3 Biological Characterization and Status

3.1 Biodiversity and Endemism Regional Context

Two recent regional assessment efforts have identified portions of the Middle Snake subbasins as being areas of regional conservation importance based on high biodiversity and/or the presence of rare or endemic organisms. In 1994, the Interior Columbia Basin Ecosystem Management Project (ICBEMP) mapped centers of biodiversity and endemism/rarity across the interior Columbia Basin (ICBEMP 2003). In 1999, The Nature Conservancy (TNC) used the Biodiversity Management Area Selection (BMAS) model to develop a conservation portfolio for the Columbia Plateau Ecoregion; the middle and upper portions of the subbasins fall within this ecoregion. In 2003, the SITES model, an upgraded version of the BMAS model, was used to develop a conservation portfolio for the lower reaches of the subbasins.

ICBEMP Centers of Biodiversity and Endemism

Expert panels of agency and nonagency scientists for the ICBEMP were convened between October 1994 and May 1995 to identify areas of rare and endemic populations of plant, invertebrate, and vertebrate species (ICBEMP 1997). These panels of experts produced maps showing areas having unusually high biodiversity and areas containing high numbers of rare or locally or regionally endemic species (Figure 22 and Figure 23, respectively). The centers of concentration were identified within a short time frame and at a coarse scale, and those identifications were based mainly on the panel's personal knowledge of areas and species locations. The panel suggested that the areas be considered a first attempt at identifying places having particularly diverse collections of rare or endemic species, or areas with high species richness. Centers of concentration might be candidates for Research Natural Areas or other natural area designations, pending further local assessment and refinement (ICBEMP 1997). Thirty percent of the Middle Snake subbasins were identified as centers of plant biodiversity, while 5% of the subbasins were selected as centers of animal biodiversity. Large areas of plant biodiversity are found in the lowermost portions of the subbasins, the Owyhee Face Drainage, and central-elevation areas of the Big Wood Drainage. Areas selected as centers of animal biodiversity are in the Birds of Prey Natural Conservation Area (Figure 22). Twenty-three percent of the subbasins were identified as areas of high plant endemism and rarity, and 9% of the subbasins are centers for animal endemism and rarity (Table 11). Plant areas of endemism and rarity occur along the Snake River corridor throughout most of the subbasins, while animal areas are more patchily distributed and include a large area in the lower subbasins, an area near the Birds of Prey Natural Conservation Area, and a small area just west of Browns Creek (Figure 23).

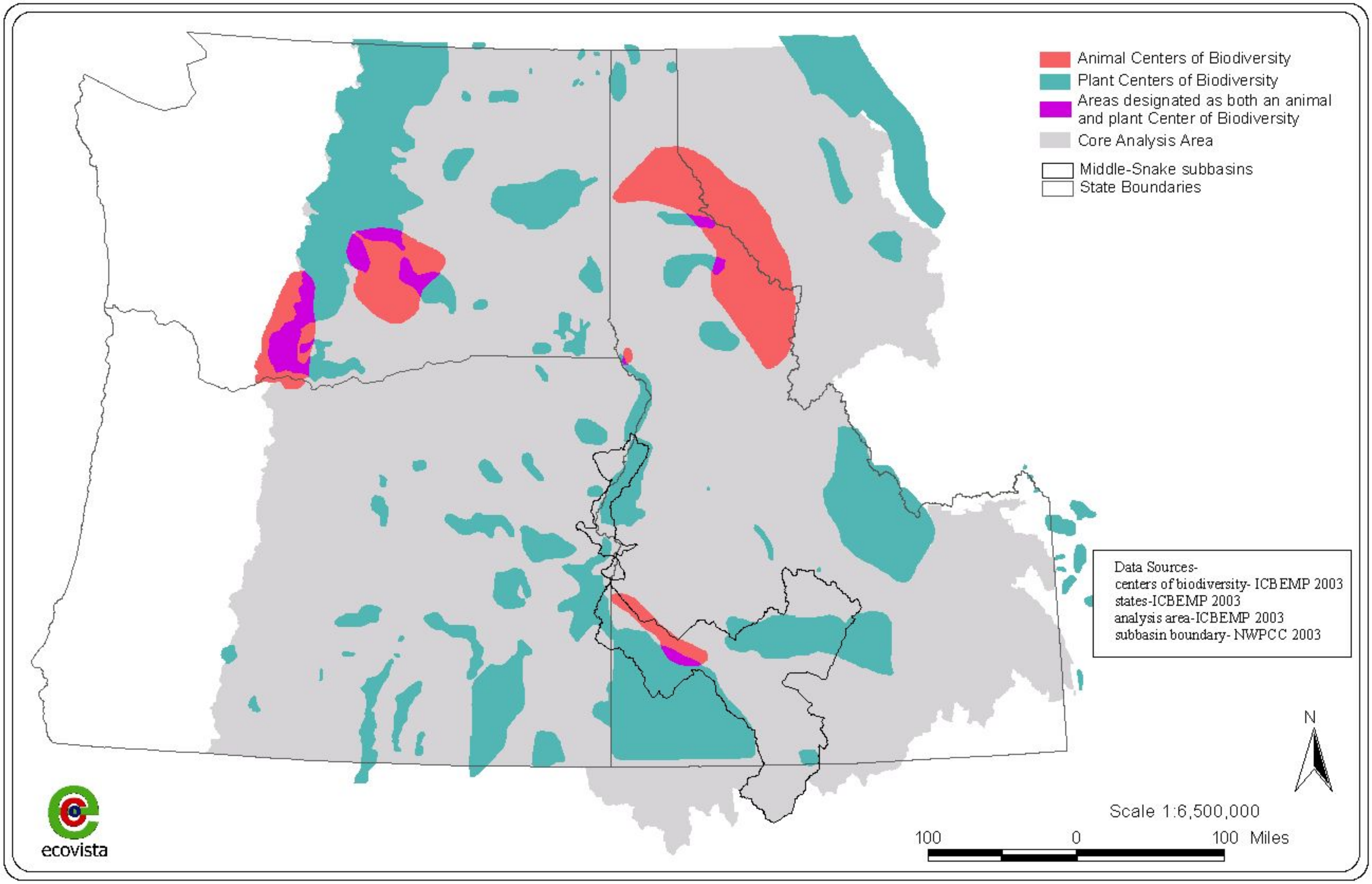

Figure 22. Centers of biodiversity in the ICBEMP analysis area and the Middle-Snake subbasins.

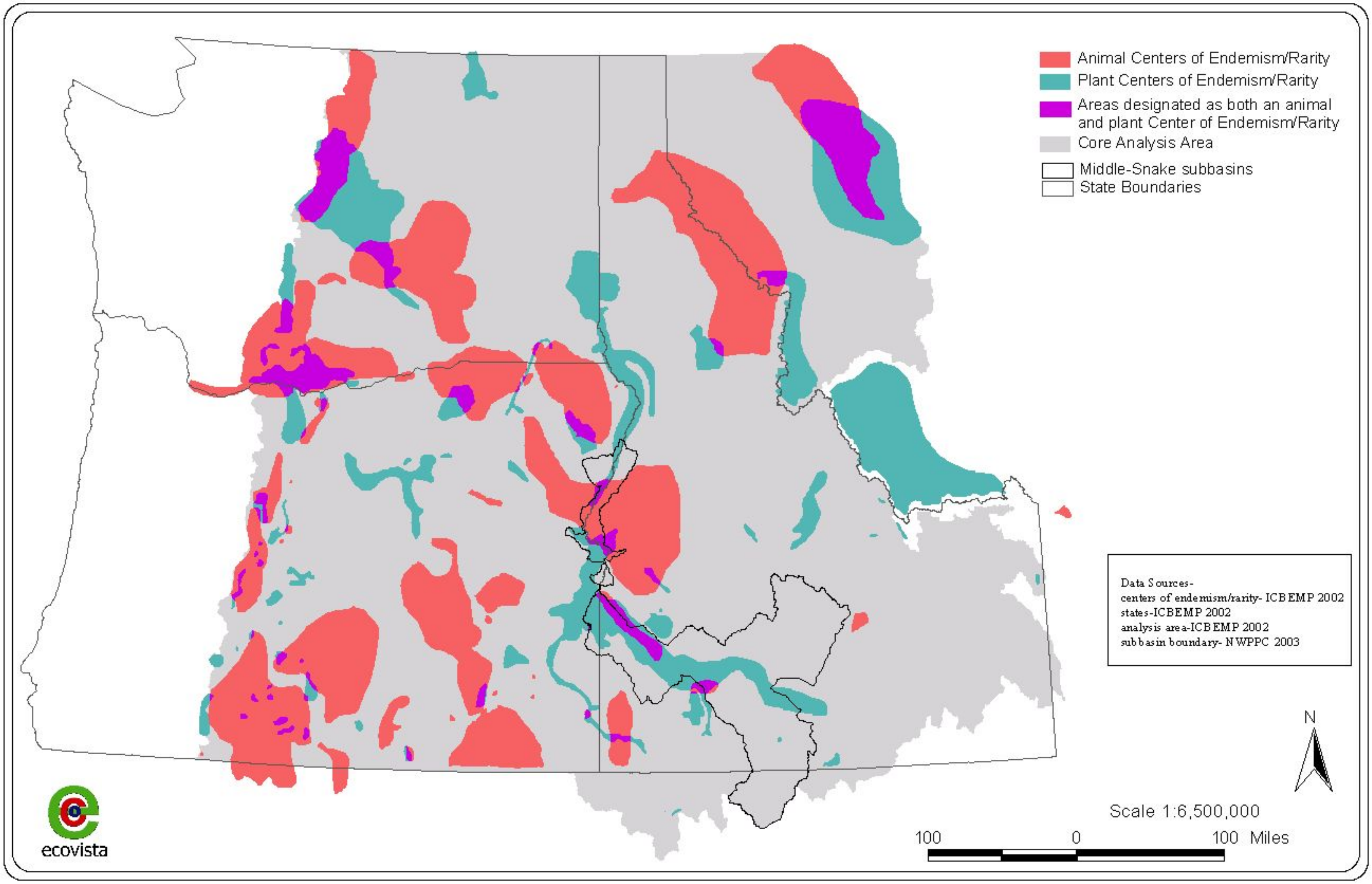

Figure 23. Centers of endemism and rarity in the ICBEMP analysis area and the Middle-Snake subbasins.

Table 11. Areas selected as centers of biodiversity or centers of endemism and rarity in the Middle-Snake subbasins.

Interior Columbia Ecosystem Management Project Designation	Area of Middle-Snake Subbasins Selected (acres)	Percentage (%) of Middle Snake Subbasins Selected
Centers of Biodiversity—Plants	2,482,634	30
Centers of Biodiversity—Animals	429,515	5
Centers of Endemism and Rarity—Animals	743,529	9
Centers of Endemism and Rarity—Plants	1,919,106	23

The Nature Conservancy's BMAS/SITES Models

TNC's vision is to conserve a set of places that, if managed appropriately, will ensure the long-term survival of all native species and natural communities (TNC 2004). TNC has been working to develop conservation portfolios at the broad-scale ecoregional level. Three-quarters of the Middle Snake subbasins lie within the Columbia Plateau Ecoregion, while the lower portion lies within the Middle Rockies–Blue Mountain Ecoregion. In 1999, TNC used the Biodiversity Management Area Selection (BMAS) model to identify a portfolio of sites that, collectively and with appropriate conservation action, would maintain all viable native species and communities in the Columbia Plateau Ecoregion, a 72,019,000-acre area covering portions of Washington, Oregon, Idaho, Nevada, California, and Utah. The Columbia Plateau Ecoregional Assessment was the first attempt at developing a methodology for conservation portfolio selection. In 2003, further refinement of this methodology was employed in developing portfolios for the 52,989,000-acre Middle Rockies–Blue Mountain Ecoregion (TNC 1999). The refined site selection model is called the SITES model. The following discussion documents the methods used in developing the conservation portfolio for the Columbia Plateau Ecoregion, which dominates the subbasins (see TNC 2003 for details about the slightly different methodology used for selecting sites in the Middle Rockies–Blue Mountain Ecoregion).

Conservation targets were selected using a coarse filter/fine filter approach. Targets representing fine filter aspects of biodiversity and comprising 154 plant species, 45 invertebrates, 49 vertebrates, 42 aquatic species, and 103 plant communities were identified for the purposes of selecting portfolio sites based on their occurrences. Coarse filter aspects of biodiversity were represented by Gap Analysis Program (GAP) cover types. An Aquatic Integrity Index developed by the ICBEMP was used to help establish aquatic targets (TNC 1999).

Conservation goals were then chosen for the targets, based on their distribution in the Columbia Plateau Ecoregion. For targets found in only one section of the ecoregion, the goal was to have all target occurrences, up to five, contained in the conservation portfolio. For targets found in more than one section, the goal was to protect all occurrences up to three per section. Goals for coarse filter target representation were established based on percentage coverage of the cover type in the ecoregion. The Element Occurrence Databases maintained by state Natural Heritage/Conservation Data Center programs were the main source of data. Gap analysis provided the vegetation layer information, and other sources supplied supplementary environmental data (TNC 1999).

The BMAS model, a GIS-driven site selection model, was used to select conservation sites that meet the greatest amount of biodiversity target goals using the least amount of land. Areas identified by panels of regional biological experts as being of conservation importance were used as a starting place for the BMAS model, using 6th field HUCs as the site selection units. The initial portfolio developed by BMAS was then edited by TNC staff to address connectivity issues and account for differences in site quality. The final portfolio contained 139 sites and covered 20% of the ecoregion and ranged in size from 50 to over 1 million acres (Figure 24; TNC 1999). Eleven percent of the Middle Snake subbasins fall within areas selected for the Columbia Plateau Ecoregion, while 7% fall within areas selected for the Middle Rockies–Blue Mountain Ecoregion. Table 12 lists the Middle Snake subbasins conservation sites for both ecoregions.

A number of conservation targets were not met by the final portfolio. However, most of these targets were at the edges of their ranges or had been poorly inventoried to date. During the next iteration of the ecoregion plan, TNC plans to focus on acquiring better information for these groups of targets (TNC 1999).

Table 12. Sites that were identified in the TNC conservation portfolio for the Columbia Plateau and the Middle Rockies–Blue Mountains ecoregional assessments and that occur in the Middle Snake subbasins, as well as those sites' protection status (TNC 1999, 2003).

Ecoregion	Site Name	Protection Status	Area of Site in Subbasin (acres)	Total Area of Site (acres)	Percentage (%) of Site in Subbasin
Columbia Plateau	Alkali Gulch	partially protected	39,512	59,724	66
	Big Wood Wild and Scenic River	protected	608	608	100
	Birds of Prey Natural Conservation Area	partially protected	160,718	160,771	100
	Bruneau River–Jacks Creek	partially protected	109,184	433,169	25
	Craters of the Moon	partially protected	172,543	356,544	48
	Dietrich Dunes	not protected	1,970	14,207	14
	Dry Creek Wild and Scenic River/Research Natural Area	protected	1,092	1,092	100
	Jarbidge Creek	partially protected	57,145	428,100	13
	Middle Snake River Corridor	partially protected	217,273	794,071	27
	Salmon Falls Creek	partially protected	211,389	211,389	100

Ecoregion	Site Name	Protection Status	Area of Site in Subbasin (acres)	Total Area of Site (acres)	Percentage (%) of Site in Subbasin
	Succor Creek	partially protected	373,260	724,922	51
	TNC Silver Creek Preserve	protected	1,857	1,857	100
	TNC Stapp–Soldier Creek Preserve	protected	90	90	100
	Weiser Sand Hills	partially protected	14,138	114,582	12
Middle Rockies–Blue Mountain	Basin Gulch Research Natural Area	protected	1,175	1,175	100
	Big Smoky Creek	not protected	14,831	57,445	26
	Big Wood River	partially protected	9,696	9,696	100
	Carey Lake Wildlife Management Area	protected	292	292	100
	Copper Basin	not protected	35,346	241,493	15
	Cuddy Mountain Research Natural Area	protected	1,053	1,053	100
	Fox Creek/Rocking M Ranch	partially protected	69,538	69,542	100
	Hells Canyon	partially protected	238,984	1,155,396	21
	ID-53-005 - WSA	protected	9,515	9,666	98
	Little Wood River	partially protected	48,616	48,616	100
	Lost Basin Grassland Research Natural Area	protected	62	62	100
	River’s Edge Ranch	protected	4	4	100
	Sawtooth National Recreation Area	protected	61,925	531,083	12
	Silver Creek, TNC	partially protected	12,284	12,284	100
	Trail Creek Canyon	protected	813	813	100
	Wallowa Mountains	partially protected	100,461	628,764	16
	Willow Creek	protected	15,518	15,518	100

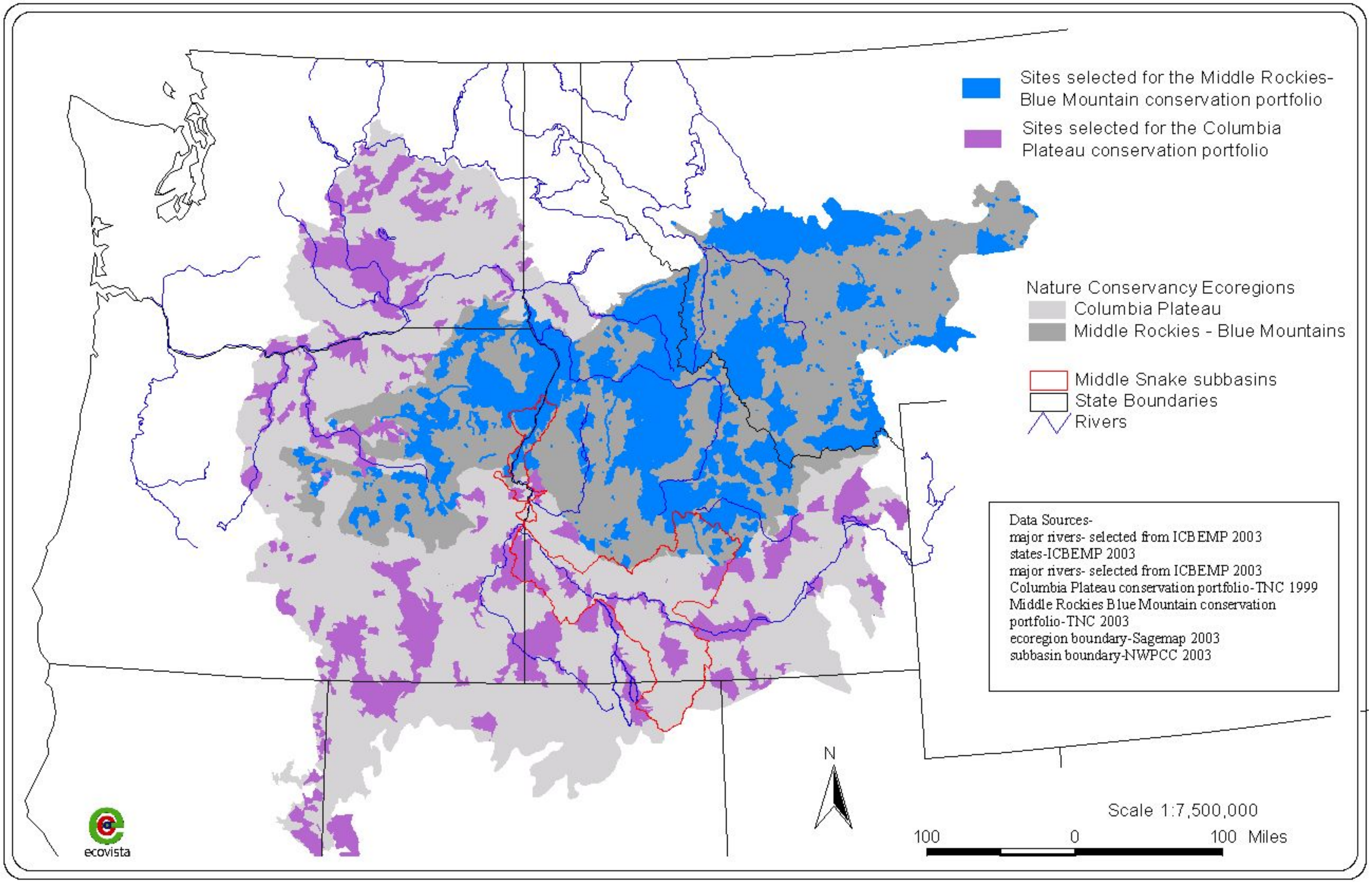

Figure 24. Areas selected by the BMAS or SITES models for The Nature Conservancy's ecoregional conservation portfolios.

After the Columbia Plateau portfolio was developed, TNC undertook a second phase in the project: they attempted to identify the factors that most threatened the portfolio sites. A threats database was not developed for the Middle Rockies–Blue Mountain Ecoregion. The dominant threats in the ecoregion, in order of number of occurrences in the portfolio sites, were the following: grazing (105), nonnative species (85), altered fire regimes (49), recreation (44), crop agriculture (42), residential development (27), diversions (26), and hydrologic alteration (19) (TNC 1999). The threats identified by the TNC process are similar to those identified as limiting factors through this assessment (see section 3.5.3). TNC identified five Columbia Plateau portfolio sites, which are partially contained in the subbasin, as the highest-priority sites for protection, based on their biological importance, current level of protection, and the scope, immediacy, and reversibility of the threats facing the sites. These sites are the Bruneau River–Jacks Creek, Craters of the Moon, Jarbidge Creek, Middle Snake River Corridor, and Succor Creek sites (Table 13).

Table 13. Threats identified to be impacting Columbia Plateau portfolio sites in the Middle Snake subbasins (TNC 1999).

Threat Type	Site Name[a]	Scope	Immediacy	Reversible	Understanding of Threat
Grazing Nonnative plants	Alkali Gulch	significant significant	occurring now occurring now	yes maybe	good moderate
Mining	Big Wood Wild and Scenic River	significant	unknown	maybe	minimal
Grazing Nonnative plants Recreation Weapons testing/training Hydrologic alteration Small population Altered fire regime	Birds of Prey Natural Conservation Area	significant significant minor unknown minor significant significant	occurring now occurring now occurring now occurring now occurring now occurring now occurring now	unknown unknown unknown unknown unknown unknown unknown	moderate moderate minimal minimal minimal minimal moderate
Hydrologic alteration Grazing Groundwater withdrawal Altered fire regime Nonnative plants Recreation	Bruneau River–Jacks Creek	significant significant significant significant significant unknown	occurring now occurring now occurring now occurring now occurring now occurring now	unknown unknown unknown unknown unknown unknown	minimal moderate moderate moderate moderate minimal
Grazing Nonnative fish Nonnative plants	Craters of the Moon	significant unknown significant	occurring now occurring now occurring now	maybe unknown maybe	moderate minimal moderate
Grazing	Dry Creek	minor	in the past	yes	minimal
Residential development Grazing Recreation Altered fire regime Hydrologic alteration Roads/rights of way Mining Nonnative fish	Jarbidge Creek	minor minor minor minor unknown minor unknown unknown	occurring now occurring now occurring now occurring now unknown occurring now unknown occurring now	no yes yes yes yes yes yes yes	moderate minimal moderate minimal none minimal none minimal

Threat Type	Site Name[a]	Scope	Immediacy	Reversible	Understanding of Threat
Loss of habitat elsewhere		unknown	occurring now	yes	minimal
Commercial development		minor	within 5-15 years	yes	minimal
Aquaculture	Middle Snake River Corridor	significant	occurring now	maybe	good
Dams		significant	occurring now	no	good
Groundwater withdrawal		significant	occurring now	maybe	good
Water pollution		significant	occurring now	maybe	good
Small population		significant	occurring now	maybe	moderate
Restriction of range		significant	in the past	no	moderate
Nonnative aquatic invertebrates		significant	occurring now	unknown	minimal
Grazing	Salmon Falls Creek	unknown	occurring now	unknown	none
Agriculture—crop	Succor Creek	minor	occurring now	no	moderate
Recreation		minor	occurring now	yes	moderate
Grazing		significant	occurring now	yes	good
Mining		significant	within 5-15 years	no	minimal
Altered fire regime		significant	occurring now	yes	moderate
Nonnative plants		significant	occurring now	yes	moderate
Agriculture—crop	TNC Silver Creek Preserve	significant	occurring now	yes	good
Diversions		significant	occurring now	yes	good
Groundwater withdrawal		significant	occurring now	maybe	good
Residential development		significant	occurring now	yes	good
Grazing		significant	occurring now	yes	good
Water pollution		minor	occurring now	yes	good
Diversions	TNC Stapp–Soldier Creek Preserve	minor	occurring now	maybe	good
Grazing		minor	occurring now	yes	good
Nonnative plants	Weiser Sand Hills	significant	occurring now	unknown	minimal
Grazing		significant	occurring now	maybe	minimal
Mining		minor	within 5 years	maybe	minimal

[a] Sites in shaded boxes were identified by TNC as the highest conservation priorities

3.2 Species Designated as Federally Threatened or Endangered

Federal protection of native animal species in the United States was initiated by Congress in 1966 with the passage of the Endangered Species Preservation Act. In 1969, protection was extended to species worldwide by the Endangered Species Conservation Act. In 1973, international commerce of plant and animal species was restricted by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). These conservation efforts were synthesized by the Endangered Species Act of 1973, an act that provided protection for U.S. and foreign species of animals, plants, and invertebrates. Amendments to the ESA were made in 1978, 1982, and 1988 but did not change the overall structure of the original act. Compliance under the Endangered Species Act as amended (ESA) is regulated by the Department of the Interior's U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Fisheries Service (NOAA Fisheries). The USFWS administers fish, wildlife, plants, and their habitats, and NOAA Fisheries manages marine and coastal resources.

The purpose of the ESA is to "conserve the ecosystems upon which threatened or endangered species depend" and conserve and recover listed species. Under the law, species may be listed as either *threatened* or *endangered*. An endangered species is "any species which is in danger of extinction throughout all or a significant portion of its range"; a threatened species is "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (section 3 of the Act). *Candidate* species are plants and animals for which the USFWS has sufficient information about biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a listing regulation is substituted by other higher-priority listing activities (67 FR 40657). Federal agencies are required to assure their actions, will not "jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such a species" (section 7 of the Act). Conservation of endangered species at the state level is encouraged by federal financial incentives and cooperative agreements (section 6 of the Act).

Four endangered mollusc species, one threatened mollusc, one threatened fish, three threatened wildlife species, two threatened plants, and three wildlife candidate species for listing occur or potentially occur within the Middle Snake subbasins (Table 14). Seven of the 1threatened, endangered, and candidate species that potentially occur in the subbasins were selected as focal species for this assessment. The Canidate species, Columbia spotted frog was also selected as a focal species (Table 14). Sections 3.4 and 3.5 describe the aquatic and terrestrial (respectively) focal species selection process, focal species biology, habitat use, and population trends, if understood. Threatened, endangered, or candidate species not selected as a focal species are briefely discussed in the text below.

Table 14. Aquatic and terrestrial species that are listed as endangered, threatened, or candidate under the ESA and that are confirmed present, or for which there is potential habitat, in the Middle Snake subbasins (IBIS 2003, USFWS 2003a).

Federal Status	Common Name	Scientific Name
Endangered	Banbury springs limpet*	*Lanx* sp.
Endangered	Utah (or desert) valvata*	*Valvata utahensis*
Endangered	Idaho springsnail*	*Pyrgulopsis idahoensis*
Endangered	Snake River physa*	*Physa natricina*
Threatened	Bliss Rapids snail*	*Taylorconcha serpenticola*
Threatened	Bull trout*	*Salvelinus confluentus*
Threatened	Bald eagle	*Haliaeetus leucocephalus*
Threatened	Lynx	*Lynx canadensis*
Threatened	Northern Idaho ground squirrel	*Spermophilus brunneus brunneus*
Threatened	Macfarlane's four-o'clock	*Mirabilis macfarlanei*
Threatened	Spalding's catchfly (also called Spalding's silene)*	*Silene spaldingii*
Candidate	Columbia spotted frog*	*Rana luteiventris*
Candidate	Yellow-billed cuckoo	*Coccyzus americanus occidentalis*
Candidate	Southern Idaho ground squirrel	*Spermophilus brunneus endemicus*

* selected as focal species for Middle Snake Subbasins Plan

Endangered Species

Moluscs

The four endangered and one threatened molusc species that occur in the subbasins were selected as focal species for this assessment; see section 3.4.1 for discussion.

Threatened Species

Bull Trout

The bull trout was selected as a focal species for this assessment; see section 3.4.1 for discussion.

Bald Eagle

The bald eagle is the second largest North American bird of prey; only the California condor (Gymnogyps californianus) is larger. Two subspecies of bald eagle are tentatively recognized: a larger, northern subspecies (Haliaeetus leucocephalus alascanus) and a smaller, southern subspecies (H. leucocephalus leucocephalus). The adult bird has a distinctive white head and tail that contrast with a dark brown body and wings. The bald eagle breeding range extends across Alaska, Canada, and all contiguous states of the United States, except for Rhode Island and Vermont. Winter range in the lower 48 states is typically associated with aquatic areas having some open water for foraging. Migration patterns are complex and depend on the age of the individual, location of breeding site, severity of climate at the breeding site, and year-round food availability. Northern birds leave the breeding areas between August and October and usually return between January and March, depending on weather conditions and food availability. High-quality winter habitat is defined by adequate food availability, presence of roost sites that provide protection from inclement weather, and absence of human disturbance. Native Americans valued bald eagles and used their feathers for ceremonial purposes. For the people of the United States, the bald eagle serves as a symbol of freedom associated with democracy, wilderness, and the environmental ethic (Buehler 2000).

Bald eagles typically nest in forested areas adjacent to large bodies of water. Nests are usually in mature forests that have some habitat edge (eases nest access) and are near (usually < 2 km) water with suitable foraging opportunities. The nest tree is usually one of the largest trees available, with accessible limbs capable of holding a nest, and the nest is placed in the tree's top quarter, just below the crown. Only one brood per season is produced unless eggs are taken or destroyed during incubation, in which case, a second brood might be attempted. Clutch size is generally one to three, with two being the most common. The incubation period is long, approximately 35 days. Lifetime reproductive success has been documented for one female: she produced a total of 23 fledged young in 13 years of nesting (Buehler 2000).

Eggs, nestlings, and fledglings are the life stages most susceptible to predation. Potential predators include black-billed magpies (Pica pica), gulls, ravens (Corvus spp.), crows (Corvus spp.), black bears (Ursus americanus), raccoons (Procyon lotor), hawks and owls, bobcats (Felis rufus), and wolverines (Gulo gulo). The maximum recorded age for a wild bald eagle is 28 years, but good survival data are still lacking for most populations. It is speculated that bald eagles may have survival patterns similar to other raptors, with first-year survival being the lowest, followed by increasing survival with age. Because bald eagles have low reproductive rates, factors affecting survival likely regulate populations. Bald eagles are optimal foragers, but diet composition varies by site and availability of prey species. Bald eagles eat a wide variety of fish, birds, mammals, reptiles, amphibians, and crustaceans. Food is obtained by direct capture, scavenging, and usurping from other bald eagles, birds, and mammals. Fish typically comprise a greater proportion of the diet, followed by birds, mammals, and other food items (Buehler 2000).

Because of concern over declining populations of bald eagle, primarily due to habitat destruction, human-caused mortality, and DDT-caused eggshell thinning, the bald eagle was designated as threatened in the conterminous United States on March 11, 1967, under a law that preceded the ESA of 1973. On July 4, 1976, the USFWS officially listed the bald eagle as a federally endangered species. In July 1995, the USFWS upgraded the status of bald eagles in the lower 48 states to threatened. It is classified by the BLM as a Type 1 sensitive species and by Idaho as endangered (IDCDC 2003). The species is considered globally secure (G4); in Idaho, it is rare as a breeder, but the nonbreeding population is apparently secure (S3BS4) (IDCDC 2003). In Idaho and the western Breeding Bird Survey (BBS) region, increasing trends (1966–2002) of 1.3% ($n = 5$ routes, $P = 0.65$) and 5.4% ($n = 88$ routes, $P < 0.001$) per year are promising for these populations (Sauer et al. 2003). In 2003, the number of occupied bald eagle territories in Idaho increased to 147, the highest number recorded since reporting began in 1979. More sites were checked than in any previous year and occupancy rates were up for the 7th straight season. Idaho's bald eagle population appears to be stable to increasing (Sallabanks 2003) and is on track with the recovery population goals established in the Pacific Bald Eagle Recover Plan (USFWS 1986). The USFWS is currently evaluating the bald eagle for delisting (USFWS 2003b).

The Middle Snake subbasins contain portions of four of the bald eagle management zone delineated by the USFWS in the recovery plan (management zones 14, 16, 17, 20)(USFWS 1986, Sallabanks 2003). The Idaho portion of the Middle Snake subbasins contains four active bald eagle nest sites and five sites that were historically occupied but are no longer utilized (Table 15). In 2003, the Idaho active bald eagle nests in the subbasin produced a total of seven bald eagle fledglings. Two active bald eagle nests in the subbasins occur in management zone 14, the Hells Canyon and Hibble Gulch nests. The Hells Canyon nest was discovered in the Payette National Forest along the Hells Canyon Reservoir in 1999 and has been occupied every year since (USFS 2003d). The Hibble nest was discovered in 2003, and successfully fledged two young. The Carey Lake nest, management zone 17, located along the banks of Carey Lake in the Little Wood River drainage produced two young in 2003. The SE Gooding nest, located near Twin Falls in management zone 20, produced one fledgling in 2003 (Sallabanks 2003; Table 15). While active bald eagle nests have been documented in management zone 16, those nests occur outside of the subbasin (Sallabanks 2003).

At least one nest is documented in the Oregon portion of the subbasin. This nest is located on the Oregon side of Oxbow reservoir and has been successfully used every year since its discovery in 2000 (USFS 2003a). Information on other nests in Oregon or Nevada was unavailable.

Table 15. Historic and currently active bald eagle surveys in the Idaho portion of the Middle Snake subbasins.

Management Zone	Nest Name	Monitoring Status	Occupied	Eggs Laid	Nest Successful	Number of young fledged
14	Dry Gulch	Historic nest-no longer monitored	-	-	-	-
14	Lone Pine	Historic nest-no longer monitored	-	-	-	-
14	Hells Canyon	Currently monitored	Y	Y	Y	2
14	Hibble Gulch	Currently monitored	Y	Y	Y	2
17	Silver Creek 1	Historic nest-no longer monitored	-	-	-	-
17	Silver Creek 2	Historic nest-no longer monitored	-	-	-	-
17	Carey Lake	Currently monitored	Y	Y	Y	2
20	Blue Lakes	Historic nest-no longer monitored	-	-	-	-
20	SE Gooding	Currently monitored	Y	Y	Y	1

The USGS Forest and Rangeland Ecosystem Science Center's Snake River Field Station coordinates the Midwinter Bald Eagle Survey, in which standard, nonoverlapping routes are surveyed by several hundred people (http://ocid.nacse.org/qml/nbii/eagles/). Seven midwinter count routes occur within the Middle Snake subbasins. Summary results from 1988 through 2000 illustrate varying annual changes in bald eagle numbers between the sites of the Middle Snake subbasins (Table 16).

Table 16. Summary results (1988–2000) for the Idaho Midwinter Bald Eagle Surveys in the Middle Snake subbasins (http://ocid.nacse.org/qml/nbii/eagles/).

Site Number	Route Name	Maximum Number of Bald Eagles	Mean Number of Bald Eagles	Minimum Number of Bald Eagles	Annual % Change
33	Brownlee Dam–Hells Canyon Dam	104	40.64	11	+6.25
44	Brownlee Reservoir	117	41.63	13	–4.90
81	Swan Falls–Walters Ferry	4	1.00	0	–4.88
42	Loverridge Bridge–Grand View	31	10.90	2	+6.74
90	Bliss–King Hill	19	9.33	4	+4.92
74	Silver Creek (Magic Reservoir–Hailey)	12	7.67	4	+0.88
73	Milner Dam–Bliss	15	4.60	0	–3.29

The greatest threats to bald eagles are from human activities. Direct threats are shooting, trapping, or poisoning; indirect threats include developments of powerlines and other structures. In addition, environmental contaminants are a significant source of mortality (Buehler 2000).

Lynx

A medium-sized forest carnivore, the lynx is characterized by long, black ear tufts, large feet, and a black tip that completely encircles the tail. The range of lynx in North America extends across the boreal forests of Canada and Alaska to tree line, northern New England, portions of the Lake States, the Pacific Northwest, and the Rocky Mountains (Tumlison 1987). The primary habitats include boreal and sub-boreal forests with openings, rugged outcrops, bogs, and thickets (Tumlison 1987, Aubry et al. 2000). In the western mountains, lynx are associated with coniferous forests and upper elevations, but mixed coniferous-deciduous forests comprise lynx habitat in the Northeast. Lynx utilize early successional forest stands for foraging and mature forest stands containing large woody debris for denning. Southern populations of lynx have large home ranges and are found in lower densities than their northern counterparts (Aubry et al. 2000). Because of the value of lynx as a furbearer, there are over 200 years of trapping records from the Hudson Bay Company. These records show approximately 10-year fluctuations in lynx harvests that are synchronized with the populations of the lynx's primary prey, the snowshoe hare (*Lepus americanus*) (Tumlison 1987).

Female lynx are capable of breeding at 10 months but may wait until their second breeding season (22–23 months) if sexual maturity is delayed. Males typically do not breed until their second year. Reduced prey may affect reproductive success, particularly in yearling females, and lynx may reproduce in alternate years if food availability is limited. Litter size ranges from one to six but is usually three to four in North America. Twenty-two years is the maximum life span in captivity, but lynx will seldom live beyond 15 years in the wild. The main sources of mortality are starvation and harvest by humans (Tumlison 1987), but recently introduced lynx in Colorado have also suffered from plague (Tanya Shenk, Colorado Division of Wildlife, personal communication).

Snowshoe hares can comprise up to 83% of the lynx diet, which may also include alternate prey such as squirrels, small mammals, beaver, deer, moose, muskrats, and birds (Tumlison 1987). Alternate prey are believed to be important constituents of lynx diets in southern boreal forests (Aubry et al. 2000).

On March 24, 2000, the lynx was listed as threatened under the ESA. (Federal Register, Vol. 65, 16052-16086). Although the USFWS considers Idaho a state where lynx are known to occur, viable populations have not been documented in the Middle Snake subbasins. Therefore, there can be no discussion of trends for this species within the subbasins. Four historical records of lynx occurance in the subbasin have been reported to the Idaho Conservation Data. In 1950 a hound hunter reported a failed attempt to harvest a lynx with hounds. In 1972, a lynx was shot in the Rock Creek drainage of Twin Falls County also in 1972 a lynx was killed by a car in the Upper Camas Creek drainage. In 1984, a lynx was illegal killed on a farm near Belvue in the Big Wood drainage. IDFG issued a citation over the incident (IDCDC 2001).

Primary threats to lynx include prey scarcity and lynx harvest (Tumlison 1987). The harvesting of lynx is no longer legal. It is also speculated that habitat fragmentation facilitating access by interspecific competitors may affect the structure and function of lynx populations (Buskirk et al. 2000).

Macfarlane's Four O'Clock

Macfarlane's four o'clock is an herbaceous perennial with a deep-seated, thickened root. It is a member of the four o'clock family (Nyctaginaceae) and was first described from specimens collected along the Snake River Canyon in 1936. They are long-lived, with one plant observed living over 20 years. The plants bloom from May through June and have bright pink, conspicuous flowers. Each flower has the potential to produce one fruit and one seed. Seed dispersal typically occurs in June and July, with germination probably occurring in early spring. Seeds fall close to the plant and are transported by gravity, rainwater, and potentially wildlife. Specific conditions required for germination and seedling survival are unknown. Plants may also reproduce clonally from a thick, woody tuber that sends out many shoots (USFWS 2000).

MacFarlane's four o'clock is found on talus slopes in canyonland corridors where the climate is regionally warm and dry and precipitation occurs mostly in winter and spring. Populations generally occur as scattered plants on open, steep (50%) slopes of sandy or talus soils and west to southeast aspects (Federal Register, Vol. 61, No. 52:10693–10697). MacFarlane's four o'clock populations range from approximately 1,000 to 3,000 feet in elevation (USFWS 2000).

At the time of its original listing as endangered in 1979 (Federal Register, Vol. 44, No. 209, 61912–61913), MacFarlane's four o'clock was known from only three populations along the Snake River canyon in Oregon (Hells Canyon National Recreation Area) and the Salmon River canyon in Idaho (BLM Cottonwood Field Office area), totaling approximately 25 plants on 25 acres (USFWS 2000). As a result of additional surveys and active management of some populations on federal lands, MacFarlane's four o'clock was downlisted to threatened in March 1996 (Federal Register, Vol. 61, No. 52:10693–10697). The number of known individuals has increased 260-fold, from 27 plants when listed to approximately 7,212 plants in 1991 (Federal Register, Vol. 61, No. 52, 10693–10697). MacFarlane's four o'clock has a recovery priority of 2 on a scale of 1 to 18. This ranking reflects a high degree of threat, high potential for recovery, and taxonomic rank as full species.

Eleven populations of MacFarlane's four o'clock are currently known. Three of these populations are found in the Snake River canyon area (Idaho County, Idaho, and Wallowa County, Oregon), six in the Salmon River area (Idaho County), and two in the Imnaha River area (Wallowa County, Oregon) (USFWS 1985; Federal Register, Vol. 61, No. 52:10693–10697). All of these populations are located north of the Middle Snake subbasins.

MacFarlane's four o'clock and its habitat have been and continue to be threatened by a number of factors, including herbicide and pesticide spraying, landslide and flood damage, disease and insect damage, exotic plants, livestock grazing, off-road vehicles, and possibly road and trail construction and maintenance. The collecting of MacFarlane's four o'clock has also been determined to be a limiting factor, as have mining, competition for pollinators, and inbreeding depression (USFWS 2000).

Northern Idaho Ground Squirrel

Both subspecies of Idaho ground squirrel are rare and spatially restricted to western Idaho and have declining populations. The northern Idaho ground squirrel's smaller size and different pelage coloration distinguish it from the southern Idaho ground squirrel. The differences in coloration are an adaptation to differences in the soils on which the two subspecies live. Northern Idaho ground squirrels are found in areas with shallow, reddish parent soils of basaltic origin, while the southern Idaho ground squirrel lives on lower-elevation, paler-colored soils formed by granitic sands and clays (Yensen 1985 and 1991, cited in Federal Register, Vol. 65, No. 66, 17779–17786).

The northern Idaho ground squirrel is a relatively small member of the genus *Spermophilus*; the mean lengths of males and females are 23.4 cm (9.2 inches) and 22.6 cm (8.9 inches), respectively (Yensen and Sherman 1997, cited in Federal Register, Vol. 65, No. 66:17779–17786). The pelage of northern Idaho ground squirrels on the dorsal area appears dark reddish-gray as the result of a mixture of black unbanded and yellowish-red banded guard hairs. The subspecies' eye ring is buffy white.

The northern Idaho ground squirrel is known to occur in shallow, dry, rocky meadows usually associated with deeper, well-drained soils and surrounded by ponderosa pine and Douglas-fir forests, at elevations of about 3,000 to 5,400 feet. This ground squirrel is not abundant in meadows that contain high densities of small trees (Sherman and Yensen 1994, cited in USFWS 2003c). The northern Idaho ground squirrel consumes at least 45 to 50 plant species. Seeds of forbs, lupines, and composites are important, while roots, bulbs, leaf stems, and flower heads are a minor component of their diet. Grasses and seeds are especially important, and the squirrel ingests large amounts of bluegrass (*Poa* spp.) and other grass seeds to store energy for winter use (Dyni and Yensen 1996, cited in USFWS 2003c). The primary predators of the northern Idaho ground squirrel include the badger (*Taxidea taxus*), northern goshawk (*Accipiter gentilis*), prairie falcon (*Falco mexicanus*), and occasionally red-tailed hawk (*Buteo jamaicensis*) (USFWS 2003c).

The northern Idaho ground squirrel has the most restricted geographical range of any *Spermophilus* taxa and one of the smallest ranges among North American mainland mammals. It is found only in isolated populations in Valley and Adams counties in Idaho (Federal Register, Vol. 65, No. 66:17779–17786). The entire range of the subspecies is about 32 by 108 km (20 by 61 miles), and, as of 2002, 34 of 40 known population sites were extant (USFWS 2003c). All known occurrences of the northern Idaho ground squirrel in the lower Middle Snake subbasins are in the Wildhorse River drainage, which flows into Hells Canyon Reservoir. Four of the 12 primary metapopulation sites delineated by the USFWS and 12 of the 21 occurrences of this subspecies recorded in the Idaho Conservation Data Center database occur in the Wildhorse River drainage (IDCDC 2001, USFWS 2003c). The northern Idaho ground squirrel was listed as threatened by the USFWS on May 5, 2000 (Federal Register, Vol. 65, No. 66:17779–17786). Populations of this subspecies have declined from approximately 5,000 animals in 1985 to fewer than 1,000 in 1998 (Federal Register, Vol. 65, No. 66:17779–17786). By 2000, preliminary surveys indicated that only about 350 individuals remained at known population sites. Based on more extensive census data collected in spring 2002, the population was estimated to be 450 to 500 animals (USFWS 2003c).

Delisting may be considered when the following recovery criteria have been met (USFWS 2003c):

- Of the 17 potential (primary and secondary) metapopulations that have been identified within the probable historical distribution, there must be at least 10 metapopulations, each maintaining an average effective population size of more than 500 individuals for 5 consecutive years.

- The area occupied by a minimum of 10 potential metapopulations must be protected (currently, 2 of the 4 primary metapopulation sites in the subbasins are partially protected and 2 are completely protected by the USFS).

- Plans have been completed for the continued ecological management of habitats for a minimum of 10 potential metapopulation sites.

- A post-delisting monitoring plan covering a minimum of 10 potential metapopulation sites has been completed and is ready for implementation.

The primary threat to the northern Idaho ground squirrel is invasion of meadows by conifers (Sherman and Yensen 1994, cited in Federal Register, Vol. 65, No. 66:17779–17786). Fire suppression and the dense regrowth of conifers resulting from past logging activities have significantly reduced meadow habitats suitable for northern Idaho ground squirrels. Reductions in the frequency of small meadow patches among forest habitats have reduced dispersal corridors, resulting in the extirpation of small, isolated populations of the subspecies (Federal Register, Vol. 65, No. 66:17779–17786). Other factors threatening the northern Idaho ground squirrel include competitive exclusion from the Columbian ground squirrel, land use changes, recreational shooting, poisoning, and naturally occurring events (Federal Register, Vol. 65, No. 66:17779–17786).

Spalding's Catchfly

Spalding's catchfly was selected as a focal species for this assessment; see section 3.5.1 for discussion.

Candidate Species

Columbia Spotted Frog

Columbia spotted frog was selected as a focal species for this assessment; see see section 3.5.1 for discussion.

Southern Idaho Ground Squirrel

The southern Idaho ground squirrel subspecies occurs at elevations ranging from 2,200 to 3,200 feet in the low, rolling hills and valleys in Gem, Payette, Washington, and extreme southern Adams counties in Idaho (Engle and Harris 2001). The population of this subspecies was estimated at 40,000 in 1985. No current population estimate was available but the subspecies appears to be in decline. In 1999, squirrels were observed at only 19 sites (37% of the historically occupied sites visited), and at 18 of these sites only a single individual was observed. Active burrows of southern Idaho ground squirrels occur in the lower Middle Snake subbasins along the banks of Hog, Jenkins, and Scott creeks (BLM 2001).

Yellow-Billed Cuckoo

A slender, long-tailed bird, the yellow-billed cuckoo migrates from its winter range in South America to breed throughout temperate North America and south to Mexico and Greater Antilles. The bird has been nicknamed the "raincrow" because it appears to call more often on cloudy days (Hughes 1999). Currently, with some debate, two subspecies are recognized, *Coccyzus americanus occidentalis* (western) and *C. americanus americanus* (eastern). The Pecos River, Texas, is the dividing line between the two subspecies, although there appears to be an intergrade along that boundary (AOU 1957).

Western cuckoos arrive on the breeding grounds in mid- to late May, which is one to two months later than their eastern counterparts do at the same latitude. By early to mid-June, considerable numbers may be present, but transients continue to be recorded in late June to mid-July. Western cuckoos depart in the fall, starting in late August, two to three weeks earlier than eastern cuckoos do, with most birds departing by mid-September. Breeding habitat is typically open woodland with clearings and low, dense scrubby vegetation. In arid environments of the West, the birds are often associated with riparian areas. Yellow-billed cuckoos are usually absent from heavily forested areas and large urban centers. Two to three weeks prior to breeding, yellow-billed cuckoos may occupy upland areas before moving into riparian areas to breed. Habitat on their winter range is similar to that on breeding areas; the species prefers woody vegetation bordering fresh water, lowlands to 1,500 meters, dense scrub, deciduous broad-leaf forest, gallery forest, and secondary forest. Western populations nest in willow, Fremont cottonwood, and mesquite; they may also nest in hackberry, soapberry, alder, and cultivated fruit trees. The nest is typically placed 0.3 to 1.0 meter from the end of a horizontal branch or in a vertical fork of a tree or large shrub, usually 1 to 6 meters above the ground. The nest may be 2 to 4 meters from the main tree trunk, and it is well concealed, particularly from above, by surrounding foliage. Because of the shortened breeding season, only a single brood is thought to be produced by western cuckoos, with the onset of breeding determined by food availability. Clutch size can be one to five eggs but is usually two or three. Large clutches (e.g., > 6) are attributed to more than one female laying eggs in a single nest (Hughes 1999). No data of nest success or young survival are available for Idaho. In the Sacramento Valley, California, the mean number of eggs per nest was 3.5 (± 1.0 SD), with 1.5 (± 0.56 SD) young surviving per nest (Laymon 1980). No information is available about lifetime reproductive success. Four years is the maximum recorded life span (Hughes 1999).

In addition to being an intraspecific brood parasite, the yellow-billed cuckoo is known to parasitize at least 11 other bird species. Evidence suggests that the yellow-billed cuckoo selects hosts that have similarly colored eggs. Brown-headed cowbirds may parasitize yellow-billed cuckoo nests but are probably rarely successful due to longer nesting requirements (11 days versus 7–9 days, respectively). Fatigued, migrating adult yellow-billed cuckoos are susceptible to predation by raptors. Nestlings may be taken by avian predators, snakes, and mammals. Yellow-billed cuckoos feed primarily on large insects, including caterpillars, katydids, cicadas, grasshoppers, and crickets. Other occasional food items are small frogs, arboreal lizards, eggs and young of birds, or fruits and seeds. Yellow-billed cuckoos most frequently forage by gleaning insects from leaves and stems while perching in open areas, woodlands, orchards, or adjacent streams (Hughes 1999).

Abundance of yellow-billed cuckoos can be highly variable, with large localized influxes occurring during times of insect abundance or outbreaks. It is difficult to determine population trends from conventional observation, mist netting, or listening-post techniques due to the quiet demeanor and skulking behavior of yellow-billed cuckoos. These methods should be considered inadequate for determining densities. The preferred and recommended method is counting responses to playback (Hughes 1999). Because of these limitations, interpretation of BBS data should be made with caution. No yellow-billed cuckoo BBS data are available for Idaho, but trend estimates for the western region indicate declines from 1966 through 2002 but not at a statistically significant level (–2.6% per year, $P = 0.31$, $n = 20$) (Sauer et al. 2003). In 2003, a survey was conducted for the yellow-billed cuckoo in recorded historic and other likely locations in Idaho. The purpose of this study was to compile historic records for yellow-billed cuckoos in the state, develop and implement sampling methodology, and establish a long-term monitoring protocol that could be used to monitor this species. Fifty-five percent (35 of 64 total historic sightings) of the historical yellow-billed cuckoo records in Idaho are from southeast Idaho, with most being from the Snake River corridor. No yellow-billed cuckoos were detected in the subbasin during the 2003 surveys, but one verified sighting occurred in 2002 near the confluence of the Snake River and Bennet Creek (TREC, Inc. 2003). The yellow-billed cuckoo was not observed during extensive fieldwork conducted by IPC personell in the Hagerman Valley (Holthuijzen 1995).

Yellow-billed cuckoos are extremely rare in the western United States and western Canada. The western yellow-billed cuckoo was given candidate status for listing under the ESA in July 2001 (Federal Register, Vol. 66, No. 143). The yellow-billed cuckoo is also listed for the Great Basin in *Birds of Conservation Concern 2002* (USFWS 2002a) and deemed a priority for conservation actions. The IDCDC (2003) reports that the yellow-billed cuckoo is globally secure (G5) but ranks it as critically imperiled as a breeder in Idaho because of its rarity and vulnerability to extinction (S1B). The bird has the same state status (S1B) in Nevada (NNHP 2003).

Limiting factors for yellow-billed cuckoos include habitat loss and fragmentation, inundation from water management projects, lowering of water tables, land clearing, cattle grazing, and pesticide use (Hughes 1999).

3.3 Special Status Species

3.3.1 Idaho

The Idaho Department of Fish and Game (IDFG) is mandated under Idaho Code § 36-103 to "preserve, protect, perpetuate and manage all wildlife." The IDFG classifies wildlife into game, furbearing animals, migratory birds, threatened or endangered species, protected nongame, and unprotected species. In addition, a list for species of special concern is maintained by the state for native animals that are "low in numbers" or "limited in distribution" or that "have suffered significant habitat losses" (IDCDC 2003). The Idaho Conservation Data Center (IDCDC) is the central repository for information pertaining to native species status and provides the most current information on Idaho's rare, threatened, and endangered animals (IDCDC 2003). In the Middle Snake subbasins, there are 50 birds, 16 mammals, 3 amphibians, and 3 reptiles that are designated by the state of Idaho as Protected or Species of Special Concern (Appendix C).

The Idaho Conservation Data Center maintains native plant data with major input provided by the Idaho Native Plant Society (INPS), a nonprofit organization "dedicated to promoting interest in native plants and plant communities, and collecting and sharing information on all phases of the botany of native plants in Idaho." In the Middle Snake subbasins, there are 20 (19 vascular and 1 nonvascular) plant species classified by the INPS as sensitive (S), meaning that they are taxa having small populations or localized distributions within Idaho but are not presently in danger of becoming extinct or extirpated from Idaho (IDCDC 2003) (Appendix D). An additional 10 plant species have been targeted for continued monitoring (M) (Appendix D); these species are common within a limited range or uncommon but without foreseeable threats (IDCDC 2003). Status rankings of the Bureau of Land Management (BLM), U.S. Forest Service (USFS), and state (Idaho, Nevada, and Oregon) natural heritage programs are also presented in Appendix D.

3.3.2 Nevada

The hunting and animal protection measures of the Nevada Department of Conservation and Natural Resources are delineated by Nevada's code of state regulations (NAC), which are defined under state law (NRS 233B.038) to outline procedure requirements of the agency. The Nevada Department of Wildlife (NDOW) is responsible for managing and restoring the state's fish and wildlife resources. Animal species are classified as game, fur-bearing, unprotected, endangered, threatened, or protected (NAC 503). State regulations define an *endangered* species as one facing the threat of extinction throughout all or a significant portion of its range. A species or subspecies is considered *threatened* if it is likely to become an endangered species in the near future. *Protected* status is assigned to a species that meets any or all of the following criteria (NAC 503.103):

- it is found only in the state and has a limited distribution
- its population may experience significant declines from human or natural causes
- deterioration and loss of habitat threatens its population
- its value (i.e., ecological, scientific, educational) justifies protection
- there is inadequate data available to determine the status of a population that is suspected to be limited in habitat or distribution or limited by other factors
- it has federal listing under the ESA

Critically endangered plants are also afforded protection under state law (NRS 527.260–527.300), and for these species, "no member of its kind may be removed or destroyed at any time by any means except under special permit issued by the state forester firewarden" (NRS 527.270). Wildlife species that are classified by Nevada as endangered, threatened, or protected and that are present or with potential habitat in the Middle Snake subbasins include 27 birds and 2 mammals (Appendix C). Two plant species of the Middle Snake subbasins—mud flat milkvetch (*Astragalus yoder-williamsii*) and obscure scorpion plant (*Phacelia inconspicua*)—are classified by the state as critically endangered (NNHP 2003).

3.3.3 Oregon

In addition to federal protection under the Endangered Species Act, threatened and endangered species receive state protection under the Oregon Endangered Species Act (Or. Rev. Stat. §§ 496.171–496.992, 498.026 [1995]). The State Fish and Wildlife Commission has the authority to add and remove species from the list. When a species is added, the commission is responsible for outlining measurable and quantifiable guidelines that are necessary to "ensure the survival of individual members of the species." The state attempts to minimize duplicative efforts when there is overlap with federally listed species and encourages collaborative programs for protecting listed species that minimize impacts on the uses of state lands.

A sensitive species classification was created under Oregon's Sensitive Species Rule (OAR 635-100-040) to encourage actions that will prevent additional species from being listed as threatened or endangered. Sensitive species constitute those naturally reproducing native animals that may become threatened or endangered throughout all or any significant portion of their range in Oregon (Table 17). Factors considered in listing species as sensitive include the potential for natural reproductive failure because of limited population numbers; disease, predation, or other natural or manmade factors; imminent or active deterioration of range or primary habitat; overutilization; and inadequate existing state or federal regulations or programs for species or habitat protection.

Sensitive species are divided into four categories defined as follows:

Critical (C)—Species for which listing as threatened or endangered is pending or for which listing as threatened or endangered may be appropriate if immediate conservation actions are not taken. Also considered critical are some peripheral species that are at risk throughout their range and some disjunct populations.

Vulnerable (V)—Species for which listing as threatened or endangered is not believed to be imminent and can be avoided thorough continued or expanded use of adequate protective measures and monitoring. In some cases, populations are sustainable, and protective measures are being implemented; in others, populations may be declining, and improved protective measures are needed to maintain sustainable populations over time.

Peripheral or Naturally Rare (R)—Peripheral species are those whose Oregon populations are on the edge of their range. Naturally rare species are those having low population numbers historically in Oregon because of naturally limiting factors. Maintaining the status quo is a minimum necessity. Disjunct populations of several species that occur in Oregon should not be confused with peripheral species.

Undetermined Status (U)—Species for which status is unclear. They may be susceptible to population decline of sufficient magnitude that they could qualify for endangered, threatened, critical, or vulnerable status, but scientific study would be needed before a judgment could be made.

Table 17. Number of wildlife species of the Middle Snake subbasins classified by Oregon as endangered (E), threatened (T), critical (C), vulnerable (V), peripheral/naturally rare (R), or undetermined (U) status (ODFW 1997). In addition, Oregon has one amphibian and two reptile species that are candidates for listing under the Oregon Endangered Species Act.

Animal Type	Number of Species per Oregon Classification						Total
	E	T	C	V	R	U	
Birds	1	2	14	9	7	9	42
Mammals	1	2	2	4	0	6	15
Amphibians and reptiles	0	0	0	6	2	2	10

The Oregon Natural Heritage Information Center maintains databases of Oregon's rare and endangered plants, animals, and ecosystems. The Oregon Natural Heritage Program (ONHP) is a partnership between the Division of State Lands and Oregon State University. The main goals of the program are to establish natural areas in Oregon, manage the Rare and Endangered Invertebrate Program for the State of Oregon, and manage the Oregon Natural Heritage Databank, containing comprehensive information on ecologically and scientifically significant natural areas in the state. The ONHP is currently working with the Oregon Department of Fish and Wildlife (ODFW) in updating the ODFW's sensitive species lists, which were last updated in 1997. Oregon's special status wildlife and plant species with potential habitat in the Middle Snake subbasins are listed in Appendix C and Appendix D.

3.3.4 Bureau of Land Management

Idaho

The Idaho BLM, in accordance with national policy (BLM Manual 6840), maintains a special status species list of animals and plants (BLM 2003). This list is used by Idaho BLM offices for prioritization guidance in conservation and management. The current list was approved by the

State Director in May 2003 and will be updated in December 2005. Special status animal species are ranked based on rarity and endangerment and classified into one of the five following categories: Type 1 (federally threatened, endangered, proposed, and candidate species), Type 2 (rangewide/globally imperiled species), Type 3 (regional/state imperiled species), Type 4 (peripheral species), and Type 5 (watch list). Definitions for special status plants differ from animals only in the Type 3 (rangewide/globally imperiled species—moderate endangerment) and Type 4 (species of concern) descriptions. There are currently 33 birds, 16 mammals, 3 amphibians, 3 reptiles, and 80 plants that are classified by the Idaho BLM as a special status species Type 1 through 5 and known to be present or to have potential habitat in the Middle Snake subbasins (Appendix C and Appendix D).

Nevada

The BLM in Nevada, in accordance with national policy (BLM Manual 6840), maintains a special status species list of animals and plants. Sensitive species of the Nevada BLM are taxa that are not already included as BLM special status species due to federal ESA listing or Nevada state listing. Nevada BLM sensitive species that are present or with potential habitat within the Middle Snake subbasins include 21 birds, 3 mammals, 1 amphibian, and 23 plants (Appendix C and Appendix D).

Oregon

The BLM in Oregon and Washington also maintains lists of *special status species* (sometimes referred to as SSS). The policy regarding special status species requires that any authorization or approval by the agency is consistent with those species' conservation needs and does not contribute to the need to list the species under the provisions of the ESA (BLM Manual 6840). In Oregon, special status species are categorized into *BLM sensitive*, *BLM assessment*, and *BLM tracking* species—categories that correspond to the Oregon Natural Heritage Program's *List 1* through *List 4* species. List 1 (threatened or endangered throughout range) species are BLM sensitive species; List 2 (threatened, endangered, or extirpated in Oregon, secure elsewhere), BLM assessment species; and List 3 (review) and 4 (watch), BLM tracking species. There are 80 wildlife species classified by the Oregon BLM as special status species that are present or with potential habitat in the Middle Snake subbasins (Table 18 and Appendix C).

Table 18. Bureau of Land Management (Oregon) special status species that are present, or for which there is potential habitat, in the Middle Snake subbasins (ONHP 2001).

Animal Type	**Number of Species per Oregon BLM Special Status Designation**				**Total**
	List 1	**List 2**	**List 3**	**List 4**	
Birds	1	21	1	28	51
Mammals	0	10	1	7	18
Amphibians and reptiles	0	7	1	3	11

3.3.5 U.S. Forest Service

The threatened, endangered, and sensitive species program of the USFS is guided by the ESA, National Forest Management Act (1976), and the Secretary of Agriculture's Policy on Fish and Wildlife (9500-4). In addition to compliance with conservation legislation and policy, Forest Service Sensitive Species Policy (FSM 2670.32) calls for National Forests to "assist states in achieving conservation goals; to complete biological evaluations of programs and activities; avoid and minimize impacts to species with viability concerns; analyze significance of adverse effects on populations or habitat; and coordinate with states, U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS)." Plant and animal species identified by the Regional Forester as *sensitive* are those for which viability is of concern and adverse effects of management are avoided or mitigated in order to prevent federal listing. USFS (Region 4 and Region 6) sensitive wildlife species that are present or have potential habitat in the Middle Snake subbasins include 20 birds, 7 mammals, 1 amphibian, and 1 reptile (Appendix C). There are 88 plant species that are classified as sensitive in Regions 4 and 6 and that may occur in the Middle Snake subbasins (Appendix D).

3.3.6 HEP Species

CH2M HILL conducted a Habitat Evaluation Procedure (HEP) study on behalf of Idaho Power Company (IPC) as part of IPC's relicensing process for the C.J. Strike Hydroelectric Project (Blair 1997). The procedure outlined by the USFWS (1980) was modified slightly for the C.J. Strike study (Blair 1997). The objectives of the study were to assess the current habitat conditions and values for wildlife, develop resource goals and potential future management actions (Table 19), and assess the effects of actions on future wildlife habitat values (habitat value = habitat unit = area × habitat suitability index). Habitat quality is defined by a habitat suitability index (HSI), and, for the C.J. Strike project, habitat quality was calculated for target year zero (TY0). Results are presented in terms of existing habitat units (HU) and future average annualized habitat units (AAHU) for cover types within the analysis area, as well as for the wildlife species. Evaluation species were selected that represented the resource goals and cover types present within the C.J. Strike Wildlife Management Area (Table 19).

Table 19. Evaluation species used to assess management actions, C.J. Strike HEP Study (Blair 1997).

Management Action	Evaluation Species							
	Mallard	Mink	Marsh Wren	Western Grebe	Yellow Warbler	Great Blue Heron	Brewer's Sparrow	Pronghorn
No change	X	X	X	X	X	X	X	X
Reduced management funding	X	X	X	—	X	—	—	X
Upland planting	—	—	—	—	—	—	X	X
Emergent wetland development	X	X	X	—	—	—	—	—

Management Action	Evaluation Species							
	Mallard	Mink	Marsh Wren	Western Grebe	Yellow Warbler	Great Blue Heron	Brewer's Sparrow	Pronghorn
Cottonwood development	—	X	—	—	—	X	—	—
Gold Island habitat development	X	X	X	—	X	X	X	X
Downstream operational impacts	X	X	X	—	X	X	—	—
Acquiring Simplot property	X	X	X	—	X	X	—	—
Improved water management	—	—	X	—	—	—	—	—
Downstream wetland/ riparian habitat	X	X	X	—	X	X	—	—
Fence springs	X	—	X	—	—	—	—	—
Acquire Prow property	X	X	X	—	X	—	X	X
BLM trade	X	X	X	—	—	—	—	—
Island loss/peninsula development	X	X	X	X	X	—	X	X
Purple loosestrife control	—	—	X	—	—	—	—	—
Trespass grazing	X	X	X	—	X	—	X	X

3.3.7 Partners in Flight High Priority Bird Species used for Monitoring

Partners in Flight (PIF) is a cooperative effort between federal, state, and local government agencies; philanthropic foundations; professional organizations; conservation groups; industry; academic community; and private individuals. The formation of PIF in 1990 was a response to growing concern about land bird species declines. One goal of PIF is to improve "monitoring and inventory, research, management, and education programs involving birds and their habitats" through collaborative partnerships and a combination of resources (PIF 2003).

Scientifically based land bird conservation plans (BCPs) based on physiographic regions outline PIF's long-term strategy for bird conservation. For each region, a BCP outlines focal habitats and priority bird species. The Middle Snake subbasins lies within the Columbia Plateau physiographic region, which contains 3 focal habitats and 24 total bird species (Table 20). The state PIF chapters of Idaho and Nevada also have individual plans that outline priority and focal species (Appendix E).

Table 20. Partners in Flight priority bird species and focal habitats identified for the Columbia Plateau physiographic region (PIF 2003).

Focal Habitat	Common Name	Scientific Name
Shrub-steppe	Swainson's hawk	*Buteo swainsoni*
	Prairie falcon	*Falco mexicanus*
	Greater sage grouse[a]	*Centrocercus urophasianus*
	California quail	*Callipepla californica*
	Long-billed curlew	*Numenius americanus*
	Black-chinned hummingbird	*Archilochus alexandri*
	Gray flycatcher	*Empidonax wrightii*
	Sage thrasher	*Oreoscoptes montanus*
	Brewer's sparrow	*Spizella breweri*
	Sage sparrow	*Amphispiza belli*
Wetlands/grasslands	Western grebe	*Aechmophorus occidentalis*
	Trumpeter swan	*Cygnus buccinator*
	Sandhill crane	*Grus canadensis*
	Franklin's gull	*Larus pipixcan*
	Tricolored blackbird	*Agelaius tricolor*
Coniferous forest	Mountain quail	*Oreortyx pictus*
	Flammulated owl	*Otus flammeolus*
	Black swift	*Cypseloides niger*
	Calliope hummingbird	*Stellula calliope*
	Lewis's woodpecker	*Melanerpes lewis*
	Williamson's sapsucker	*Sphyrapicus thyroideus*
	White-headed woodpecker	*Picoides albolarvatus*
	Black-backed woodpecker	*Picoides arcticus*
	Hermit warbler	*Dendroica occidentalis*

[a] Middle Snake subbasins focal species

3.4 Aquatic Resources

Prior to construction of hydropower dams, the Snake River from Shoshone Falls downstream, supported a diverse and rich aquatic community (Lance et al. 2001). Steelhead trout, chinook salmon, white sturgeon, redband or rainbow trout, Pacific lamprey, bull trout (*Salvelinus confluentus*), and a host of other aquatic species inhabited the river and could freely range throughout the Snake and Columbia river systems.

Construction of hydroelectric projects on the Snake River eliminated anadromous species such as chinook salmon, steelhead trout, and Pacific lamprey above the Hells Canyon Complex of dams (NPPC 1986) and contributed significantly to the reduction of native redband trout, bull trout, and white sturgeon (Lukens 1981, Cochnauer 1983, Quigley and Arbelbide 1997). Resident fish populations, including bull trout, sturgeon, and redband trout populations, have been segmented into isolated habitat areas and can no longer interact with other populations. The Swan Falls Project, downstream of C.J. Strike Dam, was built in 1901 with a fish ladder designed to pass anadromous fish. The ladder worked well only when the reservoir was at or near full pool (Irving and Cuplin 1956). The ladder was more efficient at passing steelhead because they migrated in the spring when flows were typically high, whereas chinook reached the dam during the summer and fall low flow period. This situation likely reduced chinook salmon runs greatly in the Snake River above Swan Falls Dam. Due to a variety of factors, including the inefficiency of the Swan Falls ladder, only a small run of salmon and steelhead ascended the Snake River up to the C.J. Strike Dam at the time of closure (1952). As a result, a fish ladder was not constructed (Irving and Cuplin 1956) and C.J. Strike became a complete barrier to all upstream migration. Prior to 1901, salmon and steelhead were known to spawn in the mainstem Snake River, Salmon Falls Creek, the Malad River, probably Rock Creek, and several of the spring areas where suitable spawning habitat was available (Gilbert and Everman 1895, Everman 1896). Everman (1896) described a reach of the Snake River, now inundated under Lower Salmon Falls Reservoir, as “the largest and most important salmon spawning ground of which we know in the Snake River.”

Construction of Brownlee (1959), Oxbow (1961), and Hells Canyon (1967) dams progressively eliminated anadromous species from the remainder of the Middle Snake subbasins (NPPC 1986). Numerous other dams and diversions had already blocked passage in the main tributaries and many of the smaller tributaries. The loss of anadromous fish impacted the basic biomass in the system, reducing overall nutrients, the prey base, and wildlife resources throughout the subbasins and associated tributaries.

The Middle Snake subbasins are currently inhabited by at least 49 species of fish, 23 of which are native to the region (Table 21). Generally, habitat conditions in the subbasins are poor for native fish; the few exceptions are limited to small habitat patches. Poor quality habitat, reduced quantity of habitat, and isolation of populations in fragmented habitat reduce the viability of many species.

Fish species diversity in the subbasins is relatively high, with the greatest diversity found in the mainstem of the Snake River (Maret et al. 1997). This large diversity is due primarily to the preponderance of introduced and warmwater species in the lowland waters, reservoirs, and Snake River mainstem (Maret 1997).

Currently, the dominant salmonid species throughout the subbasins include the rainbow trout and mountain whitefish (IDEQ and ODEQ 2003). Reservoir rainbow trout populations are comprised primarily of hatchery-reared trout. Native redband rainbow trout are found in a limited number of tributary streams throughout the subbasins. Bull trout are found only in limited tributary systems between Hells Canyon Reservoir and Hells Canyon Dam and in Hells Canyon Reservoir itself (IDEQ and ODEQ 2003). Prevalent nonsalmonid game species throughout the reservoirs in the subbasins include both the largemouth (*Micropterus salmoides*) and smallmouth (*M. dolomieui*) bass, black (*Pomoxis nigrmaculatus*) and white (*P. annularis*) crappie, catfish and bullhead, and white sturgeon (IDEQ and ODEQ 2003). The yellow perch (*Perca flavescens*) is also common throughout much of the subbasins (Lance et al. 2001). Nongame species common throughout the river and reservoir system(s) include the largescale sucker (*Catostomus macrocheilus*), northern pikeminnow (*Ptychocheilus oregonensis*), peamouth chubs (*Mylocheilus caurinus*), and carp (*Cyprinus carpio*) (Lance et al. 2001).

Table 21. Fish species currently inhabiting the Middle Snake subbasins.

Common Name	Species	Origin[a]	Location[b]	Status[c]	Comments
Arctic grayling	*Thymallus arcticus*	E	TL	R	
Banded killifish	*Fundulus diaphanus*	E			
Bass, largemouth	*Micropterus salmoides*	E	R	U	
Bass, smallmouth	*Micropterus dolomieui*	E	R and T	A	
Bluegill	*Lepomis macrochirus*	E	R	U	
Brook trout	*Salvelinus fontanalis*	E	R		
Brown trout	*Salmo trutta*	E			
Bull trout	*Salvelinus confluentus*	N	T	ESA T	
Bullhead, black	*Ictalurus melas*	E	R	U	
Bullhead, brown	*Ictalurus nebulosus*	E	R	R/I	
Bullhead, yellow	*Ictalurus natalis*	E	R		
Catfish, blue	*Ictalurus furcatus*	E	R	R	
Catfish, channel	*Ictalurus punctatus*	E	R	A	
Catfish, flathead	*Pylodictus olivaris*	E	R		
Chub, chiselmouth	*Acrocheilus alutaceus*	N	R and T	C	
Chub, peamouth	*Mylocheilus caurinus*	N	R	U	
Chub, Tui	*Gila bicolor*	E			
Chub, Utah	*Gila atraria*	N	R and T	C	
Common carp	*Cyprinus carpio*	E	R	C,U	
Crappie, black	*Pomoxis nigrmaculatus*	E	R	C	
Crappie, white	*Pomoxis annularis*	E	R and T	A	
Cutthroat trout (generic)	*Oncorhynchus clarki*	N	R and T	I	
Dace, longnose	*Rhinichthys cataractae*	N	R and T	C	
Dace, speckled	*Rhinichthys osculus*	N	R and T	A	
Fathead minnow	*Pimephales promelas*	E	R and T		
Mountain whitefish	*Prosopium williamsoni*	N	R	O,U	
Northern pikeminnow	*Ptychocheilus oregonensis*	N	R and T	C	

Common Name	Species	Origin[a]	Location[b]	Status[c]	Comments
Oriental weatherfish	*Misqurnus angullicaudatus*				found in ditches
Pumpkinseed	*Lepomis gibbosus*	E	R and T	U	
Redband/Rainbow trout	*Oncorhynchus mykiss*	N	R and T	U/C	redbands = U; RBT = C
Shiner, redside	*Richardsonius balteatus*	N	R and T	A	
Shiner, spottail	*Notropis hudsonium*	E	TI	R	
Sculpin, mottled	*Cottus bairdi*	N	T	C	
Sculpin, Paiute	*Cottus beldingi*	N	T	R	
Sculpin, Shoshone	*Cottus greenei*	N	R and T	R	
Sculpin, shorthead	*Cottus confusus*	N		C	
Sculpin, torrent	*Cottus rhotheus*	N	T	R	
Sculpin, Wood River	*Cottus leiopomus*	N	T		
Sucker, bridgelip	*Catostomus columbianus*	N	R	C	
Sucker, largescale	*Catostomus macrocheilus*	N	R and T	A	
Sucker, mountain	*Catostomus platyrhychus*	N			
Sucker, Utah	*Catostomus ardens*	N			
Tadpole madtom	*Noturus gyrinus*	E	R	U	
Tiger muskie	*Esox lucius* × *masquinongy*	E	TI	R	
Tilapia	*Tilapia* sp.	E	R	R	
Walleye	*Stizostedion vitreum*	E	TI	R	
Warmouth	*Lepomis gulosis*	E	R and T	R	
White sturgeon	*Acipenser transmontanus*	N	R	U	sensitive (BLM)
Yellow perch	*Perca flavescens*	E	R	C	

[a] N = Native stock, E = exotic
[b] R = mainstem Snake River, T = tributaries, TL = tributary lake, TI = tributary impoundment
[c] Relative abundance: A = abundant, R = rare, U = uncommon, C = common, and I = insufficient data; ESA status: T = listed threatened or E = listed endangered

Mollusc species are also an important component of the aquatic ecosystem within the Middle Snake subbasins. On December 14, 1992, five aquatic snails from the Snake River in south central Idaho were added to the federal list of threatened and endangered wildlife (Federal Register 57 FR 59244). All five of these listed molluscs are found within the Middle Snake subbasins. The Idaho springsnail (*Pyrgulopsis* [=*Fontelicella*] *idahoensis*), Utah (or desert) valvata (*Valvata utahensis*), Snake River physa (*Physa natricina*), and the undescribed Banbury Springs lanx (*Lanx* sp.) are listed as endangered. The Bliss Rapids snail (*Taylorconcha serpenticola*) is listed as threatened (USFWS 1995).

3.4.1 Aquatic Focal Species Selection and Characterization

As defined by the Northwest Power and Conservation Council, a focal species has special ecological, cultural, or legal status and will be used to evaluate the health of the ecosystem and the effectiveness of management actions. Federally listed species will likely be considered as focal species. Others may be included that a) have special cultural significance, b) fulfill a critical ecological function, c) serve as an indicator of environmental health, and/or d) are locally significant or rare, as determined by applicable state or federal resource management agencies (NPPC 2001).

Aquatic focal species were selected based on technical team discussions considering the aforementioned criteria. Focal species selected include

- White Sturgeon –Federal sensitive species; Represents mainstem habitats;
- Mountain Whitefish – Found in mainstem and tributaries; serves as an indicator of environmental health (water quality);
- Redband Trout – Federal sensitive species; Widespread in tributary systems;
- Bull Trout – ESA Threatened species; Found in select tributary systems;
- Wood River Sculpin – Federal sensitive species; Endemic to Wood River drainage;
- Idaho Springsnail – ESA Endangered species; limited range within subbasins;
- Utah Valvata Snail – ESA Endangered species; limited range within subbasins;
- Snake River Physa – ESA Endangered species; limited range within subbasins;
- Banbury Springs Lanx – ESA Endangered species; limited range within subbasins;
- Bliss Rapids Snail – ESA Threatened species; limited range within subbasins.

White Sturgeon

Conservation Status

The white sturgeon is a BLM sensitive species, a USFS sensitive species, and a species of special concern in the state of Idaho. Currently, Snake River white sturgeon are not listed or proposed for listing under the ESA.

Life History

Information specific to life history of white sturgeon within the Middle Snake subbasins is not available. The following life history information is extrapolated from studies conducted elsewhere in the lower Snake and Columbia rivers. This extrapolation may not be biologically sound as white sturgeon populations in the Middle Snake subbasins may possess unique characteristics. They are the farthest-upstream population of white sturgeon in the Columbia Basin, and they are highly isolated, both from lower river populations and due to restricted migration capacity within this subbasin itself. Furthermore, the environment of the middle Snake River differs from that of the Columbia and lower Snake rivers: because the Middle Snake River is smaller, habitat is often limited and water quality severely impaired.

Cochnauer (1983) estimated ages to sexual maturity of white sturgeon in the Snake River to be 5 years for males and 12 years for females. Females grow faster than males, particularly in weight after 14 years. Average length at age is roughly 9 inches at 1 year, 20 inches at 5 years, 40 inches at 15 years, and 6 to 9 feet at maturity (25–60+ years).

The white sturgeon is a benthic feeder and feeds on most anything, dead or alive. Young feed largely on larval forms of aquatic insects, crustaceans, and mollusk. Fish form a high percentage of the diet of larger sturgeon (Simpson and Wallace 1982). The sturgeon spends a large percentage of time in deep pools that have a fine substrate; such "sturgeon holes" may often range from 30 to 100 feet deep.

Across the species' range, individual sturgeon spawn only once every 3 to 11 years (Cochnauer 1983). The fish spawns during May and June in rocky bottoms near rapids and lays up to two million eggs. White sturgeon require deep run habitats with high velocities (e.g., > 1.7 m/second) (Hurley et al. 2002) for spawning (Brink and Chandler 2000, cited in Lance et al. 2001). The primary triggers for white sturgeon spawning migrations occur in the spring when the fish respond to increasing flows and water temperatures approaching 10 °C (Paragamian and Kruse in press, cited in Lance et al. 2001). Water temperature must be between 10 and 18 °C (13–16 °C is considered ideal) for successful spawning. Water temperatures of 14 to 16 °C are necessary for successful egg and larval development, and temperatures over 20 °C can be lethal (Hurley et al. 2002). Sturgeon larvae are planktonic and capable of drifting long distances with currents. The dispersal phase may last up to 6 days, resulting in long dispersal distances (100+ miles) (Hurley et al. 2002).

Substrate size and water velocity influence selection of spawning areas by white sturgeon. Spawning generally occurs in water over 3 meters deep and over cobble substrate. In the Columbia River system, reproduction has been greater during years of high flows than in years of low flow (Hanson et al. 1992). White sturgeon are broadcast spawners that release temporarily adhesive eggs into the current. The current is thought to be important for egg and larval dispersal and predator avoidance. Turbulent upwelling and deep pools near the spawning area are thought to be important factors determining spawning success (Lepla and Chandler 1995, cited in Lance et al. 2001). The adhesive eggs initially adhere to boulders in high-velocity areas and are thus subject to less predation. As the eggs become less adhesive, they are washed from the high-velocity areas and tend to settle out in slower-velocity areas, often in shallow backwater habitats. These same habitats are some of the most susceptible to being exposed to the atmosphere and subsequently desiccated due to rapid flow fluctuations related to dam operations (Lance et al. 2001).

Distribution and Population Trends

Within the Middle Snake subbasins, white sturgeon are only found in the mainstem Snake River. White sturgeon were once widely distributed in the Columbia River basin. Habitat degradation, loss of prey resources, and loss of connectivity between populations has reduced the Columbia River basin population to a fraction of historic estimates. Similarly, white sturgeon numbers in the Middle Snake subbasins have been dramatically reduced (Hurley et al. 2002). Development of the Columbia River basin hydroelectric system has created impoundments that have altered the habitat, as well as the movement of white sturgeon and their principal food resources in the Middle Snake subbasins (Saul et al. 2002).

White sturgeon are well adapted to thrive in large riverine habitats such as the Snake River in Idaho because of their size (up to 4–5 m total length) and longevity (> 100 years). As riverine habitat dwindles, these life history aspects may now be a hindrance to survival. Other unique life history characteristics include late maturation and infrequent spawning by individual fish.

With hydroelectric facilities in place on the Snake River in Idaho, white sturgeon no longer have access to hundreds of miles of river habitat and are now generally confined within river sections between dams. Downstream movement past dams has been documented, but there are no suitable fish passage structures on Snake River dams to allow upstream passage. Additionally, movement downstream can be hazardous as white sturgeon must move either past a dam over a spillway during high flows or through the turbine units. The fragmentation of these sturgeon populations has created unbalanced population structures as not all sections of river have all the necessary habitats to support all life history phases (Lance Hebdon, IDFG, personal communication, January 26, 2004).

While the construction of dams and isolation of populations have contributed significantly to the present depressed state of white sturgeon in the Snake River, sport fishing has also played a role in reducing numbers and creating unbalanced populations. Although the present sport fishing regulation for white sturgeon in the Snake River is catch and release, the populations are slow to respond due to the relatively old age of maturation and slow growth of individual fish. In many instances, the number of available females and their infrequent spawning have caused extremely slow increases in numbers of fish in the middle- to old-age groups. Even with the present catch-and-release regulations, there is a high demand for white sturgeon fishing, particularly in two reaches of the middle Snake River: below Bliss Dam, where population numbers are the highest, and immediately below C.J. Strike Dam, where fish are concentrated. The popularity of white sturgeon sport fishing is undoubtedly based on the likelihood of catching large, old-aged fish (Lance Hebdon, IDFG, personal communication, January 26, 2004). Traditionally, the Nez Perce people also harvested white sturgeon in the Snake River for subsistence purposes, though the degree of harvest is not known (Lance et al. 2001).

Of the eight fragmented reaches between dams in the Middle Snake subbasins in Idaho, only one supports a viable population of white sturgeon. The Bliss to C.J. Strike section has adequate flows in most years and varied habitat to support all life history stages of white sturgeon. In the other six sections, not all habitat requirements are available or accessible to white sturgeon that would allow population maintenance and growth. For instance, the amount of water available downstream of Milner Dam and subsequently at Shoshone Falls is not adequate to initiate or provide for successful spawning, egg incubation, and larval development in most years. Even though river discharge increases substantially from below Shoshone Falls to King Hill through influx of between 5,000 and 6,000 cfs of spring water, the recharge water is either not adequate or without seasonal characteristics to influence successful spawning above Bliss Dam (Lance Hebdon, IDFG, personal communication, January 26, 2004).

White sturgeon populations in the Middle Snake subbasins are currently fragmented by existing hydroelectric dams on the mainstem Snake River. Sturgeon populations are considered depressed throughout all reaches below C.J. Strike Dam (Lance et al. 2001). All populations above C.J. Strike Dam have similarly been termed "at risk" (Hurley et al. 2002). Currently, there is no documented natural spawning in Hells Canyon and Oxbow reservoirs (IDFG 2000), although spawning is thought to occur throughout other mainstem reaches of the subbasins. Sturgeon culture has allowed the stocking of hatchery-origin fish to the river. However, there needs to be additional evaluation of the previously released fish due to concerns about effects on wild population genetics and competition (IDFG 2001).

The following information about isolated population segments is primarily from IDFG (2003c):

Hells Canyon Dam to Oxbow Dam

This stretch of the Snake River is one of the river's shortest and consists primarily of impounded reservoir habitat and little free-flowing river, with the exceptions of the tailrace area and the Oxbow bypass (the bypassed reach from Oxbow Dam to Oxbow Powerhouse). Hells Canyon Reservoir experiences poor water quality conditions during low flow years as a result of discharges from Brownlee Reservoir and flowing though Oxbow Reservoir (Myers et al. 2002). During low flow years, anoxic conditions lethal to white sturgeon can comprise 40 to 55% of the reservoir's bottom 2-meter layer from July through September (Lepla and Chandler 2001). The reach length may be contributing to lack of recruitment (Jager et al. 2000) as suitable spawning habitat may not be available and flows may move larval white sturgeon into the reservoir where chances of success are minimized.

Abundance of white sturgeon in the river section is low. Idaho Power Company (IPC) captured three wild sturgeon, ranging in total length (TL) from 139 to 250 cm, and one hatchery-reared fish (63 cm TL) (Lepla et al. 2001). All were captured in the upstream end of Hells Canyon Reservoir in 1998. In 1992, personnel from the ODFW sampled below Oxbow Dam using setlines in the free-flowing stretch. A total of six wild white sturgeon (180–250 cm TL) and one hatchery-reared fish (40 cm TL) were captured.

The low number of white sturgeon, both adults and juveniles, suggests that limited reproduction and recruitment have been occurring in this section. It appears that no significant increase in abundance of wild sturgeon has occurred over the past 30 years.

Oxbow Dam to Brownlee Dam

The Brownlee Dam to Oxbow Dam segment is short, similar to the downstream Hells Canyon Dam to Oxbow Dam section. Oxbow Reservoir extends 19 km upstream, with suitable white sturgeon spawning habitat probably limited to only the area immediately below Brownlee Dam. Technically there is no free-flowing river section, but flowing water does occur for a limited distance during spill events or when the dam turbines are in operation. Oxbow Reservoir experiences poor water quality conditions during low flow years as the result of receiving anoxic water from Brownlee Reservoir (Lepla et al. 2001, Myers et al. 2002. Low dissolved oxygen levels lethal to white sturgeon can comprise up to 73% of the bottom 2 meters in Oxbow Reservoir during low flow years.

No sturgeon were captured in Oxbow Reservoir in 1998 (Lepla et al. 2001) although six mortalities occurred in the Brownlee tailrace from 1994 to 2001. These sturgeon ranged in length from 154.7 to 183 cm TL (Ken Lepla, IPC, personal communication, cited in IDFG 2003c). Most carcasses showed signs of external injury that presumably resulted from turbine blade strike.

Juvenile recruitment via spawning and egg incubation is limited by poor water quality, low numbers of available females spawners in any given year, and egg/larval transport out of the system. With only 1 km of free-flowing water in this section, the number of white sturgeon that can be supported and maintained in the section is in question. White sturgeon utilization of the reservoir is unknown; however, it is expected that some of the reservoir can provide necessary habitat requirements for survival.

Brownlee Dam to Swan Falls Dam

The river stretch from Brownlee Dam upstream to Swan Falls Dam is characterized by a canyon section in the upper 22 km, with the river valley broadening in the lower 167 km. Brownlee Reservoir inundates approximately 88 km of riverine habitat. Swan Falls Dam is operated as a load-attenuating hydropower facility.

Water quality in this reach has been severely degraded by nutrient loading from irrigation return and industrial and municipal sources (Harrison et al. 1999, Myers et al. 2001). The hydrograph is influenced by irrigation demands upstream of Shoshone Falls. As with the other facilities, the hydrograph is bimodal and the triggering high flows may not coincide with suitable spawning temperatures.

Although the Swan Falls-Brownlee reach of the Snake River represents the longest remaining flowing river segment, few white sturgeon reside in the reach. During a 1981 Idaho Department of Fish and Game (IDFG) study, 1,105 setline hours were utilized to capture one sturgeon. A 1985 study yielded 18 sturgeon between 30 and 249 cm TL, with a mean total length of 164 cm. A 1992 IDFG study (Kruse-Malle 1993) yielded only one sturgeon, indicating that abundance was low. A subsequent study in 1993 (Kruse-Malle and Moore 1995) yielded 13 white sturgeon. These fish ranged in total length from 90 to 213 cm. Three fish were between 90 and 110 cm TL, while the remainder were greater than 150 cm TL. All of these fish were caught within 11 km of Swan Falls Dam. No sturgeon were captured with 80 hours of gill net effort in upper Brownlee Reservoir. During 1986 through 1988, personnel from the IDFG randomly fished the Swan Falls reach, catching 29 sturgeon in 1986, 59 in 1987, and 2 in 1988. The size of these fish ranged from 60 to 398 cm TL, with most (81%) fish greater than 183 cm TL.

During a 1996–1997 study by IPC, catch rates and overall number of sturgeon (*n* = 44) sampled were low (Lepla et al. 2001). This population of sturgeon consisted primarily of larger and older individuals, with few (4%) less than 80 cm TL. The majority (75%) of sturgeon were captured in the narrow canyon section near Swan Falls Dam (river kilometer [rkm] 732.8), while only

11 fish were sampled in Brownlee Reservoir. Abundance of sturgeon greater than 90 cm (TL) was estimated at 155 individuals (70–621), or 11.0 fish/rkm, in the river segment from Swan Falls Dam to Walters Ferry (rkm 710.4).

During low flow years, low dissolved oxygen conditions lethal to sturgeon can comprise up to 80% of the bottom 2-m layer in Brownlee Reservoir. In worst-case scenarios, the transition area at the upstream end of the pool can become anoxic throughout the water column (Lepla et al. 2001). In July 1990, lethal dissolved oxygen conditions (< 1 mg/l) combined with high water temperatures (25–26 °C) caused the deaths of an observed 28 adult white sturgeon in the upper end of Brownlee Reservoir. All of these fish were greater than 115 cm TL, a reflection of the population structure in this reach.

While the absence of small fish may partly be a result of the low number of adult fish in the reach, certainly poor water quality impacts the survival of young fish during their first year. IPC (Lepla et al. 2001) sampled three eggs during 1997: one at rkm 496 on May 17 and two at rkm 725 on May 27 and 28. The eggs indicate that at least one female sturgeon spawned in 1997. Because of the disparity in sampling locations and egg stages, two females could have spawned during that year. The one larval sturgeon collected at rkm 496 in the upper end of Brownlee Reservoir may have been spawned one week earlier. Spawning habitat may occur only in the upper reach near Swan Falls Dam, suggesting that the larval white sturgeon sampled on May 17 could have drifted from the upper part of this reach. McCabe and Tracy (1993) found that white sturgeon larvae in the Columbia River downstream of Bonneville Dam were transported over 175 km downstream from spawning areas. The 2001 population estimate is 155 fish (Lepla et al. 2001), or 11.0 fish/km estimated for the canyon section only.

Swan Falls Dam to C.J. Strike Dam

The C.J. Strike to Swan Falls reach has 40 km of free-flowing water comprised mainly of low-gradient, shallow-run habitat, island complexes, and a few deep pools. There are no rapids or narrow channels to create high-velocity zones and turbulent upwelling often associated with staging and spawning areas for white sturgeon (Lepla and Chandler 2001). Only during median or high water years is spawning habitat available and then only immediately below C.J. Strike Dam. There is no spawning habitat available at 5 to 10 kcfs through the C.J. Strike Dam project (Chandler and Lepla 1997). Because of the low gradient of this section, white sturgeon spawning probably did not occur there historically.

Cochnauer (1983) suggested that the small population of sturgeon between Swan Falls and C.J. Strike dams is spawning-limited as fish younger than 5 years of age have not been found. In addition, the population decline may have started in the early 1970s (Cochnauer et al. 1985). Sturgeon sampled in this reach ranged from 100 to 180 cm TL during 1986–1987. In 1989, anglers documented that small sturgeon less than 91 cm TL were 20% of the catch. In 1990, sport anglers caught and released an estimated 181 sturgeon, with 18% less than 92 cm TL, 64 % 92 to 183 cm TL, and 18% greater than 183 cm TL.

Low abundance of sturgeon less than 92 cm TL was documented during 1979–1981, 1994–1996 (Chandler and Lepla 1997), and 2001 surveys (IPC unpublished data). Chandler and Lepla (1997) estimated that this reach has a population of 726 fish, or 16 fish/rkm. The 2001 survey conducted by IPC evaluated recent recruitment levels in response to normal and above-normal flows in the middle Snake River. In contrast to a positive post-drought recruitment trend upstream in the population between Bliss and C.J. Strike dams, there was no similar response below C.J. Strike in the more favorable water years. There was not an increase in the abundance (8%) of small sturgeon. The downstream movement (1.6%) of mid-size and larger sturgeon from C.J. Strike Dam to Bliss Dam reach is likely supporting the current population structure below C.J. Strike Dam.

Powerhouse-related mortalities have also occurred at C.J. Strike Dam. Since 1996, at least five sturgeon mortalities have been reported as a result of turbine blade strike injuries as the fish entered the draft tube when units were off-line (Ken Lepla, IPC, personal communication, cited in IDFG 2003c). In 2000, IPC began using compressed air blasts prior to unit start-ups in an effort to "clear" white sturgeon away from the turbine blades. To date, no further powerhouse related mortalities have been reported since the initiation of this action (Ken Lepla, IPC, personal communications, cited in IDFG 2003c). Dissolved oxygen levels in the tailrace of C.J. Strike Dam have been recorded as low as 5.1 mg/L; however, intervals of low dissolved oxygen are brief, usually lasting less than a week.

C.J. Strike Dam to Bliss Dam

There are 106.7 km of river and reservoir between C.J. Strike and Bliss dams, with C.J. Strike Reservoir being 38 km long. There are about 19.3 km of flowing river in the canyon area from Bliss Dam (rkm 901) to Clover Creek (rkm 885), located near the community of King Hill. The river falls about 1 meter/km through this canyon and is typically a fast, deep (10 m), run-type habitat having intermittent pools and riffles, with several pools up to 15 meters deep.

The remainder of this river reach between C.J. Strike Reservoir and the canyon at Clover Creek flows through 54.7 km of relatively flat terrain of low gradient (0.6 m/km). The run-type habitats support abundant aquatic vegetation in the summer. There are a few pools 8 to 10 meters deep and one pool greater than 20 meters deep.

Historically, many of the larger sturgeon (272–363 kg) harvested in Idaho came from this section (McDonald 1894, cited in IDFG 2003c). White sturgeon are more abundant between C.J. Strike and Bliss dams than they are elsewhere upstream from Hells Canyon Dam (Cochnauer 1983). Cochnauer (1983) estimated between 1,500 and 4,300 sturgeon of 60 to 270 cm TL inhabited the river between C.J. Strike and Bliss dams. The presence of small fish indicates that reproduction occurs in this reach. Sport anglers caught and released an estimated 389 sturgeon in 1990; of these fish, 35% were less than 91 cm TL.

Cochnauer (1983) estimated 2,192 (> 60 cm TL) white sturgeon in this section during a 1979–1981 study. The population composition included 68% juvenile white sturgeon less than 92 cm TL, 30% between 92 and 183 cm TL, and 2% greater than 183 cm TL. Lepla and Chandler (1995a) estimated there were 2,662 (> 60 cm TL) white sturgeon during a 1991–1993 survey. In the latter study, juvenile white sturgeon less than 92 cm TL comprised only 2 to 6% of the catch. The decline in abundance corresponded with an unusually prolonged period of drought lasting eight consecutive years (1987–1994) and resulting in below-normal river flows in the Snake River basin. A 2000 survey (Ken Lepla, IPC, personal communication, cited in IDFG 2003c) found that the number of wild juvenile white sturgeon (< 92 cm TL) had increased to 45% of the catch. This increase in abundance of juvenile sturgeon followed several years (1995–1998) of favorable hydrologic conditions during spawning months with normal or above-normal spring run-off.

Instream flow studies below Bliss Dam have shown load-following operations can reduce incubation and larval weighted useable area up to 30% during low and median water years, while reductions in weighted usable area for spawning were less (8–10%) (Brink and Chandler 2000).

During low and median water years, 23 to 35% of the bottom 2-m layer of the lower end of C.J. Strike Reservoir exhibits depressed dissolved oxygen levels, which can be lethal to white sturgeon (Lepla and Chandler 2001).

The C.J. Strike Dam to Bliss Dam reach of the Snake River supports one of the two most viable wild populations of white sturgeon in Idaho. Based on positive changes in population composition, there appears to be successful reproduction and growth of the populations. The present population size is 2,662 white sturgeon greater than 60 cm TL. The abundance goal for the population is 2,900 fish with the composition of 60% between 60 and 92 cm TL, 30% between 92 and 183 cm TL, and 10% greater than 183 cm TL. While the latest abundance estimate indicates the goal is close to being been achieved, the current management direction is to continue sport catch-and-release fishing. The missing component of the current population is the larger length group (> 183 cm TL). This absence is probably a result of the mid-size group of fish being harvested prior to 1970, a group that now represents the large length group. Studies in the C.J. Strike Dam to Bliss Dam reach have shown sturgeon growth within the C.J. Strike Reservoir is similar to that of healthy populations elsewhere (Table 22).

Table 22. Total lengths and mean growth rates for white sturgeon in the middle Snake River and mainstem Columbia River in the United States and the Fraser River in Canada (from USEPA 2000).

Water Body	**Total Length (cm)**		**Mean Growth Rate (cm/year)**	**References (Cited in USEPA 2000)**
	12 years	**20 years**		
C.J. Strike Reservoir	125	180	7.2 from 5 to 25 years	Cochnauer et al. 1985
Lower Columbia River	122	183	6.6 from 1 to 21 years	Galbreath 1985
Fraser River[a]	97	142	5.1 from 5 to 25 years	Scott and Crossman 1973

[a] All sturgeon were female and with fork lengths (FL) converted to total lengths (FL × 1.110 = TL)

As noted earlier, the population in this reach appears to be the source of white sturgeon below C.J. Strike Dam. Based on tag returns, it appears that approximately 2% of the population emigrates downstream annually.

Lower Salmon Falls to Bliss Dam

Bliss Dam, constructed in 1950, impounds water from the site of a natural falls upstream for approximately 8 km (Cochnauer 1983). The remaining 12.9 km of this 20.9-km river stretch is free-flowing through a canyon that is 122 to 183 meters deep. The free-flowing river gradient is relatively high (2 m/km) and provides some white sturgeon spawning habitat, even at the lowest flows. Between Lower Salmon Falls and Bliss dams, the river canyon is narrow, with bedrock and rubble lining the characteristic deep pools and rapids. The Malad (Big Wood) River enters in this section.

Two studies have concluded that few wild sturgeon remain between Lower Salmon Falls and Bliss dams. Lukens (1981) reported capturing 11 wild sturgeon in the Lower Salmon Falls tailrace. Lepla and Chandler (1995b) sampled 38 white sturgeon throughout the section: 5 of the fish were wild and 33 were hatchery reared. Wild sturgeon ranged from 60 to 133 cm TL, and hatchery-reared sturgeon ranged from 40 to 90 cm TL. From 1989 through 1994, a total of 2,612 hatchery-reared yearling white sturgeon were stocked below Lower Salmon Falls Dam.

Lower Salmon Falls Dam to Upper Salmon Falls Dam

The Lower Salmon Falls to Upper Salmon Falls reach is part of a three-dam complex comprised of reservoir habitat, except for a 1-km bypass of Dolman Island. Flows in these braided channels often are less than 500 cfs. A survey by IDFG from 1979 through 1981 found no sturgeon in this river section. Lukens (1981) concluded that no spawning habitat was available for white sturgeon.

The relatively close spacing between dams limits the amount of available free-flowing water habitat, and the short distance between dams is conducive to downstream losses of early life history stages through egg or larval drift. The establishment of a white sturgeon population in this section would likely be difficult. White sturgeon utilization of the reservoir is unknown; however, it is expected some of the reservoir can provide necessary habitat requirements for survival. Assuming both the free-flowing and reservoir sections can fully support rearing for juveniles and adults, the abundance goal would be 340 white sturgeon.

Emigration of mid-size white sturgeon into this reach could be expected as densities in the upstream segment increase to 32 fish/km. Movement of this size group is observed from the C.J. Strike Dam to Bliss Dam section (30–32/km) to the river section below C.J. Strike Dam. Because of the short river section, export of larval white sturgeon will limit contribution by natural reproduction.

Upper Salmon Falls Dam to Shoshone Falls

Flows passing over Shoshone Falls are largely dependent on the water quantity passing Milner Dam (40 rkm upstream). During the irrigation season, all of the water in the river can be diverted for irrigation purposes. From Upper Salmon Dam to Shoshone Falls, there are several large rapids that provide adequate spawning velocities within their immediate vicinity, but the overall lack of high flows means that the flows needed to disperse eggs and larvae beyond the spawning areas are often absent. Water management in the upper Snake River basin can also affect spawning and larval habitats at times by substantially altering the spring hydrograph. The diversion of irrigation water heavily influences the hydrologic pattern. From Milner Dam downstream, the hydrograph is bimodal; that is, stream flows increase in late spring, decrease as irrigation withdrawal occurs, and then show increasing flows in high water years as snowmelt in the upper Snake River causes flows to exceed the capacity of the irrigation season. The upstream irrigation diversions and flood control (to a lesser degree) can remove or shift the peak spring flows out of sync with suitable spawning temperatures.

Between Shoshone Falls and the USGS gaging station near the town of Buhl (rkm 956), several tributaries and springs contribute about 2,000 cfs to the Snake River. Most of the tributary inflow is agricultural irrigation return. Excessive nutrients have increased algae and macrophytes that have caused nighttime dissolved oxygen levels to drop to near zero in some areas (Hill et al. 1992, cited in IDFG 2003c). Most of the river recharge occurs downstream of Buhl near the lower end of this reach where Thousand Springs (rkm 940) and Banbury Springs (rkm 948) complexes contribute about 4,000 cfs.

During a 1980 study, Lukens (1981) estimated that 14 wild white sturgeon inhabited this river reach and none were less than 92 cm TL. The white sturgeon population inhabiting the Snake River between Shoshone Falls (rkm 989) and Upper Salmon Falls Dam (rkm 935) in 2001 was comprised mostly of hatchery-reared sturgeon (94%) (Lepla et al. 2002). The population was estimated at 772 sturgeon (95% confidence interval [CI] 593–1,107), of which 46 were considered wild. During the IPC 2001 study, none of the wild sturgeon was less than 183 cm TL. The absence of small wild sturgeon in both studies indicates that little, if any, recruitment has occurred to the wild population.

Artificial Propagation

Hatchery sturgeon have been stocked into the upper reaches of the middle Snake River (Table 23). Hatchery rearing allows fish to bypass spawning and larval rearing limitations and has resulted in survival beyond the first year in reaches in the middle Snake River. Survival rates for hatchery-reared sturgeon after stocking are consistent with those observed in the viable wild populations in the Bliss and Hells Canyon reaches of the Snake River in Idaho (Lepla et al. 2001). A 2001 IDFG/IPC survey of fish between Shoshone Falls and upper Salmon Falls indicated that some of the older hatchery-reared sturgeon were approaching maturation. Hatchery sturgeon released downstream of American Falls Reservoir (located in the Upper Snake subbasin, upstream of Shoshone Falls) have been documented in the reach downstream of Shoshone Falls (Dave Parrish, personal communication, cited in IDFG 2003c). Although hatchery sturgeon have limited ability to move downstream through dams, the potential for hatchery sturgeon spawning with wild populations is currently unknown.

Table 23. Hatchery sturgeon stocking information for the Middle Snake subbasins (stocking has occurred only in the two reaches shown).

Year Released	Brood Year	Number	Average TL (cm)
Upper Salmon Falls Dam to Shoshone Falls			
1990	1988	171	64–68
1991	1990	530	28–33

Year Released	Brood Year	Number	Average TL (cm)
1994	1993	352	38–46
1998	1997	158	35
1999	1997	120	35
2000	unknown	254	unknown
Lower Salmon Falls Dam to Bliss Dam			
1989	1988	2,195	33–48
1991	1990	202	33.3
1994	1993	176	33–48

Mountain Whitefish

Conservation Status

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

Life History

The preferred habitat of the mountain whitefish is cold mountain streams (Simpson and Wallace 1982) where the species is 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 will 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 long at the end of the first year and 6 to 7 inches after two years (Simpson and Wallace 1982).

Distribution and Population Trends

The mountain whitefish, a game fish and salmonid, is abundant in all major river drainages in Idaho and considered the most abundant game fish in the state (Simpson and Wallace 1982). Mountain whitefish are present in the Snake River below C.J. Strike Dam (Lance et al. 2001). In many areas, these fish provide an important winter fishery because they feed more actively than most salmonids during this period.

Limited information is available regarding abundance and trends of mountain whitefish in the Big Wood River drainage (Table 24). For sites where multiple years of data exist, trends are inconsistent. At the lower Hailey and Gimlet sites, densities appear to have remained constant and declined substantially between 2000 and 2003, potentially illustrating a high degree of annual variability in estimates (and researchers' inability to summarize trends from small data sets). The limited amount of data does not allow for clear definition of trends but does provide some baseline information on relative abundance of the species within the upper Big Wood River. Whitefish densities appear to decline with upstream location through (represented portions of) the drainage.

Whitefish do not appear to be common in central tributaries to the Snake River in the subbasins (BLM 1996). No information was located regarding mountain whitefish population status in other tributary and free-flowing river reaches of the subbasins.

Although no information was found pertaining to status of mountain whitefish in most reservoir systems within the subbasins, it is plausible that their status and trend would be similar to those described in and below C.J. Strike Reservoir. IPC sampled whitefish populations near C.J. Strike Dam from 1988 to 1996 (Brink et al. 1997, cited in Lance et al. 2001). Whitefish were most abundant during 1990, but few have been collected since 1994. Most of the whitefish sampled were longer than 300 mm. Although natural reproduction does occur in the study area, significant annual recruitment to the young-of-year life stage is not occurring (Lance et al. 2001). The IDFG believes that the whitefish population is recruitment limited in this area (Lance et al. 2001).

Table 24. Summary of density estimates for mountain whitefish (> 100 mm) at various locations within the Big Wood River drainage.

Segment[a]	Year	Population Estimate (95% CI)	Density Estimate (n/100 m^2)
Hailey–Lower	2000	330 (±101)	1.30
	2003	367 (±214)	1.75
Hailey–Upper	2003	24 (±31)	0.40
Gimlet	2000	442 (±301)	2.90
	2003	67 (±26)	0.35
Hulen Meadows	2000	44 (±33)	0.20
Site 6A (Highway Diversion)	2003	14 (±7)	0.11

[a] Segments are presented in longitudinal order from downstream (Hailey–Lower) to upstream (Site 6A)

Redband Trout

Conservation Status

The inland redband trout (*Oncorhynchus mykiss gairdneri*) has previously been petitioned for listing (Hurley et al. 2002) but is presently not listed or proposed for listing under the Endangered Species Act (ESA) (IDCDC 2003). The redband trout is considered a species of special concern by both the IDFG and the American Fisheries Society, as well as a sensitive species by the USFS and BLM (Quigley and Arbelbide 1997).

Life History

There is some knowledge of redband trout populations in the mainstem Snake River and its tributaries, but much remains unknown about their current overall status, genetic purity, or life history requirements across their historic range in the Middle Snake subbasins.

The redband trout is defined in the IDFG fish management plans (IDFG 1996, 2000) as the native rainbow trout in southwest and south-central Idaho (including the Snake River basin upstream to Shoshone Falls). Behnke (1992) identified three distinct subspecies of rainbow/redband trout, one being the native rainbow trout, including steelhead, found in the Columbia River basin east of the Cascade Range to barrier falls on the Kootenai, Spokane, and Snake rivers (to Shoshone Falls).

Based on the above definitions, it is reasonable to assume that general life history characteristics of the redband trout are similar to those of the generic “rainbow trout” described by Simpson and Wallace (1982) and Wydoski and Whitney (1979). These fish typically mature at age 2 to 3 and spawn in early spring (March–June) (Simpson and Wallace 1982). Spawning occurs in small tributaries where gravel riffles are abundant, and general spawning habits are typical of other salmonids. Hatching occurs 4 to 7 weeks after spawning, depending on the water temperature. The diet of rainbow trout consists primarily of aquatic insects, although individuals are opportunistic and will eat what is available to them. Large individuals may consume small fish of any species in addition to aquatic invertebrates.

Redband trout are adapted to fluctuations in stream flow and water temperature typical of desert streams (Behnke 1992) and are more tolerant of modifications in streamflow and temperature than other salmonids (IDEQ 2002). Zoellick (1999) identified populations in Castle, Shoofly Little Jacks, and Big Jacks creeks that tolerated temperatures above 26 °C, actively foraged at 26.2 °C, and tolerated a maximum temperature of 29 °C. Wallace (1981, cited in Schnitzspahn et al. 2000) states that redband trout “should be recognized and managed as unique populations of native trout specifically adapted to harsh desert environments.”

Even though redband trout can live in naturally higher water temperatures, there is little flexibility regarding further degradation of substrate and temperature conditions. The loss of desert riparian habitat that cools stream temperatures and filters surface runoff is a factor in determining the population dynamics of the redband trout populations. Higher densities of redbands are found in the upper reaches of the tributaries where temperatures are cooler and riffles and pools are more prevalent (IDEQ 2002).

Distribution and Population Trends

Historically, redband trout inhabited the Snake River and tributaries up to Shoshone Falls (Irving and Cuplin 1956, Behnke 1992, Quigley and Arbelbide 1997). Currently, redband trout generally occur in the upper reaches of perennial tributaries throughout the subbasin (Figure 25), often in low densities. In some drainages, redband trout are restricted to the upper reaches of the tributaries due primarily to degraded habitat, increased water temperatures, decreased water quality, decreased flows resulting from development, and physical barriers to movement such as dams, diversions, and improperly constructed river crossings (IDWR 1999).

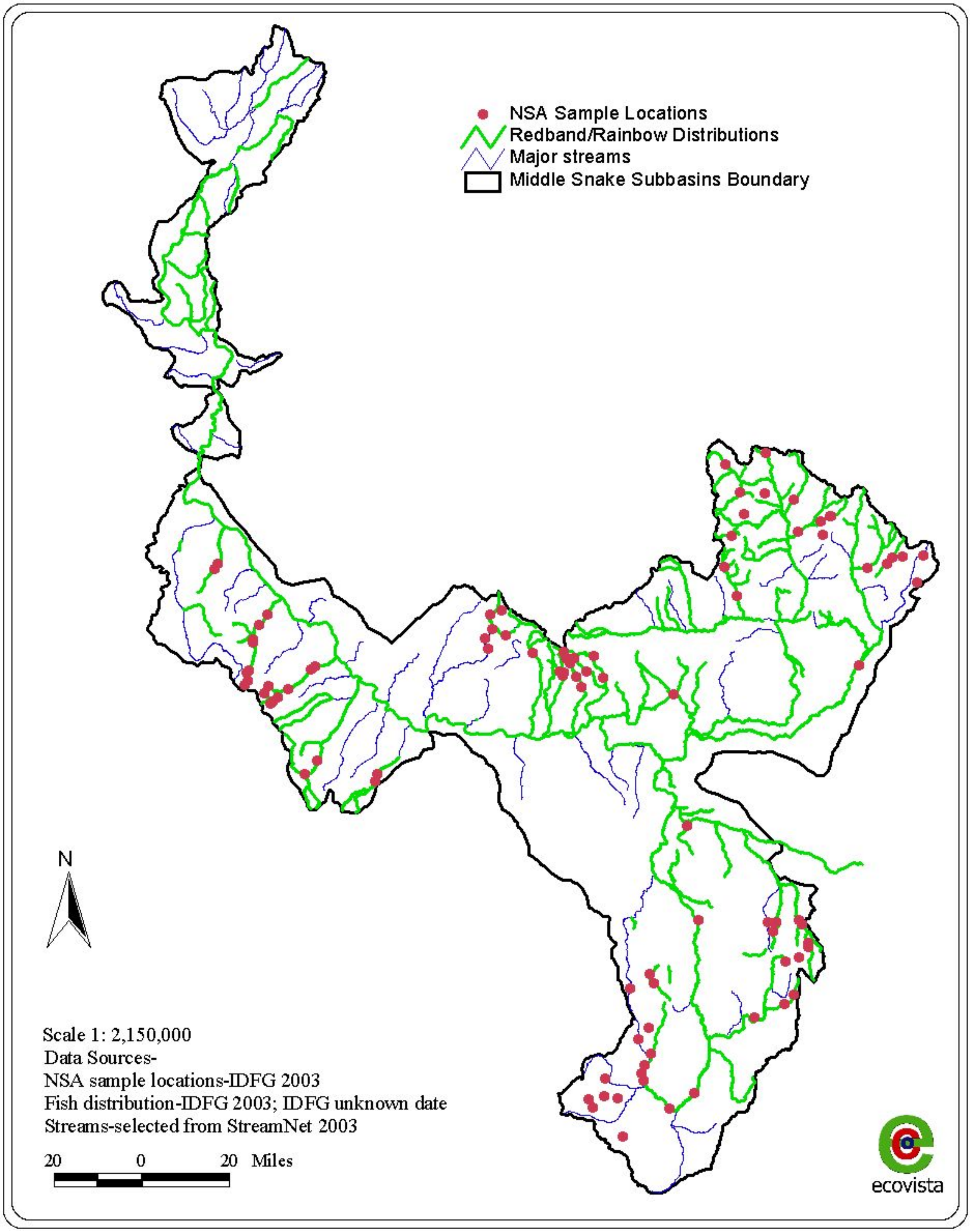

Figure 25. Redband and rainbow trout distribution in the upper Middle Snake subbasins. Redband-only distributions (excluding other rainbow trout) are not clearly defined.

Much of the information on distribution and abundance/trends for redband trout in the Middle Snake subbasins is highly specific in nature, relating to individual tributaries or small watersheds. Information in development by IDFG provides a broad scale overview of potential distributions and, to some degree relative abundance, for approximately 2/3 of the Middle Snake subbasins although analyses of this information are preliminary in nature. Information presented here is therefore subdivided to present broad scale and finer scale information separately.

IDFG Broad Scale Characterization

In the late 1990s IDFG began efforts to assess the status of the redband trout populations in southern Idaho. Data from that effort was used to identify population status and strongholds for redband trout in much of the Middle Snake subbasins (all areas upstream of the mouth of the Weiser River). IDFG states that this information represents the best scientific information available for redband trout in the Middle Snake subbasins, and that the represented sampling locations may be viewed as surrogates for populations within the context of broad scale evaluations (Kevin Meyer, IDFG, personal communication, April 22, 2004).

This represents the first analysis of this data under the time constraints given, and the information will be subject to complete analysis by IDFG in the future, thus results are subject to revision (Lance Hebdon, IDFG, personal communication, April 5, 2004). Available results from this effort supplied by IDFG are presented in Figure 26 and, due to the level of detail contained in this map, the figure has been provided separately in electronic format for those who wish to view/print the map at larger scales (file name Mid_Snake_Fig26_IDFGredband.jpg).

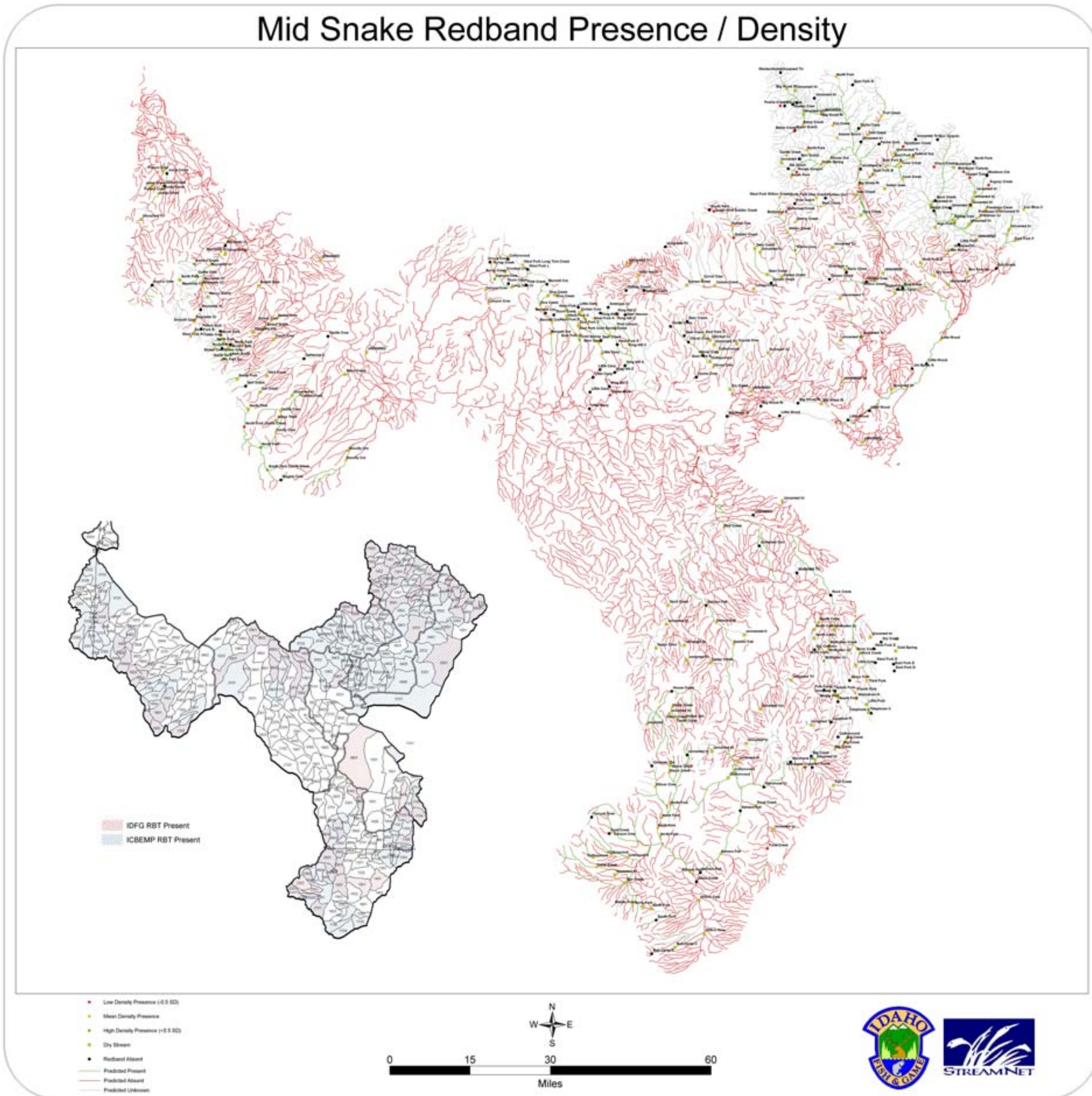

Figure 26. Predicted presence/absence (based on known occurrence and professional judgement) and relative density estimates of redband trout, where sampled by IDFG, in the Middle Snake subbasins.

For the most part, sampling sites for the redband trout status assessment to date have been randomly distributed throughout the Snake River drainage (below Shoshone Falls and above Hells Canyon Dam) in three identified categories 1) presumed redband trout presence 2) presumed redband trout absence, and 3) unknown redband trout status. Sampling sites were located with the assistance of the U.S. EPA's Environmental Monitoring and Assessment Program (EMAP). Sites were sampled by electrofishing and estimates of redband trout density at each location were obtained. For this assessment only data within the boundaries of the Middle Snake Subbasin were used (the Bruneau, Jarbidge and Owhyee drainages were excluded). Population status was determined using a simple linear extrapolation model using three primary data sources as input to the model; 1) fish survey information (IDFG unpublished data) 2) subpopulation category used for sample site selection and 3) stream order calculated from a streams layer, attributed by calculated stream order. The survey included 148 points of presumed surveyed presence and 254 points of presumed surveyed absence. Redband trout densities were calculated by dividing transect length by estimated populations of redband trout in the surveyed length. Population strength was determined by attempting to normalize[1] the redband trout densities and calculating a mean and standard deviation. Population strength was defined as; 1) moderate densities were within ½ standard deviation of the mean, 2) low densities were less than ½ standard deviation from the mean, and 3) high densities were greater than ½ standard deviation from the mean. Data analysis was accomplished by spatially joining the stream orders to the densities. This allowed for the analysis of how often the suspected presence or absence arcs were accurate (by stream order). It also allowed for a rudimentary analysis of what percentage of unknown streams actually contained redband trout. Finally, redband trout densities were extrapolated by stream orders resulting in a total population by stream order (X% of the time, a stream order of N will have redband trout present at density D). Then, tallying all densities for all streams (by order) and multiplying by respective length, a single estimate was made as to the approximate number of redband trout within the Middle Snake Province, resulting in a final estimate of 587,101 fish > 100mm. This estimate has an unquantified error that will be determined during final data analysis by IDFG (Lance Hebdon, IDFG, personal communication, April 5, 2004).

Characterization of Select Tributaries

Detailed information on redband population numbers and trends is available for select tributaries in the Middle Snake subbasins and illustrates a high degree of variability in redband trout densities, both spatially and temporally (Table 25). Many of these areas alternate from droughts, with a dramatic loss of habitat quantity and quality and a corresponding drop in fish populations and loss of age classes, to wetter cycles, in which fish populations rapidly recolonize restored habitat. Connectivity, especially for moving to refugia and recolonizing, is therefore especially important for redband trout populations in the subbasins.

[1] Although data transformation was conducted, the data distribution could not be normalized and the resultant distribution remained substantially skewed. The transformed, non-normal data was used for subsequent analyses (Lance Hebdon, IDFG, personal communication, April 21, 2004).

Table 25. Summary of observed redband trout densities in portions of the Middle Snake subbasins (BLM 1999).

Stream	Year	Site[a]	Density (n/100m^2)
Castle Creek	1976	23.4	30.0
	1977	23.4	17.0
Jump Creek	1994	5.6	58.0
	1994	5.9	17.3
	1977	10.2	120.0
North Fork Castle Creek	1996	3.7	18.0
Reynolds Creek	1994	2.8	0.0
	1994	6.6	0.0
	1997	6.6	19.7
	1976	23.7	7.0
	1977	23.7	17.0
	1994	23.7	dry
	1997	23.7	20.0
Sinker Creek	1977	7.6	34.0
	1976	8.1	21.0
	1997	16.0	18.3
	1977	17.6	4.0
Squaw Creek (N)	1997	4.8	0.0
	1997	8.7	0.0
Squaw Creek (S)	1976	0.0	0.0
Succor Creek	1976	54.1	30.0

[a] These site numbers are presumed to represent river miles, although they were not clearly defined

Redband trout occur throughout the entire Castle Creek drainage, with a stronghold[2] in the upper reaches (Figure 25and Table 26). They were absent during surveys in 1993 and 1994 at 24.8 and 16.2 miles, respectively, upstream from the mouth, presumably as a result of low flows during the drought of 1992–1994 (BLM 1997). By 1995, redband trout had recolonized down to river mile (RM) 14.7. The age structure of the fish in Castle Creek drainage was 74% juveniles and 26% adults (BLM 1997).

Redband trout were also found in Magpie Creek, West Fork Shoofly Creek, and Shoofly Creek (Table 26). Subsurface flow conditions existed in much of Magpie and West Fork Shoofly

[2] Status designations are from the Interior Columbia Basin Ecosystem Management Project (ICBEMP) and described in Appendix A.

creeks in summer 1994. By June 1996, with more normal flows, redband recolonized the sites. Magpie and West Fork Shoofly creeks are considered important redband spawning creeks (BLM 1997).

Information regarding genetic makeup of redband trout within the Middle Snake subbasins is limited. The Malad River is divided into three reaches by barriers restricting fish movement in an upstream direction. Microsatellite Analyses of redband trout in the Malad River Canyon indicated that Cove Creek (tributary to the Malad River), and the upper and middle sections showed no signs of hybridization with hatchery rainbow trout, the lower section showed signs of introgression with hatchery rainbow trout (Cegelski and Powell 2003). Results also suggested that individuals were moving downstream homogenizing adjacent populations. Saul et al. (2002) stated that results of genetic analyses were pending for samples taken from rainbow/redband trout in Box Canyon; no further information on status or results of those analyses was found for inclusion to this document. The native redband in the Wood River drainage have been described as peculiar as a result of being isolated by the falls on the Malad River at Interstate 84 (Hubbs and Miller 1948, Behnke 1992). There has been extensive introgression of hatchery rainbow trout with the native redband trout in the Big Wood River (IDFG 1995). Williams et al. (1996) sampled redband trout populations from within the Middle Snake Subbasin and found that redband trout from King Hill Creek appeared to be interior redband based on Allozyme and mitochondrial DNA (mtDNA) analsysis, while samples from the Big Wood River showed coastal rainbow trout ancestry using Allozyme and mixed ancestry using mtDNA, and Clover Creek showed mixed ancestry with Allozyme and coastal ancestry using mtDNA. Genetic analysis has been performed on redband trout populations in Castle Creek (Wishard et al. 1984), Reynolds Creek (Leary et al. 1983, Wishard et al. 1984), and Sinker Creek (Leary et al. 1983). These studies show a relatively high degree of genetic heterozygosity in each population, suggesting that, even though population levels are generally low, genetic “bottlenecks” have not occurred in these populations. In addition, little to no evidence of hatchery introgression was thought to have occurred in these three drainages based on results of genetic analyses.

Information is available regarding rainbow trout abundance in the upper portions of the Big Wood River (Table 27). Although redband trout in these areas are likely introgressed with hatchery rainbow trout from past stocking activities (currently only sterile rainbow trout are stocked), the abundance and density information provides useful information regarding current status of redband/rainbow populations in that area. Abundance of redband/rainbow trout in the Big Wood River is highly variable both spatially and temporally, with no apparent trend at any individual sampling site. In general, densities tend to decline progressively moving upstream, the highest densities generally observed at sites near the town of Hailey, ID.

Table 26. Notes on redband trout distribution and status in select tributaries within the Middle Snake subbasins.

Creek	Populations Present	Comments
Shoofly Creek	redband	Much of this system dries, especially during droughts. Redband are present in low densities in all areas of the upper creek.
Birch Creek	redband	Absent from most of the creek, stronghold in the upper reaches, adjacent to upper South Fork Castle Creek
Castle Creek	redband	Limited by high water temperatures and high sediment, stronghold in upper South Fork. Recolonized a number of areas where absent in 1994 (BLM 1997). Age structure in 1997 was 74% juvenile and 24% adult.
Sinker Creek	redband	Low fish densities (Allen et al. 1998)
Reynolds Creek	redband, speckled dace	2 of 4 sites with no redband in 1994 had been recolonized by 1997 (Allen et al. 1998).
Jump Creek	redband, shiners, suckers	A 60-foot falls provides passage barrier. The BLM (1999) considered the creek good quality average in potential volume of production

Table 27. Population and density estimates of rainbow trout[a] ≥ 200 mm long sampled from various sites on the upper Big Wood River since 1986.

Reach[b]	Year	Season	Population Estimate	95% C.I.	Density (*n*/100 m)	Density (*n*/ha)
2 (Lower Hailey)	1986	summer	352	218–598	17.6	97
	1987	summer	544	292–1,113	27.2	177
	1987	fall	583	338–1,093	29.2	189
	1988	summer	1,038	749–1,483	51.9	353
	1992	fall	974	834–1,114	48.7	331
	1995	fall	979	789–1,170	52.7	263
	1996	fall	1,351	1,168–1,534	73.1	386
	2000	fall	1,237	1,082–1,392	114.3	488
	2003	fall	701	413–989	31.7	334
2A (Upper Hailey)	2003	fall	503	191–815	179.6	838
3 (Starweather)	1986	summer	460	254–920	43.1	211
	1986	fall	81	42–171	7.6	37
	1987	summer	244	147–433	22.9	137
	1987	fall	220	128–413	20.6	123
	1988	summer	392	278–569	36.7	232
	1991	summer	547	350–743	45.3	191
	1993	fall	329	221–437	30.7	92
	1995	fall	466	320–612	46.5	222
	1996	fall	753	622–884	73.7	285
4 (Gimlet)	1986	summer	675	431–1,898	34.1	197
	1986	fall	455	258–878	23.0	133
	1987	summer	955	609–1,577	48.3	318
	1987	fall	301	187–512	15.2	100
	1988	summer	808	601–1,111	40.8	276
	1992[c]	fall	895	713–1,077	79.9	406
	1993	fall	1,001	770–1,232	64.2	326
	1995	fall	985	835–1,135	67.8	343
	1996	fall	1,280	1,120–1,440	87.0	410
	2000	fall	1,123	978–1,268	150.9	744
	2003	fall	744	545–943	86.2	392
6 (Lake Creek)	1986	summer	125	73–235	10.9	72

Reach[b]	Year	Season	Population Estimate	95% C.I.	Density (*n*/100 m)	Density (*n*/ha)
	1986	fall	168	107–277	14.6	97
	1987	summer	176	83–405	15.3	104
	1987	fall	161	97–285	14.0	95
	1988	summer	90	50–180	7.8	54
	1990[d]	fall	199	141–289	12.1	86
	1991	summer	132	94–171	11.4	81
	1992	fall	209	171–243	18.2	129
	1993	fall	213	141–285	17.3	118
	1995	fall	188	106–268	15.5	100
	1996	fall	207	158–256	17.2	104
	2000	fall	266	211–321	20.9	125
6A (Highway Channel)	1991	summer	126	63–189	12.9	86
	1992	fall	113	85–141	11.6	77
	1993	fall	269	174–364	25.2	174
	1995	fall	259	153–365	26.9	172
	1996	fall	157	119–195	15.3	87
	2003	fall	68	49–87	7.8	52
7 (Kendall Gulch)	1986	summer	43	19–108	4.0	32
	1987	summer	20	10–40	1.9	—
	1996	fall	27	22–32	2.5	19

[a] Although viable hatchery fish have not been stocked into this segment of the river for a few years, several decades of stocking hatchery strains of rainbow trout into the Big Wood River have probably influenced the genetic makeup of this population.
[b] Reaches ordered from downstream (Hailey) to upstream (Kendall Gulch)
[c] Segment length reduced due to low water flows
[d] Includes portion of old highway river site; total sample length estimated to be 1.65 km

Bull Trout

Conservation Status

The American Fisheries Society (AFS) first classified bull trout (*Salvelinus confluentus*) as a species of special concern in 1989 because of destruction of habitat, hybridization, predation, and competition from nonnative species (Williams et al. 1989). The Oregon Department of Fish and Wildlife (ODFW) listed bull trout as a sensitive/critical species in 1993 (Buchanan et al. 1997).

The bull trout in the conterminous United States was listed as threatened by the USFWS on November 1, 1999 (64 FR 58910; USFWS 2002b). Earlier rulemakings had listed distinct population segments of bull trout as threatened in the Columbia River, Klamath River, and

Jarbidge River basins (63 FR 31647, 63 FR 42757, 64 FR 17110). Bull trout distribution, abundance, and habitat quality have declined rangewide. Several local extirpations have been documented, beginning in the 1950s. Bull trout continue to occur in the Klamath River, Columbia River, Jarbidge River, St. Mary-Belly River, and Coastal-Puget Sound drainages in the states of Idaho, Montana, Nevada, Oregon, and Washington (USFWS 2002b).

In Idaho, all sport-fishing harvest of bull trout was eliminated in 1994. In Oregon, angler harvest of bull trout from Pine Creek has been closed since 1992. The extent and impact of tribal harvest (past or present) on bull trout populations are not known.

Concern over declines in bull trout (*Salvelinus confluentus*) abundance and distribution led to the development of a statewide conservation plan by Idaho in 1996 (Batt 1996) and a statewide status review of the species by Oregon in 1997 (Buchanan et al. 1997). In 2002, the USFWS released a draft bull trout recovery plan (USFWS 2002b). Major goals of these plans include summarizing the best scientific information currently available, identifying and maintaining critical bull trout habitats, implementing recovery strategies aimed at both abundance and habitat, and establishing key watersheds to achieve stable or increasing populations and maximize potential for species recovery.

Life History

Bull trout have more specific habitat requirements than most other salmonids. Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, substrate for spawning and rearing, and migratory corridors (USFWS 2002b). Strong bull trout populations are associated with a high degree of channel complexity, including woody debris and substrate with clear interstitial spaces (Batt 1996). Bull trout are found in colder streams and require colder water than most other salmonids for incubation, juvenile rearing, and spawning (USFWS 2002b). Bull trout may experience considerable stress when temperatures exceed 15 °C (59 °F) (Pratt 1992, cited in CBBTTAT 1998; Batt 1996). Optimum temperatures for incubation and rearing have been cited between 2 and 4 °C (35.6–39.2 °F) and 7 and 8 °C (44.6–46.4 °F), respectively (Rieman and McIntyre 1993).

Spawning and rearing areas are often associated with coldwater springs, groundwater infiltration, and/or the coldest streams in a watershed. Throughout their lives, bull trout require complex forms of cover, including large woody debris, undercut banks, boulders, and pools. Alterations in channel form and reductions in channel stability result in habitat degradation and reduced survival of bull trout eggs and juveniles. Channel alterations may reduce the abundance and quality of side channels, stream margins, and pools, which are areas bull trout frequently inhabit. For spawning and early rearing, bull trout require loose, clean gravel that is relatively free of fine sediments. Because bull trout have a relatively long incubation and development period within spawning gravel (greater than 200 days), transport of bedload in unstable channels may kill young bull trout. Bull trout use migratory corridors to move from spawning and rearing habitats to foraging and overwintering habitats and back. Different habitats provide bull trout with diverse resources, and migratory corridors allow local populations to connect, which may increase the potential for gene flow and support or refounding of populations (USFWS 2002b; USFWS 2004a).

See Pratt 1992, Ratliff 1992, and Ratliff et al. 1996 for additional details regarding bull trout life history characteristics.

Distribution and Population Trends

Within the Middle Snake subbasins, bull trout populations are limited to tributaries in the lower subbasin near Hells Canyon Dam (Figure 27). Pine Creek in Oregon and Indian Creek and Wildhorse River in Idaho contain bull trout populations. The Hells Canyon Complex Recovery Unit is comprised of the Snake River mainstem and tributaries in Oregon and Washington that drain to the Snake River within the Hells Canyon Complex (Hells Canyon, Oxbow, and Brownlee dams and associated reservoirs). Two core areas[3] were identified in the Hells Canyon Complex Recovery Unit, one of which lies within the Middle Snake subbasins and encompasses all known areas of bull trout distribution within the subbasins including the Pine and Indian creeks and Wildhorse River. This particular core area currently includes at least seven identified local bull trout populations (Table 28; USFWS 2004a).

Bull trout populations in the subbasins are small, mostly resident, and isolated in headwaters within the core areas (Figure 27). Recent radio-telemetry studies have documented movement of bull trout between Hells Canyon Reservoir and the Pine Creek basin (USFWS 2002b; USFWS 2004a). The use that other bull trout populations make of the mainstem habitat and connectivity to other tributaries is unknown. Populations exist in major tributaries to the Snake River, including the Bruneau, Boise, Weiser, Malheur, Payette, and Powder rivers. Historic and current interaction among these populations is unknown, although presumably all historic bull trout populations periodically interacted with other populations in the Snake River basin. Currently, interaction is difficult or impossible as most populations are isolated by fish barriers, primarily dams. Furthermore, Hells Canyon and Oxbow dams have effectively separated bull trout populations in Pine and Indian creeks and the Wildhorse and Powder rivers from populations in the Imnaha, Grand Ronde, Salmon, and Clearwater rivers downstream and the Weiser, Payette, Malheur, and Boise rivers upstream (USFWS 2004a).

All three subbasins (Pine Creek, Indian Creek, and Wildhorse River) currently provide spawning and rearing habitat for bull trout. All three subbasins also support brook trout and bull trout-brook trout hybrids. To date, all hybrids that have been captured in the Pine Creek core area and genetically tested have been first generation (F1) hybrids, with the exception of two hybrids sampled in the upper portion of Indian Creek that indicated an F1-bull trout cross (Chandler and Richter 2001 *cited in* USFWS 2004a).

Abundance estimates are available only for populations within the Pine Creek drainage in Oregon (Table 29). Based on available information, it appears that bull trout populations are relatively equal in size in the North Pine, Clear, and Upper Pine creek areas, while overall numbers are somewhat lower in East Pine Creek (Table 29). It appears that the density of bull trout in Upper Pine Creek may be higher than that in other population areas within the Pine Creek drainage (comparable estimates presented in Table 29 are extrapolated from the number of fish observed across the total range in each population area, and the distribution of bull trout

[3] Chapter 1 of the draft bull trout recovery plan (USFWS 2002b) defines core areas as follows: The combination of core habitat (i.e., habitat that could supply all elements for the long-term security of bull trout) and a core population (i.e., bull trout inhabiting core habitat) of bull trout.

within Upper Pine Creek is less extensive than that in other areas). All population areas within the Pine Creek drainage are considered to have a moderate risk of extinction (Table 29).

Trend information for bull trout is also available only for populations within the Pine Creek drainage in Oregon, and encompass only recent years (1998-2000; Table 30). No discernable trends are evident from available information although it appears that redds were generally more abundant throughout the Pine Creek drainage in 1998 than subsequent years (Table 30).

Isolation of local populations and habitat fragmentation due to passage barriers posed by culverts, irrigation diversions, and dams are the primary threats to bull trout in the Pine-Indian-Wildhorse core area. Brook trout are also a significant threat to bull trout in the Pine-Indian-Wildhorse core area. Brook trout co-occur with bull trout in many locations and numerous hybrids have been documented (USFWS 2004a).

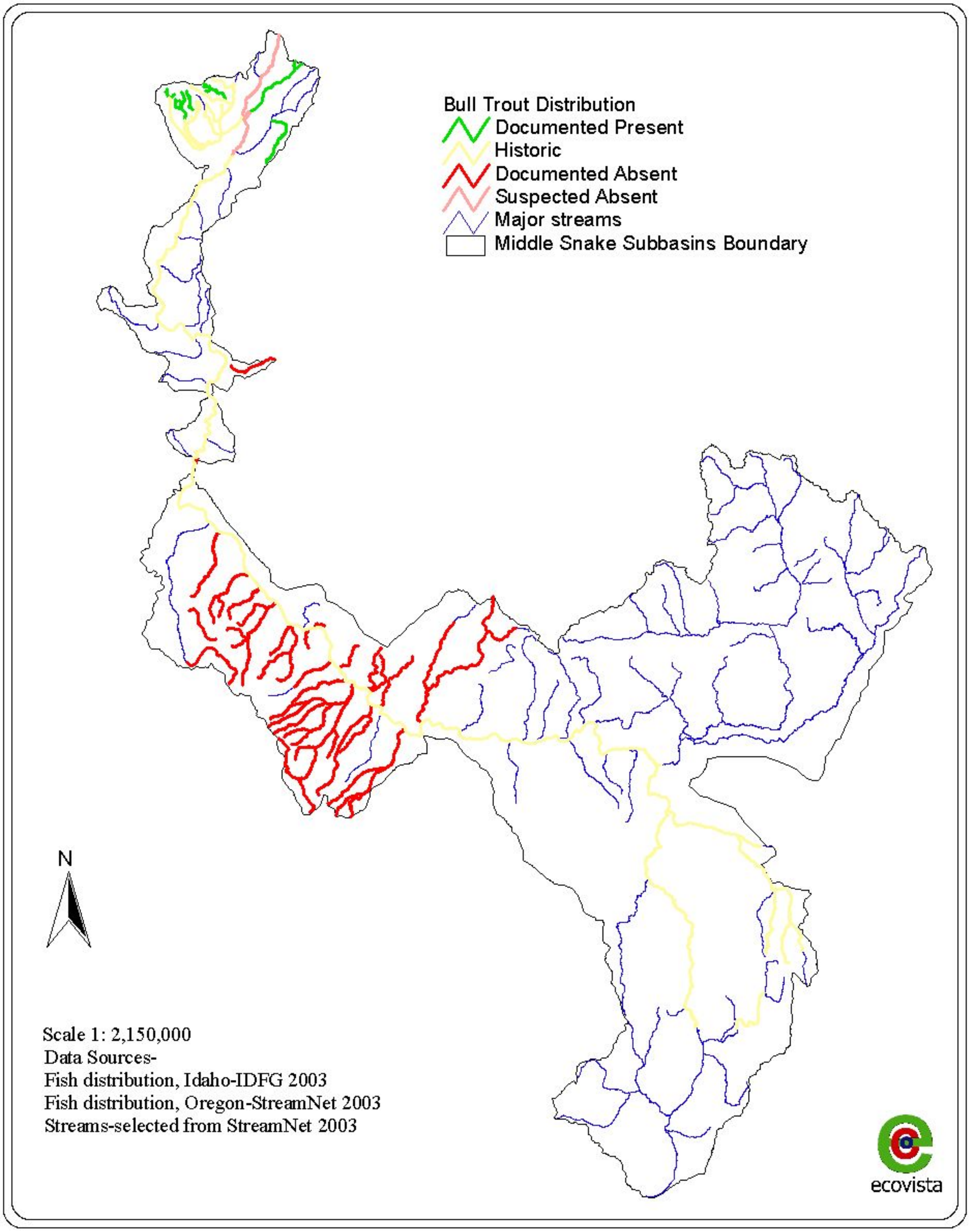

Figure 27. Bull trout presence in the Middle Snake subbasins.

Table 28. Current bull trout populations in the Hells Canyon Complex Recovery Unit within the lower Middle Snake subbasins (USFWS 2002b).

Core Area	Watershed	Local Populations
Pine/Indian/Wildhorse	Pine Creek	Upper Pine Creek (West Fork, Middle Fork, and East Fork Pine creeks)
		Clear Creek (Clear, Trail, and Meadow creeks)
		East Pine Creek
		Elk Creek (Aspen, Big Elk, Cabin, and Elk creeks)
	Indian Creek	Indian Creek
	Wildhorse River	Bear Creek
		Crooked Creek

Table 29. Bull trout population estimates for subwatersheds within the Pine Creek Basin in 1994 (USFS data; modified from Buchanan et al. 1997).

Subwatershed	Sample Size	Minimum Population Estimate[a]	Maximum Population Estimate[b]	1996 Extinction Risk
North Pine Creek[c]	98	123	368	moderate
East Pine Creek	60	75	225	moderate
Clear Creek	98	123	368	moderate
Upper Pine Creek	92	115	345	moderate
Total	**348**	**435**	**1,305**	

[a] Number of fish × 1.25 (factor developed by Kim Jones, ODFW, based on available habitat and assumption that single pass technique captures 80% of population)
[b] Minimum estimate × 3
[c] Area is equivalent to “Elk Creek” population area presented in Table 28

Table 30. Densities (number per mile) and numbers (in parentheses) of bull trout redds at index sites sampled in Pine Creek, Oregon, during 1998 through 2000 (After Fedora and Walters, in litt. 2001 *cited in* USFWS 2004a).

Site	**Stream length sampled (mile)**	**Year**		
		1998	1999	2000
Pine Creek 1	1.20	9.2 (11)	5.8 (7)	5.0 (6)
Pine Creek 2	1.00	13.0 (13)	9.0 (9)	9.0 (9)
East Fork Pine Creek 1	1.20[1]	7.5 (9)	5.8 (7)	7.1 (5)
East Fork Pine Creek 2	0.80	43.7 (35)	18.7 (15)	na
Trail Creek	0.75	na	1.3 (1)	na
Meadow Creek	0.75	57.3 (43)	1.3 (1)	25.3 (19)
Clear Creek	1.30	14.6 (19)	3.1 (4)	5.4 (7)
East Pine 1	0.65	60.0 (39)	7.7 (5)	1.5 (1)
East Pine 2[2]	0.50	na	na	10.0 (5)
Elk Creek 1	1.00	10.0 (10)	1.0 (1)	6.0 (6)
Elk Creek 2	0.50	6.0 (3)	0 (0)	na
Elk Creek 3	0.50	20.0 (10)	10.0 (5)	na
Elk Creek 4	0.40	0 (0)	0 (0)	na
Aspen Creek	0.70	15.7 (11)	5.7 (4)	4.3 (3)

Wood River Sculpin

Conservation Status

The Wood River sculpin (*Cottus leiopomus*) is considered a sensitive species by the USFS in Region 4 (Griffith 1996) and is similarly protected by all federal agencies (Buhidar 2002). The Idaho Department of Fish and Game (IDFG) classifies the fish as a species of special concern (USFS et al. 2001).

Life History

Little is known about the life history of the Wood River sculpin. The following description is drawn from the USFS et al. (2001) and Griffith (1996).

It is assumed that the life history of the Wood River sculpin is similar to that of other sculpins (Simpson and Wallace 1982, AFS 2000). Merkley and Griffith (1993, cited in USFS et al. 2001) report that the Wood River sculpin might be expected to have similar spawning and feeding behavior as the shorthead sculpin (*Cottus confusus*). Shorthead sculpin, like most cottids, spawn in the early spring, laying small broods of eggs on the underside of clean, coarse substrate that receives good water circulation. They feed primarily on benthic insect larvae (USFS et al. 2001) and exhibit seasonal variation in diet and feeding intensity. Moyle and Vondracek (1985, cited in USFS et al. 2001) concluded that western fish assemblages have relatively stable population densities over time because spawning is timed so that young-of-year are in the streams during summer and fall when productivity is maximum and stream flows are stable. Griffith (1996, cited in USFS et al. 2001) found small Wood River sculpin in upper Lake Creek in early September and speculated that Lake Creek may be the only sampled site that supports late summer, as well as early spring, spawning.

Wood River sculpin appear to require low to moderate gradient areas with coarse substrate, instream cover, and good pool-to-riffle ratios. Wood River sculpin seasonally occupy ephemeral side channels with suitable cobbles and boulders (Merkley and Griffith 1993). They are territorial (USFS et al. 2001). Sculpins in general are sensitive to habitat alteration and pollution and have been used as indicators of good water quality (Doudoroff and Warren 1957). In the winter, Griffith (1996) found Wood River sculpin only in large pools. Deep complex pools are critical to their overwinter survival.

Griffith (1996) found that abundance of Wood River sculpin was not correlated with stream width, channel gradient, or elevation. Limited information allowed Griffith (1996) to suggest the following habitat relationships relative to Wood River sculpin:

- Sculpin density appears to decline with increased embeddedness.
- Substrate size may be related to the size of the sculpin using it, i.e., the smaller the substrate, the smaller the sculpin.
- Water velocity between 1.5 and 3.0 feet per second may be optimal for adult sculpin.
- Water depth (> 4 inches) is a positive habitat attribute regardless of substrate size or flow velocity.

- Adult sculpin are most abundant in relatively deep water along the channel thalweg.

- The largest sculpin are generally associated with streambank structures (large woody debris, boulders).

Distribution and Population Trends

Wood River sculpin are endemic to the Wood River drainage (Simpson and Wallace 1982). Wood River sculpin were more widely distributed historically than today, but the actual extent of the population distribution is unknown (Wallace 1978). It is likely that the historic range consisted of all the permanent, connecting waters upstream of the waterfalls at Interstate 84 on the Malad River upstream into the Little and Big Wood rivers and tributaries (USFS et al. 2001). No systematic, basinwide inventory for Wood River sculpin has been conducted.

Current distribution of the species is restricted to the upper Little Wood River and its tributaries and the Big Wood River and its tributaries upstream from Magic Reservoir (AFS 2000) (

Figure 28).

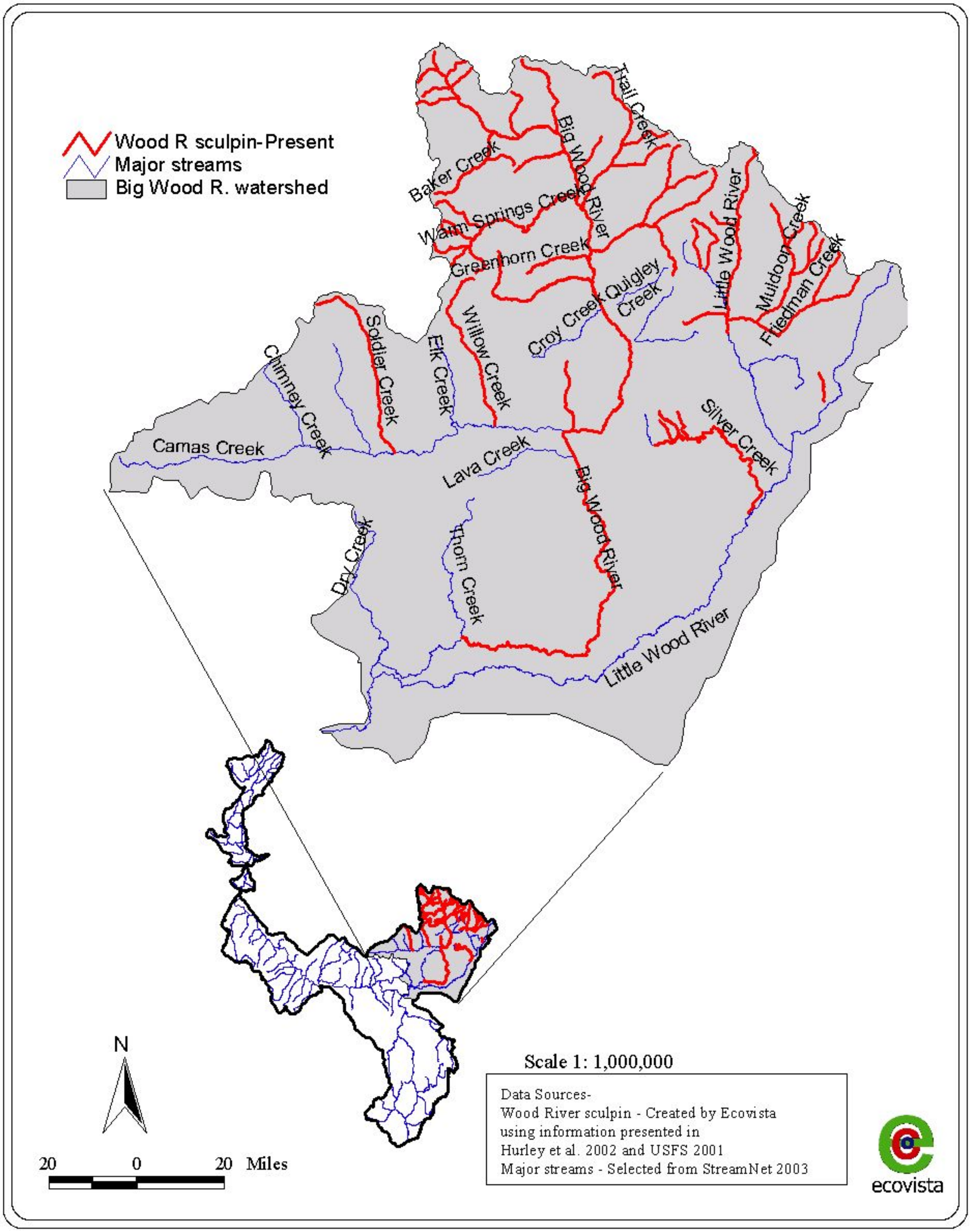

Figure 28. Wood River sculpin distribution in the Middle Snake subbasins.

Aquatic Snail Species

Conservation Status

Five aquatic snails found in the Middle Snake subbasins upstream of C.J. Strike Dam are listed for protection under the ESA. Four are listed as endangered: the Idaho springsnail (*Pyrgulopsis* [=*Fontelicella*] *idahoensis*), Utah valvata snail (*Valvata utahensis*), Snake River physa snail (*Physa natricina*), and Banbury Springs lanx (*Lanx* sp.). One aquatic snail is listed as threatened: the Bliss Rapids snail (*Taylorconcha serpenticola*) (December 14, 1992 [57 FR 59244]). All information on descriptions, life history, species distributions, and population trends is from the USFWS (1995), unless cited otherwise.

Idaho Springsnail

Description

The Idaho springsnail has a narrow, elongated shell and is approximately 0.2 to 0.25 inches wide, with up to six whorls.

Life History

The Idaho springsnail is found in flowing waters of the mainstem Snake River, excluding tributaries and coldwater spring areas. The species occurs on sand or mud between gravel to boulder-sized substrate.

Distribution and Population Trends

Historically, the Idaho springsnail was found from Homedale (RM 416) to Bancroft Springs (RM 553) and has been collected at 10 locations (USFWS 1995). The species currently occurs near the headwaters of C.J. Strike Reservoir (RM 518) upstream to Bancroft Springs (RM 553), and area representing an 80% reduction in distribution. Current populations are isolated and fragmented.

Utah Valvata Snail

Description

The Utah valvata snail is 0.2 inches long and has a shell that is about equally long as wide, with up to four whorls.

Life History

In the Snake River, the Utah valvata snail lives in sand silt and mud in shallow shoreline water, pools adjacent to rapids, or perennial flowing waters associated with large spring complexes. This species avoids heavy currents and rapids. Preferred habitat is well-oxygenated areas of limestone mud or mud–sand substrate among beds of aquatic vegetation. Primarily a detritivore, this snail is commonly associated with the aquatic plant chara. Feeding habits include grazing along the mud surface, ingesting diatoms and plant debris. In habitats with boulders on mud, the snail also feeds on diatoms and other periphyton and aquatic plants.

Distribution and Population Trends

The Utah valvata snail historically occurred in Utah Lake and the Snake River as far downstream as Grand View (RM 487). The species appears to be extirpated in Utah Lake. Current distribution is confined to the mainstem Snake River and a few springs in the Hagerman Valley (RM 579). Additionally, the species is found in select locations upstream of Shoshone Falls, which is the upper Boundary for the Middle Snake subbasins.

Snake River Physa

Description

Snake River physa are approximately 0.2 to 0.25 inches wide, with 3 to 3.5 whorls. They are amber to brown in color.

Life History

This species occurs on the undersides of gravel- to boulder-sized 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.

Distribution and Population Trends

Modern historic range was thought to extend from Grand View through the Hagerman reach (RM 487-573). The population segment near Grand View was thought to have been extirpated in the 1980s. Recent investigations in other reaches have failed to find any live Snake River physa.

Banbury Springs Lanx

Description

The Banbury springs lanx is 0.09 to 0.28 inches long, 0.07 – 0.24 inches wide, and 0.03 to 0.17 inches high.

Life History

The Banbury springs lanx has been found only in spring run habitats with well-oxygenated, clear, cold (59–61 °F) waters on boulder- or cobble-sized substrate. Known locations have relatively swift currents. The snails are most commonly found on smooth basalt, and they avoid surfaces having large aquatic macrophytes or filamentous green algae. The species has been found in water depths from 2 to 30 inches and most typically in 6 inches.

Distribution and Population Trends

The Banbury Springs lanx was first discovered in 1988 at Banbury Springs (RM 589), a second colony was found in nearby Box Canyon Springs (RM 588) in 1989, and a third very small colony was identified in TNC's Thousand Springs Preserve in 1991. The species is known to occur only in the largest, least-disturbed spring habitats at Banbury Springs, Box Canyon Springs, and Thousand Springs.

Bliss Rapids Snail

Description

The Bliss Rapids snail is 0.1 inches wide, has three whorls, and is ovid shaped. Two color variants exist: the colorless or "pale" form and the orange-red or "orange" form. The pale form is slightly smaller, with rounded whorls and more melanin pigment in the body.

Life History

The snail occurs on stable cobble–boulder substrate in flowing waters of unimpounded reaches of the mainstem Snake River and in a few spring habitats in the Hagerman Valley. The species does not burrow in sediments and avoids surfaces with attached plants. Known river populations occur only in areas associated with spring influences or rapids-edge environments, tending to flank shorelines. The snail is found at varying depths, depending on dissolved oxygen and temperature, and in shallow depths (< 0.5 inch) in permanent cold springs. The species is considered moderately negatively phototaxic, residing on lateral and undersides of rocks during daylight.

Distribution and Population Trends

The Bliss Rapids snail was known historically from the mainstem Snake River and associated springs between Indian Cove Bridge (RM 525.4) and Twin Falls (RM 610.5). Live collections indicate that the species currently exists as disjunct populations within its historic range, with colonies primarily concentrated in the Hagerman reach, tailwaters of Bliss and Lower Salmon dams, and several unpolluted springs (including Thousand, Banbury, Box Canyon, and Niagara springs).

3.4.2 Aquatic Resources Limiting Factors

The Qualitative Habitat Assessment (QHA; Mobrand Biometrics 2003b) tool provided by the Council for use in subbasin planning was not used to assess habitat limitation to aquatic species in the Middle Snake subbasins. QHA is not suitable for evaluation of mainstem habitats, nor impacts of habitat degradation to focal mollusk species. For tributary habitats, aquatics technical team discussions illustrated a preference for the use of alternative methods as described below.

Numerous sources were reviewed for documentation of limiting factors throughout the Middle Snake subbasins. Information was compiled and subsequently revised by the subbasin technical team using best professional judgment. Results of this limiting factors review for aquatic focal species are summarized in Table 31 and Table 32 for tributary and mainstem habitat areas, respectively.

The information presented in Table 31 and Table 32 delineates limiting factors for various aquatic focal species over intermediate sized areas. Areas were defined by the technical team, and are believed to have similar species and limiting factors within, and differing species and/or limiting factors between areas. This information does not attempt to address factors found to limit fish production or survival in individual streams or stream reaches, largely due to a lack of specific knowledge at that scale.

Limiting factors have been assigned a value of 1-3, depending on the degree to which they are thought to limit specific species within each area[4]. A value of 1 indicates a principal or most influential limiting factor, whereas a value of 3 indicates a less influential factor limiting population(s). A value of 2 represents factors of intermediate influence on populations. While factors have been individually "ranked" to aid in interpretation, all factors listed in Table 31 and Table 32 are considered limiting to local populations, and cumulative impacts of several factors ranked as 2 or 3 may outweigh the influence of an individual factor ranked as 1.

Limited information is available in some areas and for some species (e.g. few limiting factors specific to mountain whitefish have been defined at the landscape level within the subbasin). Subwatersheds, streams or stream reaches throughout the subbasin may realize limitations due to factors not documented here. Proposals directed at addressing such factors should supply additional information as necessary to justify the project(s). Additional information may come from finer scale assessments or research, be based on results of recent or ongoing studies, or unpublished information sources.

[4] Values were assigned by technical advisory team members using their best professional judgment. Judgments were supplied by team members only for areas/species with which they were familiar; Where discrepancies existed amongst judgments, a 'majority rules' approach was used to assign the value, applying the most commonly suggested value. If judgements were similar but no value constituted a majority, the lowest value suggested was assigned.

Table 31. Limiting factors for focal fish species in tributary habitats throughout the Middle Snake subbasins.

	Temperature	Base Flow/Irrigation	Flow Variation	Sediment	Watershed Disturbance[1]	Habitat Degradation[2]	Hatchery Influence	Harvest	Connectivity/Passage	Predation	Loss of Prey Base	Introduced Species
Wood River drainage (Including Big/Little Wood Rivers, excluding Camas Creek)												
Redband trout	1	1	1	2	1	3	2		2			3
Mountain whitefish	1	1	1	2	1	3			2			3
Wood River sculpin	1	1	1	2	1	3						U
Molluscs		1	1		2							
Camas Creek drainage												
Redband trout	1	1	1	1	1	3			3			
Mountain whitefish	1	1	1	1	1	3			3			
Wood River sculpin	1	1	1	1	1	3			3			
Rock Creek drainage												
Redband trout	3	3	3	2	1		2					U
Mountain whitefish	3	3										
Canyon Springs drainage												
Redband trout		1		1[3]		1	3		1			3
Molluscs		2		2		1	1					2
Salmon Falls Creek drainage												
Redband trout	2	2	3	1	1	2	3			3		3
Mountain whitefish	2	2	3	1	1	2				3		
Lower tributaries—below mouth of Weiser River												
Redband trout					1	1	3					
Bull trout	2			3	2	1			1		2	1
Upper/central tributaries—mouth of Weiser River upstream to Malad River												
Redband trout	1	1	2	2	2	2			1			
Molluscs (Clover Ck.)		2		1		1	1					2

1 Watershed Disturbance = Upland disturbances such as mining, timber harvest and roading, including instream sediment resulting from defined upland sources (i.e., roads)
2 Habitat Degradation = Riparian or instream habitat loss or disturbance.
3 Impact of excess sediment is substantial where it exists but limited to localized areas (e.g. Billingsley Creek).

Table 32. Limiting factors for focal fish species in mainstem habitats throughout the Middle Snake subbasins.

	Temperature	Base Flow	Flow Variation	Sediment	Watershed Disturbance[1]	Habitat Degradation[2]	Hatchery Influence	Harvest	Connectivity/Passage	Predation	Loss of Prey Base	Harassment	Introduced Species	Recruitment	Water Quality
Hells Canyon Dam–Upper Brownlee Reservoir															
White sturgeon			1						1		2			1	1
Bull trout	1				2				1		2		1		
Mountain whitefish	1		3	3		1			1		3				2
Upper Brownlee Reservoir–C.J. Strike Dam															
White sturgeon			1						1		2			1	1
Mountain whitefish	1		3	2		1			2		3				1
Molluscs	2	1	1		2	1							2		1
C.J. Strike Dam–Bliss Dam															
White sturgeon	3	1	1						1	3	2	3		2	2
Mountain whitefish	1		3						2	3				3	1
Molluscs	2	1	1		2	1	2						2		1
Bliss Dam–Shoshone Falls Dam															
White sturgeon	3	1	1	3	1				1	3	2			1	1
Mountain whitefish	1		3	1	3	1			2	3					1
Molluscs	2	1	1		2	1	2						2		1

1 Watershed Disturbance = Upland disturbances such as mining, timber harvest and roading, including instream sediment resulting from defined upland sources (i.e., roads)
2 Habitat Degradation = Riparian or instream habitat loss or disturbance

3.5 Terrestrial Resources

3.5.1 Selection of Focal Habitats and Focal Species

As defined by the Northwest Power and Conservation Council), a focal species has special ecological, cultural, or legal status and will be used to evaluate the health of the ecosystem and the effectiveness of management actions. Federally listed species will likely be considered as focal species. Others may be included that a) have special cultural significance, b) fulfill a critical ecological function, c) serve as an indicator of environmental health, and/or d) are locally significant or rare, as determined by applicable state or federal resource management agencies (NPPC 2001).

The Middle Snake subbasins technical team met in August 2003 to select focal species for the subbasin assessment. The group was uncomfortable with a species-based management approach for the subbasins. They felt that the focal species concept had utility for drawing attention to specific issues and limiting factors in the subbasins but that the primary unit of focus for the assessment and future work in the subbasins should be restoring and maintaining high-quality habitat that will support all native wildlife and plant species. The group recognized the need for the using a fine-filter approach to preserve species that might fall through the cracks of a coarse-filter habitat approach and recognized the value of species-specific descriptions in capturing the interest of the reader and helping to illustrate the impacts of habitat-level limiting factors. For these reasons, the Middle Snake subbasins technical team decided to structure its subbasins assessment and plan around focal habitat types and the factors that limit habitat quality in the subbasins. For each focal habitat type, the group selected one or more focal species to illustrate habitat issues and to highlight issues for which the habitat-based approach is too broad and species-specific objectives and strategies need to be developed in the management plan.

During the discussion, the technical team identified seven focal habitats: 1) shrub-steppe, 2) dwarf shrub-steppe, 3) desert playa and salt scrub shrublands, 4) native (interior) grasslands, 5) pine/fir/mixed conifer forests 6) upland aspen and 7) riparian/wetlands/springs. The selected focal habitats are based on the Wildlife Habitat Type (WHTs) classifications developed by the Northwest Habitat Institute (NHI 2003) with a few minor modifications (**Error! Reference source not found.**) . The interior grassland classification developed by NHI was renamed Native (interior) grasslands to clarify that the focus of this focal habitat type is native bunchgrass habitats and that it does not include the large areas of historic shrub-steppe habitat that have been converted to exotic perennial and annual grasslands. The designation of pine/fir/mixed conifer forests was one that the Middle Snake subbasins technical team was more familiar with than the conifer habitat designations used by NHI and so that term will be used to designate conifer focal habitats in this document. The riparian/wetland/spring focal habitat includes all riparian and wetland habitat types designated by NHI.

The criteria and rationale for focal habitat selection included habitats described by unique vegetative characteristics, dominant plant species, or a successional stage with important ecological ties to fish and/or wildlife (e.g., old growth). A focal habitat may also be composed of specific environmental elements integral to the viability of fish and wildlife populations (e.g., snags, caves). One or more of the following attributes were considered in focal habitat identification:

- Comparatively high fish and wildlife density
- Comparatively high fish and wildlife species diversity
- Important fish and wildlife breeding habitat, seasonal ranges, or movement corridors
- Limited availability
- High vulnerability to habitat alteration
- Unique or dependent species

The current distribution of WHTs in the Middle Snake subbasins is displayed in Figure 29. Current (1999) wildlife habitat types in the Middle Snake subbasins.

. Descriptions developed for these WHTs through the Interactive Biodiversity Information System (IBIS) were used extensively in this assessment to characterize the focal habitats. Land-use activities and human alterations to ecological processes have altered the distribution, distribution, and composition of these WHTs form what was present historically. These changes have influenced the composition and population dynamics of the wildlife communities dependent on the WHTs. Unfortunately, the scarcityof historical records and issues of scale make quantifying these changes difficult, and estimates of change should be viewed cautiously. The best attempt at mapping historic WHTs and quantifying changes in the distribution of WHTs in the subbasin has been conducted by the Northwest Habitat Institute (Figure 30; Table 33).

After the team identified focal habitats, it selected focal species to represent each focal habitat (Table 34). Preference was given to species designated as threatened, endangered, sensitive, Partners in Flight priority or focal, functional link, functional specialist, culturally important, or managed—when these species were considered good representatives of habitat quality. More focal species were selected to represent widely distributed or disproportionately important focal habitat types. The team also selected species to represent structural conditions or habitat elements that are particularly important to a variety of wildlife species in the subbasins and that are thought to be less common than they were historically. Species' susceptibility to current and historic management, data availability, and monitoring potential were also factors considered during the selection process. Draft lists of potential focal habitats and focal species were widely distributed electronically for review. At the September and October technical team meetings, the team members present reviewed comments on the focal species and made amendments to the draft list through consensus of those present.

For the seven focal habitats, characteristics, condition, and areas of potential restoration or protection priority are discussed below. For the associated focal species, descriptions, biology, available population and trend information, and threats to populations are described in section 3.5.2.

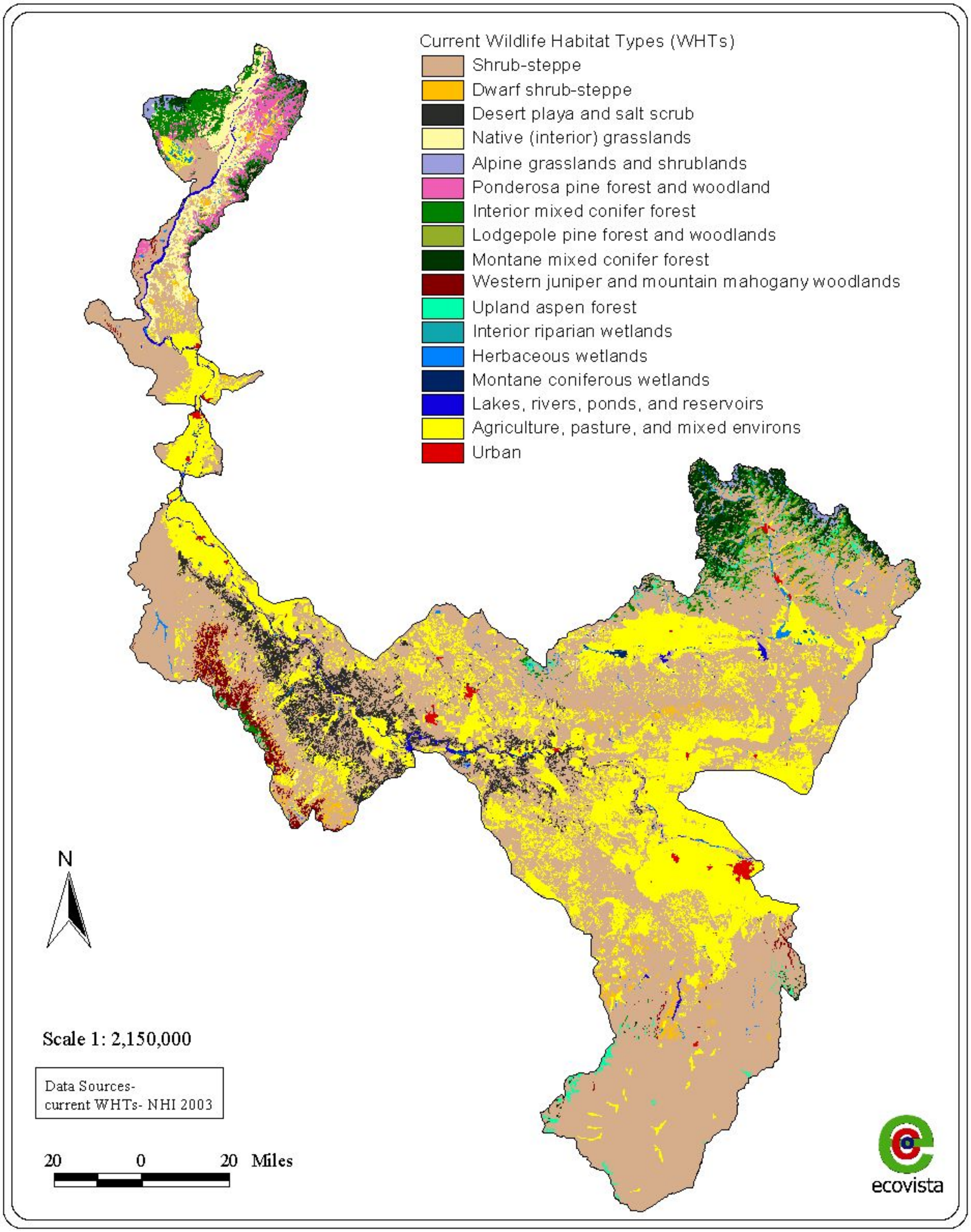

Figure 29. Current (1999) wildlife habitat types in the Middle Snake subbasins.

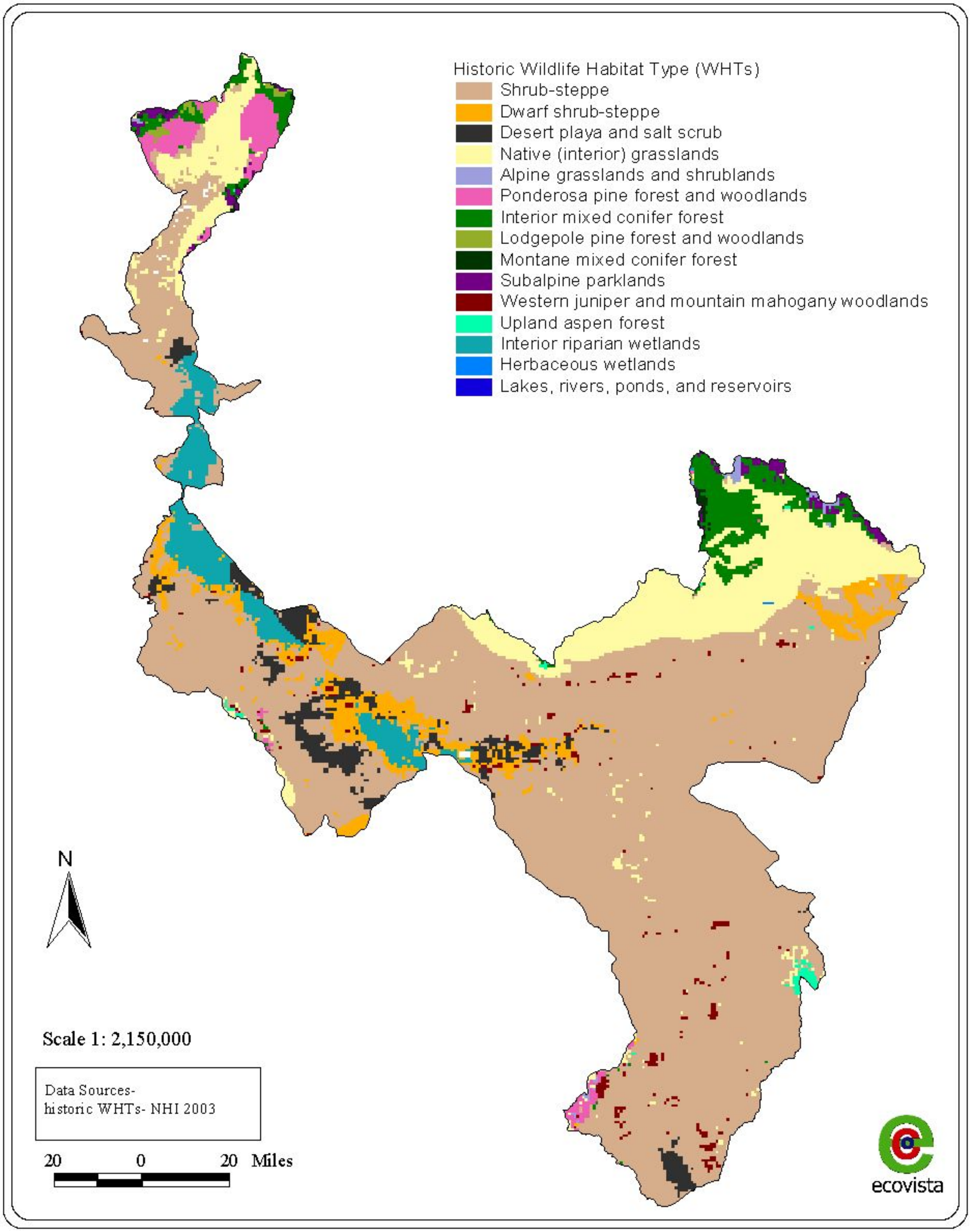

Figure 30. Historic (~1850) wildlife habitat types in the Middle Snake subbasins.

Table 33. Changes in Wildlife Habitat Type distribution between historic and current

Wildlife Habitat Type	Historic ~1850 (acres)	Current 1999 (acres)	Change (acres)	Change (percent)
Shrub-steppe	5,572,594	4,709,594	-863,000	-15
Dwarf shrub-steppe	386,533	120,566	-265,967	-69
Desert playa and salt scrub	274,838	319,603	44,765	16
Native (interior) grasslands	1,109,471	191,492	-917,979	-83
Alpine grasslands and shrublands	21,479	39,460	17,982	84
Ponderosa pine forest and woodlands	155,826	120,482	-35,345	-23
Interior mixed conifer forest	288,468	206,843	-81,625	-28
Lodgepole pine forest and woodlands	17,612	49,712	32,100	182
Montane mixed conifer forest	14,907	187,159	172,252	1,156
Subalpine parklands	57,647	0	-57,647	-100
Western juniper and mountain mahogany woodlands	86,496	96,343	9,848	11
Upland aspen forest	20,772	48,055	27,283	131
Interior riparian wetlands	339,215	5,147	-334,067	-98
Herbaceous wetlands	985	55,150	54,164	5,497
Montane coniferous wetlands	0	5,685	5,685	-
Lakes, rivers, ponds, and reservoirs	7,810	58,278	50,468	646
Agriculture, pasture, and mixed environs	0	2,123,835	2,123,835	-
Urban and mixed enviorns	0	35,323	35,323	-

Table 34. Terrestrial focal habitats and associated focal species, Middle Snake subbasins.

Focal Habitat	Focal Species
Shrub-steppe	mule deer (*Odocoileus hemionus*) pygmy rabbit (*Brachylagus idahoensis*) sage grouse (*Centrocercus urophasianus*)
Dwarf shrub-steppe	slick spot peppergrass (*Lepidium papilliferum*) spotted bat (*Euderma maculatum*)
Desert playa	fourwing saltbush (*Atriplex canescens*) pronghorn (*Antilocapra americana*)
Native grasslands	sharp-tailed grouse (*Tympanuchus phasianellus*) Spalding's catchfly (*Silene spaldingii*)
Pine/fir/mixed conifer forests	pileated woodpecker (*Dryocopus pileatus*) white-headed woodpecker (*Picoides albolarvatus*) flammulated owl (*Otus flammeolus*)
Aspen	aspen (*Populus tremuloides*)
Riparian/wetland/spring	spotted frog (*Rana luteiventris*) mountain quail (*Oreortyx pictus*) willow flycatcher (*Empidonax traillii*) willow (*Salix* spp.) sedges (*Carex* spp.)

Shrub-Steppe

Shrub-steppe (big sagebrush) habitats dominate the Middle Snake subbasins, covering over 56% (4,709,594 acres) of the land area (NHI 2003) (Figure 29). These habitats are found in the most arid portions of the subbasin. They occur at the widest range of elevations of any habitat type in the subbasin from 2,450 to more than 11,800.

Three subspecies of big sagebrush characterize the mid-tall shrubs in the shrub-steppe habitat: Basin (*Artemisia tridentata* ssp. *tridentata*), Wyoming (*A. t.* ssp. *wyomingensis*), or mountain (*A. t.* ssp. *vaseyana*) (Table 35). The distribution of different sagebrush species is highly correlated with climate and soil requirements (USFS 2003a). Areas dominated by a combination of Wyoming and Basin sagebrush are most common in the subbasin, and dominate the low to mid elevation sagebrush habitats. At higher elevations mountain sagebrush becomes the dominant species. Dwarf shrub-steppe habitats, characterized by the shorter species of sagebrush, are rare in the subbasin than the big sagebrush types. These communities are are discussed in the following section.

Figure 31. Shrub-steppe habitat (reprinted from IBIS 2003 with permission).

Table 35. Distribution (by 4th field HUC) and types of sagebrush in the Middle Snake subbasins (data from Sagemap 2003)

4th Field HUC	Big sagebrush types				Dwarf sagebrush types			Combined sagebrush types	
	Mountain	Wyoming	Basin	Wyoming and Basin	Low	Stiff	Black	Low and Mountain	Low and Wyoming
Upper Snake Rock	48,304	0	0	293,091	19,259	0	0	0	0
Salmon Falls	266,250	60,869	40,022	403,535	117,251	0	211,079	4,167	9,026
Big Wood	109,823	0	0	288,605	36,360	0	0	0	0
Camas	39,406	0	0	96,905	4,470	0	0	0	0
Little Wood	70,876	0	0	315,059	21,693	0	0	0	0
CJ Strike Reservoir	7,572	0	0	453,406	5,735	0	0	0	0
Mid Snake-Succor	25,283	103,115	0	327,488	67,130	0	0	0	15,387
Mid Snake-Payette	0	30,304	0	3,688	1,600	0	0	0	0
Brownlee Reservoir	45,611	78,404	0	12,968	17,717	1,574	0	0	0
Total Acres in Subbasin	613,125	272,693	40,022	2,194,745	291,216	1,574	211,079	4,167	24,413

Wyoming and mountain big sagebrush can codominate areas with tobacco brush (*Ceanothus velutinus)*. Rabbitbrush (*Chrysothamnus viscidiflorus*) and short-spine horsebrush (*Tetradymia spinosa*) are common associates and often dominate sites after disturbance. Big sagebrush occurs with the shorter stiff sagebrush (*A. rigida*) or low sagebrush (*A. arbuscula*) on shallow soils or high elevation sites. Many sandy areas are shrub-free or are open to patchy shrublands of bitterbrush and/or rabbitbrush (IBIS 2003).

Well-functioning shrub-steppe habitats contain a variety of native bunchgrasses and forbs which provide a mosaic of habitat, between the 10 to 30% coverage of shrubs. There are three sizes of bunchgrasses:

1. tall grass: basin wild rye (*Leymus cinereus*)

2. mid-size grasses: bluebunch wheatgrass (*Pseudoroegneria spicata*), Idaho fescue (*Festuca idahoensis*), bottlebrush squirreltail (*Elymus elymoides*), and Thurber needlegrass (*Stipa thurberiana*)

3. short grasses: threadleaf sedge (*Carex filifolia*) and Sandberg bluegrass (*Poa sandbergii*) (IBIS 2003)

Idaho fescue characterizes the most productive shrub-steppe vegetation. Bluebunch wheatgrass competes with Idaho fescue at xeric locations, while western needlegrass (*Stipa occidentalis*), long-stolon sedge (*Carex inops*), or Geyer's sedge (*C. geyeri*) increase in abundance in higher-elevation habitats (IBIS 2003). Shrub overstories competitively decrease herbaceous species composition and diversity as succession proceeds toward climax (USFS 2003a).

The most prevalent natural disturbance in shrub-steppe habitats is scattered, low-intensity ground fire usually set by summer thunderstorms. Runoff events are often extreme as water from snowmelt and rainfall is slowly absorbed by the arid soils. Cryptobiotic (or cryptogamic) crusts (a living layer of algae, lichen, and mosses atop the soils) are often associated with healthy shrub-steppe habitats and help stabilize the soils, preventing wide-scale wind and water erosion by regulating water infiltration. Blue-green algae are also a beneficial component of these crusts; they fix nitrogen that enriches the soil for nearby plants (CBI 2003).

Throughout the ecoregion, the extent of land covered by big sagebrush and mountain sagebrush cover types is significantly smaller than before 1900. In the Middle Snake subbasins most of the more than 2,000,000 acres now used for agriculture or pasture were historically shrub-steppe habitats (Table 33). More than half of the Pacific Northwest shrub-steppe habitat community types listed in the National Vegetation Classification are considered imperiled or critically imperiled (IBIS 2003). Sagebrush is a critical food source and shelter for many animals, including three focal species in the Middle Snake subbasins: the pronghorn, sage grouse, and pygmy rabbit. In addition, sagebrush benefits the ecosystem by physically protecting understory plants, increasing diversity in the plant community, and improving snow retention that may increase the water table (CBI 2003).

Exotic grasses including cheatgrass and crested wheatgrass (*Agropyron cristatum)* have invaded or been intentionally introduced to the understory of many of the subbasins shrub-steppe habitats. Figure 32 shows areas in the Idaho portion of the subbasin that are dominated by annual grasslands (usually cheatgrass) and crested wheatgrass. The map was developed to identify high quality areas for sage grouse but is broad scale enough that it was considered a good indicator of relatively high quality sage-steppe habitats in general. The Middle Snake subbasins technical team used the layer as one component in the development of shrub-steppe restoration and protection priorities in the *Middle Snake Subbasins Management Plan.*

Introduced and invasive grass species decrease the prevalence of native bunchgrasses in shrub-steppe habitats and alter the disturbance regime. Cheatgrass dries earlier in the season than bunchgrasses and can cause an earlier more frequent fire regime. This further reduces bunchgrasses when they burn before they have a chance to set seed, and destroys the fire intolerant sagebrush. Native perennial bunchgrass species 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 bunchgrass triggers the unraveling of both watershed integrity and the capability of these sites to produce wildlife habitat and commercial resources (Rust et al. 2000). Other threats to shrub-steppe ecosystems include overgrazing, increasing off-road vehicle use, water use and water quality issues, and agricultural chemical use. (CBI 2003).

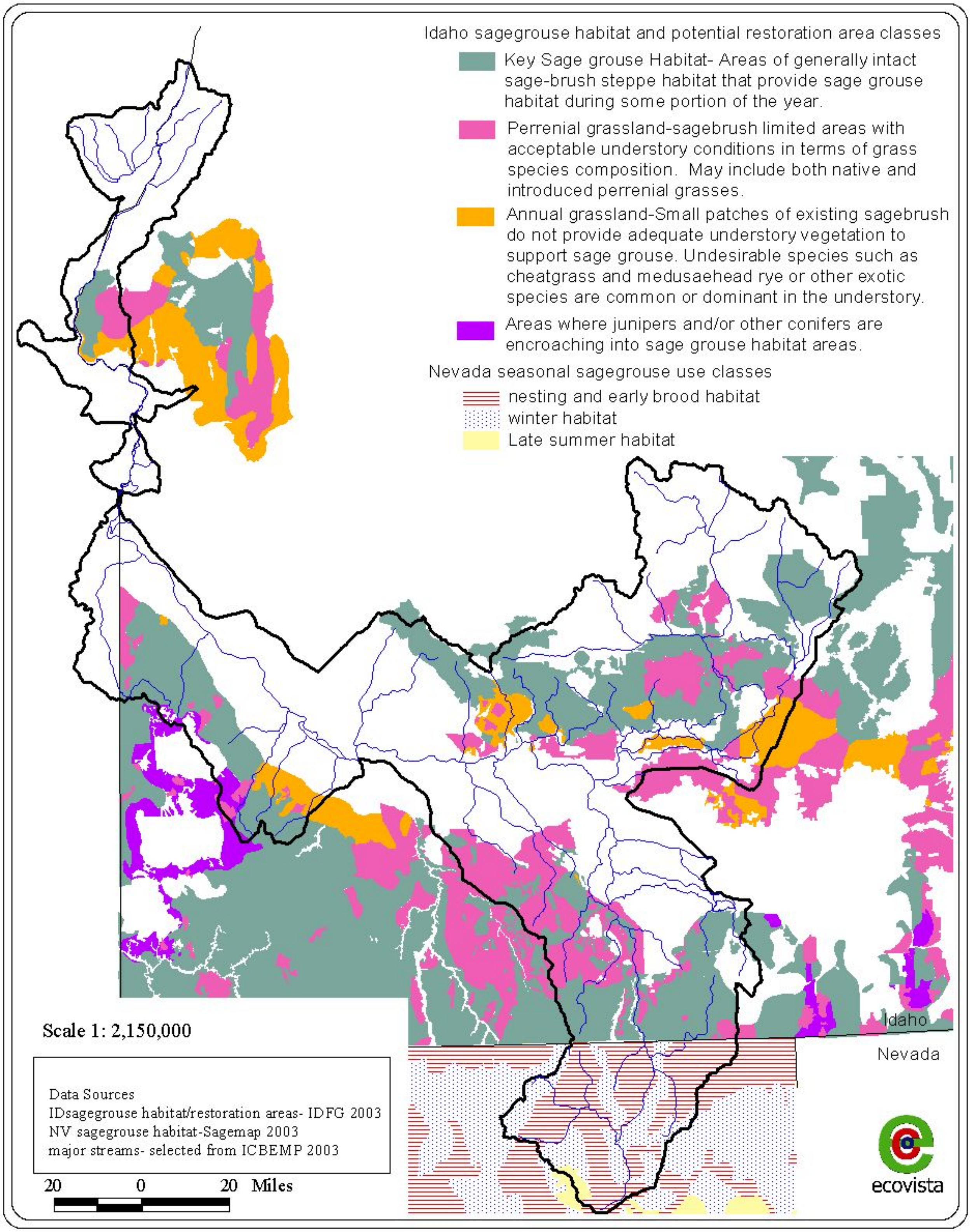

Figure 32. Areas of relatively intact shrub-steppe habitat providing high quality habitat for sage grouse and other shrub-steppe dependent wildlife and areas degraded by introduced or invasive grasses.

Dwarf Shrub-Steppe

Dwarf shrub-steppe (scabland or low sagebrush) habitats are scattered throughout the Middle Snake subbasins in approximately 1.5% (120,048 acres) of the land area (Figure 29). Vegetation data from SageMap (2003) shows the vegetation types that comprise dwarf-shrub steppe to be more abundant in the subbasin than indicated by the WHT data in Figure 29 but areas of concentration are the same (Table 35). Below C.J. Strike Dam, the majority of this habitat exists in the Owyhee uplands and forms a mosaic with western juniper and mountain mahogany habitats in the headwaters of Shoofly, Castle, Sinker, and Squaw creeks. Above the dam, dwarf shrub-steppe habitat occurs in Clover, King Hill, and Dry creeks to the north and along Salmon Falls (especially along and above Salmon Falls Creek Reservoir), Devil, and Cedar Creeks in the south. These habitats often appear on low, scabby plateaus or flats above lake basins with little soil development (Figure 33). Dwarf shrub-steppe cover is found across a wide range of elevations from 500 to 7,000 feet (152–2,134 m), with the majority in the Middle Snake subbasins occurring between 4,000 and 5,000 feet (1,220–1,524 m).

Figure 33. Dwarf shrub-steppe habitat (reprinted from IBIS 2003 with permission).

Dwarf shrub-steppe habitats generally occur on barren, shallow, loam soils (< 12 inches [30 cm] deep) over young basalts. In woodland or forest mosaics, soils supporting shrub habitats are deeper (still < 26 inches [65 cm]), but too droughty or extreme for tree growth (IBIS 2003). Dwarf-shrub steppe habitats are characterized by three types of sagebrush low sagebrush (*Artemisia arbuscula*), black sagebrush (*A. nova*), and stiff sagebrush (*A. rigida*). Low sagebrush is the most prevalent throughout most of the Middle Snake subbasins but black sagebrush dominantes the dwarf shrub-steppe communities of the Salmon Falls drainage (Table 35).

Sandberg bluegrass (*Poa sandbergii*) is the characteristic grass making up most of this habitat's sparse vegetative cover. Taller bluebunch wheatgrass (*Pseudoroegneria spicata*) or Idaho fescue (*Festuca idahoensis*) grasses may occur on the most productive sites with Sandberg bluegrass. Bottlebrush squirreltail (*Elymus elymoides*) and Thurber needlegrass (*Stipa thurberiana*) are typically found in low cover areas, although they can dominate some sites. One-spike oatgrass (*Danthonia unispicata*), prairie junegrass (*Koeleria macrantha*), and Henderson ricegrass (*Achnatherum hendersonii*) are occasionally significant components of the community. Buckwheat species (*Eriogonum douglasii*, *E. sphaerocephalum*, *E. strictum*, *E. thymoides*, *E. niveum, E. compositum*) are common and contribute to the shrub layer. Common forbs include serrate balsamroot (*Balsamorhiza serrata*), Oregon twinpod (*Physaria oregana*), Oregon bitterroot (*Lewisia rediviva*), big-head clover (*Trifolium macrocephalum*), and Rainier violet (*Viola trinervata*). Several other forbs (*Arenaria*, *Collomia*, *Erigeron*, *Lomatium*, and *Phlox* spp.) are characteristic, early blooming species. A diverse lichen and moss layer is a prominent component of these communities (IBIS 2003).

Native dwarf-shrub steppe habitats often do not have enough vegetation cover to support wildfires, making such natural disturbance rare. However, dwarf-shrub species are intolerant of fire and do not sprout. Consequently, redevelopment of dwarf shrub-steppe habitat is slow following fire or any disturbance that removes shrubs (IBIS 2003). Other natural disturbance patterns occur as a result of winter flooding in the shallow and poorly drained soils that characterize many scabland habitats. In addition, freezing of saturated soils results in "frost-heaving" that churns the soil (IBIS 2003).

These natural soil-churning disturbances have made theses communities susceptible to invasion by exotic annual grasses, which have become abundant in many of the dwarf shrub-steppe habitats of the subbasin. Heavy use by livestock or vehicles disrupts the moss/lichen layer and increases exposed rock and bare ground further increasing susceptibility to exotic plant invasion. The increased fire regime that results from cheatgrass invasion is considered a major threat to this community (Table 44).

Low sagebrush cover types have not declined to the degree that big sagebrush habitats have (USFS 2003a). However, 20% of Pacific Northwest dwarf shrub-steppe community types listed in the National Vegetation Classification are considered imperiled or critically imperiled (IBIS 2003).

Desert Playa and Salt Scrub Shrublands

The desert playa and salt scrub habitat (northern desert shrub) centers on the Great Basin of Nevada and Utah, although it is represented throughout the Columbia Plateau, Basin and Range, and Owyhee provinces. Only 4% (318,228 acres) of the land area in the Middle Snake subbasins is designated as desert playa and salt scrub habitat (IBIS 2003). The majority exists along the Snake River from the confluence of King Hill Creek downstream to the confluence of Succor Creek (Figure 29). A smaller area of habitat in the subbasins occurs along the headwaters of Rock Creek, near the Nevada border. Salt scrub habitat in the Snake River portion of the subbasins is typically composed of open, rounded, wide valleys and hilly plateaus in low-elevation, arid regions around 3,000 feet (914 m). It is usually associated with shrub-steppe cover types; however, it forms a habitat mosaic of playas, salt grass meadows, salt desert, and sagebrush shrublands and may be associated with herbaceous wetland habitat (IBIS 2003) (Figure 29).

Figure 34. Desert playa and salt scrub shrubland habitat (reprinted from IBIS 2003 with permission).

The vegetative diversity in this habitat is related to changes in salinity and fluctuations in the water table. Highly alkaline and saline soils that are poorly drained, such as gravelly flats, ash, desert pavement, or low alkaline dune ridges, generally support little or no vegetation. Less drought-tolerant species are usually found at the mouth of stream drainages or in areas with some freshwater input into a playa (KSU 2003). Generally, low to medium-tall alkali- or saline-tolerant shrubs form an open layer over a grass and annual undergrowth. Deciduous shrubs, when present, usually create less than 50% cover but can exceed 70% on previously disturbed ground (IBIS 2003).

Salt scrub range is characterized by widely spaced, deeply rooted shrubs. As moisture comes mainly during the cool, nongrowing period, it penetrates the soil deeply and is utilized by deep-rooted perennials (KSU 2003). Medium-tall shrubs that dominate well-drained sites are shadscale (*Atriplex confertifolia*), bud sagebrush (*Artemisia spinescens*), and hopsage (*Grayia spinosa*). Characteristic low shrubs are greenmolly (*Kochia americana*), saltbush (*Atriplex gardneri* or *A. nuttallii*), and winter fat (*Krascheninnikovia lanata*). Other medium-tall shrubs—big sagebrush (*Artemisia tridentata*), horsebrush (*Tetradymia nuttallii* or *T. glabrata*), Mormon tea (*Ephedra viridis*), or rabbitbrush (*Ericameria nauseosa* or *C. viscidiflorus*)—can be codominant. The medium-tall shrub black greasewood (*Sarcobatus vermiculatus*) or low shrubs—iodinebush (*Allenrolfea occidentalis*) or Mojave seablite (*Suaeda moquinii*)—can be dominant or codominant on less well-drained, generally more saline, parts of this habitat (IBIS 2003).

Herbaceous indicators of salt desert habitats occur on various sites. In densely vegetated habitats, native bunchgrasses, basin wildrye (*Leymus cinereus*), curly bluegrass (*Poa secunda*), and needle-and-threadgrass (*Stipa comata*) occur, usually with shrubs. Basin wildrye is also a common and diagnostic grass in sites with less alkaline, deeper soils and some movement of water. Indian ricegrass (*Oryzopsis hymenoides*) and bottlebrush squirreltail (*Elymus elymoides*) are dominant grasses on the alkaline dunes. Introduced plants, particularly cheatgrass (*Bromus tectorum*) or halogeton (*Halogeton glomeratus*), often dominate overgrazed sites. Saltgrass (*Distichlis spicata*) is a common, diagnostic native sod-forming grass on more saline sites that often dominates large areas with and without shrubs. Pickleweed (*Salicornia virginica*) is found in wetter, saline areas. Alkaline sites have mat muhly (*Muhlenbergia richardsonis*), alkali bluegrass (*Poa secunda* ssp. *juncifolia*), beardless wildrye (*Leymus triticoides*), and Lemmon's alkaligrass (*Puccinella lemmonii*). Common reedgrass (*Phragmites australis*), bulrush (*Scirpus americanus* and *S. maritimus*), and creeping spikerush (*Eleocharis palustris*) are diagnostic of the wettest parts of this habitat (IBIS 2003).

The major land use of this habitat type is for fall, winter, and spring range, mainly for sheep (KSU 2003). The portions of this habitat associated with water are most attractive to livestock. Other areas are designated as wildlife refuges. Overall, grazing has increased shrub and annual cover and decreased bunchgrass cover. Several exotic species invade this habitat with grazing, including Russian thistle (*Salsola kali*), tall tumblemustard (*Sisymbrium altissimum*), cheatgrass, and halogeton, a toxic exotic plant (IBIS 2003). Agricultural development is generally not feasible; consequently, grazing imposes the greatest impacts on this habitat.

Fire disturbance in this habitat is minor because of sparse vegetation and a lack of fuel. Prolonged flooding and irregular droughts are much more common natural pathways of disturbance. Many of the dominant shrub species sprout following fire, herbicide treatments, or heavy grazing. The characteristic shrubs of this habitat increase with grazing and can invade adjacent big sagebrush communities with intense grazing (IBIS 2003).

Native (interior) Grasslands

Quigley and Arbelbide (1997) concluded that fescue-bunchgrass and wheatgrass-bunchgrass cover types have significantly decreased since before 1900, while exotic forbs and annual grasses have significantly increased since that time. Fifty percent of the plant associations recognized as components of grassland habitat listed in the National Vegetation Classification are considered imperiled or critically imperiled (Anderson et al. 1998). Overgrazing by cattle near the end of the last century extensively altered these ecosystems. The native bunchgrasses of the Columbia Basin are not generally tolerant of grazing and sustain high mortality when grazed heavily in spring. Wildfires, once common in native grasslands, are far less frequent today as grazing has left less residual grass to carry fires and land management agencies maintain fire suppression policies. Both grazing and fire suppression favored shrub species over grasses and accelerated soil erosion. Site conditions have been permanently altered, and Eurasian annual grass species such as cheatgrass have aggressively colonized vast areas. Grazing continues to be widespread in these grasslands, and colonization by cheatgrass and the expansion of big sagebrush at the expense of native perennial grasses are expected to continue. Extensive amounts of land are also being converted to agricultural production. Once these ecosystems are converted, there is only limited potential for restoration to native grasslands, either mechanically or by removal of livestock. The pre-settlement mosaic of cool-season bunchgrasses and deep-rooted shrubs may now be one of the most rare ecosystems in the West.

Pine/Fir Forests

Forested lands in the Middle Snake subbasins are commonly distinguished by the types of trees they support, with differences in dominant tree species among sites generally reflecting geographic differences in temperature and moisture available for plant growth (Pfister et al. 1977, Arno 1979, Cooper et al. 1991). Due to the influence of moist, maritime air flowing in from the Pacific Coast to the Continental Divide, the climate of the subbasins is generally mild for this region (Arno 1979). At a local scale, moisture levels tend to be high at middle elevations, on north-facing slopes, and in sheltered valleys. Low, south-facing sites and high-elevation, windy ridges are relatively dry. Lands at high elevations and shaded, north-facing slopes at lower elevations are generally cold, whereas sites at low elevations and on south-facing slopes are much warmer.

Different tree species tend to thrive under different environmental conditions. For example, the ponderosa pine thrives on sites that are relatively hot and dry during summer months (Foiles and Curtis 1973). In contrast, trees like the western red cedar and western hemlock prosper in relatively mild and moist environments, like those found within the maritime-influenced climatic zones of northern Idaho and northwestern Montana (Pfister et al. 1977, Arno 1979, Cooper et al. 1991). Lodgepole pine and subalpine fir grow relatively well in very cold locations within the region (Pfister et al. 1977, Cooper et al. 1991).

Such environmental affinities explain, in large part, the pattern of tree species distribution and forest development in the northern Rocky Mountains. They also help explain why forests dominated by different types of trees tend to have different fire histories. For example, the warm, dry environments in which the ponderosa pine thrives also happen to be extremely fire-prone, while the cold, moist environments that favor growth of the subalpine fir may seldom carry fire (Fischer and Bradley 1987, Smith and Fischer 1997). To emphasize the interconnectedness of environmental factors (moisture and temperature), tree species distribution, and fire, a discussion of fire in the northern Rockies can be framed in terms of four, broad forest types: dry montane forests, moist montane forests, lower subalpine forests, and upper subalpine forests. Each of these forest types experiences a unique moisture/temperature regime, roughly corresponding to 1) warm, dry (xeric); 2) warm, moist (mesic), 3) cool, moist; and 4) cold, moist environmental conditions.

For the purposes of this assessment, the discussion of focal habitats will incorporate an age component (seral stage) of forest structure.

Xeric, Old Forest (Ponderosa Pine/Douglas-Fir)

Geographic Distribution

The ponderosa pine is the most widely distributed pine species in North America, ranging north–south from southern British Columbia to central Mexico and east–west from central Nebraska to the west coast (Little 1979). Ponderosa pine ecosystems occupy about 15.4 million hectares across 14 states (Garrison et al. 1977). Pacific ponderosa pine ranges from latitude 52 degrees N in the Fraser River drainage of southern British Columbia south through the mountains of Washington, Oregon, and California to latitude 33 degrees N near San Diego. In the northeastern part of its range, it extends east of the Continental Divide to longitude 110 degrees W in Montana and south to the Snake River Plain in Idaho (Oliver and Ryker1990).

Physical Setting

This habitat generally occurs on the driest sites supporting conifers in the Pacific Northwest. Tree species that thrive on sites that are relatively warm and dry tend to dominate. These species include ponderosa pine, Douglas-fir (*Pseudotsuga menziesii*), and western larch (*Larix occidentalis*). This habitat is widespread and variable, appearing on moderate to steep slopes in canyons and foothills and on plateaus or plains near mountains. In Idaho, this habitat can be maintained by the dry pumice soils. Average annual precipitation ranges from about 36 to 76 cm on ponderosa pine sites, often as snow.

Both the mildest and coldest of these dry montane forests can support pure stands of Douglas-fir. In the warmest and driest of these forests, ponderosa pine tends to grow in pure stands. These stands become increasingly open with decreasing elevation or increasingly dry soils, until they are so sparse that they are no longer considered forests. Ponderosa pine "woodlands," in which trees are so few and widely spaced that none of their crowns touch, are common at lower timberline and typically mark the transition from forest to grassland or shrubland. This transition generally occurs within 300 meters of the valley base elevation (Arno 1979).

Landscape Setting

This woodland habitat typifies the lower treeline zone forming transitions with mixed conifer forest and western juniper and mountain mahogany woodland, shrub-steppe, grassland, or agriculture habitats. Douglas-fir-ponderosa pine woodlands are found near or within the mixed conifer forest habitat. Ponderosa pine woodland is the vegetation type that Americans most commonly associate with western mountains (Peet 1988). However, the warm, dry conditions that naturally favor development and persistence of these open, parklike stands are characteristic of only a small fraction of the forested area within the northern Rockies. Douglas-fir often predominates at lower elevations, where valley base elevations are high and winter temperatures are too low for ponderosa pine. Western larch, the only deciduous conifer in the region, is an often conspicuous component of low-elevation forests.

Structure

This habitat is typically a woodland or savanna, with tree canopy coverage of 10 to 60%, although closed-canopy stands are possible. The tree layer is usually composed of widely spaced large conifer trees. Many stands tend towards a multilayered condition with encroaching conifer regeneration. Isolated taller conifers above broadleaf deciduous trees characterize part of this habitat. Deciduous woodlands or forests are an important part of the structural variety of this habitat. Clonal deciduous trees can create dense patches across a grassy landscape rather than scattered individual trees. The undergrowth may include dense stands of shrubs or, more often, be dominated by grasses, sedges, or forbs. Shrub-steppe shrubs may be prominent in some stands and create a distinct tree-shrub-sparse-grassland habitat.

Composition

Ponderosa pine and Douglas-fir are the most common evergreen trees in this habitat. The deciduous conifer, western larch, can be a codominant with the evergreen conifers, but seldom as a canopy dominant. Grand fir (*Abies grandis*) may be frequent in the undergrowth on more productive sites, giving stands a multilayer structure. In rare instances, grand fir can be codominant in the upper canopy.

The understories of xeric old forests are usually sparse due to the lack of moisture. Common native grasses and grasslike plants include Idaho fescue, rough fescue, bluebunch wheatgrass, pinegrass, sun sedge, and elk sedge. Forbs include arrowleaf balsamroot, lupine species, heartleaf arnica, mountain sweetroot, and western meadowrue. Common snowberry, mountain snowberry, antelope bitterbrush, bearberry, white spirea, Oregon grape, Saskatoon serviceberry (*Amelanchier alnifolia*), ninebark, russet buffaloberry, common juniper, and chokecherry are important woody species (Cooper et al. 1991, Pfister et al. 1977).

Other Classifications and Key References

The Society of American Foresters refers to this habitat as Pacific ponderosa pine-Douglas-fir. This habitat is also called needleleaf forest-ponderosa pine (Scott et al. 2002). Other references describing elements of this habitat include Voland 1976, Johnson and Clausnitzer 1992, and Lillybridge et al. 1995.

Natural Disturbance Regime

Fire plays an important role in creating vegetation structure and composition in this habitat. Most of the habitat has experienced frequent low-severity fires that maintained woodland or savanna conditions. A mean fire interval of 20 years for ponderosa pine is the shortest fire interval for the vegetation types listed by Barrett et al. (1997). Soil drought plays a role in maintaining an open tree canopy in part of this dry woodland habitat.

Succession and Stand Dynamics

This habitat is climax on sites near the dry limits of each of the dominant conifer species and more seral as the environment becomes more favorable for tree growth. Open seral stands are gradually replaced by more closed, shade-tolerant climax stands.

Effects of Management and Anthropogenic Impacts

Before 1900, this habitat was mostly open and parklike, with relatively few undergrowth trees. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that gives the habitat a more closed, multilayered canopy. For example, this habitat includes previously natural fire-maintained stands in which grand fir can eventually become the canopy dominant. Fire suppression has lead to a buildup of fuels that in turn increase the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover and tends to favor shrub and conifer species. Fire suppression combined with grazing creates conditions that support invasion by conifers. Large late-seral ponderosa pine and Douglas-fir are harvested in much of this habitat. Under most management regimes, typical tree size decreases and tree density increases in this habitat. In some areas, patchy tree establishment at the forest-steppe boundary has created new woodlands.

Status and Trends

Quigley and Arbelbide (1997) concluded that the interior ponderosa pine cover type is significantly smaller in extent than it was before 1900. They included much of this habitat in their dry forest potential vegetation group 181, 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. This habitat is generally degraded because of increased exotic plants and decreased native bunchgrasses. One-third of ponderosa pine and dry Douglas-fir or grand fir community types listed in the National Vegetation Classification are considered imperiled or critically imperiled (Anderson et al. 1998).

Summary

The xeric, old forest habitat type 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 greater than 53 cm diameter at breast height [dbh]). These types primarily occur at low elevations on south and west aspects. Some slopes in the drier habitats are steep. Important components of this habitat type are large downed material, snags, and decadence.

This forest type provides important breeding and nesting habitat for rare white-headed woodpeckers and flammulated owls. This xeric, open canopy forest type also provides ungulate winter range and serves as movement corridors in winter. Carnivores benefit from concentrated ungulate prey populations on winter range in this type. This forest type is maintained by fire and is vulnerable to fire exclusion. The low-elevation, warm aspect, low snowfall characteristics of this forest type make it vulnerable to land conversion and residential development. Intensive wood gathering can be significant to loss of snags in this type. This habitat is generally degraded because of increased exotic plants and decreased native bunchgrasses (IBIS 2003). One-third of ponderosa pine and dry Douglas-fir or grand fir community types listed in the National Vegetation Classification are considered imperiled or critically imperiled (Anderson et al. 1998).

Mesic, Young Forest

Mesic, young forest is simply the early seral components of forest habitats associated with the more moist (mesic) environments in the landscape. The early successional stages of forest habitats are often characterized by different species than climax forest species are, and these stages typically represent disturbance and/or the environmental response to that disturbance (Pfister et al. 1977, Cooper et al. 1991). For assessment purposes in the Middle Snake subbasins, the Rocky Mountain lodgepole pine has been identified as a useful proxy for identifying key habitat components on the landscape and important fish and wildlife species associated with these forest successional stages.

Geographic Distribution

Rocky Mountain lodgepole pine grows from the central Yukon Territory south throughout British Columbia and western Alberta east of the Coast Range. In the United States, it grows throughout the Rocky Mountain states from Idaho and Montana to southern Colorado and in the Cascade Range as far south as the Washington–Oregon border. Outlying eastern populations occur in the Caribou Mountains of northern Alberta, the Cypress Hills of southeastern Alberta and southwestern Saskatchewan, central Montana, and the Black Hills of South Dakota (Little1979; Critchfield 1980)

Physical Setting

This habitat is located mostly at mid to higher elevations (914–2,743 m). These environments can be cold and relatively dry, usually with persistent winter snowpack. A few of these forests occur in low-lying frost pockets, wet areas, or areas under edaphic control (usually pumice) and are relatively long-lasting features of the landscape. Average July temperature in this forest type typically falls between 60 and 64 °F. Mean annual precipitation ranges from 50 to 63 cm, with much of the precipitation falling as snow (Pfister et al. 1977, Arno 1979, Cooper et al. 1991).

Landscape Setting

This habitat appears within montane mixed conifer forest east of the Cascade Range crest and the cooler mixed conifer forest habitats. Most pumice-soil lodgepole pine habitat is intermixed with ponderosa pine forest and woodland habitats and located between mixed conifer forest habitat and either western juniper woodland or shrub-steppe habitat.

Structure

This habitat is composed of open to closed evergreen conifer tree canopies. Vertical structure is typically a single tree layer. Reproduction of other, more shade-tolerant conifers can be abundant in the undergrowth. Several distinct undergrowth types develop under the tree layer: evergreen or deciduous medium-tall shrubs, evergreen low shrubs, or graminoids with few shrubs. On pumice soils, sparsely developed shrub and graminoid undergrowth appears with open to closed tree canopies.

Composition

Subalpine fir, Engelmann spruce, and lodgepole pine dominate many stands of this forest type. Mountain hemlock (*Tsuga mertensiana*), which is relatively restricted to the maritime-influenced climatic zone west of the Continental Divide, is another key component of this habitat type. Douglas-fir, western larch, western white pine, and whitebark pine may also be present at various stages of stand development within this forest type (Pfister et al. 1977, Arno 1979, Cooper et al. 1991). Subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), and whitebark pine (*Pinus albicaulis*) are indicators of subalpine environments and present in colder or higher sites. Quaking aspen (*Populus tremuloides*) sometimes occurs in small numbers.

The undergrowth typical of the habitat type varies from grassy (in open, parklike sites) to densely shrubby. Wet sites can support luxuriant herbaceous vegetation, while dry sites usually support few forbs. Common woody species include antelope bitterbrush, dwarf huckleberry, grouse whortleberry, common juniper, devil's club, menziesia, and Oregon grape. Common forbs include twinflower, sweet scented bedstraw, twisted stalk, queencup beadlily, wild sarsaparilla, western meadow-rue, and heartleaf arnica. Other understory associates are beargrass, smooth woodrush, elk sedge, bluejoint reedgrass, and pinegrass (Pfister et al. 1977, Arno 1979, Cooper et al. 1991).

Other Classifications and Key References

Quigley and Arbelbide (1997) referred to this habitat as lodgepole pine cover type and as a part of the dry forest potential vegetation group. It is classified as needleleaf forest-lodgepole pine. Other references detailing forest associations with this habitat include Voland 1976, Johnson and Clausnitzer 1992, and Lillybridge et al. 1995.

Natural Disturbance Regime

This habitat typically reflects early successional forest vegetation that originated with fires. Inland Pacific Northwest lodgepole pine has a mean fire interval of 112 years. Summer drought areas generally have low- to medium-intensity ground fires occurring at intervals of 25 to 50 years, whereas areas with more moisture have a sparse undergrowth and slow fuel build-up that results in less frequent, more intense fire. With time, lodgepole pine stands increase in fuel loads. Woody fuels accumulate on the forest floor from insect (mountain pine beetle) and disease outbreaks and residual wood from past fires. Mountain pine beetle outbreaks thin stands that add fuel and create a drier environment for fire or open canopies and create gaps for other conifer regeneration. High-severity crown fires are likely in young stands, when the tree crowns are near deadwood on the ground. After the stand opens up, shade-tolerant trees increase in number.

Succession and Stand Dynamics

Most lodgepole pine forest and woodlands are early to mid-seral stages initiated by fire. Typically, lodgepole pine establishes within 10 to 20 years after fire. This can be a gap phase process where seed sources are scarce. Lodgepole stands break up after 100 to 200 years. Without fires and insects, stands become more closed-canopy forest with sparse undergrowth. Because lodgepole pine cannot reproduce under its own canopy, old unburned stands are replaced by shade-tolerant conifers. Lodgepole pine on pumice soils is not seral to other tree species; these extensive stands, if not burned, thin naturally, with lodgepole pine regenerating in patches. On poorly drained pumice soil, quaking aspen sometimes plays a mid-seral role and is displaced by lodgepole pine when aspen clones die.

Effects of Management and Anthropogenic Impacts

Fire suppression has left many single-canopy lodgepole pine habitats unburned to develop into more multilayered stands. Thinning of serotinous lodgepole pine forests with fire intervals of less than 20 years can reduce their importance over time. In pumice-soil lodgepole stands, lack of natural regeneration in harvest units has led to creation of "pumice deserts" within otherwise forested habitats (Cochran 1985).

Status and Trends

Quigley and Arbelbide (1997) concluded that the extent of the lodgepole pine cover type in the Pacific Northwest is the same as it was before 1900 and, in some regions, may exceed its historical extent. Five percent of Pacific Northwest lodgepole pine associations listed in the National Vegetation Classification are considered imperiled (Anderson et al. 1998). At a finer scale, these forests have been fragmented by roads and timber harvest and influenced by periodic livestock grazing and altered fire regimes.

Summary

Early seral forest size classes include herbaceous shrub, seedling, sapling, and pole size classes. Mid-seral forest size classes are those trees between 22 and 53 cm dbh. These habitat types are characterized by either moderately warm or cool moist habitats on northerly exposures. Species characteristic of the warmer habitats include grand fir, Douglas-fir, lodgepole pine, Engelmann spruce, and occasionally ponderosa pine and western larch. Understories range from beargrass and huckleberry to more diverse shrub and forb understories.

Species characteristic of the cooler habitats are subalpine fir, Engelmann spruce, and lodgepole pine, with western larch, whitebark pine, and Douglas-fir less common. The cool and moist subalpine fir is common at upper elevations on north aspects and moist lower slopes. The cool and wet subalpine fir is uncommon and occurs at upper elevations in riparian areas. Cool and moderately dry subalpine fir is very common at upper elevations on ridges and southerly aspects. Lodgepole pine is an important seral component in this type. The fire-influenced, even-aged structure is important for some species, including the lynx, snowshoe hare, and black-backed woodpecker. The mid-seral component seems to be the most limited across the landscape.

Fire exclusion has reduced early seral habitat conditions. Climax meadow and early seral habitats at both low and higher elevations, once maintained by fire, have decreased, resulting in reduced forage for ungulates. Shrublands have also declined. Recently burned habitats that provide unique elements like insect infestations, standing and down dead wood components, and early seral forage are absent due to fire exclusion. Some representative wildlife species associated with mesic, young forests include the Canada lynx, fisher, black-backed woodpecker, and Shira's moose.

Mesic, Old Forest

Geographic Distribution

The mid-elevation forests of the northern Rockies are relatively moist, receiving at least 50 cm of mean annual precipitation. The wetter conditions allow drought-tolerant tree species such as ponderosa pine, Douglas-fir, western larch, western white pine, and lodgepole pine to grow alongside less drought-tolerant species like grand fir, western redcedar, western hemlock, Engelmann spruce, and subalpine fir. These species co-occur in various combinations between 914 and 2,133 meters throughout Idaho. These assemblages are generally referred to as "mixed conifer" forests. The mixed conifer forest habitat appears primarily in the Blue Mountains, East Cascades, and Okanogan Highland ecoregions of Oregon, Washington, adjacent Idaho, and western Montana. It also extends north into British Columbia (IBIS 2003).

Physical Setting

This habitat receives some of the greatest amounts of precipitation in the inland northwest, 76 to 203 cm per year. Elevation of this habitat varies geographically, with generally higher elevations to the east. Douglas-fir is common throughout the entire spectrum of these forests but is most abundant on sites receiving 50 to 63 cm of rain per year—the driest of the mesic montane forests. Some of these relatively warm, dry stands may also support ponderosa pine and appear similar to low-elevation, dry forests. Grand fir is also common at low to middle elevations, but typically predominates on sites receiving more than 63 cm of precipitation per year (Arno 1980, Peet 1988).

On even wetter (> 81 cm of annual rainfall) yet still relatively warm sites, luxuriant forests of western redcedar and western hemlock can be found. These highly productive forests, which can contain representatives of all other eight tree species listed above, tend to occur at moderately low elevations (< 1,500 m) within the balmy, maritime-influenced climatic zone of the northern Rocky Mountains (Arno 1979, Cooper et al. 1991). This zone generally extends from northern Idaho eastward in Montana to Glacier National Park and to the Swan, Clearwater, lower Blackfoot, and Bitterroot river valleys (Arno 1979).

On cooler sites, mixtures of western larch, lodgepole pine, subalpine fir, and Engelmann spruce are common.

Landscape Setting

This habitat makes up most of the continuous montane forests of the inland Pacific Northwest. It is located between the subalpine portions of the montane mixed conifer forest habitat and lower tree line ponderosa pine forests.

Structure

Mesic, old forest habitats are montane forests and woodlands. Stand canopy structure is generally diverse, although single-layer forest canopies are currently more common than multilayered forests with snags and large woody debris. The tree layer varies from closed forests to more open-canopy forests or woodlands. This habitat may include very open stands. The undergrowth is complex and diverse. Tall shrubs, low shrubs, forbs, or any combination of these three may dominate stands. Deciduous shrubs typify shrub layers. Prolonged canopy closure may lead to development of sparsely vegetated undergrowth.

Composition

This habitat contains a wide array of tree species (9) and stand dominance patterns. Douglas-fir (*Pseudotsuga menziesii*) is the most common tree species in this habitat; it is almost always present and dominates or codominates most overstories. Lower elevations or drier sites may have ponderosa pine (*Pinus ponderosa*) as a codominant, with Douglas-fir in the overstory and often other shade-tolerant tree species in the undergrowth. On moist sites, grand fir (*Abies grandis*), western redcedar (*Thuja plicata*), and/or western hemlock (*Tsuga heterophylla*) are dominant or codominant with Douglas-fir. Other conifers include western larch (*Larix occidentalis*) and western white pine (*Pinus monticola*) on mesic sites and Engelmann spruce (*Picea engelmannii*), lodgepole pine (*Pinus contorta*), and subalpine fir (*Abies lasiocarpa*) on colder sites. Rarely, Pacific yew (*Taxus brevifolia*) may be an abundant undergrowth tree or tall shrub. Spruce-dominated forests can be found on benches and gentle north slopes, and the cedar-hemlock forest type is most common along moist canyon bottom sites or seepages

The often-luxuriant understories of moist montane forests tend to consist of diverse mixtures of shrubs and moist-site forbs. Common woody species include ninebark, common snowberry, white spirea, oceanspray, blue huckleberry, dwarf huckleberry, grouse whortleberry, bearberry, twinflower, Sitka alder, red-osier dogwood, Utah honeysuckle, menziesia, thimbleberry, common juniper, bunchberry, bristly black currant, russet buffaloberry, Saskatoon serviceberry, and devil's club. Forbs include starry Solomon's seal, rough-coated fairybells, western meadow-rue, broadleaf arnica, heartleaf arnica, mountain arnica, red baneberry, queencup beadlily, sweet scented bedstraw, Richardson's geranium, arrowleaf groundsel, wild ginger, twistedstalk, darkwoods violet, wild sarsaparilla, and western rattlesnake plantain. Other understory associates include bluejoint reedgrass, pinegrass, Columbia brome, field horsetail, oak fern, lady fern, common beargrass, and elk sedge.

Other Classifications and Key References

This habitat is called Douglas-fir (No. 12), cedar-hemlock-pine (No. 13), and grand fir-Douglas-fir (No. 14) forests by Kuchler (1964). Scott et al. (2002) classify this habitat as needleleaf forest-mixed xeric forest. Cover types that would represent this type are the Douglas-fir-dominant mixed conifer forest and ponderosa pine-dominant mixed conifer forest. Other references detailing forest associations for this habitat include Daniels 1969, Voland 1976, Johnson and Simon 1987, Johnson and Clausnitzer 1992, Zack and Morgan 1994, and Lillybridge et al. 1995.

Natural Disturbance Regime

Fires were probably of moderate frequency (30–100 years) in presettlement times. Inland Pacific Northwest Douglas-fir and western larch forests have a mean fire interval of 52 years (Barrett et al. 1997). Typically, stand-replacement fire-return intervals are 150 to 500 years, with moderate severity fire intervals of 50 to 100 years. Specific fire influences vary with site characteristics. Generally, wetter sites burn less frequently and have older stands with more western hemlock and western redcedar than drier sites do. Many sites dominated by Douglas-fir and ponderosa pine, sites that were formerly maintained by wildfire, may now be dominated by grand fir (a fire-sensitive, shade-tolerant species).

Succession and Stand Dynamics

Successional relationships of this type reflect complex interrelationships between site potential, plant species characteristics, and disturbance regime (Zack and Morgan 1994). Generally, early seral forests of shade-intolerant trees (western larch, western white pine, ponderosa pine, Douglas-fir) or shade-tolerant trees (grand fir, western redcedar, western hemlock) develop some 50 years following disturbance. Forb- or shrub-dominated communities precede this stage. These early stage mosaics are maintained on ridges and drier topographic positions by frequent fires. Early seral forest develops into mid-seral habitat of large trees during the next 50 to 100 years. Stand replacing fires recycle this stage back to early seral stages over most of the landscape. Without high-severity fires, a late-seral condition develops either single-layer or multilayer structure during the next 100 to 200 years. These structures are typical of cool bottomlands that usually experience only low-intensity fires.

Effects of Management and Anthropogenic Impacts

This habitat has been most affected by timber harvest and fire suppression. Timber harvesting has focused on large shade-intolerant species in mid- and late-seral forests, leaving shade-tolerant species. Fire suppression enforces those logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and be composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently 70% more abundant than in historical, native systems (Quinn 1997). Late-seral forests of shade-intolerant species are now essentially absent. Early-seral forest abundance is similar to that found historically but lacks snags and other legacy features.

Status and Trends

Quigley and Arbelbide (1997) concluded that the interior Douglas-fir, grand fir, and western redcedar/western hemlock cover types are more abundant now than before 1900, whereas the western larch and western white pine types are significantly less abundant. Twenty percent of Pacific Northwest Douglas-fir, grand fir, western redcedar, western hemlock, and western white pine associations listed in the National Vegetation Classification are considered imperiled or critically imperiled. Roads, timber harvest, periodic grazing, and altered fire regimes have compromised these forests. Even though this habitat is more extensive than it was before 1900, natural processes and functions have been modified enough to alter its natural status as functional habitat for many species.

Summary

Mesic, old growth is characterized by stands of trees in mesic habitats that average greater than 53 cm diameter at breast height or that existed in the 1930s. These habitat types are characterized by either moderately cool and xeric grand fir habitats or moderately warm and moist grand fir habitats. See descriptions in the mesic, young forest section above.

Mesic old growth has been fragmented by timber harvest in the subbasins but is generally better represented across the subbasins than in presettlement times because of fire suppression. Patch size diversity has sharply declined, and canopy densities have changed in some cases. Timber harvest units have been left with little standing and down dead wood habitat components. Recently burned habitats that provide unique elements like insect infestations, standing and down dead wood components, and early seral forage are absent due to fire exclusion.

Some representative species associated with old, mesic habitats include the lynx, fisher, great gray owl, northern goshawk, pileated woodpecker, and Shira's moose.

Upland Aspen

Quaking aspen (*Populus tremuloides*; subsection Trepidae of the genus Populus) is a native deciduous tree that is small to medium sized: typically less than 15 m high and 40 cm in diameter (Hickman 1993). It has spreading branches and a pyramidal, or rounded, crown (Jones and DeByle 1985, Gleason and Cronquist 1991). The bark is thin. Leaves are orb to ovately shaped, with flattened petioles. The fruit is a tufted capsule bearing six to eight seeds. A single female catkin usually bears 70 to 100 capsules. The root system is relatively shallow, with wide-spreading lateral roots and vertical sinker roots descending from the laterals. Laterals may extend over 30 meters into open areas (Jones and DeByle 1985).

Quaking aspen forms clones connected by a common parent root system. It is typically dieocious, 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 by electrophoresis (Perala 1990). In the West, quaking aspen stands are often even-aged, originating after a single top-killing event. Some stands, resulting from sprouting of a gradually deteriorating stand, may be only broadly even-aged (Jones and DeByle 1985). Clones east of the Rocky Mountains tend to encompass a few acres at most (Perala and Carpenter 1985), and aboveground stems are short lived. Maximum age of stems in the Great Lakes States is 50 to 60 years. Clones in the West tend to occupy more area, and aboveground stems may live up to 150 years (Johnston and Hendzel 1985).

Optimum conditions for germination and seedling survival include a moist mineral seedbed with adequate drainage, moderate temperature, and freedom from competition (McDonough 1979). In various collections, seeds have germinated at temperatures from 0 to 39 °C, with germination sharply reduced from 2 to 5 °C and progressively curtailed above 25 °C (Faust 1936).

Seedlings may reach 15 to 61 cm in height by the end of their first year, and roots may extend 5 to 25 cm in depth and up to 41 cm laterally. Roots grow more rapidly than shoots; some seedlings show little top growth until about their third year. During the first several years, natural seedlings grow faster than planted seedlings but not as fast as sprouts. High mortality characterizes young quaking aspen stands regardless of origin. In both seedling and sprout stands, natural thinning is rapid. Stems that occur below a canopy die within a few years (Perala 1990).

Quaking aspen is the most widely distributed tree and a major cover type in North America. Distribution is patchy in the West, with trees confined to suitable sites. Quaking aspen occurs in a large number of other forest cover types over its extensive range. It grows on moist upland woods, dry mountainsides, high plateaus, mesas, avalanche chutes, talus, parklands, gentle slopes near valley bottoms, alluvial terraces, and along watercourses. In the Rocky Mountains, quaking aspen groves are scattered throughout Engelmann spruce-subalpine fir (*Picea engelmannii-Abies lasiocarpa*) forests. Prostrate quaking aspen occur above the timberline (Perala and Carpenter 1985). Throughout its range, quaking aspen occurs in mid to upper riparian zones (Franklin and Dyrness 1973, Perala 1990). Quaking aspen grows on soils ranging from shallow and rocky to deep loamy sands and heavy clays. Good quaking aspen sites are usually well drained, loamy, and high in organic matter and nutrients (Perala 1990). Cryer and Murray (1992) stated that stable quaking aspen stands are found on only one soil order—mollisols—and a few soil subgroups of which Agric Pachic Cryoborolls and Pachic Cryoborolls are dominant. The best stands in the Rocky Mountains and Great Basin are on soils derived from basic igneous rock such as basalt and neutral or calcareous shales and limestones. The poorest stands are on soils derived from granite.

Quaking aspen is not shade tolerant (Perala 1990), nor does it tolerate long-term flooding or 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 is seral to conifers in most of its range in the West and some portions of its eastern range. Still, quaking aspen is apparently stable on some sites. These stands can remain stable for decades but eventually deteriorate. Deteriorating stands are often succeeded by conifers, but shrubs, grasses, and/or forbs gain dominance on some sites. Succession to grasses and forbs is more likely on dry sites and is more common in the West than in the East.

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. Quaking aspen crowns can grow out of reach of large ungulates in six to eight years (Patton and Jones 1977). Although many animals browse quaking aspen year-round, it is especially valuable during fall and winter when its protein levels are high relative to that of other browse species (Tew 1970).

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Quaking aspen is palatable to all browsing livestock and wildlife species (DeByle 1985). The buds, flowers, and seeds are palatable to many bird species including numerous songbirds and grouse. Elk browse quaking aspen year-round, feeding on bark, branch apices, and sprouts. Quaking aspen is important forage for mule and white-tailed deer. Deer consume the leaves, buds, twigs, bark, and sprouts. New growth on burns or clearcuts is especially palatable to deer. Quaking aspen is valuable moose browse for much of the year (Brinkman and Roe 1975); moose utilize it on summer and winter ranges. Young stands generally provide the best quality moose browse. However, researchers in Idaho found that, in winter, moose browsed mature stands of quaking aspen more heavily than nearby clearcuts dominated by quaking aspen sprouts (Ritchie 1978). The Aspen tree was selected by the Middle Snake subbasins technical team as a representative of this habitat type.

Riparian/Wetlands/Springs

Adjacent to many streams, rivers, and wetlands, riparian habitats are water-dependent systems that are strongly associated with stream dynamics and hydrology (IBIS 2003). The arid environment of the Middle Snake subbasins supports relatively few interior riparian and wetland habitats (Figure 29): far less than 1% (5,125 acres) of the land area in the subbasins (IBIS 2003).

Most of riparian areas are scattered in small, wet depressions, springs, and canyons that receive enough water to support hydrophilic vegetation.

Riparian areas are the transitional zone between terrestrial and aquatic ecosystems and often associated with beneficial characteristics of stream function (USFSa 2003). They may reduce stream temperatures by providing shade, reduce sediments through channel stabilization and filtration, increase channel habitat diversity, and improve floodwater retention and groundwater recharge (USFS 2000).

Riparian habitats consistently support greater diversity and abundance of wildlife species than other habitat types (USFSa 2003: 3–420). These areas are often important breeding habitats, seasonal ranges, or migration corridors for a variety of fish and wildlife species. There are 89 bird species, 12 amphibians, 22 mammals, and 1 reptile closely associated with riparian and/or wetland habitats in the Middle Snake subbasins (IBIS 2003).

Many of the physical processes associated with riparian areas depend on the frequency of flood events as a disturbance regime (USFSa 2003). Flooding frequency and intensity may vary greatly with hydro-geomorphic setting and stream type; however, flood cycles generally occur within 20 to 30 years in riparian shrublands. Floods rejuvenate riparian areas by creating new surfaces for primary succession, eroding existing streambank communities, depositing sediment and nutrients over potentially depleted soils, and selectively killing species not adapted to the flood event (IBIS 2003). Beaver activities in riparian habitats are an additional source of disturbance as they select younger cottonwood and willow trees to construct dams that often result in backwater pools (IBIS 2003).

Two wetland and riparian habitat characterizations have been conducted for the subbasin: in 1997, wetland habitats in the Big Wood River, Little Wood River, and Camas Creek drainages (Big Wood drainage) (Jankovsky-Jones 1997) and in 2001, wetland habitats along the mainstem Snake River from Milner Dam to the confluence with the Payette River (Jankovsky-Jones 2001). The 2001 effort included the lower reaches of the Boise and Payette rivers. Both efforts used the USFWS National Wetlands Inventory (NWI) to gain a broad perspective on the extent and types of wetlands in the survey area. Wetlands (including deepwater) habitats were found to account for 4% of the area in the Big Wood Drainage study area and 2.6% of the mainstem Snake River study area (Jankovsky-Jones 1997, 2001).

NWI uses the classes developed by Cowardin et al. (1979) to characterize wetland systems. Three types of wetland systems occur within the subbasin: lacustrine, palustrine, and riverine. Lacustrine systems are lakes and ponds that are greater than 2 meters deep. The palustrine system contains all wetlands dominated by trees, shrubs, persistent emergents, and emergent mosses and lichens. Riverine refers to wetland and deepwater habitats contained within a channel. In the Big Wood drainage, palustrine wetlands were found to be the most common of the three types, while along the mainstem Snake River, the three wetland systems covered nearly equal acreages (

Figure 35). Each of the three major wetland systems that occur in the subbasins can be broken into smaller subsystems based on water regime, vegetative composition, or soil properties (Table 36). Approximately 26% of the wetland and deepwater habitat in the Jankovsky-Jones study areas (1997, 2001) is within areas that have special management, such as Wildlife Management Areas or refuges. Protected areas are not evenly distributed across the different wetland systems. In the Big Wood River drainage area, palustrine systems are generally the best protected, while in the mainstem Snake River, a greater percentage of the lacustrine systems are protected (Table 36).

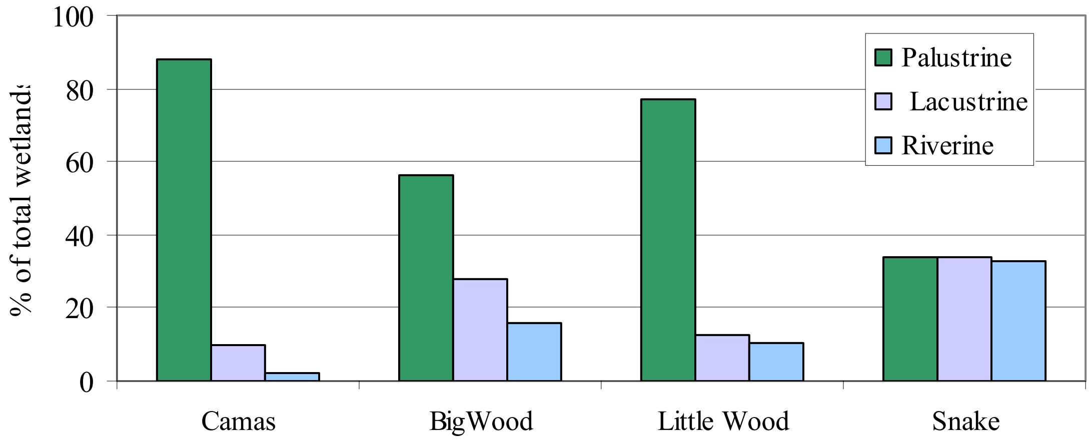

Figure 35. Differences in wetland system type prevalence across the Middle Snake subbasins.

After compiling the NWI data, Jankovsky-Jones surveyed a subset of the subbasins wetlands to characterize vegetative composition, condition, and management needs. The survey sites were selected based on information contained in the Idaho Wetland Information System and the Idaho Conservation Data Center (IDCDC), as well as areas identified by federal, state, and private land management agencies as being of local importance. During the survey selection process, preference was given to wetlands thought to support relatively natural stands of vegetation and/or high concentrations of fish, wildlife, and plant species of concern. The vegetative communities commonly found in the subbasins wetlands and riparian areas are described below.

Table 36. System, subsystem, and protection status of wetlands in portions[a] of the Middle Snake subbasins (reproduced from Jankovsky-Jones [1997, 2001])

System		Camas Creek			Big Wood River			Little Wood River			Snake River Mainstem		
		Acres Protected	Total Acres	% of Type Protected	Acres Protected	Total Acres	% of Type Protected	Acres Protected	Total Acres	% of Type Protected	Acres Protected	Total Acres	% of Type Protected
Palustrine													
	Herbaceous (emergent)	1,941	11,010	17.0	0.0	3,713	0.0	1,452	3,628	40	1,537	8,738	18
	Scrub-Shrub	9	2,311	0.3	8.0	1,809	0.4	291	756	38	1,218	3,711	33
	Forested	0.3	36	0.8	4.0	473	0.8	33	158	20	896	3,160	28
	Aquatic Bed	0.0	23	0.0	0.0	60	0.0	30	79	38	44	593	7
	Unconsolidated Bottom	9.0	125	7.2	0.0	147	0.0	18	57	32	238	2,276	10
	Unconsolidated Shore	0.4	59	6.7	0.0	14	0.0	7	83	8	14	651	2
	Total palustrine	**1,960**	**13,564**	**14.0**	**12.0**	**6,216**	**0.2**	**1,831**	**4,761**	**38**	**3,947**	**19,129**	**20**
Lacustrine													
	Limnetic	0.0	1,471	0.0	0.0	2,665	0.0	146	569	26	12,634	17,675	71
	Littoral	0.0	43	0.0	0.0	383	0.0	0.0	222	0	1,046	1,447	72
	Total lacustrine	**0.0**	**1,541**	**0.0**	**0.0**	**3,048**	**0.0**	**146**	**791**	**18**	**13,680**	**19,122**	**71**
Riverine													
	Lower Perennial	0.0	71	0.0	0.0	0	0.0	69	132	59	38	62	61
	Upper Perennial	0.0	195	0.0	9.0	1,321	0.7	115	466	25	1,723	17,176	10
	Intermittent	0.0	42	0.0	0.0	123	0.0	0.0	29	0.0	2	1,316	0.1
	Total riverine	**0.0**	**308**	**0.0**	**9.0**	**1,752**	**0.5**	**184**	**627**	**29**	**1,763**	**18,554**	**10**
Total all types		**1,959.0**	**15,413**	**12.7**	**21**	**11,016**	**<0.1**	**2,161**	**6,179**	**35**	**19,390**	**56,805**	**34**

[a] Wetlands along the lower reaches of the Boise and Payette rivers not in the subbasins are included, does not include wetlands associated with the mainstem Snake River below the Payette River and Sand Creek drainages

Forested Wetlands

On the Snake River, native forested wetlands are uncommon with occasional stands of hackberry (*Celtis reticulate*), as well as stands of tree-size water birch (*Betula occidentalis*). More commonly found are stands of the nonnative Russian olive (*Elaeagnus angustifolia*) tree (Jankovsky-Jones 2001).

Mid-elevation riparian areas of the Big Wood watershed contain deciduous forests dominated by black cottonwood (*Populus trichocarpa*), with lesser amounts of Rydberg's cottonwood (*P. acuminate*) and occasional quaking aspen (*P. tremuloides*). Quaking aspen also occurs in association with springs in valley bottoms and at upper elevations on tributaries to the major rivers. At upper elevations, forested riparian communities are dominated by *Picea* (Engelmann spruce [*Picea engelmannii*]), subalpine fir (*Abies lasiocarpa*), or lodgepole pine (*Pinus contorta*) (Jankovsky-Jones 1997).

Scrub-Shrub Wetlands

Shrublands dominated by willows and other shrubs occur as stringers along perennial water courses, in association with springs, and on subirrigated floodplains. Along the Snake River, stands of coyote willow (*Salix exigua*) are the most common shrubland type, followed by stands supporting smooth sumac (*Rhus trilobata*) and yellow willow (*Salix lutea*). Smooth sumac and water birch stands are found in association with the spring systems of the middle Snake River. Salt desert shrublands dominated by greasewood (*Sarcobatus vermiculatus*) occur occasionally in alkaline areas with shallow groundwater (Jankovsky-Jones 2001).

In the Big Wood watershed, low-elevation, high-gradient channels contain coyote willow, yellow willow, and whiplash willow (*S. lasiandra* ssp. *caudate*). In lesser-gradient, broad valley bottoms, shrubby cinquefoil (*Potentilla fruticosa*) and sagebrush (*Artemisia* spp.) occur in association with springs, seeps, and vernal wetlands. Water birch occurs along the low-gradient rivers. At mid to upper elevations, willows occasionally occur along low-gradient, meandering channels. Geyer's willow (*Salix geyeriana*) and Booth's willow (*S. boothii*), and less frequently Drummond's willow (*S. drummondiana*), occur in these areas. Wolf's willow (*S. wolfii*), planeleaf willow (*S. planifolia* var. *monica*), and bog birch (*Betula glandulosa*) occur at upper elevations in association with streams, springs, or seeps. Mountain alder (*Alnus incana*) is common on high-gradient streams in upper-elevation areas (Jankovsky-Jones 1997).

Herbaceous Wetlands

Herbaceous wetlands along the mainstem Snake River are best developed in subirrigated, broad valley bottoms, including Billingsley Creek, C.J. Strike Reservoir area, Fort Boise Wildlife Management Area, and Montour Wildlife/Recreation Management Area. The valley bottoms are often a mosaic of stands of common cattail (*Typha latifolia*) and bulrushes (*Scirpus* spp.) in permanently flooded areas grading into stands of woolly sedge (*C. lanuginose*), Nebraska sedge (*C. nebrascensis*), creeping spikerush (*E. palustris*), and/or wandering spikerush (*E. rostellata*). Western wheatgrass (*Agropyron smithii*), clustered-field sedge (*Carex praegricili*), bearded wildrye (*Elymus triticoides*), Baltic rush (*J. balticus*), common rush (*J. effuses)*, and common reed (*Phragmites australis*) are present in temporarily flooded areas. Alkaline habitats are often present with stands of American bulrush (*Scirpus americanus*) and interior saltgrass (*Distichlis stricta*) (Jankovsky-Jones 2001).

The spring systems associated with the Thousand Springs Ecosystem in the area surrounding Hagerman support a rich mixture of herbaceous species on poorly developed soils overlying basalt talus. On steep, vertical slopes or areas with continual surface water flow, vegetation is sparse. Where gradient lessens and thin soils have developed, the following species are often present: giant helleborine (*Epipactis gigantean*), western goldentop (*Euthamia occidentalis*), seep monkeyflower (*Mimulus guttatus*), watercress (*Rorippa nasturtium-aquaticum*), water speedwell (*Veronica anagallis-aquatica*), and tall fescue (*Festuca arundinacea*) (Jankovsky-Jones 2001).

Herbaceous wetlands in the Big Wood watershed are usually dominated by the sedges and sedge-like species, including beaked sedge (*Carex utriculata*), water sedge (*C. aquatilis*), Nebraska sedge, clustered field sedge, soft-leaved sedge (*C. simulate*), softstem bulrush (*Scirpus validus*), and common spikerush (*Eleocharis palustris*). Sedges were selected as focal species for this assessment see section 3.5.2 for details on these species biology and ecology). Broadleaf cattail (*Typha latifolia*) and Rocky Mountain pond lily (*Nuphar polysepalum*) are frequently present in ponds with appropriate water regimes. Tall grasslands in the basin are dominated by bluejoint reedgrass (*Calamagrostis canadensis*) and reed canarygrass (*Phalaris arundinacea*). Temporarily flooded grasslands, dominated by tufted hairgrass (*Deschampsia cespitosa*), bluestem wheatgrass (*Agropyron smithii*), alkali bluegrass (*Poa juncifolia*), or alkali cordgrass (*Spartina gracilis*), were likely more common historically and have been impacted by grazing or seeding with pasture grasses (Jankovsky-Jones 1997).

Characterization of Important Wetland Areas in the Subbasins

Jankovsky-Jones used information collected during the wetland surveys and information on rare species distributions from the IDCDC to allocate surveyed wetlands into management categories. The categories differentiate wetlands based on four factors: richness (habitat diversity within the site), rarity (presence of state rare plant associations, plants, or animals), condition (extent to which site has been altered from natural conditions), and viability (likelihood of continued existence of biota within the site). Sites were given a score of 0 (lowest) to 3 (highest) for each of the factors, and the scores were summarized and arranged from highest to lowest. The sites were then divided into four management categories described below (their descriptions are taken directly from Jankovsky-Jones 2001). These management categories are being consistently applied in wetland surveys across the state to help guide and prioritize wetland management. In addition to the middle Snake and Big Wood rivers, conservation strategies for wetlands have been developed in the Henrys Fork basin; the Spokane, Kootenai, and upper Snake river drainages; and select portions of northern, southeastern, and east-central Idaho (IDCDC 2003).

- **Class I** sites represent examples of plant associations in near pristine condition and often provide habitat for high concentrations of state rare plant or animal species. The high-quality condition of the plant association is an indicator of intact site features such as hydrology and water quality. Conservation efforts should focus on full protection, including maintenance of hydrologic regimes. Class I federal lands should be designated as Research Natural Area (RNA), Special Interest Area (SIA), Area of Critical Environmental Concern (ACEC), or

Wildlife Refuge. Private lands should be acquired by a conservation organization or secured by the establishment of conservation easements to protect biological features.

- **Class II** wetlands are differentiated from Class I sites based on condition or biological significance. Class II sites may provide habitat for state rare plant or animal species. However, human influences are apparent (i.e., portions of wetland are in excellent condition, but drier, accessible sites are impacted). The occurrence of good to excellent assemblages of common plant associations or rare plant associations qualifies a site as Class II. Wetlands with unique biological, geological, or other features may be included here. Impacts and modification to Class II sites should be avoided. Where impacts such as grazing are present, they should be managed intensively or removed. Class II federal lands should be designated as Research Natural Area, Area of Critical Environmental Concern, or Special Interest Area. Private lands should be acquired by conservation organizations or have voluntary or legal protection. Frequently, wetland meadows with hydrologic alterations are adjacent to both Class I and Class II sites where significant gains in wetland functions could be made if hydrology was restored.

- **Reference sites** represent high-quality assemblages of common plant associations in the survey area or areas where changes in management practices can be documented. The use of a reference area as a model for restoration or enhancement projects is the best way to replicate wetland functions and the distribution and composition of native plant associations. Reference areas may also serve as donor sites for plant material. Application of Best Management Practices by the current landowner or manager, or fee title acquisition to ensure the continued existence of wetland functions, should be the priority for reference sites.

- **Habitat sites** have moderate to outstanding wildlife values, such as food chain support or maintenance of water quality, and may have high potential for designation as or expansion of existing wildlife refuges or managed areas. Human influences are often present, and management may be necessary to maintain wetland functions. Livestock and human access management may be the only actions necessary. Public and federal lands should be managed to maintain and improve wildlife values. Voluntary protection and incentives for private landowners to apply best management practices (BMPs) may be used on private lands.

Jankovsky-Jones assigned Class I status to only one of the wetlands in her two study areas. She assigned Class II to seven areas, reference site to 17, and habitat site to 13 (Figure 36). Characteristics, protection status, and management needs of the Class 1 and Class 2 wetlands that occur in the Middle Snake subbasins are discussed below. A list of rated wetlands, along with class, protection status, ownership, and management needs, can be found in Appendix F. For more detailed information on community composition, see Jankovsky-Jones 1997 and 2001.

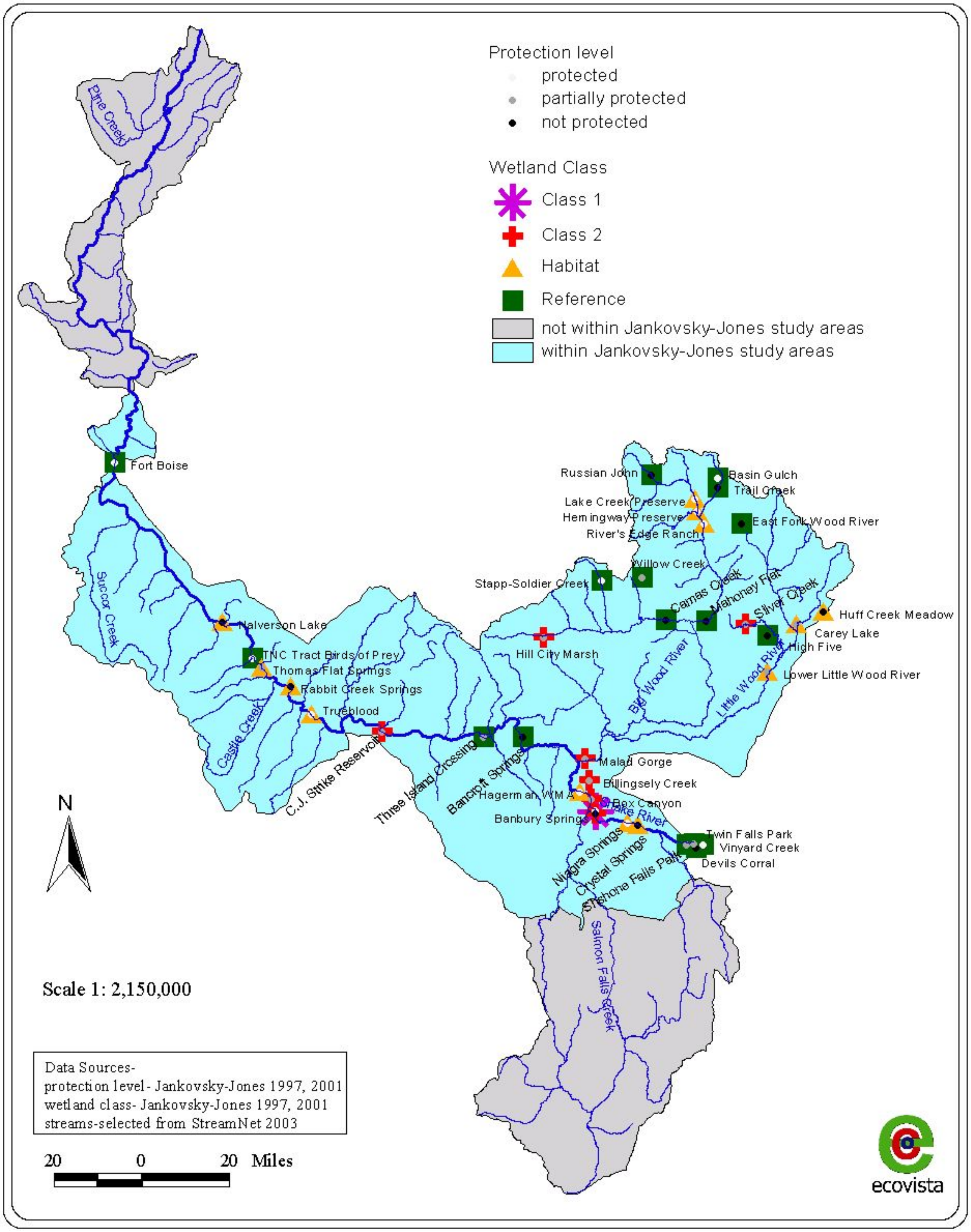

Figure 36. Important wetland areas of the Middle Snake subbasins identified by Jankovsky-Jones [1997, 2001]).

Class 1

Box Canyon

Box Canyon, on the northeast shore of the Snake River between Hagerman and Buhl, is the only Class 1 wetland area identified in the subbasins. Box Canyon is possibly the best remaining example of Thousand Springs formation habitats and reported to be the eleventh largest spring in the United States. The canyon has basalt cliffs and talus slopes that range from 60 to 200 feet above the canyon bottom. Springs emerge from the canyon side walls, as well as from springs along the amphitheater-shaped head wall. Access to the canyon is limited by steep walls, contributing to the very high quality of the wetland area. The channel ranges in width from 70 to 30 feet where talus slopes have confined the channel. The head of the canyon contains two headwater pools; downstream of these headwater pools is a 12-foot waterfall. A diversion and flume about 3/8 of a mile upstream of the confluence with the Snake River is the only area that is not in natural condition. Box Canyon has been evaluated for eligibility as a National Park and nominated as a candidate National Natural Landmark. Portions of the canyon currently managed by the BLM are designated an ACEC. Private lands in the area were recently acquired and are managed by the Idaho Department of Parks and Recreation (Jankovsky-Jones 2001).

Box Canyon supports a rich aquatic ecosystem, and many species of concern watercress (*Rorippa nasturtium-aquatica*) and water hemlock (*Cicuta douglasii*) are present at spring heads, on small vegetated islands, and on shallow stream margins. The springs contain populations of Shoshone sculpin (*Cottus greenei*), Bliss Rapids snail (*Taylorconcha serpenticola*), Utah valvata (*Valvata utahensis*), and Banbury Springs limpet (*Lanx* sp. 1). Cliff faces and the lack of disturbance make Box Canyon attractive for raptor and other bird use. Golden eagles (*Aquila chrysaetos*), red-tailed hawks (*Buteo jamaicensis*), northern harriers (*Circus cyaneus*), American kestrels (*Falco sparverius*), and prairie falcons (*Falco mexicanus*) are reported from the canyon (Jankovsky-Jones 2001).

Class 2

Banbury Springs

Banbury Springs are located about 10 miles south-southwest of Wendell, Idaho, on the east side of the Snake River. Banbury Springs supports a high-quality shrubland with extensive stands of water birch that have a rich, mesic forb understory. Banbury Springs provides habitat for five animal species of concern (California floater, Bliss Rapids snail, Utah valvata, Banbury Springs limpet, and Shoshone sculpin) and one plant species of concern (giant helleborine) (Jankovsky-Jones 2001).

Banbury Springs are currently unprotected. The area has been proposed as a mitigation site by Idaho Power Company (IPC), and mitigation actions may include removing an impoundment to restore habitat for the Banbury Springs limpet (Jankovsky-Jones 2001).

Billingsley Creek

Billingsley Creek is a highly sinuous, spring-fed stream located in southern Gooding County, approximately 1.5 miles northwest of Hagerman. The low-gradient stream supports just over 80 acres of herbaceous marsh habitat, which are somewhat uncommon on middle reaches of the Snake River. The marsh area is dominated by common cattail and hardstem bulrush (*Scirpus* *acutus*), with lesser amounts of common reed. Billingsley Creek remains ice-free during winter, making it attractive to waterfowl during cold spells. Five springs flow from the basalt rim rock into Billingsley Creek. Spring seeps are vegetated with skunkbush sumac (*Rhus trilobata*) and greasewood (Jankovsky-Jones 2001).

Billingsley Creek is partially protected as a Wildlife Management Area. Portions of the headwater springs remain unprotected, though one tract was recently acquired by the Idaho Department of Parks and Recreation. Protection of springs on adjacent private land should also be pursued (Jankovsky-Jones 2001).

Numerous exotic species are well established, including cheatgrass, (*Bromus tectorum*), medusahead (*Elymus caput-medusae*), clasping pepperweed (*Lepidium perfoliatum*), and the woody species Rusian olive, American elm (*Ulmus Americana*), and black locust (*Robinia pseudo-acacia*). Purple loosestrife (*Lythrum salicaria*) was not observed, but the species is present nearby (Jankovsky-Jones 2001).

Malad Gorge

Malad Gorge is located at the confluence of the Malad River (Big Wood River) and the Snake River. Springs emerge along the south side of the deep canyon bottom. The west canyon supports a small pond (Cove Lake) that runs for approximately 0.5 mile before entering the Big Wood River. The pond has a well-developed aquatic bed that supports the rare plants matted cowpie buckwheat (*Erigonum shockleyi* var. *shockleyi*) and giant helleborine. Poor water quality in the main channel due to irrigation flow returns is a concern (Jankovsky-Jones 2001).

Malad Gorge is partially protected as a State Park. But two impoundments below the confluence of the Big Wood River and Cove Creek are managed by IPC for diversion to the Malad Power Plant (Jankovsky-Jones 2001).

Thousand Springs

Thousand Springs border the Snake River in the Hagerman Valley. The area contains two of the last remaining undeveloped canyon wall springs of the Snake River Plains aquifer. The springs emerge from basalt flows that cascade over steep talus and boulderfields to deep channels that flow into the Snake River. Thousand Springs stream channels provide habitat for the largest known population of Shoshone sculpin. The base of the spring system provides habitat for the Utah valvata and Banbury Springs limpet. Giant helleborine is known to occur on canyon walls (Jankovsky-Jones 2001).

Box elder, locust, and Russian olive can all become established along riparian corridors. Tamarisk was reported on the Ritter Ranch in the 1980s and observed near the house at Sand Springs Creek in 1999. This weed should be eliminated. Bull thistle (*Cirsium vulgare*), teasel (*Dipsacus fullonum*), and mullein (*Verbascum* spp.) are distributed along slopes and disturbed waterways. Bull thistle appears to be abundant on portions of the canyon wall seeps (Jankovsky-Jones 2001).

The Thousand Springs site is partially protected by TNC. Portions of Sand Springs Creek are unprotected. A 30-acre wetland above the canyon rim was constructed by the North Side Canal Company to filter sediments and absorb nutrients from irrigation water, which previously entered spring creeks directly. The series of ponds and marshes have allowed TNC staff to experiment with the best ways to remove sediments and nutrients (Jankovsky-Jones 2001).

C.J. Strike Reservoir

Several species of special concern occur on the C.J. Strike site, including Clark's grebes (*Aechmophorus clarkia*), western burrowing owls (*Athene cunicularia*), ferruginous hawks (*Buteo regalis*), great egrets (*Ardea alba*), snowy egrets (*Egretta thula*), cattle egrets (*Bubulcus ibis*), bald eagles (*Haliaeetus leucocephalus*), long-billed curlews (*Numenius americanus*), black-crowned night-herons (*Nycticorax nycticorax*), merlins (*Falco columbarius*), loggerhead shrikes (*Lanius ludovicianus)*, American white pelicans (*Pelecanus erythrorhynchos*), and double-crested cormorants (*Phalacrocorax auritus*). Other animal species of special concern are the spotted bat (*Euderma maculatum*), small-footed myotis (*Myotis ciliolabrum*), long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*), fringed myotis (*Myotis thysanodes*), Yuma myotis (*Myotis yumanensis*), Townsend's big-eared bat (*Corynorhinus townsendii*), river otter (*Lutra canadensis*), western ground snake (*Sonora semiannulata*), longnose snake (*Rhinocheilus lecontei*), white sturgeon, Idaho springsnail, and Idaho dunes tiger beetle (*Cicindela arenicola*). Snake River milkvetch (*Astragalus purshii* var. *ophiogenes*), a plant species of special concern, occurs in the area. Two hundred forty species of birds are known to use the C.J. Strike Reservoir site annually. Ninety-eight species breed in the area, and 105 species commonly winter in the area. There is always a small population of merlins, goshawks (*Accipiter gentilis*), and ferruginous hawks (*Buteo regalis*) during the winter (Jankovsky-Jones 2001).

Most of the wetlands at C.J. Strike are managed by the IDFG. Private parcels that support functional wetlands that are near IDFG-managed lands should be of a high priority for cooperative agreements, acquisition, and easements (Jankovsky-Jones 2001).

Hill City Marsh

Hill City Marsh is a nearly flat prairie basin in a high desert valley at the base of the Bennett Hills in the Camas Creek drainage. Wet meadows are dominated by Nebraska sedge, clustered-field sedge, and Baltic rush. Downstream, water flows over the entire prairie to create a shallow-water marsh. The marsh is dominated by Baltic rush and creeping spike rush, with lesser amounts of Nebraska sedge. Areas of slightly raised topography that drawdown early in the growing season have grasslands dominated by interior saltgrass and bearded wildrye and shrublands dominated by silver sagebrush. The marsh area is documented to support the rare plant fringed waterplantain (*Machaerocarpus californicus*), bugleg haplopappus (*Haplopappus insecticruris*), and Heller fivefinger chickensage (*Sphaeromeria potentilloides*), as well as abundant waterfowl, shorebird, and raptor populations (Jankovsky-Jones 1997).

Hill City Marsh is partially within an established IDFG Wildlife Management Area. Land use practices on the unprotected upstream areas may be decreasing site viability. The introduction of beaver would help improve channel conditions and habitat values. No exotic species of particular concern are known to exist on or around the site (Jankovsky-Jones 1997).

Silver Creek

Silver Creek lies in a broad agricultural valley at the base of the Picabo Hills of the Little Wood River drainage. The site encompasses the headwaters of Silver Creek, a renowned fly fishing stream containing very high densities of rainbow trout and brown trout. Silver Creek is one of the best remaining examples of a high desert, cold spring ecosystem in the western United States. Herbaceous wetlands containing bulrush, cattail, and sedges alternate along stream channels with willows and birch. Shrubby cinquefoil shrublands and sedge-dominated grasslands (dominated by small beaked sedge, clustered field sedge, and Cusick's sedge) are present in spring-fed meadows that have not been converted to agricultural use (barley and alfalfa). Aspen stands are present as swamps on what may formerly have been spring heads. Thickets of wild rose are occasionally occur on drier ground on the valley floor. A large wetland complex is present near the confluence of Stalker and Patton creeks. The complex includes open water, herbaceous wetlands dominated by bulrush and cattails, and seeps dominated by beaked spike rush, alkali cordgrass, and shrubby cinquefoil, with significant amounts of alkali bluegrass (Jankovsky-Jones 1997).

Silver Creek provides habitat for two state animal species of concern—Wood River sculpin and bald eagle—and two plant species of concern—Buxbaum's sedge (*Carex buxbaumii*) and yellow ladyslipper (*Cypripedium parviflorum* var. *pubescens*). The Silver Creek population is one of only two known populations of yellow ladyslipper in Idaho (Jankovsky-Jones 1997).

TNC purchased the 479-acre core of the Silver Creek area from the Sun Valley Company in 1975 and manages it as a preserve. Since 1975, TNC has added 403 acres to the preserve. In addition, the organization has partnered with neighboring landowners to protect another 9,500 acres of the Silver Creek Valley through conservation easements (TNC 2004). Private lands that are not in conservation easements should be high priority for acquisition or easement (Jankovsky-Jones 1997).

3.5.2 Focal Species Associated with Focal Habitats

As discussed in section 3.5.1 at least one focal species was selected as a representative of each of the seven focal habitats. In most cases the focal species selected has a close relationship with the habitat type it has been chosen to represent, but in some cases (e.g. mule deer, pronghorn) the species is more of a habitat generalist but utilizes the habitat type extensively. The descriptions of the biology, habitat use, and population trends of these focal species that follows are intend to be illustrative of how the focal habitat type is important to the wildlife and plant species of the subbasins and how degradation of the habitat type can have repercussions for dependent wildlife and plant populations. Considerations of the primary threats to the focal habitats and focal species identified in this section and section 3.5.1 help the technical team identify the primary limiting factors to terrestrial populations in the Middle Snake subbasins. These factors are discussed in section 3.5.3; strategies for improving these factors are located in the Middle Snake Subbasins Management Plan.

Shrub-Steppe

Sage Grouse

Sage grouse (*Centrocercus urophasianus*) were originally distributed across 16 western states in the United States and three provinces in southwestern Canada (Storch 2000). Sage grouse have been extirpated in five states (Arizona, New Mexico, Oklahoma, Kansas, and Nebraska) and British Columbia and are "at risk" in six states (Washington, California, Utah, Colorado, North Dakota, and South Dakota) and in the Canadian provinces of Alberta and Saskatchewan (BLM et al. 2000). Sage grouse populations are sympatric with sagebrush (*Artemisia* spp.) habitats (Connelly et al. 2000). In Idaho, sage grouse are present in the southern half of the state. Sage grouse were an important game species for Native Americans and European settlers and continue to be valued for hunting and food. Because of the stunning display by sage grouse on their strutting grounds, they have become popular with naturalists and bird watchers (Storch 2000).

Sage grouse populations can be migratory or nonmigratory depending on location and associated land form but use and select for different habita features throughout the year. All sage grouse have high fidelity to seasonal ranges, and females reproduce at the site of their birth (Connelly et al. 2000). Most sage grouse nests are located under sagebrush plants (Schroeder et al. 1999). Sage grouse that nest under sagebrush have been shown to experience higher nest success (Connelly et al. 1991). Studies on sage grouse nesting habitat have documented that sage grouse tend to select nest sites under sagebrush plants that have large canopies. The canopies provide overhead cover and often correlate with an herbaceous understory usually composed of grasses which provide further cover from predators (Wakkinen 1990 cited in BLM et al 2000). Early brood-rearing generally occurs relatively close to nest sites and also are dominated by sagebrush but grass and forbs become a more important component. Chick diets include forbs and invertebrates; areas that support a wide diversity of plant species tend to provide an equivalent diversity of insects and are the best brood-rearing habitats (BLM et al 2000). In fall, sage grouse diets shift primarily to sagebrush leaves and buds (Connelly et al. 2000). Characteristics of sagebrush rangeland needed for productive sage grouse populations were outlined by Connelly et al. (2000) (Table 37). The canopy coverage of sagebrush in the five Sawtooth National Forest Management Areas of the Middle Snake subbasins that are known to have supported sage grouse populations in the recent past are displayed in Table 38.

Table 37. Vegetation characteristics required for productive sage grouse populations.

	Breeding		**Brood rearing**		**Winter**	
	Height (cm)	Canopy (%)	Height (cm)	Canopy (%)	Height (cm)	Canopy (%)
Mesic sites[a]						
Sagebrush	40-80	15-25	40-80	10-25	25-35	10-30
Grass-forb	>18[c]	≥25[d]	variable	>15	N/A	N/A
Arid sites[a]						
Sagebrush	30-80	15-25	40-80	10-25	25-35	10-30
Grass-forb	>18[c]	≥15	variable	>15	N/A	N/A
Area[b]	>80		>40		>80	

[a] Mesic and arid sites should be defined on a local basis; annual precipitation, herbaceous understory, and soils should be considered

[b] Percentage of seasonal habitat needed with indicated conditions

[c] Measured as "droop height"; the highest naturally growing portion of the plant

[d] Coverage should exceed 15% for perennial grasses and 10% for forbs; values should be substantially greater if most sagebrush has a growth form that provides little lateral cover
[e] Values for height and canopy coverage are for shrubs exposed above snow

.

The majority of documented sage grouse nesting sites occur in sagebrush with canopy coverage of 15 to 25% (USFS 2003a). Losses or changes to sage grouse breeding habitat or a reduction in canopy coverage that impacts 40% or more of a large-scale area are detrimental to sage grouse. The Shoshone Creek and Rock Creek management areas have the greatest percent of these undesirable low canopy cover areas of the Sawtooth National Forest lands of the Middle Snake subbasins but these areas also provide the greatest area of overall sage grouse habitat. None of the management areas of the Sawtooth National Forest that occur within the subbasin exceed the 40% in low canopy cover guideline which is when habitat conditions become detrimental to sage grouse. Data on canopy cover was not available for the remainder of the shrub-steppe habitats in the subbasin but in general areas identified as key sage grouse habitats on Figure 32, shrub-steppe areas shown to be dominated by aanual or perennial grass lands would be expected to provide less canopy cover and less suitable habitat.

Table 38. Sage grouse (SAGR) habitat and acres of low (< 10%), moderate (11–20%), and high (> 21%) canopy cover within management areas of the Sawtooth National Forest (USFS 2003a).

Management Areas	SAGR Habitat (total acres)	Low Canopy Cover		Moderate Canopy Cover		High Canopy Cover	
		acres	% of total	acres	% of total	acres	% of total
Big Wood River	1,328	308	23	938	71	81	6
Little Wood River	2,073	490	24	1,500	72	84	4
Soldier Creek/ Willow Creek	2,296	169	7	1,211	53	916	40
Rock Creek	40,343	5,795	14	20,060	50	14,488	36
Shoshone Creek	22,425	7,193	32	9,373	42	5,589	26

Sage grouse numbers have been declining throughout the 20th century. Between 1985 and 1994, populations declined by an average of 33%. Annual harvests during the late 1970s were reported at approximately 280,000 birds, and by 1998, the rangewide breeding population was estimated at 140,000 birds (Storch 2000). In Idaho, BBS data show populations declining at 28.3% per year ($P = 0.01$, $n = 4$ routes) from 1980 through 2002 (Sauer et al. 2003). Lek counts on the BLMs Jarbidge Resource Area indicate a decline in the number of males per lek since 1980 (JSGWG 2002). By 1997, less than one-third of the recorded lek locations ($n = 120$) were still active, and harvest records from a check station near Salmon Falls Creek Dam showed a decline in harvest by more than 80% since the 1950s (Klott 1997). Long-term harvest data on the Jarbidge Resource Area provided an average productivity estimate of 1.96 chicks per hen from 1961 through 2000 (JSGWG 2002), which is below the 2.25 chicks per hen considered necessary to maintain a stable or increasing population (Connelly et al. 2000). Sage grouse populations are also declining in the Soldier/Willow Creek, Rock Creek, and Shoshone Creek Management

Areas of the Sawtooth National Forest (USFS 2000) and sage grouse have been designated as a management indicator species for the forest (USFS 2003a). Areas inhabited by relatively strong populations of sage grouse with good habitat connectivity are identified as strongholds and displayed on Figure 37; smaller populations of sage grouse with poorer habitat connectivity are considered isolated.

Currently, sage grouse are managed as a game species and not afforded federal protection under the ESA, but seven petitions have been submitted to the USFWS requesting listing of both distinct populations and the entire species collectively (NDOW 2003). The USFWS recently completed it evaluation of three petitions to list the greater sage grouse range wide as either threatened or endangered. They determined that the petitions and other available information provide substantial biological information indicating that further review of the status of the species is warranted. The USFWS is now in the process of conducting a full status review of the species, and once the review is complete, they will determine whether to propose listing the species as either threatened or endangered (USFWS 2004b).

Great Basin populations of sage grouse are included in *Birds of Conservation Concern 2002* (USFWS 2002a) as a species that should receive priority for conservation actions. The Idaho BLM classifies sage grouse as a Type 2 sensitive species (BLM 2003). Principle threats to sage grouse include small population size, lack of genetic diversity, habitat degradation (due to invasive plants or fire), habitat loss, weather, pesticides, and herbicides (Connelly et al. 2000, Storch 2000).

Livestock grazing increases successional rates, which increases the dominance of the shrub community and subsequently reduces the herbaceous understory (when crown cover of shrubs exceeds 15%). It is highly likely that livestock grazing is occurring in all areas identified as sage grouse habitat in the Sawtooth National Forest (USFS 2003b). Livestock do not graze the same areas at the same times of the year, and some pastures are not grazed for many years. As a result, livestock grazing has varied effects on nesting and brood rearing habitat for sage grouse (USFS 2003b).

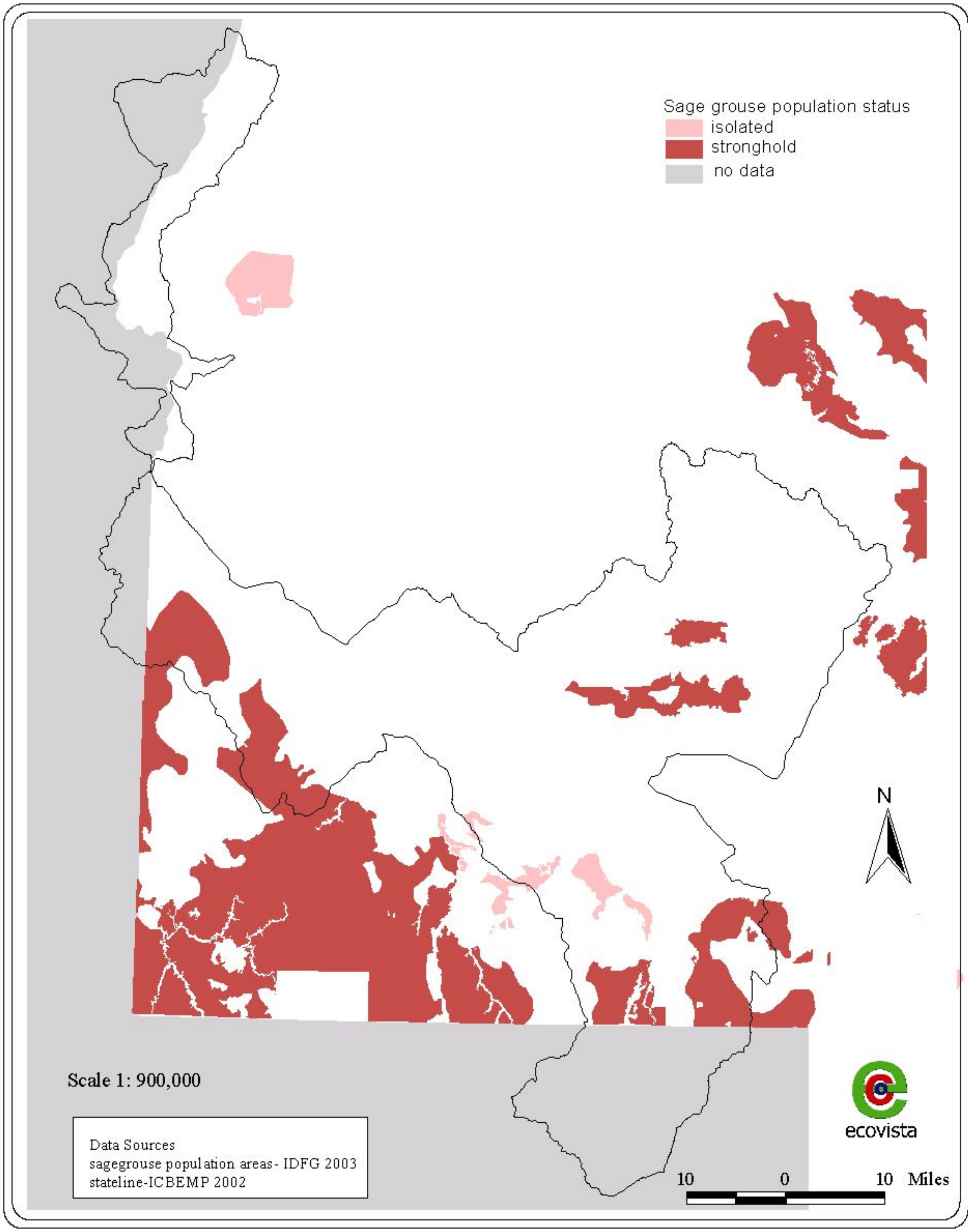

Figure 37. Stronghold and isolated stronghold sage grouse populations

Many nonnative plants out-compete native plants in sagebrush communities and are unusable by the wildlife species adapted to the native sagebrush community (USFS 2003b). In the lower-precipitation regions, declining sage grouse populations are likely tied to conversion of native shrubsteppe habitats to exotic grasslands of either crested wheatgrass following fire rehabilitation efforts or cheatgrass in the absence of fire rehabilitation. When sagebrush is included in the fire rehabilitation effort, it may take more than 10 years for suitable nesting habitat to become available and more than 20 years for overwintering habitat. In areas with more precipitation, sagebrush is still removed for long periods following a wildfire. Livestock consumption of herbaceous cover may reduce sage grouse nest success. Also, areas with heavy grazing may lead to stream entrenchment and a lowered water table that degrades meadows and increases the number of shrubs, trees, or exotic weeds. Habitat fragmentation often results in increased predation, including human, on a number of wildlife species. Sage grouse populations appear to be highest in areas where large expanses of native range are least fragmented and degraded (Klott 1997).

Mule deer

Mule deer (*Odocoileus hemionus*) are a popular game species in Idaho. Prior to the settlement of the West in the late 1800s and early 1900s, mule deer were not as abundant as they are currently Intense grazing by domestic animals and fire suppression changed plant communities once dominated by grasses to ranges dominated by shrubs. This habitat change to shrub-dominated ranges in combination with reduced livestock grazing, reduced competition from other wild ungulates due to hunting, and regulated deer harvest, promoted the mule deer population growth Overall mule deer populations statewide have declined since the 1950s and 1960s. It is unlikely that populations will increase to those levels again due to natural successional processes and diminishing available habitat (IDFG 2003a).

Mule deer populations in the Middle Snake subbasins are managed by Idaho Department of Fish and Game, Nevada Department of Wildlife, and Oregon Department of Fish and Wildlife. Thirty trend analysis areas (game/wildlife management units, or GMUs) are partially contained in the Middle Snake subbasins. Nineteen are managed by IDFG, six are managed by ODFW and five are managed by NDOW (**Error! Reference source not found.**).

The mule deer mating season usually begins in mid-November and continues through mid-December (Snyder 1991). The gestation period lasts 203 days, with most young born between May and June (Groves et al. 1997). Some July and August births do occur in some areas. Mature females commonly have twins, while yearlings have only single fawns. Weaning begins at about five weeks, and is usually completed by the sixteenth week. Female mule deer usually breed at two years while males may not mate until they are at least three or four years of age due to competition with older males. The life span of a female mule deer can be as long as 22 years, while males may live as long as 16 years. Males begin to shed their antlers in December and shedding may continue into March; mature and less healthy males may shed their antlers earlier.

Mule deer predators include humans, domestic dogs (*Canis familiaris*), coyotes (*Canis latrans*), wolves (*Canis lupus*), black bears (*Ursus americanus*), grizzly bears (*U. arctos*), mountain lions (*Felis concolor*), lynx, bobcats, and golden eagles (*Aquilla chrysaetos*) (Mackie et al. 1987). The impact of predators on mule deer populations is poorly understood (Anderson and Wallmo 1984, IDFG 2003a).

Mule deer are most likely to be found in open forested regions or on the plains and prairies (Snyder 1991). Mule deer are better adapted to open areas than white-tailed deer, although cover becomes important in winter (Snyder 1991). Areas where cover can prevent snow from accumulating beyond 30 cm are most beneficial (Hanley 1984; Nyberg 1987). Wallmo and Schoen (1980) reported that mule deer could cope with snow up to 60 cm if not dense or crusty. Black and others (1976) listed optimal cover attributes for the Great Basin shrub steppe region, including estimates of tree heights and canopy closure for thermal, hiding, fawning, and foraging cover. They estimated the proportion of cover to forage at 55% forage, 20% hiding cover, 10% thermal cover, 10% fawn-rearing cover, and 5% fawn habitat.

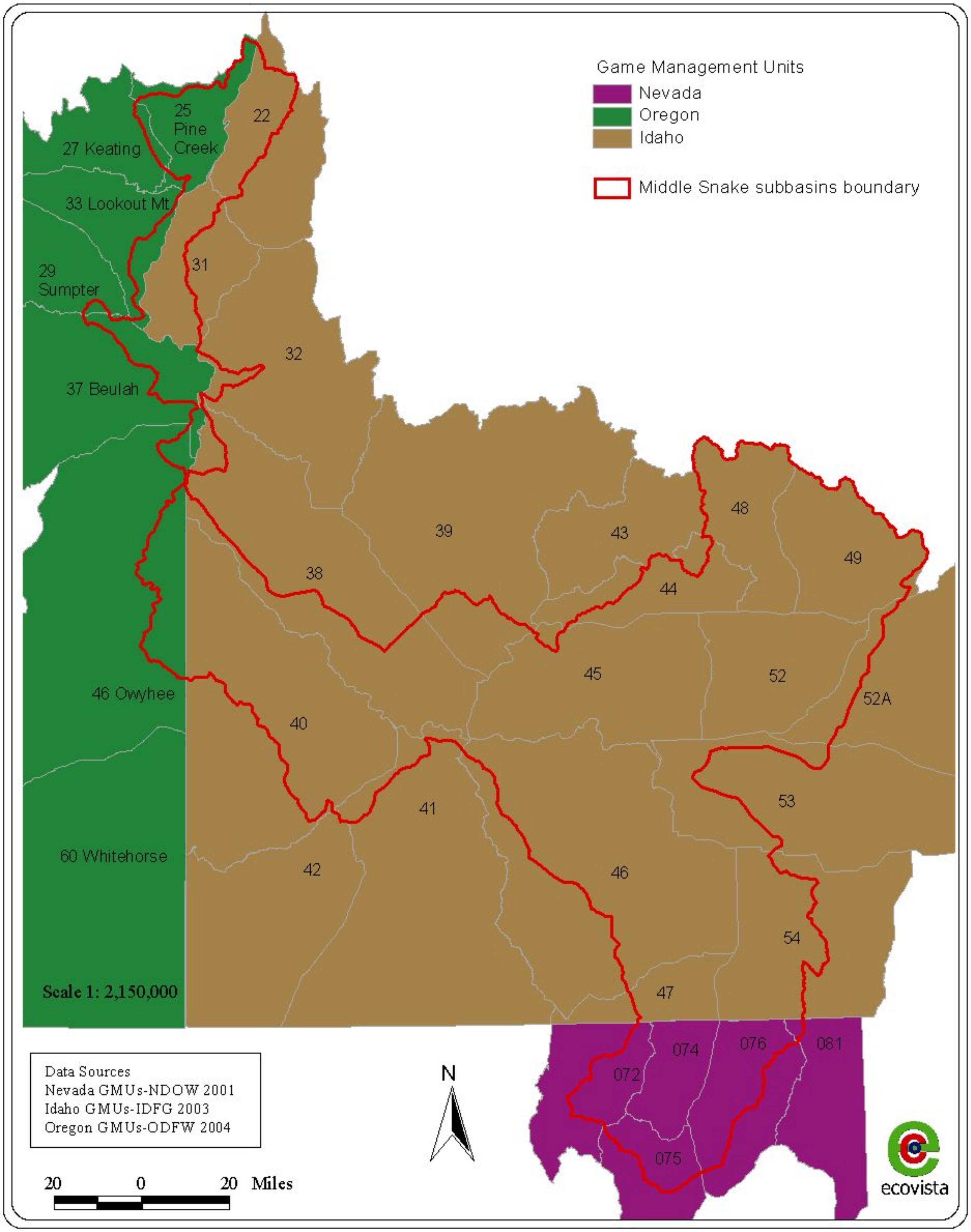

Figure 38. Game Management Units of the Middle Snake subbasins.

Mule deer are primarily browsers, feeding on several thousand different plant species across their range (Snyder 1991). They are capable of altering or severely damaging plant communities through overbrowsing (Reed 1981). Mule deer consume leaves, stems, and shoots of woody plants most often during summer and fall, while grasses and forbs compose the bulk of spring diets. However, feeding behavior is quite variable in any given location. Some of the most common foods are rabbitbrush (Ericameria spp.), mountain mahogany (Cercocarpus spp.), snowberry (Symphoricarpos spp.), buffaloberry (Shepherdia spp.), ceanothus (Ceanothus spp.), rose (Rosa spp.), serviceberry (Amelanchier spp.), sagebrush (Artemisia spp.), sumac (Rhus spp.), common chokecherry (Prunus virginiana), willow (Salix spp.), Gambel oak (Quercus gambellii), mockorange (Philadelphus lewisii), ninebark (Physocarpus spp.), mariposa (Calochortus elegans), juniper (Juniperus spp.), yucca (Yucca spp.), eurphorbia (Euphorbia spp.), manzanita (Arctostaphylos spp.), lechuguilla (Agave lechuguilla), western yarrow (Achillea millefolium), red huckleberry (Vaccinium parvifolium), swordfern (Polystichum munitum), milkvetch (Astragalus spp.), and dandelion (Taraxacum officinale). Antelope bitterbrush (Purshia tridentata), is a particularly important browse species in the area and Yeo and Rocklage (2002) found that, in areas adjacent to Oxbow Reservoir, bitterbrush composed 44% of the diet in November and 55% in December.

Mule deer need highly digestible, succulent forage in addition to woody vegetation for maintenance requirements (Anderson and Wallmo 1984). Commonly consumed grasses include bluegrasses (Poa spp.), wheatgrasses (Agropyron spp.), and bromes (Bromus spp.) (Wallmo and Regelin 1981, Gruell 1986, Mackie et al. 1987, Happe et al. 1990). The quality and quantity of spring food resources has a major effect on production and survival of fawns (IDFG 2003a). Mule deer capitalize on high-quality food resources in the summer and are able to lower their energy demands to adjust to poorer forage availability through the winter. Seasonal movements are common, but most deer with established home ranges will use the same summer and winter areas in consecutive years. The chronology of movement from lower (winter ranges) to higher (summer ranges) elevations is thought to coincide with plant phenology and rate of snow melt (Anderson and Wallmo 1984). Although winter range is considered a critical component of mule deer habitat, survival is largely influenced by the condition of a deer at the start of winter, and that condition depends on the quality of habitat the animal occupies during the rest of the year. A winter range with good thermal cover will minimize energy loss (IDFG 2003a).

Four primary areas of mule deer habitat and mule deer populations occur in the Middle Snake subbasins 1) The area surrounding the Hells Canyon complex in the lower subbasin 2) the Owyhee face area, 3) the Salmon Falls/Rock Creek drainages and 4) the Magic Valley. The distribution of mule deer habitat and it primary season of use is displayed in Figure 39. Most of the area of the subbasin that does not provide mule deer habitat is in agricultural production (Figure 29-Current WHTs). Mule deer populations in these areas are maintained at low numbers to reduce depredation on crops (IDFG 2003a).

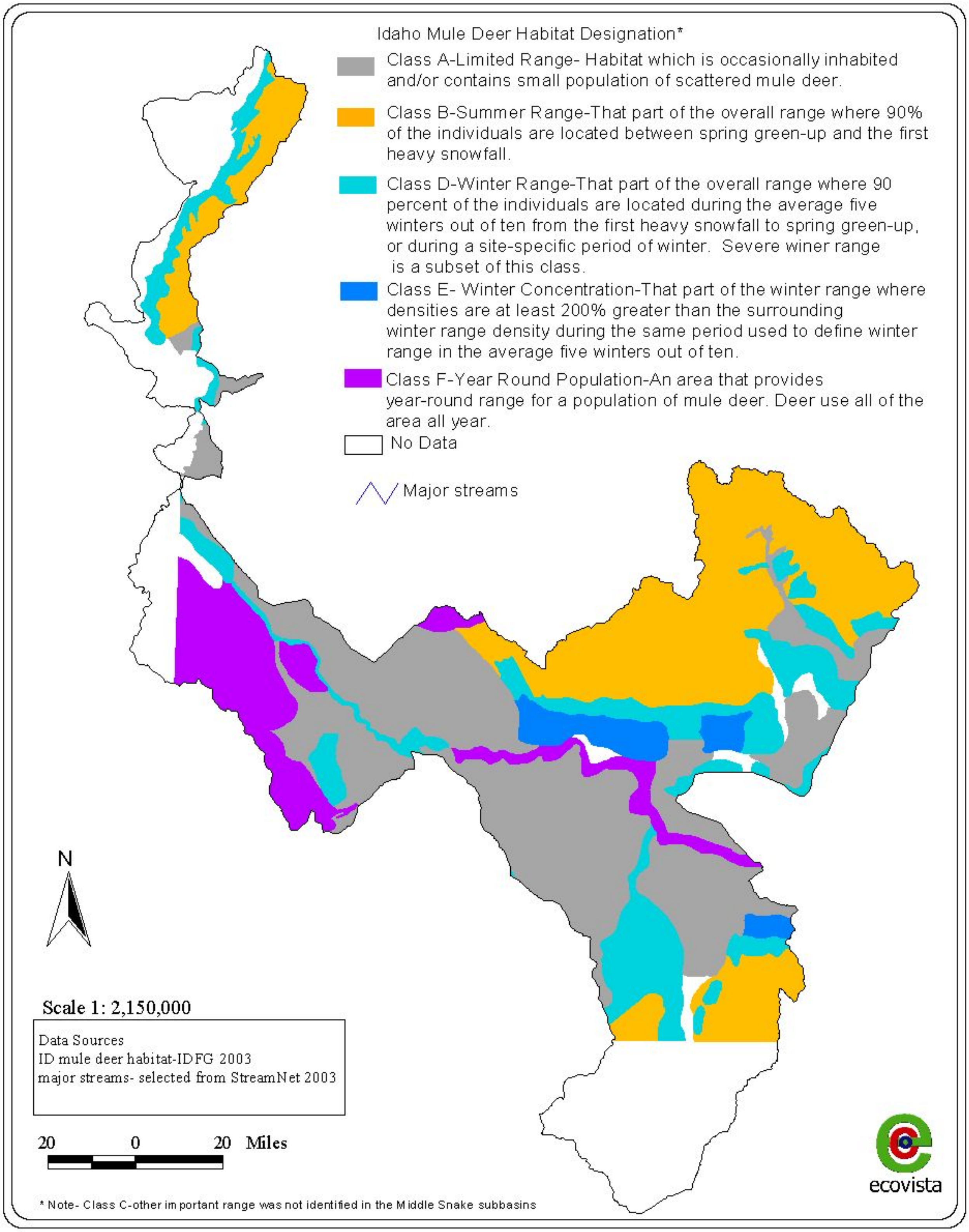

Figure 39. Distribution of mule deer habitat classes in the Middle Snake subbasins

Hells Canyon Complex (HCC)

This area supports a significant deer herd which sustains significant hunting pressure from population centers in the area. Close regulation of populations is necessary to prevent overharvest. Summer range habitat occurs in upper elevation areas while lower elevation areas provide winter range (Figure 39). Logging, grazing, fire (IDFG 2003a) and hydro modifications (Blaire 2002) are the factors that have most affected the condition of habitat in this area. Logging activity has increase shrub fields providing increased forage for mule deer. While fire and grazing have reduced shrub coverage in some areas (IDFG 2003a). Annual water-level fluctuations at Brownlee Reservoir have made crucial low-elevation winter range unavailable to mule deer (Blair 2002). Their is concern among wildlife managers in the area that the HCC Reservoir system may inhibit interchange between Idaho and Oregon subpopulations of mule deer, 2) disrupt migration between winter and summer ranges (Ratti and Lucia 1998), 3) reduce habitat selection opportunities for mule deer on the HCC Winter Range and 4) increase deer mortality from swimming reservoirs (Christensen 2001).

Magic Valley

The Magic Valley Region (Bennet Hill, Camas Creek, Big Wood Drainage) supports an important mule deer herd. During the winter of 1992-1993 deer populations declined in the area by approximately 50%. Since then populations have increased substantially as a result of high recruitment rates and in spite of poor reproductive performance. However, population levels remain below 1993 levels partially due to liberal anterless hunts in units 43, 44 and 45 designed to slow population recovery and allow for the recovery of deteriorated winter ranges. Harvest in the area includes both general and controlled hunting seasons. The controlled hunt permits in the Bennett Hills area are the most highly sought after mule deer permits in Idaho. They are so popular because of high hunter success rates, low hunter density, and the opportunity to observe many deer (IDFG 2003a).

The Bennett Hills Front contains the greatest area of Class-E winter concentration habitat in the subbasin (Figure 39). This area has some of the highest wintering deer densities in Idaho and winters a high proportion of the Mule deer in the Magic Valley region (IDFG 2003a). Other important winter range habitat in the Magic Valley region occurs in the Picabo and Black Butte Hills (Figure 39; IDFG 2003a).

Winter range condition is the most important habitat issue in the area. Excessive use by cattle and sheep severely damaged soil and vegetation in the late 1800s and early 1900s. Today livestock use in the area has been reduced to less than 15% of historic but some winter range areas are still in poor condition. Invasive plant species have also contributed to the problem. Medussahead rye has invaded many winter ranges in the area particular areas that have burned. The prevalence of cheatgrass has also increased in deer winter habitats following fire and/or prolonged heavy grazing. Conservation easements and/or acquisition and restoration of private lands in strategic locations would also help maintain or improve winter carrying capacity (IDFG 2003a).

Other important habitat issues include wildlife security and changes in habitat due to fire suppression and succession and loss of habitat to development. Wildlife security isconsidered good in unit 48 but is below optimum in units 44, 45, and 52 due to relatively high road densities and low availability of cover. Succession and in some cases heavy livestock use has caused a general decline in aspen communities in the area, many stands have become decadant and are being replaced by conifers. This has also reduced habitat quality for mule deer in the area (IDFG 2003a). Increasing human population and development in the area is reducing the habitat available to mule deer.

Owyhee face

The Owyhee face area traditionally supported substantial mule deer herds and hunting opportunity. To reduce depredation problems deer seasons were liberal until the 1970s when an area wide decline in deer populations led to greater restriction. However, moderate mule deer populations and harvest rates have been maintained in the area. Population information is limited and increased data collection effort is needed.

Deer in this area use habitat in both Idaho, and Oregon. No obvious elevational separation occurs between winter and summer range in this area (Figure 39). But it is estimated that 80% of the deer herd in western Owyhee County migrate to Oregon to winter (IDFG 2003a).

There have been several major changes to mule deer habitat in the area, over the past 30 years. There has been substantial encroachment of western juniper which has replaced more important browse species reducing the carrying capacity of the area for mule deer. In several areas of severe juniper encroachment the number of wintering deer supported has declined from several thousand to a few hundred. In many areas sagebrush communities have been seeded with crested wheatgrass or invaded by cheatgrass (Figure 32). Livestock numbers in the area have been significantly reduced and serious competition between them and mule deer are now localized on winter ranges and riparian areas.

Salmon Falls/Rock Creek

Mule deer populations in the lower elevations of the Salmon Falls and Rock Creek drainages are relatively small. Unit 46 has never supported a large resident deer herd and recent fires have destroyed large portions of the winter range further reducing carrying capacity. The burned areas are now dominated by planted crested wheatgrass or cheatgrass and have little browse to support wintering deer (Figure 42). It has been reported that mule deer were relatively abundant in Unit 53 around 1900 but habitat conditions were substantially altered with human settlement. Today more than half of unit 53 is irrigated farmland and supports only a small resident population of mule deer. Management goals are to maintain these low numbers to limit depredation problems.

At mid-upper elevations in the Salmon Falls and Rock Creek drainages conditions for muledeer improve. Portions of the deer herds in this area migrate south to winter ranges in Nevada. The Nevada portion of the Salmon Falls Drainage (Nevada units 072,074,075,076) is reported to support good deer numbers. Deer in the Nevada portion of the subbasin occupy all elevations in the area from the foothills to the upper peaks. The diversity of habitats used makes the area valuable to hunters because it provide a diversity of hunting opportunities (NDOW 2003). Deer populations in Idaho Unit 54 declined after a hard winter in 1993 and have remained low since populations despite favorable climatic conditions and conservative hunting seasons. Recruitment rates in this population are low but causes for this are poorly understood (IDFG 2003a).

Important habitat issues identified for this area include a decline in the health of aspen communities, limited quality and quantity of winter range, and security. Due to succession and in some areas heavy grazing many aspen stands in the area have become decadent and/or are being replaced by conifers. Winter range in the area has been degraded by fire, loss of the extensive bitterbrush stands on the Dry Creek, Sugarloaf and Buckbrush Flat winter ranges is expected to have long term negative effects on deer populations. While sagebrush is beginning to reestablish on some of these winter ranges bitterbrush recovery has been slow or nonexistent. The Camp Creek Fire of 1999 burned 31,194 acres in Nevada Unit 072 in the upper South Fork Salmon Falls Creek. This impacted mule deer habitat as well as habitat for other species including elk, antelope, sage grouse and fish (NDOW 2003). Because of the open nature of mule deer habitat in this area and high road densities in some areas habitat security for deer during the hunting season is considered moderate, although high security areas exist in all units. Several motorized vehicle closures have been implemented in Idaho Unit 54 but other may be necessary to provide adequate security (IDFG 2003a).

Pygmy Rabbit

In the order Lagomorpha, the pygmy rabbit (*Brachylagus idahoensis*), along with jackrabbits, hares (*Lepus* spp.), and nine other rabbit genera, forms the family Leporidae. Lagomorphs serve as the base of many predator–prey systems and can support communities of small to medium-sized predators (Chapman and Flux 1990). The pygmy rabbit has the smallest body size of any North American rabbit species (Dobler and Dixon 1990). Except for an isolated population in southeastern Washington, the range of pygmy rabbits includes most of the Great Basin and some adjacent intermountain areas of the western United States. Within the outlined range, these rabbits are found primarily on plains dominated by big sagebrush (*Artemisia tridentata*) and alluvial fans with tall, dense clumps of plants (Green and Flinders 1980). Green and Flinders (1980) speculated that dense stands of big sagebrush along riparian areas, fence lines, and borrow ditches next to roadways might serve as dispersal corridors for the rabbits. Klott (1996) reported for the Jarbidge Resource Area that much of the suitable habitat for pygmy rabbits in the area has been lost to land conversion to crested wheatgrass or annual grassland resulting from wildfire.

Pygmy rabbits are unique among North American rabbits in that they construct and utilize extensive burrow systems (Green and Flinders 1980). Burrows are usually located under big sagebrush and may have multiple entrances (Dobler and Dixon 1990, Green and Flinders 1980). Soil structure and topography are thought to be key components of burrow site selection. Movements as far as 2.6 km have been documented, but it is thought that pygmy rabbits retract their movements and stay closer to their burrow system during the winter. Pygmy rabbits feed primarily on big sagebrush, which may make up to 99% of their winter diet (Dobler and Dixon 1990). Grasses become a larger part (30–40%) of the diet in mid to late summer (Green and Flinders 1980). A study in eastern Idaho found that annual mortality for adults was as high as 88% (Wilde 1978). Predators of pygmy rabbits include the weasel (*Mustela* spp.), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), owls (*Bubo* spp.), northern harrier (*Circus cyaneus*), bobcat, and badger (*Taxidea taxus*) (Green and Flinders 1980).

Roberts (2003) included the Jarbidge, Owyhee, Shoshone, and Burley BLM Field Office (FO) areas in an extensive survey for pygmy rabbits in 2002. Prior to this study, the IDCDC (2001) database contained records for 7 old pygmy rabbit sightings/burrows from the Owyhee and Jarbidge Field Office areas, 16 from the Burley Field Office area, and 4 from the Shoshone Field Office area. Roberts (2003) found 3 additional burrow sites in the Bruneau River drainage (Owyhee Field Office area, Bruneau subbasin) and 1near Salmon Falls Reservoir (Jarbidge Field Office area, Middle Snake subbasins) and stated that the most likely place to find more rabbits of this "subpopulation" is in the remote areas adjacent to the Nevada border. Additional sites that were recently active within the last year or two were located in the Owyhee Field Office area. One recently active site was located near Magic Reservoir (Shoshone Field Office area, Middle Snake subbasins), but no active pygmy rabbit burrow systems were located in the Burley Field Office area within the Middle Snake subbasins. Roberts contends that the Owyhee and Jarbidge Field Office areas still contain suitable pygmy rabbit habitat and connectivity is still rated as fair to good. This area should be considered the second major subpopulation of Idaho pygmy rabbits (Roberts 2003). In a habitat modeling exercise, Rachlow and Svancara (2003) evaluated potential habitat for pygmy rabbits in Idaho. Their modeling exercise outlined priority areas based on average percent clay in the top 60 cm of soil, elevation, slope, vegetation, and fire. Areas of high priority for survey for pygmy rabbits due to high potential for suitable habitat in the subbasins include areas in upper Salmon Falls Creek, the Big Wood Drainage, and the Owyhee Face Drainage (Figure 40). The survey priority data support Roberts's (2003) assertion that the most likely place to find pygmy rabbits in the area is adjacent to the Nevada border; upper Salmon Falls Creek contains the greatest density of high-priority survey areas in the subbasins (Figure 40).

The isolated population of pygmy rabbits in Washington is considered a distinct population segment by the USFWS. It is federally protected under the ESA, designated as endangered on March 5, 2003 (USFWS 2003a). On April 1, 2003, a petition was filed to list the remaining pygmy rabbit populations that occur in the coterminous Intermountain and Great Basin regions as threatened or endangered under the ESA. As of December 2003, no determination has been made by the USFWS. Nevada classifies the pygmy rabbit as a game species (NDOW 2003), and Idaho has managed the pygmy rabbit as a game species but also classifies it as a species of concern (IDCDC 2003). They are considered globally secure but with cause for long-term concern (G4) and, in Idaho, uncommon but not imperiled (S3) (IDCDC 2003).

Threats to pygmy rabbits include habitat fragmentation resulting in small populations and overgrazing. Pygmy rabbits were believed to have a continuous distribution in the past, but many populations have now been isolated as a result of anthropogenic activities (Dobler and Dixon 1990).

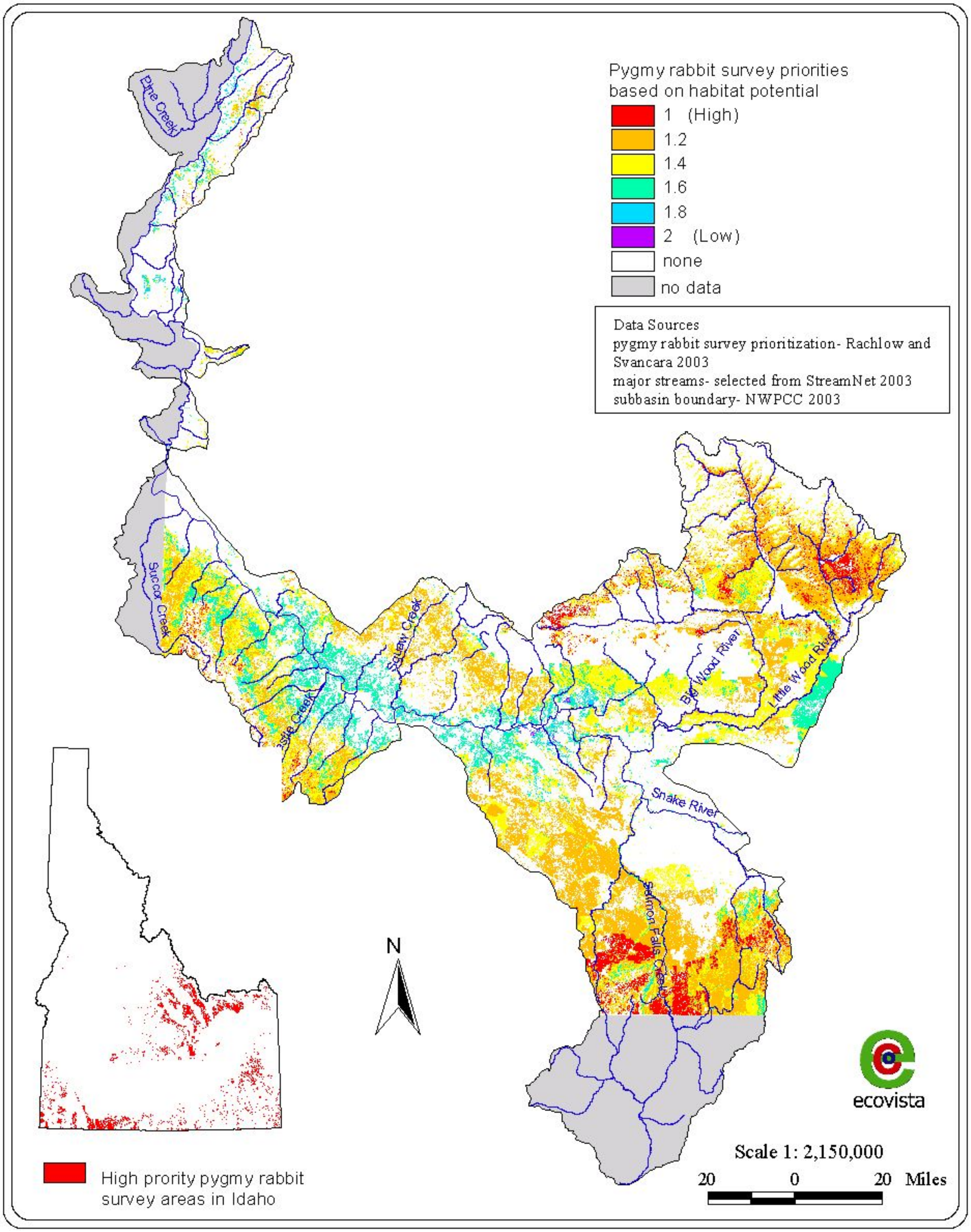

Figure 40. Survey priorities for pygmy rabbits based on habitat potential.

Slick Spot Peppergrass

A member of the mustard family, Slick spot peppergrass (*Lepidium papilliferum*) occurs exclusively in semi-arid sagebrush-steppe habitats on the lower Snake River Plain and Owyhee Plateau, in Ada, Canyon, Gem, Elmore, Payette, and Owyhee Counties of southern Idaho (Figure 41). It is a small herbaceous plant that produces white flowers and has two life cycle morphs, annuals and biennials (Moseley 1994). Slick spot peppergrass grows in low-lying patches of big sagebrush habitats, with native bunchgrasses, several kinds of wildflowers, and soil mosses and lichens in the surrounding habitat. Typically, nonnative weeds are uncommon in slick spot peppergrass habitat that is in good condition. Soils on the microsites of slick spot peppergrass have greater salt and clay concentrations (natric) than soils surrounding sagebrush habitat do, and such nitric conditions facilitate moisture retention (Quinney 1998). Slick spot peppergrass plants are restricted to these "slick spot" habitats, suggesting that soil edaphic factors determine the species' distribution on the landscape (Fisher et al. 1996).

Maintenance of a seed bank is important for year-to-year and long-term survival of plant species that inhabit environments with variable precipitation. Spring precipitation is an important factor determining how many slick spot peppergrass plants are present in an area. As slick spot peppergrass seeds can remain "dormant" but viable in the soil for up to 12 years (Caswell et al. 2003), protection of known sites is important for maintaining populations, even if individuals are not present at the time of survey or planned activity (Quinney 1998). A study of three geographically distinct populations of slick spot peppergrass identified that several soil series found in its habitat were natric or occurring near to natric soil series. Because slick spots are too small to be delineated on soil survey maps, mapped natric areas can be used to delineate potential slick spot peppergrass habitat (Fisher et al. 1996).

The Idaho Conservation Data Center database contains a total of 93 *Lepidium papilliferum* occurrences. Of this total, 75 exist, 5 are historical, and 13 are considered extirpated. Historical occurrences are those based on collections made between 1911 and 1974, most collections have vague location information making their relocation problematic (Caswell et al. 2003). The Idaho Conservation Data Center collaborated with the Idaho Army National Guard to develop a habitat integrity index to facilitate assessment and long-term monitoring slick spot peppergrass across its range (Mancuso et al. 1998). This program was designed to monitor transects of known occurrences. Rangewide, most known locations and unsurveyed suitable habitat of slick spot peppergrass are on BLM lands.

Surveys by the BLM within the Middle Snake subbasins include an effort between the BLM's Lower Snake River District and the IDCDC to conduct a systematic field investigation for slick spot peppergrass in the Bruneau Desert area (Mancuso and Cooke 2001). Survey routes, documented as polygons, covered approximately 1,660 acres (46% of total effort) in the Middle Snake subbasins and 1,945 acres (54% of total effort) within the northeast portion of the Bruneau subbasin. Although many of the areas surveyed in 2001 contained suitable-appearing habitat for slick spot peppergrass, none was found during the survey. Mancuso and Cooke (2001) recommended that remnant stands of sagebrush-steppe habitat deserve consideration as conservation targets.

To facilitate management of slick spot peppergrass across its range, 12 management areas were outlined in a Candidate Conservation Agreement for Slick spot Peppergrass. Conservation measures for each management area were designated to "eliminate, reduce or mitigate the impacts of site specific activities and threats and to maintain or restore the sagebrush-steppe habitat" (Caswell et al. 2003). Five of these management areas are in the Middle Snake subbasins (Kuna, Gowen Field/Orchard Training Area, Orchard, Mountain Home, and Glenns Ferry/Hammett Management Areas). The primary activities that impact species in these management areas are fire, recreation, military training, invasion of nonnative plant species, livestock trampling, and land use authorizations and land exchanges. Additional details regarding these threats can be found in the Candidate Conservation Agreement (Caswell et al. 2003). Standard operating procedures for LEPA, issued by BLM, incorporate measures to address each activity and can also be found in the agreement.

The Kuna management area (MA) is located south of Kuna, which is southwest of Boise. The slick spot peppergrass occurrences are located on BLM land fully or partially within the Snake River Birds of Prey National Conservation Area. Most occurrences within in this MA are relatively large, 20 acres or more. A series of wildfires in the past 10 years has converted the great majority of this shrub-steppe vegetation to annual grassland or crested wheatgrass. All but one of the known slick spot peppergrass observations in the Kuna MA are located in areas that have burned. A few small remnant shrub stands are all that remain. A population of slick spot peppergrass once covered over 1000 acres, and supported abundant subpopulations. Slick spot peppergrass is now rare over this large, burned area (Caswell et al. 2003).

The Gowen Field/Orchard Training area is located approximately 20 miles south-southeast of Boise on BLM land within the Snake River Birds of Prey National Conservation area. This area is also within the Orchard Training Range and is used by the Idaho Army National Guard for training purposes. Several of the slick spot peppergrass observations in this MA represent some of the largest occurrences rangewide. The Idaho Army National Guard has implemented a number of conservation measures that benefit slick spot peppergrass within the training range, including sponsoring much of the current or ongoing research for the species (Caswell et al. 2003).

The Orchard management area is located approximately 20 miles southeast of Boise, and east of Orchard. Most observations are on BLM and adjacent private land. Much of this area includes slick spot peppergrass populations that have burned. Occurrences within this MA range from about 3 to 500 acres, although only a portion is occupied by slick spot peppergrass (Caswell et al. 2003).

The Mountain Home management area is located near the northwestern, eastern, and southern outskirts of Mountain Home, further west to the Crater Rings area, and further south near Hammett. Eight occurrences are located primarily on BLM lands, with one partially on State land. Large areas of land in this region have burned in the past and are now dominated by annual grassland vegetation. Most occurrences in this MA are located within remnant sagebrush stands that vary in size from less than one to over 100 acres (Caswell et al. 2003).

The Glenns Ferry/Hammett management area is located northwest of Glenns Ferry, and occurrences in this area represent the eastern distribution limit of slick spot peppergrass on the western Snake River Plain. Four occurrences are known, all on BLM land. Three of the areas vary from approximately 300 to 900 acres, and are characterized by unburned sagebrush habitat over most of their extent. These blocks are some of the largest remaining in the western Snake River Plain, north of the Snake River (Caswell et al. 2003).

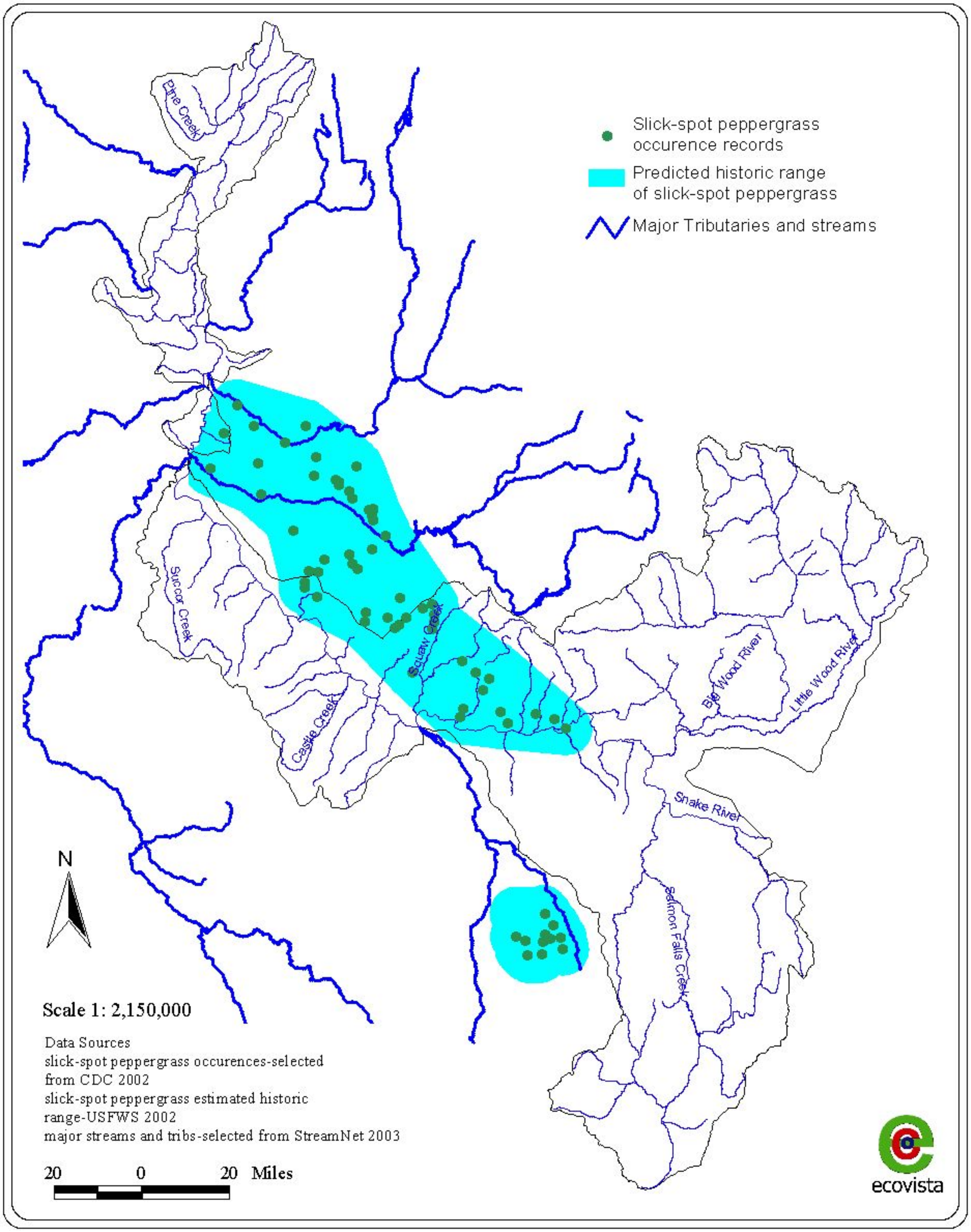

Figure 41. Predicted historic range and recent observations of slick spot peppergrass.

The rate of population loss for slickspot peppergrass is highest of any plant species in Idaho (Moseley 1994). Moseley (1994) estimated a minimum rate of extirpation of two populations per decade from when it was first discovererd in 1892 but speculates that the undocumented rate has probably been much higher during the past century. Slickspot peppergrass is considered imperiled and vulnerable to extinction because of its rarity (INPS rank of GP2) (IDCDC 2003). It was proposed for listing as endangered under the ESA, but the U. S. Fish and Wildlife Service concluded there was a lack of strong evidence of negative population trend and that current conservation efforts will be effective in reducing threats below those required for listing under the Endangered Species Act (Federal Register, Vol. 69, No. 14, January 22, 2004). The Candidate Conservation Agreement between the BLM, the State of Idaho, and nongovernmental cooperators will contribute to the implementation of conservation measures for slickspot peppergrass in Idaho.

The Candidate Conservation Agreement in conjunction with the United States Air Force's Integrated Natural Resource Management Plan (INRMP) and a conservation agreement with the City of Boise completed in 1996 are part of a holistic approach to conserving slick spot peppergrass throughout southwestern Idaho (Caswell et al. 2003). Threats to slick spot peppergrass include wildfire, wildfire management, wildfire rehabilitation, livestock grazing/trampling, nonnative plants, land development, military training, mining, motorized vehicles, predation, fragmentation/isolation, and recreation (Quinney 1998, Caswell et al. 2003).

Spotted Bat

In the family Vespertilionidae, the spotted bat (*Euderma maculatum*) is the single species of *Euderma* that is known only from western North America. Spotted bats have been recorded in a variety of habitats, but most collections have been in desert terrain. The best habitat for spotted bats occurs in the southern portions of the subbasin (Figure 42). Spotted bats are distributed across central western North America from southern British Columbia to northern Mexico (Watkins 1977). The spotted bat is a rare bat species in the United States (Barbour and Davis 1969), and populations are believed to be concentrated in a few areas across the bat's range—including the Big Bend area of Texas, northern New Mexico, southwestern Utah, and southern British Columbia (Fenton et al. 1987). Analyses of stomachs and scats revealed noctuid moths as the primary food source, and some researchers have found evidence that spotted bats will take June beetles. Avian predators include the kestrel, peregrine falcon, and red-tailed hawk. Typically, spotted bats seek refuge in crevices along cliffs, loose rocks, or boulders. Spotted bats are notoriously difficult to capture because they roost solitarily within cracks high on cliff faces and forage high in the air column (usually > 10 m) (Watkins 1977). Spotted bats will travel long distances, if necessary, between high-cliff roost sites to meadow systems for foraging. On several occasions, a radio-marked lactating female on the North Kaibab Ranger District in Arizona was documented traveling 38.5 km (each way) from her day roost site to the meadow in which she foraged (Rabe et al. 1998).

Spotted bat remains have been recovered from saw-whet owl nest boxes in the C.J. Strike Reservoir area (Klott 1996). No complete inventory for spotted bats has been conducted on the Jarbidge Resource Area, but a number of suitable cliffs occur along the Jarbidge River, Bruneau River, Salmon Falls Creek, and many side drainages. A survey (Doering and Keller 1998) of bat species of the Bruneau-Jarbidge River area recorded spotted bats throughout the study area, with the highest numbers detected in the Marys Creek vicinity, which is west-centrally located within the Bruneau subbasin. This study found spotted bats flying over all habitat types, with heavy foraging over sagebrush uplands adjacent to riparian areas. Although the study did not address population demographics, the results implicate the Bruneau-Jarbidge River area as another important population center for the species. Doering and Keller (1998) detected spotted bats at 5 of their 11 sampling localities, a site percentage that is comparable to the highest detections reported elsewhere in the literature (Fenton et al. 1987). Other surveys for bats in southwest Idaho were conducted by Perkins and Peterson (1997) in the juniper forests of the Owyhee uplands, northwest of the Bruneau subbasin. The study area was on BLM lands within Owyhee County, and their efforts concentrated on the water sources on the Owyhee Uplands Byway. Perkins and Peterson (1997) concluded that the bat populations in the areas surveyed were not numerous and species diversity was low. They did not detect any spotted bats during their sampling efforts, an absence that may reemphasize the importance of the Bruneau-Jarbidge River area as a population center for spotted bats.

The spotted bat is ranked as apparently secure across its range but with cause for concern over the long term (G4); it is classified as imperiled in Idaho because of its rarity (S2), as sensitive by the USFS (Region 4), and as moderately endangered by the BLM (IDCDC 2003). Although little is known about the spotted bat, some researchers believe that this situation more likely reflects the bat's elusive nature than the bat's status (BCI 2003).

Limiting factors for spotted bats are probably availability of prey (large moths) and roosting habitat (cliffs).

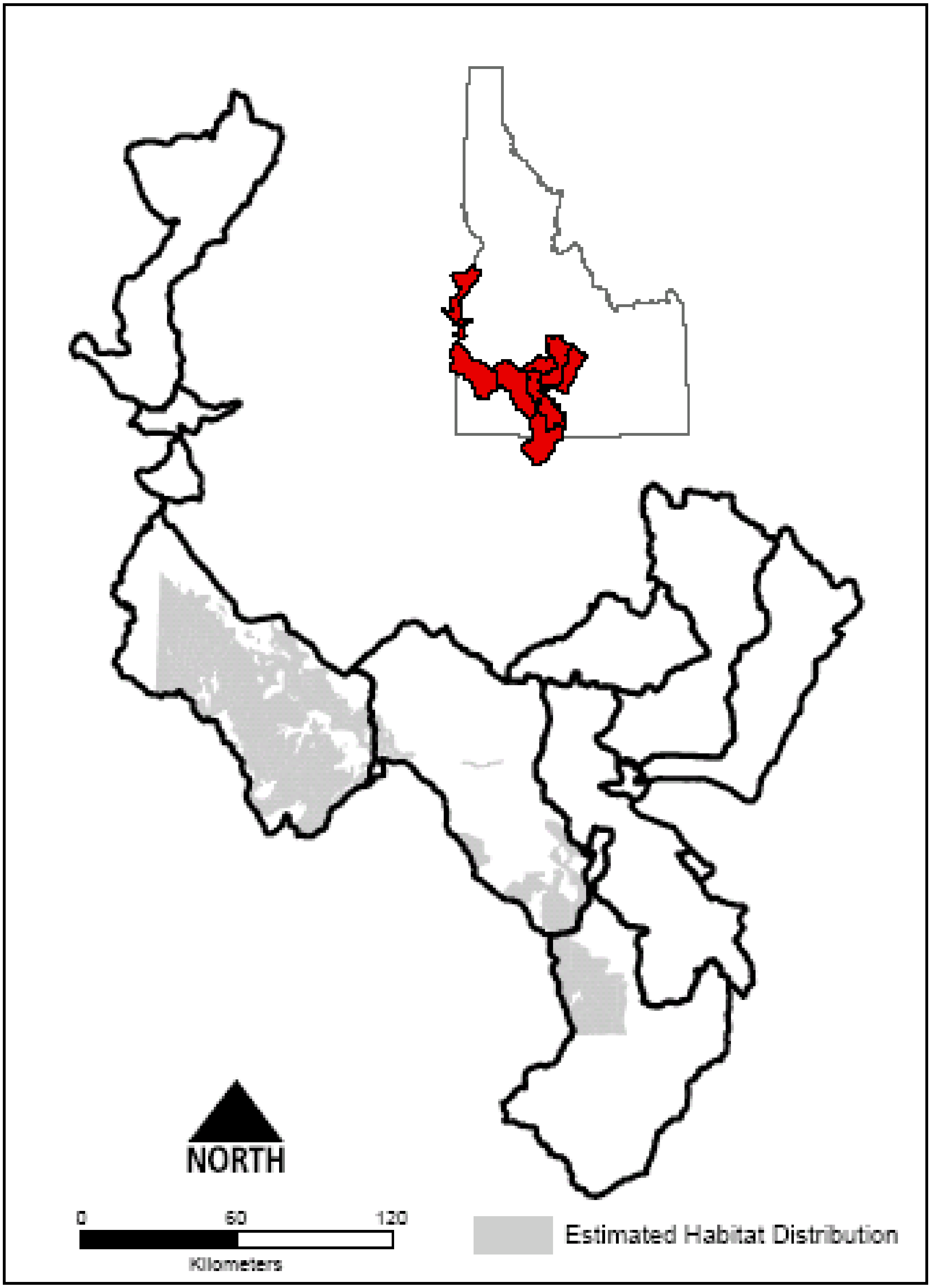

Figure 42. Estimated habitat distribution for the spotted bat in the Idaho portion of the Middle Snake subbasins (Lippincott 1997).

Desert Playa and Salt Scrub Shrublands

Fourwing Saltbush

Fourwing saltbush (*Atriplex canescens*) is a perennial shrub with many branches that ranges from 2 to 6 feet tall. A native of Idaho, it is also distributed throughout the western United States. Fourwing saltbush will grow on a wide range of soils and is mostly found in moderately deep to deep soils. It is an important species of the northern salt desert shrub association, which is characterized by hot, dry summers and cold winters. Areas where the plant can be found include desert flats, gravelly washes, mesas, ridges, slopes, and sand dunes. The active growth period for fourwing saltbush is spring and summer. Its National Wetland Indicator status is facultative to obligate upland (UPL, FACU) species (NRCS 2003).

Fourwing saltbush can be used for beautification (ornamental), erosion control, livestock, and wildlife. Due to its extensive and deep root system (20–40 feet deep), it can effectively be used for erosion control, particularly where native plants are intact. It is considered nutritious for livestock. For cattle, the nutritive value is rated fair to good during winter. Fourwing saltbush is favored by deer and is an important winter food source. Quail use the plant for cover, roosting, and food (NRCS 2003). Other species, including the pronghorn, elk, porcupine, ground squirrel, and jackrabbit, have also been observed using this plant (Bowens et al. 2003, NRCS 2003). Native Americans ground the seeds to make flour for bread (Bowens et al. 2003).

Fourwing saltbush has no serious pests, but small seedlings can be damaged by rabbits and other small rodents. Plants can be destroyed in areas of heavy foot, horseback, or vehicle travel. In areas of heavy deer concentration in winter, overgrazing may be a threat if other food sources are unavailable. Some researchers recommend that grazing by livestock should not exceed 40% of the total annual growth during the growing period and 50% during the plant dormancy period (NRCS 2003). Others recommend that maximum plant performance can be obtained by allowing livestock grazing only during the winter (Smoliak et al. 2003).

Pronghorn

The pronghorn (*Antilocapra americana*) is a large game mammal characterized by a robust build and long, slender legs and feet (O'Gara 1978). Its underside and rump are white; its back, brown with black. There are dark brown markings about the head and neck. The genus includes only one species that has been divided into five subspecies. Lines of subspecies delineation are somewhat uncertain between *A. americana americana*, *A. americana oregona*, and *A. americana mexicana*, partly because there have been numerous transplants and mixing between subspecies. A. *americana americana* comprise a vast majority of pronghorn today, likely including the Middle Snake subbasins populations. Pronghorn habitat consists of native grasslands, grassland-brushlands, and deserts. Pronghorn are polygamous and have a territorial mating system, which ensures that most mating is done by the largest and most aggressive bucks.

Before European settlement in the United States, approximately 35 million pronghorn inhabited North America. By 1924, this estimate decreased to less than 20,000 animals (O'Gara 1978). While most antelope populations in Idaho have densities that vary from low to moderate, the Little Wood valley (watershed in the Middle Snake subbasins) supports herds at relatively high densities (IDFG 2003d). Pronghorn are very important game animals in North America and valuable assets to the range because of their willingness to consume noxious weeds.

Pronghorn population numbers in Idaho are low to moderate compared with high-quality habitats in Wyoming and Montana. Lower numbers in Idaho are considered attributable to low annual precipitation, poor range conditions, and conflicts with private landowners (Rachael et al. 2003). Northern populations of pronghorn depend heavily on browse, particularly in winter when it can make up 80% or more of the diet (O'Gara 1978). Sagebrush may be an important winter dietary item, and animals may switch to forbs during the summer. Pronghorn will move between winter and summer areas, and ranges of equal proportion of browse and forb species should meet yearlong dietary requirements of pronghorn populations. Pronghorn water requirements are related to the succulence and quantity of preferred forage. In the presence of forbs with high moisture content, water consumption decreases. Prong horn habitat is widely distributed across the subbasin Figure 43.

Pronghorn populations in the Middle Snake subbasins are managed by Idaho Department of Fish and Game, Nevada Department of Wildlife, and Oregon Department of Fish and Wildlife. Thirty trend analysis areas (game/wildlife management units, or GMUs) are partially contained in the Middle Snake subbasins. Nineteen are managed by IDFG, six are managed by ODFW and five are managed by NDOW (Figure 38). Pronghorn management units are divided into five groups in Idaho, with each group comprised of management units having similar attributes and hunting opportunities (Rachael et al. 2003). The Middle Snake subbasins are primarily in Group 2 (GMUs 45, 46, 47, 49, 52, 52a, and 53) and Group 4 (GMUs 38, 48, and 54), included in the Southwest and Magic Valley Regions (IDFG 2003d). Management objectives for Group 2 are to maintain an average horn length of 12.0 inches in the firearm buck harvest and a preseason buck to doe ratio of greater than 40:100. Group 2 units generally support high pronghorn antelope populations, high hunter densities, and high harvest rates in many units. Low population numbers prohibit harvest of pronghorn antelope in Group 4 (IDFG 2003d).

Pronghorn populations have fluctuated widely during the past 25 years in Group 2. Successive years of drought followed by a severe winter in 1992-1993 resulted in population declines of 30-50%. Hunts and permit levels were adjusted to encourage population recovery. Pronghorn populations in GMUs 49 and 52 (area surrounding portions of the Big and Little Wood Rivers in the Middle Snake subbasins) increased over the past 4-5 years after seven years of low and relatively stable populations. Populations in GMU 46 (area surrounding the southern tributaries to the Snake River between Salmon Falls Creek and CJ Strike Reservoir) and GMU 47 (area surrounding upper Salmon Falls Creek) have declined slightly (IDFG 2003d).

Sex and age composition data are collected annually during August in GMUs 46, 47, and 49 (area in the headwaters of the Big and Little Wood River) of Group 2. From 1991-2002 observed buck to doe ratios have averaged 0.37 bucks/does in Unit 46 and 0.32 bucks/doe in Unit 49. In August 2002, a small sample of pronghorn was classified with an observed ratio of 0.83 fawns/doe; the highest reproductive performance ever documented from that population. GMU 54 (Rock Creek watershed) in Group 4 has relatively small numbers of pronghorn (IDFG 2003d). The low-elevation sagebrush/grasslands in the Rock Creek Management Area provide habitat for antelope (USFS 2000).

Since the 1993 decline, pronghorn numbers have increased in the Camas Prairie area (GMUs 44, 45, and 52) and in the Little Wood watershed (GMU 49) and declined slightly in the area surrounding Salmon Falls Creek (GMUs 46 and 47) (IDFG 2003d).

During the past 15 years, fires have removed more than a million acres of sagebrush-dominated habitat in the Magic Valley Region (largely Group 2 units), with long-term negative effects on winter range and fawning habitat. While fires may have improved spring, summer, and fall pronghorn habitat in some areas, these fires will likely hinder recovery of pronghorn antelope in GMUs 46, 47, 49, and 52A to the high levels of the late 1980s and early 1990s (IDFG 2003d).

Composition surveys for pronghorn conducted by the NDOW in northeastern Elko County varied by unit (GMUs 72, 74, 75, 76, 77, 79, and 81) (Cox et al. 2003). The ratio for the sample was 37 bucks: 100 does: 39 fawns. This estimate should be interpreted with caution since most of the data were collected before the hunting season and a portion of the bucks classified did not survive the hunting season. The pronghorn herd in this area appears to be static or slightly decreasing in population levels. Because a large amount of this area burned in 2000 and 2001, food availability should increase, a change that could benefit pronghorn in most of the units. IDFG conducted a fixed-wing line transect survey in 2002 in Unit 41. Results have not been released, but incidental observations of pronghorn during bighorn sheep surveys and other opportunistic sightings indicate a static population.

The C.J. Strike HEP Study (section 3.3.6) results for pronghorn rated the shrub savanna cover type as very good-quality habitat (Habitat Suitability Index [HIS] = 0.94). The slight lowering of the HSI value was influenced by taller than preferred shrubs. The remaining evaluated habitats (HSI values at TY0) for pronghorn included shrubland (0.73), desertic shrubland (0.78), desertic herbland (0.84), grassland (0.50), and forbland (0.50). Upland planting and trespass grazing would result in the greatest absolute change in AAHUs (Table 39) (Blair 1997).

Table 39. Projected changes in future average annual habitat units by cover type for the pronghorn, C.J. Strike HEP Study (Blair 1997).

Action	Cover Type (acres)						Total (AAHU) (acres)	Net Change[a] (acres)
	Desertic Herbland	Shrubland	Desertic Shrubland	Shrub Savanna	Forb-land	Grass-land		
No change	1,340.51	578.92	1,644.17	4,451.84	6,339.15	1,476.85	15,831.44	0.00
Upland planting								
—Native	1,168.37	552.41	1,456.99	3,923.15	7,727.08	1,496.74	16,324.74	493.30
—Silver sage	1,202.29	566.81	1,487.86	4,006.95	8,779.42	1,568.71	17,612.04	1,780.60
Gold Island habitat development	—	54.24	—	—	—	—	54.24	54.24
Peninsula development	—	—	92.43	—	—	—	92.43	92.43
Trespass grazing								
—Increased	1,244.72	528.14	1,433.37	3,792.75	6,339.15	1,476.85	14,814.98	–1016.46
—Reduced	1,293.66	567.79	1,472.02	4,070.59	6,339.15	1,476.85	15,220.06	–611.38

Action	Cover Type (acres)						Total (AAHU) (acres)	Net Change[a] (acres)
	Desertic Herbland	Shrubland	Desertic Shrubland	Shrub Savanna	Forb-land	Grass-land		

[a] The net change results from comparing AAHUs for the subject action with the "no change" management action

Threats to pronghorn include fences, interstate highways, railways, and other barriers to movement. Domestic sheep pose competitive threats to pronghorn because they consume palatable forbs and sheep-proof fences restrict pronghorn movements. Cattle may also share resources with pronghorn; one researcher reported that one cow utilized as much food as 38 pronghorn did (O'Gara 1978).

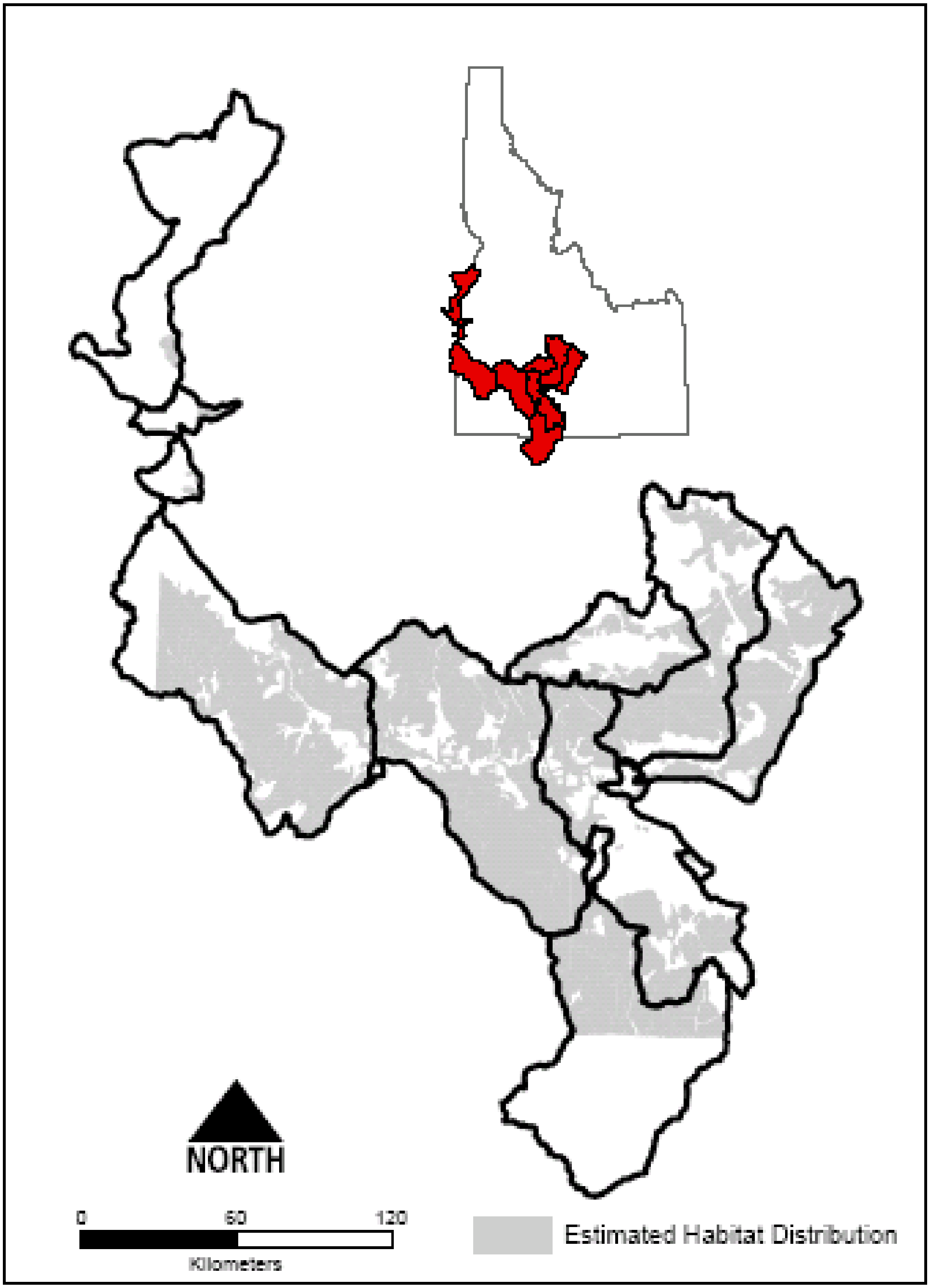

Figure 43. Estimated habitat distribution for pronghorn in the Idaho portion of the Middle Snake subbasins (Lippincott 1997)

Native Grasslands

Sharp-Tailed Grouse

Sharp-tailed grouse (*Tympanuchus phasianellus*) are found from north-central Alaska, the Yukon Territory, Northwest Territories, northern Manitoba, northern Ontario, and central Quebec south to eastern Washington, northeast Utah, and Colorado. The species occurs in the Great Plains from eastern Colorado to northern Minnesota, northern Wisconsin, and northern Michigan (Johnsgard 1983). The Columbian sharp-tailed grouse (*T. phasianellus columbianus*) is a resident from northern British Columbia south to eastern Washington, western Montana, northern Utah, and western Colorado (CDFG 1992). The Columbian sharp-tailed grouse range formerly extended to California, Nevada, and New Mexico (Irving 1950, Marks and Marks 1988).

The species was previously classified as a category 2 (C2) candidate species under the ESA (Federal Register, Vol. 59, No. 219, 58982–59028) until February 1996, when category 2 and all species in that category were dropped from the candidate list. The sharp-tailed grouse is now designated a sensitive species by both the BLM and USFS (IDCDC 2003).

The sharp-tailed grouse is a medium-sized grouse of the western prairies and plains. Adults measure 15 to 20 inches (38–50 cm) in length. Adults have a buff-colored, pale breast with a speckled brown back and a dominant black eye stripe. The displaying males inflate purple- and pink-colored air sacs and dance at mating grounds called leks. The pointed tail for which the bird gets its name shows white on the sides during flight.

Columbian sharp-tailed grouse are typically found in sagebrush semi-deserts (Prose 1987). Of the nine cover types near Mann Creek in western Idaho, Columbian sharp-tailed grouse used big sagebrush (*A. tridentata*) types more than or in proportion to availability, used low sagebrush (*A. arbuscula*) types in proportion to availability, and avoided shrubby eriogonum (*Eriogonum* spp.) cover types. Columbian sharp-tailed grouse selected areas with greater density and coverage of arrowleaf balsamroot (*Balsamorhiza sagittata*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) in big sagebrush sites (Marks and Marks 1988). Columbian sharp-tailed grouse broods in Wyoming were found most often (73%) in mountain shrub and sagebrush-common snowberry (*Symphorocarpus albus*) habitats (Klott and Lindzey 1990).

Sharp-tailed grouse are a true lek species: males defend small territories on traditional "dancing grounds" where they compete for mating opportunities. Typically, only a few males mate. The height of male displaying occurs in the spring (Marks and Marks 1988). The female begins to make a nest at about the same time she begins to visit the dancing grounds or possibly even before. After successfully mating, she leaves the dancing grounds and probably does not return. Males also display at dancing grounds during autumn. The autumn display is thought to recruit first-year males into the lekking group and maintain or improve territorial position among established males (Johnsgard 1983).

Young male sharp-tailed grouse probably begin establishing peripheral territories their first fall of life, and these territories are held again the following spring (Johnsgard 1983). Females probably breed for the first time as yearlings (Gratson 1988).

Sharp-tailed grouse generally lay up to 12 eggs. Eggs are laid at a rate of one per day, and incubation begins when the last egg has been laid. The incubation period is 23 to 24 days. The precocial young all hatch on the same day (Johnsgard 1983, Marks and Marks 1988). Renesting attempts sometimes occur but probably contribute no more than 10% of the offspring in an average season (Johnsgard 1983). After the young hatch, they are led away from the nest. Chicks are able to fly to a limited degree when they are 10 days old and rapidly become independent. By the time they are 6 to 8 weeks old, they are fully independent, and broods gradually break up and disperse (Johnsgard 1983).

A common characteristic of sharp-tailed grouse leks is low, sparse vegetation, allowing good visibility and unrestricted movement (Prose 1987). Height and density of vegetation appear to be important factors in selection of leks (Gregg 1987). Sharp-tailed grouse leks have been reported on mowed wet meadows, cattle-trampled areas around windmills, low ridges and knolls, and recent burns (Prose 1987). Leks are often located relatively close to dense herbaceous cover from the previous year's growth ("residual" cover) (Prose 1987).

Sharp-tailed grouse nest on the ground, preferably among tall, rank grasses but may also nest in brushy or woody areas. Residual herbaceous vegetation is important nesting cover because little current growth is available in early spring when most nests are constructed (Prose 1987). Female sharp-tailed grouse usually do not travel far from leks to nest if suitable cover is available.

Favored brooding sites are those that contain relatively dense herbaceous cover, associated with a mixture of shrubs and forbs (Johnsgard 1983). Broods use cultivated lands that are generally avoided before nesting (Gregg 1987). Openings in forested areas may also be used (Hamerstrom 1963, Johnsgard 1983). Woody cover is more important for broods than for nesting hens (Miller 1963).

After the mating season, males gradually move away from their leks to foraging and daytime roosting sites that usually include brushy cover, aspen or willow thickets, or young conifer stands. In Utah, during the day, sharp-tailed grouse roosted in weeds and grass during June and early July and in shrubs and bushes in late July and August. Night roosts located in fairly open upland sites with good ground cover are preferred by sharp-tailed grouse over roosts in marsh and bog vegetation (Johnsgard 1983).

Winter use of habitats varies with snow depth (Swenson 1985). As food and cover are reduced in open habitats, sharp-tailed grouse move into woody vegetation (Johnsgard 1983, Prose 1987). Sharp-tailed grouse also dig snow burrows for shelter if snow depth is adequate; death may occur in severe weather if no snow is available for burrowing (Johnsgard 1983).

Growth form of dominant grasses is important in late winter habitat. In late winter and early spring, when shrub canopies are open and dry snow is unavailable for burrowing, heavy or deep (> 4 inches [10.2 cm]) snow may collapse sod-forming grasses. Bunchgrasses are more resistant to collapsing under heavy snow and can provide cover when snow is up to 12 inches (30.5 cm) deep (Prose 1987).

Good quality grass and brushy cover are essential for sharp-tailed grouse. The height and density of vegetation are generally more important than species composition in determining sharp-tailed grouse habitat quality (Prose 1987). Sharp-tailed grouse prefer areas that contain cover in scattered openings rather than evenly distributed cover (Miller 1963). Scattered shrubs and shrubby breaks are more important during late summer and fall than they are in midsummer when grass height is sufficient. Woody vegetative cover generally becomes increasingly important during fall and winter (Prose 1987). Lippincott identified the best habitat for sharp - tailed grouse in the subbasin just below the confluence of the Weiser River.

For the Columbian sharp-tailed grouse, shrubs and small trees are important habitat components only during late fall and winter. During the rest of the year, weed-grass cover and cultivated crops such as wheat and alfalfa provide important food and cover (Johnsgard 1983).

Sharp-tailed grouse are primarily herbivorous and utilize a variety of leafy plant material including buds, fruits, and catkins of woody species. During spring and summer, herbaceous plants make up the bulk of the sharp-tailed grouse diet. During fall and winter, sharp-tailed grouse rely more on woody species (Johnsgard 1983, Prose 1987). Sharp-tailed grouse younger than 10 weeks old feed primarily on insects such as short-horned and long-horned grasshoppers, beetles, and ants. At 12 weeks, they consume about 90% plant material, a composition that closely resembles the adult diet (Prose 1987).

During spring and summer in Washington, green herbaceous materials composed the bulk of the sharp-tailed grouse diet; grass blades alone (especially Sandberg bluegrass [*Poa secunda*]) totaled 50% of the spring diet and 75% of the summer diet. Flower parts, particularly those of dandelion (*Taraxacum officinale*) and buttercup (*Ranunculus* spp.), made up the rest of the spring and summer food (Johnsgard 1983). The summer diet of adult plains sharp-tailed grouse in Nebraska sandhills was 91% plant material, 5% insects, and 4% unknown materials. Important food items by volume included 54% clover (*Trifolium* spp.), 9% rose hips (*Rosa* spp.), 6% Bessey cherry (*Prunus besseyi*), 4% dandelion, and 3% eastern poison ivy (*Toxicodendron radicans*) (Prose 1987).

During fall, the birds eat a diverse array of seeds and cultivated grains, especially in agricultural areas. In nonagricultural areas, they eat shrub fruits and seeds and green leaves of herbs, shrubs, and trees (Johnsgard 1983). October foods of 53 plains sharp-tailed grouse showed a similar emphasis on plant items (89%), including heavy use of fruits. Important plant foods during this period were rose (46%), clovers, (16%), American nightshade (*Solanum americanum*) (11%), clammy groundcherry (*Physalis heterophylla*) (7%), dandelion (3%), and western snowberry (*Symphoricarpos occidentalis*) (2%). Insects comprised 8% of the October diet (Prose 1987).

Availability of grain, fruiting shrubs, or deciduous trees is important in winter. Paper birch (*Betula papyrifera*) and quaking aspen are major winter food sources for prairie sharp-tailed grouse when snow cover prevents foraging on grains or similar foods (Johnsgard 1983). The fruits of black hawthorn (*Crataegus douglasii*) and the buds of Saskatoon serviceberry (*Amelanchier alnifolia*) and chokecherry were the main winter foods of Columbian sharp-tailed grouse in western Idaho (Marks and Marks 1988).

Some predators of sharp-tailed grouse include the red fox (*Vulpes vulpes*), coyote (*Canus latrans*), great horned owl (*Bubo virginianus*), and other raptors (Gratson et al. 1990).

The populations and distributions of the Columbian, prairie, and plains sharp-tailed grouse have all decreased from loss of habitat due to intensive livestock grazing, conversion of range to cropland, and other human activities (Johnsgard 1983). Overstocking results in loss of vegetation necessary for nesting and may reduce shrubby cover needed for broods. Woody vegetation frequently deteriorates in areas where livestock are concentrated. In such areas, it would be desirable to fence off some woody stands to provide cover for sharp-tailed grouse (Sisson 1976, Marks and Marks 1988). In western Idaho, mountain shrub and riparian cover types were the most important winter habitats for Columbian sharp-tailed grouse. These cover types are sometimes heavily damaged by livestock. Any disturbance that may damage or eliminate these cover types may have severe negative impacts on Columbian sharp-tailed grouse (Marks and Marks 1988). In general, grazing should be regulated so that approximately 15% of an area remains unused during a season (Sisson 1976).

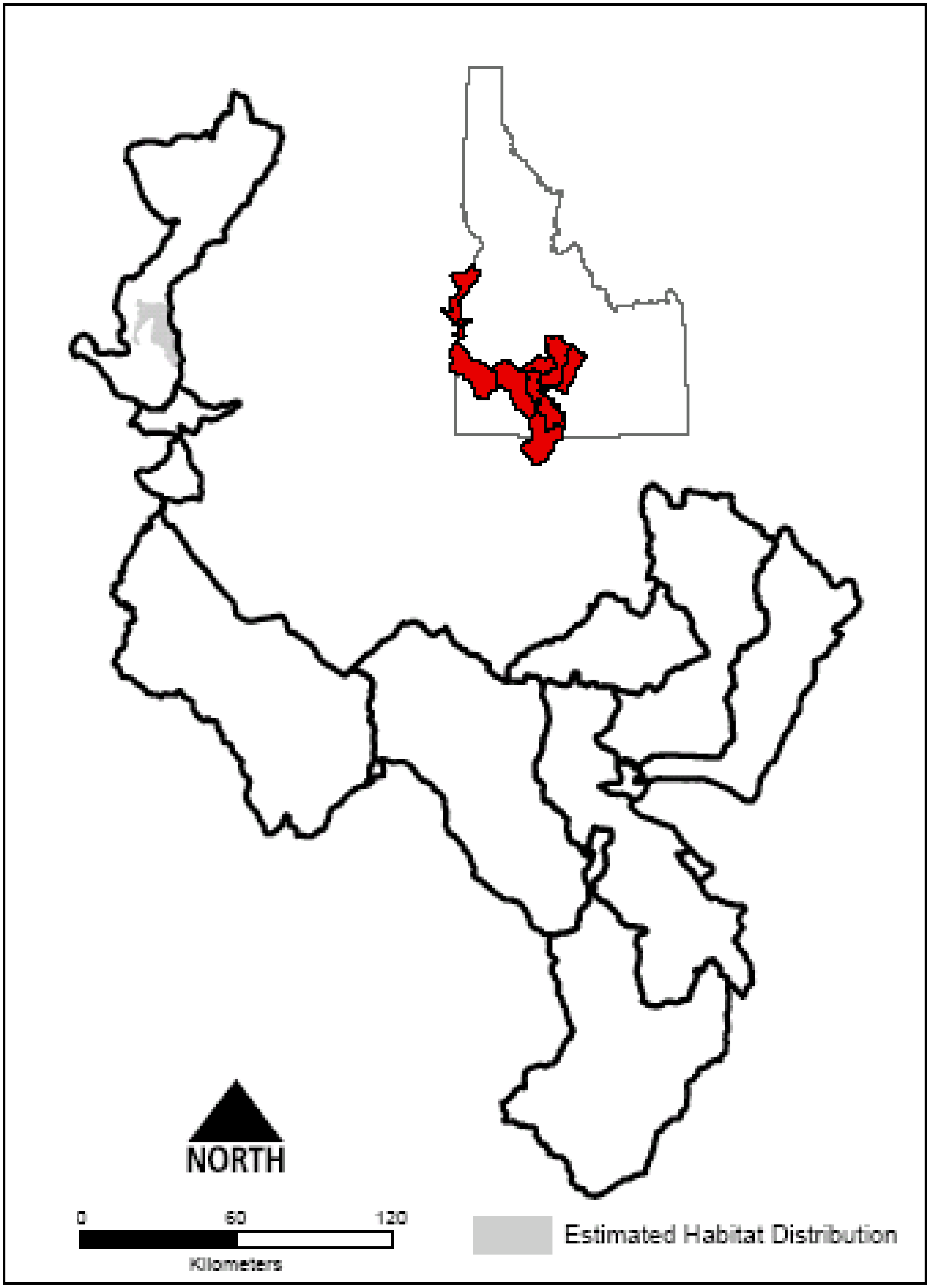

Figure 44. Estimated habitat distribution for the sharp-tailed grouse in Idaho portions of the Middle Snake subbasins (Lippincott 1997).

Spalding's Catchfly

Spalding's catchfly (*Silene spaldingii*), a member of the pink or carnation family (Caryophyllaceae), is a long-lived perennial herb with four to seven pairs of lance-shaped leaves and small greenish-white flowers. The plant is distinguished by its very sticky foliage and flower petals that are shallowly lobed; other similar catchfly species can make identification difficult. Spalding's catchfly ranges from 8 to 24 inches in height. The taproot grows to over 3 feet, making the plant extremely difficult to transplant. Spalding's catchfly flowers and is easiest to spot late in the season when the plant is green and surrounding vegetation is dry and brown (Lorain 1991, Mancuso and Moseley 1994). Flowering occurs in midsummer or later, peaking around the third week in July. Plants on exposed southerly slopes flower first, while those on north and east aspects bloom later. Fruit and seed maturation occurs in August, with seed dispersal taking place in late August to early September (Lorain 1991). Reproduction is apparently by seed only as rhizomes or other means of vegetative propagation are lacking. Seeds appear to require cold stratification, so germination occurs mainly in the spring (Lesica 1988).

Spalding's catchfly may be found in deep-soiled valleys or on the northern slopes of more shallowly soiled foothills and canyon hillsides. Soils are mostly productive silt/loams (loess) with occasional loams and skeletal silt/loams. These mesic prairie habitats also support two other rare regional endemics: Jessica's aster (*Aster jessicae*) and Palouse goldenweed (*Haplopappus liatriformis*). Occupied habitat includes remnants of the Palouse Prairie in west-central Idaho and southeastern Washington, the Channeled Scablands in eastern Washington, the Wallowa Plateau in northeastern Oregon, the Canyon Grasslands of the Snake River and its tributaries in Idaho, and the Intermontane Valleys of northwestern Montana and south-central British Columbia (Hitchcock et al. 1964).

The plant prefers open native grassland habitats and is associated with Idaho fescue (*Festuca idahoensis*), rough fescue (*F. scabrella*), or bluebunch wheatgrass (*Pseudoroegneria spicata*, formerly called *Agropyron spicatum*); sometimes it occurs with occasional shrubs or conifers such as (*Rosa nutkana*) and (*Symphoricarpos albus*) (Mancuso and Moseley 1994). In Idaho, Spalding's catchfly is currently known to occur in three counties: Nez Perce, Idaho, and Lewis, none of which are in the Middle Snake subbasins. However, 98% of Spalding catchfly occurrences in Idaho are within native grasslands, (Hill and Gray 2004). Suitable habitat has been identified on the Payette National Forest, and downstream of the Middle Snake subbasins in Hells Canyon, suggesting that suitable habitat may occur in the subbasins. Additional surveys in grasslands in the Middle Snake subbasins (assessment section 3.5.1: Selection of Focal Habitats and Focal Species, Figure 28: wildlife habitat types in the Middle Snake subbasins), may result in documented occurrences of Spalding's catchfly in the subbasins.

Spalding's catchfly is currently known from 117 sites. Of these sites, over 60% are comprised of fewer than 50 individuals, and only 9 locales are comprised of 500 or more individuals. Over half the sites and individuals are located on privately owned lands. Spalding's catchfly was listed as a threatened species under the ESA on October 10, 2001. In addition, the plant is designated as endangered by Oregon and threatened by Washington. The British Columbia and Idaho Conservation Data Centers and the Montana Natural Heritage Program consider the plant to be rare and imperiled. Both the BLM and USFS consider the plant a sensitive species.

A recovery plan is in early stages of development and has not yet been released. The 2004 Conservation Strategy for Spalding's Catchfly (*Silene spaldingii* Wats.) (Hill and Gray 2004) is a useful interim guide for describing limiting factors, protection and restoration priorities, and additional survey needs (M. Hemker, USFWS, personal communication, April 6, 2004).

Much of the Palouse Prairie grassland habitat portion of Spalding's catchfly's range has been converted to crop agriculture or pastureland. Although probably once widespread in the Palouse region, the plant is now known from mainly small, fragmented sites on the periphery of its former range. Most remaining populations are small and threatened by weed invasion (including yellow starthistle in places) and herbicide treatment (particularly because many populations are small and located near farmlands and roads) (Gamon 1991, Lorain 1991, Hill and Gray 2004). Disturbances to soil and vegetation, both natural (fire, soil slumps, animal burrowing and trailing, etc.) and anthropogenic (livestock grazing and trampling, cultivation, road-building, fire suppression activities, off-road recreational use, etc.) are also major contributing factors (Hill and Gray 2004). Loss of genetic fitness (loss of genetic variability and effects of inbreeding) is a threat to small, fragmented populations where genetic exchange is severely limited.

Livestock grazing has major negative effects on Spalding's silene and its habitat. Prolonged heavy grazing pressure from domestic livestock in some areas has resulted in major alterations of the structure, function and composition of the fescue bunchgrass communities that support Spalding's catchfly and has promoted weed invasion. Life histories of native plant species are often fine-tuned to a particular regime of fire frequency, intensity and seasonal distribution. Alterations of fire regimes, including fire suppression, increasing fire severities and frequencies, and out-of-season fires, have the potential to degrade Spalding's catchfly habitat (Hill and Gray 2004).

The conservation recommendations for Spalding's catchfly focus on protection of existing populations and habitat, and maintenance of potential habitat. The following recommendations were summarized in the conservation strategy to reduce the most imminent and pervasive threats to Spalding's catchfly and its habitat. In order of priority, recommendations address the following issues (additional details can be found in Hill and Gray 2004): 1) habitat degradation from non-native invasive plants, and major contributing disturbance factors, livestock grazing and fire (see additional guidelines for effective weed, livestock, fire management, and habitat restoration), 2) inventory of potential unsurveyed habitat (specific recommendations identify areas with immediate survey needs), 3) habitat fragmentation (specific recommendations are given to help protect pollinators, reduce further habitat fragmentation, protect small populations on isolated habitat fragments, retain genetic diversity of threatened small populations, and suggest areas that would allow protection of groups of small populations), 4) monitoring (recommendations identify priority monitoring needs and provide suggestions of appropriate monitoring methodology), and 5) reporting and record-keeping (recommendations are made to help standardize and improve reporting and record-keeping across the four-state region of Spalding's catchfly known distribution).

Pine/Fir Forest (dry, mature)

White-Headed Woodpecker

The white-headed woodpecker (*Picoides albolarvatus)* is considered rare throughout the northern part of its range (Cannings 1992). It is listed as a species of special concern in Idaho (Blair and Servheen 1993). A medium-sized woodpecker, it is about 21 to 23 cm long. It has a black body with a white head and white patches on its wings. The male woodpecker has a red spot on its nape. The plumage of juvenile woodpeckers is similar to that of the adult woodpeckers, but the black is duller (Garrett et al. 1996).

The birds live in montane, coniferous forests from British Columbia to California and seem to prefer a forest with a relatively open canopy (50–70% cover) and an availability of snags (a partially collapsed, dead tree) and stumps for nesting. The birds prefer to build nests in trees having large diameters, with preference increasing with diameter. The understory vegetation is usually very sparse within the preferred habitat and local populations are abundant in burned or cut forest where residual large diameter live and dead trees are present. The best habitat for white-headed woodpecker in the subbasin occurs in the lower subbasin. This area supports the largest concentration of ponderosa pine in the subbasin. White-headed woodpeckers feed primarily on the seeds of large ponderosa pines during the winter (Blood 1997).

White-headed woodpeckers are monogamous and may remain associated with their mate throughout the year (Robinson 1957). The pair builds its nests in old trees, snags, or fallen logs and always in dead wood. Every year the pair constructs a new nest, an activity that may take three to four weeks. The nests are, on average, 3 meters above the ground. The old nests are sometimes used for overnight roosting by the birds.

The breeding season is between May and July. During this time, the male roosts in the cavity with the young until they are fledged (Milne and Hejl 1989). The incubation period usually lasts for 14 days, and the young leave the nest after about 26 days (Yom-Tov and Ar 1993). White-headed woodpeckers have one brood per breeding season, and there is no replacement brood if the first brood is lost. The woodpeckers fledge about three to five young every year (Milne and Hejl 1989).

The woodpeckers are not very territorial except during the breeding season, and they are essentially nonmigratory (Garrett et al. 1996). They are not especially social birds outside of family groups and pair bonds and generally do not have very dense populations (about one pair bond per 8 hectares) (Garrett et al. 1996). The territory protected is not as large as this home range, however.

Unlike other members of its genus, the white-headed woodpecker appears to subsist largely on vegetable matter, with about 50 to 90% of the diet comprised of ponderosa pine seeds; the remainder is made of ants, beetles, other insects, and spiders (Beal 1911, Ligon 1973). When foraging for insects on conifer trunks or branches, the woodpecker flakes and chips bark away with angled strokes, using the bill as a pry, rather than by drilling the wood directly (Ligon 1973). In summer, the woodpecker feeds by gleaning plant foliage in needle clusters rather than drilling and excavating.

There are a few threats to white-headed woodpeckers such as predation and the destruction of its habitat. Chipmunks are known to prey on the eggs and nestlings of white-headed woodpeckers (Garrett et al. 1996). There is also predation by the great horned owl on adult white-headed woodpeckers. The major threat to this species, however, is the loss of its habitat and nesting sites (Cannings 1992). Logging removes the larger trees that the birds prefer to use for nesting. Fire suppression favors the replacement of pines by firs, and so the birds loose their source of food as well as their nesting sites (Raphael 1983). Population declines have been noted for white-headed woodpeckers in Idaho due to forest fragmentation and modification (Blair and Servheen 1993).

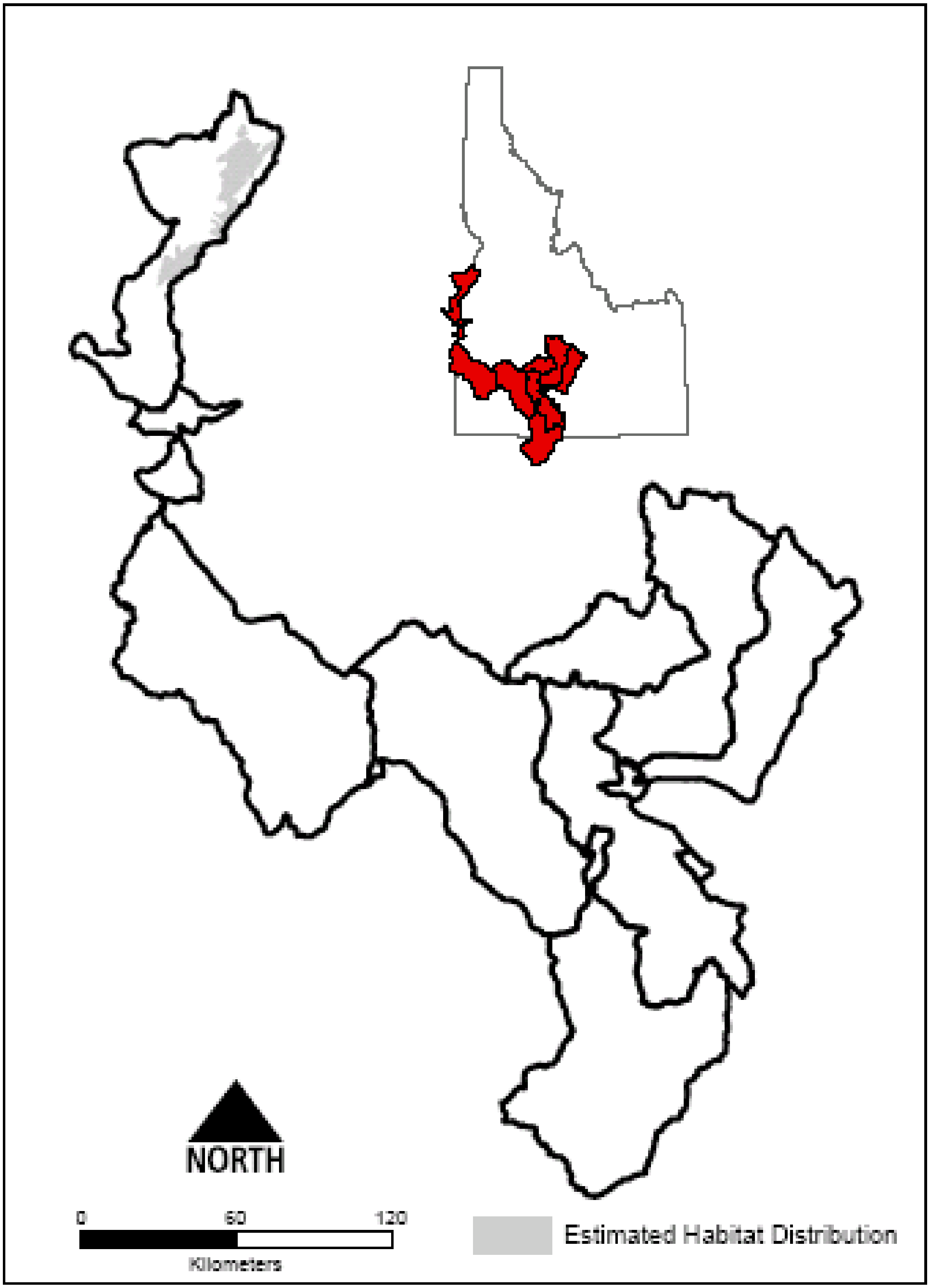

Figure 45. Estimated habitat distribution for the white-headed woodpecker in the Idaho portion of the Middle Snake subbasins (Lippincott 1997)

Flammulated Owl

The flammulated owl (*Otus flammeolus*) is the only small owl with dark blackish-brown eyes (all other small owls have yellow irises), making it very distinctive. The owl is about 17 cm long and weighs between 45 and 63 g (McCallum 1994). The facial disk is pale gray with rusty brown around the eyes, boldest between the eye and white eyebrows that start at the bill and wrap around into the forehead. The chest is light gray with deep-brown or black streaks, a splash of cross-barring, and dark mottling with intermittent rust. The backside is darker grays and browns, mottled with grayish-horn to gray-brown. Although the sexes are alike in appearance, the male and female can be distinguished by call (the female has a higher-pitched whining call) (McCallum 1994).

The flammulated owl is also an insectivore and one of the most migratory owls in North America. The owl breeds in Idaho but leaves the state each year to overwinter somewhere between Central Mexico and Guatemala. Most owls migrate southward at the beginning of October and return to the breeding areas in late April or early May. The owls migrate primarily at night, and it is believed that their migratory patterns are influenced by insect abundance (Balda et al. 1975).

Even though the owl has a lengthy migration, the breeding-site fidelity is high, and nests are often used for several years. Most nest sites are in woodpecker holes or natural tree cavities, but the birds will also use nest boxes (Bull and Anderson 1978, Smith 1981). The owl also seems to be somewhat colonial, congregating in breeding populations limited to one area with adjacent areas of optimum habitat having no birds present (McCallum 1994). Egg laying occurs from about mid-April through the end of May. Generally, two to four eggs are laid, and incubation requires 21 to 22 days, by female and fed by male (Cannings and Cannings 1982, Goggans 1986). The young fledge at 21 to 25 days, staying within about 100 meters of the nest and being fed by the adults for the first week (Linkhart and Reynolds 1987, McCallum 1994). During the second week, the young begin to learn to forage but are still supplemented by the adults (Richmond et al. 1980). The young become independent after about 25 to 32 days after fledging (Linkhart and Reynolds 1987). Although the maximum age recorded for a wild owl is only about eight years, the life span is probably longer than this (Reynolds and Linkhart 1990).

The flammulated owl is generally associated with dry, montane-forested habitats, often with thick brush understory or sapling thickets (McCallum 1994). The owl's favored areas are open aspen or ponderosa pine forest where the summers are dry and warm, the insect abundance or diversity is high, and there are available nesting cavities (McCallum et al. 1994). The owl may also occur in forests with mixes of oak, Douglas-fir, white fir, incense cedar, or sugar pine. A major factor determining habitat selection may also be related to temperatures with upper elevation limits set by low nocturnal temperatures and lower elevation limits set by high daytime temperatures (or humidity) (McCallum et al. 1994). Flammulated owl habitat occurs in the mid-upper elevation forests of the subbasin (Figure 46).

The diet of the flammulated owl includes nocturnal arthropods like owlet moths, beetles, crickets, grasshoppers, caterpillars, centipedes, millipedes, spiders, and scorpions (McCallum 1994). Prey may be taken at the ground, among foliage, and often in the air (Reynolds and Linkhart 1987, 1992). A few records exist of flammulated owls consuming prey other than insects (i.e., small mammals, birds, or lizards), but these records are suspect as some are unsubstantiated or the owls possibly misidentified (McCallum 1994).

Predators such as red squirrels, cats, and bear raid flammulated owl nests (Richmond et al. 1980). Adults are also subject to predation by the Cooper's hawk (*Accipiter cooperii*) and great horned owl (*Bubo virginianus*). To date, no diseases have been found in the flammulated owl population (McCallum 1994).

The flammulated owl is considered to be one of the most abundant owls of the western pine forests, and surveys in Idaho report densities up to 1.25 males per 40 hectares (Moore and Frederick 1991). However, anthropogenic modifications of the owl's preferred habitat in the past century may have caused undetected increases or decreases in numbers (McCallum and Gehlbach 1988). Changes in forest structure may also change insect abundance and hence impact flammulated owl populations. Reynolds and Linkhart (1992) suggested that flammulated owls have higher individual fitness in old forest habitats.

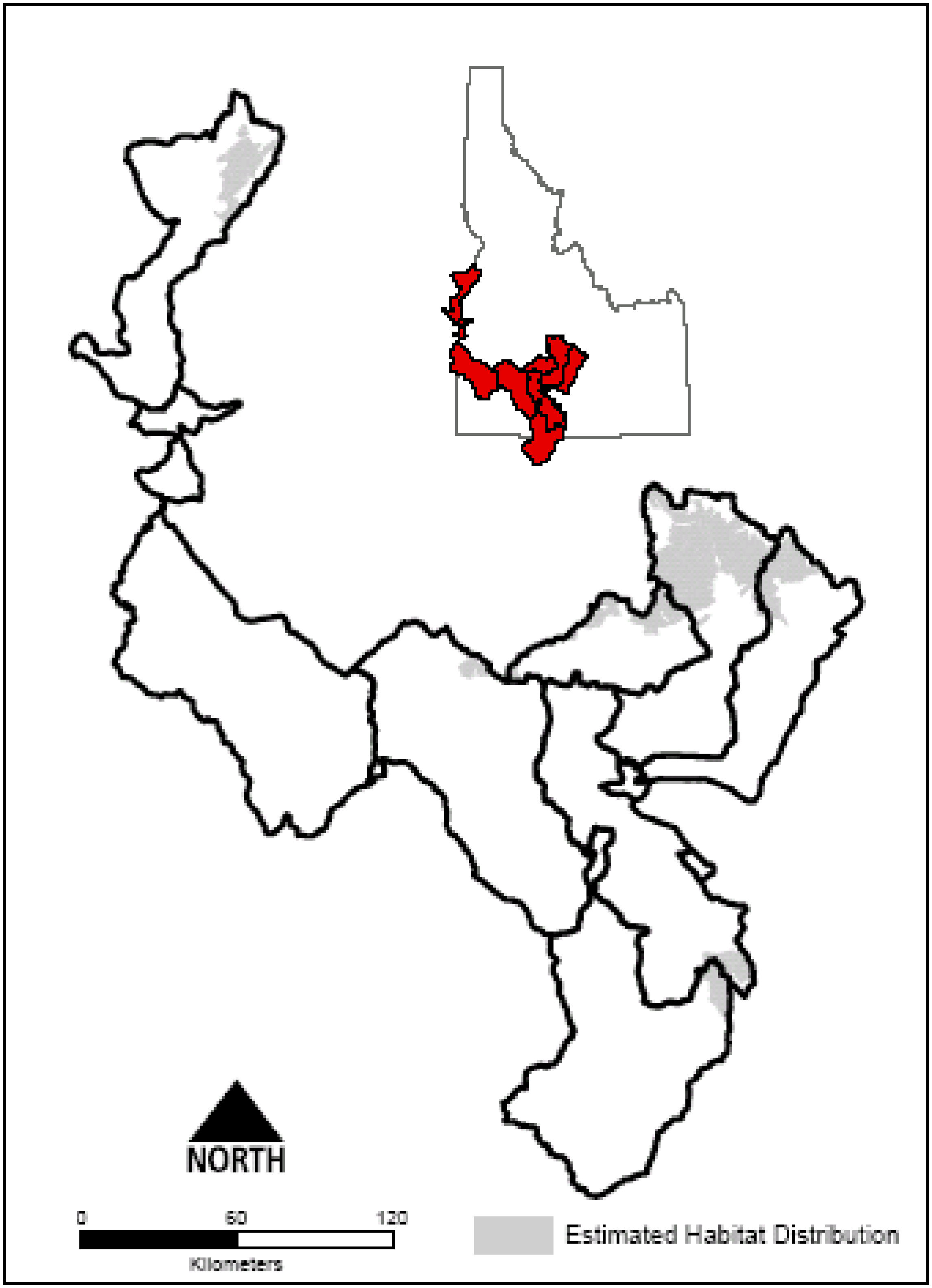

Figure 46. Estimated habitat distribution for flammulated owl in the Idaho portion of the Middle Snake subbasins (Lippincott 1997).

Pileated Woodpecker

The largest woodpecker in Idaho, the pileated woodpecker (*Dryocopus pileatus*) is a permanent resident of deciduous or coniferous forests. The pileated woodpecker is best recognized by its large, dull black body and brilliant red crest. A white line extends from the bill across the cheek and down the neck. Because of its size and chisel-shaped bill (Short 1982), this woodpecker is particularly adept at excavating, and it uses this ability to construct nests and roost cavities and to find food. The pileated woodpecker prefers to nest in mesic areas that are close to streams; it selects stands with the greatest basal area, greatest density of stems, and highest crown canopy. Habitat for pileated woodpeckers in the subbasin is fairly limited and occurs in the higher elevation forest areas (Figure 47). Pileated woodpeckers have been occasionally observed along two breeding bird survey routes in the hells canyon area (Table 40).

Courtship begins in February to March, and a mated pair shares a territory all year. A clutch size of four is most common for this woodpecker. The incubation period is approximately 15 to 18 days (Kilham 1979, Harris 1982). Both parents incubate eggs alternately during the day; the male incubates at night (Bull and Jackson 1995). This woodpecker will breed after its first year, and each year thereafter (Bull and Meslow 1988). It is known to live for at least nine years in the wild (Hoyt and Hoyt 1951, Hoyt 1952), but its lifespan is thought to be longer than nine years (Bull and Jackson 1995).

The pileated woodpecker eats insects, primarily carpenter ants and wood-boring beetle larvae, as well as wild fruits and nuts (Hoyt 1957). It pries off long slivers of wood to expose ant galleries. The pileated woodpecker uses its long, extensible, pointed tongue with barbs and sticky saliva to catch and extract ants from tunnels (Hoyt 1950).

This woodpecker is adapted primarily for climbing on vertical surfaces, although it occasionally hops on the ground. It is awkward on small branches and vines when reaching for fruit. The bird is a strong flier, with slightly undulating strong flight, which is rather slow but vigorous and direct (Sutton 1930, Short 1982). At night, the pileated woodpecker sleeps or roosts in a tree cavity, usually with multiple entrances (Bull et al. 1992). During conspecific conflict, there is much chasing, calling, striking with wings, and jabbing with bills (Bull and Jackson 1995). Used to proclaim a territory, drumming is most frequent in the morning but can occur through the day. Its frequency increases during early spring as courtship activities begin (Mellen et al. 1992).

Known predators of the pileated woodpecker include the northern goshawk (*Accipiter gentilis*), Cooper's hawk (*A. cooperii*), red-tailed hawk (*Buteo jamaicensis*), great horned owl (*Bubo virginianus*), American marten (*Martes americana*), and gray fox (*Urocyon cinereoargenteus*) (Bull and Jackson 1995). Hawks primarily attack and chase pileated woodpeckers while in flight.

A large, nonmigratory insectivore, the pileated woodpecker may provide an important role in controlling insect outbreaks, particularly those of tree beetles. Also, this woodpecker may be a keystone species because its nest excavations provide habitat for many other species (Aubrey and Raley 2002). The pileated woodpecker hollows out nests 20 cm wide and up to 60 meters deep.

Timber harvest has had the most significant impact on the pileated woodpecker's habitat. Forest fragmentation likely reduces population density and makes the birds more vulnerable to predation as they fly between forest fragments. Removal of large-diameter live and dead trees, downed woody material, and canopy closure eliminates nest and roost sites, foraging habitat, and cover (Bull and Jackson 1995).

Historically, different groups of Native Americans hunted these birds for a variety of reasons. Some tribes believed the red head crest was a talisman against all evil (Gabrielson and Jewett 1940), while other tribes used parts of the woodpecker for medicinal purposes. Some believed that possession of the woodpecker's head gave the owner the power to seek out and capture prey (Crabb 1930).

Table 40. Numbers of pileated woodpecker observed on breeding bird survey routes in the Middle Snake subbasins

Year of survey	Route name, state, general location	
	Newbridge, OR	Hells Canyon, OR
	Clear and Fish Creek Hells Canyon Area	Pine Creek Drainage Hells Canyon Area
1992	0	NS
1993	2	NS
1994	0	NS
1995	2	3
1996	0	0
1997	0	NS
1998	1	1
1999	NS	NS
2000	NS	NS
2001	1	NS
2002	NS	NS

NS-Not surveyed

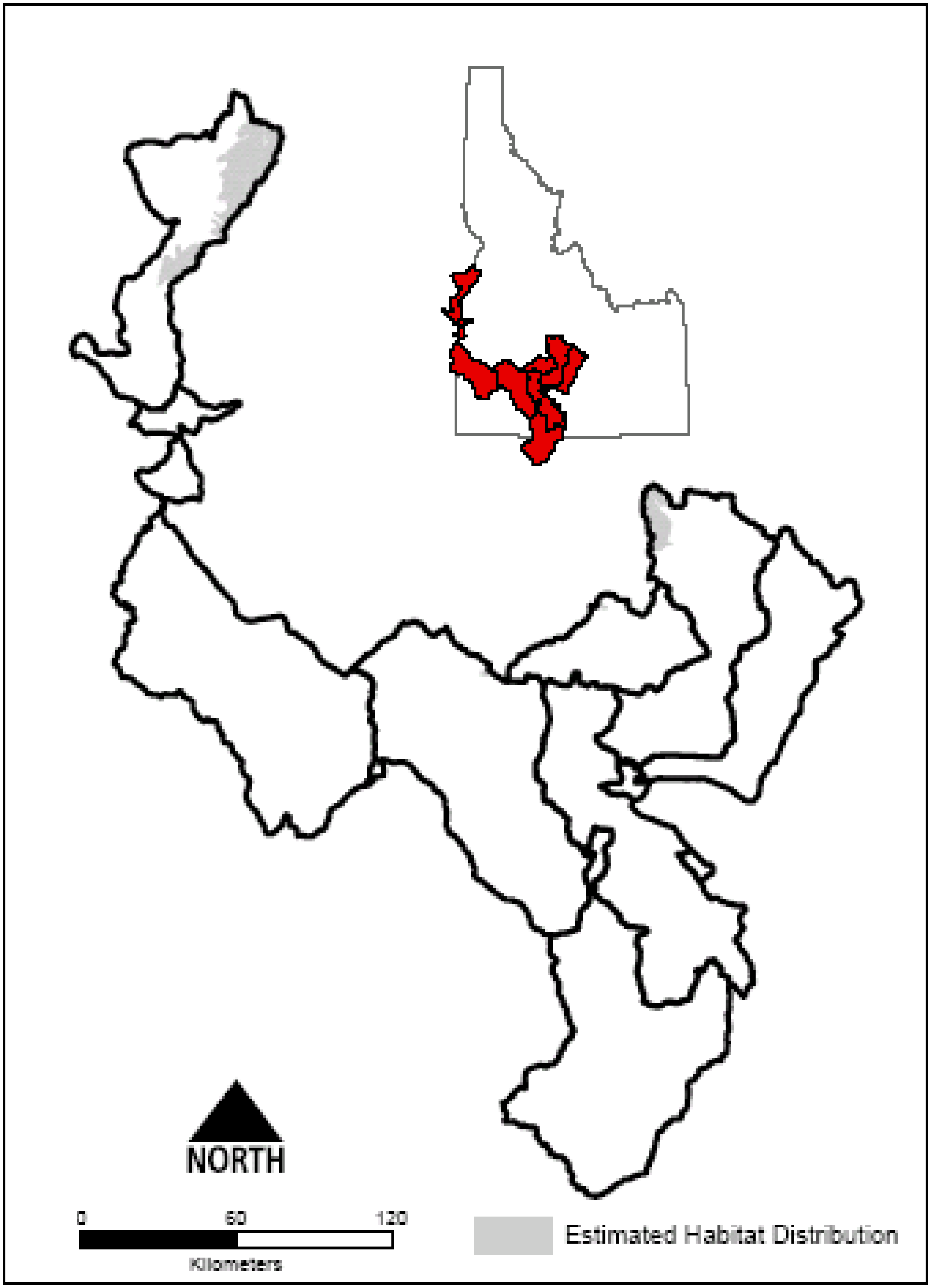

Figure 47. Estimated habitat distribution for pileated woodpecker in the Idaho portion of the Middle Snake subbasins (Lippincott 1997)

Aspen

Aspen

The Middle Snake subbasins technical team determined that the aspen tree (Populus tremuloides) is the best indicator for the aspen focal habitat type. Aspen are palatable to all browsing livestock and wildlife species. The buds, flowers, and seeds are palatable to many bird species including numerous songbirds and ruffed and sharp-tailed grouse (USFS 2004). According to the TT, aspen are limited by altered fire regime and grazing /browsing in the Middle Snake subbasins.

Disturbances such as burning or clearcutting tend to maintain quaking aspen. Fire suppression limits aspen and often leads to conifer encroachment. Fire will probably not rejuvenate an apen stand if biomass is so low that suffer as a consequence. Fire-killed aspen stands are promptly revegetated by root sprouts (suckers). The trees produce abundant litter that contains more nitrogen, phosphorus, potash, and calcium than leaf litter of most other hardwoods, resulting in nutrient rich humus. This humus reduces runoff and aids in percolation and recharge of ground water. Wide adapability of quaking aspen makes it well-suited for restoration and rehabilitation projects on a wide range of sites (USFS 2004).

There is increasing concern that in the West, poor quaking aspen regeneration is due, at least in part, to wildlife overbrowsing young sprout. Where browsing pressure is heavy, ungulates may remove quaking aspen regeneration before it grows above browseline. To provide for quaking aspen regeneration in such areas, enough quaking aspen must be removed to create an unbrowsed surplus of new growth. A few areas of the West have such large elk populations that even after large-scale wildfires, quaking aspen sprouts attained little height growth because of intense browsing. In such areas, quaking aspen sprouts probably require protection from browsing (USFS 2004). Aspen in the Middle Snake Subbasin are most prominent in the Upper elevation areas of the Big Wood and Salmon Falls drainages in these areas they sometimes account for up to 11% of the vegetative community (Figure 48).

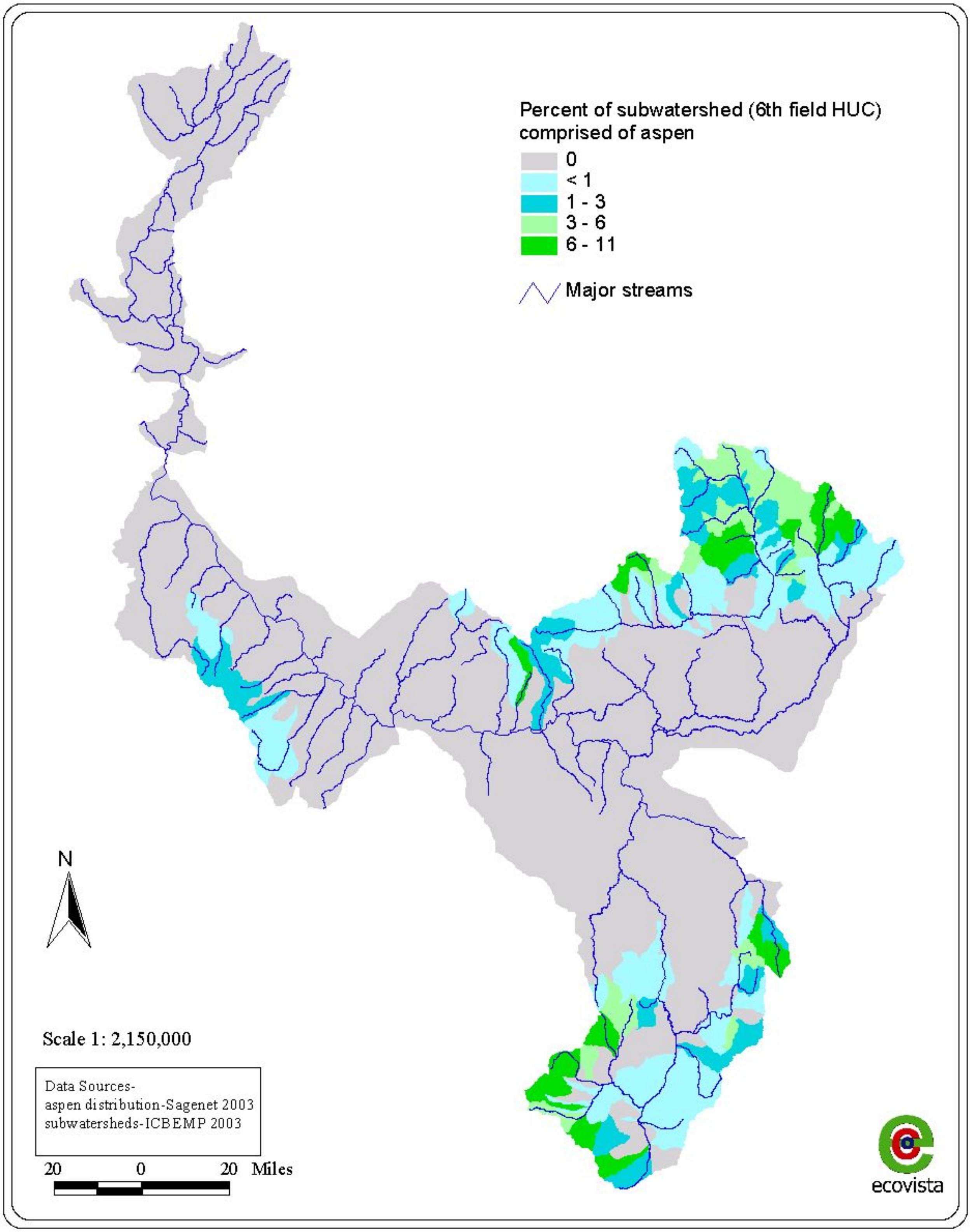

Figure 48. Aspen distribution in the Middle Snake subbasins

Riparian/Herbaceous Wetlands

Spotted Frog

The Columbia spotted frog (*Rana luteiventris*) occurs in four genetically distinguishable populations in northwestern North America (Green et al. 1996, 1997). These disjunct populations are highly fragmented, occurring on isolated mountains and arid-land springs. Two of these genetically distinguishable populations occur in Idaho: the main population north of the Snake River in central Idaho and portions of the Great Basin population in the Owyhee Mountains of southwestern Idaho. While the main population of spotted frogs appears to be widespread and abundant (Clark et al. 1993, Gomez 1994), the Great Basin population appears to be suffering from local extinctions and declines. Consequently, Idaho implemented a long-term monitoring program for the Owyhee Mountain subpopulation (Engle 2000) to determine the status of the Great Basin spotted frog population.

The Great Basin population of the Columbia spotted frog is a candidate species for listing under the Endangered Species Act (ESA). As of February 2002, publication of a proposal to list had been precluded by other higher priority listing actions. The Idaho Conservation Data Center has classified the spotted frog as S2S3, because it is considered rare or uncommon but uncertainty exists about its imperilment (IDCDC 2003). A conservation agreement between multiple partners has been signed in Nevada and covers the northeast Nevada (Elko County) subpopulation of Columbia spotted frogs (September 2003).

The Columbia spotted frog is a medium-sized frog, reaching lengths of up to 9 cm. The frog's dorsal ground color ranges from olive green to brown and is marked by spots having irregular borders and light-colored centers. Pigmentation on the frog's abdomen varies from yellow to red, and a light-colored stripe runs along its upper lip. As a tadpole, the spotted frog is generally brownish-green dorsally with gold flecks. Ventrally, these tadpoles have a silvery color, and their intestines are visible.

Range-wide, spotted frogs use a variety of habitat types including cold-water ponds, streams, lakes, and springs adjacent to mixed coniferous and subalpine forest, grassland, and brush land (Stebbins 1985). Spotted frogs are generally found in or near permanent bodies of water. Habitat usually consists of a small spring, pond, or slough with a variety of herbaceous emergent, floating, and submergent vegetation. During the summer, these frogs can be found some distance from their aquatic breeding sites, but they are still associated with moist vegetation (Gomez 1994, Bull and Hayes 2001). Engle and Munger (1998) studied spotted frog movements in the Owyhee Mountains in Idaho and reported that, while five adults moved distances greater than 1,000 m, most movements were less than 500 meters.

Columbia spotted frog populations begin breeding in early March and continue through late April. Breeding usually begins with a male vocalizing, stimulating the other males to call simultaneously. The vocalization is described as a clicking noise or as a soft bubbling sound (Morris and Tanner 1969, Stebbins 1985). Egg masses are deposited in open, shallow areas near the shoreline. It has been reported that the frogs will deposit eggs in the same area annually (Morris and Tanner 1969, Nussbaum et al. 1983). The egg masses are not attached to vegetation and float freely in the water (Ross et al. 1993, 1994). Depending on water temperature, the eggs will hatch tadpoles in 10 to 21 days. The Columbia spotted frog remains in the tadpole stage for two to three months before undergoing metamorphosis into an adult frog. Preliminary skeletochronological work indicates that Columbia spotted frogs can live at least 9 years in southwestern Idaho (Engle and Munger 1998).

The spotted frog is an opportunistic forager that eats a wide variety of insects, as well as different mollusks, crustaceans, and arachnids (Miller 1978, Licht 1986). Larvae eat algae, organic debris, plant tissue, and minute water-borne organisms.

In 1994, surveys in Nevada identified two adult spotted frogs in Salmon Falls Creek, and observations the same year in Idaho south of the Snake River were from southwestern Owyhee County. Spotted frog surveys were conducted on the BLM Jarbidge and Snake River Resource Areas in 1994 (McDonald and Marsh 1995) and 1995 (McDonald 1996). Six of seven sites in the Jarbidge Resource Area were in the Middle Snake subbasins. Despite sightings in northeast Nevada around the same time of the surveys, no spotted frogs were detected in these survey efforts. A review by McDonald and Marsh (1995) of historical observations from Twin Falls County showed no records of spotted frogs. For within the Middle Snake subbasins, the Idaho Conservation Data Center has records of spotted frogs along North Fork Castle Creek (1 record, 1997), between the headwaters of North Fork Salmon Falls Creek and Wilson Creek (2 records, 1997), and in the headwaters of Succor Creek (1 record, 1996). Spotted frog habitat of the Owyhee Mountain subpopulation tends to be near permanent, slow-moving water where there is little vegetation and water temperatures are warmer than at non-frog sites (Munger et al. 1997). A modest negative association of recent grazing and spotted frog presence was also detected during this investigation. Movement between habitats during spring breeding, summer foraging, or winter hibernation is likely along riparian corridors (Engle and Munger 1998). Although spotted frogs are capable of long movements (e.g., 676 m), most resightings of a population in the Owyhee Mountains were within 10 meters of the original capture site (Engle and Munger 1998). Females have exhibited site fidelity to their natal ponds (Engle and Munger 2003).

Survival is largely influenced by environmental factors, predators (e.g., exotic trout), and cattle (Reaser 2000). Heavy fall grazing resulted in decreased survival for migrating subadult and female spotted frogs in the Owyhee Mountains due to the lack of vegetative cover and a reduced water corridor (Engle and Munger 2003). A number of researchers have asserted that amphibian populations worldwide are undergoing population declines (see Munger et al. 1996). No long-term data are available on population numbers of spotted frogs in the Middle Snake subbasins, but studies and field surveys have been underway to establish presence or absence and long-term monitoring of spotted frogs in the Owyhee Mountains (Gerber et al. 1997, Engle and Munger 2003). An assessment of population structure of spotted frogs in the Owyhee Mountains revealed a downward trend in population numbers from 1997 through 1999 (Engle and Munger 2003). In Nevada, surveys from 1994 through 1996 indicated that 54% of the known sites before 1993 no longer supported spotted frogs (Reaser 1997).

Nonindigenous bullfrogs and fish are probably a primary cause of declining populations of spotted frogs (Storm 1966, Nussbaum et al. 1983, McAllister et al. 1993). Introduced fishes, particularly warmwater species such as largemouth bass, sunfishes, perch, and bullhead catfishes, prey on both spotted frog tadpoles and adults (Hayes and Jennings 1986). Grazing, spring development, road and trail construction, water diversion, fire in riparian corridors, and pesticides have altered or eliminated wetlands and introduced a wide array of contaminants to many aquatic systems, with potential impacts to spotted frog populations. Habitat loss and alteration have also resulted in increased isolation of remaining spotted frog populations and habitats.

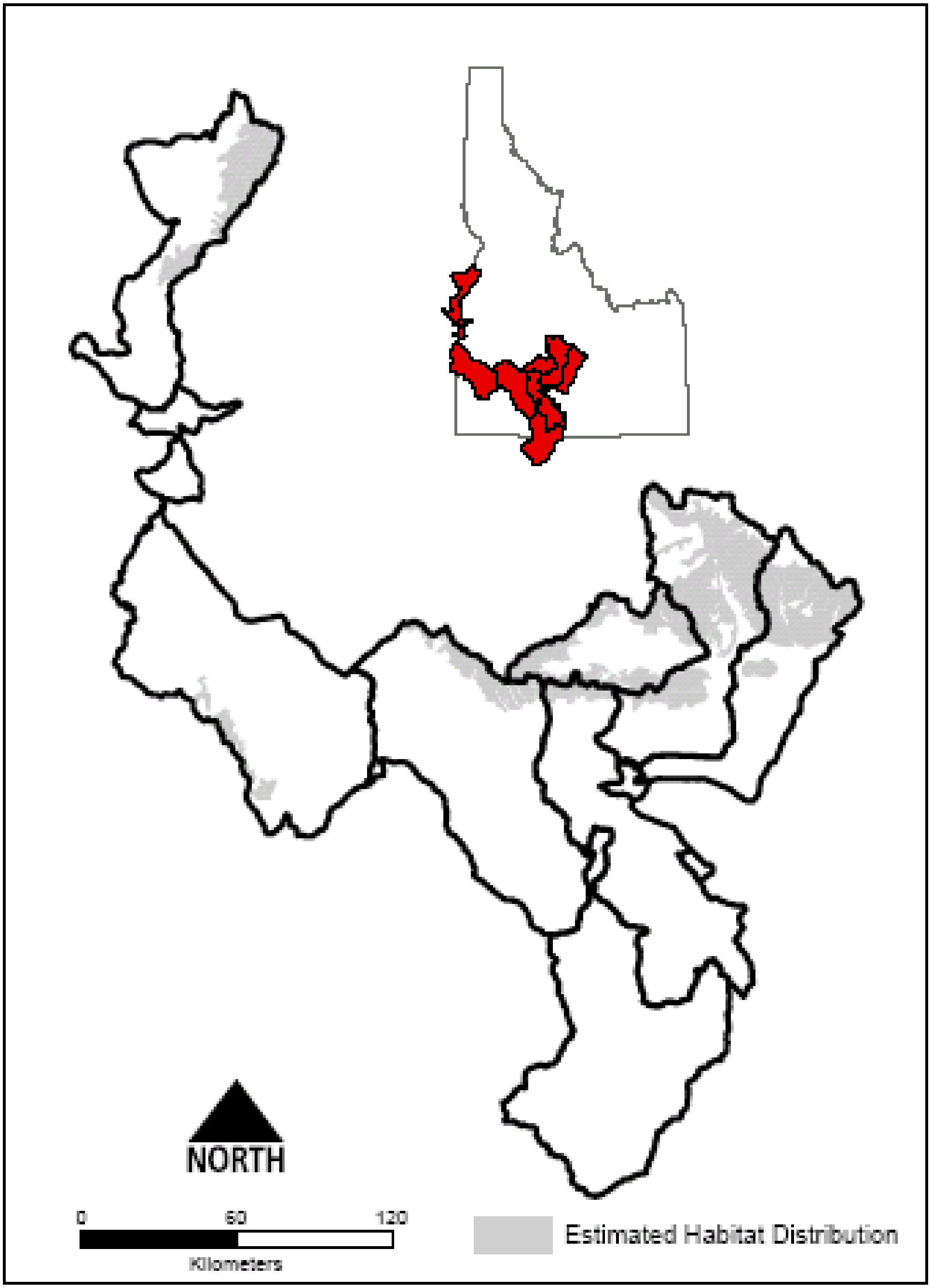

Figure 49. Estimated habitat distribution for Columbia spotted-frog in the Idaho portion of the Middle Snake subbasins (Lippincott 1997)

Mountain Quail

The mountain quail *(Oreortyx pictus*) is the largest North American quail north of Mexico. Rangewide mountain quail are distributed in five western states including California, Washington, Oregon, Nevada, and Idaho, as well as in Baja Norte, Mexico. They are also found in small disjunct populations as introduced birds on Vancouver Island, British Columbia, and the San Juan Islands, Washington (USFWS 2003d). Mountain quail are found in relatively high numbers throughout suitable habitat in the Coast and Cascade ranges and the Rouge, Umpqua and Willamette valleys of western Oregon. However, population numbers in the eastern portion of their range, which includes the Middle Snake subbasins have declined dramatically since the 1930s. Due to these declines, the eastern population of mountain quail was considered for listing under the ESA. On July 2003, the USFWS found that this listing was not warranted, in large part due to concerns over the discreteness of the two populations (USFWS 2003d). The mountain quail is classified as a species of special concern by the IDFG and as a sensitive species by the BLM and Regions 1 and 4 of the USFS (Section 3.3).

Mountain quail habitat in relatively arid areas such as the Middle Snake subbasins consists of tall dense shrubs close to water, usually in riparian areas (Heekin et al. 1993). Mountain quail are usually elevational migrants and winter in coveys below the snow line. In March, pairs start moving to nesting areas, often up in elevation to open forest (Cassirer 1995). Mountain quail nest in a concealed depression on the ground. The female typically lays two clutches of 7 to 10 eggs, one of which is incubated and raised by the male (Heekin et al. 1993). Mountain quail nest sites in Oregon were most commonly located in Douglas-fir/common snowberry associations (Pope and Crawford 1999).

Mountain quail eat primarily plant material throughout the year, based at least partially on abundance. This plant material includes perennial seeds, fruits, flowers and leaves of annual forbs, legumes, and mushrooms. Invertebrate animal matter makes up only 0 to 5% of the adult diet but a larger percentage of the juvenile diet (USFWS 2003d). Mountain quail food-producing shrubs found in the subbasins and surrounding area are white alder, serviceberry, hackberry, black hawthorn, smooth sumac, poison ivy, currant, black locust, elderberry, and snowberry. Other shrub species such as chokecherry, ninebark, and syringa have not been identified as food sources but are important components of mountain quail habitat (see summary of food sources contained in Rocklage and Edelmann 2001).

Mountain quail are prey to numerous predators but are especially vulnerable to hawks. Other known predators include great horned owl (*Bubo virginianus*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), and rattlesnake (*Crotalus* sp.) (USFWS 2003d). Results from predation studies conducted in the Imnaha subbasin indicate predation rates of more than 60% a year (Pope and Crawford 2002, cited in USFS 2003b).

Mountain quail have rapidly declined in central and southwestern Idaho over the past 30 years (USFS 2003a). In Idaho, mountain quail populations are now confined to remnant populations along the mid- to lower Snake River corridor, the lower Salmon River drainage, and the Little Salmon River drainage (Cassirer 1995). In eastern Oregon, mountain quail were historically found primarily in Malheur, Baker, and Wallowa counties. They appear to be extirpated from areas adjacent to Brownlee and Oxbow reservoirs on the Snake River (Brennan 1989, cited in Rocklage and Edelmann 2001). Hunting of mountain quail has been banned since 1984 in Idaho (Rocklage and Edelmann 2001).

Population declines are largely attributed to deterioration and loss of habitat due to intensive agriculture, livestock grazing, and fire suppression, especially along riparian areas (Rocklage and Edelmann 2001). Agricultural development has virtually eliminated mountain quail habitat in the Boise and middle Snake River drainages. Livestock grazing has resulted in loss of cover, particularly of plants that provide food for mountain quail (Rocklage and Edelmann 2001). Impoundments on the Snake River are believed to have eliminated critical winter habitat for mountain quail in southern Idaho and eastern Oregon and are also a direct cause of mountain quail mortality, as birds may drown while attempting to fly across large reservoirs (Rocklage and Edelmann 2001). Predation of mountain quail by feral cats is also a problem in areas near human habitation (USFS 2003a).

The mountain quail is designated sensitive by the BLM in Idaho. This designation will likely remain due to low numbers and isolated populations, as well as because of the effects of heavy grazing and habitat fragmentation. Also, most of the low-elevation habitat used by this species is not under federal mandate (USFS 2003a). In 2000, a petition was submitted to the USFWS to list under the ESA mountain quail populations in the Snake River basin (Crawford and Pope 1999). The IDFG currently prohibits hunting mountain quail in Idaho (Klott 1996).

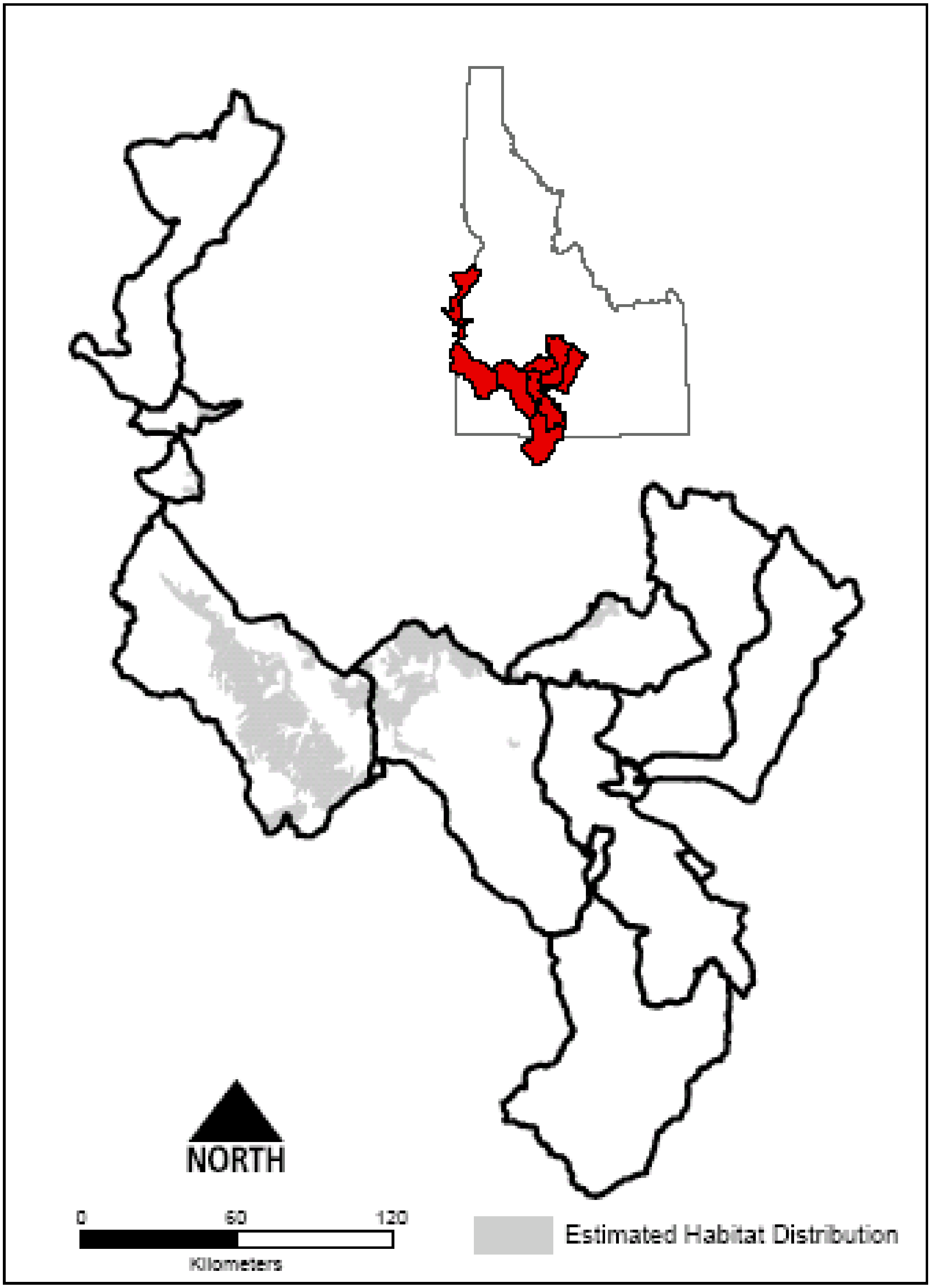

Figure 50. Estimated habitat distribution for mountain quail in the Idaho portion of the Middle Snake subbasins (Lippincott 1997)

Willow Flycatcher

The willow flycatcher (*Empidonax traillii*) is a common migratory bird species that breeds in a variety of riparian habitats. Willow flycatchers over-winter in southern Mexico and northern South America in habitats similar to those occupied on the breeding grounds. There are five subspecies of *E. traillii*; only one, *E. traillii adastus*, is found in the Middle Snake subbasins.

A small bird, the willow flycatcher is between 13 and 17 cm long (Godfrey 1986) and weighs on average 16 g (Dunning 1984). It has a grayish-green back and wings, whitish throat, light gray-olive breast, and pale yellowish belly. The bird has a distinctive eye ring and white wing bars. Its bill is dull yellow-orange or pinkish on the lower mandible and blackish on the maxilla. The sexes are similar in appearance, except during the breeding season when females develop a brood patch.

The willow flycatcher breeds between early May and late July. The female selects a nesting site and builds the nest while the male perches nearby (Gorski 1969). Generally, the nest is built low in the crotch of a bush or small tree near water (Hoffmann 1927). Female willow flycatchers lay between three and four eggs, occasionally five (Holcomb 1974). Eggs are incubated for about 14 days (McCabe 1991), the female generally performing all incubation duties (McCabe 1991). Both adults feed the young, but the female plays a major role (Holcomb 1972, McCabe 1991). The chicks fledge at about 14 to 15 days from hatch. The first few days after fledging, fledglings often huddle together on the same perch and remain near the nest for three or four days; they then follow the adults until 24 to 25 days old (Walkinshaw 1966). Willow flycatchers begin breeding at their first year and may live for up to 11 years (Sedgwick 2000).

Predators of willow flycatcher include the cooper's hawk (*Accipiter cooperi*), great horned owl (*Bubo virginianus*), red squirrel (*Tamiasciurus hudsonicus*), fox (*Vulpes* spp.), and striped skunk (*Mephitis mephitis*). Most nest predation is believed to be mammalian, including the long-tailed weasel (*Mustela frenata*), mink (*M. vison*), and voles (*Microtus* spp.) (Paxton et al. 1997, Stoleson and Finch 1999). Mule deer might trample some nests, and cattle grazing in riparian areas might knock over nests as they move through riparian vegetation (King 1955, Valentine et al. 1988).

Because the willow flycatcher is restricted to river corridors, it is vulnerable to human activities that may alter or change such habitats, including river dewatering, canalization, overgrazing, dam construction, and urbanization. Willow flycatchers will not even attempt nesting in the absence of water (Johnson and Winter 1999).

Willow flycatchers primarily forage aerially for insects but will occasionally feed on fruit. Drinking has not been reported, and water needs are presumably met from their insect diet (Sedgwick 2000).

The Breeding Bird Survey (BBS) for 1966 to 1996 shows a survey wide, significantly decreasing trend for the species of 2.5% average per year (Sauer et al. 1997). Willow flycatchers are occasionally observed along three of the breeding survey routes in the subbasin, not possible to determine population trends from these observations. The willow flycatcher was a rare visitor in the Hagerman Valley in spring (Holthuijzen 1995).

Table 41. Numbers of willow flycatchers observed on breeding bird survey routes in the Middle Snake subbasins

Year of survey	Route name, state, general location				
	Triangle	Picabo, ID	Newbridge, OR	Magic Mountain, ID	Hells Canyon, OR
	Castle Creek Drainage	Silver Creek Drainage	Clear and Fish Creek Hells Canyon Area	Rock Creek Salmon Falls Creek Drainages	Pine Creek Drainage Hells Canyon Area
1985	0	NS	NS	NS	NS
1986	0	NS	NS	NS	NS
1987	0	NS	NS	1	NS
1988	0	3	NS	2	NS
1989	0	3	NS	0	NS
1990	0	0	NS	1	NS
1991	1	NS	NS	0	NS
1992	0	NS	0	0	NS
1993	0	0	0	1	NS
1994	0	NS	1	2	NS
1995	0	NS	0	NS	1
1996	NS	0	1	NS	1
1997	NS	1	0	2	NS
1998	0	1	NS	NS	0
1999	0	0	NS	0	NS
2000	NS	1	NS	0	NS
2001	0	1	0	0	NS
2002	0	NS	NS	0	NS

Not surveyed

Limiting factors for willow flycatchers may include predation, brood parasitism, and weather (Sedgwick 2000). Additional anthropogenic impacts to willow flycatchers are structures (e.g., towers) encountered by nocturnal migrants, alteration of riparian zones, and habitat degradation. Grazing can induce soil compaction and gullying, reduce amounts of willows, and alter willow height and volume (Harris et al. 1987). Reducing cattle grazing and eliminating willow cutting and spraying resulted in increases in densities of willow flycatchers in Oregon (Taylor and Littlefield 1986). Willow flycatcher abundance was greater in areas that were relatively undisturbed (Taylor l986).

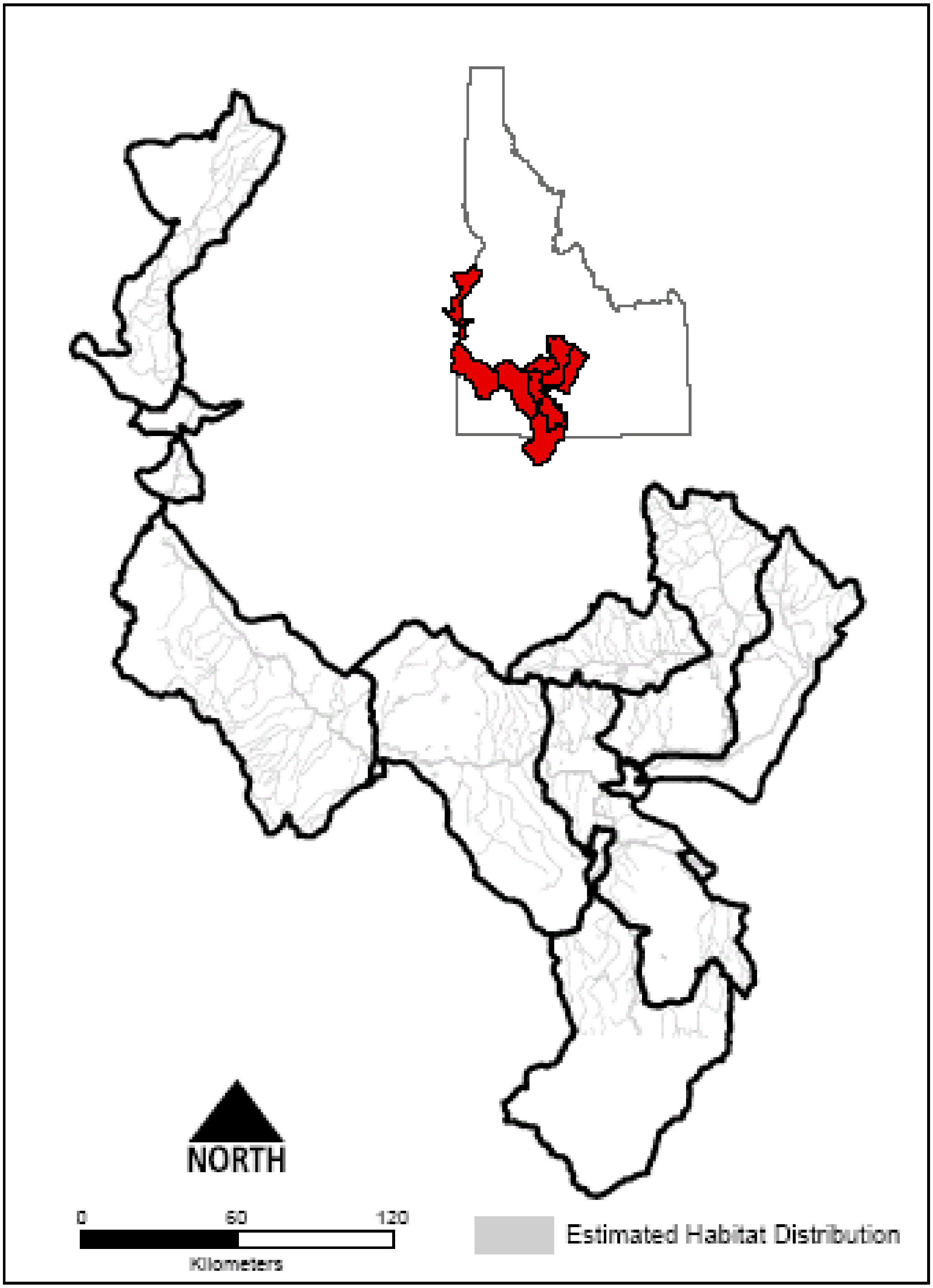

Figure 51. Estimated habitat distribution for willow flycatcher in the Idaho portion of the Middle Snake subbasins (IDFG 2003)

Willow (*Salix* spp.)

Willows were selected as a group to represent the riparian/wetland/spring focal habitat type as they are an important source of food and cover for a variety species. Willows are a preferred food of moose and beaver (as well as a source of lodge building material by beaver). Willow pollen is also an important food source in spring for honeybees. In the West, willows (Salix spp.) are considered to be more palatable to sheep, although cattle may make greater use of them as they tend to frequent riparian areas (USFS 2004). Willows support aquatic systems by reducing stream temperatures through shading and provide erosion control on disturbed sites by stabilizing streambanks. Willow species are valuable in revegetating disturbed areas as they are capable of colonizing a wide range of riparian sites. Planting willow stem cuttings has been recognized as a valuable tool for restoring riparian habitats and should be emphasized (USFS 2003c). High density willow plantings (cuttings planted on 18 inch [45 cm] centers) used to stabilize eroded stream banks in the Pacific Northwest cost about $6,000/acre ($14,800/ha) in 1979. This was a considerable savings compared to a 20-foot (6 m) high rock riprap at about $40,000/acre ($98,800/ha) (USFS 2004). Willow are also culturally important as they all produce salacin, which is closely related chemically to salicylic acid, the active ingredient in aspirin. Native Americans used the leaves of willows to treat mosquito bites, bee stings, and stomach aches. They also used the stems for implements such as baskets, arrow shafts, scoops, and fish traps (USFS 2003c).

Seven species of willow have been documented by IDCDC (2001) in the Middle Snake subbasins, arroyo willow (*S. lasiolepis*), booth willow (*S. boothii*), wolf's willow (*S. wolfii*), coyote willow (*S. exigua*), geyer willow (*S. geyeriana*), whiplash willow (*S. lasiandra* ssp. *caudata*), and yellow willow (*S. lutea*). Jankovsky-Jones (1997) found shrublands dominated by willows and other shrubs to be common throughout the Big and Little Wood River, and Camas Creek drainages. Tall willow shrublands, at lower elevations on larger river systems such as the Big Wood River, have coyote willow (*S. exigua*), yellow willow *(S. lutea),* and whiplash willow *(S. lasiandra* ssp. *Caudate).* The low elevation willows, wolf's's willow *(S. wolfii),* and planeleaf willow *(S. planifolia* var. *monica)*, occur at upper elevations in association with streams, springs, or seeps. At mid to upper elevations willow dominated vegetation is associated with low gradient meandering channels, dominated by geyer's willow (*S. geyeriana*) and booth's willow *(S. boothii)* with lesser amounts of drummond's willow *(S. drummondiana*).

The arroyo willow is associated with three rare plant associations (arroyo willow/barren, arroyo willow/mesic graminoid, and arroyo willow/red-osier dogwood) in the Middle Snake subbasins (IDCDC 2001). This species of willow grows as an erect, branching shrub or small tree up to 30 feet. Arroyo willows inhabit a wide range of areas, common along stream banks and in dry stream beds, in cismontane to montane plant communities to an elevation of 7000 feet and occasionally on the desert. The arroyo willow blooms in February to April.

The booth willow is associated with four rare plant associations in the subbasin (IDCDC 2001). This is a tall willow species is frequently found on alluvial terraces with beaver activity (beaver dams raise the local water table), along streams, and near seeps or springs. This community has adapted to spring floods and prefers groundwater levels within 1m of the surface the rest of the year (MNHP 2002). Livestock grazing in this association should be avoided when soils are wet to avoid churning of the soil surface. Booth willow stands exposed to heavy browsing pressure usually show signs of reduced vigor, such as highlining, clubbing, or dead clumps, with eventual decrease in willow coverage. The East Fork Wood River site surveyed by Jankovsky-Jones (1997) includes a 4 mile sinuous reach of the East Fork in a moderately wide valley bottom. The reach includes riparian shrublands, dominated by booth willow and geyer's willow. High quality occurrences of booth willow are present near Trail Creek in Blaine County.

The wolf's willow is generally associated with dry community types and typically occurs in meadows, on lower toeslopes, and on benches or terraces associated with broad valley bottoms. Cover value and browse potential are low to moderate due to the short stature and low palatability of wolf's willow. The presence of tuffted hairgrass (an associated species) is indicative of sites where little or no grazing has occurred, and has been documented in the Middle Snake subbasins (IDCDC 2001). The response of wolf's willow to fire is unknown. Prescribed burns may be a method to rejuvenate decadent clumps. It is suggested that hot, quick fires would result in more sprouts than slower fires. Beaver frequently play a role in the maintenance of hydrology associated with sites dominated by wolf's willow. Removal of beaver from these systems should be evaluated closely. In areas where streams are downcut, the use of rock check dams may aid in rehabilitation of areas impacted by a lowered water table. Rooting of cuttings of wolf's willow is erratic. Cuttings should first be rooted and nursery grown to ensure survival. Best results are obtained from cuttings taken in the spring from dormant two and four year old wood. Cuttings 30-50 cm long and greater than 1 cm produce the best results. At Hill City Marsh in the Big Wood River watershed, the removal of livestock grazing has resulted in an increase in willow cover along channels and voluntary establishment of willows on former agricultural ground (Jankovsky-Jones 1997).

Coyote willow is a small, deciduous shrub growing in moist sands and gravel that requires a minimum of 20 to 25 inches annual precipitation. Coyote willow is associated with four rare willow associations in the Middle Snake subbasins (IDCDC 2001). The 'Silvar' cultivar is often used for stream bank stabilization, riparian site restoration, bioengineering projects, wildlife habitat, and shelter belts. Other uses are for erosion control and promotion of native plant diversity. This species will establish naturally by seed, however, the more common way is by hardwood cuttings taken in late winter (NRCS 2004).

Geyer willow is larger than many associated shrub willows. It grows as a large deciduous shrub or small tree sometimes up to 20 feet tall. Geyer willow is often somewhat removed from the stream's edge, occurring in broad, low gradient valley bottoms. It is usually found in somewhat open stands, occurring as well-spaced individuals with numerous, straight, nearly erect stems. This species is found in scattered mountain ranges in southern Idaho, eastern Oregon, and Nevada which encompass the Middle Snake subbasins (USFS 2004).

Geyer willow is highly palatable to moose and ungulates; widely spaced clumps also allow for easy access and movement. Livestock and wild ungulates prefer geyer willow over drummond willow, wolf's willow, and booth willow. Geyer willow communities also provide excellent habitat for deer and excellent nesting and foraging habitat for a variety of birds (USFS 2004).

Geyer willow is recommended for use in revegetating disturbed riparian areas. It is especially useful for streambank stabilization. It is usually planted as rooted or unrooted stem cuttings as this species contain predeveloped root primordia. Stem cuttings root quickly and develop roots along the entire length of the buried portion about 10 to 15 days after planting. Top-killed geyer willow plants sprout following fire. Quick, hot fires generally result in numerous sprouts per plant. Slow burning fires result in fewer sprouts as these fires often burn down into the roots, reducing geyer willow's sprouting ability (USFS 2004). Geyer willow is associated with two rare willow associations (IDCDC 2001).

The *lasiandra* species (Pacific willow) grows mostly west of the Cascades, but also occurs in moist parts of eastern Washington, northern Idaho, and northwestern Montana. Variety *caudata* (whiplash willow) grows east of the Cascades, especially in the Rocky Mountains. Whiplash willow occurs in four rare willow association in the subbasins (IDCDC 2001). This species typically occurs in early seral communities along river banks or on moist alluvium. It is a fairly important browse for mule deer and is heavily consumed by beaver in the winter. Although cattle will eat it, stands provide limited value for livestock overall, as forage production of grasses and shrubs is often low due to frequent flooding. It was rated as having low palatability for sheep, horses, and cattle. Cuttings from this species root along the entire length of the stem, with roots appearing in about 10 days. If streambank erosion has created a nearly vertical cut bank, slope reshaping may be needed to enhance success of transplants. Under any method of revegetation, sites should be fenced to protect them from grazing and trampling (USFS 2004).

Yellow willow is generally found below 6,000 feet (1,830 m) in Idaho. It is a deciduous shrub, or rarely, a small tree growing up to 23 feet tall. Yellow willow/ bladder sedge is a rare willow association documented in the Middle Snake subbasins (IDCDC 2001). Yellow willow is generally a pioneer or early seral species occurring along streambanks subjected to periodic flooding. In these riparian communities, it is often found with cottonwoods and other willows. Dense stands of yellow willow provide excellent thermal and hiding cover for many wildlife species

It has been reported that yellow willow is universally browsed by livestock. Yellow willow can be used to revegetate disturbed riparian areas by planting cuttings. Unrooted willow stem cuttings should be planted on sites that provide sufficient moisture to start and maintain growth throughout the growing season. Since willows are sensitive to both competition and shading, dense tall grasses will reduce transplant survival. Therefore grasses may need to be removed by cutting or by herbicide application. Generally yellow willow has the ability to sprout from its roots or stem base following fire. Its numerous wind dispersed seeds are important in revegetating areas following fire (USFS 2004).

Jankovsky-Jones (1997) found shrublands dominated by willows and other shrubs to be common throughout the Big and Little Wood River, and Camas Creek drainages. Tall willow shrublands, at lower elevations on larger river systems such as the Big Wood River, have coyote willow (*Salix exigua*), yellow willow *(S. lutea),* and whiplash willow *(S. lasiandra* ssp. *Caudate).* The low elevation willows, wolf's's willow *(Salix wolfii),* and planeleaf willow *(S. planifolia* var. *monica)*, occur at upper elevations in association with streams, springs, or seeps. At mid to upper elevations willow dominated vegetation is associated with low gradient meandering channels, dominated by *Salix geyeriana* (Geyer's willow) and *S. boothii* (Booth's willow) with lesser amounts of *S. drummondiana* (Drummond's willow).

The cumulative effects of fire exclusion, lowered beaver populations, streamside development, grazing, and irrigation diversions have reduced wet meadows, willows, and the general amount of riparian areas in the Big Wood River Management Area of the Sawtooth National Forest (USFS 2000). Overgrazing by livestock can threaten riparian species unless management practices provide protection. When soils are moist, the surface may be churned by livestock, damaging vegetation and compacting soils (USFS 2003c). Willow communities that are becoming old are not regenerating as a result of fire suppression in the Little Wood River and Soldier Creek/Willow Creek Management Areas (USFS 2000). Willows sprout quickly after fire if depth of the burn in the soil is low to moderate. Prescribed fire is widely used as a wildlife management tool to rejuvenate decadent willow stands and stimulate sprouting (USFS 2003c).

Protected community types surveyed in the Big Wood River Basin have an overstory dominated by the coyote willow, geyer willow, and booth willow (Jankovsky-Jones 1997). Additional rare willow occurrences are documented in the Middle Snake subbasins including whiplash willow (four associations), wolf's willow (one association), yellow willow (two associations), and arroyo willow (three associations) (IDCDC 2001). Tall willow shrublands dominated by yellow willow and whiplash willows are represented in managed areas by small isolated occurrences. Significant gains in increasing the acreage of scrub-shrub wetlands in the survey area could be made by fencing tributary streams such as those in the Camas and Big Wood drainages where willow remnants are present as narrow stringers. Additionally, the watershed restoration project in the Willow Creek drainage will provide a model to apply to other watersheds in the basin (Jankovsky-Jones 1997).

The majority of the forested wetlands within protected areas are aspen stands associated with springs in the Silver Creek Valley. All of the major drainages support cottonwood forests with relatively intact hydrologic regimes. Tall willow shrublands (an under protected type in the scrubshrub class) will likely be protected by targeting cottonwood stands. Jankovsky-Jones (1997) recommends protection of 26 sites in the Middle Snake subbasins supporting cottonwood stands in addition to stands providing floodwater storage in urban areas.

Sedges (*Carex* spp.)

Sedges are perennial plants that resemble grasses, grow in shallow water or moist soils, and can reach 4 feet in height. Sedges often grow in thick clusters or tussocks. Stems of sedges are usually triangular. Spikes occur on the upper sections of the plant and can be single or in groups. Plants are usually monoecious with male and female flowers separate (Agricultural Extension Office 2000).

Sedges were selected as a group to represent the riparian/wetland/spring focal habitat type because sedges provide important food and habitat for wildlife and are important for minimizing erosion and stabilizing stream channels. Additionally, many sedge species are susceptible to human influenced disturbance and are experiencing declining population trends. Sedge species are being replaced by less desirable grass species as a result of livestock grazing in riparian areas in the area (USFS 2000).

Ten species of the Carex genus tracked by the Idaho CDC (IDCDC 2001) have been documented to occur in the subbasins. Global ranks for these species range from G2-G5, while state ranks range from S1-S4. Rare Carex species observations in the subbasin are most common in the Big

Wood and Little Wood River drainages, this is likely due to more intense surveys in this area as well as the abundance of suitable wetland habitats. Available descriptions of the habitat use, population trends, importance to wildlife and mangement considerations for the rare Carex species of the subbasin follow. These descriptions are summarized from those available in Jankowsky-Jones (1997, 2001).

Table 42. Rare Carex species documented in the Middle Snake subbasins by the IDCDC (2001).

Common Name	Scientific Name	Global Rank	State Rank	Number of observations in IDCDC database in subbasins	Location of observations
Water sedge	Carex aquatilis	G5	S4	2	Big Wood, Little Wood
Buxbaum's sedge	Carex buxbaumii	G3	S1	2	mid-elevation Little Wood
Woolly sedge	Carex lanuginosa	G3	S2	6	mid-upper Camas, mid-upper Big Wood, mid-upper Little Wood
Small wing sedge	Carex microptera	G4	S3	1	upper Camas
Nebraska sedge	Carex nebrascensis	G4	S3	5	mid-upper elevation Big Wood, mid-upper elevation Little Wood, mid-upper elevation Salmon Falls, mid-upper elevation Camas
Clustered field sedge	Carex praegracilis	G2	S2	2	upper Camas, lower little wood
Short-beaked sedge	Carex simulata	G4	S2	4	mid-upper Camas, mid-upper Big Wood, mid-upper Little Wood
Mt. Shasta sedge	Carex straminiformis	G4	S2	2	upper Big Wood, upper Little Wood
Foothill sedge	Carex tumulicola	G4	S1	1	Reynolds Creek
Bladder sedge	Carex utriculata	G5	S4	6	mid-upper elevation Big Wood, mid-upper elevation Little Wood, mid-upper elevation Salmon Falls

Water sedge

Water sedge (*Carex aqualtilis*) stands are located in wet depressions such as broad meadows, toe slope seeps or gentle slopes below seeps, flat alluvial terraces adjacent to streams, and swales formed by abandoned channels. The water table in suitable *Carex aqualtilis* habitat remains at or near the soil surface throughout the growing season. Available water capacity is moderate to high. Suitable soils have a high organic matter accumulation, typically 30-120 cm thick. Moss ground cover is usually high in these habitats.

Waterfowl may use wetter extremes of this type for foraging (Hansen et al. 1995). This type may provide early spring forage for deer when adjacent uplands are still covered by snow. Streams are generally too small or intermittent to support salmonids (Kovalchik 1987).

Buxbaum's sedge

Buxbaum's sedge (Carex buxbaumii) is a well-marked and distinct species. The light-gray green, densely-papillate perigynia give the inflorescence a distinctive coloration that makes field inventory for flowering stems rather easy. Buxbaum's sedge is distributed throughout the boreal regions of the Northern Hemisphere; although it is widespread, it is relatively uncommon and infrequently collected. In the western United States it reaches as far south as Colorado, Utah, and central California, but is not recorded for Nevada (Jankovsky-Jones 1997).

Buxbaum's sedge is known from five widely disjunct areas of Idaho: 1) Island Park (Fremont Co), 2) the Sawtooth Valley (Blaine and Custer counties), where it is found along lake edges and associated wetlands; 3) Tule Lake (Valley Co), where one population is known; 4) Kaniksu NF (Bonner and Boundary counties) where several populations are known from the Priest River Valley and Selkirk Mountains; and 5) Silver Creek populations, which occur in the Middle Snake subbasins.

In the subbasin Buxbaum sege occurs on substrates that are saturated to the surface season-long and along slow-moving stretches of the stream channel. The species always occurs on soils that are high in organic matter.

The populations of Buxbaum's sedge at Silver Creek are on land managed by The Nature Conservancy. This includes lands held both fee title and under conservation easements. No threats to the population were observed. Potential threats could include invasion of reed canary grass where populations are present along spring channels. Currently the Silver Creek populations of Buxbaum’s sedge at Silver Creek are extensive and appear viable (Jankovsky-Jones 1997).

Wolly Sedge

Wolly sedge *(Carex lanuginosa)* is distributed in Colorado, Utah, Idaho, Montana, British Columbia, Washington, and Oregon. It usually occupies former active fluvial surfaces along low to moderate elevation floodplains and headwater basins or meadows. Stands may occur in depressions and swales at the saturated edge of stream channels or in seasonally standing water.

Surface textures range from fine sandy to sandy clay loams on floodplains, to organic loam in the basins (Kovalchik 1987). Floodplain soils are often flooded during spring runoff and the water table is well downin the rooting zone (within 1 m of the surface) by mid summer. The basin sites have higher water tables and are moist through most summers (Kovalchik 1987).

Wolly sedge appears able to withstand moderate grazing pressures, though overuse of stands may increase the presence of invasive species. Trampling by livestock as well as heavy machinery use may result in compaction or displacement of soils (Padgett et al. 1989). Vegetation composition and structure can be altered due to impacts such as water development, recreational activities, or agriculture. With management intervention such as grazing schedules, fencing, education, and stream rehabilitation to elevate water tables, moderately disturbed stands recover rapidly due to the rhizomatous habit of the sedge (Kovalchik 1987). Prescribed fire is a useful tool onthis type. Fire can be used in spring or late smmer to help reduce litter accumulation and competitors. Woolly sedge should be very resistant to damage by ground fire (Kovalchik 1987, Hansen et al. 1988). This species is useful for improving degraded riparian sites. Long, creeping rhizomes form a dense mat, effectively stabilizing streambank soils (Hansen et al. 1988).

Landforms containing woolly sedge provide important habitat for raptors, deer, and elk (Kovalchik, 1987). Wet stands of the type may provide nesting and feeding areas for waterfowl (Hansen et al. 1995).

Nebraska sedge

The Nebraske sedge (*Carex nebrascensis)* plant association has been documented in every western state, with the possible exception of New Mexico and Washington (Manning and Padgett 1995).

This association typically occurs at low to mid-elevations in the mountains, ca. 3,300 to 9,200 feet depending on latitude. It most often occurs in meadows and on broad alluvial terraces, but it is also found around seeps. It is most commonly associated with fine-textured mineral soils (Mollisols, Andisols, Entisols, and rarely occurs on organic substrates (Histisols). Water tables are typically at or near the surface, at least in the early growing season, occasionally dropping to more than 1 m. Although stands can occur near streams and rivers, the high water tables found in this type appear to result from lateral subirrigation rather than fluvial flooding. Valley bottom widths can range from very narrow to very broad (typically moderate to broad). Gradients are typically low although there is a wide range of variability.

Nebraska sedge is very palatable to livestock. It is an excellent soil binder in wet meadows. Several studies suggest that management of this associationshould allow for regrowth at the end of the grazing season to replenish carbohydrate reserves for winterrespiration and early spring growth. The typically wet, fine-textured soils are susceptible to compaction and hummocking by excessive livestock use particularly if the sod layer is broken. Grazing value ratings are high for elk, cattle and horses, and medium for sheep and deer. Nebraska sedge also provides food and cover for waterfowl. The erosion control potential rating is high. It is valuable for streambank stabilization because of its strong rhizomes and dense roots (Manning and Padgett 1995).

Short-beaked sedge

The short-beaked sedge (*Carex simulata*) community type is a minor type which occurs near the South Fork of the Salmon River and throughout the Centennial Mountains of Idaho (Mutz and Queiroz 1983). Stands are located in wet depressions such as broad meadows, toe slope seeps or gentle slopes below seeps, flat alluvial terraces adjacent to streams, and swales formed by abandoned channels on organic soils. Water tables remain at or near the soil surface throughout the growing season.

The strongly rhizomatous short-beaked sedge appears to form a dense, stable community (Padgett et al. 1989). Continually high water tables limit the successful establishment of most other species. A lowered water table may result in site conditions similar to those of the C. utriculata habitat type. Due to the season long high water table, the sites are often inaccessible and minimally disturbed (Hansen et al. 1995). Short-beaked sedge appears able to withstand moderate grazing pressures, though impacts on soils may include hummocking and pitting (Padgett et al. 1989). Long rest periods may be required to maintain or improve a grazed short-beaked sedge plant community (Hansen et al. 1995). Prescribed fire is not a useful tool on this type. If the soil surface becomes dry, the organic soil may be quite flammable and fire will penetrate the soil and destroy sedge rhizomes (Kovalchik 1987).

Mt. Shasta sedge

Mt. Shasta sedge (*Carex straminiformis*) typically occurs in alpine cirque basins; with granite substrate. Mt. Shasta sedge grows in dense tufts up to 4 dm tall. The leaves are crowded near the base and are generally much shorter than the culms. The leaves are rather firm, flat or nearly so, and mostly 2-4 mm wide. The spikes occur 3-10 in the inflorescence, are about 1 cm long or less, and are closely crowded in a compact head. Mt. Shasta sedge is distributed in the Sierra Nevada and White Mountains of California and adjacent Nevada, north irregularly to southern Washington. It is disjunct in the Wasatch Mountains of central Utah (Salt Lake and Utah Counties) and in central Idaho (Cronquist 1969 cited in Moseley 1993). Mt. Shasta sedge is a rare species and is proposed sensitive species in the Big Wood and Little Wood River Management Areas of the Sawtooth National Forest (USFS 2000).

Nine populations are now known from south-central Idaho, in Custer, Blaine, Boise, and Valley Counties. Two observations of Mt. Shasta sedge in the Middle Snake subbasins have been reported to the IDCDC. Both of these observations occur on the Sawtooth National Forest along the ridge separating the Big Wood drainage from the Salmon subbasin. On of these observations occurs in the headwaters of the Little Wood River and the other in the headwaters of the Big Wood River (IDCDC 2001). In 1993, Moseley observed that the upper Little Wood River population of Mt. Shasta sedge was isolated from any obvious anthropogenic threats (1993).

3.5.3 Terrestrial Limiting Factors

The Middle Snake subbasin terrestrial technical team identified six factors as the primary limiting factors to terrestrial species in the subbasin. The extent of the impact of these limiting factors varies spatially within the subbasin. The terrestrial technical team attempted to illustrate this spatial variation by habitat type and by 4th field HUC (Table 43; Table 44). Altered fire regime, grazing and browsing, and invasive exotics have the most widespread impacts, with each limiting factor identified to affect all but one of the habitats in the subbasin (Table 43). Invasive exotics was the limiting factor identified to have the most severe impact of any limiting factor in the subbasin; this limiting factor was identified as having sever impacts in all but the Brownlee 4th field HUC (Table 44). Each of the limiting factors and its impacts on terrestrial species is discussed below. Strategies for reducing the impact of the limiting factors on the terrestrial and aquatic species in the subbasin were developed by the Middle Snake subbasins technical team in the Middle Snake subbasins management plan.

Table 43. Focal habitat types and associated limiting factors in the Middle Snake subbasins.

Focal Habitat Type	Altered Fire Regime	Grazing/ Browsing	Altered Hydrologic Regime	Timber Harvest	Land-Use Conversion	Invasive/ Exotics
Shrub-steppe	x	x			x	x
Dwarf shrub-steppe	x	x			x	x
Native grasslands	x	x			x	x
Desert playa and salt scrub	x	x			x	x
Pine/fir forest (dry, mature)	x			x	x	x
Aspen	x	x				
Riparian/ wetlands/springs		x	x		x	x

Table 44. Rankings of the impacts of limiting factors for each watershed in the Middle Snake subbasins (3 = low, 2 = moderate, 1 = severe).

Watershed	Altered Fire Regime	Grazing/ Browsing	Altered Hydrologic Regime	Timber Harvest	Land-Use Conversion	Invasive/ Exotics
Brownlee Reservoir	2	3	1	3	0	2
Middle Snake River—Payette River	1	1	1	0	2	1
Middle Snake River—Succor Creek	1	1	1	0	2	1
C.J. Strike Reservoir	1	1	1	0	2	1
Upper Snake River—Rock Creek	1	1	1	2	2	1
Salmon Falls Creek	1	1	3	3	3	1
Big Wood River	2	2	2	2	3	1
Little Wood River	2	1	1	3	2	1
Camas Creek	2	1	1	0	2	1

Invasive/Exotics

Invasive plant and animal species–also referred to, as exotics, non-natives, introduced, or nonindigenous species–are organisms that have expanded beyond their native range or have been introduced from other parts of the world. Species are considered invasive if their presence in an ecosystem will cause environmental harm, economic harm, or harm to human health. Invasive species can displace native species, alter predator-prey relationships, destroy crops, and decrease ecosystem resiliency (EPA 2001). Some species were introduced into the wild intentionally, while others have been introduced unintentionally and expanded on their own. Invasive species are usually non-native species, and they are often exotic species from another part of the world. Native species can also be characterized as invasive if they dominate their ecosystem due to human induced changes to that ecosystem (EPA 2001).

Of particular concern in the Columbia River Basin are introduced weedy plants, which are invading rangelands, forests, and riparian ecosystems at an alarming rate. Human activities such as grazing of livestock or logging, with its associated road networks, often disturb biotic communities enough to allow establishment and in some cases domination of invasive species. Control of infestations has been difficult, and the ecological consequences have been serious. Negative impacts include reduction in biodiversity, forage, habitat and aesthetic quality, and even soil productivity. The rapid expansion of exotic weed populations has been a deterrent to restoring native plant communities and re-establishing historic ecological conditions (CPLUHNA 2003, D'Antonio and Vitousek 1992). One study estimates that the total costs of invasive species in the United States amount to more than $100 billion each year (Pimentel *et al.* 1999, WGA 2000). The Nature Conservancy and others list invasive species as the second leading cause in species endangerment nationwide (TNC 2003). About 42% of all federally ESA Threatened or Endangered species are listed because of threats from invasive plants Connelly *et al*. 2000, Perryman 2003, WGA 2000). Preventing the spread and establishment of invasive exotic species in other areas of the subbasins is a priority.

Invasive exotics were identified by the terrestrial technical team as having the most severe impact of any limiting factor in the subbasins (Table 43). They were identified as limiting in every focal habitat with the exception of aspen groves with severe impacts in all but the Brownlee 4th field HUC watershed (Table 44). Table 45 summarizes grazing threats identified to be impacting Columbia Plateau conservation portfolio sites in the Middle Snake subbasins (TNC 1999). Many of the sites are current (1999) and significant threats, that can potentially be reversed. Additional information regarding each site is provided in assessment section 3.1. While all sites have current and significant impacts, it is not certain whether restoration or eradication efforts will remove the threat.

Table 45. TNC conservation portfolio sites in the Middle Snake subbasins identified as impacted by non native plants (TNC 1999).

Site Name	Scope	Immediacy	Reversible	Understanding of Threat
Alkali Gulch	significant	occurring now	maybe	moderate
Birds of Prey Natural Conservation Area	significant	occurring now	unknown	moderate
Bruneau River–Jacks Creek	significant	occurring now	unknown	moderate
Craters of the Moon	significant	occurring now	maybe	moderate
Succor Creek	significant	occurring now	yes	moderate
Weiser Sand Hills	significant	occurring now	unknown	minimal

There are 21 documented noxious weed species in the Middle Snake subbasins (Table 46).

Table 46. Noxious weeds present in the Middle Snake subbasins (IDSA 2004).

Common Name	Species name	# of land survey sections in subbasins with species occurrence
Field Bindweed	*Convolvulus arvensi*	3227
Canada Thsitle	*Cirsium arvense*	2668
Puncture Vine	*Tribulus terrestris*	2521
Diffuse Knapweed	*Centaurea diffusa*	1985
Rush Skeletonweed	*Chondrilla juncea*	1968
White-Top	*Cardaria draba*	1192
Scotch Thistle	*Onopordum acanthium*	696
Russian Knapweed	*Acroptilion repens*	336
Poison Hemlock	*Conium maculatum*	228
Spotted Knapweed	*Centaureai maculosa*	158
Dalmation Toadflax	*Linaria dalmatica*	108
Leafy spurge	*Euphorbia esula*	100
Black Henbane	*Hyoscyamus niger*	80
Purple Loosestrife	*Lythrum salicaria*	79
Perennial Pepperweed	*Lepidium latifolium*	64
Dyers Wood	*Isatis tinctoria*	48
Musk Thistle	*Carduus nutans*	29
Jointed Goatgrass	*Aegilops cylindrica*	11
Yellow Starthistle	*Centaurea solstitia*	6
Yellow Toadflax	*Linaria vulgaris*	6
Buffalo Bur	*Solanum rostratum*	4

Noxious weeds pose significant long-term threats to ecosystem health. These species reduce plant biodiversity, habitat quality and quantity and generally lower the ecological quality of the habitat. Shrub-steppe communities are particularly threatened by the expansion of cheatgrass, which has contributed to an increased fire frequency and conversion of sagebrush-steppe habitat to annual grasslands (Keane et al. 2002).

Altered Fire Regime

Fires are a natural component of the ecosystem, which help to determine the distribution, composition and structure of vegetation. While Native Americans are known to have used fire, major changes in natural fire regimes began with the arrival and settlement of Anglo-Americans in the area. Because settlers saw fire as a threat, they actively suppressed it whenever they could. in some areas of the subbasin these attempts have been very successful, while in others the introduction of exotic grasses particularly cheatgrass (*Bromus tectorum*), has resulted in dramatically shortened fire return intervals. Both of these types of fire regime alterations have resulted in changes in the vegetative communities and ecosystem processes in the subbasins. These changes have had numerous far reaching impacts on the wildlife populations that depend on these communities.

Fires that burn in sagebrush communities usually result in total mortality, causing sage grouse and other species to relocate into unburned areas. Herbaceous plants usually re-establish themselves within 3 to 5 years, while sagebrush takes 10 to 15 years. Habitat loss and conversion have reduced or eliminated opportunities for sage grouse to relocate following a burn (USFS 2003b). Wildfire with failed suppression has been and will continue to be an important factor for causing changes in sagebrush communities (USFS 2003b).

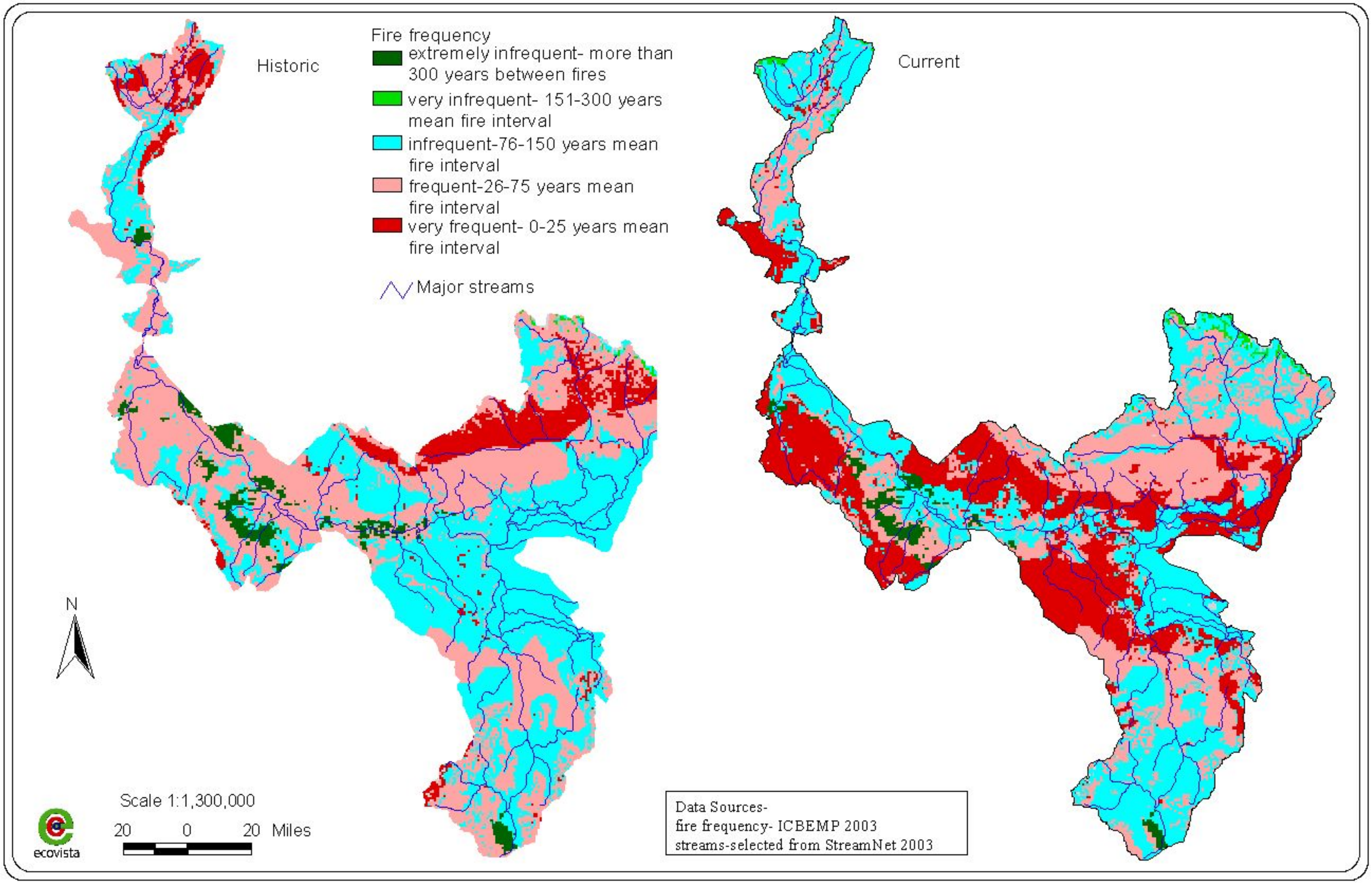

Figure 52. Changes in fire frequency between historic (1900) and current (1995)

Causes and impacts of increased fire frequency

Fires can have a devastating and long-lasting effect on shrub-steppe communities. Sagebrush species are highly susceptible to fire injury. Although big sagebrush communities will carry fire, low fuel productivity resulted in a fairly low rate of spread prior to the invasion of cheatgrass. Sagebrush are very slow growing and in areas where fires are now much more common than they were historically sagebrush and other shrub species have been reduced or eliminated.

High livestock stocking levels combined with 14 years of below normal precipitation that culminated in the severe drought of 1934, resulted in drastic reductions in native understory grasses. The decline in native understory vegetation cover provided exotic annuals such as Russian thistle (*Salsola iberica*), tumble mustard (*Sisymbrium altissimum*) cheatgrass (*Bromus tectorum*), halogeton (*Halogeton glomeratus*), bur buttercup (*Ranunculus testiculatus*), and medusahead wildrye (*Taeniatherum caput-medusae*) the opportunity to invade (USDI 1995). These species are now widespread in grassland, sagebrush and riparian communities in the subbasin (USDI 200c, USDI 1995, USDI 1999).

The addition of cheatgrass and other annuals to the sagebrush/bunchgrass community, has resulted in a shortening of fire return intervals (USDI 1999). Cheatgrass dries earlier in the season than native bunchgrasses forming a continuous, fine fuel source that ignites easily and allows fire to spread rapidly (DAF 1998). Cheatgrass produces heavy seed crops and readily reseeds itself after fires (USDI 1995). In years when above average precipitation falls in the spring more and larger fires develop due to increased grass production and a greater availability of fine fuels once these grasses dry (USDI 1998). Big sagebrush is highly susceptible to fire injury and slow growing; in areas where fires are now much more common than they were historically sagebrush and other shrub species have been reduced or eliminated.

From 1981 through 1986 wildfires resulted in extensive loss of shrub communities within the Snake River Birds of Prey NCA. During this period, over half of the shrub cover in the area burned causing a massive conversion of shrub communities to annual vegetation types. Attempts to rehabilitate the burned shrub stands through reseeding or natural replacement was largely unsuccessful due to the effects of 7 years of drought from 1987 to 1993 (USDI 1995). Similar large fires have occur in many of the lower elevation shrub-steppe habitats of the subbasin in recent years.

Reductions in the extent of perennial grass and shrub communities have resulted in reduced suitability of the subbasin for a multitude of wildlife species. Perennial grass species are preferred as browse over annual grasses by many species including the Townsend's ground squirrel. Lack of shrub cover has been shown to result in reductions in black-tailed jack rabbit populations. Townsend's ground squirrel and black-tailed jack rabbits are the primary prey species of raptors in the Snake River Birds of Prey area and reductions in their populations would eventually reduce the ability of the subbasin to support raptors (USDI 1995). Loss of shrub species in has reduced the suitability of the subbasin for sharp-tailed grouse and likely contributed to their reduced range. Reductions in sagebrush cover may have negatively effected sage grouse and other sagebrush dependent species. Reductions in perennial grass coverage and loss shrubs has reduced the range of big game species in the subbasin (USDI 2001b).

Impacts of reduced fire frequency

In the higher elevation and forest habitats of the subbasin effort at fire suppression have been more successful. Reductions in fire frequencies have also had dramatic impacts on the vegetative communities and wildlife habitats of the subbasins.

Longer time periods between fires (lengthened fire intervals) at higher elevations (higher precipitation zones) have allowed various junipers and/or pinyon pines and Douglas fir/lodgepole pine to encroach into mountain sagebrush-grassland communities. In the Great Basin, juniper and pinyon are relatively long-lived species (approximately 1,000 and 600 years, respectively). Depending on specific location, however, 66 to over 90% of individual trees are less than 130 years old. Fire return intervals have increased from 12-25 years to over 100 years. These communities lose the perennial herbaceous understory as the canopy closes in large part due to competition from the encroaching conifers. This encroachment further leads to unmanageable fuel loads and very intense fires resulting in final loss or elimination of perennial herbaceous understory species, and loss of the original sagebrush habitat. Without a healthy herbaceous understory, these disturbed communities become susceptible to cheatgrass or other invasive species establishment, further reducing habitat quality for sagebrush obligates and other species both wild and domestic that utilize sagebrush habitats.

Prior to settlement, juniper was primarily confined to rocky ridges or surfaces with sparse vegetation. Extensive livestock grazing pressure between 1880 and 1930, reduced the availability of fine fuels and combined with fire suppression resulted in a lengthening of fire return intervals. (USDI 1999). Juniper expansion is prevalent in the southern potion of the subbasin particularly in the area of Reynolds Creek (USDI 1999). Most expansion has been into big sagebrush communities, although open meadows, grasslands, aspen groves, and riparian communities have also been impacted (USDI 1999).

Even though the life span of western juniper exceeds 1,000 years, the oldest living western juniper currently reported over 1,600 years old; the vast majority of the juniper plants in the subbasin are <100 years. These young juniper stands appear to be considerably denser than the pre-settlement stands preceding them (Quigley and Arbelbide 1997).

Juniper expansion can increase habitat suitability for some wildlife populations while reducing it for others. Juniper expansion into sagebrush habitats results in reduced understory forage production reducing mule deer winter range and browse availability for deer and other grazing species. Alterations of low and big sagebrush structure attributable to the expansion of western juniper have the potential to be deleterious to sage grouse and other sagebrush dependent wildlife populations (Quigley and Arbelbide 1997). Juniper expansion into the riparian zone has contributed to the reduction or elimination of quaking aspen a species with exceptional importance to many wildlife species (USDI 1999). In some areas western juniper has been implicated in reduced infiltration and increased runoff and erosion (Quigley and Arbelbide 1997). However, juniper trees can provide cavities for nesting birds and bats and thermal and escape cover for a variety of wildlife species. During severe winters, juniper cover may play a critical role in deer survival (USDI 1998).

Western juniper is very susceptible to mortality from fire and prescribed burns are being considered in an attempt to halt or slow juniper expansion (USDI 1999). This technique needs to be employed with caution though as fire also negatively impacts sagebrush populations and can increase the areas susceptibility to invasion by noxious weeds and cheatgrass. Cutting of juniper is also employed as a control technique in the subbasin (USDI 1999). More research on the impacts of juniper encroachment on wildlife populations and control measure is needed (Quigley and Arbelbide 1997).

The greatest effect of fire suppression on biological diversity is not on the diversity within a particular habitat (Whittaker 1977), but on the diversity of habitats across a landscape. Landscapes with high diversity resulting from fire perpetuate high species diversity by providing opportunities for the establishment and maintenance of early successional species and communities (Connell 1978; Reice 1994). Fire suppression, on the other hand, increases uniformity in habitats as competition eliminates early successional species, leaving only shade-tolerant understory plants to reproduce. Burned landscapes included habitat types dominated by early successional pines, shrubs, or herbaceous species, whereas unburned landscapes were more uniform in their cover of later successional fir-dominated communities (Stuart 2003).

Before the era of fire suppression, fires burned across the landscape at a variety of fire intensities, fire sizes and fire return intervals based upon localized climate, with fire return intervals on a cold/wet to warm/dry gradient. This created a mosaic of stand ages and a variety of vegetation conditions, from meadow and savannah to dense, old forest. Natural landscapes are often created or maintained by burning, and the plants on these landscapes have ways of dealing with natural fire (INFMS 2003).

Each species has a unique set of characteristics that determines how it is affected by fire. Many plants have adapted to fire by evolving protective mechanisms such as thick bark. Fire may stimulate a positive response in other species, which may get bigger and produce more seeds. Even plants that are killed by fire may have coping mechanisms allowing the species to survive fire, even when individuals are burned. They may have hard seeds that survive until fire readies them to grow, or light, easily dispersed seeds that can quickly reinvade a burned area. Most employ some combination of these strategies (INFMS 2003).

Initially, fire suppression was very successful because of low fuel loadings; but without fires to consume them, large fuel loads have accumulated over time (CPLUHNA 2003). Because of heavy fuel accumulations, fires that occur now are more intense and more difficult to contain. In recent years, fires that burned tens and hundreds of thousands of acres have occurred in California, Idaho, Montana, Oregon, Washington, and Wyoming (Martin and Sapsis 1992; Agee 1993; Covington *et al*. 1994; Johnson *et al*. 1994). While most ecosystems occasionally experience very large fires (Romme and Despain 1989), the present-day frequency of large fires is unprecedented.

Grazing/Browsing

One of the most significant human-induced changes affecting the western landscape has been the widespread introduction of domestic livestock. Brought to the Southwest by the Spanish in the late 1500s, cattle and sheep only began to have a significant impact on the region's biota with their large-scale transportation into the region with the arrival of the railroads in the late 1800s. By 1890, hundreds of thousands of cattle and/or sheep were grazing on the rangelands of the west (CPLUHNA 2003). Livestock have played (and continue to play) an important role in changes to ecosystems in the West. For instance, 91% of the public land in the western United States is grazed (Belsky and Blumenthal 1997).

The majority (88%) of the Middle Snake subbasins has grazing allotments, the status and use of which are unknown (ICBEMP 2003). Table 47 summarizes grazing threats identified to be impacting Columbia Plateau conservation portfolio sites in the Middle Snake subbasins (TNC 1999). Many of the sites are current (1999) and significant threats, that can potentially be reversed. Additional information regarding each site is provided in assessment section 3.1.

Table 47. TNC conservation portfolio sites in the Middle Snake subbasins identified as impacted by grazing (TNC 1999).

Site Name	Scope	Immediacy	Reversible	Understanding of Threat
Alkali Gulch	significant	occurring now	yes	good
Birds of Prey Natural Conservation Area	significant	occurring now	unknown	moderate
Bruneau River–Jacks Creek	significant	occurring now	unknown	moderate
Craters of the Moon	significant	occurring now	maybe	moderate
Dry Creek	minor	in the past	yes	minimal
Jarbidge Creek	minor	occurring now	yes	minimal
Salmon Falls Creek	unknown	occurring now	unknown	none
Succor Creek	significant	occurring now	yes	good
TNC Silver Creek Preserve	significant	occurring now	yes	good
TNC Stapp–Soldier Creek Preserve	minor	occurring now	yes	good
Weiser Sand Hills	significant	occurring now	maybe	minimal

The Middle Snake subbasin terrestrial technical team identified grazing/browsing as a primary factor limiting terrestrial species in the subbasins (Table 44). The extent of impact varies spatially within the subbasin; however, every focal habitat type with the exception of dry, mature pine/fir forest habitats was described as limited by grazing/browsing. The impacts of grazing/browsing were rated as severe in 7 of the 9 4th field HUC watersheds in the Middle Snake subbasins. These areas include Middle Snake River/Payette River, Middle Snake River/Succor Creek, C.J. Strike Reservoir, Upper Snake River/Rock Creek, Salmon Falls Creek, Little Wood River, and Camas Creek watersheds (Table 44). The Big Wood River and Brownlee Reservoir watersheds were described as having moderate and low levels of impacts, respectively. Impacts vary with animal density and seasonal distribution.

Impacts to riparian - wetland habitats

Riparian areas are critical ecosystems in the semi-arid landscape of the West, yet in the last few decades many have been seriously degraded and others entirely lost due to human activities and land use. The abundance of food, water, and shade, which attracts wildlife to these areas, also attracts livestock. Despite widespread recognition of the problem and attempts to remove or restrict livestock from riparian areas, riparian degradation due to overgrazing is a serious problem (Belsky *et al.* 1999).

The direct effects of livestock grazing upon the wetland riparian habitats have been summarized as follows (Harper *et al*. 2003):

- Higher stream temperatures from lack of sufficient woody streamside cover.
- Excessive sediment in the channel from bank and upland erosion.
- A high coliform bacterium counts.
- Channel widening from hoof-caused bank sloughing and later erosion by water.
- Change in the form of the water column and the channel it flows in.
- Change, reduction, or elimination of vegetation.
- Elimination of riparian areas by channel degradation and lowering of the water table.
- Gradual stream channel trenching or braiding depending on soils and substrate composition with concurrent replacement of riparian vegetation with more xeric plant species.

Riparian systems at lower elevations are increasingly characterized by a reduction of plant species diversity and density. Overgrazing of palatable species of willows and cottonwood saplings, combined with the introduction of less palatable nonindigenous species such as Russian olive (*Elaeagnus angustifolia*), has contributed to changes in overall plant community structure. Livestock waste may increase nutrient concentrations and bacterial counts in waterways, resulting in exceedances of water quality standards (plan section 5.2: Clean Water Act considerations).

The Spotted Frog, mountain quail, and willow are focal species chosen by the terrestrial technical team to represent riparian/herbaceous wetland habitats that are negatively impacted by grazing/browsing (assessment section 3.5.2: Focal Species Associated with Focal Habitats).

Impacts to shrub-steppe

Livestock may graze plants that are either listed, forage for listed species, or provide cover or protection for listed species. Livestock grazing in shrub-steppe habitats alters species community composition and disrupts ecosystem function, often leading to invasion of non native plants, and a higher frequency of fire (USFWS 1999).

The primary direct impacts from cattle are the grazing of plants and trampling of vegetation and soil (Marlow and Pogacnik 1985). Grazing can alter the prey availability of certain predators by removing herbaceous vegetation, which serves as food, and cover for small mammals (Ward and Block 1995). A reduction in vegetation cover increases raindrop impact, decreases soil organic matter and soil aggregates, and decreases infiltration rates (Blackburn 1984). Other impacts include increased overland flow, reduced soil water content, and increased erosion. Continuous yearlong grazing can result in large bare areas around water sources and creation of established trails to and from points of livestock concentrations.

Impacts to Forests

By grazing and trampling herbaceous species livestock affect understory species composition directly; this differs from the more indirect effects they have on overstory trees (Belsky and Blumenthal 1997). Impacts vary with animal density and distribution: the more evenly grazers are distributed, the lower their impact on any given area (Gillen *et al*. 1984). Unfortunately, cattle show strong preferences for certain environments, leading to high use in some areas and little or no use in others (Belsky and Blumenthal 1997).

Livestock also alter understory plant composition as animals select more palatable species, leaving the less palatable ones to increase in dominance (Smith 1967, Skovlin *et al*. 1976). The effects of livestock grazing on understory composition and biomass are sometimes difficult to distinguish from the effects of tree canopy closure (Smith 1967), which creates shadier, cooler, and moister conditions. However, when Arnold (1950) separated the effects of livestock grazing from those of tree canopy closure, he found that grazing alone was sufficient to reduce the cover of most native bunchgrass species.

Domestic livestock, in addition to other practices that disturb soils, have been instrumental in the establishment of alien weedy species in western forests (Franklin and Dyrness 1973; Johnson *et al*. 1994). Livestock act as vectors for seeds, disturb the soil, and reduce the competitive and reproductive capacities of native species. Exotic weeds have been able to displace native species, in part, because native grasses of the Intermountain West and Great Basin are not adapted to frequent and close grazing (Stebbins 1981;). Consequently, populations of native species have been severely depleted by livestock, allowing more grazing-tolerant weedy species to invade. It is possible that in some areas aggressive alien weeds such as cheatgrass (*Bromus tectorum*) and Kentucky bluegrass (*Poa pratensis*) have permanently replaced native herbaceous species (Smith 1967; Laudenslayer *et al*.1989).

Forest Soils and Plant Litter

By consuming aboveground plant biomass, domestic livestock also reduce the amount of biomass available to be converted into litter and, therefore, increase the proportion of bare ground (Belsky and Blumenthal 1997). Schulz and Leininger (1990) found, for example, that grazed areas of a riparian meadow had 50% lower litter cover and 400% more bare ground than ungrazed areas. Johnson (1956) reported that litter biomass in a ponderosa pine/bunch grass ecosystem was reduced 40% and 60% by moderate and heavy livestock grazing, respectively. Such reductions in litter may have severe consequences on forested ecosystems because litter is critical for slowing overland flow, promoting water infiltration, serving as a source of soil nutrients and organic matter, and protecting the soil from freezing and the erosive force of raindrops (Thurow 1991, Facelli).

Compaction and Infiltration

The rate at which water penetrates the soil surface governs the amount of water entering the ground and the amount running off. Livestock alter these rates by reducing vegetative and litter cover and by compacting the soil (Lull 1959). As a result livestock grazing is usually associated with decreased water storage and increased runoff (Belsky and Blumenthal 1997). Lower soil moisture contents in turn reduce plant productivity and vegetative cover, creating negative feedback loops that further degrade both the plant community and sod structure (Belsky and Blumenthal 1997). These changes in soil structure may also lead to increased water stress and tree mortality during dry periods, exacerbating the water stress resulting from the higher tree densities. Therefore, disturbance and compaction of forest soils by cattle and sheep may contribute to the increased incidence of water-stress, tree mortality, and fire in western forests (Belsky and Blumenthal 1997).

Runoff and Erosion

As livestock reduce plant cover and compact the soil, the volume of overland water flow increases (Belsky and Blumenthal 1997). With increasing runoff, soil erosion also increases (Dunford 1954). Smith (1967), for example, found that grazed pastures in a ponderosa pine/bunchgrass range lost 3-10 times more sediment than ungrazed pastures. The strong relationship between runoff and erosion was also demonstrated by Forsling (1931), who found that summer rainstorms on grazed subalpine hillsides accounted for 53-85% of annual sediment loss. Following elimination of livestock from the watershed, vegetative cover increased 150% whereas the proportion of annual runoff from summer rainstorms dropped 72%, causing a corresponding 50% drop in sediment loss (Forsling 1931).

Big game impacts and dietary overlap with livestock

Numerous studies have documented the impact of grazing and browsing by big game animals upon habitats (Clark 2003). Heavy browsing by big game animals may inhibit shrub and grass cover, alter the plant composition, alter vegetative structure, prevent adequate plant reproduction, or cause direct mortality (Gaffney1941, Korfhage *et al.* 1980, Edgerton 1987 and Irwin *et al.*1994, Nolte and Dykzeul 2000). Generally, big game impacts to the habitat become significant when the animals become so numerous as to exceed the carrying capacity of the habitat. This may occur at spatial and temporal scales depending upon the season and the condition of the habitat (e.g. winter range or naturally or artificially altered (Begon and Mortimer 1986).

Dietary overlap between big game animals and livestock is subject to the specific forage components required by the animals and the timing of ungulate use. Dietary overlap between elk and cattle is most likely to occur on fall cattle range that is used by elk later in the year as winter range. Dietary overlap between elk and domestic sheep occurs during the summer when both species rely heavily on forbs; however, elk tend to be more selective between forb species than do sheep (Clark 2003). Elk tend to remain on a forb-dominated diet throughout the summer while sheep diets transition from forbs to grasses and browse as the season progresses (Clark 2003).

The diets of cattle and mule deer are most prone to overlap during the spring when mule deer diets contain a substantial amount of graminoids. However, spring mule deer diets are primarily dominated by forbs and browse while spring cattle diets contain mostly graminoids. Consequently, the degree of diet overlap between cattle and mule deer is relatively small. The diets of domestic sheep and mule deer overlap during the spring and fall when both ungulates are using browse and forbs. When browse is limited, both domestic sheep and mule deer rely heavily upon graminoids (Clark 2003).

Winter bighorn sheep diets and summer-fall cattle diets have the greatest potential for overlap of any seasonal diet combination between these two ungulates. Under this combination, the diets of both, cattle and bighorn sheep are dominated by graminoids. However, as with elk and cattle, the differences in seasonal habitat use displayed by cattle and bighorn sheep minimizes the potential for dietary competition between these species. Dietary overlap between domestic sheep and bighorn sheep is not understood as well (Clark 2003).

Dietary overlap between cattle and pronghorn is generally considered minimal as the two ungulates do not share significant food sources or ranges. Dietary overlap between domestic sheep and pronghorn is typically the highest during the spring and fall when both species are consuming sizable quantities of browse. However, as with cattle and pronghorn, the degree of similarity between the diets of pronghorn and sheep is generally quite low (Clark 2003).

Altered Hydraulic Regime

Hydrologic regimes play a major role in determining the biotic composition, structure, and function of aquatic, wetland, and riparian ecosystems. In recent decades, growing concern for the protection of biological diversity has led to increased scrutiny of the consequences of human-induced hydrologic alteration to natural ecosystems (Richter *et al.* 1996). Both natural events and human activities affect watersheds. Natural events such as storms, fires, and droughts can suddenly alter watershed conditions at large scales. However, individual human activities typically have smaller and more predictable impacts, but their cumulative impact can be far greater. Increases in population, land development, and economic activity increase demands for water, waste disposal, and raw materials (Meiman and Schmidt 1994). These activities increase pollutant releases to water and air and degrade or fragment natural habitats (EPA 2001).

Habitat Loss and Modification

Human activities such as residential and commercial development, recreation, and resource extraction have changed, fragmented, and destroyed natural habitats. Habitat loss has severe impacts and can be permanent. Wetland habitat losses have contributed to significant declines in waterfowl populations. Forest habitat losses impact many plant and animal species in both aquatic and terrestrial habitats. Forest and wetland losses increase overland flow and reduce filtration of sediments and pollutants, increasing the likelihood that pollutants will reach streams, rivers, and estuaries (EPA 2001).

Habitat modification is less obvious, but detrimental nonetheless. For example, when communities build roads over streams, they modify the stream habitat. Road culverts can prevent fish passage and seriously impact fish populations. Anadromous fish, species that migrate from freshwater to saltwater and back to freshwater, cannot breed successfully if culverts block their migration routes. Anadromous species may have value for recreational and commercial fishermen or they may provide a critical food supply for commercially valuable fish. Urban streams often provide examples of habitat modification. When communities straighten and channelize urban streams and line them with concrete, they modify the vegetative and physical structure of the riverine habitat, increase river velocities during rainstorms, and decrease river volumes during dry periods. Straightened and channelized streams also carry more sediments and chemical pollutants to their receiving waters (EPA 2001).

Farm, forestry, and other rural road construction; streamside vehicle operation; and stream crossings usually result in significant soil disturbance and create a high potential for increased erosion processes and sediment transport to adjacent streams and surface waters. Road construction involves activities such as clearing of existing native vegetation along the road right-of-way; excavating and filling the roadbed to the desired grade; installation of culverts and other drainage systems; and installation, compaction, and surfacing of the roadbed.

Although most erosion from roadways occurs during the first few years after construction, significant impacts may result from maintenance operations using heavy equipment, especially when the road is located adjacent to a water body. In addition, improper construction and lack of maintenance may increase erosion processes and the risk for road failure (EPA 2001).

Hydromodification

People, plants, and animals depend on sufficient water flows in rivers and streams. If stream flows are low, fluctuating, or blocked by physical barriers, these changes can affect many plant and animal species (USDA 1994). These changes can also affect recreational opportunities. Hydromodification has become widespread due to our efforts to capture, control, store, and divert water. These alterations support drinking water supplies, hydropower, irrigation, flood control, manufacturing uses, and recreation. Few human actions have more significant impacts on a river system than dam construction. Dams change upstream and downstream habitats, water temperatures, water quality, and sediment movement. They also block or slow the movement of materials and organisms throughout a watershed (EPA 2001) and increase flooding and subsequent loss of property.

Channelization, which is river and stream channel engineering undertaken for the purpose of flood control, navigation, drainage improvement, and reduction of channel migration potential includes activities such as straightening, widening, deepening, or relocating existing stream channels and clearing or snagging operations (Brookes 1990). These forms of hydromodification typically result in more uniform channel cross-sections, steeper stream gradients, a reduction in average pool depths and altered stream/river flow (EPA 1993).

Channel modification activities deprive wetlands of enriching sediments, change the ability natural systems to both absorb hydraulic energy and filter pollutants from surface waters, and cause interruptions in the different life stages of aquatic organisms (Sherwood *et al*. 1990). A frequent result of channelization and channel modification activities is a diminished suitability of instream and riparian habitat for fish and wildlife. Hardening of banks along waterways has eliminated instream and riparian habitat, decreased the quantity of organic matter entering aquatic systems, and increased the movement of non-point source (NPS) pollutants from the upper reaches of watersheds into coastal waters (EPA 1993). Increased or fluctuating temperatures can harm fish and other aquatic organisms whose life cycles and breeding success are inextricably linked to water temperature. Thermal modification has eliminated many fish species and other aquatic organisms from streams across the nation (EPA 2001).

Channel modification projects usually require regularly scheduled maintenance activities to preserve and maintain completed projects. These maintenance activities may also result in a continual disturbance of instream and riparian habitat. In some cases, there can be substantial displacement of instream habitat due to the magnitude of the changes in surface water quality, morphology and composition of the channel, stream hydraulics, and hydrology (EPA 1993).

Instream hydraulic changes can decrease or interfere with surface water contact to stream bank areas during floods or other high-water events. Channelization and channel modification activities that lead to a loss of surface water contact in stream bank areas also may result in reduced filtering of pollutants by streamside area vegetation and soils. Areas of the stream bank that are dependent on surface water contact (i.e., riparian areas and wetlands) may change in character and function as the frequency and duration of flooding change. Drainage rates from streamside areas were 2.6 times higher in the channelized area than in undisturbed areas during preliminary project activities and 5.3 times higher following construction (Erickson *et al*. 1979). Schoof (1980) reported several other impacts of channelization, including drainage of wetlands, reduction of oxbows and stream meander, clearing of floodplain hardwood, lowering of ground-water levels, and increased erosion (EPA 1993).

Channelization and channel modification activities can lead to loss of instream and riparian habitat and ecosystem benefits such as pathways for wildlife migration and conditions suitable for reproduction and growth. Eroded sediment may deposit in new areas, covering benthic communities or altering instream habitat (Sherwood *et al*., 1990).

Channelization and channel modification projects can lead to an increased quantity of pollutants and accelerated rate of delivery of pollutants to downstream sites. Alterations that increase the velocity of surface water or that increase flushing of the streambed can lead to more pollutants being transported to downstream areas at possibly faster rates. Urbanization has been linked to downstream channelization problems (Anderson 1992). When chemical compounds are introduced into a watershed, they can compromise drinking water systems, contaminate fish, and degrade water quality. Chemicals reach water bodies from many sources, including factories, wastewater treatment plants, cars, boats, lawns, and crop fields. Widespread nonpoint sources of chemical inputs to water bodies from property owners, resource users, and everyday activities continue to threaten watershed health (EPA 2001).

One of the more significant changes in instream habitat associated with channelization and channel modification is in sediment supply and delivery. Channel modification has been linked to accelerated rates of erosion (Hynson *et al*. 1985). These changes in sediment supply can include problems such as increased sedimentation in some areas or decreased sediment in other areas (Hynson *et al*. 1985; Merigliano 1996). Excessive volumes of sediments entering water bodies can diminish water clarity, alter habitats, impair fish spawning success, and increase drinking water treatment costs. Timber harvesting, mining, agriculture, and construction can introduce excessive sediments if improperly managed. These activities remove vegetation and manipulate soils, allowing wind or water to carry loosened sediments to nearby water bodies. Increases in impervious surfaces decrease infiltration of rainwater into soils and increase surface runoff. Increases in surface runoff increase soil erosion and sediment transport to streams, rivers, and lakes (EPA 2001).

Timber Harvest

Logging began in the vast forests of the west in the 1870s and 1880s when materials and supplies were needed for construction of the transcontinental railroad. Subsequent settlement of the frontier by pioneers and immigrants increased the demand for timber products. Shortly after the turn of the century, new technologies allowed greater harvest on terrain previously unavailable for logging. During the mid-century, dramatic increases in timber harvest and road building occurred in the National Forests and private lands throughout the west. An agricultural model of sustainable forestry favoring even-aged stands became the standard of timber harvest operations. During this time, typical harvests removed one-third to two-thirds of the available volume. At these residual-stocking rates, stem density increased while tree size and age decreased (CPLUHNA 2003).

Effects of Timber Harvest on Wildlife

Wildlife is an integral part of any forest. Forests are not static, and changes in forest structure and vegetative species composition will favor certain species of wildlife and deprive others of some elements necessary for reproduction and survival. Timber harvesting can have positive, negative, and neutral effects on wildlife habitat depending on the life requirements of the species inhabiting the area (Cook and O'Laughlin 2000).

One important aspect of the relationship between wildlife and timber harvesting is not how many trees are removed, but how much vegetation remains for food and cover for the species inhabiting the area. Populations of animals of low mobility and specific habitat requirements i.e. amphibians, reptiles, small birds, and small mammals, can be adversely affected at the time of a timber harvest even if the cut is limited to a small area or to a single tree. Highly mobile animals i.e. large birds and mammals are less affected. The age and size classes of trees that remain after harvesting and their spatial relationship are important (Patton 1992).

Land-Use Conversion

Settlers and their livestock began to move into the region during the late 1800s.

A major population boom occurred after World War II and has continued since, particularly in metropolitan areas. These urban populations have tapped the water and energy resources of the region and contributed to heavy recreational use, particularly at popular destinations. With more and more people claiming their share of the region’s water, energy and recreational resources, conflicts between mutually exclusive uses such as eco-tourism, recreational off-road vehicles, and ranching are becoming widespread and chronic (Reisner 1993, Ringholz 1996, Talbot and Wilde 1989).

The population of the Columbia River Basin has increased six-fold since the turn of the century and has more than doubled since the mid-1960s. This growth rate is two-and-a-half times greater than the nation’s rate of 39% for that same period. Population growth is some areas of the Columbia River Basin is now outpacing growth in the western U.S. as a whole, as people fleeing the urbanization of the Pacific Coast move into the intermountain west (USDA 1996).

The fastest growing area in the Columbia River Basin is the State of Idaho with a population growth rate of 28.5% followed by Washington and Oregon with population growth rates of 21.1 % and 20.4% respectively (CensusScope 2003). Ada County in Southwest Idaho saw its population rise from 205,000 people in 1990 to 300,000 people in 2000, an increase of 46% in just ten years (CensusScope 2003).

Recreation, tourism and quality of life issues play a significant role in population increases across the region. The population growth trend and its related development directly challenge community and environmental quality in many ways. Communities throughout the basin are struggling to deal with the impacts of this population growth to agricultural lands, water quality, forests, wildlife and habitat (Worster 1985).

Development

Land conversion on the urban fringe, also called "sprawl", is an important issue to address because it has a number of impacts on the natural environment and human activity. Farm and ranch lands, forests, and other open space are transformed into subdivisions, ranchettes, shopping areas with expansive parking lots, and roads. This carves away at wildlife habitat and wetland/ riparian areas are frequently diminished. The Natural Resources Conservation Service estimates that 6,461,210 hectares were converted in the western states between 1992 and 1997. They further estimate that 2,234,658 hectares of conversion, or about one-third, occurred in non-metropolitan areas (USDA NRCS 2001).

Urban lands grew in Idaho from an estimated 222,658 hectares in 1982 to 305,497 hectares in 1997. This growth primarily came from the conversion of natural resource lands (cropland, pastureland, rangeland and forestland). This is a 37% increase in urban lands. From 1982 to 1997, conversions of resource lands to urban lands were estimated at 38,161 hectares of cropland, 16,551 hectares of pastureland, 9,388 hectares of rangeland, and 15,620 hectares of forestland. This is an estimated total of 79,723 hectares removed from the rural land base for urban uses. The rate of conversion increased from an estimated 4,552 hectares per year between 1982 and 1992 to 6,701 hectares per year from 1992 to 1997. This is an increase of 47.2%. The rate of increase was highest on rangeland, followed by pastureland, cropland, and then forestland.

Sprawl fragments habitat when new developments divide undisturbed habitat. The resulting fragmentation is particularly harmful to wide ranging species that rely on large territories to draw food and cover. Without adequate continuous habitat, a population of large, wide-ranging animals will eventually disappear from an area, with harmful ripple effects felt throughout the ecosystem (USDA NRCS 2001). Sprawl inevitably translates into more roads, which in turn open up previously undisturbed habitat and open space to additional development.

Fragmentation

Habitat fragmentation involves the division of large, contiguous areas of habitat into smaller patches isolated from one another. Some habitats (lakes, riparian zones, archipelagos) are naturally fragmented. Some habitat fragmentation results from natural processes such as fires, floods, and insect outbreaks. Habitat fragmentation has become an increasingly important issue in conservation biology during the last century as human activities shape the environment and landscape (Weclaw 1998). A key hypothesis is that a reduction in the area of a habitat patch can decrease its suitability for animals to a disproportionately greater degree than the actual reduction in area (Johnson 2001). It is obvious that the numbers of a species are likely to decline if its habitat is reduced; fragmentation effects imply that the value of the remaining habitat also is diminished (Johnson 2001).

Three types of fragmentation effects have been distinguished: patch-size effects, edge effects, and isolation effects (Faaborg *et al*. 1993; Johnson and Winter 1999). Patch-size effects are those that result from differential use or reproductive success associated with habitat patches of different sizes (Johnson 2001). Some of the patch-size effects may be induced by edge effects—phenomena such as avoidance, pairing success, predation, interspecific competition, prey availability, parasitism that may be different near the edge of a habitat edge in the interior of a patch (Faaborg *et al*. 1993; Winter and Faaborg 1999). Finally, isolation from similar habitat can influence use of a particular habitat patch because of reduced dispersal opportunities. Each of these factors—patch size, edge effects, and isolation—can affect the occurrence, density, or reproductive success of animals in a habitat patch.

Habitat fragmentation results in both biotic and abiotic changes to the landscape. Fragmentation affects predator – prey relationships, species composition, dispersal, density, distribution, and population genetics, as well as, microclimate variables such as sunlight penetration and temperature (Donovan *et al*. 1995, Greenwood *et al*. 1995, Johnson and Temple 1990, Knopf 1994, Paton 1994, Robinson *et al*. 1995, Weclaw 1998, Whitcomb 1981, Winter *et al*. 2000). Although there is insufficient evidence to suggest that habitat fragmentation is entirely undesirable (Schmiegelow *et al*. 1997) it often results in habitat loss that in turn has contributed to extinction of species (Turner 1996).

Land development in big game winter range (i.e., native grasslands and juniper/mountain mahogany habitat types) is a significant wildlife habitat issue, particularly for mule deer and elk. The amount and quality of winter range is very often the factor limiting deer and elk populations. Subdivision development in winter ranges constitutes a permanent loss of habitat and a permanent reduction of the carrying capacity of the land for big game. This loss of a habitat component in short supply results in fewer deer and elk for hunters (Trent 2000).

Winter range provides two critical needs: shelter and food. At one time wildlife biologists thought food was the most important component of winter range and their efforts were directed to measuring the production of winter range plants and planting desirable species. This was important, but food resources are not the only reason why animals select an area to winter. Of equal, and in some instances more, importance is the microclimate of the winter range and how it enhances the ability of animals to minimize their energy loss during a time of food shortage (Trent 2000).

Slope, elevation, aspect and vegetative cover combine to make some places warmer, more secure and less snowy. Animals wintering in these areas do not deplete their fat reserves as fast and are therefore more likely to survive the winter. When winter ranges are lost to subdivisions this important "place" is lost and cannot be replaced or mitigated by enhancing vegetation in an adjacent area (Trent 2000).

Roads and trails

Table 48. Thirteen road-associated factors with deleterious impacts on wildlife (Wisdom et al. 2000).

Road-Associated Factor	Effect of Factor in Relation to Roads
Snag reduction	Reduction in density of snags due to their removal near roads, as facilitated by road access

Down log reduction	Reduction in density of large logs due to their removal near roads, as facilitated by road access
Habitat loss and fragmentation	Loss and resulting fragmentation of habitat due to establishment and maintenance of road and road right-of-way
Negative edge effects	Specific case of fragmentation for species that respond negatively to openings or linear edges created by roads
Overhunting	Nonsustainable or nondesired legal harvest by hunting as facilitated by road access
Overtrapping	Nonsustainable or nondesired legal harvest by trapping as facilitated by road access
Poaching	Increased illegal take (shooting or trapping) of animals as facilitated by road access
Collection	Collection of live animals for human uses (e.g., amphibians and reptiles collected for use as pets) as facilitated by the physical characteristics of roads or by road access
Harassment or disturbance at specific use sites	Direct interference of life functions at specific use sites due to human or motorized activities, as facilitated by road access (e.g., increased disturbance of nest sites, breeding leks or communal roost sites)
Collisions	Death or injury resulting from a motorized vehicle running over or hitting an animal on the road
Movement barrier	Preclusion of dispersal, migration or other movements as posed by a road itself or by human activities on or near a road or road network
Displacement or avoidance	Spatial shifts in populations or individual animals away from a road or road network in relation to human activities on or near a road or road network
Chronic negative interaction with humans	Increased mortality of animals due to increased contact with humans, as facilitated by road access

OHMV's are becoming increasingly popular and their use in the subbasin and surrounding area is expected to increase by 70% over the next twenty years (UDSI 1999). The relative proximity of the subbasin to the Treasure valley and the long riding season in low elevation areas, make it very popular with OHMV users. OHMV use is particularly concentrated in the Owyhee front area of the subbasin especially in the area surrounding Rabbit Creek, which contains an OHMV trailhead (USDI 1999). Between 1987 and 1998 a minimum estimate of ninety miles of new trails were developed in this area (USDI 1999). Off-road vehicle use in the subbasin sometimes occurs within critical or important wildlife habitats, cultural sites, and sensitive plant habitats. Negative impacts on ash dwelling endemics and other special status plants were observed at several locations (USDI 1999). Amphibians, reptiles, birds and small mammals have all been shown to suffer serious impacts from OHMV activity (USDI 1999). Special status animal species identified by the BLM to be most likely to be negatively impacted by increases in OHMV use include, western toad, western ground snake, longnose snake, long-billed curlew, burrowing owl, ferruginous hawk, multiple neotropical migrant birds and kit fox. These impacts include, direct mortality, loss of habitat, burrow collapse, depletion of prey species and disturbance of breeding or migration patterns (USDI 1999). For example lack of suitable loose textured soil may be a natural limiting factor for kit foxes. Increased soil compaction or destabilization of dunes due to OHMV use may inhibit burrow establishment (Wisdom et al. 2000).

Invasive Exotics

Invasive plant and animal species–also referred to, as exotics, non-natives, introduced, or nonindigenous species–are organisms that have expanded beyond their native range or have been introduced from other parts of the world. Species are considered invasive if their presence in an ecosystem will cause environmental harm, economic harm, or harm to human health. Invasive species can displace native species, alter predator-prey relationships, destroy crops, and decrease ecosystem resiliency (EPA 2001). Some species were introduced into the wild intentionally, while others have been introduced unintentionally and expanded on their own. Invasive species are usually non-native species, and they are often exotic species from another part of the world. Native species can also be characterized as invasive if they dominate their ecosystem due to human induced changes to that ecosystem (EPA 2001).

Of particular concern in the Columbia River Basin are introduced weedy plants, which are invading rangelands, forests, and riparian ecosystems at an alarming rate. Human activities such as grazing of livestock or logging, with its associated road networks, often disturb biotic communities enough to allow establishment and in some cases domination of invasive species. Control of infestations has been difficult, and the ecological consequences have been serious. Negative impacts include reduction in biodiversity, forage, habitat and aesthetic quality, and even soil productivity. The rapid expansion of exotic weed populations has been a deterrent to restoring native plant communities and re-establishing historic ecological conditions (CPLUHNA 2003, D'Antonio and Vitousek 1992). One study estimates that the total costs of invasive species in the United States amount to more than $100 billion each year (Pimentel *et al*. 1999, WGA 2000). The Nature Conservancy and others list invasive species as the second leading cause in species endangerment nationwide (TNC 2003). About 42% of all federally ESA Threatened or Endangered species are listed because of threats from invasive plants Connelly *et al*. 2000, Perryman 2003, WGA 2000).

Impacts to shrub-steppe

Sagebrush steppe ecosystems of the western United States are examples of fireprone ecosystems. Many wildlife species depend on sagebrush steppe ecosystems for survival (Knick and Van Ripper III 2002). Unfortunately, a change in the natural fire regime is decreasing the extent of sagebrush ecosystems, and the populations of wildlife species that depend on sagebrush are undergoing steep declines because of habitat loss (Connelly et al. 2000). The invasion of cheatgrass is fueling larger and more frequent fires that are out-competing sagebrush as well as the associated forb and grass species that are native components of that ecosystem (Pyke 2002). It has been estimated that 25% of the original sagebrush ecosystem is now annual heatgrass/medusa-head rye grassland, and an additional 25% of the sagebrush ecosystem has only cheatgrass as an understory constituent (Perryman 2003). Annual grass invasions may only be the first wave; perennial invasive species are already making serious inroads in the western United States. Potential subsequent domination by perennial invasive species will virtually eliminate any resemblance to our existing ecosystems (Perryman 2003).

Impacts to riparian/herbaceous wetlands

A pest weed of Idaho's aquatic environment is the European purple loosestrife (*Lythrum salicaria*), which was introduced in the early 19th century as an ornamental plant (Malecki *et al*. 1993). Purple loosestrife is capable of invading many wetland types, including freshwater wet meadows, tidal and non-tidal marshes, river and stream banks, pond edges, reservoirs, and ditches. It has been spreading at a rate of 115,000 ha/yr and is changing the basic structure of most of the wetlands it has invaded (Thompson *et al*. 1987). Purple loosestrife enjoys an extended flowering season, generally from June to September, which allows it to produce vast quantities of seed. The flowers require pollination by insects, for which it supplies an abundant source of nectar. A mature plant may have as many as thirty flowering stems capable of producing an estimated two to three million, minute seeds per year (Swearingen 1997). Competitive stands of purple loosestrife have reduced the biomass of 44 native plants and endangered wildlife (Gaudet and Keddy 1988). Loosestrife now occurs in 48 states and costs $45 million per year in control costs and forage losses (ATTRA 1997, Pimentel *et al*. 1999).

A second aquatic weed of concern in Idaho is Eurasian watermilfoil (*Myriophyllum spicatum L*.). Eurasian watermilfoil was accidentally introduced from Eurasia in the 1940s. Two theories exist as to how it entered North America: 1) it escaped from an aquarium; or 2) it was brought in attached to commercial or private boats. A resort owner is thought to have introduced watermilfoil into the Tennessee Valley Authority reservoir system in 1953. Eurasian milfoil can form large, floating mats of vegetation on the surface of lakes, rivers, and other water bodies, preventing light penetration for native aquatic plants and impeding water traffic. The plant thrives in areas that have been subjected to various kinds of natural and manmade disturbance. Eurasian watermilfoil tends to invade disturbed areas where native plants cannot adapt to the alteration. It does not spread rapidly into undisturbed areas where native plants are well established. By altering waterways, humans have created a new and unnatural niche where milfoil thrives (Remaley 1998).

Impacts to pine/fir forests

An ecologically significant weed to forested habitats in Idaho is the spotted knapweed (*Centaureai maculosa*). Spotted knapweed was introduced to North America from Eurasia as a contaminant in alfalfa and possibly clover seed, and through discarded soil used as ship ballast. It was first recorded in Victoria, British Columbia in 1883, and spread further in domestic alfalfa seeds and hay before it was recognized as a serious problem (Carpinelli 2003). This species infests a variety of natural and semi-natural habitats including barrens, fields, forests, prairies, meadows, pastures, and rangelands. It out competes native plant species, reduces native plant and animal biodiversity, and decreases forage production for livestock and wildlife. Spotted knapweed may degrade soil and water resources by increasing erosion, surface runoff, and stream sedimentation. It has increased at an estimated rate of 27% per year since 1920 and has the potential to invade about half of all the rangeland (35 million acres) in Montana alone (Carpinelli 2003). Spotted knapweed is capable of establishing itself into undisturbed sites; however, disturbance allows for rapid establishment and spread.

Impacts to native grasslands

The most significant invasive weed for native grasslands is cheatgrass, which is discussed within the shrub-steppe section above.

Populations of noxious weeds, which make up only a small portion of all alien taxa, are doubling on BLM land within the interior Columbia River basin every 5 to 6 years (Wooten and Morrison 1995). Noxious weeds destroy wildlife habitat, reduce plant and animal diversity, displace threatened and endangered species, and cost millions of dollars in treatment and loss of productivity on the land (ISDI 1991). The spread of exotics has substantial implications for management in the future because of its known rates of spread (Table 49) and lack of natural control agents. The primary conduits for noxious weed and exotic plant transport are roads, trails, and rivers (USFS 2003a: 3–613).

Table 49. Rates of spread for untreated noxious weed species and acreage of the Sawtooth National Forest susceptible to invasion (USFS 2003a: 3–630, 620) (Try to add acreage of BLM land susceptible to invasion).

Species	Annual Rate of Spread (%)	Acres Highly Susceptible to Invasion	
		Forest	BLM
Leafy spurge	12–50	68,599	?
Spotted knapweed	24–40	288,382	?
Diffuse knapweed	18–40	100,587	?
Yellow starthistle	6–17	8,003	?
Rush skeletonweed	10–50	89,984	?

Along the Brownlee Reservoir reach, medusahead is also common. Introduced from Eurasia, medusahead is an aggressive winter annual grass, predominant on millions of acres of semiarid rangeland in the Pacific Northwest (Whitson et al. 1992), and a poor-quality food source for wildlife species (Savage et al. 1969). It is also extremely competitive, even crowding out such undesirable species as cheatgrass.