammal species can be found in sagebrush habitats. Some of these species are sagebrush obligates or near obligates. Sagebrush and the native perennial grasses and forbs of the shrub-steppe are important sources of food and cover for wildlife. Native perennial bunchgrasses serve a keystone role in maintaining vegetative and watershed stability and resilience to disturbance events and environmental change. Loss of the abundance and vigor of bunchgrasses triggers the unraveling decay of watershed integrity and the capability of these sites to produce wildlife habitat and commercial resource values (Rust *et al*. 2000). This habitat provides important wildlife breeding habitat and seasonal ranges.

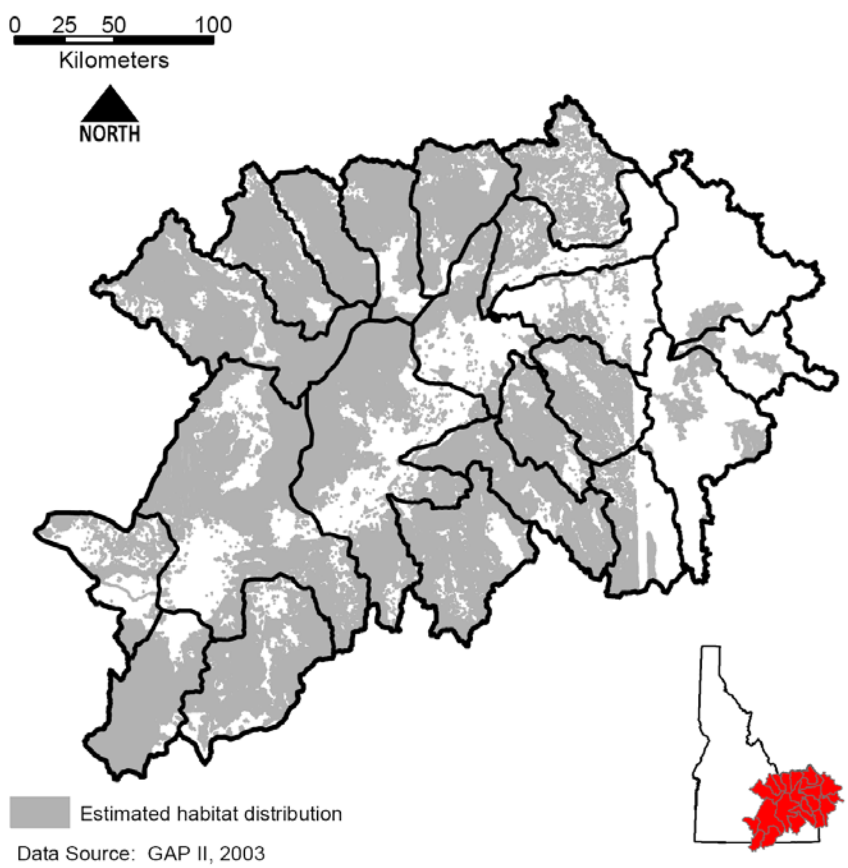

Figure 2-34. Estimated current distribution of shrub-steppe habitat in the Upper Snake province.

2.3.3.1 Focal Species

Sagebrush species, plus the northern sagebrush lizard (*Sceloporus graciosus graciosus*), greater sage grouse (*Centrocercus urophasianus*), and sage sparrow (*Amphispiza belli*) are focal species for the shrub-steppe habitat in the Upper Snake province (Table 2-25).

Different species of sagebrush provide food, cover, and nesting substrate, especially for sage-steppe obligates such as the greater sage-grouse during winter months. The sagebrush sometimes protects other native forbs and grasses from overgrazing and acts to stabilize soil. Sagebrush species also tend to be drought tolerant and cycle nitrogen. Three sagebrush species are highlighted in the shrub-steppe habitat: Wyoming big sagebrush (*Artemisia tridentata* ssp. w*yomingensis*), mountain big sagebrush (*Artemisia tridentata* var. *vaseyana*), and black sagebrush (*Artemisia nova*).

Wyoming big sagebrush (*Artemisia tridentata* ssp. w*yomingensis*) is a native shrub (Balliette *et al*. 1986, Dorn 1988, Hickman 1993, Cronquist *et al*. 1994) and is the most drought tolerant of the three major big sagebrush subspecies (Meyer and Monsen 1993). Wyoming big sagebrush is also a long-lived species; maximum life span may exceed 150 years (Ferguson 1964). This sagebrush is preferred browse for wild ungulates (Peek *et al*. 1979, Welch and McArthur 1986, Shaw and Monsen 1990, Bray *et al*. 1991), and Wyoming big sagebrush communities are important winter ranges for big game (McArthur *et al*. 1977, Tweit and Houston 1980, Hironaka *et al*. 1983, Mueggler and Stewart 1981).

Pronghorn usually browse Wyoming big sagebrush heavily (Allen *et al*. 1984). On the Idaho National Engineering and Environmental Laboratory, for example, the shrub comprised 90% of the diet of pronghorn from fall through spring. Lagomorphs may browse Wyoming big sagebrush heavily in winter (Gates and Eng 1984). Wyoming big sagebrush is a crucial food item for the greater sage grouse and part of the bird's critical habitat (Tweit and Houston 1980, Clifton 1981, Autenrieth *et al*. 1982, Welch *et al.* 1991, Fischer *et al*. 1993, Fischer *et al.* 1996). Fire is the principal means of renewal for decadent stands of Wyoming big sagebrush (Blank *et al.* 1994).

Mountain big sagebrush (*Artemisia tridentata* var. *vaseyana*) is also a long-lived (50+ years), native shrub (Beetle and Johnson 1982, Blank *et al.* 1994). Mountain big sagebrush is readily killed by fire and requires at least 15 years to recover after fire (Bunting *et al*. 1987). There has been extensive documentation that many wild animals rely on the big sagebrush ecosystem for both food and cover (McGee 1979, Nagy 1979, Peek *et al*. 1979, Blaisdell *et al*. 1982, Hironaka *et al*. 1983, Noste and Bushey 1987, Shaw and Monsen 1990, Wambolt *et al*. 1994, Welch *et al*. 1996). Wildlife researchers have argued that neither the importance of sagebrush as forage nor the effects of foraging on sagebrush are fully appreciated (Wambolt 1995, 1996; Welch and Wagstaff 1992).

A native evergreen shrub, black sagebrush (*Artemisia nova*) is small, spreading, and aromatic. Black sagebrush is a significant browse species within the Intermountain region (McMurray 1986) and provides highly nutritious winter forage. Although black sagebrush is not as productive as many other forage species, its winter nutritive quality is second only to big sagebrush (Cook and Stoddart 1953, Behan and Welch 1986).

Table 2-25. Status and life history information for vertebrate focal species selected for shrub-steppe habitat in the Upper Snake province. See Appendix H for detailed life history and biological information for each of the focal species.

Focal Species	Northern Sagebrush Lizard	Greater Sage-Grouse	Sage Sparrow
Conservation Status	Protected nongame species in Idaho	Game species in Idaho	Protected nongame species in Idaho
Population Status	Demonstrably widespread, abundant, and secure	Not rare and apparently secure, but with cause for long-term concern	Not rare and apparently secure, but with cause for long-term concern
Age at First Reproduction	?	Females are sexually mature their first fall and nest the following spring; males are sexually mature the spring following their first winter.	Both sexes breed in their first year.
Frequency of Reproduction	Iteroparous; adult females produce 2 clutches annually.	Iteroparous; hens attempt to raise one brood in a season.	Iteroparous; annual breeders. Produce 2–3 clutches per year.
Number of Offspring/ Fecundity	A single clutch of 1–8 eggs	Hens incubate 7–15 eggs for about 25–27 days. After hatching, chicks wait until they are dry before leaving the nest.	Females lay 1–4 eggs, usually 3.
Life span/ Longevity	?	Thought to be up to 10 years in the wild, but in one study, average in both hunted and protected populations was 1–1.5 years; in another study, 3–4 years was considered old.	3 years for males, 2 years for females; banded birds known to live for 6 years
Predators	Include striped whipsnakes, night snakes, and a variety of predatory birds	Raptors and crows are the primary predators, while coyotes, bobcats, minks, badgers, and ground squirrels are the most important ground predators.	Townsend's ground squirrels, loggerhead strikes, and common ravens take eggs and young. Great horned owls are known to take adults.
Diet	Insects (e.g., beetles, flies, ants, caterpillars, etc.), spiders, ticks, mites, and aphids	Sagebrush, grasses, forbs, and insects comprise the annual diet.	Insects and seeds. Diet changes with the season: 44% animal and 56% seed and plant material in fall, 13% animal and 87% seed and plant material in winter.

Focal Species	Northern Sagebrush Lizard	Greater Sage-Grouse	Sage Sparrow
Trophic Relationships	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore); eats terrestrial invertebrates	Heterotrophic consumer, primary consumer (aquatic herbivore and foliovore), flower/bud/catkin feeder, frugivore (fruit-eater), secondary consumer (primary predator or primary carnivore of terrestrial invertebrates)	Heterotrophic consumer, primary consumer (herbivore), spermivore (seed-eater), secondary consumer (primary predator or primary carnivore); eats terrestrial invertebrates

2.3.4 Pine/Fir Forests (Dry, Mature)

The majority of the xeric, old forest habitat in the Upper Snake province is found in the uppermost and eastern portions of the province (Figure 2-35) and is significantly less in extent than it was before 1900 (Quigley and Arbelbide 1997). Quigley and Arbelbide (1997) included much of this habitat in their dry forest potential vegetation group, which they concluded has departed from natural succession and disturbance conditions. The greatest structural change in this habitat is the reduced extent of the late seral, single-layer condition (4–24% canopy cover and > 53 cm diameter at breast height [dbh]). Important components of this habitat are large downed material, snags, and decadence. This habitat is generally degraded because of increases in exotic plants and decreases in native bunchgrasses (IBIS 2003). One-third of the dry Douglas-fir or grand fir community types listed in the National Vegetation Classification are considered imperiled or critically imperiled (Anderson *et al*. 1998). Important components of mesic, old forest types are large snags and large trees for nesting habitat for habitat specialists. Large logs provide foraging and nesting habitat. Early seral forest that results from timber harvest is different from forest created by fire. Large overstory trees that remained after fire contributed a snag component that is missing under a logged regime.

2.3.4.1 Focal Species

The black-backed woodpecker, great gray owl, boreal owl, and northern goshawk (*Accipiter gentilis atricapillus*) were chosen as focal species for the pine/fir forest (xeric, old) habitat in the Upper Snake province (Table 2-26).

The black-backed woodpecker (*Picoides arcticus*) is dependent on fire landscapes and other large-scale forest disturbances (Hutto 1995, Caton 1996, Murphy and Lehnhausen 1998, Hoyt 2000). Fire suppression and post-fire salvage logging are detrimental to this species and have reduced its habitat. The woodpecker is designated as a species of special concern in Idaho.

The great gray owl's diet consists almost entirely of small rodents. About 90% of the diet is made up of pocket gophers (*Thomomys* spp.) and voles (*Microtus* spp.) (Franklin 1988). The primary foods of the boreal owl are small mammals, birds, and insects. Voles are this owl's preferred food and may make up as much as 75% of the diet (Palmer 1986, Hayward *et al.* 1993). The role of prey availability in both nomadic movement patterns and yearly variation in nesting success and productivity suggests that food supply may regulate owl abundance in some portions of its range (Hayward and Hayward 1993). In addition, researchers suggest that timber harvest has potential impacts on populations (Bull and Duncan 1993).

The northern goshawk uses stands of old-growth forest as nesting sites (DuBois *et al*. 1987). The diet of the northern goshawk changes with the season. In spring and summer, the bird takes mainly birds and a few small mammals. In winter, the diet consists of prey species that do not migrate or hibernate. The goshawk is also an important predator of the boreal owl.

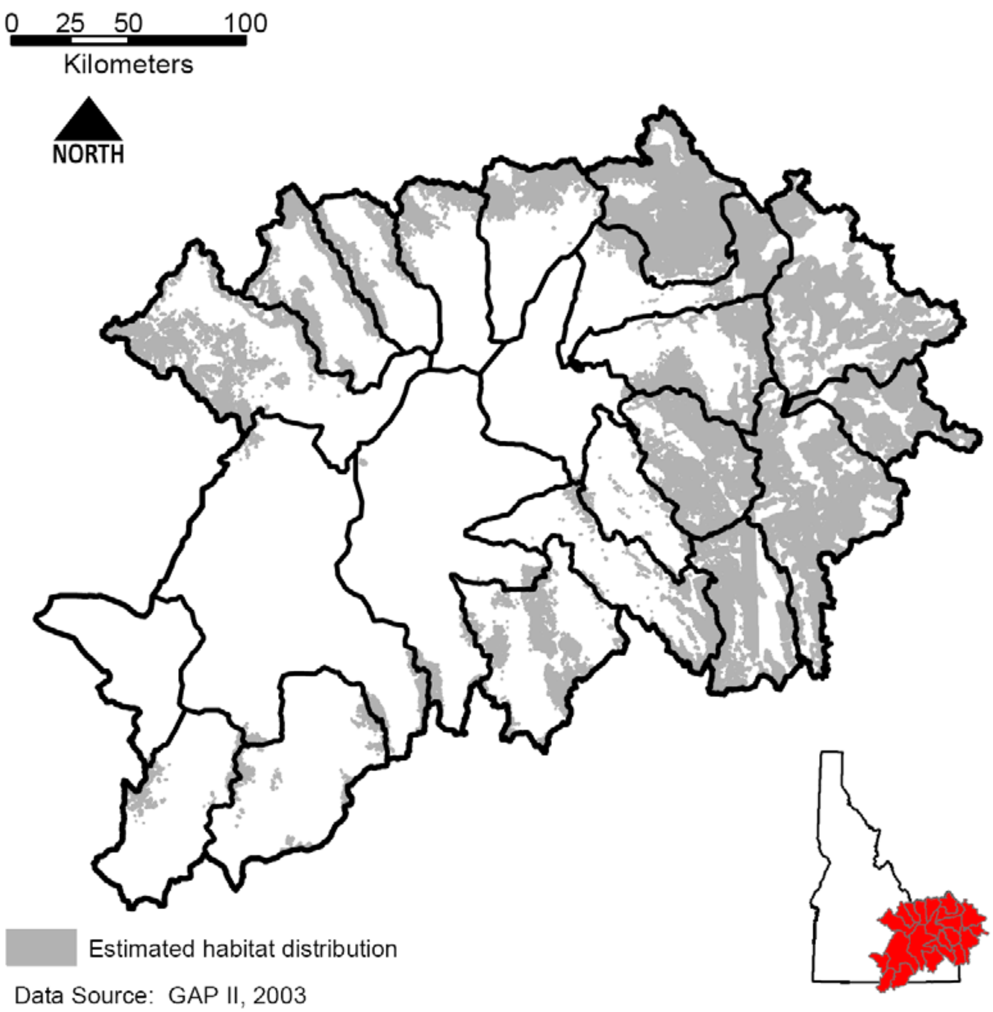

Figure 2-35. Estimated current distribution of pine/fir forests (dry, mature) habitat in the Upper Snake province.

Table 2-26. Status and life history information for vertebrate focal species selected for pine/fir forest habitat in the Upper Snake province. See Appendix H for detailed life history and biological information for each of the focal species.

Focal Species	Black-backed Woodpecker	Great Grey Owl	Boreal Owl	Northern Goshawk
Conservation Status	Protected nongame species in Idaho	Protected nongame species in Idaho	Protected nongame species in Idaho	Protected nongame species in Idaho
Population Status	Rare or uncommon but not imperiled in Idaho	Imperiled because of rarity in Idaho	Imperiled because of rarity in the Idaho	Not rare and apparently secure, but with cause for long-term concern
Age at First Reproduction	No data	Commonly at 3 years; some birds will occasionally breed at 2 years and rarely in the first year.	Both sexes can breed the year after hatching.	25% breed as yearlings; another 25%, their second year; and the remainder, their third year.
Frequency of Reproduction	Iteroparous; one clutch per season	Iteroparous; one clutch per season	Iteroparous; one clutch per season	Iteroparous; one clutch per season
Number of Offspring/ Fecundity	6 eggs (usually 4) are laid	Clutch size is 3–5 eggs.	Clutch size ranges from 2–4 eggs, with 3 being more common.	Females lay 1–5 eggs; 3 is the usual number
Life span/ Longevity	As long as 8 years	At least 13 years	Known to live for almost 16 years. Adult annual survival was 46%.	Maximum life span is at least 11 years.
Predators	Little information is available on the causes of mortality, but predation by raptors is presumed to be a cause.	Frequent predation on juvenile owls is by northern goshawks and great horned owls; red-tailed hawks are known to attack juveniles. Lynx and great horned owls may occasionally kill an adult. Other potential predators are black bears and fishers.	Marten are important predators of owlets and adult females at the nest site; another nest predator is the pine squirrel. Important predators of young and adults include the Cooper's hawk, northern goshawk, and great horned owl.	Predators are large avian species such as the bald eagle and golden eagle.

Focal Species	Black-backed Woodpecker	Great Grey Owl	Boreal Owl	Northern Goshawk
Diet	Includes 75% insects such as wood-boring beetles, grubs, weevils, ants, other beetles, and spiders. Berries and other small fruits, acorns, and nuts are also eaten.	Almost entirely small rodents. About 90% of the diet consists of pocket gophers and voles. Other small mammals include shrews, mice, squirrels, young rabbits, hares, rats, moles, and weasels. Small birds, ducks, and grouse are also taken. There's a report of a sharp-shinned hawk taken.	Primary foods are small mammals, birds, and insects. Voles are the preferred food, making up as much as 75% of the diet.	Diet changes with the season. Spring and summer–mainly birds, with a few small mammals. In the winter, their diet consists of prey species that do not migrate of hibernate.
Trophic Relationships	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore), vertebrate eater (consumer or predator of herbivorous vertebrates); eats terrestrial invertebrates	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore), vertebrate eater (consumer or predator of herbivorous vertebrates)	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore), vertebrate eater (consumer or predator of herbivorous vertebrates)	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore), vertebrate eater (consumer or predator of herbivorous vertebrates)

2.3.5 Juniper/Mountain Mahogany

Juniper/mountain mahogany habitats are an integral component of wildlife seasonal ranges within the Upper Snake province (Figure 2-36). Curl-leaf mountain mahogany is an excellent food source for all classes of browsing animals in both summer and winter; it is one of the few browse species that meets or exceeds the protein requirements for wintering big game animals. In mature mountain mahogany stands, much of curl-leaf mountain mahogany foliage is out of reach of browsing animals but provides excellent winter cover. Mountain mahogany has a limited distribution and is very vulnerable to habitat alteration. It occurs at high elevations on xeric, south-facing aspects on low-productivity sites. Habitat development occurs at geologic timescales.

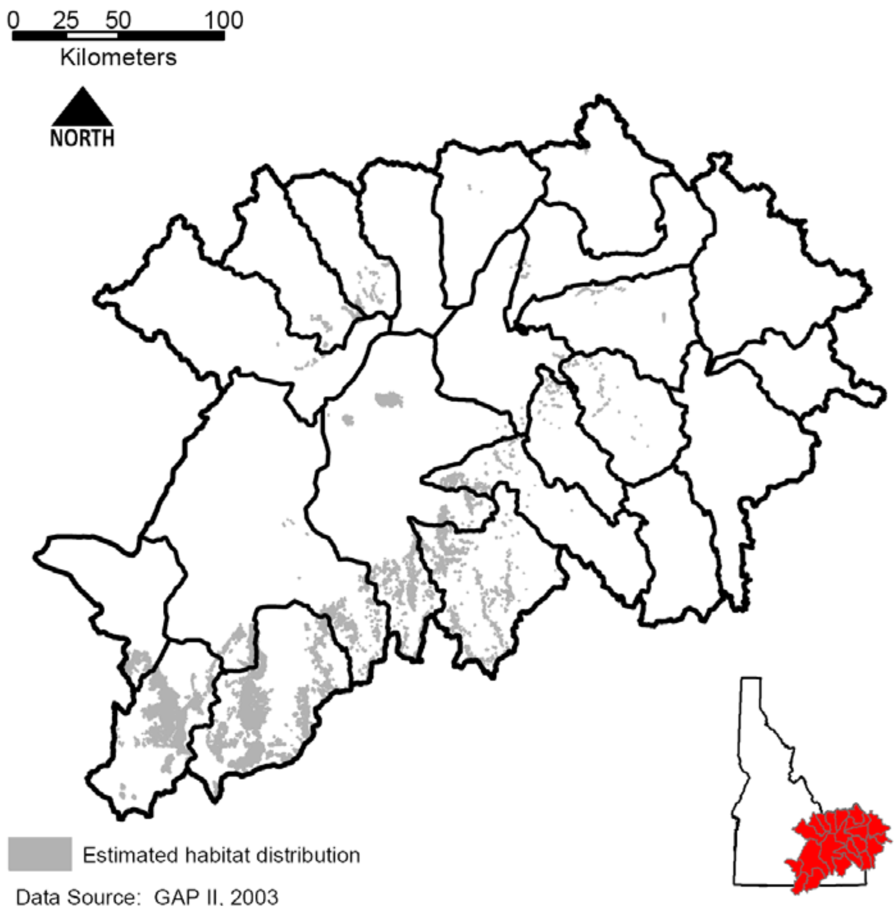

Figure 2-36. Estimated current distribution of juniper/mountain mahogany habitats in the Upper Snake province.

One-third of the Pacific Northwest mountain mahogany community types listed in the National Vegetation Classification are considered imperiled or critically imperiled (Anderson *et al.* 1998). Western juniper, although less important than mountain mahogany as a food source, provides thermal cover and access to important understory forage species under natural fire regimes. Lengthened fire intervals have allowed junipers to encroach into mountain sagebrush-grassland communities. As the juniper communities mature, the perennial herbaceous understory is lost due to competition, reducing the wildlife value of the habitat. The biggest conservation concern with western juniper habitat is the continued maturation and expansion into shrub-steppe habitat and subsequent loss of habitat diversity across the landscape. Although juniper habitat covers significantly greater area than it did before 1900, the habitat is generally degraded because of increased amounts of exotic plants and decreased native bunchgrasses. One-third of Pacific Northwest juniper community types listed in the National Vegetation Classification are considered imperiled or critically imperiled (Anderson *et al*. 1998).

2.3.5.1 Focal Species

A native, xerophytic, evergreen shrub or small tree, curl-leaf mountain mahogany (*Cercocarpus ledifolius*) can be extremely long-lived. It is good forage for all classes of browsing animals in both summer and winter (Stanton 1974, Davis 1990).

Curl-leaf mountain mahogany is one of the few browse species that meets or exceeds the protein requirements for wintering big game animals (Davis 1990). In Idaho, it is very palatable to bighorn sheep and mountain goats (Dittberner and Olson 1983). In mature stands, much of curl-leaf mountain mahogany foliage is out of reach of browsing animals but provides excellent winter cover (Stanton 1974).

As a codominant member of the sagebrush-forest ecotone in Idaho, curl-leaf mountain mahogany is associated with snowberry (*Symphoricarpos* spp.), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), bluebunch wheatgrass (*Pseudoroegneria spicata*), Sandberg bluegrass (*Poa secunda*), Idaho fescue (*Festuca idahoensis*), and Columbia needlegrass (*Achnatherum* spp.) (Scheldt and Tisdale 1970).

Curl-leaf mountain mahogany may be planted to help stabilize soil in disturbed areas such as roadcuts and mine spoils (Hungerford 1984). Because of its tolerance to heat and drought, curl-leaf mountain mahogany can be used for water-efficient landscaping in arid environments (Gutknecht 1989).

Fire usually kills curl-leaf mountain mahogany. Curl-leaf mountain mahogany seedlings establish after fire, although establishment may be slow and influenced by the amount of rainfall.

2.3.6 Whitebark Pine

Whitebark pine (*Pinus albicaulis*) habitats have fire-dependent ecological characteristics with several obligate or near obligate wildlife species. Most of the whitebark stands appear to occur in the Closed Basin and Snake Headwaters subbasins (Figure 2-37). Whitebark pine habitats provide important seasonal ranges and a high-value seed crop for wildlife. They are also a culturally significant source of food for Native Americans. Whitebark pine seeds are a preferred food of the threatened grizzly bear and many other mammals and birds. An assessment of the interior Columbia River basin found that the area of whitebark pine cover types has declined 45% since 1900 (Keane 1995b). Most of this loss occurred in the more productive, seral whitebark pine communities; 98% of these communities have been lost. Practically all the remaining whitebark pine stands are old. Whitebark pine is reported to be functionally extinct on the Mallard-Larkins Pioneer Area in the Idaho Panhandle National Forest (Zack 1995). Sixty years of fire suppression have advanced forest succession at the expense of seral whitebark pine communities. Successional replacement due to fire exclusion is a major cause of whitebark pine decline (Keane *et al*. 1994).

Whitebark pine cannot maintain its functional role in mountain ecosystems unless areas suitable for its regeneration are available across the landscape (Kendall 2003). An exotic fungus, white pine blister rust, has killed many whitebark pine trees in the moister parts of its range. White pine blister rust, which was introduced from Europe to western North America around 1910, has spread to most whitebark pine forests. Although white pine blister rust can damage all North American white pine species, whitebark pine is the most vulnerable. Rust infection rates in the Sawtooth National Recreation Area in central Idaho are generally light, but low elevations may harbor some heavily infected sites (Smith 1995). It is clear that the blister rust epidemic in whitebark pine has not yet stabilized, even in regions with the longest history and highest infection levels of rust. The most likely prognosis for whitebark pines in sites already heavily infected with rust is that they will continue to die until most of the trees are gone (Kendall 2003). In the future, whitebark pine trees will be all but absent in most areas, and small, isolated populations will be lost until rust-resistant types evolve. Without intervention, such resistance is expected to require hundreds—if not thousands—of years because whitebark pine matures slowly and most of the population soon will be lost (Kendall 2003).

Figure 2-37. Estimated current distribution of whitebark habitat in the Upper Snake province.

2.3.6.1 Focal Species

The focal species for the whitebark pine habitat are whitebark pine (*Pinus albicaulis*) and the Clark's nutcracker (Table 2-27).

Whitebark pine is a slow-growing, long-lived, ectomycorrhizal, and native conifer characteristic of the tree line (Ahlenslager 1987). Trees often reach 400 to 700 years of age, and the minimum seed-bearing age of whitebark pine trees is between 20 and 30 years. Whitebark pine grows on dry, rocky sites on high mountains between 5,900 and 9,940 feet (1,800–3,030 m), and the dispersal of whitebark pine seeds by Clark's nutcrackers strongly affects the distribution and abundance of this species (Tomback 1977). Whitebark pine survives where tree growth is limited and provides hiding and thermal cover for wildlife (Ahlenslager 1987). Cavity-nesting birds use tree trunks and snags. Mule deer, elk, and predatory animals also use whitebark habitat (Pfister *et al.* 1977, Tomback 1981).

Trees in well-developed stands are 49 to 66 feet (15–20 m) tall and 23 to 35 inches (60–90 cm) in diameter (Ahlenslager 1987). Growing at the uppermost limits of growth, trees are usually dwarfed or contorted. At the upper tree line, this species takes on a spreading growth form and grows in isolated cushions of "alpine scrub" between 1 and 3.3 feet (0.3–1 m) (Ahlenslager 1987).

Table 2-27. Status and life history information for vertebrate focal species selected for whitebark habitat in the Upper Snake province. See Appendix H for detailed life history and biological information for the focal species.

Focal Species	Clark's Nutcracker
Conservation Status	Protected nongame species
Population Status	Demonstrably widespread, abundant, and secure
Age at First Reproduction	First breeding in second winter/spring
Frequency of Reproduction	Iteroparous; annual breeder unless cone crop of major seed sources failed the previous fall; one clutch per season.
Number of Offspring/Fecundity	Range is 2–6 young (average is 2–3 young).
Life span/Longevity	Known to live up to 17 years
Predators	Little information; predation by raptors
Diet	Pine seeds are the primary food for both adults and nestlings, although the bird is known to eat insects, acorns, berries, snails, carrion, and sometimes eggs of small birds (Mulder *et al*. 1978, Tomback 1978, Tomback and DeWolfe 1981). The Clark's nutcracker is also aggressive enough to prey on small vertebrates, such as ground squirrels (*Spermophilus* spp.), chipmunks (*Tamias* spp.), and voles (*Microtus*) (Mulder *et al.* 1978).
Trophic Relationships	Heterotrophic consumer, primary consumer (herbivore), spermivore, frugivore, secondary consumer (primary predator or primary carnivore of terrestrial invertebrates; ovivorous (egg eater)
Key Ecological Role	Prey for secondary or tertiary consumer (primary or secondary predator); disperses seeds/fruits (through ingestion or caching)

2.3.7 Aspen

The widespread distribution of quaking aspen (*Populus tremuloides*) forests on the region's high plateaus and mountain ranges and the aspen's importance to many wildlife species make these forests a significant biotic community in the Upper Snake province (Figure 2-38). The understory of most aspen communities is luxuriant when compared with those of associated coniferous forests and results in greater animal diversity. Understory vegetative diversity is dependent upon the localized moisture regime (CPLUHNA 2003). Aspen stands are in decline across the West. The combination of modern fire suppression and a steady increase in domestic animal grazing and elk herbivory has prevented aspen regeneration in many forests; conifer understories are now widely overtopping aspen stands (CPLUHNA 2003). Because aspen stands are so different from conifer stands, they are very important for landscape diversity and wildlife habitat. Although aspen stems are short lived and snags do not stand long, the wood is soft, often decayed, and therefore useful to snag and cavity-dependent species. Young aspen sprouts are an important food source for mule deer and Rocky Mountain elk.

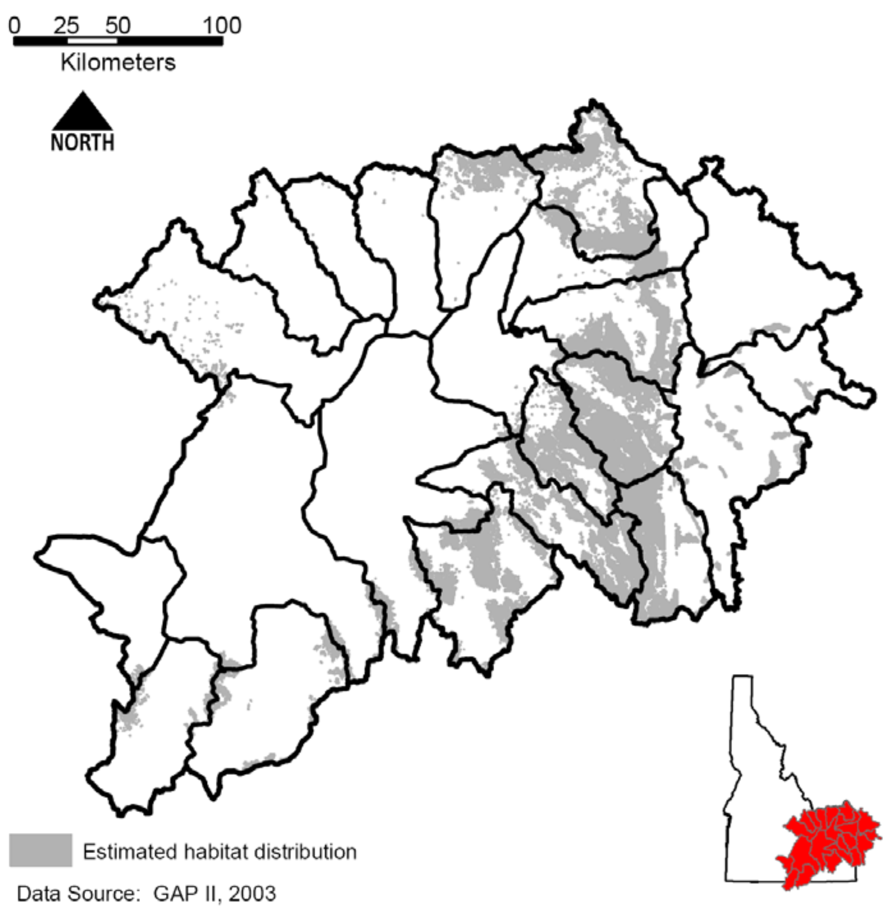

Figure 2-38. Estimated current distribution of aspen habitat in the Upper Snake province.

2.3.7.1 Focal Species

Quaking aspen (*Populus tremuloides*) is a native deciduous tree that forms clones connected by a common parent root system. Quaking aspen is the most widely distributed tree and a major cover type in North America. Even though quaking aspen is an important mid-seral species, maps showing the distribution of the species in the Upper Snake province are currently incomplete.

Throughout its range, quaking aspen occurs in mid to upper riparian zones (Franklin and Dyrness 1973, Perala 1990). Quaking aspen is not shade tolerant (Perala 1990); neither does it tolerate long-term flooding nor waterlogged soils (Perala 1990). Even if quaking aspen survives flooding in the short term, stems subjected to prolonged flooding usually develop a fungus infection that greatly reduces stem life (and renders the wood commercially useless) (Davidson *et al*. 1959). Quaking aspen readily colonizes after fire, clearcutting, or other disturbances.

Quaking aspen forms clones connected by a common parent root system. It is typically dioecious, with a given clone being either male or female; however, some clones produce both stamens and pistils (Jones and DeByle 1985). Quaking aspen stands may consist of a single clone or aggregates of clones. Clones can be distinguished by differences in phenology, leaf size and shape, branching habit, and bark character and also by electrophoresis (Perala 1990).

Quaking aspen forests provide important breeding, foraging, and resting habitat for a variety of birds and mammals. Wildlife and livestock utilization of quaking aspen communities varies with species composition of the understory and relative age of the quaking aspen stand. Young stands generally provide the most browse. Although many animals browse quaking aspen year-round, it is especially valuable during fall and winter when its protein levels are high relative to other browse species (Tew 1970).

2.3.8 Mountain Brush

Mountain brush habitat is sparsely scattered throughout the Upper Snake province (Figure 2-39). The mountain brush habitat includes mesic upland deciduous shrub communities and warm mesic shrubs, which are upland shrublands that occur naturally or are initiated by fire or clearcutting. The mesic upland deciduous shrub communities include alder (*Alnus rhombifolia*), maple (*Acer grandidentatum*), hawthorn (*Crataegus douglasii*), tobacco brush (*Ceanothus velutinus*), buffaloberry (*Shepherdia canadensis*), chokecherry (*Prunus virginiana*) Prince’s pine, huckleberry (*Gaylussacia dumosa*), whortleberry (*Vaccinium scoparium*), ocean spray (*Holodiscus discolor*), raspberry, rose (*Rosa* spp.), and spirea (*Spiraea betulifolia*). The warm mesic shrublands include alder, serviceberry (*Amelanchier alnifolia*), Oregon grape (*Mahonia aquifolium*, formerly *Berberis aquifolium*), snowberry (*Symphoricarpos albus*), tobacco brush, ninebark (*Physocarpus* spp.), chokecherry, rose, currant, willow, elderberry (*Sambucus racemosa*), and spirea. Mountain big sagebrush may also be present. The sharp-tailed grouse depends on this type for wintering habitat. Mountain brush is widely regarded as important to wildlife for its food and cover values, as well as important for providing integral components of watershed stability and species diversity.

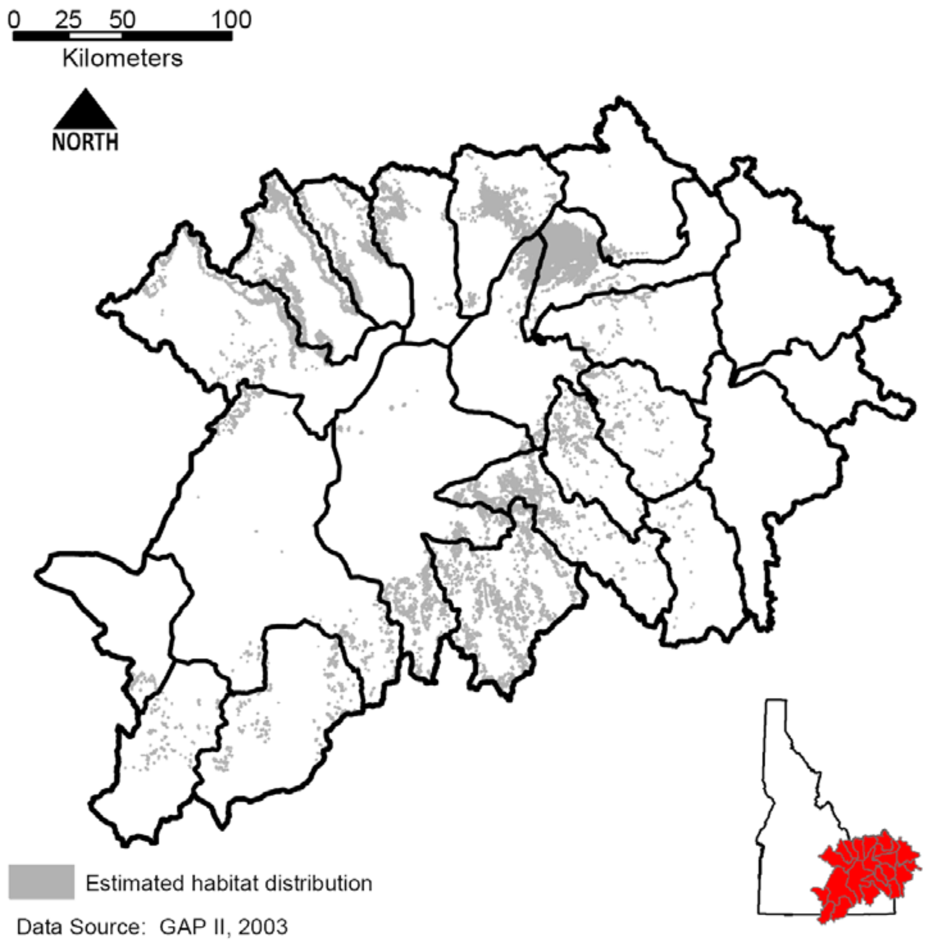

Figure 2-39. Estimated current distribution of mountain brush habitat in the Upper Snake province

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2.3.8.1 Focal Species

The focal species for mountain brush habitat in the Upper Snake province include antelope bitterbrush (*Purshia tridentata*), green-tailed towhee (*Pipilo chlorurus*), mule deer (*Odocoileus hemionus*), and Rocky Mountain elk (*Cervus elaphus nelsoni*) (Table 2-28).

A native, deciduous shrub, antelope bitterbrush is important browse for wildlife and livestock (Murray 1983, Noste and Bushey 1987, Vander Wall 1994); it also supports several insect populations. Pronghorn (Gullion 1964, Young 1989), mule deer (Gullion 1964, Williams and Aldon 1976), elk (Hobbs et al. 1981), bighorn sheep, and moose utilize antelope bitterbrush extensively (Murray 1983). Ungulates, birds, and rodents also use antelope bitterbrush for cover (Parker 1975, Griffith and Peek 1989).

Elk and mule deer are migratory species, moving to lower elevations in winter to feed (Figure 2-40 and Figure 2-41). Primarily browsers, mule deer feed on several thousand different plant species across their range and are capable of altering or severely damaging plant communities through overbrowsing (Reed 1981). Elk are grazers rather than browsers. They prefer to forage on grasses and forbs, but they utilize woody browse in the mountain brush habitat during winter.

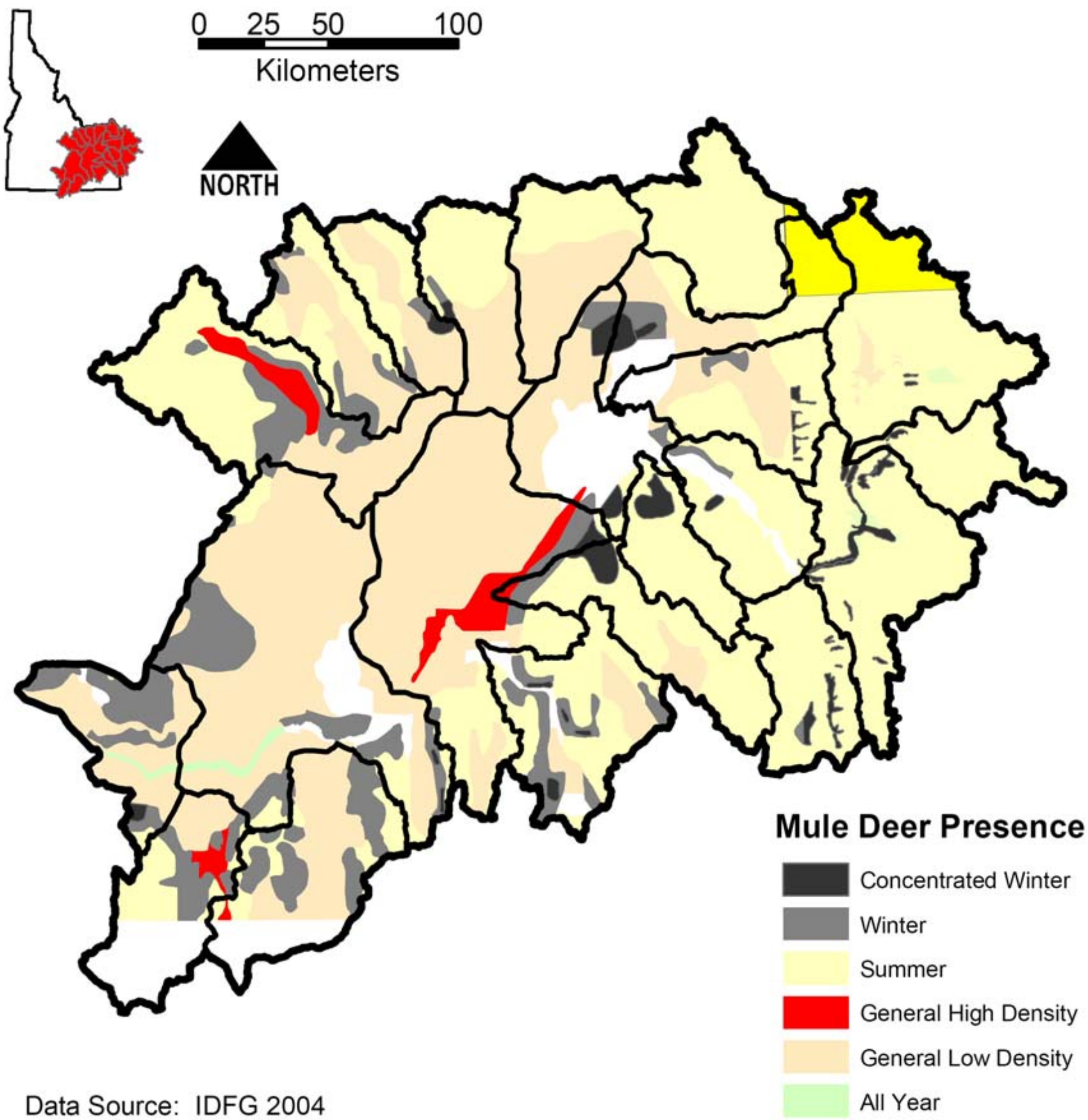

Figure 2-40. Estimated current mule deer distribution in the Upper Snake province.

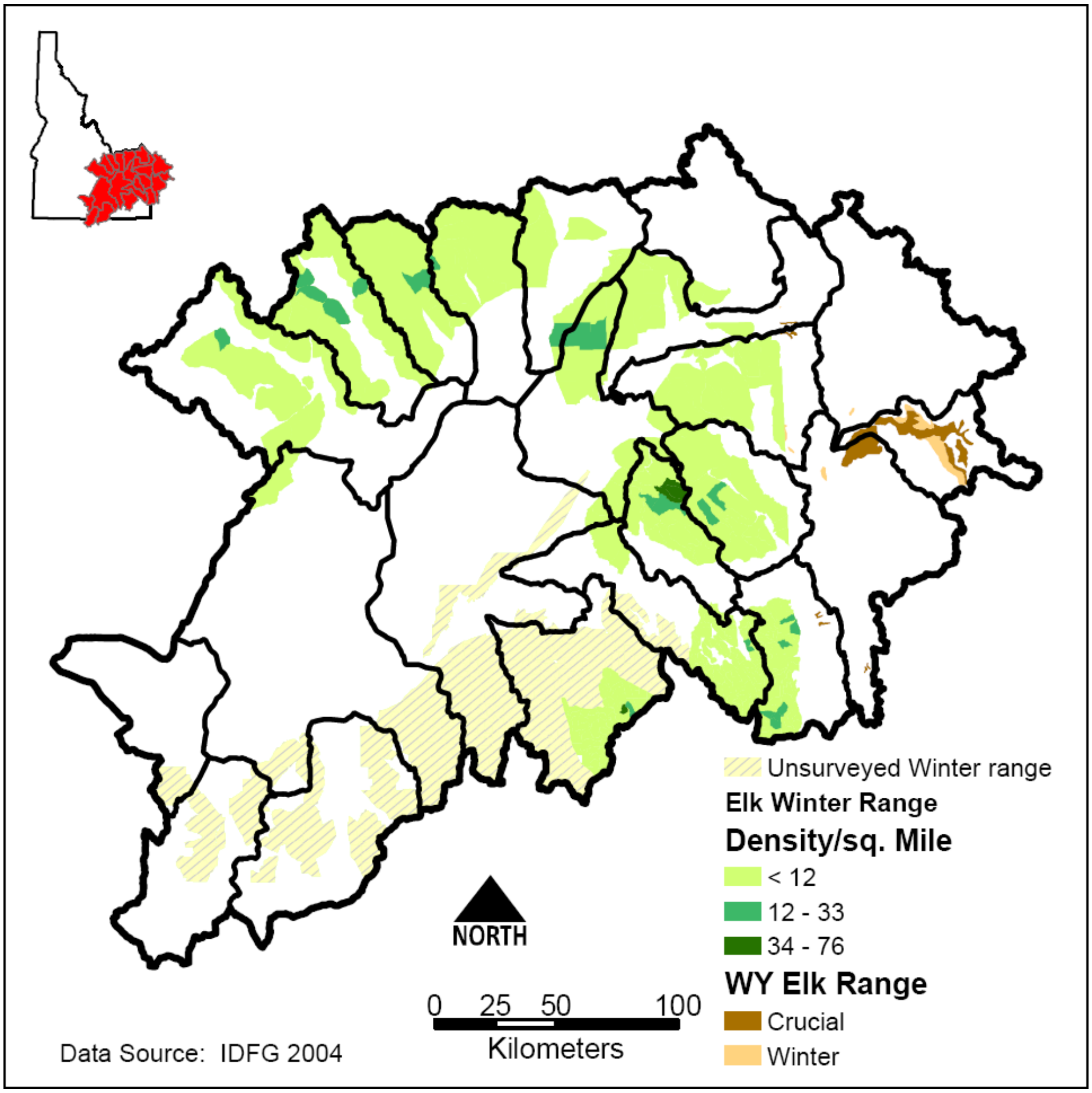

Figure 2-41. Rocky Mountain elk winter range population estimates in the Upper Snake province (IDFG 2004 unpublished aerial survey data collected during 1984-2003).

Table 2-28. Status and life history information for vertebrate focal species selected for brush habitat in the Upper Snake province. See Appendix H for detailed life history and biological information for each of the focal species.

Focal Species	Green-tailed Towhee	Mule Deer	Rocky Mountain Elk
Conservation Status	Protected nongame species in Idaho	Game species in Idaho	Game species in Idaho
Population Status	Demonstrably widespread, abundant, and secure	Demonstrably widespread, abundant, and secure	Demonstrably widespread, abundant, and secure

Focal Species	Green-tailed Towhee	Mule Deer	Rocky Mountain Elk
Age at First Reproduction	Unknown	Females usually breed at 2 years, while males may not mate until they are at least 3 or 4 years of age due to competition with older males.	Females breed at 2 years of age.
Frequency of Reproduction	Iteroparous; breeds annually	Iteroparous; breeds annually	Iteroparous; breeds annually
Number of Offspring/ Fecundity	One clutch per season. Females lay 2–5 eggs, 4 being the usual. Will replace lost clutches.	Mature females commonly have twins, while yearlings have only single fawns.	Usually a single calf, but twins are common.
Life span/ Longevity	Can live to at least 7 years and 8 months.	Females can live as long as 22 years, while males may live as long as 16 years.	Potential life span is 20 years.
Predators	Predators of adults and juveniles include the sharp-shinned hawk, Cooper's hawk, northern goshawk, peregrine falcon, American kestrel, red-tailed hawk, and long-eared owl. Nest predators include the Steller's jay, red squirrel, least chipmunk, long-tailed weasel, black-billed magpie, striped skunk, spotted skunk, and gopher snake.	Include humans, domestic dogs, coyotes, wolves, black bears, grizzly bears, mountain lions, lynx, bobcats, and golden eagles	Include humans, wolves, coyotes, black bears, grizzly bears, and mountain lions
Diet	Major food items are weed seeds and insects, including beetles, bees, wasps, butterflies, moths, grasshoppers, crickets, true bugs, and flies.	Primarily browsers, deer feed on several thousand different plant species across their range.	Some populations prefer to graze, while others rely more heavily on browse. Grasses and forbs are preferred during spring and early summer, and woody browse is preferred during winter.
Trophic Relationships	Heterotrophic consumer, primary consumer (herbivore), spermivore (seed-eater), frugivore (fruit-eater), secondary consumer; eats terrestrial invertebrates	Heterotrophic consumer, primary consumer (herbivore and foliovore), browser (leaf, stem eater), grazer (grass, forb eater), fungivore (fungus feeder)	Heterotrophic consumer, primary consumer (herbivore), browser (leaf, stem eater), grazer (grass, forb eater), fungivore (fungus feeder)

2.3.9 Threatened and Endangered Wildlife Species

The Endangered Species Act (ESA) and other federal regulations have significant implications on management of public and private lands in the Columbia River Basin. While these laws are intended to protect and recover individual species near extinction, the quantity and quality of many habitats across the U.S. are in decline and new species continue to be listed under ESA. Practices of managing wildlife and their habitat on a species-by-species basis sometimes fail to recognize the importance of biological diversity, or "biodiversity," to the health of the ecosystem (Wheeler 1996). The protection of a threatened or endangered species often results in the protection of small parcels of habitats that often benefits other non-listed species. For terrestrial assessment purposes, the technical teams opted to base the assessment and management plan upon an ecosystem-based approach with an emphasis upon focal habitats and a select number of focal species for each focal habitat. This habitat-based assessment places greater emphasis upon key habitats and their functional components, and less emphasis upon selected focal species. An artifact of this approach is the perception that threatened, endangered, candidate or sensitive (TECS) species are being overlooked or ignored. The technical teams recognized the significant role TECS species have in the ecosystem structure and function; however, the technical teams also felt that some TECS species were inappropriate choices as focal species for the following reasons:

- Some TECS species are not necessarily the best indicators of habitat type.
- TECS species are not always the best indicators of habitat quality.
- TECS species are not necessarily the best indicators of the effectiveness of management actions.
- TECS species habitat evaluation protocols at the watershed scale are non-existent.
- Sometimes very little information is available for TECS species.
- TECS species-specific recovery analysis was not the goal of the assessment.
- Many non-TECS species were more effective at meeting the focal species selection criteria (Section 2.0).

Federal management direction predicates that TECS species are addressed through the Endangered Species Act and other laws or regulation, thus, TECS species must be considered in the planning process regardless of the assessment approach. Further, the management and recovery responsibility for species listed under the Endangered Species Act fall under federal authority. The assessment addresses the significance of TECS species separately from other focal species by tabulating them and mapping known locations of pertinent species within the planning area, but does not attempt to assess their management or recovery.

2.3.9.1 Bald Eagle (Haliaeetus leucocephalus)

The bald eagle is a large bird of prey associated with aquatic ecosystems. The bird historically ranged throughout North America. It was first listed as endangered under the ESA on March 11, 1967 (32 FR 4001). Since that first listing, the bald eagle population has increased in number and expanded in range. It is estimated that the species has doubled its breeding population every 6 to 7 years since the late 1970s. The improvement is a direct result of the banning of DDT and other organochlorines, habitat protection, and other recovery efforts. On July 12, 1995, the status of the bald eagle was downlisted to threatened (60 FR 35999). In the Pacific region, development-related habitat loss was identified to be a major factor limiting the abundance and distribution of bald eagles.

The bald eagle breeds from central Alaska across Canada to Labrador and Newfoundland and south to southern mainland Alaska and the Aleutian Islands (DeGraaf *et al*. 1991). It also breeds in Baja California, central Arizona, and southwestern and central New Mexico, as well as along the Gulf Coast from Texas to Florida (Donohoe 1974, DeGraaf *et al*. 1991). Bald eagles winter in most of their breeding range, from southern Alaska and Canada southward (Donohoe 1974, DeGraaf *et al*. 1991). Resident populations are found along the Atlantic, Pacific, and Gulf coasts (Johnsgard 1990).

Bald eagles are capable of breeding in their fifth year but may not start breeding until they are 6 or 7 years old (Gerrard *et al*. 1992). The breeding season extends from January through March and can vary with elevation and latitude. A breeding pair usually mates for life. Females lay a single clutch of one to three eggs. The chicks hatch after an incubation period of 35 days and fledge between 10 to 12 weeks. Bald eagles can live up to 28 years in the wild and up to 36 years in captivity (Green 1985, Johnsgard 1990).

Bald eagles prefer habitat near seacoasts, rivers, large lakes, or other large areas of open water (Peterson 1986). They prefer to nest, perch, and roost primarily in old growth and mature stands of conifers or hardwoods. Eagles usually select the oldest and tallest trees that have good visibility and an open structure and that are near prey (Glinski *et al*. 1983, Johnsgard 1990, Kralovec *et al*. 1992, Garrett *et al*. 1993). A study in Maine showed that bald eagles preferred areas with "super-dominant" trees and avoided lakes that were surrounded by dense forest or inhabited by coldwater fishes. They used areas away from human disturbance and selected nesting sites near lakes with an abundance of warmwater fishes (Livingston *et al*. 1990). Another study showed a preference for nesting near lakes with a circumference greater than 7 miles (11 km). The smallest body of water supporting a nesting pair of bald eagles was 20 acres (8 ha) (Peterson 1986).

Eagles choose sites farther than 0.75 mile (1.2 km) from low-density human disturbance and farther than 1.2 miles (1.8 km) from medium- to high-density human disturbance (Peterson 1986). Wintering bald eagles in New Mexico and Arizona used a disproportionate amount of snags in the largest class size (no dbh given) for perching and usually perched in the top one-third of these trees. For roosting, eagles preferred the largest live trees having open structures for visibility (Grubb and Kennedy 1982).

Habitat suitability index models have been developed for wintering bald eagles in lacustrine and estuarine habitats of the central and northern states (Peterson 1986). Bald eagles need old growth or late-successional forests for nesting and roosting (Lehmkuhl and Ruggiero 1991). Nest snags must be sturdy to support nests. Tree height or species is not as important as the abundance of comparatively large trees near feeding areas (Glinski *et al*. 1983). Lakes greater than 3.8 square miles (10 km^2) may be optimal for breeding bald eagles, although longer and narrower bodies of water can support breeding pairs. Nest trees should have an open form and sturdy branches in the upper one-third of the tree. Eagles nest in the overstory. Forests used for nesting should have a canopy cover of less than 60% (may be as low as 20%) and be near water (Snyder 1993). In treeless areas, bald eagles nest on cliffs or on the ground (Peterson 1986).

Roosting sites need not be as near to water as nesting sites. It is more important that roosting sites are in dense stands of old growth that offers protection from weather. Eagles usually arrive at roost sites after dark and depart from them before dawn. It is therefore difficult to determine important roost sites by observing eagles during daylight hours (Grubb and Kennedy 1982).

Average home ranges for eight pairs of bald eagles in Oregon were 1,650 acres (660 ha), with an average distance between nest territories of 2 miles (3.2 km) and an average of 0.3 mile (0.5 km) of shoreline per pair (Johnsgard 1990). In Arizona, the estimate for home range was 24.6 square miles (64 km^2), with 9.4 to 11.2 miles (15–18 km) of shoreline for each pair.

Bald eagles eat fish, reptiles, birds, mammals, invertebrates, and carrion, including livestock carrion. Some food species of eagles include bullhead fish (*Ictalurus* spp.), alewife (*Alosa pseudoharengus*), chain pickerel (*Esox niger*), sucker (*Catostomus* spp.), salmon (*Oncorhynchus* spp.), white perch (*Morone americana*), smallmouth bass (*Micropterus dolomieui*), eel (*Anguilla rostrata*), sea otter (*Enhydra lutris*), pied-billed grebe (*Podilymbus podiceps*), Canada goose (*Branta canadensis*), American coot (*Fulica americana*), mallard (*Anas platyrhynchos*), pintail (*A. acuta*), hare (*Lepus* spp.), and prairie dog (*Cynomys* spp.) (Peterson 1986, Kralovec *et al.* 1992, Livingston *et al*. 1990).

Eggs, nestlings, and fledglings are most vulnerable to predators. Reported predation of eggs in tree nests is by black-billed magpies (*Pica pica*), gulls (*Larus* spp.), ravens and crows (*Corvus brachyrynchos* and *C. corax*), black bears (*Ursus americanus*), bobcats *Felis rufus*), wolverines (*Gulo gulo*), and raccoons (*Procyon lotor*) (Chrest 1964, Hensel and Troyer 1964, Sprunt and Ligas 1964, McKelvey and Smith 1979, Nash *et al*. 1980). Few nonhuman species are able or likely to prey on immature or adult bald eagles (Buehler 2000), except when the bird is in the nest. Fledglings on the ground are vulnerable to mammalian predators.

Humans pose the greatest threat to bald eagles through habitat destruction, pesticide use, and poaching (Buehler *et al*. 1991). Bald eagles are flushed, in order of increasing ease, from perches, nests, and foraging areas by human disturbance (Grubb and King 1991). They are most easily disturbed by pedestrian traffic and least disturbed by aircraft. Establishing buffer zones of 148 to 296 feet (400–800 m) in Oregon and 167 to 592 feet (450–1,600 m) in the Southeast was recommended to reduce the impact of human disturbance on nesting pairs (Grubb and King 1991).

Silvicultural treatments for maintaining eagle habitat in ponderosa pine (*Pinus ponderosa*) of various age and structure, subclimax mixed conifer, Douglas-fir (*Pseudotsuga menziesii*), and oak (*Quercus lobata*; *Q. kellogii*) stands in northeastern California have been detailed (Burke 1983).

Because forest structure (density and height class) determines avian community composition, changes in forest structure lead to changes in avian communities (Diem and Zeveloff 1980, Smith 1980). A stand-replacing fire will, therefore, likely change bald eagle use of a forest. Fires that destroy old growth forest can reduce eagle populations (Yellowstone National Park 1991). If low-intensity, litter-reducing fires are not allowed to burn in old growth forests, stand-replacing, high-intensity crown fires can result (Covington and Moore 1992).

Fires create snags, which are important perching and nesting sites for bald eagles. Snags can possibly increase potential for lightning-caused fire when standing, and when fallen, they increase fuel loading (Lyon 1977). These increased potentials may be hazardous in areas where fire control for maintaining bald eagle populations is necessary. There have been no studies to determine whether the hazards of snags outweigh their benefits to eagles. Snag attrition rates have been listed for lodgepole pine forests following fire (Lyon 1977). Old growth eastern white pine (*Pinus strobus*) forests in Ontario continually recruit snags in the absence of fire because of their uneven-aged structure (Quinby 1991). Catastrophic fires in mature and old growth forests can create even-aged conditions that may stop continuous snag recruitment (Quinby 1991).

- **Trophic Relationships—**heterotrophic consumer, secondary consumer (primary predator or primary carnivore of vertebrates), piscivorous (fish eater); ovivorous (egg eater), carrion feeder.

- **Key Ecological Role—**pirates food from other species, controls terrestrial vertebrate populations (through predation or displacement), provides primary creation of aerial structures (which are possibly used by other organisms).

2.3.9.2 Gray Wolf (Canis lupus)

The gray wolf (*Canis lupus*) was listed as threatened under the ESA on March 11, 1967 (32 FR 4001). On November 18 and 22, 1994, areas in Idaho, Montana, and Wyoming were designated as nonessential experimental populations in order to initiate gray wolf reintroduction projects in central Idaho and the Greater Yellowstone Area (59 FR 60252, 59 FR 60266). Special regulations for the experimental populations allow flexible management of wolves, including authorization for private citizens to take wolves in the act of attacking livestock on private land.

The gray wolf is a social species, normally living in packs of 2 to 12 wolves. Packs tend to occupy a territory of 500 to 1,000 square kilometers and defend this area from other packs and individual wolves. Packs are primarily family groups consisting of a breeding pair, their pups from the current year, offspring from the previous year, and occasionally an unrelated wolf. Normally, only the top-ranking (alpha) male and female in each pack breed and produce pups. A pack has a single litter annually of four to six pups (range 1–11 pups). Yearling wolves often disperse from their natal packs and become nomadic, covering large areas while searching for unoccupied habitat and an individual of the opposite sex to begin their own territorial pack.

- **Trophic Relationships—**heterotrophic consumer, primary consumer (herbivore), frugivore (fruit-eater), secondary consumer (primary predator or primary carnivore of vertebrates), tertiary consumer (secondary predator or secondary carnivore).

- **Key Ecological Role—**is a primary burrow excavator (fossorial or underground burrows), creates and uses trails (possibly used by other species), controls terrestrial vertebrate populations (through predation or displacement), creates feeding opportunities for other organisms.

2.3.9.3 Lynx (Lynx canadensis)

On March 24, 2000, the Canada lynx was federally listed as threatened (65 FR 16051) under the ESA. Lynx populations experience volatile swings, becoming very low about every ten years (Burt and Grossenheider

1976, Fox 1978, Mech 1980, USFWS 1994). Therefore, they can be rare in any given area at these times.

Some female lynx can breed as yearlings (Snyder 1991a). Prey scarcity may suppress breeding (Lippincott 1997). The breeding season extends between January and February and sometimes into April (Nellis *et al*. 1972, Brainerd 1985). The gestation period lasts between 62 and 74 days (Snyder 1991a). Females generally give birth in March or April, but sometimes in May or June, producing one litter of three to four kittens (Snyder 1991a). The maximum life span for a lynx is between 15 and 18 years in captivity (Snyder 1991a).

Lynx occur in both dense climax forests and second growth stands. In Alaska and Canada, they prefer boreal forests, and in the Intermountain West, they prefer spruce (*Picea* spp.)–subalpine fir (*Abies lasiocarpa*) and lodgepole pine (*Pinus contorta*) forests. Lynx are associated with dense climax forests at elevations above 1,200 m (Koehler and Brittell 1990), and they also use early seral stage communities bordering dense forests. Because their populations are closely tied to snowshoe hare (*Lepus americanus*) numbers, lynx can also be found in second growth forests when hare are numerous (DeVos and Matel 1952, Heinselman 1973).

Lynx require a mix of early and late seral habitats to meet their food and cover needs. Early seral habitats provide the lynx with a prey base, while mature forests provide denning space and hiding cover (Snyder 1991a). Pockets of dense forest must be interspersed with prey habitat. Lynx den in rotten logs, beneath tree roots, and in rock crevices. Koehler (1990) reported that lynx use forests having a high density of downfall logs (more than 40 logs/46 m^2 lying 0.3–1.3 m above the ground).

Lynx prey primarily on snowshoe hare. Their diet also includes ducks (*Anas* spp.); upland game birds (especially grouse [*Dendragapus* spp.]); and various forest rodents, including squirrels (scuirids, spermophilids). Lynx also feed on deer (*Odocoileus* spp.), moose (*Alces alces*), and caribou (*Rangifer tarandus*) carcasses. Saunders (1963) reported that lynx are able to kill these large mammals.

Predators of lynx include people, mountain lions (*Felis concolor*), bears (*Ursus* spp.), and other lynx. Because of the cyclic nature of the population, one management strategy to ensure kitten recruitment is to put a moratorium on trapping for the three years following the declining phase of lynx (USFWS 1994).

Lynx can also be managed by managing for snowshoe hare, their primary prey. Hare populations increase dramatically following disturbance; particularly fire (Snyder 1991a). For instance, fires that create snowshoe hare cover and food generally benefit lynx (Heinselman 1973, Koehler and Brittell 1990). Fire may have negative short-term effects by eliminating cover for snowshoe hare and lynx. However, as succession progresses and snowshoe hares become abundant, lynx benefit. Lynx usually do not cross openings greater than 90 m, and they use travel corridors with tree densities of 450 per hectare. Therefore, fires or logging operations that create large openings without leaving travel corridors between pockets of dense forest may be detrimental to lynx (DeVos and Matel 1952, Saunders 1963, Grange 1965, Deems and Pursley 1978).

- **Trophic Relationships—**heterotrophic consumer, secondary consumer (primary predator or primary carnivore), vertebrate eater (consumer or predator of herbivorous vertebrates).

- **Key Ecological Role—**is an apex predator, is an indicator of specific habitat elements, uses runways created by other species.

2.3.9.4 Grizzly Bear (*Ursus arctos horribilis*)

The grizzly bear (*Ursus arctos horribilis*) was first listed as endangered in the conterminous United States (lower 48 states) on March 11, 1967 (32 FR 4001). Less than a decade later on July 28, 1975, the grizzly bear was listed as threatened (40 FR 31734). Within the area covered by this listing, this species occurs in Idaho, Montana, Washington, and Wyoming. On November 17, 2000, the U.S. Fish and Wildlife Service published a final rule (65 FR 69644) to designate a grizzly bear nonessential, experimental population in the Selway-Bitterroot ecosystem. Later, the agency published a notice of intent (June 22, 2001, 66 FR 33623) to reevaluate its decision to establish an experimental population of grizzly bears in east-central Idaho and western Montana.

The grizzly bear tends to be crepuscular, with the least activity occurring at midday (Snyder 1991b). Grizzly bears hibernate, entering their dens in October and emerging in May. The total time in hibernation depends on food availability, weather conditions, and sex (Snyder 1991b). Grizzly bears may emerge from their den early if disturbed by human activity. Grizzly bears dig their own den, usually excavated in hillsides, although dens are also made in rock caves, in downfall timber, and beneath trees and stumps (Willard and Herman 1977, Servheen 1981).

Grizzly bears breed between May and July, usually in two- to four-year intervals. Implantation is delayed, and gestation lasts about 184 days (Snyder 1991b). The birthing season is in late November through February. Litter size varies from one to four cubs, with two cubs being the most common. The cubs remain with the female for the first two winters. The age of maturity for female grizzly bears is between 5 and 8 years (Snyder 1991b). The average life span of a grizzly bear is 25 years, or more in captivity (Jonkel 1978, Servheen 1981, Craighead and Mitchell 1987).

Although timber is an important habitat component, grizzly bears prefer more open habitats. Timbered plant communities most frequented by grizzly bears include subalpine fir (*Abies lasiocarpa*)-whitebark pine (*Pinus albicaulis*), lodgepole pine (*P. contorta*)-Douglas-fir (*Pseudotsuga menziesii*), and spruce (*Picea* spp.)-western red cedar (*Thuja plicata*)-hemlock (*Tsuga* spp.) forests. Sedge (*Carex* spp.)-bluegrass (*Poa* spp.) meadows are also important, as well as shrubfields and lowland high-elevation riparian communities (Willard and Herman 1977, Blanchard 1980, McLellan and Shackleton 1988). The bears typically choose low-elevation riparian sites, wet meadows, and alluvial plains during spring (Willard and Herman 1977, Reichert 1989). During summer and fall, grizzly bears more frequently use high-elevation meadows, ridges, and open, grassy timbered sites (Servheen 1983, Reichert 1989).

Optimal grizzly bear covers are wooded areas interspersed with grassland and shrubland. Ruediger and Mealy (1978) defined hiding cover as that capable of hiding an animal of 61 m or less in an area of 12 to 20 hectares. Thermal cover was defined as coniferous trees at least 12 m tall with a 70% canopy cover in a 3- to 20-hectare area. Ruediger and Mealy (1978) recommended maintaining 30% of grizzly bear habitat as cover. Graham (1978) found that in Yellowstone National Park, grizzly bears preferred open areas that were within 50 m of cover. McLellan and Shakleton (1988) reported that the bears use areas within 100 m of roads during the day but that darkness is sufficient "cover" for road use at night. Grizzly bear use daybeds in timbered areas that are near feeding sites (Blanchard 1980, Reichert 1989).

Grizzly bears eat primarily grasses, forbs, roots, tubers, and fruits. They also eat carrion, grubs, insects (particularly army cutworm moths [Noctuidae] and ladybird beetles [Coccinelidae]), fish, small rodents, various bird species, and garbage (Zager and Jonkel 1983). Adult males also prey on black bears and subordinate grizzly bears (Hechtel 1985). Orchards, beehives, and crops may be damaged by grizzly bears; they may also prey on livestock (Jonkel 1978, Servheen 1983). Some of the more common plant foods are russet buffaloberry (*Shepherdia canadensis*), Saskatoon serviceberry (*Amelanchier alnifolia*), Sitka mountain ash (*Sorbus sitchensis*), snowberry (*Symphoricarpos* spp.), hawthorn (*Crataegus* spp.), honeysuckle (*Lonicera* spp.), whitebark pine seeds, pine (Pinaceae) vascular cambium, willow (*Salix* spp.), dogwood (*Cornus* spp.), huckleberry and blueberry (*Vaccinium* spp.), dandelion (*Taraxacum* spp.), sweetvetch (*Hedysarum* spp.), clover (*Trifolium* spp.), cowparsnip (*Heracleum* spp.), glacier lily (*Erythronium grandiflorum*), horsetail (*Equisetum* spp.), lomatium (*Lomatium* spp.), kinnikinnick (*Arctostaphylos uva-ursi*), strawberry (*Fragaria* spp.), buckthorn (*Rhamnus* spp.), paintbrush (*Castilleja* spp.), thistle (*Cirsium* spp.), fritillary (*Fritillaria* spp.), boykinia (*Boykinia richardsonii*), and sheathed cottonsedge (*Eriophorum vaginatum*) (Graham 1978, Zager 1980, Servheen 1983, Hechtel 1985, Craighead and Mitchell 1987).

Grizzly bear predators include humans and other grizzly bears (Jonkel 1978).

Grizzly bears have a low reproductive rate and late maturation age, which make them susceptible to overharvesting (Snyder 1991b). Also, many grizzly bears are poached or hit by cars and trains. Other factors contributing to the bear's decline are habitat use and disturbance by humans, both for commercial and recreational purposes, and fire control, which in some instances can result in reduced acres of food-rich seral shrubfields (Jonkel 1978, Knight 1980, Zager *et al*. 1983). Grizzly bears have been known to prey on livestock where their ranges overlap with areas containing livestock and to occasionally kill humans as a result of chance encounters, usually in the backcountry. Because of conflicts between grizzly bears and humans, grizzly bear habitat should be isolated from developed areas and preferably be located in areas that receive only light recreational, logging, or livestock use (Spowart and Samson 1986).

- **Trophic Relationships**—heterotrophic consumer, primary consumer (herbivore), spermivore, frugivore, root feeder, secondary consumer (primary predator or primary carnivore of terrestrial invertebrate and vertebrate species), piscivorous (fish eater), carrion feeder, cannibalistic.

- **Key Ecological Role**—is a primary burrow excavator (fossorial or underground burrows), uses trails created by other species, controls terrestrial vertebrate populations (through predation or displacement), disperses seeds/fruits (through ingestion or caching), creates feeding opportunities (other than direct prey relations).

2.4 Environmental Conditions

Natural ecosystems are enormously intricate. The complex mosaic of habitats within the Interior Columbia River basin results from the interaction of soil and vegetative characteristics, climate, wind, fire, wildlife, and human activity. All of these variables contribute to the "proper" functioning of these systems, which develop in a variety of ways over time. The natural pathways of development in these habitats produce diverse ecosystems, which are extremely productive in terms of both biological resources and useful products for society (Carey *et al*. 1996).

Over the past century, however, humans have become an increasingly significant factor in how these systems function by disturbing and accentuating many of these ecological processes and interactions. As anthropomorphic processes modify the pathways and patterns of ecosystem development and succession, the structure of the system has become simplified (Carey *et al*. 1996). Simplification and loss of diversity has, in turn, led to the loss or potential loss of plant, animal, and fish species and reduced the ability of the land and waters to provide continued, predictable flows of resources that contribute to both traditional and current human values and demands (USFS 1996).

An ecosystem is defined as a community of plants, animals, and other living organisms and their physical environment. In many ways, the physical environment determines what the ecosystem is or can be. The geology of the Upper Snake province and the natural processes that continue to shape the subbasins of that province today are major influences on the aquatic ecosystem. The province's natural physical features change considerably over the length and breadth of the subbasins. The geology and geomorphology of the Upper Snake province are described in section 1.

The Upper Snake province is characterized at the subbasin scale by the habitats and areas summarized in Table 2-1. For assessment purposes, habitat analyses were conducted at the watershed scale in terms of the following focal habitat classifications: aquatic habitats, riparian/herbaceous wetlands, open water, shrub-steppe, pine/fir forests, juniper/mountain mahogany, whitebark pine, aspen, and mountain brush (Figure 2-31).

2.4.1 Snake Headwaters Subbasin

2.4.1.1 Greys–Hoback (GHB)

Aquatic—Information for this section was taken from WGFD (2004).

The Greys River drainage is a natural, free-flowing system with some areas of channel entrainment due to road construction. The basin has areas of lateral channel migration and areas of large woody debris accumulation. Most of the drainage is characterized by large cobble substrate. Boulder-rubble substrates dominate in the canyon sections. The minimum stream flows needed to maintain or improve existing conditions in the Greys River at critical flows are 350 cfs between April and June and 204 cfs for the remaining months (Bradshaw and Annear 1993). The Little Greys River drainage is a stable, free-flowing system with generally stable channels. The watershed is erosive with soils containing a lot of clay. Overgrazing is notable along Greyback Ridge. There are pockets of suitable spawning gravels, with the better gravels above and including Steer Creek. Other tributaries lack good spawning or holding habitats. The area has a poor pool-to-riffle ratio (< 30% pools). Standing water is limited to shallow eutrophic catch basins.

The upper Greys–Hoback watershed is predominantly alpine tundra. Spawning for standing waters is limited and generally in outlet streams. Water exchange is usually associated only with spring runoff. The canyon sections of streams are contained largely in bedrock formations with large rubble-boulder substrate and few areas of gravel. The streambanks are steep and timbered. Meadow sections exhibit a relatively high degree of lateral migration in alluvial floodplains with willows. Cobble-gravel-sand substrates dominate, resulting in unstable channels with poor development. The entire system is considered high gradient with poor wintering habitat and high seasonal flow variation. Tributaries are subject to heavy silt loads when there is precipitation. Such loading is the result of oil exploration/timber roading, as well as some overgrazing, and unstable lands and avalanches. Heavy silt loads are particularly common on Cliff Creek and upstream from Bondurant. Channel manipulation and dewatering is common from Deadshot Ranch to the Elkhorn Store (near the confluence of Dell Creek). Standing water in the Hoback River drainage consists of alpine lakes located in the Gros Ventre Wilderness.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Greys–Hoback watershed results from various forms of development and/or conversion within the floodplain. Ninety-one points of water diversion have been constructed in the Greys–Hoback watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. This watershed is located in the more remote areas of the Snake Headwaters subbasin, so anthropogenic influences are less pronounced. Current estimates of riparian/herbaceous wetland habitat composition in the watershed amount to nearly 3%. **Open Water—**Open water habitats are not a significant component of the landscape in the Greys–Hoback watershed. Two dams on Flat Creek and the Snake River in Teton County have created approximately 66 acres (27 ha) of open water habitat.

Shrub-Steppe—Shrub-steppe habitats currently comprise 12% of the landscape in the Greys–Hoback watershed. According to the best estimates, shrub-steppe habitats have increased nearly 2,600% from historical conditions. Increases may be attributed to two components of an altered fire regime. Stand replacement fires have burned approximately 5% of the Greys–Hoback watershed, and when fires are suppressed, the shrub component of grassland habitat expands at the expense of native grassland habitat. Regardless, the quality of remaining shrub-steppe habitat is severely reduced from the historical condition (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (dry, mature)—Pine/fir forests are the most significant habitats in the Greys–Hoback watershed, amounting to over 50% of the vegetative composition. According to the best data available, pine/fir forests have increased 142% from historical conditions. The quality of the pine/fir forest habitat has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of Douglas-fir and lodgepole pine habitat. Historically, this habitat was mostly open and park-like, with relatively few undergrowth trees. It was the predominant landscape feature. Timber harvest activities in the watershed during the 1900s selectively harvested the mature stands, while other factors limit reestablishment of normal forest successional processes. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Greys–Hoback watershed. The western juniper component of the habitat is at the northern periphery of its range in the Snake Headwaters subbasin; however, it continues to expand its range due in large part to an altered fire regime. The lengthened fire-return intervals give western junipers a competitive advantage over the shrub/forb vegetation. According to the best available information, the western juniper component has decreased 100% from historical conditions. The mountain mahogany component is not a significant vegetative element in the Greys–Hoback watershed.

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Greys–Hoback watershed at alpine and subalpine elevations but they are not a significant vegetative element on the landscape. According to the best available information, whitebark pine habitat has declined 100% from historical conditions due to blister rust and an altered fire regime.

Aspen—Aspen habitat is a patchily distributed resource in the Greys–Hoback watershed. This habitat is a prominent component of the landscape in the Snake Headwaters subbasin and currently comprises 5% of the landscape in the Greys–Hoback watershed. It has been estimated that aspen habitats in the Greys–Hoback watershed have decreased 92% from historical conditions due primarily to the effects of an altered fire regime.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Greys–Hoback watershed. According to the best available data, the mountain brush habitats currently comprise less than 1% of the habitat in the Greys–Hoback watershed.

2.4.1.2 Gros Ventre (GVT)

Aquatic—The Gros Ventre River is relatively stable above the town of Kelly. Downstream the river enters a floodplain area where the river channel is relatively unstable and braided, with broad channels and large cobble substrate. Results from instream flow work conducted by Annear and Bradshaw (1992) indicated that the lower stretches of the Gros Ventre River have considerably less productive potential than most trout streams in Wyoming. There are few suitable spawning substrates in the Gros Ventre River proper, with large cobble, rubble, boulder, and bedrock being the primary substrates. Silt and sand commonly choke gravel deposition areas. The land mass is generally unstable and subject to erosion during precipitation events throughout the drainage. This instability is aggravated by timber harvest and roading. There are stable banks in canyon sections. A channel with lateral migration/braiding is notable in glacial-cobble alluvium through Grand Teton National Park/National Elk Refuge. The basin is generally high gradient with poor pool-riffle ratios (< 30% pools). There are ice problems similar to those of the Hoback River drainage. Also, there are considerable diversions downstream from Lower Slide Lake. Most standing water in the Gros Ventre watershed is situated in the alpine tundra, with water exchange limited to spring runoff. The majority of lakes fail to overwinter fish. Lower Slide Lake is losing depth due to increased silt deposition in the upper reaches since the river has bypassed Upper Slide Lake.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Gros Ventre watershed results from various forms of development and/or conversion within the floodplain. Five points of water diversion have been constructed in the Gros Ventre watershed for irrigation purposes. This watershed is located in the more remote areas of the Snake Headwaters subbasin, so anthropogenic influences are less pronounced, and the diversions are few. Current estimates of riparian/herbaceous habitat composition in the watershed amount to 3%. **Open Water—** Open water habitat encompasses less than 1% of the landscape in the Gros Ventre watershed. It is assumed that all open water habitat in the watershed is naturally occurring. **Shrub-steppe—**Shrub-steppe habitats currently comprise 6% of the landscape in the Gros Ventre watershed. According to the best estimates, shrub-steppe habitat has increased nearly 3,087% from historical conditions. Shrub-steppe habitat increases may be attributed to two components of an altered fire regime. Stand replacement fires have burned approximately 5% of the Gros Ventre watershed, and when fires are suppressed, the shrub component of grassland habitat expands at the expense of native grassland habitat. Regardless, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (dry, mature)—Pine/fir forests are the most significant habitats in the Gros Ventre watershed, amounting to one-third of the vegetative composition. Based on the best data available, this habitat has increased 58% from historical conditions. The quality of the pine/fir forest habitat has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires.

Historically, this habitat was mostly open and park-like, with relatively little undergrowth trees. Timber harvest activities in the watershed during the last century selectively harvested the mature stands, while other factors limit reestablishment of normal forest successional processes. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Gros Ventre watershed. The western juniper component of the habitat is at the northern periphery of its range in the Snake Headwaters subbasin; however, it continues to expand its range due in large part to an altered fire regime. The lengthened fire-return intervals give junipers a competitive advantage over the shrub/forb vegetation. According to the best available information, the western juniper component has decreased 100% from historical conditions. The mountain mahogany component is not a significant vegetative element in the Gros Ventre watershed.

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Gros Ventre watershed at alpine and subalpine elevations but it is not a significant vegetative element on the landscape. According to the best available information, whitebark pine habitat has declined 100% from historical conditions due to blister rust and an altered fire regime.

Aspen—Aspen habitat is a patchily distributed resource in the Gros Ventre watershed but a prominent component of the landscape in portions of the Snake Headwaters subbasin where it comprises 1% of the vegetative composition. It has been estimated that aspen habitats in the Gros Ventre watershed have decreased 94% from historical conditions primarily due to the effects of an altered fire regime.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Gros Ventre watershed. According to the best available data, the mountain brush habitats currently comprise less than 1% of the habitat in the Gros Ventre watershed.

2.4.1.3 Palisades (PAL)

Aquatic— The Palisades watershed contains the South Fork of the Snake River downstream from Palisades Dam, Palisades Reservoir and tributaries to the River and Reservoir. Flows in the South Fork Snake are controlled by flows from the dam. Altered flows appear to favor reproduction of rainbow trout, which have been increasing in numbers in recent years. A collaborative effort is underway to change winter and spring flow management in an attempt to reduce habitat suitability for rainbow trout spawning and early rearing. Palisades Dam has no fish passage which blocked fish access to spawning tributaries above the dam. Some culverts under Highway 26 can become impassable to fish depending on reservoir levels. Most tributary habitat in the watershed is in good shape.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Palisades watershed results from various forms of development and/or conversion within the floodplain. Three hundred fifty-one points of water diversion have been constructed in the Palisades watershed for irrigation purposes. The most significant of the diversions is Palisades Dam, whose regulated flows have significant ramifications for hydrologic processes, maintenance of cottonwood riparian habitats within the historic floodplain, and wetland structure and function in the watershed. Current estimates of riparian/herbaceous habitat composition in the watershed amount to nearly 3%. Innundation of the Snake River by the construction of Palisades dam resulted in significant losses of riparian habitats and species.

Open Water—Open water habitat comprises 2% of the landscape in the Palisades watershed. Most of this habitat was created when Palisades Dam created over 16,000 acres (6,475 ha) of open water habitat when it was completed in 1958. This is an increase of 2,100% from historical conditions. An additional 10 acres (4 ha) of open water habitat was created when the Antelope Creek dam was completed in 1991. Water level manipulations affect aquatic habitat quantity and quality in the Palisades watershed by altering upstream and downstream hydrologic processes.

Shrub-steppe—Shrub-steppe habitats currently comprise 14% of the landscape in the Palisades watershed. According to the best estimates, shrub-steppe habitat has increased nearly 1,929% from historical conditions. Shrub-steppe habitat increases may be attributed to two components of an altered fire regime. Stand replacement fires have burned approximately 3% of the Palisades watershed, and when fires are suppressed, the shrub component of grassland habitat expands at the expense of native grassland habitat. Regardless, the quality of remaining shrub-steppe habitat is severely reduced from historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (dry, mature)—Pine/fir forests are significant habitats in the Palisades watershed, amounting to 20% of the vegetative composition. Based on the best data available, this habitat has decreased 35% from historical conditions. Historically, this habitat was mostly open and park-like, with relatively little undergrowth trees. Timber harvest activities in the watershed during the last century selectively harvested the mature stands, while other factors limit reestablishment of normal forest successional processes. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Palisades watershed. The western juniper component of the habitat is at the northern periphery of its range in the Snake Headwaters subbasin; however, it continues to expand its range due in large part to an altered fire regime. The lengthened fire-return intervals give junipers a competitive advantage over the shrub/forb vegetation. The mountain mahogany component is not a significant vegetative element in the Palisades watershed.

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Palisades watershed at alpine and subalpine elevations. Whitebark pine habitat is not a significant vegetative element on the landscape. Less than 1% of the watershed contains whitebark pine habitat. According to the best available information, whitebark pine habitat has declined 81% from historical conditions due to blister rust and an altered fire regime.

Aspen—Aspen habitats are broadly distributed resources in the Palisades watershed. Aspen habitat is a prominent vegetative component and currently comprises 20% of the vegetative landscape. It has been estimated that aspen habitats in the Palisades watershed have decreased 38% from historical conditions primarily due to the effects of an altered fire regime.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape, and they are not a significant vegetative component of that landscape in the Palisades watershed. According to the best available data, the mountain brush habitats currently comprise less than 1% of the habitat in the Palisades watershed and have increased 589% from historical conditions.

2.4.1.4 Salt (SAL)

Aquatic—This information was taken from WGFD (2004).

The Lower Salt River Basin covers 334 square miles (865 km^2) and includes the Salt River drainage below Fairview, Wyoming. The Salt River is dewatered for approximately 4 miles near Fairview due to diversions. Headwaters originate on the west slope of the Salt River Range in the Bridger-Teton National Forest. The practice of willow removal in the past has resulted in degraded streambanks. Revetments have helped to stabilize the streambanks; however, the area is still subject to slumping due largely to agricultural and grazing practices. The Salt River tends to cut laterally and fill pools rather than form good point and lateral bars. There are some large woody debris piles for overhead cover. There is a general lack of bedform variability for a stream of this size. An abundance of fines has resulted in few clean gravel beds. Reservoirs comprise the majority of standing waters, with a few alpine lakes that lack adequate spawning. The headwater streams are fairly stable but tend to be intermittent or small, with a low carrying capacity.

The Upper Salt River Basin is a natural, free-flowing system above Highway 89. The area has fairly stable banks and channel development. Large woody debris piles and undercut banks are adequate for the existing population. There is fairly large rubble/boulder substrate in the canyon reaches and fair to good gravels in the meadow reaches.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Salt watershed results from various forms of development and/or conversion within the floodplain. Two hundred ninety-eight points of water diversion have been constructed in the Salt watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Nineteen miles of riparian habitat were destroyed by mechanical and chemical means during the middle part of the 1900s. Current estimates of riparian/herbaceous wetland habitat composition in the watershed amount to 2% of the landscape. **Open Water—**Open water habitat encompasses less than 1% of the landscape in the Salt watershed. Collectively, 6 dams in the Salt watershed created approximately 575 acres (233 ha) of open water habitat. Lake levels may be stabilized or manipulated at any time of the year for recreation, power, and irrigation. Water level manipulations affect aquatic habitat quantity and quality in the Salt watershed by altering upstream and downstream hydrologic processes.

Shrub-Steppe—Shrub-steppe habitats currently comprise 8% of the landscape in the Salt watershed. According to the best estimates, shrub-steppe habitat has increased nearly 2,359% from historical conditions. Shrub-steppe habitat increases may be attributed to altered fire regimes. Stand replacement fires have burned approximately 1% of the Salt watershed, and when fires are suppressed, the shrub component of grassland habitat expands at the expense of native grassland habitat. Regardless, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (dry, mature)—Pine/fir forests are the most significant habitats in the Salt watershed, amounting to 17% of the vegetative composition. Based on the best data available, this habitat has decreased 31% from historical conditions. The quality of the pine/fir forest habitat has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Salt watershed. **Whitebark Pine—**Whitebark pine habitats are broadly distributed across the Salt watershed at alpine and subalpine elevations. Whitebark pine habitat is not a significant vegetative element on the landscape. Less than 1% of the watershed contains whitebark pine habitat. According to the best available information, whitebark pine habitat has declined 100% from historical conditions due to blister rust and an altered fire regime.

Aspen—Aspen habitats are broadly distributed resources in the Salt watershed. Aspen habitat is a prominent landscape component and currently comprises 12% of the watershed. It has been estimated that aspen habitats in the Salt watershed have decreased 48% from historical conditions primarily due to the effects of an altered fire regime.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Salt watershed. Mountain brush habitats currently comprise less than 1% of the habitat in the Salt watershed.

2.4.1.5 Snake Headwaters (SHW)

Aquatic—The upper Snake River basin (above Jackson Lake Dam) is a natural, free-flowing stream system. The area is subject to periodic mass wasting triggered by heavy precipitation or earthquakes. Large woody debris is common but not excessive. The stream exhibits natural meandering with a healthy riparian area. The glacial/alluvial floodplain exhibits large gravel-cobble substrate with a fair amount of suitable spawning gravel, sand, and fines. Spawning primarily occurs within the mainstem. There is adequate, but somewhat limited, spawning success resulting in a less dense population. There is virtually no standing water other than sterile alpine lakes in Grand Teton National Park along the crest of the Teton Range. Flow in the Snake River proper is regulated by Jackson Lake Dam, while all tributaries within the lower Snake River basin are free flowing. Dikes have been constructed between Moose and South Park for flood protection. The diking has resulted in channeling and loss of instream structure. The channel is continuing to deteriorate with age within the diked reach. Natural banks are relatively stable with a healthy riparian area for an alluvial/glacial floodplain. The substrate is approximately 50% cobble in the mainstem of the Snake River. The majority of suitable spawning areas occur on deeded lands in Spring Creek tributaries between the Hoback River and Cottonwood Creek. Diversions are of little effect. Tributaries within the canyon reach (Hoback River to Palisades Reservoir) are high gradient with limited potential. Most standing water is located within Grand Teton National Park.

Riparian/Herbaceous Wetlands—Twenty-six points of water diversion have been constructed in the Snake Headwaters watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Current estimates of riparian/herbaceous habitat composition in the watershed amount to 3%. This watershed is located in the more remote areas of the Snake Headwaters subbasin and contains both Yellowstone and Grand Teton National Parks, so anthropogenic influences are less pronounced.

Open Water—Open water habitat encompasses approximately 6% of the landscape in the Snake Headwaters watershed. Proportionally, the Snake Headwaters watershed has the greatest amount of open water habitat of Upper Snake province watersheds. Most of this habitat was created when Jackson Lake Dam was completed in 1911, creating over 25,000 acres (10,117 ha) of open water habitat. An additional 1,380 acres (558 ha) were created by the construction of dams on Randolf Creek, Wallace Creek, Spread Creek, and Leidy Creek. Lake levels may be stabilized or manipulated at any time of the year for recreation, power, and irrigation, affecting aquatic habitat quantity and quality by altering upstream and downstream hydrologic processes.

Shrub-Steppe—Shrub-steppe habitats currently comprise 4% of the landscape in the Snake Headwaters watershed. According to the best estimates, shrub-steppe habitat has increased nearly 1,143% from historical conditions. Shrub-steppe habitat increases may be attributed to two components of an altered fire regime. Stand replacement fires have burned approximately 5% of the Snake Headwaters watershed, and when fires are suppressed, the shrub component of grassland habitat expands at the expense of native grassland habitat. The quality of remaining shrub-steppe habitat is severely reduced from the historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (dry, mature)—Pine/fir forests are the most significant habitats in the Snake Headwaters watershed, amounting to 65% of the vegetative composition. Based on the best data available, this habitat has increased 68% from historical conditions.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Snake Headwaters watershed. The western juniper component of the habitat is at the northern periphery of its range in the Snake Headwaters subbasin; however, it continues to expand its range due in large part to an altered fire regime. **Whitebark Pine—**Whitebark pine habitats are broadly distributed across the Snake Headwaters watershed at alpine and subalpine elevations. The Snake Headwaters watershed contains the greatest proportion (3%) of whitebark pine habitat of all Upper Snake province watersheds. Whitebark pine habitat has declined 91% from historical conditions due to blister rust and an altered fire regime.

Aspen—Aspen habitats are a patchily distributed resource in the Snake Headwaters watershed and are not a significant component in the watershed. **Mountain Brush—**Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Snake Headwaters watershed.

2.4.2 Upper Snake Subbasin

2.4.2.1 American Falls (AMF)

Aquatic—American Falls Reservoir covers 58,078 surface acres and has a usable storage of 1,671,300 acre-feet. The Snake River from the backwaters of American Falls Reservoir upstream to Tilden Bridge, a distance of approximately 20 miles (32 km), is considered an excellent trout stream. Numerous springs arise on the Fort Hall Bottoms, located near the upper end of American Falls Reservoir and between the Portneuf River on the south and the Snake River on the north. These springs produce approximately 1,800,000 acre-feet of water annually, more than enough to fill American Falls Reservoir. The two largest of the reservation springs are Clear Creek (7 miles [11 km] long) and Spring Creek (11 miles [18 km] long). These creeks are considered high-quality spawning and rearing streams and managed by the Shoshone-Bannock Tribes. The Snake River flows 37 river miles (60 km) from Tilden Bridge to the Gem State Power Dam and runs through a mixed cottonwood riparian community. Water is diverted from the river at numerous points in this reach. During the irrigation season and early fall, river flows vary depending on amount released from upriver storage and amount diverted at each canal.

Riparian/Herbaceous Wetlands—Five hundred points of water diversion have been constructed in the American Falls watershed for irrigation purposes. The most significant diversion is American Falls Dam. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Current estimates of riparian/herbaceous wetland habitat composition in the watershed amount to 3%.

Open Water—Open water habitat comprises 2% of the landscape in the American Falls watershed. Collectively, 6 dams in the watershed created approximately 387 acres (157 ha) of open water habitat. **Shrub-Steppe—**Shrub-steppe habitats currently comprise nearly 45% of the landscape in the American Falls watershed. According to the best estimates, shrub-steppe habitat has decreased nearly 52% from historical conditions. Shrub-steppe habitat decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture, inundation from American Falls Reservoir, and significant losses from rangeland fires during the previous century. Furthermore, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions, mostly by livestock grazing and noxious weeds (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are not a significant vegetative component in the American Falls watershed, amounting to just 1% of the landscape. **Juniper/Mountain Mahogany—**The juniper/mountain mahogany woodland habitat is a minor vegetative element in the American Falls watershed. Approximately 1% of the current landscape is characterized by these habitat elements. **Whitebark Pine—**Whitebark pine is not an identified vegetative element either historically or currently in the American Falls watershed.

Aspen—Aspen habitat is a patchily distributed resource associated with riparian habitats in the American Falls watershed. Current estimates of aspen habitat composition in the watershed amount to slightly more than 1%. **Mountain Brush—**Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the American Falls watershed. According to the best available data, the mountain brush habitats currently comprise less than 1% of the habitat in the American Falls watershed. Mountain brush habitat gains have been estimated to be 165% from historical conditions.

2.4.2.2 Blackfoot (BFT)

Aquatic—The Blackfoot River and tributaries total 346 miles (557 km), covering 734 surface acres. Blackfoot Reservoir covers 19,000 surface acres and contains 350,000 acre-feet of water at full capacity. The Blackfoot River is the reservoir's major tributary and has a mean annual flow of 168 cfs. The river upstream from the reservoir extends 35 miles (56 km) to its origin at the confluence of Lane and Diamond creeks. Habitat conditions are generally fair in the upper river and tributaries, with a few exceptions due to livestock grazing and irrigation diversions. One of the largest phosphate ore reserves in the United States is located in this drainage. Environmental problems associated with phosphate mining have been minimal to date. However, there is an ongoing investigation into effects of selenium from mines on the fish and wildlife in the upper Blackfoot River drainage.

Riparian/Herbaceous Wetlands—Five hundred fifty points of water diversion have been constructed in the Blackfoot watershed for irrigation purposes. The most significant diversion is Blackfoot Dam. Current estimates of riparian/herbaceous habitat composition in the watershed amount to 3%. **Open Water—**Open water habitat comprises 2% of the landscape in the Blackfoot watershed. Most of this habitat was created when Blackfoot dam was completed in 1925, creating approximately 36,000 acres (14,569 ha) of open water habitat with the formation of Blackfoot Reservoir. An additional 742 acres (300 ha) of open water habitat was created when dams were completed on the Bear River, Cutoff Canyon Creek, Chicken Creek, Angus Creek, and the Blackfoot River.

Shrub-Steppe—Shrub-steppe habitats currently comprise nearly 61% of the landscape in the Blackfoot watershed. According to the best estimates, shrub-steppe habitat has decreased nearly 3% from historical conditions. Decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture, inundation from Blackfoot Reservoir, and losses to rangeland fires during the previous century. Furthermore, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions by livestock grazing (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are not a significant vegetative component in the Blackfoot watershed, amounting to less than 5% of the landscape. However, based on the best available data, this habitat has increased 16% from historical conditions. The habitat increase may be a result of an altered fire regime that has allowed localized patches of forest to expand at the expense of shrub-steppe or grassland habitats. The quality of the pine/fir forest habitat has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Blackfoot watershed. Less than 1% of the current landscape is characterized by these habitat elements. Based on the best available data, juniper/mountain mahogany habitat has decreased 73% from historical conditions.
Whitebark Pine—Whitebark pine is not an identified vegetative element either historically or currently in the Blackfoot watershed.

Aspen—Aspen habitat is a prominent, although patchily distributed, resource in the Blackfoot watershed. Current estimates of landscape composition amount to 11% in the watershed. It has been estimated that aspen habitats in the Blackfoot watershed have decreased 62% from historical conditions primarily due to the effects of an altered fire regime.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Blackfoot watershed.

2.4.2.3 Goose (GSE)

Aquatic—Goose Creek begins in Idaho, flows southward into Nevada, turns and flows northward back into Idaho, and then flows northward through high desert until it empties into Lower Goose Creek (Oakley) Reservoir. This reservoir stores water for irrigation and flood control and supports a fishery of stocked rainbow trout and some cutthroat trout. Goose Creek is the major stream in the watershed. Historically, Goose Creek connected to the Snake River; currently, Goose Creek ends at Oakley Reservoir. There is minimal stream habitat remaining downstream of Oakley Reservoir. Headwater tributaries are thought to be in good condition. Big Cottonwood and Dry creeks are tributaries to the Snake River in the Goose watershed that were isolated by Murtaugh Reservoir.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Goose watershed results from various forms of development and/or conversion within the floodplain. Eleven hundred points of water diversion have been constructed in the Goose watershed for irrigation purposes. Current estimates of riparian/herbaceous habitat composition in the watershed amount to less than 1%. Data limitations prevent an accurate or precise quantification of the direct and indirect losses of riparian/herbaceous wetland habitat in the Goose watershed (Appendix 2-1).

Open Water—Open water habitat encompasses less than 1% of the landscape in the Goose watershed.

Goose Creek Reservoir provides the only significant source of open water habitat in the watershed. Approximately 1,350 acres (546 ha) of habitat were created when Goose Creek Dam was completed in 1916. Lake levels may be stabilized or manipulated at any time of the year for recreation, power, and irrigation. Water level manipulations affect aquatic habitat quantity and quality in the watershed by altering upstream and downstream hydrologic processes.

Shrub-Steppe—Shrub-steppe habitats currently comprise nearly 65% of the landscape in the Goose watershed. According to the best estimates, shrub-steppe habitat has decreased nearly 27% from historical conditions. Decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture and losses from rangeland fires during the previous century. Furthermore, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are not a significant vegetative component in the Goose watershed, amounting to less than 2% of the landscape. However, based on the best available data, this habitat has increased 341% from historical conditions. These habitat increases may be a result of an altered fire regime that has allowed localized patches of forest to expand at the expense of shrub-steppe or grassland habitats. Historically, this habitat was mostly open and park-like, with relatively little undergrowth. Timber harvest activities in the watershed during the last century selectively harvested the mature stands, while other factors limit reestablishment of normal forest successional processes. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat becomes increasingly significant in terms of vegetative composition in the southern portions of the Upper Snake province. In the Goose watershed, juniper/mountain mahogany vegetative composition is estimated to be greater than 7%. Based on the best available data, juniper/mountain mahogany habitat has increased 15% from historical conditions. Juniper/mountain mahogany expansion is largely attributed to an altered fire regime that no longer inhibits the expansion of this habitat, an expansion at the expense of the shrub-steppe and native grassland habitats.

Whitebark Pine—Whitebark pine is not an identified vegetative element either historically or currently in the Goose watershed.

Aspen—Aspen habitats are a patchily distributed resource in the Goose watershed. Aspen habitat is not a significant component in the watershed and currently comprises 1% of the landscape. It has been estimated that aspen habitats in the Goose watershed have decreased 58% from historical conditions primarily due to the effects of an altered fire regime.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Goose watershed.

2.4.2.4 Idaho Falls (IFA)

Aquatic—The mainstem Snake River and the South Fork Snake River downstream from Heise are in this watershed. Three low-head power dams that do not have fish passage fragment the mainstem Snake River. Habitat is degraded by sediment impacts from the Teton Dam collapse. The South Fork Snake River in this watershed is subject to substantial water withdrawals during irrigation season.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the

Idaho Falls watershed results from various forms of development and/or conversion within the floodplain. Twelve hundred fifty points of water diversion have been constructed in the Idaho Falls watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. **Open Water—**Open water habitat encompasses less than 1% of the landscape in the Idaho Falls watershed. Collectively, 5 dams in the watershed created approximately 856 acres (346 ha) of open water habitat. **Shrub-Steppe—**Shrub-steppe habitats currently comprise nearly 22% of the landscape in the Idaho Falls watershed. According to the best estimates, shrub-steppe habitat has decreased nearly 76% from historical conditions. Decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture and losses from rangeland fires during the previous century. Also, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are not a significant vegetative component in the Idaho Falls watershed, amounting to less than 1% of the landscape. Based on the best available data, this habitat has decreased 92% from historical conditions. **Juniper/Mountain Mahogany—**The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Idaho Falls watershed. Less than 1% of the current landscape is characterized by these habitat elements. **Whitebark Pine—**Whitebark pine is not an identified vegetative element either historically or currently in the Idaho Falls watershed.

Aspen—Aspen habitat is a patchily distributed resource associated with riparian habitats in the Idaho Falls watershed. Current estimates of aspen habitat composition in the watershed amount to slightly more than 1%.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and are significant vegetative components of the landscape in the Idaho Falls watershed. According to the best available data, the mountain brush habitats currently comprise 3.5% of the habitat in the Idaho Falls watershed. Mountain brush habitat gains are estimated to be 1,207% from historical conditions.

2.4.2.5 Lower Henrys (LHF)

The Lower Henrys watershed includes the mainstem Henrys Fork downstream of the Ashton Dam to the confluence with the South Fork and including the Falls River drainage. The lower 4 miles of the Falls River is dewatered seasonally, while the remainder of the drainage is in good shape.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Lower Henrys watershed results from various forms of development and/or conversion within the floodplain. Five hundred fifty points of water diversion have been constructed in the Lower Henrys watershed for irrigation purposes. Current estimates of riparian/herbaceous habitat composition in the watershed amount to 3%. **Open Water—**Open water habitat encompasses less than 1% of the landscape in the Lower Henrys watershed. Collectively, 11 dams on Blue Creek, Spring Creek, Sand Creek, and the Henrys Fork have created approximately 750 acres (305 ha) of open water habitat. The most significant amount of habitat was created when Ashton Dam was completed in 1913. Lake levels may be stabilized or manipulated at any time of the year for recreation, power, and irrigation. Water level manipulations affect aquatic habitat quantity and quality in the watershed by altering upstream and downstream hydrologic processes.

Shrub-Steppe—Shrub-steppe habitats currently comprise nearly 22% of the landscape in the Lower Henrys watershed. According to the best estimates, shrub-steppe habitat has decreased nearly 75% from historical conditions. The decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture and losses from rangeland fires during the previous century. Furthermore, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are a significant vegetative component in the Lower Henrys watershed, amounting to 10% of the landscape. Based on the best available data, these habitats have increased 143% from historical conditions. However, data limitations pertaining to historical acreages of forested habitats prevent the precise quantification of habitat gains (Appendix 2-1). The quality of the pine/fir forest habitat has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Lower Henrys watershed. Less than 1% of the current landscape is characterized by these habitat elements. Based on the best available data, juniper/mountain mahogany habitat has decreased 97% from historical conditions. Frequent fires and conversion to dryland and irrigated agriculture have inhibited the expansion of the western juniper component that is common to this region. **Whitebark Pine**—Whitebark pine habitats are broadly distributed across the Lower Henrys watershed at alpine and subalpine elevations. Whitebark pine habitat is not a significant vegetative element on the landscape. Less than 1.5% of the watershed contains whitebark pine habitat. According to the best available information, whitebark pine habitat has declined 92% from historical conditions due to blister rust and an altered fire regime.

Aspen—Aspen habitat is a patchily distributed resource associated with riparian habitats in the Lower Henrys watershed. Current estimates of aspen habitat composition in the watershed amount to slightly more than 8%. Aspen habitat losses from historical conditions are estimated at 63%. These losses may be attributed primarily to reduced structure and function resulting from altered hydrologic regimes.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and are significant vegetative components of the landscape in the Lower Henrys watershed. According to the best available data, the mountain brush habitats currently comprise 15% of the habitat in the Lower Henrys watershed. Mountain brush habitat gains are estimated to be 9,218% from historical conditions.

2.4.2.6 Portneuf (PTF)

Aquatic—The Portneuf River and tributaries total 297 miles (478 km) of stream and drain nearly 1,300 square miles (3,367 km^2). There are four irrigation storage reservoirs in the watershed covering 1,704 acres (690 ha). The Portneuf River flows into American Falls Reservoir. From this confluence upriver to Siphon Road, the Portneuf River is on the Fort Hall Indian Reservation. The Shoshone-

Bannock Tribes manage reaches of the river and reservoir on this reservation. From American Falls Reservoir upstream to Pocatello, the river receives considerable spring water and has desirable water temperatures for trout. The reach from Pocatello upstream to Marsh Creek contains very few trout, receives very little fishing pressure, and is severely impacted by sediment, irrigation withdrawals, damaged streambanks, and high water temperatures. The Portneuf River, where it flows through Pocatello, was channelized and directed through a flat-bottom, vertical-sided cement flume that is a barrier to upstream movement. From the confluence of Marsh Creek upstream to the Portneuf/Marsh Valley Canal diversion, silt is less of a problem, but low flows caused by irrigation diversions adversely affect the populations of feral brown trout, the main game species in this area. Much of the sediment in the lower Portneuf River comes from Marsh Creek.

Conditions improve upriver from the Portneuf/Marsh Valley diversion since very little water is diverted upriver from here. Also, during summer, water is added to this reach from Chesterfield Reservoir for diversion approximately 20 miles (32 km) downriver at the Portneuf/Marsh Valley Canal. From the Portneuf/Marsh Valley Canal upstream to Lava Hot Springs, a distance of approximately 4 miles, the main problem for fish is severe bank erosion caused by livestock and exacerbated by full flows during the summer growing season. This area contains a mixture of hatchery and natural rainbow trout, brown trout, and cutthroat trout. The 16 miles (26 km) from Lava Hot Springs upstream to Kelly-Toponce Road Bridge once supported an excellent feral rainbow trout population and was a very popular fishery. The Portneuf River above Lava Hot Springs was at one time considered a “blue ribbon” trout stream (Mende 1989). Harvest of wild trout on the river declined in the late 1980s to a few hundred fish annually and was so low that restrictive regulations would not have been effective. The Idaho Department of Fish and Game, angler groups, the Natural Resource Conservation Service, and landowners began a cooperative effort to correct sediment problems in the Portneuf-Marsh Valley Canal Company’s “outlet canal,” the channelized reach below Chesterfield Reservoir. This reach was identified as contributing most heavily to sediment in the river below. This 10-mile reach upstream from the Kelly-Toponce Road bridge to Chesterfield Reservoir had been extensively damaged by stream channel alterations and contains few trout. From Chesterfield Reservoir upstream, the river has a base flow of less than 10 cfs and significant beaver activity.

Riparian/Herbaceous Wetlands—Thirty-one hundred points of water diversion have been constructed in the Portneuf watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Current estimates of riparian/herbaceous habitat composition in the watershed amount to less than 1%. **Open Water—**Open water habitat encompasses less than 1% of the landscape in the Portneuf watershed.

Approximately 1,700 acres (687 ha) of habitat were created by the construction of 7 dams on Yago Creek, Twentyfourmile Creek, Hawkins Creek, Wiregrass Creek, Deer Creek, and the Portneuf River. Most of the open water habitat was created (1,593 acres [645 ha]) when the Portneuf Dam was completed in 1912. All of the larger lakes and many of the smaller lakes in Idaho have dams that maintain lake levels. Lake levels may be stabilized or manipulated at any time of the year for recreation, power, and irrigation. Water level manipulations affect aquatic habitat quantity and quality in the watershed by altering upstream and downstream hydrologic processes.

Shrub-Steppe—Shrub-steppe habitats currently comprise nearly 46% of the landscape in the Portneuf watershed. Based on the best estimates, this habitat has decreased nearly 51% from historical conditions. Shrub-steppe habitat decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture and losses from rangeland fires during the previous century. Furthermore, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are not a significant vegetative component in the Portneuf watershed, amounting to less than 1% of the landscape.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Portneuf watershed. Less than 1% of the current landscape is characterized by these habitat elements. Based on the best available data, juniper/mountain mahogany habitat has decreased 14% from historical conditions. Frequent fires and conversion to dryland and irrigated agriculture have inhibited the expansion of the western juniper component that is common to this region. **Whitebark Pine—**Whitebark pine is not a significant vegetative element either historically or currently in the Portneuf watershed.

Aspen—Aspen habitats are a patchily distributed resource in the Portneuf watershed. Aspen habitat is not a significant component in the watershed and currently comprises less than 1% of the landscape. It has been estimated that aspen habitats in the Portneuf watershed have decreased 69% from historical conditions primarily due to the effects of an altered fire regime.

Mountain Brush—Mountain brush habitats are irregularly distributed and are not a significant vegetative component of that landscape in the Portneuf watershed. According to the best available data, the mountain brush habitats currently comprise less than 1% of the habitat in the Portneuf watershed.

2.4.2.7 Raft (RFT)

Aquatic—The Raft River originates in Utah, courses northward near City of Rocks, and then flows out onto the Raft River plain. As it flows northward through the high desert, it is continually dewatered. The drainage is naturally very dry (containing few perennial streams) and also subject to irrigation withdrawals. Water does not reach the river mouth; the river becomes completely dry. Sedimentation is a problem, and it is likely that temperature is also a problem because there is little riparian vegetation. There are Yellowstone cutthroat trout in the upper reaches of the drainage. Although there is little information on the Raft River system in the literature, Bell (1979) has some data on Raft River tributaries. Sublett Reservoir, a small reservoir used for water storage, has excellent rainbow and brown trout reproduction in tributary streams. Below the reservoir, river water is dissipated by withdrawals until the river is completely dewatered. Eightmile Creek and Sixmile Creek are known to support trout.

Riparian/Herbaceous Wetlands—Twenty-one hundred points of water diversion have been constructed in the Raft watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Other forms of development and/or land conversion within the 50- and 100-year floodplains impact wetland habitat quantity and quality. Current estimates of riparian/herbaceous habitat composition in the watershed amount to more than 1%.

Open Water—Open water habitat encompasses less than 1% of the landscape in the Raft watershed. Collectively, 4 dams in the watershed have created approximately 110 acres (45 ha) of habitat. Sublett Reservoir provides 89% of the open water habitat in the watershed. Lake levels may be stabilized or manipulated at any time of the year for recreation, power, and irrigation. Water level manipulations affect aquatic habitat quantity and quality in the watershed by altering upstream and downstream hydrologic processes.

Shrub-Steppe—Shrub-steppe habitats currently comprise nearly 60% of the landscape in the Raft watershed. According to the best estimates, this habitat has decreased nearly 45% from historical conditions. Shrub-steppe habitat decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture and losses from rangeland fires during the previous century. The quality of remaining shrub-steppe habitat is severely reduced from the historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are not a significant vegetative component in the Raft watershed, amounting to 6.3% of the landscape. However, based on the best available data, these habitats have increased 4.7% from historical conditions. These habitat increases may be a result of an altered fire regime that has allowed localized patches of forest to expand at the expense of shrub-steppe or grassland habitats. The pine/fir forest habitat has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires.

Historically, this habitat was mostly open and park-like, with relatively little undergrowth trees. Timber harvest activities in the watershed during the last century selectively harvested the mature stands, while other factors limit reestablishment of normal forest successional processes. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Raft watershed. Currently, 1% of the landscape is characterized by these habitat elements. Based on the best available data, juniper/mountain mahogany habitat has decreased 37% from historical conditions. Frequent fires and conversion to dryland and irrigated agriculture have inhibited the expansion of the western juniper component that is common to this region. The mountain mahogany component is even less significant as a vegetative element in the Raft watershed.

Whitebark Pine—Whitebark pine is not a significant vegetative element either historically or currently in the Raft watershed.

Aspen—Aspen habitats are a patchily distributed resource in the Raft watershed. Aspen habitat currently comprises nearly 7% of the landscape. It has been estimated that aspen habitats in the Raft watershed have decreased 29% from historical conditions primarily due to the effects of an altered fire regime.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and are not a significant vegetative component of that landscape in the Raft watershed. According to the best available data, the mountain brush habitats currently comprise 1.5% of the habitat in the Raft watershed.

2.4.2.8 Teton (TET)

Aquatic—The Teton River originates on the west slope of the Teton Mountains and drains around 800 square miles (2,072 km^2) in Idaho and an additional 327 square miles (847 km^2) in Wyoming. From the headwaters to its confluence with the Henrys Fork near Rexburg, the mainstem Teton River is about 64 miles (103 km) long. Upstream from the confluence approximately 16 miles (26 km), the Teton River splits into two forks (North Fork and South Fork). The flow into the respective forks is regulated for irrigation purposes.

The Teton River has been subject to a variety of serious environmental constraints. The most serious and devastating of these was the construction and collapse of the Teton Dam on June 5, 1976. On the day of the collapse, the evacuation of the nearly full reservoir resulted in a discharge of nearly 1.7 million cfs below the dam site. These flows not only altered the river below the dam site, but the evacuation of water resulted in a series of massive landslides that transformed the Teton Canyon from a riffle-pool environment into a series of deep, slow pools with short, high-gradient drops. In addition to the habitat alteration caused by the Teton Dam disaster, water table declines, loss of instream flows to irrigation diversions, cattle grazing, and development have restricted the quantity and quality of Teton River aquatic habitat.

In 1998, the Teton River Fishery Enhancement Program began to improve fishing by restoring habitat lost by the flood and the cumulative effects of gradual changes in land-use practices. Cooperative fencing, pasture management, and livestock non-use agreements with landowners are being used to protect and improve riparian habitat in tributaries and river sections. In addition, revegetation and tree revetments are being used to speed recovery and reduce sediment, while fish passage problems at culverts and canal diversions are being resolved.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Teton watershed results from various forms of development and/or conversion within the floodplain. Twenty-one hundred sixty points of water diversion have been constructed in the Teton watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Current estimates of riparian/herbaceous habitat composition in the watershed amount to 1%. Data limitations prevent an accurate or precise quantification of the direct and indirect losses of riparian/herbaceous wetland habitat in the Teton watershed (Appendix 2-1).

Open Water—Open water habitat is nearly nonexistent in the Teton watershed. The construction of Teton Dam in 1975 would have created approximately 2,100 acres (850 ha) of open water habitat, but the collapse of the dam in 1976 resulted in the loss of that habitat. The dam has never been rebuilt. Two additional dams, on Tygee Creek and Spring Creek, have created 12 acres (5 ha) of habitat in the watershed. All of the larger lakes and many of the smaller lakes in Idaho have dams that maintain lake levels. Lake levels may be stabilized or manipulated at any time of the year for recreation, power, and irrigation. Water level manipulations affect aquatic habitat quantity and quality in the watershed by altering upstream and downstream hydrologic processes.

Shrub-Steppe—Shrub-steppe habitats currently comprise nearly 44% of the landscape in the Teton watershed. Based on the best estimates, this habitat has decreased 89% from historical conditions. Shrub-steppe habitat decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture and losses from rangeland fires during the previous century. Furthermore, the quality of remaining shrub-steppe habitat is likely severely reduced from the historical conditions through livestock grazing (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are not a significant vegetative component in the Teton watershed, amounting to 2% of the landscape. However, based on the best available data, these habitats have increased 122% from historical conditions. These habitat increases may be a result of an altered fire regime that has allowed localized patches of forest to expand at the expense of shrub-steppe or grassland habitats. The quality of the pine/fir forest habitat has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that increases the likelihood of stand-replacing fires.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of Douglas-fir and lodgepole pine habitat. Historically, this habitat was mostly open and park-like, with relatively little undergrowth trees. It was the predominant landscape feature. Timber harvest activities in the watershed during the last century selectively harvested the mature stands, while other factors limit reestablishment of normal forest successional processes. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a significant vegetative element in the Teton watershed. Currently, 8% of the landscape is characterized by these habitat elements. However, data limitations prevent the accurate or precise quantification of direct and indirect losses or gains of these habitat elements in the watershed.

Whitebark Pine—Whitebark pine is not a significant vegetative element either historically or currently in the Teton watershed.

Aspen—Aspen habitat is a patchily distributed resource associated primarily with riparian habitat in the Teton watershed. Aspen habitat currently comprises 2% of the landscape. It has been estimated that aspen habitats in the Teton watershed have decreased 31% from historical conditions. These losses may be primarily attributed to reduced structure and function that result from altered hydrologic regimes and to altered fire regimes that no longer inhibit conifer encroachment.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and are not a significant vegetative component of that landscape in the Teton watershed. According to the best available data, the mountain brush habitats currently comprise less than 1% of the habitat in the Teton watershed. Mountain brush habitat losses are estimated to be 94% from historical conditions due to altered fire regime characteristics that no longer inhibit the encroachment of dominant conifer species.

2.4.2.9 Upper Henrys (UHF)

Aquatic—The Upper Henrys watershed includes the headwaters of the Henrys Fork of the Snake River, its tributaries, Henrys Lake, and Warm River. The Henrys Fork originates in the Island Park Caldera, with over half of the total discharge above Ashton coming from a series of springs on the east side of the caldera (Benjamin 2000). The largest of these springs, Big Springs, has a discharge of over 5 m^3 per second and is considered to be the headwaters of the Henrys Fork. Henrys Lake is a natural lake that was dammed to increase the storage capacity in 1923. The dam increased the lake level by about 5 meters (16.4 feet). The lake is approximately 6,500 acres (2,630 ha), with a storage capacity of around 90,000 acre-feet. The dam inundated historic tributary spawning habitat. Tributaries to Henrys Lake have been subject to habitat improvement projects in an attempt to increase natural recruitment. Irrigation ditches have also been screened in an attempt to reduce fish losses. Island Park Dam regulates flow on the Henrys Fork and is also a complete fish passage barrier. The river is dominated by rainbow trout, and past silt releases from the dam may still impact habitat immediately downstream from the dam. A small dam on the Buffalo River (tributary to the Henrys Fork just downstream of Island Park Dam) recently had fish passage installed. Mesa Falls on the Henrys Fork was a natural barrier to fish movement.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Upper Henrys watershed results from various forms of development and/or conversion within the floodplain. Seven hundred fifty points of water diversion have been constructed in the Upper Henrys watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Other forms of development and/or land conversion within the 50- and 100-year floodplains impact wetland habitat quantity and quality. Current estimates of riparian/herbaceous habitat composition in the watershed amount to 3%. Data limitations prevent an accurate or precise quantification of the direct and indirect losses of riparian/herbaceous wetland habitat in the Upper Henrys watershed (Appendix 2-1).

Open Water—Open water habitat encompasses less than 1% of the landscape in the Upper Henrys watershed.

Collectively, 15 dams in the watershed have created approximately 14,675 acres (5,939 ha) of habitat. Island Park Reservoir and Henrys Lake provide 95% of the open water habitat in the watershed. Smaller structures have been constructed on Spring, Icehouse, Strong, Thurmon, Sheep, Blue, Sheridan, and Dry creeks and the Henrys Fork. Lake levels may be stabilized or manipulated at any time of the year for recreation, power, and irrigation. Water level manipulations affect aquatic habitat quantity and quality in the watershed by altering upstream and downstream hydrologic processes.

Shrub-Steppe—Shrub-steppe habitats currently comprise 4.5% of the landscape in the Upper Henrys watershed. According to the best estimates, this habitat has increased nearly 602% from historical conditions. Shrub-steppe habitat increases may be attributed to a component of an altered fire regime whereby the shrub component of grassland habitat expands at the expense of native grassland habitat. Regardless, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are a significant vegetative component in the Upper Henrys watershed, amounting to 22% of the landscape. Based on the best available data, these habitats have increased 67% from historical conditions. However, data limitations pertaining to historical acreages of forested habitats prevent the precise quantification of habitat gains (Appendix 2-1). The quality of the pine/fir forest habitats has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of Douglas-fir and lodgepole pine habitat. Historically, this habitat was mostly open and park-like, with relatively little undergrowth trees. It was the predominant landscape feature. Timber harvest activities in the watershed during the last century selectively harvested the mature stands, while other factors limit reestablishment of normal forest successional processes. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Upper Henrys watershed. Currently, less than 1% of the landscape is characterized by these habitat elements. Based on the best available data, juniper/mountain mahogany habitat has decreased 99% from historical conditions. Frequent fires and conversion to dryland and irrigated agriculture have inhibited the expansion of the western juniper component that is common to this region. The mountain mahogany component is even less significant as a vegetative element in the Upper Henrys watershed.

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Upper Henrys watershed at alpine and subalpine elevations although it comprises less than 1% of the watershed. According to the best available information, whitebark pine habitat has declined 99% from historical conditions due to blister rust and an altered fire regime.

Aspen—Aspen habitats are broadly distributed resources in the Upper Henrys watershed. Aspen habitat is a prominent vegetative component and currently comprises 17% of the vegetative landscape. It has been estimated that aspen habitats in the Upper Henrys watershed have decreased 64% from historical conditions due primarily to the effects of an altered fire regime that promotes conifer encroachment.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Upper Henrys watershed. According to the best available data, the mountain brush habitats currently comprise less than 1% of the habitat in the Upper Henrys watershed. Mountain brush habitat losses are estimated to be less than 1% from historical conditions due to an altered fire regime that no longer inhibits the encroachment of dominant conifer species.

2.4.2.10 Upper Snake–Rock (USR)

Aquatic—The Snake River in the Upper Snake–Rock watershed is heavily impacted by flow regulation and temperature alterations from upstream reservoirs. Murtaugh Dam is an impassable barrier to fish migration, Vinyard and Deer Creeks, which are accessible to fish from the Snake River, may provide limited spawning habitat for trout in this watershed.

Riparian/Herbaceous Wetlands—Riparian/herbaceous wetlands are a significant habitat element of the landscape in the Upper Snake–Rock watershed. The most quantifiable impact to wetland habitats in this watershed results from various forms of development and/or conversion within the floodplain. Two thousand seven hundred seventy-five points of water diversion have been constructed in the Upper Snake–Rock watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Current estimates of riparian/herbaceous habitat composition in the watershed amount to 7%. Data limitations prevent an accurate or precise quantification of the direct and indirect losses of riparian/herbaceous wetland habitat in the Upper Snake–Rock watershed (Appendix 2-1).

Open Water—Open water habitat encompasses slightly more than 1% of the landscape in the Upper Snake–Rock watershed. Most of the 4,000 acres of open water habitat was created when Milner Dam was completed in 1905. An additional 727 acres (294 ha) of open water habitat was created when the Auger Falls, Twin Falls, Wilson Lake, and Shoshone Falls dams were built. Lake levels may be stabilized or manipulated at any time of the year for recreation, power, and irrigation. Water level manipulations affect aquatic habitat quantity and quality in the Upper Snake–Rock watershed by altering upstream and downstream hydrologic processes.

Shrub-Steppe—Shrub-steppe habitats currently comprise nearly 12% of the landscape in the Upper Snake–Rock watershed. Based on the best estimates, this habitat has decreased 81% from historical conditions. Shrub-steppe habitat decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture and losses from rangeland fires during the previous century. Furthermore, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions by livestock grazing (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are a significant vegetative component in the Upper Snake–Rock watershed, amounting to 45% of the landscape. The quality of the pine/fir forest habitats has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires.

The xeric, mature forest component of the pine/fir forest habitat in this watershed is primarily characterized by lodgepole pine with aspen habitat "stringers." The majority of forested stands are overly mature and decadent. There are only limited amounts of Douglas-fir in the watershed in localized areas. Some portions of the watershed that have either been burned or had timber removed within the last century have a younger tree cohort that gives the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a comparatively minor vegetative element in the Upper Snake–Rock watershed. Currently, less than 1% of this watershed's landscape is characterized by these habitat elements. Based on the best available data, juniper/mountain mahogany habitat has decreased 7% from historical conditions. At mid elevations where this habitat occurs, frequent fires have reduced the extent of the habitat and prevented the expansion of western juniper commonly observed in other parts of its range. The mountain mahogany component is even less significant as a vegetative element in the Upper Snake–Rock watershed.

Whitebark Pine—Whitebark pine habitat is not a significant vegetative element in the Upper Snake–Rock watershed. Less than 1% of the watershed contains whitebark pine habitat.

Aspen—Aspen habitats are broadly, though patchily, distributed in the Upper Snake–Rock watershed. Aspen habitat is a prominent vegetative component and currently comprises 14% of the vegetative landscape.

The habitat is closely associated with pine/fir forest habitats and wet/spring riparian areas at mid to high elevations. The effects of altered hydrologic processes in this watershed most likely limit aspen habitat. In some areas of the watershed, decreased fire frequency undoubtedly allows conifers to encroach and dominate aspen.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and are significant vegetative components of that landscape in the Upper Snake–Rock watershed. According to the best available data, the mountain brush habitats currently comprise less than 1% of the habitat in the Upper Snake–Rock watershed. Mountain brush habitat gains are estimated to be 368% from historical conditions.

2.4.2.11 Lake Walcott (LWT)

Aquatic—The Snake River in this watershed is heavily impacted by flow regulation and temperature alterations from reservoirs within the watershed and upstream. Flows in the mainstem Snake River are controlled by American Falls, Minidoka, and Milner dams. Minidoka Dam forms Lake Walcott in this watershed. There is a legal minimum flow of 0 cfs in the Snake River below Milner Dam and downstream of Minidoka Dam. Most tributaries in the watershed are disconnected. Rock Creek in the Lake Walcott watershed contains very few perennial streams.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Lake Walcott watershed results from various forms of development and/or conversion within the floodplain. One thousand fifty points of water diversion have been constructed in the Lake Walcott watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Current estimates of riparian/herbaceous habitat composition in the watershed amount to less than 1%.

Open Water—Open water habitat encompasses less than 1% of the landscape in the Lake Walcott watershed. Most of the 56,000 acres (22,662 ha) of open water habitat was created when American Falls Dam was completed in 1978. An additional 11,850 acres (4,796 ha) of habitat was created by the construction of Minidoka Dam 1906. Together, these two waterbodies provide the most significant open water habitat in terms of quantity and quality for numerous fish and wildlife species in the Upper Snake province. Eight additional structures create a total of 160 acres (65 ha) of habitat in the watershed. Lake levels may be stabilized or manipulated at any time of the year for recreation, power, and irrigation. Water level manipulations affect aquatic habitat quantity and quality in the American Falls watershed by altering upstream and downstream hydrologic processes.

Shrub-Steppe—Shrub-steppe habitats currently comprise nearly 18% of the landscape in the Lake Walcott watershed. Based on the best estimates, this habitat has decreased 51% from historical conditions. Shrub-steppe habitat decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture and losses due to frequent rangeland fires during the previous century. Furthermore, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions by livestock grazing (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are not a significant vegetative component in the Lake Walcott watershed, amounting to less than 1% of the landscape. Pine/fir forests were likely never a significant vegetative element in the watershed. Based on the best available data, this habitat has increased 402% from historical conditions. Habitat gains may be attributable to an altered fire regime that has allowed localized patches of forest to expand at the expense of shrub-steppe or grassland habitats. The quality of the pine/fir forest habitat has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a comparatively minor vegetative element in the Lake Walcott watershed. Currently, less than 1% of the landscape is characterized by these habitat elements. Based on the best available data, juniper/mountain mahogany habitat has decreased 65% from historical conditions. At mid elevations where this habitat occurs, frequent fires have reduced the extent of the habitat and prevented the expansion of western juniper commonly observed in other parts of its range. The mountain mahogany component is an even less significant vegetative element in the Lake Walcott watershed.

Whitebark Pine—Whitebark pine is not an identified vegetative element either historically or currently in the Lake Walcott watershed.

Aspen—Aspen habitat is a patchily distributed resource associated primarily with riparian habitat in the Lake Walcott watershed. Aspen habitat currently comprises less than 1% of the landscape. It has been estimated that this habitat in the Lake Walcott watershed has decreased 67% from historical conditions. These losses may be attributed primarily to reduced structure and function resulting from altered hydrologic regimes.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Lake Walcott watershed. According to the best available data, the mountain brush habitats currently comprise less than 1% of the habitat in the Lake Walcott watershed. Mountain brush habitat losses are estimated to be 55% from historical conditions.

2.4.2.12 Willow (WIL)

Aquatic—The Willow Creek drainage includes over 95 miles (153 km) of streams above Ririe Reservoir. Most of these streams are in narrow canyons and contain important wild cutthroat populations. Since 1924, up to 20,000 acre-feet of water a year has been diverted from the Willow Creek drainage to Blackfoot Reservoir through Clark's Cut Canal. Intense agricultural practices have contributed to poor riparian habitat conditions in the upper watershed. Water quantity and quality have suffered as a result. The Natural Resource Conservation Service has identified the Willow Creek drainage as one of the 10 worst soil erosion areas in the United States. A water quality program has been initiated to reduce loss of topsoils and improve the water quality of Willow Creek above Ririe Dam. Riparian habitat improvement through improved grazing management is a high priority on both state and private lands.

Riparian/Herbaceous Wetlands—Riparian/herbaceous wetlands are a significant habitat element of the landscape in the Willow watershed. The most quantifiable impact to wetland habitats in the Willow watershed results from various forms of development and/or conversion within the floodplain. Three hundred points of water diversion have been constructed in the Willow watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Current estimates of riparian/herbaceous habitat

composition in the watershed amount to 11%.
Open Water—Open water habitat encompasses less than 1% of the landscape in the Willow watershed. The Grays Lake structure created approximately 22,000 acres of intermittent open water habitat in the center of the Willow watershed. Ririe Dam, which was built in 1976, created an additional 1,560 acres (631 ha) of habitat. Eight smaller dams created the remaining 300 acres of open water habitat across the watershed.

Shrub-Steppe—Shrub-steppe habitats currently comprise nearly 36% of the landscape in the Willow watershed. Based on the best estimates, this habitat has increased 41% from historical conditions. However, the quality of shrub-steppe habitat in the watershed is severely reduced from the historical conditions by livestock grazing (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are not a significant vegetative component in the Willow watershed, amounting to 2% of the landscape. Based on the best available data, this habitat has decreased 82% from historical conditions. The quality of pine/fir forest habitat in the watershed has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a comparatively minor vegetative element in the Willow watershed. Currently, less than 1% of the landscape is characterized by these habitat elements.

Whitebark Pine—Whitebark pine habitat is not a significant vegetative element in the Willow watershed. Less than 0.1% of the watershed contains whitebark pine habitat. Based on the best available data, whitebark pine habitat has decreased 41% from historical conditions.

Aspen—Aspen habitats are broadly distributed resources in the Willow watershed. Aspen habitat is a prominent vegetative component and currently comprises nearly 25% of the vegetative landscape. It has been estimated that this habitat in the Willow watershed has decreased 42% from historical conditions due primarily to the effects of an altered fire regime promotes conifer encroachment.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Willow watershed.

2.4.3 Closed Basin Subbasin

2.4.3.1 Beaver–Camas (BCM)

Aquatic— Beaver and Camas Creeks are small streams that drain the southern edge of the Centennial Mountains and flow south ending in Mud Lake. Most of the headwater streams are in forested lands. The lower end flows through agricultural/pasture land and has some sediment and riparian issues resulting from land use.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Beaver–Camas watershed results from various forms of development and/or conversion within the floodplain. Nine hundred points of water diversion have been constructed in the Beaver–Camas watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Current estimates of riparian/herbaceous habitat composition in the watershed amount to less than 1%.

Open Water—Open water habitat is nearly nonexistent in the Beaver–Camas watershed. Fourteen acres (5.6 ha) of habitat were created when the Hagenbarth and Paul dams were constructed on Crooked Creek and East Modoc Creek, respectively.

Shrub-Steppe—Shrub-steppe is the most encompassing habitat in the Beaver–Camas watershed. This habitat currently comprises nearly 53% of the landscape in the Beaver–Camas watershed. Based on the best estimates, this habitat has increased 2% from historical conditions. Shrub-steppe habitat increases in the watershed may largely be attributed to the altered fire regime that allows the shrub component of grassland habitats to expand at the expense of native grasslands. The quality of shrub-steppe habitat in the watershed is severely reduced from the historical conditions by livestock grazing (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are an important vegetative component in the Beaver–Camas watershed, amounting to 13% of the landscape. Based on the best available data, these habitats have increased 43% from historical conditions. The quality of the pine/fir forest habitats has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of Douglas-fir and lodgepole pine habitat. Historically, this habitat was mostly open and park-like, with relatively little undergrowth trees. It was the predominant landscape feature. Timber harvest activities in the watershed during the last century selectively harvested the mature stands, while other factors limit reestablishment of normal forest successional processes. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Beaver–Camas watershed, amounting to less than 1% of the current habitat. The western juniper component of the habitat is at the northern periphery of its range in this portion of the Upper Snake province; however, it continues to expand its range due in large part to an altered fire regime. The lengthened fire-return intervals give conifers a competitive advantage over the shrub/forb vegetation. The mountain mahogany component of the habitat has declined across the Beaver–Camas watershed because of the altered fire regime. Although mountain mahogany is not a significant component of the landscape, the habitat is of critical importance to overwintering wildlife species (Hickman 1975, Dittberner and Olson 1983, Miller and Tausch 2001).

Whitebark Pine—Whitebark pine habitat is not a significant vegetative element in the Beaver–Camas watershed. Less than 1% of the watershed contains this habitat. Based on the best available data, whitebark pine habitat has decreased 97% from historical conditions.

Aspen—Aspen habitats are broadly distributed resources in the Beaver–Camas watershed. Aspen habitat is an important vegetative component and currently comprises nearly 3% of the vegetative landscape. It has been estimated that aspen habitats in the Beaver–Camas watershed have decreased 50% from historical conditions due primarily to the effects of an altered fire regime that no longer inhibits conifer encroachment.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Beaver–Camas watershed. According to the best available data, the mountain brush habitats currently comprise 3% of the habitat in the Beaver–Camas watershed.

2.4.3.2 Birch (BCK)

Aquatic— Birch Creek contains the smallest amount of stream habitat of any of the sinks drainages. Most of the drainage is considered to be good habitat but the lower section is completely diverted.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Birch Creek watershed results from various forms of development and/or conversion within the floodplain. One hundred points of water diversion have been constructed in the Birch Creek watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Current estimates of riparian/herbaceous habitat composition in the watershed amount to less than 1%. **Open Water**—Open water habitat is not identified as occurring in the Birch Creek watershed.

Shrub-Steppe—Shrub-steppe is the most encompassing habitat in the Birch Creek watershed. Shrub-steppe habitats currently comprise nearly 64% of the landscape in this watershed. Based on the best estimates, this habitat has decreased 6% from historical conditions. Shrub-steppe habitat losses in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture and losses due to frequent rangeland fires during the previous century. Furthermore, the quality of remaining shrub-steppe habitat is severely reduced from the historical conditions by livestock grazing (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are an important vegetative component in the Birch Creek watershed, amounting to nearly 10% of the landscape. Based on the best available data, these habitats have decreased 10% from historical conditions. The quality of the pine/fir forest habitats has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of Douglas-fir and lodgepole pine habitat. Historically, this habitat was mostly open and park-like, with relatively little undergrowth trees. It was the predominant landscape feature. Timber harvest activities in the watershed during the last century selectively harvested the mature stands, while other factors limit reestablishment of normal forest successional processes. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Birch Creek watershed, amounting to less than 1% of the current habitat. The western juniper component of the habitat is at the northern periphery of its range in this portion of the Upper Snake province; however, it continues to expand its range due in large part to an altered fire regime. The lengthened fire-return intervals give conifers a competitive advantage over the shrub/forb vegetation.

Based on the best available data, the western juniper component has increased 706% from historical conditions. The mountain mahogany component of the habitat has declined across the Birch Creek watershed because of the altered fire regime. Although mountain mahogany is not a significant component of the landscape, the habitat is of critical importance to overwintering wildlife species (Hickman 1975, Dittberner and Olson 1983, Miller and Tausch 2001).

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Birch Creek watershed at alpine and subalpine elevations. Whitebark pine habitat is probably most pristine in the watersheds of the Closed Basin subbasin. Current estimates indicate that whitebark pine habitat comprises 8% of the landscape in the Birch Creek watershed. Whitebark pine habitat has increased in the Birch Creek watershed an estimated 12% from historical conditions.

Aspen—Aspen habitats are patchily distributed and a minor habitat element in the Birch Creek watershed. Although rarely occurring in the Birch Creek watershed, aspen habitat is an important vegetative component and currently comprises less than 1% of the vegetative landscape. It has been estimated that aspen habitats in this watershed have decreased 82% from historical conditions due primarily to the effects of an altered fire regime that no longer inhibits conifer encroachment.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Birch Creek watershed. According to the best available data, the mountain brush habitats currently comprise nearly 2% of the habitat in the Birch Creek watershed. Mountain brush habitat gains are estimated to be 5,529% from historical conditions.

2.4.3.3 Big Lost (BLR)

Aquatic—The Big Lost River is the largest of the Closed Basin watersheds. Streamflow in the lower section of the Big Lost River is regulated by Mackay Dam, which was built in 1916 as an irrigation supply reservoir. Downstream from the dam substantial irrigation withdrawal occurs dewatering the lower section and sections of the river have been channelized for flood control purposes. Above the reservoir sections of the Big Lost River are dewatered during irrigation season. Tributary streams are considered productive trout habitat. Historically, the Big Lost River flowed into the Snake River Plain Aquifer.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Big Lost River watershed results from various forms of development and/or conversion within the floodplain. Thirty-eight hundred points of water diversion have been constructed in the Big Lost River watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Current estimates of riparian/herbaceous habitat composition in the watershed amount to 2.7%. **Open Water—**Open water habitat encompasses less than 1% of the landscape in the Big Lost River watershed. Mackay Dam on the Big Lost River created 1,392 acres (563 ha) of intermittent open water habitat when it was constructed in 1918.

Shrub-Steppe—Shrub-steppe is the most encompassing habitat in the Big Lost River watershed. This habitat currently comprises nearly 58% of the landscape in the Big Lost River watershed. Based on the best estimates, this habitat has decreased 4.6% from historical conditions. Shrub-steppe habitat decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture and losses due to frequent rangeland fires during the previous century. The quality of remaining shrub-steppe habitat is severely reduced from the historical conditions by livestock grazing (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are an important vegetative component in the Big Lost River watershed, amounting to nearly 10.3% of the landscape. Based on the best available data, these habitats have decreased 50% from historical conditions. The quality of the pine/fir forest habitats has shifted from a mix of seral stages to a young seral-dominated habitat with higher stem density and lower diversity and cover of understory species. Fire suppression has led to a buildup of fuels that in turn increases the likelihood of stand-replacing fires.

Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Big Lost River watershed, amounting to less than 1% of the current habitat. The western juniper component of the habitat is at the northern periphery of its range in this portion of the Upper Snake province; however, it continues to expand its range due in large part to an altered fire regime. The lengthened fire-return intervals give conifers a competitive advantage over the shrub/forb vegetation. The mountain mahogany component of the habitat has likely declined across the Big Lost River watershed because of the altered fire regime. According to the best estimates, mountain mahogany habitat has declined 97%. Although not a significant component of the landscape, this habitat is of critical importance to overwintering wildlife species (Hickman 1975, Dittberner and Olson 1983, Miller and Tausch 2001).

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Big Lost River watershed at alpine and subalpine elevations. Whitebark pine habitat is probably most pristine in the watersheds of the Closed Basin subbasin. Current estimates indicate that whitebark pine habitat comprises 8% of the landscape in this watershed. According to the best available information, whitebark pine habitat has declined 4.6% from historical conditions due to blister rust and an altered fire regime.

Aspen—Aspen habitats are patchily distributed and a minor habitat element in the Big Lost River watershed. Although rarely occurring in the Big Lost River watershed, at 1% of the vegetative landscape, aspen habitat is an important ecological component. It has been estimated that aspen habitats in the Big Lost River watershed have decreased 26% from historical conditions due primarily to the effects of an altered fire regime that no longer inhibits conifer encroachment.

Mountain Brush—According to the best available data, the mountain brush habitats currently comprise nearly 1% of the habitat in the Big Lost River watershed. Mountain brush habitat gains are estimated to be 6,569% from historical conditions.

2.4.3.4 Little Lost (LLR)

Aquatic—The Little Lost River flows southwesterly between the Lost River and Lemhi mountains until the river sinks into the Snake River Plain Aquifer. Portions of the lower Little Lost River are dried up during the year by irrigation diversions. Habitat restoration activities have been improving habitat in the watershed with positive results. The flow in the Little Lost River is a typical snowmelt dominated hydrograph. Impacts to riparian habitat are likely contributing to increased water temperatures in some tributaries in the watershed.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Little Lost River watershed results from various forms of development and/or conversion within the floodplain. Six hundred fifty points of water diversion have been constructed in the Little Lost River watershed for irrigation purposes. The diversions have significant ramifications for hydrologic processes and wetland structure and function in the watershed. Current estimates of riparian/herbaceous habitat composition in the watershed amount to 1.4%.

Open Water—Open water habitat is nearly nonexistent in the Little Lost River watershed. One hundred acres (40.5 ha) of habitat were created when Summit Dam was constructed in 1921 on Pass and Big Gulch creeks.

Shrub-Steppe—Shrub-steppe is the most encompassing habitat in the Little Lost River watershed. Shrub-steppe habitats currently comprise nearly 53% of the landscape in the Little Lost River watershed. Based on the best estimates, this habitat has decreased 18% from historical conditions. Shrub-steppe habitat decreases in this watershed are likely a result of habitat conversion to dryland and irrigated agriculture and losses due to frequent rangeland fires during the previous century. The quality of remaining shrub-steppe habitat is severely reduced from the historical conditions by livestock grazing (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are an important vegetative component in the Little Lost River watershed, amounting to nearly 13% of the landscape. Based on the best available data, these habitats have decreased 2% from historical conditions. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Little Lost River watershed, amounting to less than 1% of the current habitat. The mountain mahogany component of the habitat has declined across the Little Lost River watershed because of the altered fire regime. According to the best estimates, mountain mahogany habitat has declined 87%. Although mountain mahogany is not a significant component of the landscape, the habitat is of critical importance to overwintering wildlife species (Hickman 1975, Dittberner and Olson 1983, Miller and Tausch 2001).

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Little Lost River watershed at alpine and subalpine elevations. Whitebark pine habitat is probably most pristine in the Closed Basin subbasin watersheds. Current estimates indicate that whitebark pine habitat comprises 8% of the landscape in the Little Lost River watershed. According to the best available information, whitebark pine habitat has declined 4.6% from historical conditions due to blister rust and an altered fire regime.

Aspen—Aspen habitats are patchily distributed and a minor habitat element in the Little Lost River watershed. Although rarely occurring in the Little Lost River watershed, at 1% of the vegetative landscape, aspen habitat is an important ecological component. It has been estimated that aspen habitats in this watershed have decreased 26% from historical conditions due primarily to the effects of an altered fire regime that no longer inhibits conifer encroachment.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Little Lost River watershed. According to the best available data, the mountain brush habitats currently comprise 3% of the habitat in the Little Lost River watershed. Mountain brush habitat gains are estimated to be 3,770% from historical conditions.

2.4.3.5 Medicine Lodge (MDL)

Aquatic—Medicine Lodge Creek is the largest stream in the Medicine Lodge Watershed. Medicine Lodge Creek flows in a southerly direction until it reaches the desert where the waters sink into the Snake River Plain Aquifer. The watershed is small with only 98 named streams and approximately 600 km of stream habitat with most streams on public land. Stream habitat is considered good throughout much of the watershed.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Medicine Lodge watershed results from various forms of development and/or conversion within the floodplain. Five hundred points of water diversion have been constructed in the Medicine Lodge watershed for irrigation purposes. Current estimates of riparian/herbaceous habitat composition in the watershed amount to less than 1%. **Open Water—**Open water habitat encompasses less than 1% of the landscape in the Medicine Lodge watershed. It is assumed that all open water habitat in the watershed is naturally occurring. **Shrub-Steppe—**Shrub-steppe is the most predominant focal habitat in the Medicine Lodge watershed. Shrub-steppe habitats currently comprise nearly 54% of the landscape in the Medicine Lodge watershed. This habitat has increased 38% from historical conditions. Shrub-steppe habitat increases in the watershed may be attributed to an altered fire regime that allows the shrub component of grassland habitats to expand at the expense of native grasslands. Livestock grazing reduces the quality of remaining shrub-steppe habitat from the historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forests (Dry, Mature)—Pine/fir forests are an important vegetative component in the Medicine Lodge watershed, amounting to nearly 8% of the landscape. Based on the best available data, these habitats have decreased 52% from historical conditions. Historically, this habitat was mostly open and park-like, with relatively little undergrowth trees. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multilayered canopy.

Juniper/Mountain Mahogany—The juniper/mountain mahogany woodland habitat is a minor vegetative element in the Medicine Lodge watershed, amounting to less than 1% of the current habitat The mountain mahogany component of the habitat has declined across the Medicine Lodge watershed because of the altered fire regime. According to the best estimates, mountain mahogany habitat has declined 99%.
Whitebark Pine—Whitebark pine habitat is not a significant vegetative element in the Medicine Lodge watershed. Less than 1% of the watershed contains this habitat. Based on the best available data, whitebark pine habitat has decreased 65% from historical conditions due to blister rust and an altered fire regime.

Aspen—Aspen habitats are patchily distributed and a minor habitat element in the Medicine Lodge watershed. Although rarely occurring in this watershed, at 1% of the vegetative landscape, aspen habitat is an important ecological component. It has been estimated that aspen habitats in the Medicine Lodge watershed have decreased 98% from historical conditions primarily due to the effects of an altered fire regime that no longer inhibits conifer encroachment.

Mountain Brush—Mountain brush habitats are irregularly distributed across the landscape and not a significant vegetative component of that landscape in the Medicine

Lodge watershed. The mountain brush habitat currently comprises 1% of the habitat in the Medicine Lodge watershed. Mountain brush habitat gains are estimated to be 378% from historical conditions.