3 Species Characterization and Status

3.1 Species of Ecological Importance

The Snake River within the Hells Canyon Snake subbasin is currently inhabited by at least 30 species/races of fish, 23 of which are endemic to the region (see Appendix C). A variety of key fish species use the Snake Hells Canyon subbasin during various stages of their lives (Table 9 and Table 10). Currently, the mainstem Snake River provides upstream and downstream passage (a migration corridor) for all anadromous and many resident salmonids. It is used by fall chinook and white sturgeon to support all of their life history stages (WDFW et al. 1990, BLM 2000a). Subadult bull trout also use the mainstem for rearing and overwintering, whereas use by juvenile spring chinook is less common. Sockeye salmon, a federally listed (endangered) species, use the mainstem Snake River (below the confluence with the Salmon River) during downstream and upstream migration.

Table 9. General life history stages of various focal salmonid species occurring in the Snake Hells Canyon subbasin (from BLM 2000a, IDEQ and ODEQ 2001, Columbia Basin Research 2004).

Life History Stage	Fall Chinook Salmon[1]	Spring/Summer Chinook Salmon	Sockeye Salmon	Steelhead Trout	Bull Trout
Adult migration	August–October	April–July	June–September	September–May	August–September
Spawning	September 15–December 15	August 1–July 15	NA	February 1–July 15	September 1–April 1
Adult/subadult rearing	NA[2]	NA	NA	NA	Year-long
Adult overwintering	NA	NA	NA	November–March	Winter
Incubation and emergence	October–April	August–April	NA	March–July	September–March
Rearing	May–August	1 year	NA	1–3 years	2–3 Years
Smolt emigration	June–August	April–July	April–July	April–July	NA

[1] Occur in mainstem Snake River only
[2] Not applicable

Table 10. Salmonid life history stages and their general occurrence in the Snake Hells Canyon subbasin (BLM 2000a; M. Hanson, Oregon Department of Fish and Wildlife, personal communication, April 19, 2001).

Species	Life History	Occurrence
Fall chinook	Spawning/rearing	Mainstem Snake River
Spring/summer chinook	Spawning/rearing	Accessible tributaries (i.e., Granite and Sheep creeks)
Spring/summer chinook	Rearing (limited)	Mainstem Snake River
Sockeye salmon	Adult/Juvenile migration	Mainstem Snake River
Summer steelhead	Spawning/rearing	Accessible tributaries
Bull trout	Rearing (subadult and adult)	Mainstem Snake River
Bull trout	Overwintering	Mainstem Snake River
Bull trout	Spawning/early rearing	Accessible tributaries (i.e., Granite and Sheep creeks)
Westslope cutthroat trout (resident forms)	Spawning/rearing	Granite and Sheep creeks
White sturgeon	Spawning/rearing	Mainstem Snake River

The Snake Hells Canyon subbasin provides suitable habitat for an estimated 373 species of wildlife during at least some portion of the year. This number includes 12 species of amphibians, 258 birds, 87 mammals, and 16 reptiles (IBIS 2003; Appendix C). All of these species depend on features of the habitat provided by the subbasin's vegetation, rocks, soils, and climate (see section 1 for details on vegetation, soils, geology, and climate; see also section 3.5.10 for details on habitat use). In addition, wildlife species perform ecological roles within their environment, and these roles can influence and alter the biotic and abiotic environments they inhabit. These interactions are termed key ecological functions (KEFs). Critical functional link species are the only species that perform a specific ecological function in a community. Their removal would signal loss of that function in the community. Thus, these species are critical to maintaining the full functionality of a system (IBIS 2003). Thirty-two species have been identified as critical functional link species in the Blue Mountain Ecoprovince. Examples of the critical functions contributed by critical functional link species in the subbasin include the physical fragmentation of standing wood by the black bear in herbaceous wetland and alpine grassland habitats, the impoundment of water behind diversions or dams by the American beaver in numerous habitat types, and the creation of roosting, denning, or nesting opportunities by the red squirrel in various forest habitats (see Appendix D for a complete list of critical functional link species and their critical functions).

3.1.1 Species Designated as Threatened or Endangered

Federal

In 1973, the Endangered Species Act (ESA) was passed, building on and strengthening the provisions of the Endangered Species Preservation Act of 1966, the Endangered Species Conservation Act of 1969, and the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). 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. Endangered means that a species is in danger of becoming extinct throughout all or a significant portion of its range. Threatened means that a species is likely to become endangered within the foreseeable future. All species of animals and plants are eligible for listing (Kilpatrick 2001).

The ESA makes it illegal for any person subject to the jurisdiction of the United States to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any endangered species of fish or wildlife within the United States. The USFWS and NOAA Fisheries (or NMFS) jointly administer the act. The USFWS administers terrestrial species, freshwater species, and migratory birds, while NOAA Fisheries administers marine species (Kilpatrick 2001). Three species listed as endangered, eight listed as threatened, and four designated as candidate species under consideration for listing occur or potentially occur within the Snake Hells Canyon subbasin (Table 11).

Table 11. ESA-listed or candidate species that are known to or potentially occur in the Snake Hells Canyon subbasin.

Status	Common Name	Scientific Name
Endangered	Idaho springsnail	*Pyrgulopsis idahoensis*
Endangered	Snake River physa	*Physa natricina*
Endangered	Sockeye salmon	*Oncorhynchus nerka*
Threatened	Bald eagle	*Haliaeetus leucocephalus*
Threatened	Bull trout	*Salvelinus confluentus*
Threatened	Chinook salmon	*Oncorhynchus tshawytscha*
Threatened	Gray wolf	*Canis lupus*
Threatened	Lynx	*Lynx canadensis*
Threatened	MacFarland's four o'clock	*Mirabilis macfarlanei*
Threatened	Spalding's catchfly	*Silene spaldingii*
Threatened	Steelhead trout	*Oncorhynchus mykiss*
Candidate	Columbia spotted frog	*Rana luteiventris*
Candidate	Pacific lamprey	*Lampetra tridentata*
Candidate	Slender moonwort	*Botrychium lineare*
Candidate	Yellow-billed cuckoo	*Coccyzus americanus occidentalis*

State

Oregon, Idaho, and Washington also maintain lists of threatened and endangered fish and wildlife species (Table 12). Ten species that occur or potentially occur in the subbasin are listed by Idaho, Oregon, or Washington as threatened or endangered.

Table 12. Species that occur or potentially occur in the Snake Hells Canyon subbasin and are listed as threatened or endangered by Oregon, Idaho, or Washington.

Common Name	Scientific Name	Status
American peregrine falcon	*Falco peregrinus anatum*	Oregon–Endangered Idaho–Endangered
American white pelican	*Pelecanus erythrohynchos*	Washington–Endangered
Bald eagle	*Haliaeetus leucocephalus*	Idaho–Endangered Oregon–Threatened Washington–Threatened
Chinook	*Oncorhynchus tshawytsha*	Oregon–Threatened
California wolverine	*Gulo gulo luteus*	Oregon–Threatened
Ferruginous hawk	*Buteo regalis*	Washington–Threatened
Fisher	*Martes pennanti*	Washington–Endangered
Gray wolf	*Canis lupus*	Idaho–Endangered Oregon–Endangered Washington–Threatened
Lynx	*Lynx canadensis*	Washington–Threatened
Pacific lamprey	*Lampetra tridentata*	Idaho–Endangered

3.1.2 Status of Federally or State Listed Endangered or Threatened Species

Aquatic Species

Four species occurring within the subbasin are currently under the jurisdiction of NOAA Fisheries because of their listing under the ESA. These species include Snake River fall chinook salmon and spring/summer chinook salmon, listed as threatened on May 22, 1992 (Federal Register 57:14653), Snake River sockeye salmon, listed as endangered on November 20, 1991 (Federal Register 56:58619), and Snake River summer steelhead, listed as threatened on October 17, 1997 (Federal Register 62:43937, August 18, 1997). Bull trout, under the jurisdiction of the USFWS were also listed under the ESA on July 10, 1998 (Federal Register 63:31647, June 10, 1998). Pacific lamprey is a candidate for federal listing but is listed as endangered by the state of Idaho.

All of the federally listed and candidate fish species within the Snake Hells Canyon subbasin (spring/summer and fall chinook salmon, sockeye salmon, steelhead trout, Pacific lamprey, and bull trout) have been selected as focal species for this assessment. Detailed discussions of each of these species are presented in section 3.4.

Terrestrial Species

American Peregrine Falcon

The American peregrine falcon (*Falco peregrinus anatum*) was listed as endangered in 1970 under a precursor to the ESA of 1973. A Pacific states peregrine recovery plan (USFWS 1982) was completed in 1982 for the Pacific recovery zone. The plan identified recovery objectives that needed to be met in order to have a self-sustaining population. These goals were met and contributed to the delisting of the American peregrine falcon on August 20, 1999. The bird has made a remarkable comeback. For example, in the 1960s, it was considered extirpated from Oregon, but in 1994, there were 37 known nest sites that produced 60 young (Marshall et al. 1996). The American peregrine falcon is still considered an endangered species in Oregon and Idaho, but as recovery continues, changes in status are being considered.

Numerous sightings of peregrine falcons have occurred within the subbasin, and in 1996, a nest was observed in the canyons cliffs just downstream of Hells Canyon Dam (Akenson 2000). This nest successfully produced one female young in 1996. Observers of the nest between 1997 and 2000 monitored a pair of birds at the eyrie exhibiting behaviors indicative of occupancy (prey delivery, copulation, and patrolling the territory). But due to the location of the nest, observation is difficult and the current status of young production at the nest is unknown (Turley and Holthuijzen 2002).

American White Pelican

American white pelicans (*Pelecanus erythrohynchos*) potentially migrate through the subbasin on their way to breeding locations in southern Oregon and Idaho. This use has not been documented.

Bald Eagle

Because of concern over declining populations of bald eagle (*Haliaeetus leucocephalus*), 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. Currently, the agency is evaluating the bald eagle for delisting (USFWS 1999). The bald eagle was selected as a focal species for this assessment, so information on habitat use and status in the Snake Hells Canyon subbasin is included in section 3.5.7.

California Wolverine

The California wolverine (*Gulo gulo luteus*) occurs in Alaska and across the boreal forests of Canada south into the northwestern United States. Hash (1987) described a contradiction in the North American range of the wolverine beginning around 1840 with the onset of extensive exploration, fur trade, and settlement. State records suggest very low wolverine numbers in Montana, Idaho, Oregon, and Washington from the 1920s through 1950s, with increases in wolverine sightings since the 1960s (Banci 1994). In the continental United States, the presence of wolverines has been confirmed in Wyoming, Washington, Oregon, Idaho, and Montana. Only Idaho and Montana are known to support reproducing populations of wolverines (Turley and Holthuijzen 2002).

The California wolverine is not federally listed, but it is listed as threatened in Oregon under the state ESA. Reasons for this listing include susceptibility to forest fragmentation and expanding human populations (Marshall et al. 1996).

Surveys conducted by the Wallowa-Whitman National Forest between 1991 and 1994 documented the presence of wolverines in the HCNRA although densities were low (USFS 2003c). This finding is typical of the species since, even under the best of conditions, wolverine densities tend to be low. Hornocker and Hash (1981) concluded that wolverine densities are greatest when there is a large and diverse big game population such as that which occurs within the subbasin. Wolverines are normally solitary and so sparsely distributed that difficulty in finding mates may limit populations (Edelmann and Copeland 1999).

The wolverine inhabits tundra and coniferous forest zones, generally at higher altitudes during summer and mid- to lower elevations during winter. Low-elevation riparian areas may be important winter habitat. They are solitary except during the breeding season and when females are rearing young (Spahr et al. 1991). Den sites in Idaho are typically associated with large boulder talus, caves, rocks, or downed logs. They are most commonly found on northerly aspects, in subalpine cirque basins with little overhead canopy cover, and above 8,000 feet in elevation. The den entrances are located in soft snow near trees or rocks, with a vertical tunnel extending 1 to 5 meters to ground level (Copeland 1996).

The best den sites in the HCNRA are located in the Seven Devils area (USFS 2003c). During a helicopter survey conducted in 1998, one set of wolverine tracks was located and then confirmed with ground inspection. No den or other indication of reproductive activity was detected (Edelmann and Copeland 1999). Because female wolverines are extremely sensitive to human disturbance near natal dens, protection of natal denning habitat from human disturbances is considered critical for the persistence of wolverines (Copeland 1996). Disturbance of den sites in the Seven Devils Mountains is unlikely since the main road entering the area is closed through the denning season each year (USFS 2003c).

Mapping of wolverine sightings suggests that the Seven Devils Mountains may provide the only suitable habitat linking wolverine subpopulations in Idaho and Oregon. Wolverines dispersing from source habitats in central Idaho may be reluctant to cross canyon habitats. The narrow canyon and forested habitats of the Seven Devils area may provide the only suitable travel corridor linking subpopulations in the two states. Low dispersal may impact the regional viability of wolverine by reducing genetic interchange and lowering the likelihood that all suitable habitat patches are continuously inhabited. Maintaining and enhancing the integrity of movement corridors between the Seven Devils Mountains and other contiguous mountain habitats in Idaho and Oregon may be essential for ensuring regional wolverine persistence (Edelmann and Copeland 1999).

Columbia Spotted Frog

The Columbia spotted frog (*Rana luteiventris*) has been a candidate for listing under the ESA since December 14, 1992 (Federal Register 57:59257). The Columbia spotted frog was selected as a focal species for this assessment, so information on habitat use and status in the Snake Hells Canyon subbasin is included in section 3.5.6.

Fisher

The fisher (*Martes pennanti*) is not federally listed, but it is listed as endangered by Washington and as sensitive on the Regional Forester's sensitive species lists for Regions 1, 4, and 6. Fisher are found in low to mid-elevation mixed conifer forests. They are almost exclusively found in mature and late/old-structure forests. Jones 1991 found that the majority of fisher travel was up and down riparian areas that contained a very dense canopy closure and high concentration of downed logs. Home ranges vary from 6 to 120 km^2. Home ranges of females were stable among seasons and years, but males moved extensively in late winter and early spring and shifted among years. Fishers tend to avoid openings. They will use large-diameter downed logs, snags, stumps, and rock cavities for rearing their young (USFS 2003c).

Trapping and habitat loss due to logging extirpated fisher from Oregon by the early 1900s. However, reintroductions in 1961 in the Eagle Cap Wilderness in Oregon reestablished fisher, at least for two decades. However, populations from this transplant never really increased, and fishers have not been documented within the Oregon side of the Wallowa-Whitman National Forest since the early 1980s. In north-central Idaho, fishers were also reintroduced in the early 1960s. This population has done well and now exists on the Payette, Nez Perce, and Clearwater National Forests. Their current distribution includes portions of HCNRA on the Idaho side near the Seven Devils area. On the Nez Perce National Forest, Jones (1991) indicated that a strong population of fisher exists in mature and late/old-structure forests. Connectivity between these areas is very important to maintain (USFS 2003c). Forest fragmentation, which reduces and isolates suitable habitat, is the greatest threat to fisher populations (Spahr et al. 1991, Marshall et al. 1996).

Gray Wolf

The status of the gray wolf (*Canis lupus*) differs within the HCNRA, depending on the state. In the Oregon portion of the HCNRA, wolves have recently been reclassified from endangered to threatened under the ESA. In the Idaho portion, wolves are classified as an experimental, nonessential population and managed under separate but similar guidelines (USFWS et al. 2003).

Wolves are currently not known to occur in the subbasin although suitable habitat exists. Wolves are considered to have been extirpated from Oregon by 1972. During 1995 and 1996, 35 wolves were reintroduced into central Idaho by the USFWS. The reintroduction was successful, and populations quickly expanded. By the end of 2002, approximately 263 wolves in at least 19 packs were living in Idaho (USFWS et al. 2003).

The subbasin contains ungulate populations and a large wilderness, both of which provide requirements sufficient for wolf habitation. Wolves are occasionally observed in the area, and with continued expansion of the wolf population in Idaho, resident wolves may soon become established within the area (USFS 2003b).

Canada Lynx

The Canada lynx (*Lynx canadensis*) was listed as a threatened species by the USFWS on March 24, 2000 (Federal Register 65:16051) (ODFW 2003b). The USFWS recently completed a reevaluation of the original listing and considered changing the listing of lynx to endangered. The agency concluded that this change was not warranted, and the lynx remains listed as threatened (Columbia Basin Bulletin July 11, 2003). Critical habitat has not been designated for the Canada lynx (ODFW 2003b).

Historical evidence indicates that lynx historically used or traveled through the subbasin. County court records of bounties paid for predators between 1899 and 1922 indicate that lynx once existed in Wallowa County, but densities or numbers cannot be determined from these records. In 1969, a lynx was shot in the Imnaha subbasin, which borders the Snake Hells Canyon subbasin to the west. According to Rust (1946), lynx were not abundant but were distributed throughout northern Idaho in the early 1940s. Over the past decade, numerous unconfirmed sightings have been recorded, suggesting that lynx may still inhabit portions of the Blue Mountains area although in extremely low numbers (USFWS 2003a). Several unconfirmed observations of lynx have been made in the subbasin (Edelmann and Pope 2001). An unconfirmed lynx sighting was made by IPC personnel in the subbasin below the confluence with the Salmon River near Cave Creek on the Idaho side of the Snake River (Turley and Holthuijzen 2002).

In accordance with the interagency Lynx Conservation and Assessment Strategy (LCAS), the USFWS, BLM, and USFS have cooperated to identify lynx analysis units (LAUs) where suitable habitat for lynx is present. These LAUs encompass forested lands that have vegetation characteristics and elevations typically used by lynx (USFWS 2003a). In the northern Rocky Mountains, the majority of lynx occurrences are associated within Rocky Mountain conifer forest. And within this type, most of the occurrences are in moist Douglas-fir and western spruce/fir forest. Most lynx occurrences are in the 1,500- to 2,000-meter (4,920–6,560-foot) elevation class (McKelvey et al. 2000). Of the 652,488 acres within the HCNRA, only about 73,600 acres (11%) meet the definition of potential lynx habitat. This habitat occurs in seven LAUs that are fully or partially contained within the HCNRA boundary (USFWS 2003a). Two LAUs have been delineated within the HCNRA portion of the subbasin (Figure 32); these LAUs entirely encompass the upper half of the subbasin. The LAUs in this subbasin are adjacent to LAUs in the neighboring Imnaha and Salmon subbasins.

Canada lynx habitat includes a mosaic of early seral stages that support snowshoe hare populations and late seral stages of dense old-growth forest that provide ideal denning and security habitat. The results of an analysis of lynx habitat conditions conducted by the Wallowa-Whitman National Forest for the subbasins LAUs are displayed in Table 13.

Table 13. Disposition of lynx habitat within the lynx analysis units of the Snake Hells Canyon subbasin.

LAU	Primary Forage		Marginal Forage		Denning		Unsuitable		Total acres of lynx habitat in LAU (Total acres in LAU)
	(acres)	% of total lynx habitat	(acres)	% of total lynx habitat	(acres)	% of total lynx habitat	(acres)	% of total lynx habitat	
Snake/Pittsburg	92	4	178	7	2,368	90	12	0	2,650 (196,636)
Snake/Hat Point	2,560	11	48	0	16,003	72	3,685	17	22,296 (149,561)

Although the Snake/Hat Point LAU is slightly smaller than the Snake/Pittsburg LAU, it contains much more habitat that meets the vegetative and elevational requirements of lynx (Table 13). The Snake/Hat Point LAU contains the Seven Devils area of the Hells Canyon Wilderness. This area is believed to be core lynx habitat, although resident lynx are not known to occur here. Habitat in this area may form part on an important link between lynx habitats in the Wallowa Mountains of Oregon and the Rocky Mountains of Idaho. The unsuitable lynx habitat in the Snake/Hat Point LAU is primarily a result of wildfire. Much of this habitat is composed of densely stocked stands of trees that will likely convert into primary forage within five years (USFWS 2003a).

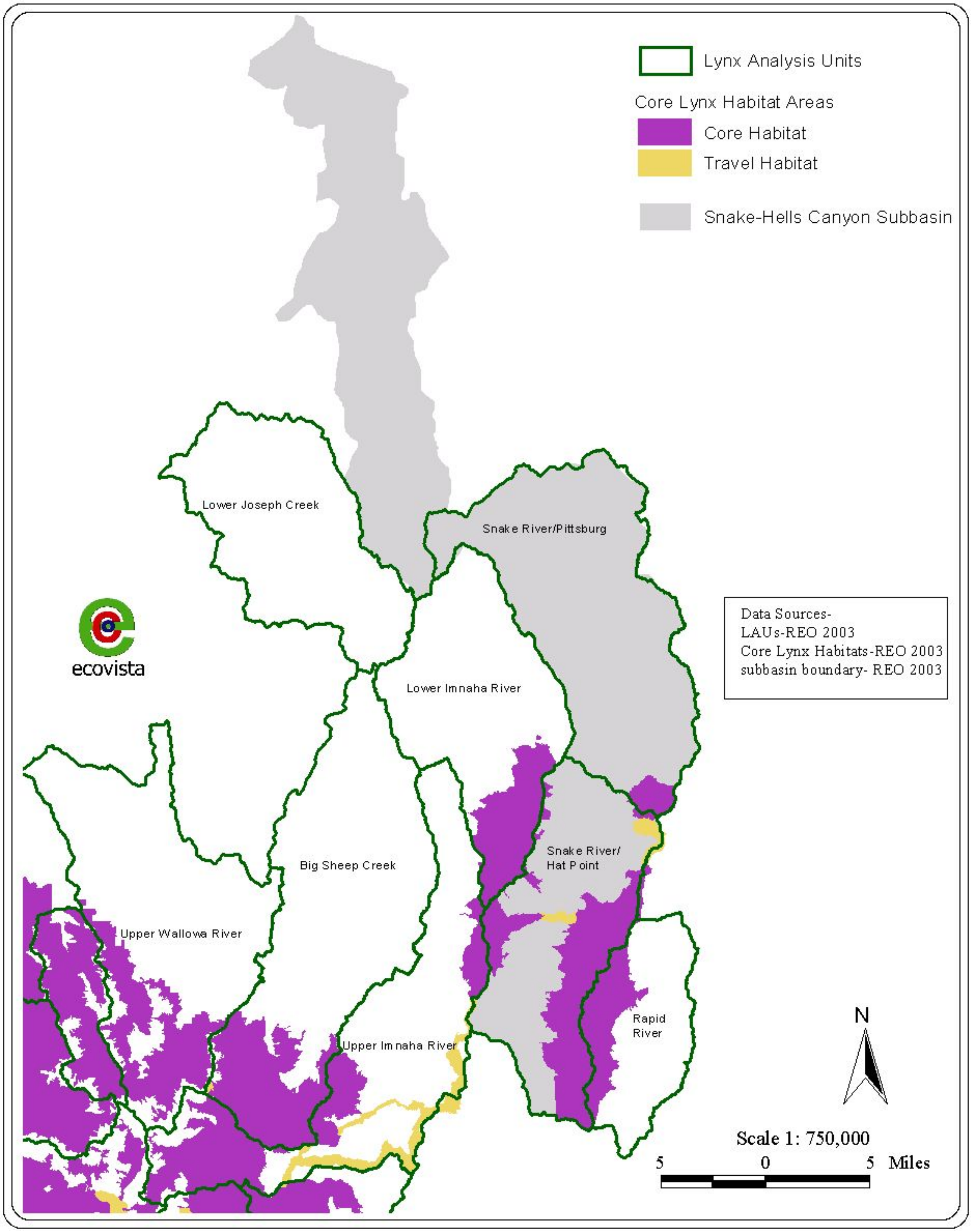


Figure 32. Lynx analysis areas and core lynx habitat areas on USFS lands of the Snake Hells Canyon subbasin.

MacFarlane's Four o'clock

At the time of its original listing as endangered in 1979 (USFWS 1979), MacFarlane's four o'clock (*Mirabilis macfarlanei*) was known from only three populations along the Snake River canyon in Oregon (HCNRA) and the Salmon River canyon in Idaho (BLM Cottonwood Field Office area), totaling approximately 25 plants on 25 acres (USFWS 2000a). 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 (USFWS 1996). The number of known individuals has increased 260-fold from 27 plants when listed to approximately 7,212 plants in 1991 (USFWS 1996).

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 the winter and spring. It generally occurs as scattered plants on open, steep (50%) slopes of sandy or talus soils with west to southeast aspects (USFWS 1996). MacFarlane's four o'clock populations range from approximately 1,000 to 3,000 feet in elevation (USFWS 2000a).

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, Idaho), and two in the Imnaha River area (Wallowa County, Oregon) (USFWS 1985, 1996). Of the three populations within the Snake Hells Canyon subbasin, all occur on USFS land administered by the Wallowa-Whitman National Forest. Population sizes range from approximately 3,000 individuals on 100 acres at Tyron Bar to only 100 plants on 1 acre at the Pleasant Valley site (USFS 2003b). The Pittsburg Landing site in Idaho has 2,024 plants scattered in eight distinct subgroups on a total of 9.3 acres. The Pittsburg Landing site occurs within an active cattle allotment, which has prompted managers to construct exclusion fences around some plants and initiate a long-term monitoring study in 2001 (USFS 2003b).

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, insect damage and disease, 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 2000a). Construction of Hells Canyon Dam may also have inundated habitat and/or populations of MacFarlane's four o'clock, but estimates indicate that probably no more than 5% of potential habitat was impacted (USFS 2003b).

Spalding's Catchfly

Spalding's catchfly (*Silene spaldingii*) grows in grass/forb communities on undisturbed slopes or flats in swales and drainages and in small, undisturbed vegetation strips surrounded by cultivated fields (Lorain 1991). It occurs on mesic grasslands of the Palouse prairie region in southeastern Washington, channeled scablands in southeastern Washington, intermontane valleys in northwestern Montana and adjacent British Columbia, the Wallowa Plateau in northeastern Oregon, and the canyon grasslands of Idaho and Oregon (Hill and Gray 2003). Elevations range between 1,750 and 5,100 feet, and populations almost always occur on northerly aspects (USFS 2003b).

Federal action to protect Spalding's catchfly was initiated on January 9, 1975, when the Smithsonian Institute reported that this plant was considered threatened or endangered. In 1984, the species listing was found to be warranted but precluded by other pending listing actions. On February 27, 1995, a petition was received by the USFWS to list Spalding's catchfly as endangered. On October 22, 1999, the Federal Register published the listing priority guidance to clarify the rulemaking in setting priorities with this species (USFWS 1999b). A final rule listing Spalding's catchfly as a threatened species was published on October 10, 2001 (USFWS 2001). Active conservation of this species is ongoing. A conservation strategy has recently been drafted and should be complete in 2004 (Hill and Gray 2003), and the USFWS has initiated recovery plan development (Gina Glenne, USFWS Snake River office, personal communication, October 28, 2003).

Spalding's catchfly was first collected in the vicinity of the Clearwater River, Idaho, between 1836 and 1847 (USFWS 1999b). It is known from a total of 68 populations in the United States and British Columbia, Canada, with a combined population of approximately 24,400 plants (Hill and Gray 2003). The majority of populations occur in Washington (39 total), while Idaho and Oregon have 11 and 8 populations, respectively (Hill and Gray 2003).

Two known populations of Spalding's catchfly occur within the Snake Hells Canyon subbasin. The Redensky Flat population in the Corral Creek drainage is the largest in Idaho and jointly managed by The Nature Conservancy and BLM (Hill and Gray 2003). The Redbird Point population is on private land approximately 20 miles south of Lewiston, Idaho. Both of these sites were discovered during rare plant surveys in 1993 and represented the first locations found within canyon grassland communities (Mancuso 1994). No populations are known to occur farther south within the subbasin or on the Oregon side of the Snake River, although unexplored potential habitat exists throughout the Snake Hells Canyon subbasin.

Spalding's catchfly and its habitat have been, and continue to be, threatened by a number of human-related factors. These factors include invasion by invasive/nonnative species; destruction, modification, or curtailment of its habitat and range; herbicidal drift; changes in land use, grazing practices, agriculture development, and urbanization; disease or predation; and overutilization for commercial, recreational, scientific, or educational purposes (USFWS 1999b). Hill and Gray (2003) also suggest that reductions in pollinators, prolonged drought, and fire may pose threats to this species.

Yellow-billed Cuckoo

The yellow-billed cuckoo (*Coccyzus americanus*) migrates from its winter range in South America to breed throughout temperate North America south to Mexico and Greater Antilles. It has experienced severe declines and is now rare or absent in most of the western United States (Csuti et al. 2001). Western yellow-billed cuckoos were given candidate status for listing under the ESA in July 2001 (Federal Register 66:143).

Yellow-billed cuckoos are associated with thick, closed-canopy riparian forests with an understory of dense brush. These forests are usually composed of various species of willows and cottonwoods. Studies in California have suggested that patches of suitable habitat must be at least 37 acres in size and include over 7.5 acres of closed-canopy riparian forest (Csuti 2001). Due to its dependence on a combination of habitat features such as dense willow understory for nesting, a cottonwood overstory for foraging, and large contiguous patches of habitat, the yellow-billed cuckoo is consider to be more sensitive to habitat loss than other riparian obligate species (Turley and Holthuijzen 2002).

Although the Snake Hells Canyon subbasin provides potentially suitable habitat for the yellow-billed cuckoo (BLM 2002), surveys conducted by Cassirer (1995) during 1993 and 1994 and IPC during the late 1990s (Turley and Holthuijzen 2002) did not document any occurrences. Yellow-billed cuckoos have always been rare in the subbasin but more common in southeastern Idaho. Fifty-five percent (35 of 64) of the historical yellow-billed cuckoo records in Idaho are from southeastern Idaho, usually along the Snake River corridor (TREC, Inc. 2003).

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

3.1.3 Species Recognized as Rare or Significant to the Local Area

State Sensitive and Species of Special Concern

Each of the three states with land in the Snake Hells Canyon subbasin maintains a list of species considered sensitive or vulnerable to population declines (IDFG 2003b, ODFW 2003c, WDFW 2003b) (Table 14). Each state uses similar criteria but different classifications.

In Oregon, native animals that may become threatened or endangered throughout all or any significant portion of their range in Oregon are listed as sensitive. Factors considered in this listing include the potential for natural reproductive failure because of limited population numbers, disease, predation, other natural or human-related 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 (ODFW 2003c). Sensitive species are organized into the following four categories:

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

Vulnerable—Species for which listing as threatened or endangered is not believed to be imminent and can be avoided through 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.

Undetermined—Species for which status is unclear. These species may be susceptible to population decline of sufficient magnitude to qualify for endangered, threatened, critical, or vulnerable status, but scientific study would be needed before a judgment could be made.

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

Idaho maintains a list of species of special concern. These include native species low in numbers, limited in distribution, or affected by significant habitat losses (IDFG 2003b).

Washington lists as sensitive any species vulnerable or declining and likely to become endangered or threatened throughout a significant portion of its range in the state without cooperative management or removal of threats. Species being considered for listing as sensitive are designated as candidate, while a designation of monitor is used for species for which more data are needed to determine a listing (WDFW 2003b).

Table 14. Species considered sensitive or vulnerable to population declines for each of the states with land in the Snake Hells Canyon subbasin.

Common Name	Species Name	Idaho	Washington	Oregon
American marten	*Martes americana*			sensitive–vulnerable
American peregrine falcon	*Falco peregrinus anatum*		sensitive	
American white pelican	*Pelecanus erthrorhynchos*	species of special concern		
Ash-throated flycatcher	*Myiarchus cinerascens*		monitor	
Bank swallow	*Riparia riparia*			sensitive–undetermined
Barrow’s goldeneye	*Bucephala clangula*			sensitive–undetermined
Black swift	*Cypseloides niger*		monitor	
Black tern	*Chilidonias niger*	species of special concern	monitor	
Black-backed woodpecker	*Picoides arcticus*	species of special concern	candidate	sensitive–critical
Black-crowned night-heron	*Nycticorax nycticorax*		monitor	
Black-tailed jack rabbit	*Lepus californicus*		candidate	
Bobolink	*Dolichonyx oryzivorous*		monitor	sensitive–vulnerable
Boreal owl	*Aegolius funereus*	species of special concern	monitor	sensitive–undetermined
Bufflehead	*Bucephala albeola*			sensitive–undetermined
Bull trout	*Salvelinus confluentus*		candidate	sensitive–critical
Burrowing owl	*Athene cunicularia*			sensitive–critical
Caspian tern	*Sterna caspia*		monitor	
Chinook salmon (fall)	*Oncorhynchus tshawytscha*		candidate	
Chinook salmon (sp., sum.)	*Oncorhynchus tshawytscha*		candidate	
Clark’s grebe	*Aechmophorus clarkii*		monitor	
Columbia spotted frog	*Rana luteiventris*		candidate	sensitive–undetermined
Common loon	*Gavia immer*		sensitive	
Desert horned lizard	*Phrynosoma platyrhinos*			sensitive–vulnerable
Ferruginous hawk	*Buteo regalis*			sensitive–critical
Fisher	*Martes pennanti*	species of special concern		
Flammulated owl	*Otus flammeolus*	species of special concern	candidate	sensitive–critical

Common Name	Species Name	Idaho	Washington	Oregon
Forster’s tern	*Sterna forsteri*		monitor	
Fringed myotis	*Myotis thysanodes*		monitor	sensitive–vulnerable
Grasshopper sparrow	*Ammodramus savannarum*		monitor	
Great blue heron	*Ardea herodias*		monitor	
Great egret	*Ardea Alba*	species of special concern	monitor	
Great gray owl	*Strix nebulosa*	species of special concern	monitor	sensitive–vulnerable
Greater sandhill crane	*Grus canadensis*			sensitive–vulnerable
Green-tailed towhee	*Pipilo chlorurus*		monitor	
Gyrfalcon	*Falco rusticolus*		monitor	
Harlequin duck	*Histrionicus histrionicus*	species of special concern		sensitive–undetermined
Horned grebe	*Podiceps auritus*		monitor	sensitive–vulnerable
Leopard dace	*Rhinichthys falcatus*		candidate	
Lesser goldfinch	*Carduelis psaltria*		monitor	
Lewis’ woodpecker	*Melanerpes Lewis*		candidate	
Loggerhead shrike	*Lanius ludovicanus*	species of special concern	candidate	
Long-billed curlew	*Numenius americanus*		monitor	
Long-eared myotis	*Myotis volans*		monitor	sensitive–undetermined
Long-legged myotis	*Myotis volans*		monitor	
Merlin	*Falco columbarius*		candidate	
Merriam’s shrew	*Sorex merriami*		candidate	
Mounatin quail	*Oreortyx pictus*	species of special concern		sensitive–undetermined
Night snake	*Hypsiglena torquata*		monitor	
Northern goshawk	*Accipiter gentilis*	species of special concern	candidate	sensitive–critical
Northern grasshopper mouse	*Onychomys leucogaster*		monitor	
Northern leopard frog	*Rana pipiens*			sensitive-–critical
Northern pygmy owl	*Glaucidium gnoma*	species of special concern		sensitive–critical
Olive-sided flycatcher	*Contoupus cooperi*			sensitive–vulnerable
Osprey	*Pandion haliaetus*		monitor	

Common Name	Species Name	Idaho	Washington	Oregon
Pacific lamprey	*Lampetra tridentata*			sensitive–vulnerable
Pallid bat	*Antrozous pallidus*			sensitive–critical
Pileated woodpecker	*Dryocopus pileatus*		candidate	sensitive–vulnerable
Prairie falcon	*Falco mexicanus*		monitor	
Preble’s shrew	*Sorex preblei*		monitor	
Pygmy nuthatch	*Sitta pygmaea*	species of special concern		sensitive–critical
Pygmy shrew	*Sorex hoyi*		monitor	
Redband trout	*Oncorhynchus mykiss*	species of special concern		
Red-necked grebe	*Podiceps grisegena*			sensitive–critical
Red-tailed chipmunk	*Tamias ruficaudus*		monitor	
Ring-necked snake	*Diadophis punctatus*		monitor	
Sage sparrow	*Amphispiza belli*		candidate	
Sagebrush lizard	*Sceloporus graciosus*		candidate	
Sagebrush vole	*Lagurus curtatus*		monitor	
Silver-haired bat	*Lasionycteris noctivagans*			sensitive–undetermined
Small-footed myotis	*Myotis ciliolabrum*		monitor	
Sockeye salmon	*Oncorhynchus nerka*		candidate	
Spruce grouse	*Falcipennis canadensis*			sensitive–undetermined
Steelhead/redband trout	*Oncorhynchus mykiss*		candidate	sensitive–vulnerable
Striped whipsnake	*Masticophis taeniatus*		candidate	
Swainson’s hawk	*Buteo swainsoni*		monitor	sensitive–vulnerable
Tailed frog	*Ascaphus truei*			sensitive–vulnerable
Three-toed woodpecker	*Picoides tridactylus*	species of special concern	monitor	sensitive–critical
Tiger salamander	*Ambystoma tigrinum*		monitor	
Townsend’s western big-eared bat	*Corynorhinus townsendii townsendii*	species of special concern	candidate	sensitive–vulnerable
Turkey vulture	*Cathartes aura*		monitor	
Upland sandpiper	*Bartramia longicauda*	species of special concern		sensitive–critical

Common Name	**Species Name**	**Idaho**	**Washington**	**Oregon**
Vaux’s swift	*Chaetura vaui*		candidate	
Western grebe	*Aechmophorus occidentalis*		candidate	
Western pipistrelle	*Pipistrelle hesperus*	species of special concern	monitor	
Western rattlesnake	*Crotalus viridis*			sensitive–vulnerable
Western small-footed myotis	*Myotis ciiolabrum*			sensitive–undetermined
Western toad	*Bufo boreas*		candidate	sensitive–vulnerable
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	species of special concern		
White-headed woodpecker	*Picoides albolarvatus*	species of special concern	candidate	sensitive–critical
White sturgeon	*Acipenser transmontanus*	species of special concern		
Williamson’s sapsucker	*Sphyrapicus throideus*			sensitive–undetermined
Willow flycatcher	*Empidonax traillii*			sensitive-undetermined
Wolverine	*Gulo gulo luscus*	species of special concern	candidate	
Woodhouse’s toad	*Bufo woodhousii*		monitor	

USFS and BLM Sensitive Species List

The USFS region's sensitive species program provides goals and objectives for managing sensitive species and their habitats. These goals and objectives are included in the Regional Forester's sensitive species list to prevent the need for federal listing in the future. According to USFS policy, all actions and programs authorized, funded, or carried out by the USFS are to be reviewed to determine their potential effect on threatened and endangered species, sensitive species, and species proposed for listing. In addition, species on the current Regional Forester's sensitive species list (Table 15) are to be given the same management consideration as federally listed species (USFS 1995). The BLM also maintains a list of sensitive species (Table 16).

Table 15. USFS Region 1, 4, and 6 sensitive species with potential habitat in the Snake Hells Canyon subbasin (USFS 1995, IDFG 2003b).

USFS Region	Common Name	Species Name
6	American peregrine falcon	*Falco peregrinus anatum*
6	Black rosy finch	*Leucosticte arctoa atrata*
1	Black-backed woodpecker	*Picoides arcticus*
6	Blue Mountain cryptochian caddisfly	*Cryptochia neosa*
4	Boreal owl	*Aegolius funerus*
1, 4, and 6	California wolverine	*Gulo gulo luteus*
1 and 4	Common loon	*Gavia Immer*
6	Ferruginous hawk	*Buteo regalis*
1 and 4	Fisher	*Martes pennanti*
1 and 4	Flammulated owl	*Otus flammeolus*
4	Great gray owl	*Strix nebulosa*
6	Greater sandhill crane	*Grus canadensis tabia*
1, 4, and 6	Harlequin duck	*Histrionicus histrionicus*
6	Long-billed curlew	*Numenius americanus*
4 and 6	Lynx	*Lynx canadensis*
1 and 4	Mountain quail	*Oreortyx pictus*
6	Northern bald eagle	*Haliaeetus leucocephalus*
1 and 4	Northern goshawk	*Accipiter gentilis*
4	Three-toed woodpecker	*Picoides tridactylus*
1, 4 and 6	Townsend's western big-eared bat	*Corynorhinus townsendii townsendii*
6	Upland sandpiper	*Bartramia longicauda*
1and 4	White-headed woodpecker	*Picoides albolaravatus*
6	Yellow-billed cuckoo	*Coccyzus americanus occidentalis*

Table 16. Species listed as sensitive by the BLM with potential habitat in the Snake Hells Canyon subbasin (BLM 2002).

Common Name	Scientific Name
Black-backed woodpecker	*Picoides arcticus*
Brewer's sparrow	*Spizella breweri*
Columbia River tiger beetle	*Cincindela columbica*
Common gartersnake	*Thamnophis sirtalis*
Flammulated owl	*Otus flammeolus*
Fringed myotis	*Myotis thysanodes*
Grasshopper sparrow	*Ammodramus savannarum*
Lewis woodpecker	*Melanerpes lewis*
Mountain quail	*Oreotys pictus*
Northern goshawk	*Accipiter gentilis*
Peregrine falcon	*Falco peregrinus anatum*
Prairie falcon	*Falco mexicanus*
Shortface lanx	*Fisherola nuttalli*
Townsend's western big-eared bat	*Corynorhinus townsendii townsendii*
Vaux's swift	*Chaetura vauxi*
Western pipistrelle	*Pipistrellus hesperus*
Western toad	*Bufo boreas*
White-headed woodpecker	*Picoides albolarvatus*
Willow flycatcher	*Empidonax traillii*
Yellow-headed blackbird	*Xanthocphalus xanthocephalus*

Partners in Flight

Partners in Flight (PIF) was established in 1990 as a conservation effort focused on landbirds and their habitats. The collaborative effort was initiated because of concern over continental and local declines in numerous bird populations due in part to habitat loss, degradation, fragmentation on breeding and wintering grounds and along migratory routes, reproductive problems associated with nest predation, brood parasitism, and competition with exotic species. Partnerships among many agencies—including federal, state, and local government agencies; philanthropic foundations; professional organizations; conservation groups; industry; the academic community; and private individuals—have contributed to the great success of Partners in Flight. Partners in Flight works to enhance cooperation between private and public sector efforts in North America and the Neotropics in order to improve monitoring and inventory, research, management, and education programs involving birds and their habitats (PIF 2003).

The development of bird conservation plans for the entire continental United States is one of the primary activities of Partners in Flight. The group's goal is to ensure long-term maintenance of healthy populations of native landbirds. The planning process for the bird conservation plans has four steps: 1) identify species and habitats most in need of conservation (i.e., prioritization), 2) describe desired conditions for these habitats based on knowledge of species life history and habitat requirements, 3) develop biological objectives to be used as management targets or goals to achieve desired conditions, and 4) recommend conservation actions to be implemented by various entities at multiple scales to achieve biological objectives (PIF 2003).

Bird conservation plans are organized by physiographic areas and state. The Snake Hells Canyon subbasin lies within the Central Rocky Mountains physiographic area and is included in the bird conservation plan for Oregon and Washington (PIF 2003). This conservation plan emphasizes an ecosystem management approach to landbird preservation, but it includes components of single species and indicator species management. The most important habitat features and conditions for landbirds within the planning area were identified, and then focal species considered representative of those habitats were selected to help guide conservation planning (Table 17).

Table 17. Priority habitat features and associated landbird species for conservation in habitats of the Partners in Flight Northern Rocky Mountains Landbird Conservation region of Oregon and Washington.

Habitat Type	**Focal Species Blue Mountain Subprovince**	**Habitat Feature/ Conservation Focus**
Dry Forest (ponderosa pine and ponderosa pine/Douglas-fir/grand fir)	white-headed woodpecker (*Picoides albolarvatus*)	large patches of old forest with large trees and snags
	flammulated owl (*Otus flammeolus*)	old forest with interspersion, grassy openings, and dense thickets
	chipping sparrow (*Spizella passerina*)	open understory with regenerating pines
	Lewis' woodpecker (*Melanerpes lewis*)	patches of burned old forest
Mesic mixed conifer (late successional)	Vaux's swift (*Chaetura vauxi*)	large snags
	Townsend's warbler (*Dendroica townsendi*)	overstory canopy closure
	varied thrush (*Ixoreus naevius*)	structurally diverse; multilayered
	MacGillivray's warbler (*Oporornis tolmiei*)	dense shrub layer in forest openings or understory
	olive-sided flycatcher (*Contopus cooperi*)	edges and openings created by wildfire
Riparian woodland	Lewis' woodpecker (*Melanerpes lewis*)	large snags
Riparian shrub	willow flycatcher (*Empidonax trallii*)	willow/alder shrub patches
Unique habitats	hermit thrush (*Catharus guttatus*)	subalpine forest

Habitat Type	Focal Species Blue Mountain Subprovince	Habitat Feature/ Conservation Focus
Unique habitats	upland sandpiper (*Bartramia longicauda*)	montane meadows (wet/dry)
	vesper sparrow (*Pooecetes gramineus*)	steppe shrublands
	red-naped sapsucker (*Sphyrapicus nuchalis*)	aspen
	gray-crowned rosy finch (*Leucosticte tephrocotis*)	alpine

White Sturgeon

White sturgeon (*Acipenser transmontanus*), although common in the mainstem Snake River, is a locally significant species present in the Snake Hells Canyon subbasin and valued for both sport and ecological reasons. White sturgeon has been selected as a focal species for this assessment and is discussed in section 3.4.8.

Redband Trout

Although present in the Snake Hells Canyon subbasin, little information exists on redband trout (*Oncorhynchus mykiss*) because of the difficulty in morphologically distinguishing juveniles from anadromous juvenile rainbow trout (steelhead). Nonanadromous rainbow trout occurring in the Snake Hells Canyon subbasin may be divided into two groups: one group is sympatric with steelhead (evolving alongside), while the other is allopatric (evolving outside the historical range of steelhead) (BLM 2000b). The sympatric form, or nonanadromous steelhead, are considered to be historically derived or associated with steelhead (BLM 2000b). Cherry, Cook, and Deep creeks all provide several miles of rainbow habitat above natural migratory fish barriers. Cherry, Cook, and McGraw creeks are also believed to contain pure strains of redband trout (USFS 1999). Redband trout in the Snake Hells Canyon subbasin are considered to have special ecological significance because of their potentially limited distribution and relative abundance and their locally adapted life history.

3.1.4 Special Status Plants

Numerous rare plant species are known or suspected to occur in the Snake Hells Canyon subbasin. The unique geology, climate, elevational extremes, and topographic relief of the area provide a rich environment for speciation and specialization within the flora (Fiedler 1986, Kruckeberg 1986). Portions of the subbasin were identified as regional centers for plant biodiversity and endemism during the ICBEMP assessment (Figure 29 and Figure 30). Twenty-one species are endemic to the Hells Canyon ecosystem, of which six are considered rare (Table 18) (USFS 2003a). Many other species occurring in the Snake Hells Canyon subbasin are of conservation concern by one or more entities with management authority in the area.

Rare plant species are typically ranked based on factors including distribution, number of populations, population size, threats, and extinction risk. Typically, each state maintains its own list of rare plant taxa that are ranked using a system of codes. Federal land management agencies maintain similar lists of sensitive species (USFS) or special status species (BLM). These lists may or may not be ranked. In general, species having a 1 in their ranking are the most rare and/or at risk. Species with higher numbers are less imperiled but still of conservation concern. USFS sensitive species are not ranked by that agency but are generally included if they are on one or more state listings. IDFG (2003c), ODFW (2003c), USFS (2003a), and Washington Department of Fish and Wildlife (WDFW) (2003b) include more complete explanations of the codes.

Table 18. Rare and endemic plant species known or suspected to occur in the Snake Hells Canyon subbasin. Codes denote conservation status within the USFS, BLM, and state (IDFG 2003c, ODFW 2003c, USFS 2003a, WDFW 2003b).

Species	**Endemic**	**USFS Sensitive**			**BLM**	**ID**	**OR**	**WA**
		R-1	**R-4**	**R-6**				
Allium tolmeii var. *persimile*			S		3	S3	3	
Arabis crucisetosa	common							
Arabis hastatula	rare			S			1	
Astragalus vallaris	common							
Botrychium simplex		S				S2		
Bupleurum americanum							2	
Calochortus macrocarpus var. *maculosus*					2	S2	1	S1
Calochortus nitidus		S	S	S	2	S3	2	S1
Camassia cusickii			S			S2		
Carex hystericina				S			2	
Carex interior				S			3	
Chrysothamnus nauseosus ssp. *nanus*					5	S3		
Crepis bakeri ssp. *idahoensis*					2	S2		S1
Epipactus gigantea		S	S		3	S3		
Erigeron disparipilus				S			2	
Erigeron engelmanii var. *davisii*	rare			S			2	
Frasera albicaulis var. *idahoensis*	common							
Haplopappus hirtus var. *sonchifolius*		S				S1		
Haplopappus liatriformis					2	S2		S2
Haplopappus radiatus			S		3	S3	1	
Leptodactylon pungens	rare		S	S	3	S2	1	
Lomatium rollinsii	common						4	S2

Species	Endemic	USFS Sensitive			BLM	ID	OR	WA
		R-1	R-4	R-6				
Lomatium salmoniflorum		S			3	GP3	2	
Lomatium serpentinum	common							
Mimulus hymenophyllus	rare			S	5	S1	1	
Mirabilis macfarlanei[1]	rare	S	S	S	1	S2	1	
Nemophila kirtleyi	common							
Pediocactus simpsonii var. *robustior*	common				4	S3	4	S?
Penstemon elegantulus	common							
Pentogramma triangularis		S			3	S1		
Phacelia minutissima			S		3	S2	1	
Phlox colubrina	common							
Primula cusickiana				S			2	
Ribes cereum var. *colubrinum*	common							
Ribes wolfii						S2		
Rubus bartonianus	rare		S	S		S2	1	
*Silene Spaldingii**					1	S1	1	S2
Thelypodium laciniatum var. *streptanthoides*					5	S2		
Trifolium plumosus var. *plumosus*					3	S2	3	S1
Trollius laxus var. *albiflorus*				S			2	

3.1.5 Extirpated Species

Several species are known to have occurred in the Snake Hells Canyon subbasin and are suspected of having been extirpated. Table 17 lists these species and provides information about their current status.

Table 19. Species extirpated from the Snake Hells Canyon subbasin (based on Johnson and O'Neil 2001, exceptions noted)

Common Name	Scientific Name	Comments
Bighorn sheep	*Ovis canadensis*	Successfully reintroduced (see section 3.5.2)
Yellow-billed cuckoo	*Coccycuz americanus occidentalis*	Possibly extirpated; rare observations occasionally occur. Breeding pair in LaGrande in 1992
Gray wolf	*Canis lupus*	May be recolonizing from Idaho
Grizzly bear	*Ursus arctos*	Last grizzly in Oregon shot in Wallowa County in 1931
Sharp-tailed grouse	*Tympanuchus phasianellus*	Thought to be extirpated (BLM 2002)
White-tailed jackrabbit	*Lepus townsendii*	Thought to be extirpated (BLM 2002)

3.1.6 Game Species

One amphibian, 42 birds, and 22 mammal species in the subbasin are managed as game species by the states of Oregon, Washington, and Idaho (Table 20). Revenues generated through the harvest of many of these species provide significant economic gain to these states.

Table 20. Game species of the Snake Hells Canyon subbasin (IBIS 2003).

Common Name	Scientific Name	State Classification		
		ID	OR	WA
Bullfrog	*Rana catesbeiana*		game fish	game species
Greater white-fronted Goose	*Anser albifrons*	game bird	game bird	game bird
Ross's goose	*Chen rossii*	game bird	game bird	game bird
Canada goose	*Branta canadensis*	game bird	game bird	game bird
Wood duck	*Aix sponsa*	game bird	game bird	game bird
Gadwall	*Anas strepera*	game bird	game bird	game bird
Eurasian wigeon	*Anas penelope*		game bird	game bird
American wigeon	*Anas americana*	game bird	game bird	game bird
Mallard	*Anas platyrhynchos*	game bird	game bird	game bird
Blue-winged teal	*Anas discors*	game bird	game bird	game bird
Cinnamon teal	*Anas cyanoptera*	game bird	game bird	game bird

Common Name	Scientific Name	State Classification		
		ID	OR	WA
Northern shoveler	*Anas clypeata*	game bird	game bird	game bird
Northern pintail	*Anas acuta*	game bird	game bird	game bird
Green-winged teal	*Anas crecca*	game bird	game bird	game bird
Canvasback	*Aythya valisineria*	game bird	game bird	game bird
Redhead	*Aythya americana*	game bird	game bird	game bird
Ring-necked duck	*Aythya collaris*	game bird	game bird	game bird
Greater scaup	*Aythya marila*		game bird	game bird
Lesser scaup	*Aythya affinis*	game bird	game bird	game bird
Harlequin duck	*Histrionicus histrionicus*	game bird	game bird	game bird
Surf scoter	*Melanitta perspicillata*		game bird	game bird
Bufflehead	*Bucephala albeola*	game bird	game bird	game bird
Common goldeneye	*Bucephala clangula*	game bird	game bird	game bird
Barrow’s goldeneye	*Bucephala islandica*	game bird	game bird	game bird
Hooded merganser	*Lophodytes cucullatus*	game bird	game bird	game bird
Common merganser	*Mergus merganser*	game bird	game bird	game bird
Red-breasted merganser	*Mergus serrator*	game bird	game bird	game bird
Ruddy duck	*Oxyura jamaicensis*	game bird	game bird	game bird
Chukar	*Alectoris chukar*	game bird	game bird	game bird
Gray partridge	*Perdix perdix*	game bird	game bird	game bird
Ring-necked pheasant	*Phasianus colchicus*	game bird	game bird	game bird
Ruffed grouse	*Bonasa umbellus*	game bird	game bird	game bird
Spruce grouse	*Falcipennis canadensis*	game bird	game bird	game bird
Blue grouse	*Dendragapus obscurus*	game bird	game bird	game bird
Wild turkey	*Meleagris gallopavo*	game bird	game bird	game bird
Mountain quail	*Oreortyx pictus*	game bird	game bird	game bird
California quail	*Callipepla californica*	game bird	game bird	game bird
Northern bobwhite	*Colinus virginianus*	game bird	game bird	game bird
American coot	*Fulica americana*	game bird	game bird	game bird
Common snipe	*Gallinago gallinago*	game bird	game bird	game bird
Mourning dove	*Zenaida macroura*	game bird	game bird	game bird
American crow	*Corvus brachyrhynchos*	game bird		

Common Name	Scientific Name	State Classification		
		ID	OR	WA
Eastern cottontail	*Sylvilagus floridanus*			game mammal
Nuttall's (mountain) cottontail	*Sylvilagus nuttallii*	game mammal		game mammal
Snowshoe hare	*Lepus americanus*	game mammal		game mammal
Black-tailed jackrabbit	*Lepus californicus*			game mammal
American beaver	*Castor canadensis*	game mammal		
Muskrat	*Ondatra zibethicus*	game mammal	game mammal	
Red fox	*Vulpes vulpes*	game mammal		
Black bear	*Ursus americanus*	game mammal	game mammal	game mammal
Raccoon	*Procyon lotor*	game mammal		
American marten	*Martes americana*	game mammal		
Mink	*Mustela vison*	game mammal		
American badger	*Taxidea taxus*	game mammal		
Northern river otter	*Lutra canadensis*	game mammal		
Mountain lion	*Puma concolor*	game mammal	game mammal	game mammal
Bobcat	*Lynx rufus*	game mammal		
Rocky Mountain elk	*Cervus elaphus nelsoni*	game mammal	game mammal	game mammal
White-tailed deer	*Odocoileus virginianus ochrourus*	game mammal	game mammal	game mammal
Moose	*Alces alces*	game mammal		game mammal
Pronghorn antelope	*Antilocapra americana*	game mammal	game mammal	game mammal
Mountain goat	*Oreamnos americanus*	game mammal	game mammal	game mammal
Bighorn sheep	*Ovis canadensis*	game mammal	game mammal	game mammal

3.2 Species Introductions and Artificial Production

3.2.1 Aquatic Species

Design hatchery capacity in the Snake River Basin is approximately 10 million steelhead, 17.6 million chinook, 1 million coho and a few hundred thousand sockeye. Although the majority of these fish are not produced or released within the Snake Hells Canyon subbasin itself, most must pass through the subbasin when migrating to or from the ocean. The following section provides a description of artificial production strategies and programs in place within or affecting the Snake Hells Canyon subbasin.

Idaho Department of Fish and Game

IDFG operates artificial production programs for anadromous species in the subbasin for harvest mitigation, supplementation, and conservation. These programs conform to statewide fisheries policies and management goals identified in the *2001–2006 Fisheries Management Plan* (IDFG 2001a). Hatchery and genetic management plans (HGMPs), specified in the NOAA Fisheries 2000 Federal Columbia River Power System and 1999 hatchery biological opinions (NMFS 2000a,b), have been prepared for all anadromous hatchery programs in Idaho. The complete HGMPs and associated draft reports and recommendations are available at www.nwcouncil.org/fw/apre/Default.htm.

Harvest Mitigation Programs

Chinook salmon and steelhead harvest mitigation is provided through hatchery programs funded by IPC and through the USFWS's Lower Snake River Compensation Plan (LSRCP). IDFG operates hatchery programs funded by IPC; LSRCP-authorized programs are operated by the IDFG and USFWS. The IDFG strongly emphasizes maintaining selective fisheries with the steelhead and chinook salmon programs. All harvest mitigation fish production (also called reserve production) is externally marked with an adipose fin clip to enable selective fisheries and provide for origin-specific stock monitoring and broodstock management at trapping and spawning sites.

IPC provides funding for operation of Oxbow and Rapid River fish hatcheries. Oxbow Fish Hatchery is in the Snake Hells Canyon subbasin at the Hells Canyon Complex on the Snake River. Rapid River Fish Hatchery is located on Rapid River, a tributary to the Little Salmon River, which is in turn a tributary to the Salmon River near Riggins. Chinook salmon trapped at the Oxbow facility are transferred to Rapid River Fish Hatchery for holding, spawning, incubation, and juvenile rearing.

IPC facilities mitigate for anadromous production habitat lost as a result of construction of the Hells Canyon Complex on the Snake River. The annual mitigation objective for IPC hatcheries is to release 400,000 pounds of steelhead smolts (at approximately 4.5 fish per pound) and 4 million chinook salmon smolts. No adult return objectives are specified in the IPC mitigation agreement.

The LSRCP program was authorized to mitigate losses caused by the construction and operation of the four lower Snake River dam and navigation lock projects. The program goals are unique in that they focus on replacing losses of returning adult salmon and steelhead rather than on releasing a given number of smolts or pound of smolts. The LSRCP adult return goals were allocated to the project area (above Ice Harbor Dam for fall chinook and above Lower Granite Dam for spring/summer chinook and steelhead) and not simply to the hatcheries. The measure of success in meeting LSRCP adult return goals is an estimate of the sum of adult returns to the various Snake River Basin fisheries, to the hatcheries of origin, and to natural spawning areas within the Snake River Basin. An extensive monitoring and evaluation program in the basin documents hatchery practices and evaluates the success of the hatchery programs at meeting LSRCP mitigation and cooperator objectives. The LSRCP hatchery monitoring and evaluation program identifies hatchery rearing and release strategies that allow LSRCP programs to meet their mitigation, ESA, and Tribal Trust responsibilities.

To properly evaluate the LSRCP program, adult returns to facilities, spawning areas, and fisheries that result from hatchery releases are documented. The IDFG's LSRCP program requires the cooperative efforts of its Hatchery Evaluation Study, Harvest Monitoring Project, and Coded Wire Tag Laboratory. The Hatchery Evaluation Study evaluates and provides oversight of certain hatchery operational practices (broodstock selection, size and number of fish reared, disease history, and time of release). Hatchery practices are assessed in relation to their effects on adult returns, and recommendations for improvement of hatchery operations are made. The Hatchery Evaluation Study and IDFG's BPA-funded supplementation research projects are continuously coordinated because these programs overlap in several areas including juvenile outplanting, broodstock collection, and spawning (mating) strategies. LSRCP hatchery production plays a substantial role in IDFG's supplementation research.

The Harvest Monitoring Project provides comprehensive harvest information to evaluate the success of the LSRCP in meeting adult return goals. It estimates the numbers of hatchery and wild/natural fish in the fishery and overall returns to the project area in Idaho. Data on the timing and distribution of the marked hatchery and wild stocks in the fishery are also collected and analyzed to develop LSRCP harvest management plans. Harvest data provided by the Harvest Monitoring Project are coupled with hatchery return data to estimate returns from LSRCP releases. Coded-wire tags are used extensively to evaluate fisheries contribution of representative groups of LSRCP production releases. However, most of these fish serve experimental purposes as well for evaluating hatchery-controlled variables such as size, time, and location of release; rearing densities; and natural rearing.

Supplementation Programs

Two tiers of supplementation programs are carried out in the subbasin. Tier 1 supplementation consists of intensive research projects approved within the Northwest Power and Conservation Council Fish and Wildlife Program and funded by BPA. Separate projects for steelhead (Steelhead Supplementation Studies in Idaho Rivers) and chinook salmon supplementation (Idaho Supplementation Studies) are currently active in the subbasin.

Broodstock and juvenile production for the Tier 1 supplementation programs are managed and maintained separately from other hatchery programs. Supplementation broodstock typically consists of natural-origin adult recruits and adult returns from prior supplementation broodstocks. Adults from the reserve (or harvest mitigation) production programs may be incorporated into some supplementation broodstocks. The progeny of a supplementation broodstock are marked differently (pelvic fin clip or coded-wire tag but, no fin clip) than reserve production fish. If a hatchery is at juvenile rearing capacity, the rearing of Tier 1 supplementation fish may displace some reserve production.

Tier 2 supplementation actions are those not associated with the ongoing intensive evaluations. Returns of reserve production adults in some years may exceed a hatchery's need with respect to an egg-take goal. Excess adults or their progeny (eggs, fry, parr) have primarily been used in on-site and off-site tribal supplementation programs. Tier 2 supplementation actions are coordinated and agreed to among state and tribal comanagers. Hatcheries may be involved in rearing eggs or juveniles for Tier 2 supplementation. Attempts are being made to identify unique marks for fish released as juveniles so they may be adequately monitored and managed when returning as adults. If they are at production capacity, priority for rearing space is 1) reserve production, 2) Tier 1 supplementation production, and 3) Tier 2 supplementation production.

Conservation Programs

The IDFG Chinook Salmon Captive Rearing program is the primary artificial production program in the Snake Hells Canyon subbasin that addresses anadromous fish conservation. This program differs from typical artificial production programs in that fish culture, not propagation, is the primary activity used to achieve program objectives. Hence, production, as used in classical hatchery terminology, is not an objective of the program. This program represents the application of two different captive culture strategies, broodstock and rearing, to achieve conservation and rebuilding objectives. This captive culture effort is consistent with section 9.6.4 ("Artificial Propagation Measures") direction in the 2000 FCRPS biological opinion and with sections III.C (biological objectives) and III.D (strategies) of the Northwest Power and Conservation Council's 2000 Columbia River Basin Fish and Wildlife Program (Northwest Power Planning Council 2000).

The IDFG initiated a captive rearing research program for populations at high risk of extinction to maintain metapopulation structure. Captive rearing is a short-term approach to species preservation. The main goal of the captive rearing approach is to avoid demographic and environmental risks of cohort extinction; maintaining the genetic identity of the breeding unit is an important but secondary objective. The strategy of captive rearing is to prevent cohort collapse in the specified target populations by providing captively reared adult spawners to the natural environment, which in turn maintain the continuum of generation-to-generation smolt production. Each generation of smolts, then, provides the opportunity for population maintenance or increase if environmental conditions prove favorable for that cohort. A captive rearing approach is most appropriate when the primary limiting factors depressing a population operate during the smolt-to-adult return life stage (outside the subbasin). In this case, captive rearing intervention for a portion of a cohort preempts exposure to external limiting factors. Freshwater spawning and production for the cohort is maintained while limiting factors external to the subbasin are addressed.

The captive rearing program was developed primarily as a way to maximize the number of breeding units cultured while minimizing intervention impacts through the collection and subsequent rearing of early life stages through adulthood. Only enough juveniles or eggs are collected from target populations to provide an adequate number of spawners, about 20, to ensure that acceptable genetic diversity can be maintained without additional natural escapement. (According to the Stanley Basin Sockeye Technical Oversight Committee, it is reasonable to assume that 20 fish could encompass 95% of the genetic diversity of the population.) However, this number remains somewhat speculative because of uncertainties associated with the ability of the captive rearing approach to produce adults with the desired characteristics for release into the wild (Fleming and Gross 1992, 1993; Joyce et al. 1993; Flagg and Mahnken 1995). Juveniles and/or eggs would be collected each year from cohorts of low-resiliency populations, those expected to return 10 or fewer spawning pairs to their respective spawning areas. To meet its objectives, the program must be able to produce an adequate number of adults with the proper morphological, physiological, and behavioral attributes to successfully spawn and produce viable offspring in their native habitats.

Little scientific information regarding captive culture techniques for Pacific salmonids was available at the inception of this program. Following Flagg and Mahnken's (1995) work, the IDFG captive rearing program was initiated to develop the technology for captive culture of chinook salmon and to monitor and evaluate captively reared fish during both the rearing and post-release/spawning phases. In addition to technology development, the IDFG program also addresses population dynamics and population persistence concerns. These population level concerns include 1) maintaining a minimum number of spawners in high-risk populations and 2) maintaining metapopulation structure by preventing local extinction.

Lower Snake River Compensation Plan

The LSRCP program was authorized to mitigate losses caused by the construction and operation of the four lower Snake River dam and navigation lock projects. The program has been modified through the years to meet its mitigation, ESA and Tribal Trust responsibilities. The Lyons Ferry Complex is comprised of Lyons Ferry and Tucannon hatcheries, operated by WDFW, and a system of acclimation ponds throughout Southeastern Washington. The Nez Perce Tribe operates three acclimation facilities above Lower Granite Dam for fall chinook from Lyons Ferry Hatchery, two in the Snake River and one in the Clearwater River. These hatchery and acclimation facilities rear and release fish to compensate for 18,300 Snake River fall chinook, 1,152 Tucannon River spring chinook, 4,656 Snake River summer steelhead, and 67,500 angler days of recreation on resident fish. Management intent for each species is different and will be discussed in each species section below.

Lyons Ferry Hatchery - Fall Chinook

The Lyons Ferry Hatchery (LFH) and Nez Perce Tribal Hatchery operations represents the sole fall chinook salmon compensation effort under the LSRCP in the Snake River basin. No information was provided for inclusion into this assessment regarding the NPTH program. The LFH utilizes native stock Snake River fall chinook for the program. These fish are part of the Snake River fall chinook ESU and have been identified by NOAA Fisheries as the appropriate stock for recovering the population.

While planning and designing the LSRCP facilities in the 1970s, the steep fall chinook decline caused concern that these fish might become extinct before mitigation facilities could be completed to maintain and enhance the run. An egg bank program for fall chinook was initiated in 1976 to preserve genetic material for compensation of 18,300 adults. Production releases from LFH began in the mid-1980s with fish from the egg bank program. Recent releases and returns have increased while the genetic integrity of the stock has been maintained.

Current management objectives for LFH are driven by the ESA and the *Columbia River Fish Management Plan*. These objectives are to 1) maintain genetic integrity of LFH/Snake River stock, 2) produce 900,000 yearling smolts (450,000 on-station release and 450,000 for three equal releases at Pittsburg Landing, Captain John, and Big Canyon acclimation sites above Lower Granite Dam) and produce subyearlings as possible for release at LFH and above Lower Granite Dam, and 3) reduce stray hatchery fish escaping above Lower Granite Dam to maintain the genetic integrity of Snake River fall chinook. The program produces subyearlings, even though their survival is lower than for yearlings, to mimic the natural life history of Snake River fall chinook.

Evaluation of the program has included 1) tagging all releases by the WDFW and a portion of those released above Lower Granite Dam, as well as monitoring adult returns to LFH and Lower Granite Dam, 2) determining the most effective release strategy between barging or direct stream releases, 3) determining adult fallback rate at Ice Harbor and Lower Granite dams and providing the recommendations for the best trapping location of broodstock, and 4) experimenting with cryopreserved semen. Evaluation work conducted in the early 1980s showed a nearly 11-fold survival advantage of releasing yearling smolts versus subyearling smolts at LFH. This work has supported management decisions to release yearling smolts to increased available broodstock, with subyearlings released occurring after baseline production is achieved. The Nez Perce Tribe and USFWS are conducting ongoing studies of fall chinook released above Lower Granite Dam, while the WDFW monitors hatchery operations and adult returns to the lower Snake River below Lower Granite Dam.

Future Plans

The WDFW has released subyearlings from LFH for the past three years, concurrently with the subyearling releases above Lower Granite Dam from tribal facilities. The WDFW is proposing continued LFH subyearling releases rather than solely releasing fish above Lower Granite Dam. Low broodstock numbers have been an obstacle to program success, which has been influenced by a small founding population, low smolt-to-adult survival of subyearling and yearling fall chinook in the mainstem corridor, and removal of stray Columbia River chinook from the broodstock during the late 1980s and early 1990s. However, recent increases in total smolt releases have had a positive effect on the number of adults returning to the Snake River basin. Spawning practices at LFH and trapping operations at Lower Granite Dam have maintained the genetic integrity of the stock. Production and monitoring and evaluation for fiscal year 2002 did not change significantly from past years but continued to focus on maximizing smolt-to-adult survival and maintaining stock integrity.

Lyons Ferry Hatchery - Summer Steelhead

Annually, approximately 60,000 to 120,000 hatchery summer steelhead smolts have been reared and released into the Snake River near LFH. The original intents of these releases were to build broodstock returns to LFH to support the mitigation program, return adults to meet the LSRCP goal, and reestablish successful steelhead fisheries. Although maintaining populations of wild steelhead in the basin was and is a management intent of the comanagers, no specific supplementation goals for Snake River populations were identified. Stocks of fish released into the river generally have been Wells (1983–1986), Wallowa (1984–1989), and Lyons Ferry (1987–present), with incidental releases of Clearwater, Oxbow, and Skamania stocks occurring infrequently in the past. However, during the life of the LSRCP program, wild populations throughout the Snake River basin generally declined (except for run years 1999 and 2000).

The LSRCP program is successfully returning adult hatchery-origin steelhead and therefore meets or exceeds LSRCP goals. These fish have created and supported successful sport fisheries within the Snake River basin and some of its tributaries. Releases of summer steelhead for the Washington portion of the Snake River decreased in 2000, but these releases have not been agreed to through the negotiation process specified in the 1988 *Columbia River Fish Management Plan* negotiation process. Decreased releases of LFH stock into the Snake River resulted from a management response following the NOAA Fisheries determination that this stock constitutes a jeopardy to the listed natural populations (April 2, 1999, biological opinion issued by NOAA Fisheries). Concurrent with this mitigation success has been increasing concern with possible effects of hatchery returns on wild populations as they return to their release sites or stray into adjacent subbasins that support natural populations.

Future Plans

Past evaluations have focused on increasing the survival of hatchery-reared steelhead and assessing the contribution of LFH-released fish to Columbia and Snake basin fisheries. Areas of concern include stray rates of hatchery-stock steelhead into tributary rivers, the degree of incidental hooking mortality on natural adults, contribution of hatchery steelhead to the decline in wild populations, and the availability of a more appropriate stock for compensation and proposed supplementation in the basin. Evaluations will continue to monitor Snake River steelhead releases and harvest and to focus on ways to minimize effects of the compensation program on natural populations, such as size and timing of releases or other release strategies that may decrease the potentially negative interactions between hatchery and wild fish. Further, the evaluation programs will continue to assess the potential for mitigation fisheries (identified in the original LSRCP legislation and consistent with the Northwest Power and Conservation Council's recognition of the value of "Harvest Hatcheries") where possible. In addition, expanded genetic evaluation of hatchery and naturally produced steelhead has begun to more fully describe the genetic stock structure within the basin and possibly help determine the availability of an acceptable, locally adapted broodstock for use in the program.

Nez Perce Tribe Supplementation Programs

In 1996, Congress instructed the U.S. Army Corps of Engineers (USCOE) to construct, under the Lower Snake River Compensation Plan (LSRCP), final rearing and acclimation facilities for fall chinook in the Snake River basin to complement their activities and efforts in compensating for fish lost due to construction of the lower Snake River dams. Fisheries co-managers of *U.S. v Oregon* supported and directed the construction and operation of acclimation and release facilities for Snake River fall chinook from Lyons Ferry Hatchery at three sites above Lower Granite Dam. The Nez Perce Tribe (NPT) played a key role in securing funding and selecting acclimation sites, then assumed responsibility for operation and maintenance of the Fall Chinook Accllimation Facility (FCAP). In 1997, Bonneville Power Administrative (BPA) was directed to fund operations and maintenance (O&M) for FCAP satellites. Two acclimation facilities, Captain John Rapids and Pittsburg Landing, are located on the Snake River between Asotin, WA and Hells Canyon Dam and one facility, Big Canyon, is located on the Clearwater River at Peck at the confluence of Big Canyon Creek and the Clearwater River. The Capt. John Rapids facility is a single pond while the Pittsburg Landing and Big Canyon sites consist of portable fish rearing tanks assembled and disassembled each year. Acclimation of 450,000 yearling smolts (150,000 each facility) begins in March and ends 6 weeks later. When available, an additional 2,400,000 fall chinook sub-yearlings may be acclimated for 6-weeks and released as subyearling smolts.

Pittsburg Landing satellite is located in the Hells Canyon National Recreation Area (HCNRA) near Whitebird, Idaho. The site is located on the Idaho side of the Snake River at River Mile (RM) 215, about 31 miles downstream of Hells Canyon Dam.

Captain John Rapids satellite is located on the Snake River between Asotin, Washington and the mouth of the Grand Ronde River at RM 164. The site is on the Washington side of the river, 20 miles upstream of Asotin, with vehicle access provided by the Snake River Road.

Big Canyon acclimation site is located on the lower Clearwater River adjacent to US Highway 12 near Peck, Idaho. The site is 4 miles below the confluence of the North Fork and Middle Fork of the Clearwater River at RM 35.

FCAP is a supplementation project; in that hatchery produced fish are acclimated and released into natural spawning habitat for the purpose of returning a greater number of natural spawners. Only Snake River stock is used; juvenile production occurs at Lyons Ferry Hatchery. This long-term project is intended to ultimately work towards ESA-delisting of Snake River fall chinook by NOAA Fisheries. Complete adult returns for all three facilities occurred in the year 2002. The progeny from these fish become ESA-listed fish, as will those from all future adult returns. Hence, this production contributes to the ESA-delisting cycle and represents the first full generation of spawners.

The immediate goal of the project is a concerted effort to ensure that the Snake River fall chinook salmon above Lower Granite Dam do not go extinct. Long-term goals of the project are:

1. Increase the natural populations of Snake River fall chinook spawning above Lower Granite Dam.
2. Sustain long-term preservation and genetic integrity of this population.
3. Keep the ecological and genetic impacts of non-target fish populations within acceptable limits.
4. Assist with the recovery of Snake River fall chinook to remove from ESA-listing.
5. Provide harvest opportunities for both tribal and non-tribal anglers.

Idaho Power Company

Idaho Power Company is obligated to provide mitigation for lost fish and fishing opportunity resulting from construction of the Hells Canyon Hydroelectric Complex. Under a 1980 FERC settlement agreement, IPC is obligated to produce 400,000 pounds (about 1.8 million fish at 4.5 fish per pound) of steelhead smolts, 4 million spring/summer chinook smolts and 1 million fall chinook smolts. Because of poor access and limited remaining habitat in the Snake Hells Canyon subbasin, most of the mitigation releases have been relocated to the Salmon River subbasin. Annually IPC releases about 300,000 spring chinook smolts and 500,000 steelhead smolts at Hells Canyon Dam. Starting with broodyear 2000, IPC has produced and released a few hundred thousand fall chinook smolts at Hells Canyon Dam. The fall chinook smolt release is expected to reach 1 million smolts within the next few years, pending development of facilities and adequate broodstock, and an ongoing negotiation among the management entities for a long term fall chinook management plan (Herb Pollard, NOAA Fisheries, personal communication, December 2003).

3.2.2 Terrestrial Species

Ten nonnative terrestrial vertebrate species are thought to occur within the subbasin. The majority of these species are native to Asia or Europe and were not introduced directly to the Snake Hells Canyon subbasin but colonized from surrounding areas (Table 21). Five species of introduced game birds inhabit the subbasin. Although these game birds are economically important because they provide hunting opportunities, they may compete with native birds for food and nest sites (Table 21) (Johnson and O'Neil 2000). The remaining introduced species are generally considered undesirable and may have negative impacts on native wildlife. For instance, starlings have been documented to usurp nest sites from many species of native birds, and bullfrogs have been shown to outcompete and prey on native amphibian species. Introduced wildlife species are not currently considered to be a significant factor limiting native wildlife populations in the subbasin. However, if bullfrog populations on Craig Mountain continue to increase, they may begin to have an impact on the diverse amphibian populations that the area supports (Llewellyn and Peterson 1998).

Table 21. Introduced wildlife species of the Snake Hells Canyon subbasin (Johnson and O'Neil 2001).

Common Name	Scientific Name	Origin	Reason for Original Introduction*
Chukar	*Alectoris chukar*	Eurasia	game
Gray partridge	*Perdix perdix*	Eurasia	game
Ring-necked pheasant	*Phasianus colchicus*	Eurasia	game
California quail	*Callipepla californica*	Southwestern United States	game
Rock dove	*Columba livia*	Eurasia	aesthetics, racing, messengers
European starling	*Sturnus vulgaris*	Eurasia	aesthetics
House sparrow	*Passer domesticus*	Eurasia	aesthetics, insect control
Bullfrog	*Rana catesbeiana*	Eastern and central United States	Insect control, aesthetics, hunting, food
Norway rat	*Rattus norvegicus*	Asia	stowaway
House mouse	*Mus musculus*	Europe	stowaway

* not all species were directly introduced to the Snake Hells Canyon subbasin, most colonized from other areas

3.3 Focal Species Identification

Eight fish species and 12 wildlife species were selected as focal species for this assessment. Aquatic species selection was based on their listing status (e.g., threatened) and their ecological, social, cultural, and/or local significance (Table 22). In addition to the above criteria, wildlife focal wildlife species were selected as representatives of the wildlife habitat types in the subbasin. More focal species were selected to represent widely distributed or disproportionately important habitat types, compared with habitats that are only a minor component of the landscape. Species were selected that represent structural conditions or habitat elements particularly important to a variety of wildlife species in the subbasin and that are thought to be less common now than they were historically. Susceptibility to current and historical management, data availability, and monitoring potential were also factors considered during the selection process. The list of focal species used for the neighboring Imnaha subbasin was used as a starting place in selecting focal species for the Snake Hells Canyon subbasin to promote province-level consistency.

The focal species were selected by a technical team made up of resource professionals who represented a variety of management entities (Nez Perce Tribe, USFWS, USFS, Oregon Department of Fish and Wildlife [ODFW], IDFG). Focal species were selected during a discussion, which took into account the various planning guidance documents available.

Table 22. Aquatic and terrestrial focal species selected for use in this assessment.

Aquatic	
Type	**Focal Species**
Anadromous	Spring chinook salmon Fall chinook salmon Steelhead trout Sockeye salmon Pacific lamprey
Resident	Bull trout Rainbow/redband trout White sturgeon
Terrestrial	
Wildlife Habitat Type	**Focal Species**
Eastside and montane mixed conifer forest	American marten Boreal owl Rocky Mountain elk
Ponderosa pine forests and woodlands	Flammulated owl White-headed woodpecker
Lodgepole pine forests and woodlands	Black-backed woodpecker
Alpine grasslands and shrublands	Mountain goat
Eastside grasslands	Rocky Mountain bighorn sheep Grasshopper sparrow
Agriculture, pastures, and mixed environs	Mule deer
Open water	Bald eagle
Wetland and riparian areas	Mountain quail Columbia spotted frog
Caves	Townsend’s western big-eared bat

3.4 Aquatic Focal Species Population Delineation and Characterization

3.4.1 Spring Chinook Salmon

Distribution

Stream-type chinook were historically widely distributed, occupying an estimated 46% of the Columbia Basin and occurring as far up the Snake River as Shoshone Falls (RM 615; Haas 1965). Spring chinook spawning does not occur in the mainstem Snake River within the Snake Hells Canyon subbasin. Below the confluence with the Salmon River, Asotin Creek (not contained within the Snake Hells Canyon subbasin) is the only tributary stream used by chinook salmon for spawning, while a limited amount of rearing may occur in lower reaches of some of the other larger tributaries (i.e., Captain John Creek; Figure 33) (WDFW et al. 1990, BLM 2000b). Above the Salmon confluence, Granite and Sheep creeks are the only tributaries used for spawning, although they are used very minimally (BLM 2000a). Limited juvenile rearing may occur in lower tributaries when stream conditions are suitable.

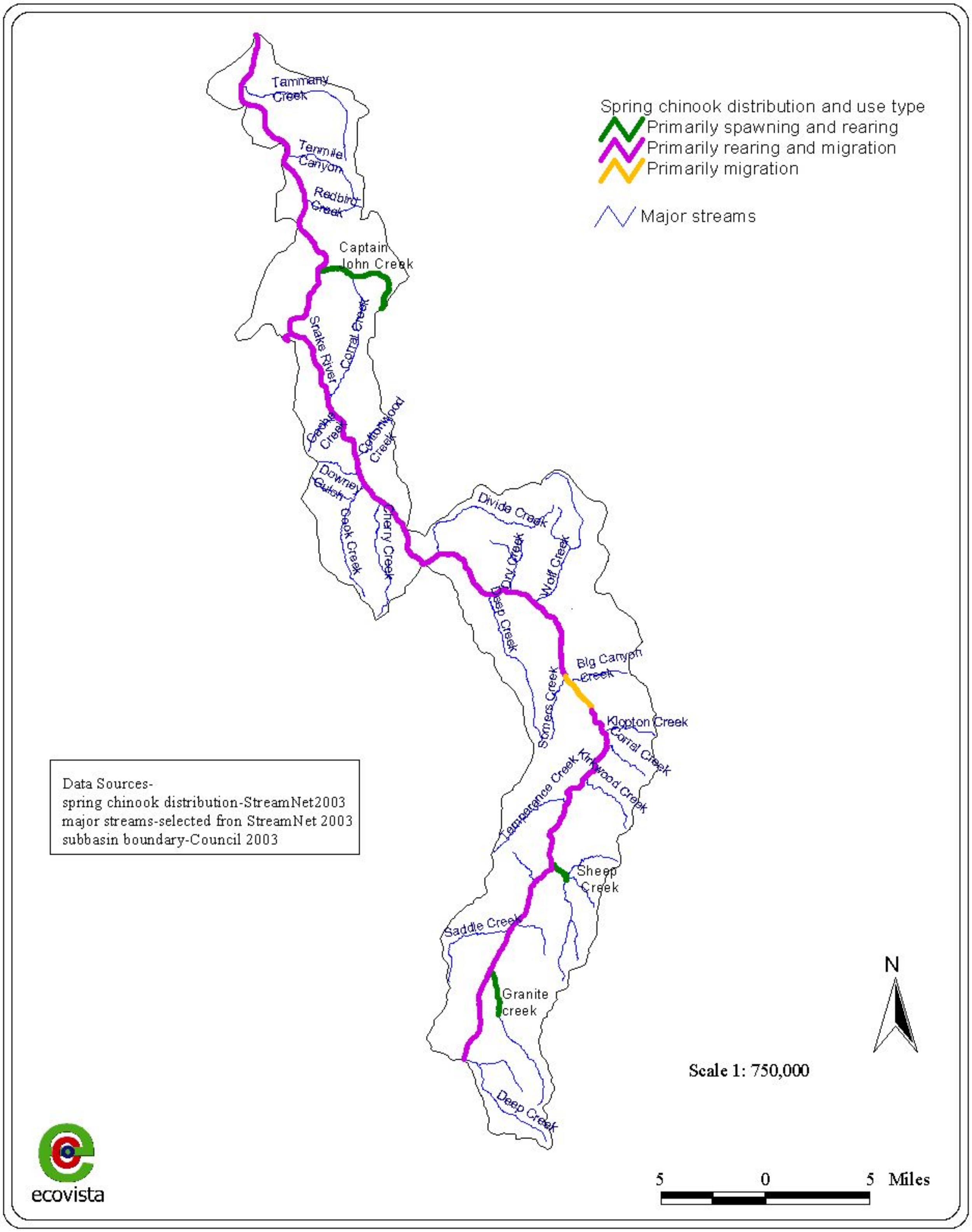


Figure 33. Spring chinook distribution in the Snake Hells Canyon subbasin.

Population Data and Status

Abundance and Trends

Historically, Snake River spring and summer chinook spawned in virtually all accessible and suitable habitat in the Snake River system (Fulton 1968). A substantial proportion of Columbia Basin spring/summer chinook were estimated to have originated in the Snake River basin in the late 1800s, with total production probably exceeding 1.5 million in some years (NMFS 2000a). By the mid-1900s, however, the abundance of adult spring/summer chinook salmon had declined considerably. Fulton (1968) estimated that an average of 125,000 adults per year entered the Snake River tributaries from 1950 through 1960. Adult counts at dams show that this value has continued to decline since the 1960s.

Until recently increased returns in 2001 and 2002, the number of naturally spawning spring/summer chinook salmon in the Snake River basin had been at all-time lows with an overall downward trend (Figure 34). Spring chinook salmon abundance within the Snake Hells Canyon subbasin has likely followed similar long-term trends, although recent increases in overall returns to the Snake River may have been less pronounced within the subbasin due to limited habitat availability. Most chinook salmon stocks in the remaining accessible habitat are severely depressed and at risk (BLM 2000a,b). Detailed information on biology and trends of Snake River spring and summer chinook can be found in Matthews and Waples 1991, Healy 1991 and ODFW and WDFW 1998.

Productivity

No productivity information is available relating directly to spring chinook salmon within the Snake Hells Canyon subbasin.

Life History Diversity

The highly variable life histories of stream-type chinook allow the species to adapt to a wide range of environmental conditions. Adult spring chinook salmon destined for the Snake River and its tributaries enter the Columbia River in early spring, pass Bonneville Dam from March through May, and reach the Snake River by late April (BLM 2000b). They arrive at staging areas from late May to early July and spawn from August to mid-September (IDFG 1992, cited in BLM 2000b). Spawning adults are typically four to five year olds (spending 2–3 years in the ocean), although they may return to the subbasin as three to six year olds. Fry emerge from February to April, rear through the summer in the natal stream, and then migrate downstream into the mainstem or larger tributary (i.e., Captain John or Asotin Creek) where they overwinter. Spring chinook outmigrate as age 1+ juveniles, passing Lower Granite Dam from late April through June.

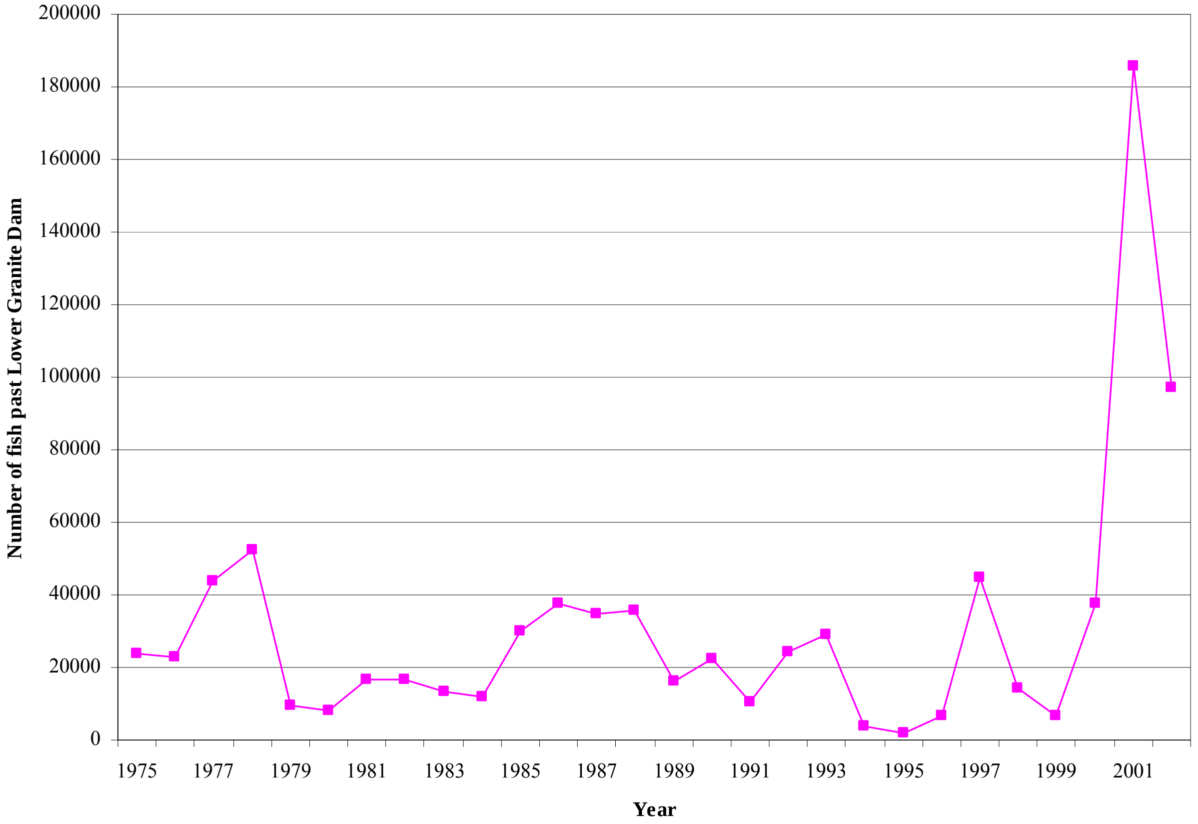


Figure 34. Adult returns of spring/summer chinook past Lower Granite Dam annually since 1975 (StreamNet 2003).

Carrying Capacity

Limited information is available related to carrying capacity of spring chinook and other focal species in the subbasin. That which is available relates only to carrying capacity of the smolt life history stage and, in some cases, inaccurately reflects known distribution of use areas (either through addition or omission of currently recognized use areas). The information is presented as a relative picture of potential smolt carrying capacity throughout major areas of the subbasin (e.g., upriver versus downriver tributary or mainstem habitats) only.

Estimates of spring chinook salmon smolt carrying capacity are available for select stream reaches in which spawning and rearing is known or suspected to occur (Table 23). Estimates are based on data downloaded from the StreamNet website (PSMFC 2004), which was originally produced using the smolt density model developed in 1989 as part of the Northwest Power Planning Council's presence/absence database. Detailed overview of methods used to estimate smolt carrying capacity are presented in Northwest Power Planning Council (1989). In short, the smolt density model estimates potential smolt capacity, accounting for both the amount of available habitat and relative quality of that habitat within a given stream reach. Estimates are considered very rough, but they likely provide a reasonable picture of the relative distribution of carrying capacity throughout the subbasin.

Table 23. Smolt capacity of spring chinook in various areas of the Snake Hells Canyon subbasin (PSMFC 2004).

Subbasin Area	Smolt Capacity
Upriver Tributaries–Above Salmon River Confluence	
Granite Creek	3,593
Sheep Creek	5,663
Downriver Tributaries–Below Salmon River Confluence	
N/A	0
Upriver Mainstem–Above Salmon River Confluence	
Snake River	620,417
Downriver Mainstem–Below Salmon River Confluence	
Snake River	90,649

Unique Population Units

Based on preliminary designations, no unique population units of spring chinook have been defined within, or encompassing any portion of, the Snake Hells Canyon subbasin (McClure et al. 2003).

Genetic Integrity

Information regarding genetic makeup and integrity of spring chinook salmon within the Snake River basin (including the Snake Hells Canyon subbasin) is presented in McClure et al. 2003. Much of the existing genetic information is unavailable for public distribution due to proprietary or other reasons; therefore, it is not included in this document. Readers are referred to McClure et al. 2003 for an overview of existing genetic information.

Harvest

No information is available regarding tribal or sport harvest of spring chinook salmon within the subbasin.

Habitat Condition

The Snake Hells Canyon subbasin provides designated critical habitat for spring/summer chinook salmon, as designated on December 28, 1993 (Federal Register 58:68543) and effective on January 27, 1994.

Spring/summer chinook habitat in the Snake Hells Canyon subbasin has been severely degraded over the past century. Even before mainstem dams were built, habitat was lost or severely damaged in the high-elevation streams used for chinook spawning and rearing (Fulton 1968). Construction and operation of irrigation dams and diversions; inundation of spawning areas by impoundments; and siltation and pollution from sewage, farming, logging, and mining all contributed to reductions in habitat quantity and quality (Fulton 1968). Habitat loss following completion of the Columbia/Snake hydropower/water storage system further contributed to habitat losses, as many primary spawning and rearing areas were no longer accessible (NMFS 2000a).

Chinook habitat in the Snake Hells Canyon subbasin consists of the mainstem Snake River, primarily used for migration, and its associated tributaries, some of which support limited spawning and rearing. In addition to a migration route, the mainstem Snake River provides rearing and staging habitat for spring chinook produced in tributary subbasins. The amount of rearing is unknown (WDFW et al. 1990).

Excluding the four primary tributaries (Clearwater, Grande Ronde, Imnaha, and Salmon rivers), the only tributaries known to contain habitat that supports spawning and rearing life history phases of spring/summer chinook are Granite and Sheep creeks (IDEQ 1998; BLM 2000a,b). Accessible tributary streams may be used by juvenile spring/summer chinook for rearing when conditions are suitable or when conditions in the mainstem become unsuitable (BLM 2000a,b).

3.4.2 Fall Chinook Salmon

Distribution

Snake River fall chinook were historically distributed from the mouth of the Snake River to a natural barrier at Shoshone Falls, Idaho, at RM 615 (Haas 1965). Swan Falls Dam was the first impoundment to inundate spawning and rearing habitat in 1901, eliminating 385 miles of habitat in the upper river (Tiffan et al. 1999). Following construction of Swan Falls Dam, most production occurred in the 30-mile reach from the dam to Marsing, Idaho (Connor et al. 2002). From the late 1950s through the mid-1970s, development and completion of the Snake River hydropower system further reduced available fall chinook spawning and rearing areas in the free-flowing river reach to approximately 100 miles between the backwaters of Lower Granite Reservoir and Hells Canyon Dam (Figure 35) (Tiffan et al. 1999).

Although the remaining free-flowing section represents about 17 percent of the historically available river miles, the Hells Canyon reach has never been considered to be the best spawning and rearing habitat. The historically most important spawning and rearing areas were located upstream of Hells Canyon where the river temperatures are regulated by the Thousand Springs inflow and the river is spread in broad gravel riffles compared to the relatively narrow and rocky river section remaining. However, the remaining habitat in Hells Canyon and in the lower reaches of the larger tributaries of this section are now the only areas that this ESU persists (Herb Pollard, NOAA Fisheries, personal communication, December 2003).

Snake River fall chinook currently spawn from Asotin (RM 148.5) to Hells Canyon Dam (RM 247), utilizing both shallow- (<3.0 m) and deep-water (≥3.0 m) habitats for redd construction (Groves 2001). The distribution of redds throughout this area is highly variable from year to year, and data collected from 1991 to 2000 suggest that, although "shifts" in spawning distribution may occur, such shifts do not appear to maintain themselves for extended periods. Redd surveys between 1988 and 1993 located greater percentages of redds in areas farther downstream (below the Grande Ronde River) relative to surveys in 1994 and 1995, suggesting an upstream shift in spawning distribution (Rondorf and Tiffan 1997). However, subsequent data have shown an increased number of redds reported from these same downstream areas (Groves 2001).

Population Data and Status

Abundance and Trends

Detailed information on biology and trends of Snake River fall chinook can be found in Waples *et al.* 1991a, Healy 1991 and ODFW and WDFW 1998. Throughout the early 1900s, populations of Snake River fall chinook salmon remained stable at high levels of abundance (NMFS 2000a). Although historical abundance of Snake River fall chinook is speculative, adult escapement estimates suggest a decline in abundance by as many as three orders of magnitude since the 1940s and by perhaps another order of magnitude from pristine levels (NMFS 2000a). During the period 1938–1949, wild runs of Snake River fall chinook averaged 72,000 fish. During the 1950s, runs averaged 29,000 fish (Irving and Bjornn 1981). Construction of the Hells Canyon Complex (1958–1967) and lower Snake River dams (1961–1975) eliminated or severely degraded 530 miles of spawning habitat.

Fall chinook populations in the Snake Hells Canyon subbasin are depressed (Quigley and Arbelbide 1997) but showing considerable improvement following restoration efforts. Returning wild fall chinook salmon counts from 1975 through 1980 averaged 600 fish per year (Waples et al. 1991a). From 1981 to 1990 and 1991 to 1999, respectively, wild fall chinook counts over Lower Granite Dam averaged 369 and 557 fish per year (Figure 36).

The number of redds observed within the mainstem Snake River (shallow-water and deep-water inclusive) has increased over recent years, from 46 in 1991 to 1,113 in 2002 (Table 24). Redd counts in 2002 were the highest recorded since annual searches began in 1986. The increase in returns since 1998 may be attributable to supplemental releases of juvenile fish in previous years (G. Mendel, personal communication, May 2001). Evidence presented by Groves (2001) suggests that carrying capacity in terms of spawning has not been attained at even the highest levels of escapement in recent years (since 1991).

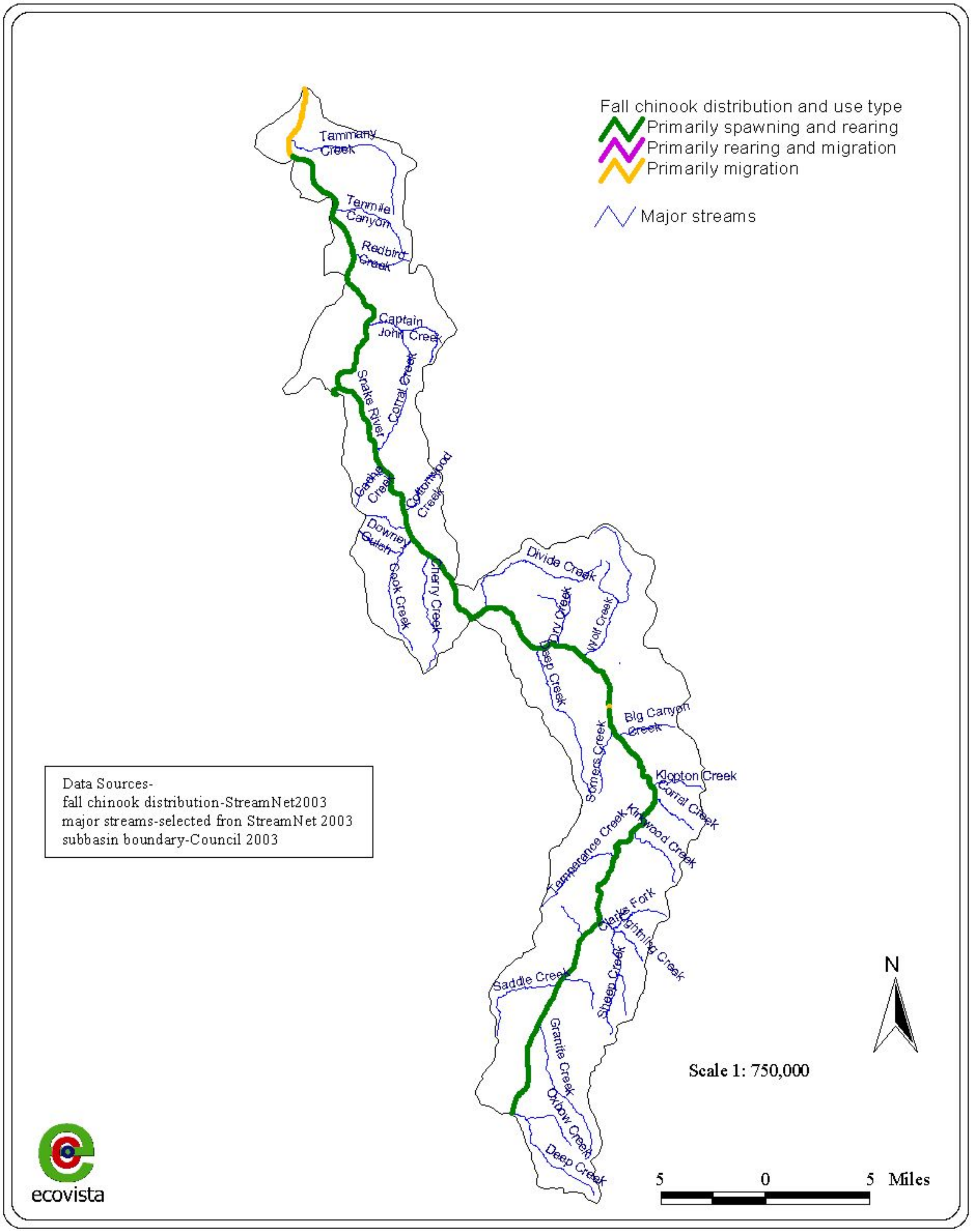


Figure 35. Fall chinook distribution in the Snake Hells Canyon subbasin.

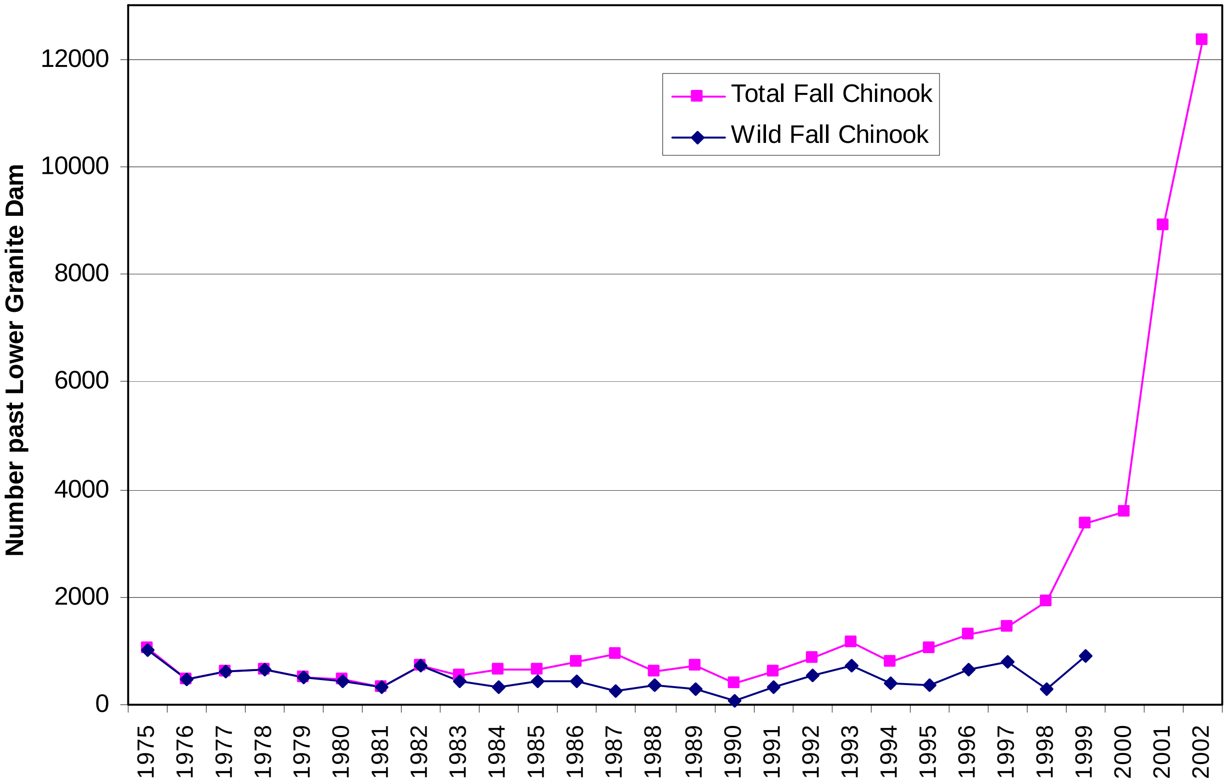


Figure 36. Total (StreamNet 2003) and wild (BLM 2000a) returns of fall chinook salmon past Lower Granite Dam annually since 1975.

Productivity

The Hells Canyon Snake subbasin supports the bulk of fall chinook spawners in the Snake River ESU, typically accounting for 55 to 65% of all fall chinook redds surveyed upriver from Lower Granite Dam (Table 24).

Life History Diversity

Because of their ESA listing, little applied research has been conducted regarding the incubation life history stage of fall chinook in the Snake Hells Canyon subbasin. Methods used to define habitat and water quality criteria relative to incubation life history stages generally require unnecessary and unacceptable levels of direct “take” (in the form of mortality) and are prohibited under the ESA. It is therefore reasonable to use surrogate measures such as laboratory experiments or sedimentation indices to define criteria for incubation life history stages of fall chinook. Empirical data suggest that fine sediments (<6.4 mm) that comprise 20 to 25% of the redd substrate will have a deleterious effect on incubation success (Eaton and Bennett 1996), including a reduction in the porosity of the redd. The less porous redd will consequently have a reduced intragravel water velocity, which will in turn affect oxygen delivery to developing embryos and removal of metabolic wastes. Eaton and Bennett (1996) found that Snake River fall chinook survival to emergence (STE) was not significantly impaired by low water velocity and that successful STE occurred when velocities were at least 0.3 cm/s. Early or premature emergence has been documented when oxygen concentrations within the redd are unsuitable

(Alderice et al. 1958) or water temperatures become warm. Connor et al. (2002) found fry emergence of Snake Hells Canyon fall chinook to occur earliest in the upper reach (above the Salmon River confluence) where water temperatures were warmest. Connor's research also establishes that the historical spawning/incubation areas (those occurring near or within the Marsing reach of the Snake River) likely had warmer water temperatures than contemporary reaches and that, because of this difference, fall chinook salmon juvenile life histories likely progressed on an earlier time schedule than they do currently.

Upon emergence in early May to early June, fall chinook juveniles inhabit the sandy littoral areas (Tiffan et al. 1999, BLM 2000a) for up to two months or until water temperatures are no longer suitable. The movement away from the littoral zone signifies the progression from parr to smolt stages, which for fall chinook occurs earlier in life than it does for other anadromous salmonids. The downstream migration of subyearling fall chinook from the Snake River in Hells Canyon is protracted, occurring from late spring (June) through midsummer (August; Rondorf and Miller 1993, Connor et al. 2002). Late emigration of hatchery fish to Lower Granite Dam may be affected by a number of factors including fall chinook salmon size at time of release, river flow, and water temperature at time of release (Rondorf and Miller 1993, 1994, 1995). Connor et al. (1998 and 2002) found late emigration timing to be detrimental to production: smolt survival to Lower Granite Dam decreased with reduced summer flows and higher water temperatures.

Hells Canyon fall chinook smolts range between 2.7 and 3.9 inches in length. Studies have shown that outmigrating fall chinook juveniles are capable of moving substantial distances during the day as well as at night, swimming actively only at low water velocities and rarely drifting passively (Rondorf and Miller 1993, 1994, 1995). During their migration, subyearlings have a biological requirement for food and may consume terrestrial insects and zooplankton in reservoir reaches and aquatic insects in the free-flowing reaches.

Based on annual redd searches from 1991 to 1999, redd construction timing in the Hells Canyon Snake initiates by mid-October, peaks in early to mid-November, and is essentially completed by late November or early December (Rondorf and Miller 1993, 1994, 1995; Groves 2001; Connor et al. 2002). Spawning was determined to initiate when water temperatures dropped below 16 °C and terminated when temperatures approached 5 °C (Table 25). Groves (2001) found the relationship between spawn timing and temperature to be less predictable, however, since fish were observed initiating spawning activities when temperatures were as high as 17 °C or delaying activities at temperatures around 12 °C. Based on survey data from 1991 to 2000, Groves (2001) proposes that fall chinook spawn timing between Asotin and Hells Canyon Dam is equally influenced by the total number of fish within the population and how clumped their distribution is on arrival upstream of Lower Granite Dam. Groves (2001) concludes that, as the escapement past Lower Granite Dam increases, spawning tends to begin earlier, peak within a short time, and end earlier than when escapement is depressed. Groves and Chandler (1999) determined that redd depths for Snake River fall chinook salmon ranged from 0.2 to 6.5 m and mean water column velocity during spawning ranged from 0.6 to 1.7 m/s (Table 25). Substrate sizes used for spawning ranged from 1.0 to 5.9 inches (Groves and Chandler 1999). Groves and Chandler (2001) determined that the mean area required for a female fall chinook salmon to successfully build a redd was 45.8 m^2 ($n = 8$, standard error = 3.87).

Carrying Capacity

Groves and Chandler (2001) presented the most recent assessment of the redd capacity of the Snake Hells Canyon subbasin. Spatially, Groves and Chandler (2001) concluded that the most suitable area for redds (~ greatest adult carrying capacity) existed in the upper Hells Canyon reach (above the mouth of the Salmon River). The authors determined that habitat availability for redd construction increases moderately at discharges from Hells Canyon Dam of 8,000 to 13,000 cfs, remains stable at discharges of 13,000 to 15,000 cfs, and decreases rapidly at discharges greater than 15,000 cfs. The greatest estimated redd capacity occurred with a discharge of 13,000 cfs from Hells Canyon Dam. Within a discharge range (from Hells Canyon Dam) of 8,000 to 13,000 cfs, redd capacity of the Snake River within the Snake Hells Canyon subbasin was between 3,450 and 3,750 redds (±1,217). At 9,500 cfs, a discharge level normally associated with IPC's protective flow program, modeled results predicted a redd capacity of 3,587 redds (±1,222).

No numerical estimates of juvenile fall chinook rearing capacity are available. However, Chandler et al. (2001) found availability of fall chinook rearing habitat in the Snake River to be most abundant (~ greatest juvenile carrying capacity) below the mouth of the Salmon River, with maximum modeled availability about six times higher than that above the mouth of the Salmon River.

Unique Population Units

Based on preliminary designations, a single population unit has been defined encompassing all fall chinook spawning within the Snake River drainage, including fall chinook salmon within the Snake Hells Canyon subbasin (McClure et al. 2003).

Genetic Integrity

Information regarding genetic makeup and integrity of fall chinook salmon within the Snake River basin (including the Snake Hells Canyon subbasin) is presented in McClure et al. 2003. Much of the existing genetic information is unavailable for public distribution due to proprietary or other reasons; therefore, it is not included in this document. Readers are referred to McClure et al. 2003 for an overview of existing genetic information.

Table 24. Number of fall chinook redds counted upriver from Lower Granite Dam, 1986–2002. An empty cell indicates that no searches were conducted in the corresponding river or method for that year (A.P. Garcia, USFWS, Ahsahka, Idaho, unpublished data; data from the Clearwater subbasin and Salmon River provided by the Nez Perce Tribe).

River	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Snake River within the Snake Hells Canyon subbasin																	
Snake (aerial)[1]	7	66	64	58	37	41	47	60	53	41	71	49	135	273	255	535	878
Snake (camera)[2]						5	0	67	14	30	42	9	50	100	91	175	235
Subtotal—Hells Canyon	**7**	**66**	**64**	**58**	**37**	**46**	**47**	**127**	**67**	**71**	**113**	**58**	**185**	**373**	**346**	**710**	**1,113**
Other Areas within the Snake River Fall Chinook ESU																	
Clearwater (RM 0-41)			21	10	4	4	25	36	30	20	66	58	78	179	164	290	520
Clearwater (RM 41-74)							1	0	0	0	0	0	0	2	7	16	4
Middle Fork Clearwater (RM 74-98)									0	0	0	0	0	0	0	0	0
North Fork Clearwater							0	0	7	0	2	14	0	1	0	0	0
South Fork Clearwater							0	0	0	0	1	0	0	2	0	1	0
Grande Ronde	0	7	1	0	1	0	5	49	15	18	20	55	24	13	1	5	0
Imnaha		0	1	1	3	4	3	4	0	4	3	3	13	9	8	197	111
Salmon							1	3	1	2	1	1	3	0	9	38	72
Selway									0	0	0	0	0	0	0	22	31
Subtotal—Other Areas	**0**	**7**	**23**	**11**	**8**	**8**	**35**	**92**	**53**	**44**	**93**	**131**	**118**	**206**	**189**	**593**	**738**
Total—Snake River ESU	**7**	**73**	**87**	**69**	**45**	**54**	**82**	**219**	**120**	**115**	**206**	**189**	**303**	**579**	**535**	**1,303**	**1,851**

[1] The targeted search area was the entire reach from the head of Lower Granite Reservoir to Hells Canyon Dam.

[2] The targeted search areas were discrete sites composed mainly of 1- to 6-inch bottom substrates. The number of sites searched varied each year.

Table 25. Physical habitat and water quality criteria for various life history stages of fall chinook salmon occurring within the Snake Hells Canyon subbasin (from Groves and Chandler 2001).

Life History Stage	Parameter	Life History Criteria	
		Suitable Range	Optimal Range
Adult migration	temperature	1–8 °C *as well as* 15–21 °C	8–15 °C
Spawning	temperature	5–10 °C *as well as* 15–16 °C	10–15 °C
Spawning	depth	between 0.2 and 6.5 m	
Spawning	velocity	water column velocities between 0.6 and 1.7 m/s	
Spawning	substrate	between 2.6 and 15.0 cm long-axis length	
Rearing	temperature	1–10 °C *as well as* 15–21 °C	10–15 °C
Rearing	depth	littoral depths up to 1.5 m	
Rearing	substrate	littoral substrates measuring <22.5 cm long-axis lengths	
Rearing	velocity	mean water column velocities <0.4 m/s	
Rearing	morphometry	lateral shoreline slopes <40%	
Juvenile migration	temperature	1–8 °C *as well as* 15–21 °C	8–15 °C
All stages	DO	40–76% saturation @ ≤16 °C	≥76% saturation @ ≤16 °C

Harvest

No consumptive (catch-and-keep) sport fishery exists for fall chinook salmon within the Snake Hells Canyon subbasin. No information is available regarding tribal or incidental harvest of fall chinook within the subbasin.

Habitat Condition

Critical habitat was designated for Snake River fall chinook salmon on December 28, 1993 (Federal Register 58:68543) and effective on January 27, 1994. The Snake Hells Canyon subbasin provides designated critical habitat for fall chinook salmon.

Between 1991 and 2000, no single spawning site was utilized every year, and only 4% of sites where redds had been observed were used in 8 of those 10 years; 18% of sites where redds had been observed were used in 6 of those 10 years (Groves 2001). The continued use of new spawning sites and lack of consistent re-use of spawning sites suggest that the available spawning habitat for fall chinook salmon within the Snake Hells Canyon subbasin is not fully seeded under current escapement levels (Groves 2001). Connor et al. (2001) estimated that the Snake River within the Snake Hells Canyon subbasin is currently capable of supporting a total of approximately 2,500 redds. Since 1986, fall chinook redd surveys within the Snake River have not located more than 373 redds (1999) in any single year.

Prior to impoundment, the mainstem Snake River and the lower reaches of several tributaries provided key spawning and rearing habitat for fall chinook (Rondorf and Tiffan 1997). The upper reaches of the mainstem Snake River, particularly near the town of Marsing, Idaho (RM 390, approximately 144 miles upstream of Hells Canyon Dam; Haas 1965), were the primary areas used by fall chinook salmon, with only limited spawning activity reported downstream of RM 272 (NMFS 2000a). Access to spawning areas upstream of Hells Canyon Dam was blocked starting in 1955 by the three-dam complex. After construction of the dams, the areas available for spawning included 104 miles of free-flowing Snake River downstream of Hells Canyon Dam, in the tailraces below the four Snake River dams, and in associated major tributaries including the Imnaha, Salmon, Grande Ronde and Clearwater (Rondorf and Tiffan 1997). The fact that Snake River fall chinook spawn in the lower reaches of the primary tributaries may, however, be due to the overall reduction in available habitat, as historical evidence documenting tributary spawning is inconclusive (Connor et al. 2002). An estimated 80% of the Snake River drainage formerly used by fall chinook salmon for spawning and rearing has been eliminated due to habitat changes or lack of access (USFS 1999).

The timing of fall chinook salmon life history events and growth are largely regulated by water temperature and differ both within and between subbasins. Connor et al. (2002) found two distinct temperature regimes occurring within the Snake Hells Canyon subbasin: the warmer upper Snake River reach (from the confluence of the Imnaha River upstream to Hells Canyon Dam) and the slightly cooler, lower Snake River reach (from the head of Lower Granite Reservoir to the confluence of the Salmon River). Within the two reaches, Connor et al. (2002) determined that fall chinook from the upper reach grew faster and smolted earlier than those from the lower reach. Similarly, when compared against results of beach seine hauls from the Hanford reach (Columbia River) in April and McNary Reservoir (Columbia River) in May, subyearling chinook salmon seined from the Hells Canyon reach of the Snake River in June had attained a larger size more quickly than Columbia River subyearlings, due in large part to intrasubbasin temperature differences (Rondorf and Tiffan 1995).

Based on a total effective area model, in 1993, the predicted suitable spawning habitat (that which successfully met slope, depth, velocity, substrate, and scour criteria) in the Snake Hells Canyon subbasin) was determined to be 9% of shallow-water transitional, 0% of shallow-water-lateral, and 6% of deep-water transitional (Rondorf and Tiffan 1994). The estimates, when compared to fall chinook production, suggest that known spawning sites are probably underseeded (Rondorf and Tiffan 1994). Through hydraulic and habitat modeling (RHABSIM), Groves and Chandler (2001) estimated the quantity, quality, and availability of fall chinook spawning habitat downriver of Hells Canyon Dam and found that habitat availability increases moderately as discharge from Hells Canyon Dam increases from 8,000 to 13,000 cfs, remains stable from 13,000 to 15,000 cfs, and decreases rapidly at discharges greater than 15,000 cfs. They found that the morphometry of the Snake River through Hells Canyon is such that a given increase in discharge may increase the weighted usable habitat area in downstream reaches (below the Salmon confluence) due to the reduced gradient and shoreline slope, while effectively reducing habitat quantity and quality in upstream reaches characterized by steeper gradients and shoreline slopes. Groves and Chandler (2001) found that the change in measured and predicted stage at the various discharge levels (8,000 to 15,000 cfs) varied by only about 0.9 m and that this change would influence about 9% of all measured redds that had been observed at that depth.

The quality of fall chinook spawning substrate, measured at index reaches throughout the Snake Hells Canyon subbasin, is generally high, although some studies have documented gravel too large for spawning (Rondorf and Tiffan 1996). Percent fines in the substrate, fines by depth, and surface fines vary by year and site, but overall they are not considered to inhibit cobble utilization or incubation success (Rondorf and Tiffan 1994, 1996; BLM 2000a). Groves and Chandler (2001) determined that the percentage of fines (<1 mm) increased in a downstream progression, although percentages were determined to be within an acceptable range (<11%). Similarly, Groves and Chandler (2001) found permeability values (i.e., hydraulic conductivity) to be lowest at RM 152 (0.009 cm/s), increasing as distance upstream increased (ranging from 0.07 to 0.21 cm/s), with the highest values occurring at the most upstream sample locations. Results from all sites fell within the normal range of values determined for alluvium and are typical for fluvial sediments comprising a riverbed. Using sedimentation evaluation statistics (i.e., geometric mean particle size [dg], degree of sorting [sg], and Fredle index [Fi]), Groves and Chandler (2001) estimated that STE for fall chinook occurring within the Hells Canyon reach fell within an acceptable range (61 to 90% at sites in the upper canyon and 58 to 87% in the lower canyon) and, as data indicate, that STE was highest in the uppermost reaches.

Using the RHABSIM model, Groves and Chandler (2001) estimated the redd capacity of the Snake River downstream of Hells Canyon Dam to be between approximately 3,450 and 3,750 redds (±1,217), given a discharge range of 8,000 to 13,000 cfs. This estimate falls within the recovery goals for Snake River fall chinook that require sufficient suitable habitat upstream of Lower Granite Reservoir to support a minimum of 1,250 redds.

3.4.3 Steelhead Trout

Distribution

Steelhead trout are the most widespread of the selected aquatic focal species in the Snake Hells Canyon subbasin. In Idaho, some of the larger tributaries above the Salmon River confluence with known spawning and rearing populations of summer steelhead include Divide, Wolf, Getta, Kirkwood, Sheep, and Granite creeks (see Figure 1) (BLM 2000a). Due to their use by steelhead and other focal species, Granite Creek and Sheep Creek are considered to be priority watersheds by the Cottonwood Field Office (BLM 2000b). Larger tributaries utilized for spawning and rearing in Oregon include Somers, Temperance and Saddle creeks. Other Idaho and Oregon tributaries used by steelhead include Dry, Highrange, Big Canyon, West, Kurry, Klopton, Corral, Kirby, Kirkwood, Sheep, Bernard, Three, Granite, Deep creeks (all in Idaho), Deep, Cougar, Salt, Sand, Rush, Sluice, Battle, Stud, and Hells Canyon creeks (all in Oregon).

Juveniles utilize a wide array of habitats throughout the Snake River in Hells Canyon and are generally ubiquitous where other salmonids occur, including areas adjacent to hatchery smolt-release locations (ODFW 2001). Captain John Creek is the primary area below the Salmon River confluence (and within the Snake Hells Canyon subbasin boundary) in which both spawning and rearing of steelhead occurs (Figure 37) (BLM 2000b). Other tributaries (below the Salmon River confluence) with limited use (often rearing only) include Tammany, Tenmile, Corral, Cache, Cottonwood, and Cherry creeks (BLM 2000b).

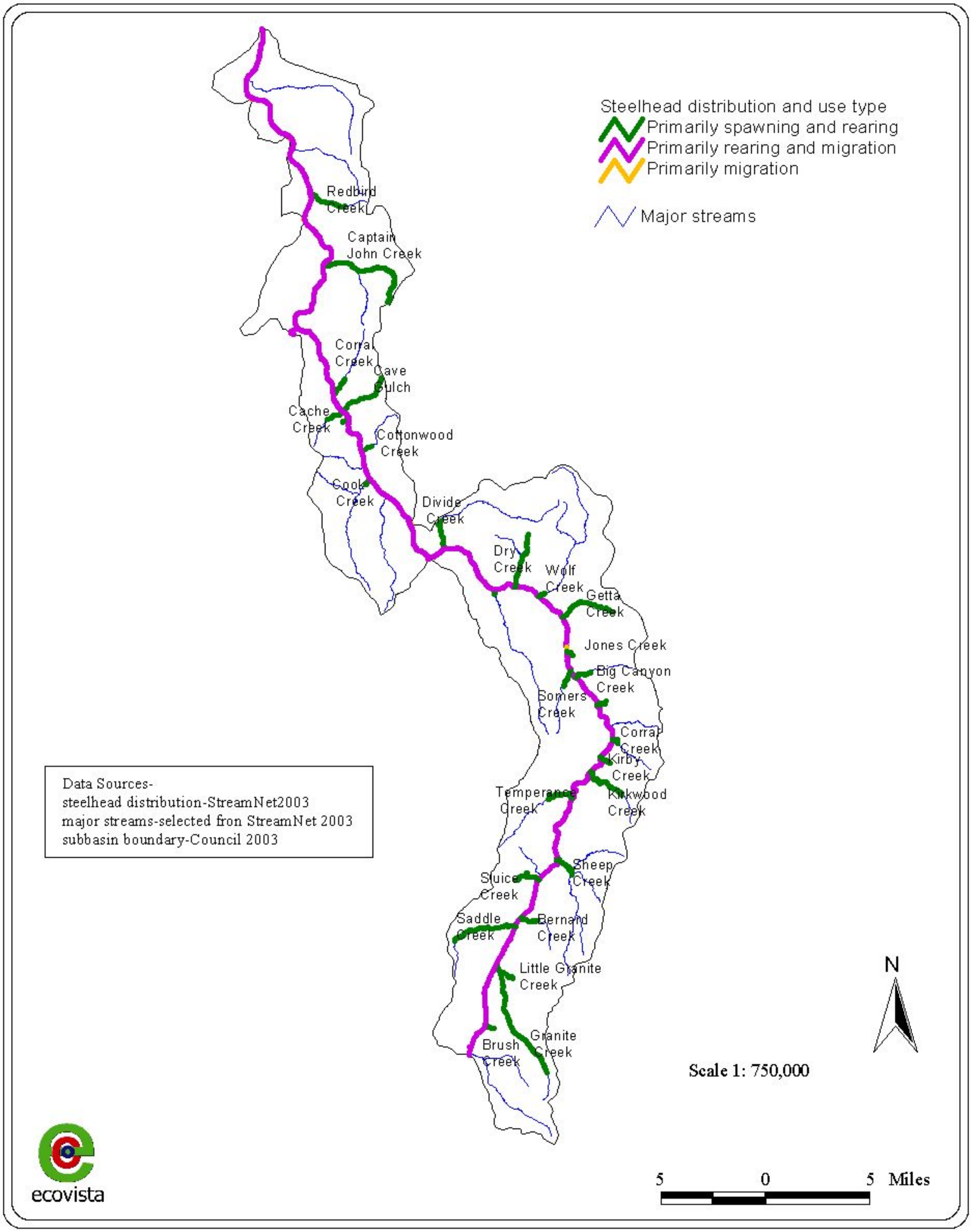


Figure 37. Steelhead distribution within the Snake Hells Canyon subbasin.

Population Data and Status

Abundance and Trends

Detailed information on biology and trends of Snake River summer steelhead can be found in Busby *et al*. 1996 and ODFW and WDFW 1998. No subbasin-specific information is available regarding abundance or trends for steelhead in the Snake Hells Canyon subbasin. Mallett (1974) estimated that 55% of all Columbia River steelhead trout historically originated from the Snake River basin. The following excerpts from Busby et al. (1996) summarize trends in Snake River steelhead population(s) at the time of that publication:

> …there has been a severe recent decline in natural run size. The majority of natural stocks for which we have data within this ESU have been declining. Parr densities in natural production areas have been substantially below estimated capacity in recent years. The aggregate trend in abundance for this ESU (indexed at Lower Granite Dam) has been upward since 1975, although natural escapement has been declining during the same period. However, the aggregate trend has been downward (with wide fluctuations) over the past 10 years, recently reaching levels below those observed at Ice Harbor Dam in the early 1960s. Naturally produced escapement has declined sharply in the last 10 years.

Although steelhead stocks are still considered depressed, recent trends in Snake River steelhead counts have shown substantially increased numbers since 1999 for both natural and composite (hatchery and natural) runs (Figure 38). Recent run sizes, although much improved relative to the past 20 years, are still considered far depressed from historical numbers, and much of the available habitat in the Snake River system remains underseeded.

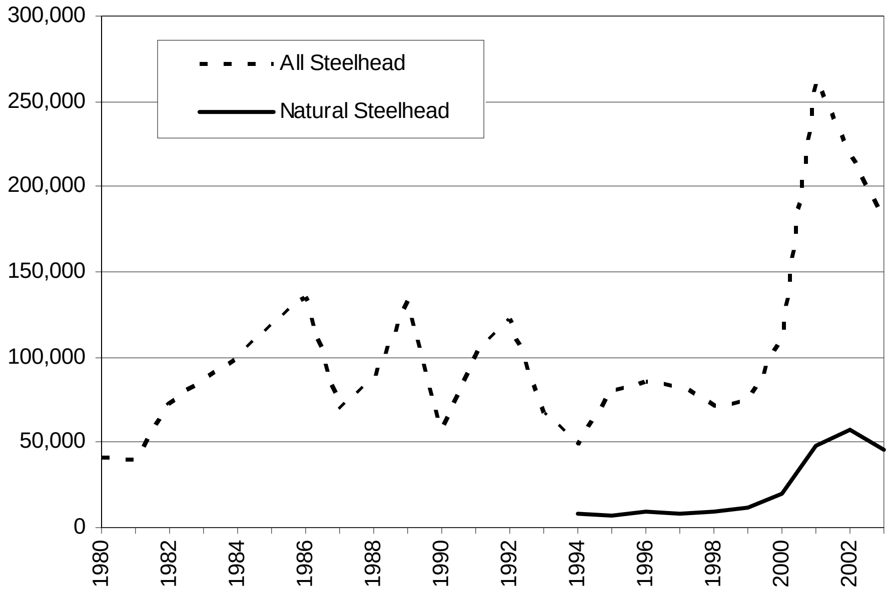


Figure 38. Annual total and natural steelhead counts over Lower Granite Dam since 1980 (Columbia Basin Research 2004).

Productivity

No productivity information is available for steelhead within the Snake Hells Canyon subbasin.

Life History Diversity

Steelhead occurring in the Snake Hells Canyon subbasin are typical A-run steelhead from the mid-Columbia and Snake basins. Most adults (60%) return from the ocean after one year of marine rearing (ODFW 2001). Two-salt and occasionally three-salt fish comprise the remainder of returns to the Snake River. Females generally predominate, with a 3:2 sex ratio on average (ODFW 2001). Returning adults range in size from 45 to 91 cm in length and average 1.4 to 6.8 kg.

Adults generally enter the Columbia River from May through August, reaching their natal streams from September through April (ODFW 2001). Adults use accessible and suitable habitat throughout the subbasin for spawning. Spawning is initiated in March in lower elevation habitat and continues through early June in higher elevation, snowmelt-dominated habitat.

Most naturally produced smolts migrate after rearing for two years (ODFW 2001). A much lower percentage migrates after one or three years. Smolt outmigration from the basins extends from late winter until late spring. Peak smolt movement is associated with increases in flow, generally occurring between mid-April and mid-May.

Carrying Capacity

No information is available regarding carrying capacity of steelhead within the Snake Hells Canyon subbasin.

Unique Population Units

Based on preliminary designations, the Snake Hells Canyon subbasin contains all or portions of three steelhead population areas. The “Snake River Hells Canyon tributaries” steelhead population area includes all mainstem and tributary habitats above the mouth of the Salmon River. The “Little Salmon and Rapid River” population area includes mainstem Snake River tributaries in Hells Canyon below the mouth of the Salmon River but above the mouth of the Grande Ronde River. The “Grand Ronde River lower mainstem tributaries” population area includes mainstem Snake River tributaries in Hells Canyon below the mouth of the Grande Ronde River (Michelle McClure, Northwest Fisheries Science Center’s Interior Columbia Technical Recovery Team, personal communication, January 13, 2003).

Genetic Integrity

Information regarding genetic makeup and integrity of steelhead within the Snake River basin (including the Snake Hells Canyon subbasin) is presented in McClure et al. 2003. Much of the existing genetic information is unavailable for public distribution due to proprietary or other reasons; therefore, it is not included in this document. Readers are referred to McClure et al. 2003 for an overview of existing genetic information.

Harvest

Steelhead harvest in the Snake Hells Canyon subbasin has been restricted to hatchery fish only since 1979 (ODFW 2001). Consumptive fisheries for wild steelhead are unlikely to be reinstated in the foreseeable future (ODFW 2001). Adult hatchery steelhead returns of fish produced from the LSRCP and IPC hatchery programs have allowed harvest opportunities since 1986. Oregon punch card estimates of hatchery fish harvest ranged from 1,116 to 2,444 fish for the 1991–92 through 1993–94 fishing seasons. Angler effort has tended to follow the availability of hatchery fish with effort, being high in high return years and low in low return years (ODFW 2001).

Habitat Condition

Critical habitat for Snake River summer steelhead trout was originally established in February 2000 (Federal Register 65:7764). This critical habitat is under redesignation following withdrawal of previous critical habitat designations for this and 18 other ESUs, in accordance with a NOAA Fisheries consent decree (NMFS 2002).

Below the confluence of the Salmon River, the quality of steelhead habitat in the Snake Hells Canyon subbasin is highest in those limited areas afforded protection by the HCNRA (e.g., Cook Creek). Above the confluence with the Salmon River, most tributary watersheds are contained within either the HCNRA or Hells Canyon Wilderness (exceptions include Divide, Dry, Wolf, and Getta creeks). Steelhead habitat quality above the Salmon River confluence is highest in Granite and Sheep creeks. These are generally larger tributaries and provide access to suitable spawning and rearing habitat.

Habitat in the mainstem Snake River is primarily used for upstream and downstream migration, but this habitat may also facilitate rearing life history forms of steelhead. Adult steelhead also winter in the mainstem Snake River (BLM 2000b).

Although steelhead are considered to occupy the widest array of habitat types of any anadromous salmonid in the Interior Columbia Basin, an estimated 7,737 river miles of historically occupied habitat have been eliminated or are no longer accessible (Northwest Power Planning Council 1986). Within the Snake Hells Canyon subbasin, habitat is restricted to that occurring between Hells Canyon Dam and Clarkston, Washington, much of which has been modified to some degree by various land-use activities. Coarse-scale assessments conducted for the Northwest Power Planning Council (1990) identified low flow levels (dewatering), high temperatures, lack of high-quality pools, passage impediments, and streambank degradation as negatively affecting steelhead habitat in various tributaries to the Snake River within the Snake Hells Canyon subbasin.

3.4.4 Sockeye Salmon

Distribution

Snake River sockeye salmon (*Oncorhynchus nerka*), the rarest of federally listed Snake River salmonids (Federal Register 58:68543), use the lower reaches of the Snake River within the Snake Hells Canyon subbasin as a migration corridor (Figure 39) for accessing the Salmon River drainage en route to spawning grounds in the Stanley Basin (see Huntington et al. 2001).

Population Data and Status

Abundance and Trends

Detailed information on biology and trends of Snake River sockeye salmon can be found in Waples *et al.* 1991b, Burgner 1991, and ODFW and WDFW 1998. Subbasin specific information does not exist since the species uses the Snake Hells Canyon subbasin only as a migration corridor.

Adult sockeye runs at the mouth of the Columbia River may have numbered more than two million before the beginning of the twentieth century. From 1910 through 1934, although some passage may have occurred, adult sockeye salmon were largely prevented from returning to the Sawtooth Valley in Idaho by the presence of the Sunbeam Dam (McClure et al. 2003). Between 1954 and 1968, adult returns to Redfish Lake in the Salmon subbasin ranged from 11 to 4,361 fish (Bjornn et al. 1968, cited in McClure et al. 2003). Since 1990, the number of Snake River sockeye adults crossing Lower Granite Dam (Figure 40) en route to Redfish Lake has ranged from zero (1990) to 282 fish (2000). An intensive, captive broodstock program has been initiated to conserve the remaining population.

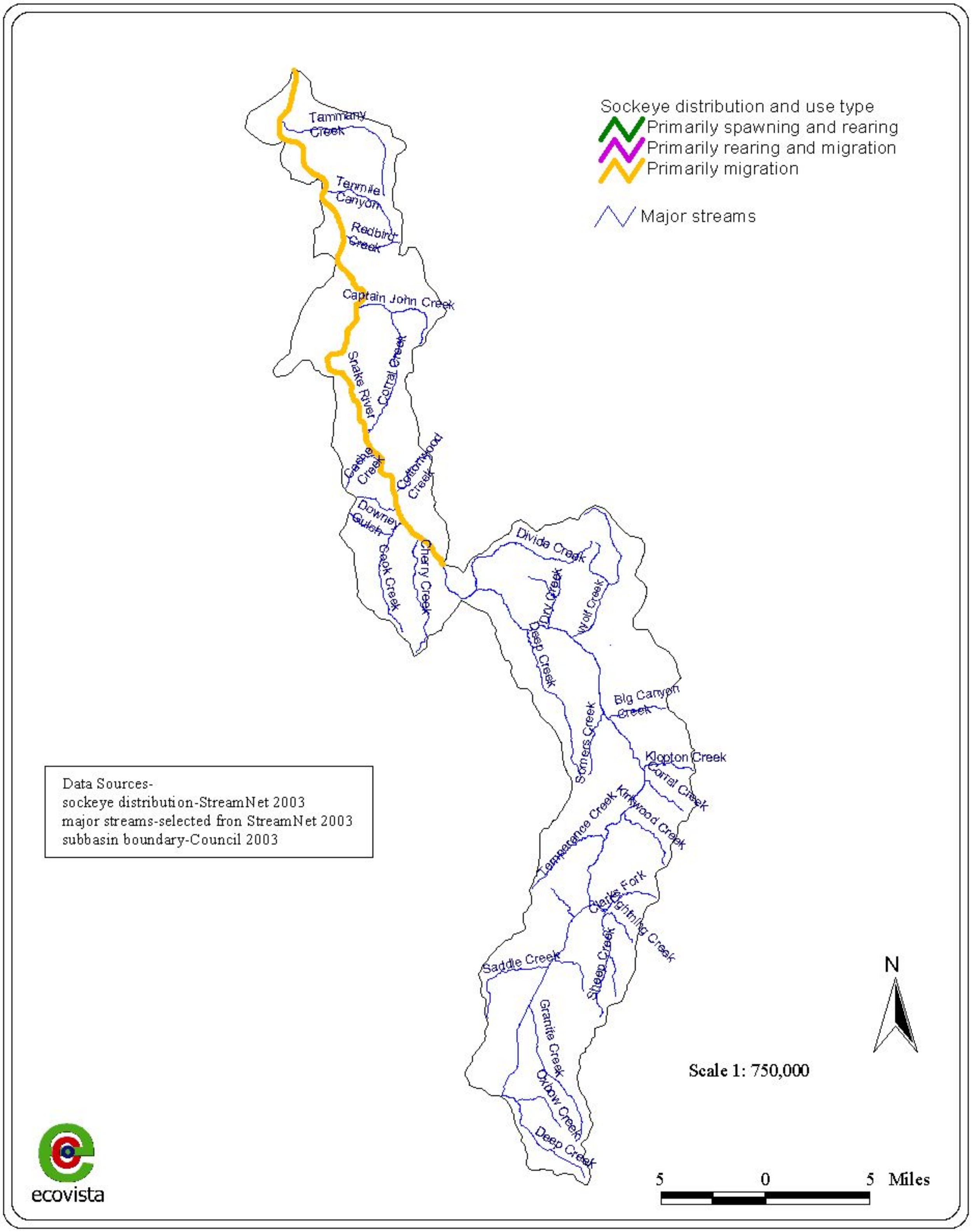
Based on critically low population numbers and the risk of extinction, IDFG, in cooperation with NMFS, Shoshone-Bannock Tribes, BPA, University of Idaho, and others, initiated a species conservation program in 1991. At the center of this effort is a captive broodstock program that produces fish for reintroduction back to the habitat and for meeting future broodstock needs. Reintroduction efforts have been ongoing in Redfish Lake since 1993 (see Huntington et al. 2001 for additional details regarding the species conservation program).

Productivity

The Snake Hells Canyon subbasin provides a migration corridor for sockeye salmon migrating to or from the Salmon subbasin in Idaho. No spawning or rearing of sockeye occurs within the Snake Hells Canyon subbasin, making productivity information for that species irrelevant within this subbasin assessment.

Life History Diversity

Information on life history diversity of Snake River sockeye salmon will not be provided in this assessment since the species only uses the Snake Hells Canyon subbasin as a migration corridor. Readers are referred to Waples et al. (1991b) and Huntington et al. (2001) for details regarding life history characteristics of Snake River sockeye salmon.



Data Sources-
sockeye distribution-StreamNet 2003
major streams-selected fron StreamNet 2003
subbasin boundary-Council 2003

Figure 39. Sockeye salmon distribution in the Snake Hells Canyon subbasin.

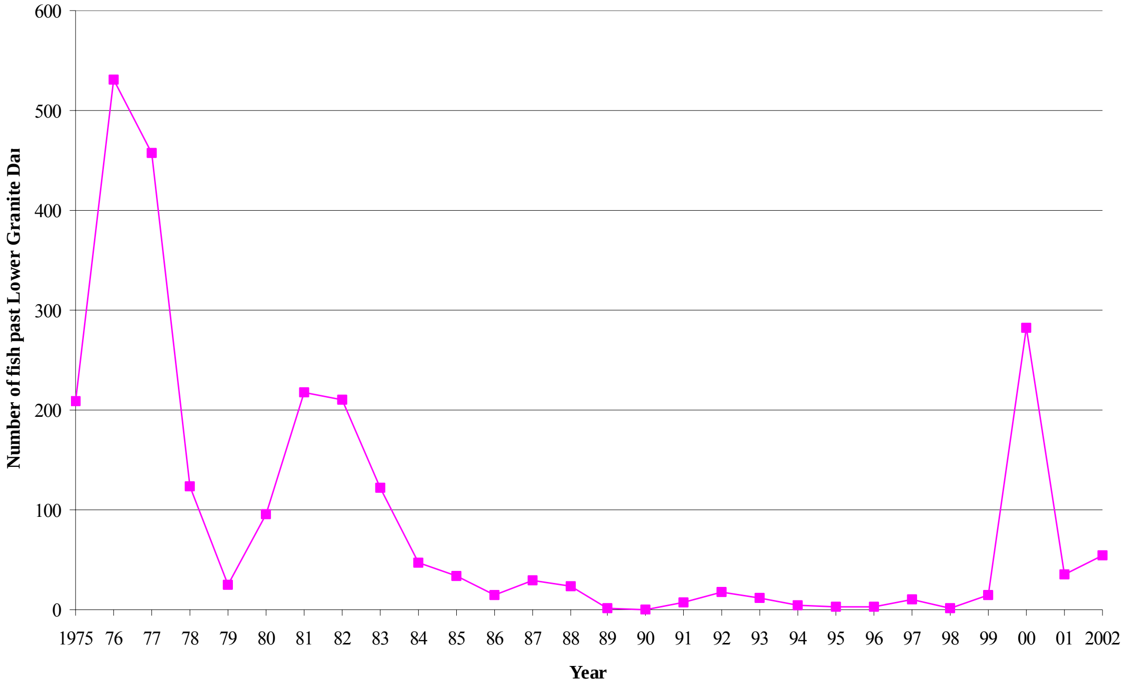


Figure 40. Numbers of Snake River sockeye passing Lower Granite Dam annually since 1975 (StreamNet 2003).

Carrying Capacity

Sockeye salmon were not known to spawn historically within the Snake Hells Canyon subbasin; the current capacity of the migratory corridor within the subbasin as it relates to recovery of the listed Snake River stock is unknown.

Unique Population Units

Sockeye salmon migrating through the Snake Hells Canyon subbasin are part of the Snake River sockeye salmon ESU although the subbasin itself does not lie within the ESU boundary.

Genetic Integrity

Information on the genetic integrity of Snake River sockeye salmon is not provided in this assessment since the species only uses the Snake Hells Canyon subbasin as a migration corridor. Readers are referred to Brannon et al. (1992, 1994), Robison (1996), Winans et al. (1996), Waples et al. (1997), and Powell and Faler (2000) (all cited in Huntington et al. 2001) for details regarding genetic characteristics of Snake River sockeye salmon.

Harvest

No information on historical harvest of sockeye salmon that may have occurred within the Snake Hells Canyon subbasin is available. Harvest of/fishing for sockeye salmon in Idaho closed in 1965. The current chance of Idaho sockeye entering the downriver salmon harvest is considered remote due to extremely low numbers at the mouth of the Columbia River since 1989 (IDFG 1998).

Habitat Condition

The Snake Hells Canyon subbasin provides a migratory corridor for adult and juvenile sockeye salmon during the periods from July to August and April to June, respectively. The portion of the Snake River within the Snake Hells Canyon subbasin and below the mouth of the Salmon River is designated critical habitat for fish en route to the upper Salmon subbasin (see Huntington et al. 2001).

3.4.5 Pacific Lamprey

Distribution

The Pacific lamprey (*Lampetra tridentata*) is an anadromous and parasitic lamprey widely distributed along the Pacific coast of North America and Asia. It was recently thought that Pacific lamprey still occurred in all areas that remain accessible to salmon and steelhead (Simpson and Wallace 1982). However, Pacific lamprey are believed to have been extirpated from some accessible areas within the Snake River drainage (e.g., Imnaha River and Asotin Creek subbasins; see Rabe et al. 2001 and Stoval et al. 2001, respectively). Various large tributaries to the Snake Hells Canyon subbasin are known (e.g., Clearwater and Salmon subbasins; see Cichosz et al. 2001 and Huntington et al. 2001, respectively) or suspected (Grande Ronde subbasin; see Nowak 2001) to still have Pacific lamprey present.

Although Pacific lamprey are found in the Snake River drainage, distribution data specific to the Snake Hells Canyon subbasin are unavailable. Most likely, potential use is limited to the mainstem Snake River for migration and larger accessible tributaries for spawning and rearing (BLM 2002). Groves et al. (2001) support this assertion, stating that there is no evidence that Pacific lamprey used or use the mainstem Snake River for spawning or rearing. According to the BLM (2002), no tributaries between Captain John Creek and the mouth of the Salmon River are known to be used by Pacific lamprey for spawning and rearing.

Population Data and Status

Abundance and Trends

Similar to other anadromous fishes, the distribution and abundance of Pacific lamprey has been reduced due to construction of dams and water diversions, as well as by degradation of spawning and rearing habitats. Historical runs of Pacific lamprey were large, with as many as 400,000 individuals migrating past Bonneville Dam on the lower Columbia River (Harrison 1995). Counts of lamprey passing Ice Harbor Dam on the Snake River were 40 and 399 in 1993 and 1994, respectively, in contrast to the 1960s when roughly 50,000 were counted annually at the same location (Harrison 1995). Currently, an estimated 3% of the lamprey that pass Bonneville Dam are counted at Lower Granite Dam (Close 2000).

Productivity

No productivity information is available for Pacific lamprey within the Snake Hells Canyon subbasin.

Life History Diversity

No Pacific lamprey life history information specific to the Snake Hells Canyon subbasin or surrounding areas is available, although life history studies are currently underway in the nearby Clearwater subbasin (see Cochnauer and Claire 2001). Pacific lamprey adults generally enter fresh water between July and September, but they do not mature until the following March. Spawning occurs from April through July in sandy gravel immediately upstream of riffles. Eggs hatch in two to three weeks, and the ammocoetes spend up to the next six years in soft substrate as filter feeders before emigrating to the ocean (Simpson and Wallace 1982). Kan (1975, cited in Groves et al. 2001) estimated that lamprey off the Oregon coast may spend 20 to 40 months in the ocean before returning to fresh water to spawn. Readers are referred to Close et al. (1995) for additional details regarding generic life history characteristics of Pacific lamprey in the Columbia River basin.

Carrying Capacity

The carrying capacity of lamprey habitat in the Snake Hells Canyon subbasin has not been defined. It is agreed, however, that habitat availability in the subbasin is not a factor limiting production and that underseeding is likely the primary cause for concern.

Unique Population Units

Population delineation for Pacific lamprey in the Snake River basin has not been conducted. It is therefore unknown whether lamprey within the Snake Hells Canyon subbasin constitute all or part of a unique population unit.

Genetic Integrity

No information is available regarding genetic integrity of Pacific lamprey within the Snake Hells Canyon subbasin.

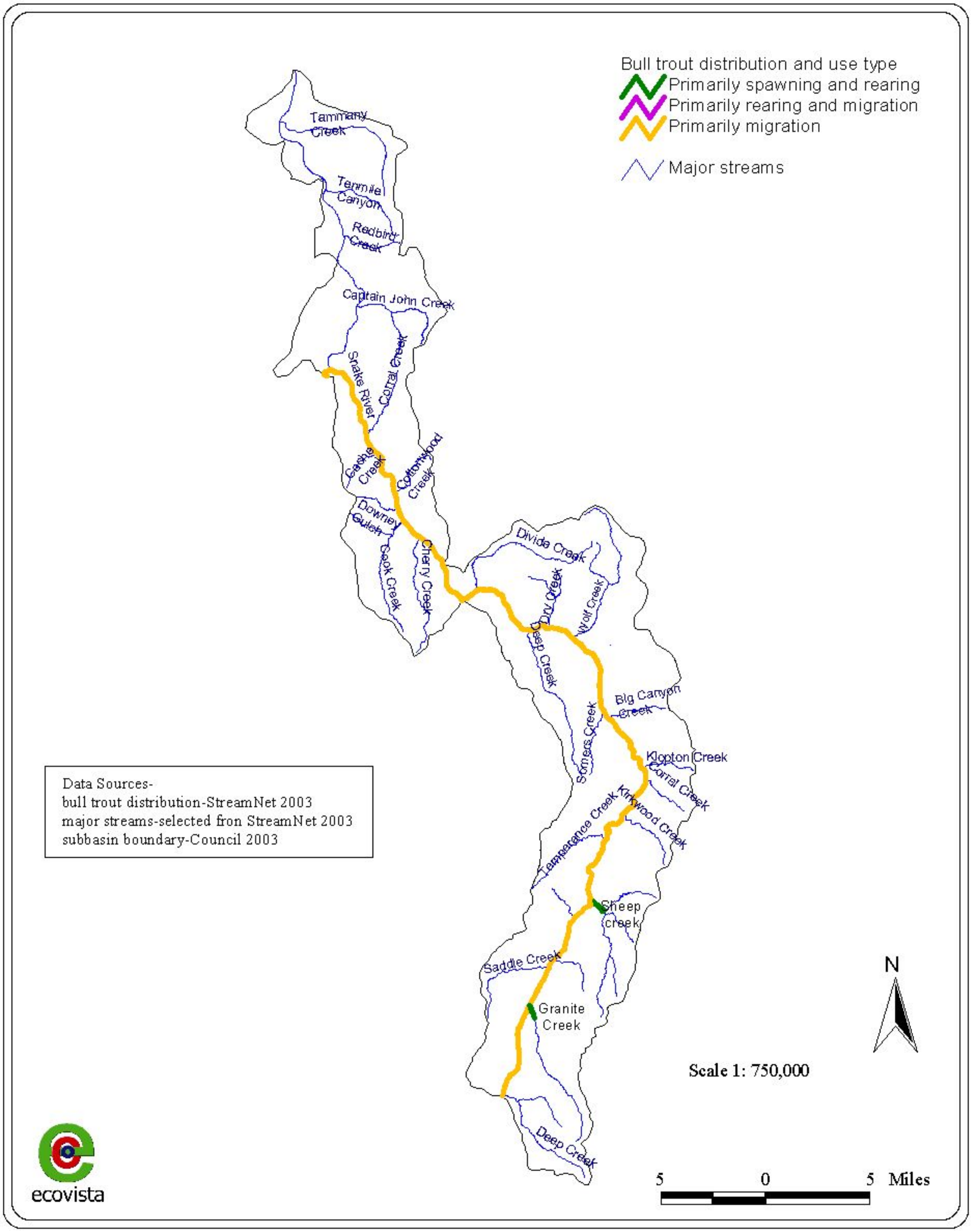
Harvest

Native Americans harvested lamprey for consumption or trade and either roasted or dried the meat before eating it. Fishermen in the Snake, Columbia, and Fraser rivers commonly use lamprey as bait for white sturgeon (Groves et al. 2001). Commercial harvest of lamprey for medicinal anticoagulants, teaching specimens, and food continues today (Close et al. 1995). In 2001, the state of Oregon permitted commercial and personal-use harvest of the lamprey population in the Willamette River but restricted commercial harvest to 14,400 pounds (ODFW 2001). It is unclear to what degree, if any, downriver commercial and/or localized harvest for bait impacts Pacific lamprey populations within the Snake Hells Canyon subbasin.

3.4.6 Bull Trout

Distribution

The Snake Hells Canyon subbasin lies within the historic native range of bull trout, although no clear documentation of the historical distribution of bull trout within the subbasin exists. Surveys for bull trout have been conducted throughout the subbasin, with current distribution of bull trout defined in the mainstem Snake River and portions of Granite and Sheep creeks (Figure 41).



Data Sources-
bull trout distribution-StreamNet 2003
major streams-selected fron StreamNet 2003
subbasin boundary-Council 2003

Figure 41. Bull trout distribution in the Snake Hells Canyon subbasin.

Population Data and Status

Abundance and Trends

Historical abundance and trend data are scarce because bull trout were considered a nuisance fish (IDEQ 1998). Bull trout are also difficult to detect during surveys because they hide and tend to be nocturnal. Therefore, they are often missed or underestimated during electrofishing and daytime snorkel surveys (IDEQ 1998). That fluvial bull trout may occupy a portion of a stream for only a limited amount of time further limits survey and abundance measures.

The lack of information regarding migratory phases of bull trout has led to the misidentification of fluvial fish as resident fish (Hemmingsen et al. 2001a). Management implications resulting from this confusion may underestimate the importance of maintaining migratory habitat crucial for connectivity among various populations. To address these management issues, new efforts are currently underway. The ODFW has initiated studies to determine the distribution of juvenile and adult bull trout and their respective habitats; the agency is also studying fluvial and resident life history patterns. While results are still preliminary, ODFW has documented radio-tagged Grande Ronde fish in the Snake River as far downstream as RM 146, just upstream of Asotin, Washington (e.g., Hemmingsen et al. 2001a,b), although documenting the extent and duration of their residence in the mainstem currently represents a research need (M. Hanson, ODFW, personal communication, April 19, 2001). In the lower reaches of the Imnaha River, large migrant-sized bull trout are incidentally caught by steelhead anglers each year, and ODFW believes that these fish are migrants that use the Snake River seasonally (B. Knox, ODFW, personal communication, 2000). Fluvial bull trout are occasionally captured at the IDFG smolt trap near Lewiston, but the catch rates have been no more than one bull trout annually. Bull trout are also often caught in the steelhead fishery during the winter from the mouth of the Grande Ronde River to Asotin (G. Mendel, WDFW, personal communication, May 2001), as well as in upriver reaches (Tim Johnson, fishing guide, personal communication, February 2004).

Above the Salmon River confluence, the only known tributaries containing spawning and rearing bull trout are Sheep and Granite creeks (Buchanan et al. 1997, IDEQ 1998, BLM 2000a). Data are lacking for population size, movement, and/or life histories of bull trout using this portion of the subbasin. Important watersheds that produce forage fish for bull trout (i.e., rainbow trout/steelhead) in the upper subbasin include Divide, Getta, and Kirkwood creeks (IDEQ 1998). Similar watersheds occurring in Oregon include Saddle and Temperance creeks (IDEQ 1998). Other Snake River tributaries also produce forage fish; however, small size, low flows, steep gradient, and fish passage barriers limit anadromous production.

Below the Salmon River confluence, the only known tributaries providing spawning and early rearing of bull trout are the Grande Ronde River and Asotin Creek in Washington (Figure 41) (IDEQ 1998, BLM 2000b; see also Johnson et al. 2001, Nowak 2001), neither of which lies within the Snake Hells Canyon subbasin. Various Snake River tributaries also produce forage fish for bull trout, but small size, low flows, steep gradient, and fish passage barriers often limit production. Captain John Creek in Idaho and Asotin Creek are considered the greatest tributary producers of forage fish in the lower subbasin (IDEQ 1998).

Productivity

No productivity information is available for bull trout in the Snake Hells Canyon subbasin.

Life History Diversity

Data specific to the Snake Hells Canyon subbasin on population size, movement, and/or life histories of bull trout are not available.

Carrying Capacity

No information is available regarding bull trout carrying capacity within the Snake Hells Canyon subbasin.

Unique Population Units

All bull trout found within the Snake Hells Canyon subbasin are considered part of Bull Trout Recovery Unit 11 (Imnaha–Snake River basins), as defined by the USFWS (2002c). Several subpopulations of bull trout occur upstream of the reservoir influence of Lower Granite Dam, and migrants from these groups can move freely to and from Lower Granite Reservoir. These groups include fish from Asotin Creek and the Grande Ronde, Imnaha, and Salmon rivers. The USFWS (2002c) has found little evidence to suggest that these populations use habitat associated with the federal Columbia River hydropower system in the Lower Snake River.

Genetic Integrity

No information is available regarding genetic integrity of bull trout within the Snake Hells Canyon subbasin.

Harvest

No consumptive (catch-and-keep) sport fishery exists for bull trout within the Snake Hells Canyon subbasin. Nor is information available regarding tribal or incidental harvest of bull trout within the subbasin.

Habitat Condition

The quality of available bull trout habitat in the Snake Hells Canyon subbasin is variable. Bull trout use mainstem Snake River habitat for migration and subadult foraging and rearing life history phases (year-long). The water quality of the mainstem Snake River within the subbasin is generally excellent and fully supports all beneficial uses identified for the river (recreation, primary and secondary contact recreation, salmonid spawning, domestic water supply, agricultural water supply, and cold water biota; IDEQ 1998). Elevated summer water temperatures are not optimum for salmonid rearing, and high sediment concentrations occur during high-flow events (IDEQ 1998). The potential exists for fluvial bull trout populations from the Grande Ronde, Imnaha, and Salmon rivers to use the mainstem Snake River.

Habitat quality for bull trout in tributaries feeding the Snake River below the Salmon River confluence is considered marginal (BLM 2000b). Low flows, elevated levels of deposited sediment, high summer water temperatures, poor instream cover, and low numbers of high-quality pools limit potentially usable bull trout habitat (BLM 2000b). The only tributary containing habitat that supports bull trout spawning and early rearing in the lower Hells Canyon Snake is Asotin Creek (see Johnson et al. 2001).

Granite and Sheep creeks are the only tributary streams occurring above the Salmon River that provide spawning and early rearing habitat for bull trout (BLM 2000a). Both tributaries are proposed as critical habitat in the USFWS bull trout recovery plan (USFWS 2000b). Because both are fourth-order drainages that occur within the Hells Canyon Wilderness, they have a proportionate amount of undisturbed habitat. Granite Creek flows into the Snake River at RM 239.7, while Sheep Creek enters the Snake River at RM 229.4. Granite Creek contains approximately 7 miles of stream used by fluvial bull trout, while Sheep Creek contains approximately 6 miles (IDEQ 1998). No documentation of a resident bull trout population exists for either creek. Habitat in the two streams supports spring/summer chinook salmon, rainbow/steelhead trout, cutthroat trout, and bull trout. No brook trout occur in either drainage. Past monitoring efforts by IDFG have documented relatively low bull trout numbers within the monitored stream segments. During 1998, no bull trout were observed at the trend monitoring stations (IDEQ 1998).

3.4.7 Redband Trout

Distribution

Although redband trout likely existed historically throughout the Snake Hells Canyon subbasin (Quigley and Arbelbide 1997), little is known about the current distribution or status of redband trout populations in the subbasin. One reason for the lack of information is the inability to differentiate juvenile steelhead and resident redband trout phenotypically. In addition, coexistence of the two subspecies throughout much of the occupied habitat in the Snake Hells Canyon subbasin complicates efforts to gather information on redband trout population(s).

Currently, redband trout likely inhabit all of the tributary systems inhabited by steelhead (see Figure 37 and the accompanying textual description of steelhead distribution). Redband trout are commonly more widely distributed than steelhead are within tributary habitats, often occurring in reaches upstream of current steelhead passage barriers.

Population Data and Status

Abundance and Trends

Redband trout are considered a species of special concern by the American Fisheries Society and the state of Idaho and classified as a sensitive species by the USFS and BLM (Quigley and Arbelbide 1997), suggesting their potentially limited or declining abundance. However, no information is available regarding the numerical abundance or trends of redband trout within the Snake Hells Canyon subbasin.

Productivity

No information is available regarding productivity of redband trout within the Snake Hells Canyon subbasin.

Life History Diversity

Redband trout are thought to represent the resident form of steelhead trout in areas where they coexist (or coexisted historically), although the subspecies also exists in areas outside the historic range of steelhead trout (Behnke 1992). Sympatric fish with resident and anadromous life histories form different breeding populations due to assortative mating (they prefer mates with a life history similar to their own), but the populations are not completely reproductively isolated from each other (Currens 1987).

Long-standing natural barriers do exist in some Hells Canyon tributaries (e.g., waterfalls in Cherry, Cook, and McGraw creeks) above which redband trout populations exist in isolation from steelhead populations (ODFW 1995). However, throughout much of the Snake Hells Canyon subbasin, redband trout likely coexisted with steelhead at some point. Current steelhead migration barriers in many tributaries are often "temporary" in nature, being deposited, removed, and/or redeposited by major flood events on a semiregular interval (e.g.,10–20 years; Ed Schriever, IDFG, personal communication, December 2003).

Carrying Capacity

No information is available regarding carrying capacity of redband trout within the Snake Hells Canyon subbasin.

Unique Population Units

Descriptions of population units for redband trout were located only for those areas of the subbasin within Oregon (ODFW 1995). It is unclear whether any other unique population units do or may exist within the portions of the subbasin contained in Idaho or Washington. The ODFW (1995) indicates the presence of at least two unique population units of redband trout contained wholly or partially within the Snake Hells Canyon subbasin:

> **Lower Snake River from Hells Canyon Dam to the Oregon–Washington Border:** This group includes summer steelhead and redband trout in the Snake, Grande Ronde, and Imnaha rivers. Systematic comparisons between this group and other Oregon populations outside the study area have not been made. Allozyme data indicate that the populations in these basins differ from those in the Yakima River and above the Hells Canyon Complex (Waples et al. 1991; Currens 1988, 1990, 1991, 1992, all cited in ODFW 1995). The groups are definitely reproductively isolated from Columbia River populations in Oregon, although intermediate populations extend down the Snake River in Washington.
>
> **McGraw Creek:** This group consists of a unique redband trout population isolated above a high waterfall on lower McGraw Creek. This creek is a direct tributary of the Snake River to the Hells Canyon Reservoir. The population does not appear to be closely related to any other Snake River *O. mykiss*. It is unique in both allozyme and meristic characteristics and may comprise its own subspecies (Currens 1991, cited in ODFW 1995).

Genetic Integrity

Hybridization of redband trout and stocked rainbow trout is common (Quigley and Arbelbide 1997) and often leads to questions over the genetic integrity of existing redband trout population(s). However, with the exception of limited information regarding genetics of redband trout in the Oregon portions of the subbasin (see prior information on unique population units), no information is available regarding the genetic makeup or integrity of redband trout within the Snake Hells Canyon subbasin.

Harvest

No information is available regarding current or historic harvest of redband trout within the Snake Hells Canyon subbasin.

Habitat Condition

No information regarding habitat conditions specific to redband trout was located for areas within the Snake Hells Canyon subbasin. According to ODFW (1995), habitat problems affecting most redband trout populations include irrigation diversions and cattle grazing. These activities modify river channels; remove riparian vegetation; block migration corridors; decrease summer flows, occasionally to complete dewatering; and increase summer water temperatures. Many populations have retreated to headwater areas as a result of these activities, causing extensive population fragmentation and declines in numbers. Other general habitat conditions and constraints are probably most similar to those previously described for steelhead (see section 3.4.3).

3.4.8 White Sturgeon

Distribution

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 historical estimates. Within the Snake Hells Canyon subbasin, white sturgeon are currently found only in the mainstem Snake River, a distribution likely unchanged from historical conditions despite their reduced abundance.

Population Data and Status

Abundance and Trends

Snake River white sturgeon are listed as sensitive species by the BLM and USFS and as a species of special concern by the state of Idaho. Currently, Snake River white sturgeon are not listed or proposed for listing under the ESA. However, the USFWS lists the Kootenai River (Idaho, Montana, and British Columbia) white sturgeon population as endangered.

Population status information has been collected in various segments of the Snake River between Lower Granite and Hells Canyon dams since 1970 (Table 26). Currently, white sturgeon populations in the subbasin are considered viable (USFS 1999). Population estimates were 10,000 fish in 1977 (Coon et al. 1977), 4,000 fish in 1985 (Lukens 1985), 3,800 fish in 2000 (Tuell and Everett 2001), and 3,625 fish in 2002 (IDFG 2003c).

Table 26. Population abundance estimates reported for white sturgeon between Lower Granite Dam (Rkm 108) and Hells Canyon Dam (Rkm 398).

Location	Abundance (estimator)	Sample Year(s)	Author
Lower Granite Dam site to Hells Canyon Dam (Rkm 174–398)	8,000–12,000 (Schnabel)	1972–1975	Coon et al. 1977
Clearwater River to Hells Canyon Dam (Rkm 224–398)	3,955 (Schnabel)	1982–1984	Lukens 1985
Lower Granite Reservoir (Rkm 174–240)	1,372 (Jolly-Seber) 1,524 (Schnabel)	1990–1991	Lepla 1994
Lower Granite Reservoir (Rkm 174–240)	1,804 (Schnabel)	1992	Bennett et al. 1993
Salmon River to below Hells Canyon Dam (Rkm 303–383)	1,312 (Schnabel) 1,600 (Jolly-Seber)	1997–2000	Lepla et al. 2001
Lower Granite Dam to Salmon River (Rkm 174–303)	2,544 (Schnabel) 1,823 (Jolly-Seber)	1997–1999	Heofs 1997, 1998 Tuell and Everett 2000, 2001

White sturgeon less than 92 cm total length comprised 86% of the population between 1972 and 1975and 80% of the population between 1982 and 1984. In addition, the proportion of white sturgeon between 92 and 183 cm, which were heavily harvested until 1970, comprised 4 and 18% of the populations sampled in the 1970s and 1980s, respectively (Figure 42) (Coon et al. 1977, Lukens 1985). In contrast, of the white sturgeon collected during the 1997–1999 period, only 57% were less than 92 cm, while 30% ranged between 92 and 183 cm (Tuell and Everett 2001).

The Hells Canyon reach along the Oregon–Idaho border contains the highest densities of Snake River white sturgeon (BLM 2000b). Key habitats are generally associated with the deep holes occurring between Hells Canyon and Lower Granite dams. Relative distribution of fish from Lower Granite Dam to the mouth of the Salmon River is shown in Figure 43 (Tuell and Everett 2001).

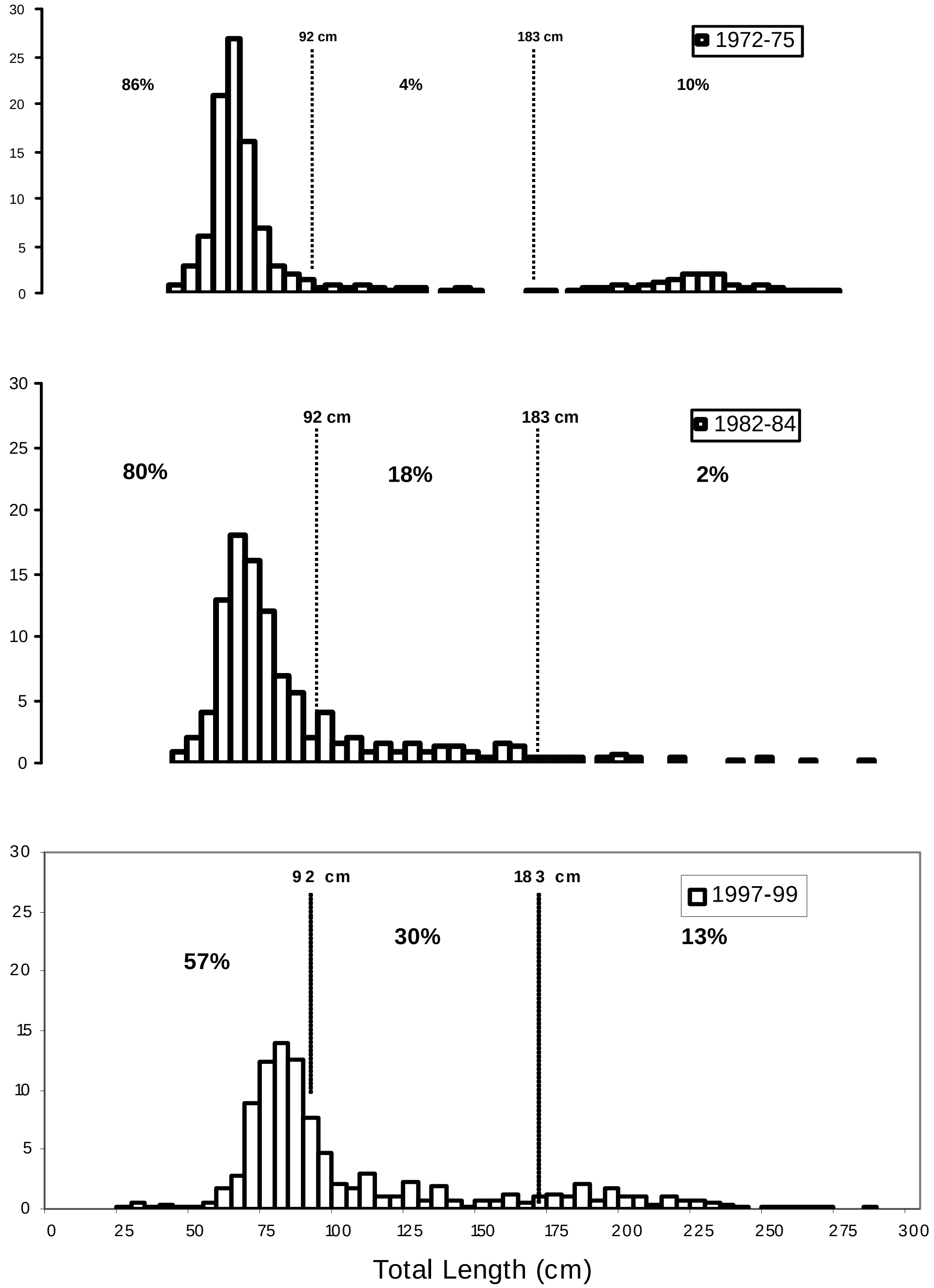


Figure 42. The length (total length) frequency distributions of sturgeon sampled from the Hells Canyon reaches of the Snake River, 1997–1999 (Tuell and Everett 2001), 1982–1984 (Lukens 1985), and 1972–1975 (Coon et al. 1977) and the percentage of the populations less than 92 cm, between 92 and 183 cm, and greater than 183 cm.

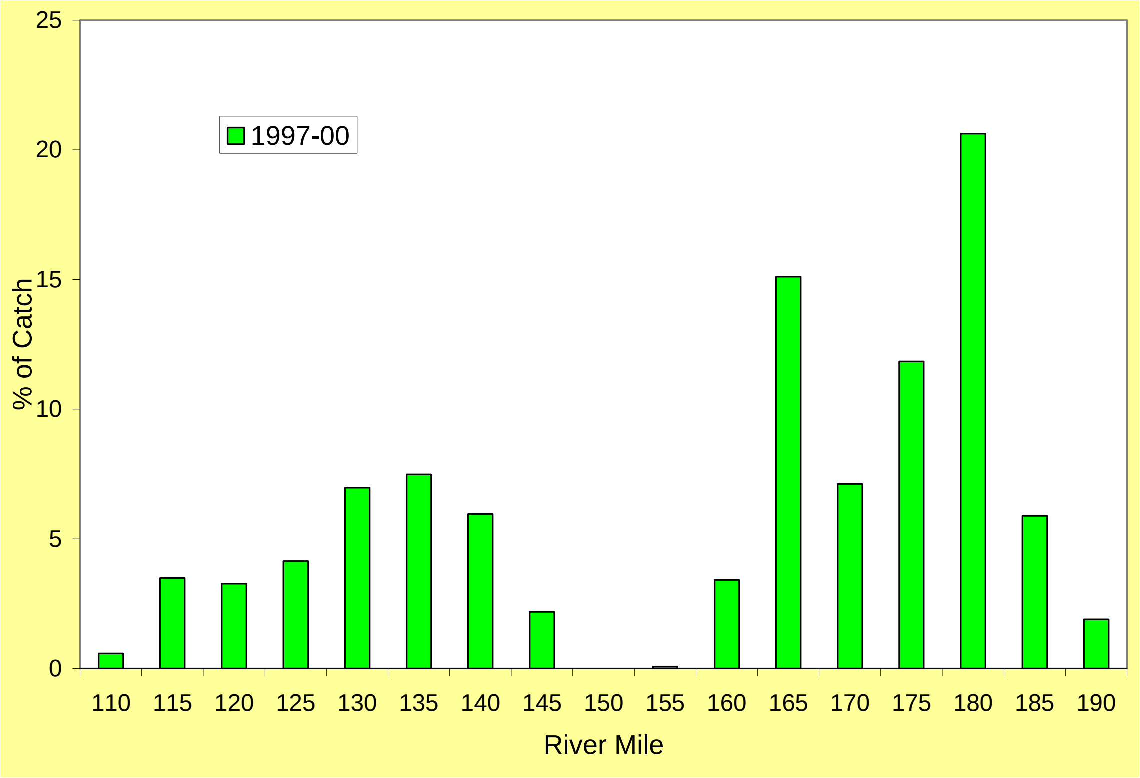


Figure 43. Relative distribution of white sturgeon between Lower Granite Dam and the confluence of the Salmon River (1997–2000) (J. Hesse, Nez Perce Tribe, personal communication, May 2001).

Productivity

No information is available regarding productivity of white sturgeon within the Snake Hells Canyon subbasin.

Life History Diversity

The following information is summarized from the Interior Columbia Basin aquatic component report (Quigley and Arbelbide 1997). The white sturgeon becomes sexually mature at 10 to 15 years, and spawning intervals may be 4 to 11 years. The fish spawns during May and June in rocky bottoms near rapids and lays up to two million eggs. A fish at one year is 9 inches in length; at 5 years, 20 inches in length; at 15 years, 40 inches in length (15 to 20 pounds); and at 25 to 60 years, 6 to 9 feet in length. Females grow faster than males, particularly in weight, after 14 years. The Idaho record for a white sturgeon is 1,500 pounds, caught on a set line in the Snake River in 1898. The rod-and-reel record is 394 pounds, caught in the Snake River in 1956.

The white sturgeon is a bottom feeder that feeds on almost anything, dead or alive. Young feed largely on larval forms of aquatic insects, crustaceans, and mollusks. Fish form a high percentage of the diet of larger sturgeon. The sturgeon spends a large percentage of time in deep pools with poor light. “Sturgeon holes” often range from 30 to 100 feet in depth. Because of poor light conditions, the sturgeon utilizes four barbels on the snout for touching and smelling.

Substrate size and water velocity influence selection of spawning areas by white sturgeon. Spawning generally occurs in water over 3 m in depth 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). Adults and juveniles prefer deep pool habitat with a fine bottom substrate. Adults tend to move downstream in the summer and fall months and upstream in the winter and spring months. Fish tend to stay in shallower water during the spring and summer and move to deeper waters during the winter.

Carrying Capacity

No information is available regarding the carrying capacity of white sturgeon within the Snake Hells Canyon subbasin.

Unique Population Units

Brannon et al. (1988) and Setter and Brannon (1992) compiled information on genetic similarity of white sturgeon throughout the Columbia River system, including the Snake River. Reports by those authors concluded that some differences exist between white sturgeon of the Columbia, Snake, and Kootenai rivers, but there is not enough genetic distance to base a strong argument for consideration as separate stocks.

However, white sturgeon between Hells Canyon and Lower Granite dams are isolated from other population areas due to lack of adequate passage at both upstream and downstream dams. Although there has been documentation of downstream movement past dams, there are no suitable fish passage structures on Snake River dams to allow upstream passage. Movement downstream can be hazardous: white sturgeon must either move past a dam over a spillway during high flows or through the turbine units. The inability of white sturgeon to move freely past dams has created unbalanced population structures in most areas where they exist within the Snake River basin (IDFG 2003c).

Genetic Integrity

No information is available specifically regarding the genetic makeup or integrity of white sturgeon within the Snake Hells Canyon subbasin. Data gathered by Brannon et al. (1988) and Setter and Brannon (1992), although adequate for general comparison of areas throughout the Columbia River basin, are not adequate to characterize the genetic integrity of white sturgeon within the Snake Hells Canyon subbasin.

Harvest

Traditionally, the Nez Perce people harvested white sturgeon in the Snake River for subsistence purposes, although numerical characterization of that harvest is unavailable. The Nez Perce Tribe practices subsistence and ceremonial take of white sturgeon in the Snake River below Hells Canyon Dam, removing an unknown number of spawning-sized individual sturgeon annually (IDFG 2003c).

Sport harvest occurred prior to 1970, but a catch-and-release fishery has been implemented since then. Limited catch statistics indicate variability in numbers and size of white sturgeon collected by both year and river reach (Table 27).

Table 27. White sturgeon catch from the Snake Hells Canyon subbasin by reach and length code for 1989–1991 from sturgeon permit data (IDFG unpublished data).

	<3 feet in length			**3–6 feet in length**			**>6 feet in length**			**Total—all lengths**		
	'89	**'90**	**'91**	**'89**	**'90**	**'91**	**'89**	**'90**	**'91**	**'89**	**'90**	**'91**
Below Salmon R. Confluence	81	33	165	26	48	98	15	41	57	122	122	320
Above Salmon R. Confluence	30	48	86	76	138	183	92	138	133	198	324	402

Although the current fishery is catch-and-release only for white sturgeon, harvest impacts may still influence the population. IDFG (2003c) provides the following characterization of the potential impacts of the existing catch-and-release fishery on white sturgeon

> Even with sport catch and release regulations, the biological aspects of repeated catch-and-release angling is largely unknown for white sturgeon. Booth et al. (1995) indicates that angling can be one of the most severe forms of exhaustive exercise that fish experiences. Several studies on different species of fish have shown that exhaustive exercise, including angling results in a variety of severe physiological disturbances that altered reproductive performance and delayed mortality (Nelson 1998, Lambert and Dutil 2000, Schreer et al. 2001). IPC (Ken Lepla, IPC, personal communication) documented hooking mortality on white sturgeon below C.J. Strike Dam in July 2001. Necropsy of two white sturgeon revealed the presence of 3- 20 angler hooks in the digestive tract, several of which punctured the esophagus and intestinal tracts. Delayed hooking mortality and illegal harvest are two unknown but potential sources of mortality on white sturgeon populations. The increasing demand placed on white sturgeon population can only exacerbate impacts on stability or restoration of populations in all sections of the Snake River. Future investigations on white sturgeon populations in the Idaho's Snake River must include the extent of sport angler usage as well as an assessment of hooking mortality.

Habitat Condition

Development of the Columbia River basin hydropower system has created impoundments that have altered the habitat and movement of white sturgeon and their principal food resources in the lower Snake River between Hells Canyon and Lower Granite dams. The upstream and downstream dams have considerable influence over the nature of sturgeon habitat. The upstream reservoirs have shifted the timing, natural flow patterns, and temperature regimes of the Snake River below the Hells Canyon Complex (Coon 1978). Flows have been increased through the fall, winter, and early spring to meet power demands, effectively emptying the reservoirs prior to spring runoff. Spring peaks have been reduced and spread out over a longer duration. These changes may decrease quality spawning and incubation habitat (BLM 2000b). Bedload, suspended solids, and nutrients are trapped behind upstream impoundments, creating a deficit to downstream reaches. Overall, however, the condition of sturgeon spawning and rearing habitat is considered to be good (Saul et al. 2001).

3.5 Terrestrial Focal Species Population Delineation and Characterization

As discussed in section 0, terrestrial focal species were selected for the Snake Hells Canyon subbasin primarily because they were good indicators of broader habitat conditions. For this reason, the following information is organized by the WHT for which the species was selected to represent. The descriptions of terrestrial focal species biology, habitat use, and population trends are intended to be illustrative of the importance of the habitat type for wildlife in the subbasin and the factors that may be influencing the quality of that habitat for the native wildlife of the subbasin.

3.5.1 Alpine Grasslands and Shrublands

Mountain Goat

Mountain goats (*Oreamnos americanus*) inhabit subalpine or alpine mountain zones (Christensen 2001). Good goat habitat is dominated by cliffs or extremely steep rocky slopes. The cliffs and rock outcrops provide security, cover, and shelter from extreme weather. Interspersed with the rocks are areas of high-quality forage (ODFW 2003d). Adept at surviving on a variety of plants, mountain goats have been documented eating grasses, forbs, sedges, mosses, lichens, shrubs, and conifer trees (Christensen 2001). Food preferences and forage areas tend to shift seasonally. Grasses are preferred in most areas and used year-round if available. Shrubs and conifers become more prominent in the mountain goat diet in the winter when grasses are less available. South- to west-facing slopes limit snow depth and provide the greatest food availability during winter, while north- and east-facing slopes often have greater snow accumulations that lead to better summer forage (ODFW 2003d). Reasons for the selection of mountain goats as a focal species for this assessment include economic and cultural importance, potential vulnerability to human influenced changes in vegetative community, vulnerability to human disturbance, and a demonstrated vulnerability to extirpation.

IPC contracted with the Rocky Mountain Elk Foundation to conduct an assessment of big game habitat in the company's area of operations. One of the subareas included in the study, the "Hells Canyon subarea," roughly corresponds with the boundaries of the Snake Hells Canyon subbasin. However, it includes the area around Brownlee Reservoir but excludes the lower subbasin downstream of the Washington state line. As part of this effort, panels of local big game experts identified areas of important big game habitat. More than 49,000 acres of currently utilized mountain goat habitat and almost 99,000 acres of potential mountain goat habitat were delineated in the Hells Canyon subarea. Habitat succession and maturation and dispersed recreation were the factors identified as most limiting the effectiveness of habitat in the area to support mountain goats (Christensen 2001).

The historical distribution of mountain goats in Oregon is debated. Some documents indicate that mountain goats are not native to Oregon and result from introductions (Verts and Carraway 1998, Johnson and O'Neil 2001). However, a review of literature documenting archaeological evidence of the species' presence, accounts of observations in the journals of Oregon's early explorers, and early scientific accounts and descriptions of the species led the ODFW to conclude that mountain goats were part of Oregon's native wild fauna until or just prior to the time of European settlement (ODFW 2003d).

Mountain goats are native to Idaho, and published archaeological investigations document their historical presence on the Idaho side of Hells Canyon (Verts and Carraway 1998). Unregulated hunting in the late 1800s and early 1900s resulted in major population declines. By the mid-1900s, it is estimated that there were less than 3,000 mountain goats in Idaho. Remnant populations were centered in the mountains of central Idaho. Mountain goats were extirpated from the Hells Canyon area by the 1930s (Edelmann and Rocklage 2001).

Two distinct populations of mountain goats currently occupy the subbasin: one in the Seven Devils Mountains of Idaho and the other near Sluice Creek in Oregon. The Idaho population was formed through translocation in 1962 and supplemented in 1964. The Oregon population was formed through translocation in 2000 (Edelmann and Rocklage 2001).

In April 1996, IPC and the IDFG conducted a helicopter census of the Seven Devils mountain goat population. At this time of year, goats are often observed at lower elevations where green forage becomes available earliest. Observers counted 117 goats in April 1996. Nine of these goats were goats observed above Hells Canyon Dam in the Middle Snake subbasin. Goats observed in the subbasin occurred at an average elevation of 1,410 feet above the Snake River (Edelmann and Rocklage 2001).

Population trends were difficult to assess because previous surveys were conducted over slightly different areas or during different seasons of the year. However, the comparisons that could be made indicate a 15% population decline between 1993 and 1996 and a decline in the kid:adult ratios. Due to the low initial population size and low reproductive potential of mountain goat, this population decline is of significant concern, but additional surveys are needed to verify the decline. The current management goal of the IDFG is to maintain the Seven Devils population above 90 goats (Edelmann and Rocklage 2001).

Possible reasons for the declines in population of the Seven Devils herd include natural environmental stochasticity, changes in vegetation from the 1994 Granite Creek fire, and increased predator populations. The Seven Devils mountain goat population has been hunted each year since 1983, with harvest levels averaging between three and four goats a year. This level of harvest is unlikely to have played a causal role in reducing the mountain goat population. However, little is known about the effects of harvest on mountain goat population stability, and Hayden (1990) considered that investigating population responses to harvest is the most important research topic regarding mountain goats (Edelmann and Rocklage 2001).

In 2000, 3 male and 13 female mountain goats were released into the Oregon portion of the Snake Hells Canyon subbasin near Sluice Creek. Ongoing monitoring of the population indicates that reproduction has been good and the 2002 population estimate was 30 animals. Hells Canyon could potentially support a population of 200 goats (ODFW 2003d).

3.5.2 Eastside Grasslands

Rocky Mountain Bighorn Sheep (Ovis canadensis canadensis)

Introduction

The Rocky Mountain bighorn sheep (*Ovis canadensis*), classified as a game animal in Idaho, Oregon, and Washington, is under the administrative management of the IDFG, ODFW, and WDFW, respectively. Sportsmen consider it a premier game species, but hunting opportunities are limited due to low population numbers. Once common in many parts of the basin, bighorn sheep were extirpated throughout the Northwest earlier in the twentieth century due to overharvest, disease, and habitat loss. Reintroduction efforts have brought bighorns back to the Columbia Basin, but many populations remain small and isolated. The Rocky Mountain Bighorn sheep was selected as a focal species for this assessment due to its sensitivity to changes in grassland habitat composition and structure, its cultural and economic importance and the management challenges associated with protecting bighorn sheep populations from disease.

Diet

Bighorn sheep are opportunistic foragers that utilize whatever plant species are available to them (Todd 1972). The primary component of bighorn sheep diet is grasses, although forbs and shrubs may contribute significantly to the diet in some regions or seasons (Shackleton et al. 1999). Bluebunch wheatgrass (*Pseudoregneria spicatum*), Idaho fescue (*Festuca ovina* var. *ingrata*), basin wild rye (*Elymus cinereus*), and various bluegrass (*Poa* spp.) and brome (*Bromus* spp.) species comprise the majority of grasses consumed by bighorns in the Columbia Basin.

Diet varies seasonally (Shackleton et al. 1999 and references therein) and among individuals (Hickey 1975) and sex classes (Shank 1982). Shank (1982) attributed the variation in diets between ewes/lambs and adult males to the different availability of plant species on the geographically segregated ranges of the two groups.

Reproduction

Female bighorn sheep reach sexual maturity at approximately 2.5 years of age although, in some cases, females can mate as young as 1.5 years and give birth as two year olds (Van Dyke 1978). Females are iteroparous, usually producing a single lamb (sometimes twins) yearly until they die or become too old to breed. Males do not reach sexual maturity until about seven or eight years old (Geist 1971). Once rams reach sexual maturity, they may actively breed ewes for only a few years. During that time, they may sire many offspring (Shackleton et al. 1999). Bighorns are polygamous, with a few dominant rams performing most of the breeding (ODFW 2003d).

Mating occurs during the fall rut, which typically lasts from two to three weeks. Timing of the rut varies geographically. The gestation period for Rocky Mountain bighorns has been estimated at 173 to 176 days (Geist 1971, Blunt et al. 1972, Whitehead and McEwan 1980). Birth occurs in the spring during periods of high forage availability and, as a result, varies considerably across the geographic range of the species. In Oregon, lambing generally occurs during April and May (ODFW 2003d) in steep, rocky terrain where ewes can give birth in seclusion. Shackleton et al. (1999:122) attribute three primary functions to the isolation and ruggedness of lambing sites: 1) a relatively predator-proof habitat, 2) shelter from inclement weather, and 3) isolation required for the development of the mother–young bond.

Mortality

Mortality factors vary by life stage. Young sheep may experience high rates of mortality during their first year of life. Date of birth and birth weight both contribute indirectly to early mortality rates (Geist 1971, Hass 1989). Lambs with low birth weight may be more susceptible to disease, predation, or hypothermia during severe weather events. A study by Festa-Bianchet (1988) found that lambs born late in the season may miss the period of peak forage nutrition for lactating females and therefore be more likely to die from inadequate nutrition.

Disease is a significant mortality factor for young bighorn sheep. Pneumonia caused by *Pasteurella* has been a contributing factor in low lamb survival in several local populations throughout Oregon, Washington, and Idaho (Coggins 1988, Akeson and Akeson 1992, Cassirer et al. 1996). Lungworms (*Protostrongylus*) have also been implicated in lamb mortalities at Hart Mountain, Oregon (Cottam 1985).

Predation by coyote, cougar, and bobcat and incidentally by wolverine and black bear can all contribute to lamb mortality (Shackleton 1985). Coyotes in particular have been shown to have significant impacts to lamb survival in some populations (Hebert and Harrison 1988, Hass 1989). The susceptibility of lambs to predators may be related to the availability and quality of escape/security cover (Shackleton et al. 1999).

The primary adult mortality factors are disease and predation. Recurrent infestations of lungworm, scabes (*Psoroptes ovis*), and *Pasteurella* can have significant impacts to small, localized herds. Cassirer et al. (1996) documented the loss of 50 to 75% of the bighorns in four of ten herds in the Hells Canyon ecosystem of Oregon and Washington following a *Pasteurella* outbreak in 1995. A more thorough discussion of the role of *Pasteurella* in bighorn sheep recovery is provided in the section about disease below.

Cougar and humans appear to be the principal large predator of adult bighorns. In small populations or those being newly established through transplants, predation can be a significant factor in success and establishment of populations. In one case, four transplants into Hells Canyon involving 53 sheep experienced a loss of 11% of the transplanted individuals from cougar kills and human-caused mortalities, including an animal attempting to cross a highway (Coggins et al. 2000). Since sheep were reintroduced to Hells Canyon, harvest has been strictly targeted on rams. Human hunters (both legal and poachers) disproportionately select for mature, breeding-age rams.

Habitat Requirements

Bighorn sheep habitat consists of steep, rocky, open terrain with abundant bunchgrasses. Vegetative structure is important to bighorns since they require long sight distances to detect and avoid predators. As a result, bighorn tend to avoid dense forests (USDA 2003a). Gregarious and extremely loyal to their home range, bighorns typically inhabit river canyons, talus slopes, cliffs, open meadows, and clearcut or burned forests. The use of each habitat type varies seasonally and with requirements such as breeding, lambing, and thermal cover (Valdez and Krausman 1999).

Habitat use also varies by sex, with mature males occupying separate ranges from females, lambs, and immature rams. Males tend to inhabit areas of higher forage quality but greater predation risk, while maternal groups select habitat with greater security cover, even if this choice results in poorer forage quality or availability (Shackleton et al. 1999).

Elevational migrations are common, and bighorns will follow the wave of new vegetation upward in the spring. Preferred climate is relatively warm and arid with cold, dry winters. Low annual snowfall is important for lamb survival. Bighorn sheep require 4 to 5% of their body weight in water each day, but they may be able to get sufficient water from succulent plants in the spring and snow in the winter so as not to be limited by standing water sources (Valdez and Krausman 1999).

Bighorn Sheep Population and Distribution

Historic Population

Humans and mountain sheep have coexisted in North America for more than 30,000 years. Bighorn sheep were historically widespread throughout the drier, nonforested regions of western North America. Nowak (1991) estimated that 1.5 to 2 million individual *Ovis canadensis* may have inhabited North America prior to their decline in the nineteenth century. Bighorns were an important historical resource for Native Americans. Horns and bones were used to make tools and ornaments, hides were used for clothing, and the meat was an important protein source (Valdez and Krausman 1999). Reports by early explorers, trappers, and settlers suggest that, at one time, bighorn sheep were one of the most abundant large animals in Idaho. They were also especially abundant in Hells Canyon and the Wallowa Mountains of Oregon (ODFW 2003d).

Overgrazing by cattle and sheep, disease, and uncontrolled hunting greatly reduced and often extirpated populations. Bighorn populations have increased since the 1900s due to a series of reintroductions, but much of their previous range is still unoccupied (Wisdom et al. 2000). Transplanting is necessary to stimulate new populations in unoccupied habitats because bighorn are extremely loyal to their territories and will not readily move into new ranges (Parker 1985).

Current Population

There are currently four extant Rocky Mountain bighorn sheep herds within the Blue Mountains of southeast Washington: Asotin Creek, Black Butte, Wenaha, and Mountain View (Fowler 1999). An additional 11 herds occur in northeastern Oregon, and four herds are found within the Idaho portion of Hells Canyon (Table 28). All of these herds comprise and contribute to bighorn populations of the Snake Hells Canyon subbasin.

Table 28. Bighorn sheep population status within or adjacent to the Snake Hells Canyon subbasin in Idaho, Oregon, and adjacent southeastern Washington (IDFG 2002, ODFW 2003d, WDFW 2003c, Hells Canyon Initiative 2004).

Herd	# Releases (# animals)	2002-3 Pop. Estimate	Current Status
Asotin Creek, WA	3 (25)	45[a]	Increasing
Bear-Minam, OR	4 (48)	35	Static

Herd	# Releases (# animals)	2002-3 Pop. Estimate	Current Status
Big Canyon, ID	2 (22)	21	Declining
Black Butte, WA	No Data	80	Unknown
Lostine, OR	1 (20)	80	Increasing
Lower Hells Canyon, OR	3 (45)	35	Increasing
Lower Imnaha, OR	3 (36)	165	Increasing
Mountain View, OR/WA	No Data	20	Static
Muir Creek, OR	2 (27)	25	Declining
Myers Creek, ID	1 (?)	16	Unknown
Redbird, ID	1 (17)	150	Increasing
Saddle Creek, OR	None	12	Increasing
Sheep Mountain, OR	4 (42)	35	Static
Upper Hells Canyon, OR	2 (54)	45	Static
Upper Hells Canyon, ID	4 (78)	25	Increasing
Upper Joseph Creek, OR	None	40	Increasing
Wenaha, OR/WA	2 (430)	65	Static

[a] P. Fowler, WDFW, personal communication, 2004
[b] Established by natural dispersal from other herds

Much of the current success of Rocky Mountain bighorn sheep populations is the direct result of reintroduction efforts. As recently as February 2002, 20 sheep from Montana were released along the Snake River above Kirkwood Creek (IDFG 2002). Potential future release sites have been identified in Sheep Creek and Big Canyon in Idaho and Saddle Creek in Oregon (Hells Canyon Initiative 2004).

Historic Distribution

The geographic range of the species is quite large and extends from southeastern British Columbia and southwestern Alberta south along the Cascade and Sierra Nevada mountains into Baja California, eastward through Montana to western North Dakota, South Dakota, and Nebraska, as well as into central Colorado and New Mexico, western Texas, and eastern Coahuila, Mexico (Verts and Carraway 1998).

In Oregon, Rocky Mountain bighorn sheep occupied suitable habitat from the John Day–Burnt River divide north and east to the Snake River and the Oregon–Washington state line. Bighorn sheep were considered abundant throughout the Idaho portion of the Hells Canyon ecosystem. Historical distribution of bighorns in Washington in not entirely clear (WDFW 1995), but there is general agreement that Rocky Mountain bighorns inhabited the Blue Mountains region where they occupied all suitable habitat within the rugged river canyons of the area.

Current Distribution

Current distribution is restricted to four geographic areas within the Blue Mountains: Asotin Creek, Black Butte, Wenaha, and Mountain View (Fowler 1999). An additional 11 populations occur within northeastern Oregon (ODFW 2003d), and four herds are found in Idaho within Hells Canyon.

The current distribution of Rocky Mountain bighorn sheep is the result of transplants that targeted areas with suitable habitat and lacked conflicts with domestic sheep. The last Oregon population estimate in 2003 was 637 Rocky Mountain bighorns in 12 herds (ODFW 2003d). Washington estimates from 2002 were 239 Rocky Mountain bighorns within five herds (WDFW 2003c). Idaho populations within the Clearwater region contain an estimated 223 animals (Hells Canyon Initiative 2004).

Factors Affecting Bighorn Sheep Population Status

Currently there are three key factors threatening the successful reestablishment of a population of Rocky Mountain bighorn sheep in the Snake Hells Canyon subbasin: 1) the continuing threat of disease transmission from domestic sheep and goats, 2) a large portion of the bighorn sheep habitat not being in protected status and vulnerable to land management changes negative to bighorn sheep, and 3) the continued threat of noxious weed invasion on core Rocky Mountain bighorn sheep habitat in the Snake Hells Canyon subbasin.

Habitat Loss

Within the Snake Hells Canyon subbasin, only a small proportion of bighorn sheep habitat has been lost due to land conversion for agricultural production and urban development. A high percentage of public landownership and the steep, rugged nature of bighorn sheep habitat has afforded some level of protection from some of the more destructive land uses.

Habitat Degradation

Aggressive nonnative plants and other noxious weeds are the primary factor negatively impacting habitat quality. Across their range in Washington, Idaho, and Oregon, bighorn habitat has suffered encroachment from yellow starthistle (*Centaurea solstitialis*), knapweed (*Centaurea* spp.), common crupina (*Crupina vulgaris*), rush skeletonweed (*Chondrilla juncea*), leafy spurge (*Euphorbia esula*), and other plants. Such encroachment reduces forage quality and vigor. In the Snake Hells Canyon subbasin, habitat conditions are generally good, but yellow starthistle and diffuse knapweed (*Centaurea diffusa*) are threats to the continued quality of Rocky Mountain bighorn sheep range (see section 4.1.2). Due to fir exclusion, fire-adapted grasses and shrubs have become more decadent. Bighorn sheep use their vision to detect predators. Fire suppression is one of the major factors that have reduced the quality of habitat for this species (BLM 2002).

Livestock Grazing

Historical overgrazing of Rocky Mountain bighorn sheep habitat by domestic livestock has reduced range quality and increased competition for resources. Periods of historical overgrazing by livestock have contributed to the degradation of range quality and the susceptibility of native communities to introduced invasive plant species. Many of the range areas within the Snake Hells Canyon subbasin are still recovering from historical overgrazing.

Domestic sheep and goat grazing presents a unique constraint on Rocky Mountain bighorn sheep recovery within the Snake Hells Canyon subbasin due to the transmission of disease pathogens. In fact, an outbreak of *Pasteurella* was just documented within the Big Canyon herd as of April 8, 2004 (Barker 2004). This issue is covered in more detail below.

Disease

Disease transmission from domestic sheep and goats has proven to be the largest threat to wild bighorn sheep populations in the tri-state region of Oregon, Washington, and Idaho. With the exception of lungworm and scabies, most diseases negatively affecting bighorns commonly occur in domestic sheep, and disease prevalence in bighorns generally increases with contact between bighorns domestic sheep. The Oregon bighorn sheep and Rocky Mountain goat plans provide an explanation of the hazards of disease transmission in bighorn sheep (2003d). The following is quoted directly from that document:

> When bighorn sheep come in contact with infected domestic sheep, bighorns usually die of pneumonia within 3–7 days of contact (Martin et al. 1996, Schommer and Woolever 2001). Because exposed bighorns do not die immediately infected individuals may return to their herd and infect other individuals, which can cause 70–100% of the herd to die (ODFW 2003d). The significant Hells Canyon die-off of 1995–96 was believed to have started when a feral goat interacted with wild bighorns in the Tenmile drainage south of Asotin (Cassirer et al. 1996). During the 1995–96 die-off, the Black Butte, Mtn. View, and Wenaha herds experienced 75, 65, and 50 percent mortality, respectively (Cassirer et al. 1996). The die off did not affect the Asotin Creek herd (Fowler 1999).

Field treatment of pasteurellosis with antibiotics has had some success, but prevention needs to be emphasized. The most effective prevention is separation between bighorns and domestic sheep or goats (ODFW 2003d). The amount of separation necessary to protect bighorn sheep from interaction with domestic sheep is variable based on each location's specific circumstances. After a *Pasteurella* die-off in 1993 in an Aldrich Mountain, California, bighorn herd, trailing practices of a domestic sheep band were modified to provide 5 miles of separation in the spring and 20 miles of separation in the fall. This approach has protected that population of bighorns from any recurrence of *Pasteurella* (ODFW 2003d). In Hells Canyon, a 25-mile separation between Rocky Mountain bighorn sheep and domestic sheep has proven ineffective at insulating bighorns from *Pasteurella* transmission (Schommer and Woolever 2001).

A single public land grazing allotment on the Payette National Forest allows domestic sheep grazing. All sheep allotments on the Wallowa-Whitman National Forest have been discontinued (USFS 2003a). There are a few commercial sheep and goat grazing operations within or adjacent to the Snake Hells Canyon subbasin that continue to provide disease transmission opportunities to wild bighorns. Most notably are a sheep herd in lower Joseph Creek and a herd of goats based in the White Bird, Idaho, area that are used in weed-control efforts. Domestic sheep and goats are also kept sporadically in small quantities as hobby animals in the river bottoms of the Snake River system and adjacent subwatersheds.

Grasshopper Sparrow

This section draws heavily from the species description prepared by Paul Ashley and Stacy Stoval (2004). See http://www.nwcouncil.org/fw/subbasinplanning/ for additional information on grasshopper sparrow biology.

The grasshopper sparrow (*Ammodramus savannarum*) is a small migratory bird that breeds throughout most of the lower 48 states, but it is often locally distributed and even uncommon to rare in parts of its range (Vickery 1996). Grasshopper sparrows arrive on the breeding grounds in mid-April and depart for the wintering grounds in mid-September (Vickery 1996). They winter across the southern tier of states south into Central America. The grasshopper sparrow was selected as a focal species for this assessment based on their reliance on large areas of bunchgrass dominated grasslands, a habitat type that as declined significantly in abundance in the subbasin and the Columbia Basin as a whole.

In 1996, Vickery (1996) reported that grasshopper sparrow populations have declined by 69% across the United States since the late 1960s. In Washington, the grasshopper sparrow is considered a Watch species and a candidate for listing by the state (Table 14). In Oregon, it has a state Natural Heritage Program status of imperiled, while in Washington and Idaho, it has a state Natural Heritage Program rank of vulnerable (2003). Breeding Bird Survey data show long-term declines in populations of grasshopper sparrow in all three of the states partially contained by the Snake Hells Canyon subbasin (Sauer et al. 2003).

Table 29. Trends for grasshopper sparrow from Breeding Bird Survey data, 1980–2002 (Sauer et al. 2003).

State	1996–2002 Trend	1980–2002 Trend
Washington	–4.9	–3.0
Idaho	–7.4	–10.7
Oregon	–4.4	–1.6

The diet of the grasshopper sparrow varies by season. In the spring and summer, grasshopper sparrows rely on invertebrates for 60% of their diet and seeds for the remainder. In the fall, seeds become a greater component of the diet, making up 71% of the total while invertebrates make up the remainder. No data were available on the composition of the winter diet (Martin et al. 1951, cited in Vickery 1996).

Grasshopper sparrows are monogamous throughout the breeding season and nest in semicolonial groups of 3 to 12 pairs (Ehrlich 1988). The female incubates the eggs alone (Ehrlich 1988), while the male defends the pair's territory (Smith 1963). The incubation period lasts from 11 to 13 days (Smith 1963, Harrison 1975, Ehrlich 1988), with a nestling period of 6 to 9 days after hatching (Harrison 1975, Hill 1976, Kaspari and O'Leary 1988). Hatchlings are blind and covered with grayish-brown down (Smith 1968). After the young hatch, both parents share the responsibilities of tending the hatchlings (Smith 1963). Brood parasitism by brown-headed cowbirds has been documented, but rates are generally low (Vickery 1996).

Throughout most of their range, grasshopper sparrows can produce two broods, one in late May and a second in early July (Smith 1968, Vickery 1996). However, in northern portions of its range, such as the Snake Hells Canyon subbasin, one brood is probably most common (Wiens 1969, Vickery et al. 1992).

Predators of the grasshopper sparrow include hawks, loggerhead shrikes, mammals, and snakes (Vickery 1996). Nest predators cited include raccoons (*Procyon lotor*), red fox (*Vulpes vulpes*), northern black racers (*Coluber constrictor constrictor*), blue jays (*Cyanocitta cristata*), and common crows (*Corvus brachyrhynchos*) (Wray et al. 1982, Johnson and Temple 1990).

Grasshopper sparrows prefer grasslands of intermediate height and are often associated with clumped vegetation interspersed with patches of bare ground (Bent 1968, Blankespoor 1980, Vickery 1996). Vickery (1996) states that exposed bare ground is the critical microhabitat type for effective foraging. Other habitat requirements include moderately deep litter and sparse coverage of woody vegetation (Smith 1963; Bent 1968; Wiens 1969, 1970; Kahl et al. 1985; Arnold and Higgins 1986). In east-central Oregon, grasshopper sparrows occupied relatively undisturbed native bunchgrass communities dominated by *Agropyron spicatum* and/or *Festuca idahoensis* (Holmes and Geupel 1998). Vander Haegen et al. (2000) found no significant relationship with vegetation type (i.e., shrubs, perennial grasses, or annual grasses), but they did find one with the percent cover of perennial grass. Grasshopper sparrows are area sensitive, preferring large grassland areas over small areas (Herkert 1994a,b; Vickery et al. 1994). Key habitat features of grasshopper sparrow habitat are displayed in Table 30.

Grasshopper sparrows occasionally inhabit cropland but at lower densities than are found in grassland habitats (Smith 1963, Smith 1968, Ducey and Miller 1980, Basore et al. 1986, Faanes and Lingle 1995, Best et al. 1997). Early season mowing of hayfields causes major nest failures in grassland nesting species (Knapton 1994). Areas where hayfields are adjacent to bunchgrass grasslands may serve as population sinks for grasshopper sparrows (Wisdom et al. 2000). Grasshopper sparrows are also included as members of shrub-steppe communities that exhibit the features described in Table 30 (Altman and Holmes 2000).

Table 30. Key habitat relationships required for breeding grasshopper sparrows (Altman and Holmes 2000).

Conservation Focus	**Key Habitat Features**			
	Vegetative Composition	**Vegetation Structure**	**Landscape/Patch Size**	**Special Considerations**
native bunchgrass cover	native bunchgrasses	bunchgrass cover >15% and >60% total grass cover; bunchgrass >25 cm tall; shrub cover <10%	>40 ha (100 ac)	larger tracts better; exotic grass detrimental; vulnerable in agricultural habitats from mowing, spraying, etc.

In the Snake Hells Canyon subbasin, the best habitats for grasshopper sparrow historically occurred in the northernmost portions of the subbasin (Wisdom et al. 2001). Much of this area has been converted to agricultural or urban land uses. Wisdom et al. (2001) found that some of the subwatersheds in this area historically contained between 75 and 100% source habitats for grasshopper sparrows. Source habitat for grasshopper sparrows still exists in the subbasin but has become less dense. Currently, the subwatersheds with the greatest density of grasshopper sparrow source habitat contain between 25 and 50% source habitat. The Breeding Bird Survey Route Was-023 Asotin is partially contained in the lower Snake Hells Canyon subbasin. The majority of the route lies in the lower portions of the neighboring Asotin subbasin but enters the subbasin for 4.7 miles near the confluence of the Snake River and Asotin Creek. Grasshopper sparrows have been observed along the route every year since 1983, with the exception of 1992. Counts of grasshopper sparrows along the route have been variable, ranging from a high of 12 in 1998 to a low of 0 in 1992. The average over the 20-year period was 6.65 grasshopper sparrows per year (Sauer et al. 2003). Variability has been commonly observed in grasshopper sparrow populations as they are known to move from year to year, depending on the location of suitable habitat (Csuti et al. 2001). It is impossible to determine grasshopper sparrow population trends in the Snake Hells Canyon subbasin from available data.

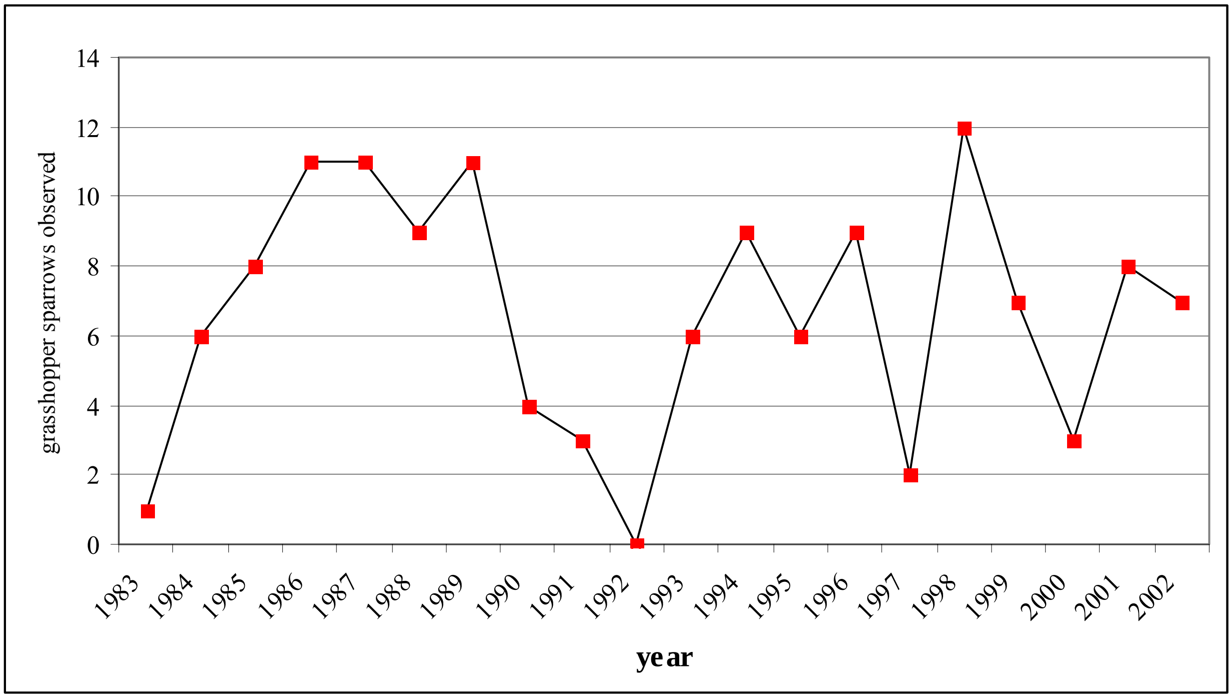


Figure 44. Grasshopper sparrow counts along the Breeding Bird Survey Route Was-023 Asotin, 1983–2002 (Sauer et al. 2003)

Primary threats to the species have been identified as loss, degradation, and incompatible management of grassland habitat (NatureServe 2003). Maintaining the quality, size and connectivity of the remaining bunchgrass habitat in the subbasin should be a priority for maintaining grasshopper sparrows. See section 0 for more discussion of the loss and degradation of grassland habitats as a limiting factor to wildlife species; see also the *Snake Hells Canyon Management Plan* for strategies for addressing this limiting factor.

3.5.3 Montane Mixed Conifer Forest

American Marten

The American marten *(Martes americ*ana) is a medium-sized carnivorous mammal that inhabits boreal forests of North America. In the western United States, marten ranges include Oregon, Idaho, Washington, Montana, Wyoming, Colorado, Utah, New Mexico, Nevada, and California (Strickland et al. 1982). It is globally distributed throughout Canada and Alaska and south through the Rockies, Sierra Nevada, northern Great Lakes region, and northern New England. Total population size is unknown but is probably at least several hundred thousand. Martin populations are considered secure in Idaho but vulnerable in Oregon (NatureServe 2003). The species was assigned Oregon state sensitive status due to declining habitat quantity and quality caused by the harvest of mature and old-growth timber (Turley and Holthuijzen 2002).

The American marten breeds in summer, and delayed implantation results in an average litter of three or four in spring. The young are usually born in hollow trees but sometimes in rock dens. Young are weaned in six weeks, and males are sexually mature in one year, while females mature in one to two years (NatureServe 2003).

The diet of the American marten consists mainly of small mammals, birds, insects, and carrion. When in season, berries and other vegetative matter contribute to their diet. American marten forage both on the ground and in trees and are expert at exploiting subnivean prey (voles, red squirrels, etc.) (NatureServe 2003).

American marten prefer structurally complex habitats with multiple canopy layers and abundant down woody debris and understory shrubs (Koehler and Hornocker 1977). They are associated with old-growth forest, particularly in winter, and were selected as a focal species due to their established status as an indicator of mature forest conditions (BLM 2002). Home range size is variable but usually averages less than 10 km^2, although it may be larger when food sources are scarce (Slough 1989).

In the Snake Hells Canyon subbasin, American marten inhabit mesic coniferous forests typically above 4,500 feet (BLM 2002). The marten is considered a valuable furbearing species, and historic overharvest caused marten population declines in many areas. Today loss of habitat and fragmentation are the primary factors impacting American marten populations (NatureServe 2003).

American martens have been historically documented in the subbasin, but two recent sampling efforts have failed to detect their presence. Martens were not observed by Eshelman (1998) during mammal live-trap studies conducted during the spring and summer of 1996 in areas surrounding Kirkwood, Bernard, Sheep, and Granite creeks. Remote-camera surveys conducted by Edelman and Pope (2001) at the confluence of perennial streams with the Snake River between Hells Canyon Dam and the Salmon River also failed to detect presence of American martens. Due to the secretive nature of the species, these results may not indicate a declining population trend but may warrant closer monitoring of martens in the subbasin. Two potential sightings of marten tracks were reported during wildlife surveys conducted at Craig Mountain in 1995 (Cassirer). Adequate information is not currently available to assess population status or distribution in and adjacent to the Snake Hells Canyon subbasin (Turley and Holthuijzen 2002).

Boreal Owl

The boreal owl (*Aegolius funereus*) breeds in North America, from the treeline in central Alaska east to Newfoundland; south-central Oregon in the Cascade and Blue mountains, and in the Rocky Mountains south through Washington, Idaho, Montana, Wyoming, and Colorado to northern New Mexico; then east through central Saskatchewan, southern Manitoba, northern Minnesota, southern Quebec, and Ontario. It breeds in Eurasia, from the treeline in northern Scandinavia, Russia, and Siberia, south in the mountains to southern Europe, the western Himalayas, and western China (AOU 1983, Hayward and Hayward 1993). The boreal owl winters mainly in the breeding range; however, it may move south in the eastern United States and Europe during eruption years (AOU 1983, Hayward and Hayward 1993, NatureServe 2003).

Reliable populations number are unavailable, and obtaining them is complicated by nomadism caused by fluctuating prey density (Hayward and Hayward 1993). Boreal owls are listed as a species of concern by the state of Idaho, a monitor species by the state of Washington, and as sensitive-status undetermined by the state of Oregon (Table 12).

Boreal owls nest in abandoned woodpecker holes or natural cavities in standing snags, usually in older forests with complex physical structures. Some success has been achieved in getting them to use artificial nest boxes (Harrison 1978). Females typically occupy the nest cavity one to three weeks prior to egg laying. In Idaho, nesting was initiated between mid-April and late May. After the female incubates the eggs for between 25 and 36 days, a clutch of 4 to 6 young hatches. The young owls fledge at about 4 to 5 weeks and are independent after 5 to 6 weeks. Boreal owls are sexually mature by one year (NatureServe 2003).

Boreal owls hunt from a perch and capture prey on the ground (DAI 2004). They eat primarily small mammals but sometimes birds and insects. They forage mostly at night. The best foraging habitat for boreal owls is in spruce–fir stands (DAI 2004).

In Idaho, the annual home range averaged 3,774 acres (1,289–10,174 acres), with a larger range in winter than in summer (Hayward et al. 1987). Boreal owl home ranges overlapped extensively, and they were found to defend the nest site only (NatureServe 2003).

In the Rockies, boreal owls generally inhabit mature, multilayered spruce–fir forest. They are usually found in remote subalpine habitats, and their early breeding season is usually associated with deep snow. Consequently, very few surveys have occurred. They are known to occur on a limited basis in northeastern Oregon and western Idaho. No population estimates have been made (USFS 2003c).

Large stand-replacement fires can destroy the structure of stands that serve as boreal owl habitat. Such fires are thought to be a major adverse impact to the species. Returning to a more natural fire regime through prescribed burning would reduce the threat of large stand-replacement fires to boreal owl habitat in the subbasin (USFS 2003c). Timber harvest may also be a threat to boreal owls since it affects their habitat by removing nest trees and forest structure and it can reduce prey populations. However, harvest has been very limited in the subalpine habitats of the HCNRA (USFS 2003c).

Rocky Mountain Elk

Relative to other wildlife species, elk (*Cervus elaphus nelsoni*) are considered habitat generalists. They favor a mix of grassland/shrub landscapes and forested landscapes that provide important security cover. Considered grazing animals, elk feed on grasses, sedges, and forbs all year. They shift to more shrubs in the winter as nonwoody plants become less available and less nutritious Christensen 2001). Elk were chosen as a focal species for this assessment due to their economic and cultural importance, their sensitivity to security issues and the importance of the subbasin for providing winter range habitat, they were selected as a representative of the coniferous WHTs because of the importance of these areas in providing cover. Thermal cover may be limited within the winter ranges of the subbasin (BLM 2002).

Optimum elk habitat consists of a forage cover ratio of 60% forage area and 40% cover (Thomas *et al.* 1979 cited in Ashley and Stoval 2004). Cover quality is defined in two ways; satisfactory and marginal. Satisfactory cover consists stands of coniferous trees that are > 40 feet tall, with a canopy closure of > 70%. Marginal cover is defined as coniferous trees > 10 feet tall with a canopy closure of > 40%. Cover provides protection from weather and predators. Forage areas are all areas that do not fall into the definition of cover. Proper spacing of forage and cover areas is very important in order to maximize use of these areas by elk (Thomas *et al.* 1979 cited in Ashley and Stoval 2004).

Idaho Power Company contracted with the Rocky Mountain Elk Foundation to conduct an assessment of big game habitat in the company's area of operations. One of the subareas included in the study, the "Hells Canyon subarea," roughly corresponds with the boundaries of the Snake Hells Canyon subbasin. However, it includes the area around Brownlee Reservoir but excludes the lower subbasin downstream of the Washington state line. As part of this effort, panels of local big game experts identified areas of important big game habitat. This effort recognized the subbasin as having some of the most crucial big game winter habitat in the region. Deer and elk persist throughout much of the surrounding area based on the capacity of the Snake River canyon to provide winter range and support these populations (Christensen 2001).

Elk in the Snake Hells Canyon subbasin are managed by the state wildlife departments Idaho, Oregon and Washington and contains portions of nine of the management units used by these agencies, six of these unit contain the majority of the subbasin and are listed below. The Washington Unit 186 contains most of the Washington portion of the subbasin. The Oregon units 58-Chesnimus and 59-Snake River are partially contained within the subbasin. The subbasin contains portions of Idaho Game Management Units 11, 13, and 18. IDFG collectively refers to these units as the Hells Canyon Zone.

The resident elk population in Washington GMU 186 varies between 50 and 150 elk. Elk from Oregon move into GMU 186 during the winter months, increasing the elk population by 250 to 550 elk, depending on the severity of winter conditions (Ashley and Stoval 2004). Elk are maintained at relatively low population levels in this unit due to concerns of agricultural damage (Ashley and Stoval 2004). Elk have caused damage to grain, legumes, hay, and rangeland forage in the subbasin. Cultivated crops are the main concern in the northern part of the subbasin, while livestock forage is the primary concern in the rest (IDFG 2003e).

Management objectives for the Hells Canyon zone (Idaho portion of the subbasin) are to establish a population of 1,950 cows and 525 bulls. Historically, elk herds were scattered, and numbers were low in this area. Elk populations increased in the area as a result of large fires that occurred in the beginning of the 20th century, that created fast brushfields that provided abundant forage areas for elk. Elk herds began to decline again in the 1970s, as a result of the maturation of these brush fields, logging and road building activity which reduced security, and loss of some major winter ranges (IDFG 2003e). Elk populations in all the Idaho game units in the subbasin meet management objective except for, adult bull numbers in Unit 11 (Table 31).

Table 31. Winter status and objectives for Elk in the Hells Canyon Elk Zone (number below objective in bold)

Unit	Current Status				Objective		
	Survey Year	Cows	Bulls	Adult Bulls	Cows	Bulls	Adult Bulls
11 Lower subbasin	2002	646	184	**66**	600-900	150-250	100-150
13 Craig Mountain Area	2001	890	185	117	500-700	100-150	50-100
18 HCRNA Area	2000	558	253	161	500-700	150-225	100-150
Zone Total		2094	622	344	1600-2300	400-645	250-400

Primary threats to elk in the Snake Hells Canyon subbasin include fragmentation of late successional forests and invasion by weeds and nonnative grasses, particularly cheatgrass and yellow starthistle. Security is a moderate concern, road densities are moderate, and access is restriction during many seasons. Big game in the subbasin exhibit medium to low vulnerability to hunters (IDFG 2003e).

3.5.4 Lodgepole Pine Forests and Woodlands

Black-backed Woodpecker

The black-backed woodpecker *(Picoides arcticus*) ranges from Alaska and Canada, south into northeastern Oregon along the Cascade Range and the Blue Mountains. The species prefers high-elevation forests, inhabiting forest dominate by lodgepole pine and ponderosa pine mixed with other conifers (Marshall et al. 1996, Csuti et al. 1997). The species is locally common in Oregon, with a spotty distribution. The black-backed woodpecker breeds throughout Idaho in suitable habitat (Turley and Holthuijzen 2002). The black-backed woodpecker was selected as a focal species for the lodgepole pine habitat type because of its association with fire killed, and mature trees, two elements that have been reduced by management practices in some areas.

Population trends are poorly understood, but the species has probably undergone declines over the twentieth century due to suppression of fire, cutting of snags, and loss of mature and old-growth forests. Documenting population trends is complicated by irregular population irruptions, and population extensions outside resident ranges occur in response to fires and insect outbreaks, temporarily boosting local populations (Bock and Bock 1974, Yunick 1985). The species is rarely detected on the North American Breeding Bird Survey, in part because there are relatively few survey routes in montane and northern boreal forests (NatureServe 2003).

The black-backed woodpecker has been designated a species of special concern by the state of Idaho, a sensitive species in the state of Oregon, and a candidate species by the state of Washington. Black-backed woodpeckers are a sensitive species for Region 1 of the USFS and the BLM.

The species' diet contains large numbers of bark beetles and wood-boring beetle adults and larvae (Marshall et al. 1996, USFS 1998). The species occasionally eats fruits, nuts, sap, and cambium (Terres 1980). Woodpeckers may be attracted by the clearly audible chewings of wood-boring insects in recent burns (Taylor and Barmore 1980). In a study in northeastern Oregon, 97% of foraging occurred on ridges. The birds preferred to forage in lodgepole pine and ponderosa pine and fed almost equally on live and dead trees. The species used trees averaging 31 cm diameter at breast height (dbh) and 18 m tall, with more than 40% of their needles intact. This finding suggests that they preferred live or recently dead trees (Bull et al. 1986).

Nests are located in the body of dead or dying pine snags that have pronounced decay and are infested with beetles and beetle larvae (Bock and Bock 1974, Wisdom et al. 2000). The male does most of the excavation, and a new cavity is excavated every year. The nest cavity is usually 0.6 to 4.6 m above the ground (NatureServe 2003). In Idaho, used nest trees average 32.3 cm dbh ($N = 15$; Saab and Dudley 1998). Both sexes incubate 2 to 6 eggs (usually 4) for 14 days. Young are tended by both parents (DAI 2004). Females feed young more often than males, but they carry less food in each visit. Although males visit less often, they come with more food and perhaps supply 50 to 75% of the food to nestlings (Kilham 1983). Usurpation of nesting cavities by hairy woodpeckers and Lewis' woodpeckers causes stress and excessive energy costs in territorial competition (Wisdom et al. 2000).

Stands inhabited by black-backed woodpeckers are typically old-growth lodgepole pine or recently burned forests with standing dead trees (USFS 1998, BLM 2002). In Montana, Hutto found that the species is almost exclusively associated with early successional burned forests, although it is occasionally observed in mixed conifer, lodgepole pine, Douglas-fir, and spruce–fir forests (1995a,b). The number of small trees present in a burn served as the best correlate of species abundance (Hutto 1995b). Hutto (1995b) suggests that a mosaic of recently burned forests may represent source habitat where local reproduction exceeds mortality. The low densities of woodpeckers in unburned forests may be sink populations that are maintained by birds that move into these areas as conditions on post-fire habitats become less suitable over time (NatureServe 2003).

Black-backed woodpeckers have been documented frequently in the HCNRA, although no systematic surveys have been conducted. Habitat conditions are thought to be excellent in many parts of the HCNRA because of the low emphasis on timber harvest, abundance of dead wood and insects, and overstocked stands. These conditions probably allow the HCNRA to act as source habitats for black-backed woodpeckers migrating to new areas (USFS 2003c). Recent fires have contributed to improved habitat conditions for the black-backed woodpecker in the Craig Mountain area (BLM 2002).

Suppression of fires and post-fire logging, as well as the threat of large, severe wildfires that reduce numbers of decaying snags, serve as limiting factors for the black-backed woodpecker (Dixon and Saab 2000). Goggans (1989) cites the above factors and the conversion of mature and old-growth forests to young stands with few decayed trees as significant threats to the species. Management should focus on maintenance of natural patterns of forest fire, wood-boring insects, disease, and decay. Heartrot in trees and snags is important for nests, diseased trees for roosts, and beetle-infested trees for foraging (Goggans et al. 1989, Rodrick and Milner 1991).

Better information is needed on demographics, population density, population irruptions, seasonal movements, breeding territory, home range sizes, productivity, survivorship, juvenile dispersal, and winter ecology of black-backed woodpeckers. More detailed information is also needed on habitat use, diet, and response to land management activities, particularly forest harvest patterns and changes in fire regimes. In addition, a better understanding is needed regarding the ecology and interactions with fire and insect infestations, including a comparison of densities and productivity between unburned forests and recent burns. (NatureServe 2003).

3.5.5 Ponderosa Pine Forests and Woodlands

Flammulated Owl

This Section draws heavily from the species description prepared by Paul Ashley and Stacy Stoval (2004). Please see http://www.nwcouncil.org/fw/subbasinplanning/ for additional information on flammulated owl biology.

The flammulated owl (*Otus flammeolus)* is a tiny owl with dark brown eyes, dark body, and small ear tuffs (USFS 2003c). These owls are one of the most migratory of all North American owls, going south of Mexico during most of the fall and winters. They are found in the Snake Hells Canyon subbasin from late-spring to early fall to breed. The flammulated owl is a species dependent on large diameter Ponderosa pine forests (Hillis *et al.* 2001). The mature and older forest stands that are used as breeding habitat by the flammulated owl have changed during the past century due to fire management and timber harvest. Concerns that the narrow habitat requirements of the flammulated owl make it susceptible to populations declines led the State of Oregon to designate the flammulated owl a state-sensitive critical species (Marshall *et al.* 1996). Partners of flight uses the flammulated owl as a focal species for the dry forest habitat type (see section 3.1.3). Flammulated owls were selected as a focal species for the ponderosa pine WHT due to their close association with this habitat type and due to concerns that the reduced abundance of mature ponderosa pine habitat types in the subbasin and across the region may be negatively impacting populations of flammulated owls.

Flammulated owls are entirely insectivores; nocturnal moths are especially important during spring and early summer (Reynolds and Linkhart 1987). As summer progresses and other prey become available, lepidopteron larvae, grasshoppers, spiders, crickets, and beetles are added to the diet (Goggans 1986). The flammulated owl is distinctively nocturnal although it is thought that the majority of foraging is done at dawn and dusk.

Flammulated owl predators include spotted and other larger owls, accipiters, long-tailed weasels (Zeiner et al. 1990), felids and bears (McCallum 1994).

Males arrive on the breeding grounds before females. In Oregon, they arrive at the breeding sites in early May and begin nesting in early June (Goggans 1986). They call to establish territories and to attract arriving females. Birds pair with their mates of the previous year, but if one does not return, they often pair with a bird from a neighboring territory. The male shows the female potential sites from which she selects the one that will be used, usually an old pileated woodpecker or northern flicker hole (Ashley and Stoval 2004).

The laying of eggs happens from about mid-April through the beginning of July. Generally 2 - 4 eggs are laid and incubation requires 21 to 24 days, by female and fed by male. The young fledge at 21 -25 days, staying within about 100 yards of the nest and being fed by the adults for the first week. In Oregon, young fledge in July and August (Goggans 1986). The young leave the nest around after about 25 days but stay nearby. In Colorado, owlets dispersed in late August and the adults in early October (Reynolds and Linkhart 1987).

The flammulated owl occurs mostly in mid-level conifer forests that have a significant Ponderosa pine component (McCallum 1994). In the northern Blue Mountains they typically occur at elevations above 700 meters and below 1,400 meters. Flammulated owls habitat in the subbasin consists primarily of mature to old, open canopy Ponderosa pine, Douglas-fir, and grand fir (Bull and Anderson 1978; Goggans 1986; Powers et al. 1996).   Reductions in mature ponderosa pine habitat have resulted in loss of habitat for this species in Oregon (Marshall et al. 1996, Csuti et al. 2001), Idaho (Engle and Harris 2001), and much of their range.

Flammulated owls are obligate secondary cavity nesters (McCallum 1994), requiring large snags in which to roost and nest. The owls nest primarily in cavities excavated by flickers (Colates spp.), hairy woodpeckers (Picoides villosus), pileated woodpeckers (Dryocopus pileatus), and sapsuckers (Sphyrapicus spp.) (Goggans 1986; McCallum 1994). For 33 nests studied in northeastern Oregon by Bull et al. (1990), 67 percent were created by pileated woodpeckers, 27 percent by northern flickers (Colaptes auratus), and 6 percent by decay. Flammulated owls used pileated woodpecker cavities significantly more than expected based on availability.

In northeastern Oregon, Bull and Anderson (1978) found that Ponderosa pine was an overstory species in 73 percent of flammulated owl nest sites. Powers et al. (1996) reported that Ponderosa pine was absent from their flammulated owl study site in Idaho and that Douglas-fir and quaking aspen (Populus tremuloides) accounted for all nest trees. Flammulated owls will nest only in snags with cavities that are deep enough to hold the birds, and far enough off the ground to be safe from terrestrial predators.

In studies from northeastern Oregon and south central Idaho, nest sites were located 16-52 feet high in dead wood of live trees, or in snags with an average diameter at breast height (DBH) of >20 in. (Goggans 1986; Bull et al. 1990; Powers et al. 1996). Bull et al. (1990) found that stands containing trees greater than 20 in. DBH were used more often than randomly selected stands. Reynolds and Linkhart (1987) suggested that stands with trees >20 in. were preferred because they provided better habitat for foraging due to the open nature of the stands, allowing the birds access to the ground and tree crowns. Some stands containing larger trees also allow more light to the ground that produces ground vegetation, serving as food for insects preyed upon by owls (Bull et al. 1990).

Both slope position and slope aspect have been found to be important indicators of flammulated owl nest sites (Goggans 1986, Bull et al. 1990). In general, ridges and the upper third of slopes were used more than lower slopes and draws (Bull et al. 1990). It has been speculated that ridges and upper slopes may be preferred because they provide gentle slopes, minimizing energy expenditure for carrying prey to nests. Prey may also be more abundant or at least more active on higher slopes because these areas are warmer than lower ones (Bull et al. 1990).

Flammulated owls prefer to forage in older stands because the open crowns and park-like spacing characteristic of these stands permits maneuverability during feeding (USFS 1994b). Grasslands in and adjacent to forest stands are thought to be important foraging sites (Goggans 1986). A pair of owls appears to require about 2-10 acres during the breeding season, and substantial patches of brush and understory to help maintain prey bases (Marcot and Hill 1980). Areas with edge habitat and grassy openings up to 5 acres in size are beneficial to flammulated owls (Howle and Ritcey, 1987) for foraging.

Flammulated owls are present throughout the northern Blue Mountains in appropriate habitat types. The abundance of ponderosa pine stringers adjacent to grasslands habitats in the subbasin indicate good breeding habitat for flammulated owls (USFS 2003c). Not much is known about historical population trends of flammulated owls. Nocturnal call surveys conducted in the early 1990s indicate a state population of less than 1,000 in Idaho. Eleven records of sightings or flammulated owl call backs in the subbasin have been reported to the Idaho Conservation Data Center. Nine of these observations occurred during the nocturnal call surveys conducted in 1991 in the upper portion of the subbasin (Moore and Frederick 1991).Data on flammulated owl populations in the subbasin is insufficient to determine population numbers or trends for the species. Population data are also inadequate for trend assessment at the scale of the western united states, but loss and fragmentation of mature forest habitat suggests that populations are declining (Sauer et al. 2003; NatureServe 2003).

Flammulated owls prefer late seral ponderosa pine forests, activities that alter or remove these habitats pose the greatest threat to the species. Several studies have shown a decline in flammulated owl numbers following timber harvesting (Marshall 1957; Howle and Ritcey 1987). Management practices that remove snags reduce the availability of cavities suitable for nesting and are also a threat (Reynolds et al. 1989). The suppression of wildfires has allowed many ponderosa pines to proceed to the more shade resistant fir forest types, which is less suitable habitat for these species (Marshall 1957; Reynolds et al. 1989; see section 4.2.2)

Aerial spraying of carbaryl insecticides to reduce populations of forest insect pests may affect the abundance of non-target insects important in the early spring diets of flammulated owls (Reynolds et al. 1989).

Flammulated owls come late to breeding grounds, and competition for nest sites may be a factor limiting breeding success (McCallum 1994). Saw-whet owls, screech owls, and American kestrels compete for nesting sites, but flammulated owls probably have more severe competition with non-raptors, such as woodpeckers, other passerines, and squirrels for nest cavities (Zeiner et al. 1990, McCallum 1994). Birds from the size of bluebirds upward are potential competitors. Owl nests containing bluebird eggs and flicker eggs suggest that flammulated owls evict some potential nest competitors (McCallum 1994). The introduced European starling also uses and competes with flammulated owls for flicker cavities. Encouraging the maintenance and growth of pileated woodpecker and northern flicker populations will help maintain high numbers of cavities, thereby minimizing this competition (Zeiner et al. 1990).

White-headed Woodpecker

The white-headed woodpecker (*Picoides albolarvatus*) is a nonmigratory bird that is a year-round resident of lower-elevation ponderosa pine habitats in the subbasin. White-headed woodpeckers have been designated a species of special concern by the state of Idaho, a candidate for listing by the state of Washington, and sensitive by the state of Oregon. They are considered sensitive by Regions 1 and 4 of the USFS and sensitive by the BLM. Partners in Flight uses the white-headed woodpecker as a focal species for ponderosa pine in the Blue Mountains (see section 3.1). White-headed woodpeckers are particularly vulnerable due to their highly specialized winter diet of ponderosa pine seeds (Ashley and Stoval 2004).

White-headed woodpeckers feed primarily on the seeds of large ponderosa pines. This diet makes the white-headed woodpecker quite different from other species of woodpeckers who feed primarily on wood-boring insects (Blood 1997; Cannings 1995). White-headed woodpeckers do use secondary food sources, including insects, mullein seeds, and suet feeders during the spring and summer (Blood 1997; Joy et al. 1995). By late summer, white-headed woodpeckers shift to their exclusive winter diet of ponderosa pine seeds. This dependence is likely the key limiting factor to the white-headed woodpecker's distribution and abundance (Ashley and Stoval 2004).

White-headed woodpeckers are monogamous and may remain associated with their mate throughout the year. They build their nests in old trees, snags, or fallen logs but always in dead wood. Every year, the pair bond constructs a new nest. This construction may take three to four weeks. The nests are, on average, 3 m off the ground. The old nests are used for overnight roosting by the birds (Ashley and Stoval 2004).

The woodpeckers fledge about 3 to 5 birds every year. During the breeding season (May to July), the male roosts in the cavity with the young until they are fledged. The incubation period usually lasts for 14 days, and the young leave the nest after about 26 days. White-headed woodpeckers have one brood per breeding season, and there is no replacement brood if the first brood is lost. The woodpeckers are not very territorial except during the breeding season. They are not especially social birds outside of family groups and pair bonds, and they generally do not have very dense populations (about 1 pair bond per 8 ha) (Ashley and Stoval 2004).

Chipmunks are known to prey on the eggs and nestlings of white-headed woodpeckers. There is also predation by the great horned owl on adult white-headed woodpeckers. However, predation does not appreciably affect the woodpecker population (Ashley and Stoval 2004).

White-headed woodpeckers live in montane, coniferous forests. Studies in Oregon show that abundance of the species is positively associated with increasing abundance of large-diameter ponderosa pines (Marshall et al. 1996) Although most abundant in uncut forest stands, it will utilize areas where forested vegetation treatments provide sufficient densities of ponderosa pine. Closed canopy stands with heavy shrub or young conifer regeneration are less likely to support the species than open stands with 50% or less canopy cover (USFS 2003c). Highest abundances of white-headed woodpeckers occur in old-growth stands (Ashley and Stoval 2004).

The bird excavates its nest cavities in moderately decayed wood, usually in large-diameter snags (USFS 2003c). Generally large ponderosa pine snags consisting of hard outer wood with soft heartwood are preferred by nesting white-headed woodpeckers. In British Columbia, 80% of reported nests have been in ponderosa pine snags, while the remaining 20% have been recorded in Douglas-fir snags. Excavation activities have also been recorded in trembling aspen, live ponderosa pine trees, and fence posts (Cannings et al. 1987, cited in Ashley and Stoval 2004). Breeding territories in Oregon were found to be 104 ha in continuous forest and 321 ha in fragmented forests (Dixon 1995).

Although systematic surveys for this species have not been conducted on the HCNRA, the species is occasionally observed. These observations indicate that white-headed woodpeckers densities are greatest in the southern portion of the subbasin (USFS 2003c). White-headed woodpeckers have also been observed on the Garden Creek Preserve (Neiman 1987, cited in Cassirer 1995). Declines in the availability of mature ponderosa pine have resulted in a severe decline in abundance of this species in the Blue Mountains. Many late/old-structure stands of ponderosa pine still exist in the HCNRA, and this area may provide source habitats for white-headed woodpeckers colonizing adjacent areas (USFS 2003c).

Nesting and foraging requirements are the two critical habitat attributes limiting the population growth of this species of woodpecker. Both of these limiting factors are very closely linked to the habitat attributes contained within mature open stands of ponderosa pine. Past land-use practices, including logging and fire suppression, have resulted in significant changes to the forest structure within the ponderosa pine ecosystem (Ashley and Stoval 2004).

3.5.6 Wetland and Riparian Areas

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 2003b). 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 Snake Hells Canyon subbasin 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 2003b). 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 3.1). The mountain quail was selected as a focal species for this assessment due to the importance of the subbasin in supporting some of the few remaining mountain quail populations in the region and the association of mountain quail with high quality riparian areas.

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 (Brennan 1989, 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). Small numbers have persisted along several tributaries of the Imnaha River, and an additional population has recently been reintroduced to the Imnaha subbasin (Crawford and Pope 1999). Hunting of mountain quail has been banned since 1984 in Idaho and is limited in eastern Oregon (Rocklage and Edelmann 2001).

Mountain quail habitat in relatively arid areas such as the Snake Hells Canyon subbasin 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). Nest sites in the Imnaha subbasin 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 2003b). Mountain quail food-producing shrubs found in the subbasin 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 2003b). 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).

The Snake Hells Canyon subbasin is one of the few areas where populations of mountain quail are thought to persist in the state of Idaho, but recent survey efforts seem to indicate a declining population trend, despite the persistence of apparently high-quality habitat. In 1995, Cassirer conducted a survey of mountain quail and their habitat on Craig Mountain. In the ten years previous to her study, mountain quail observations in Wapshilla, China, Eagle, Dough, and Captain John creeks had been reported to the Idaho Conservation Data Center. However, in 1995, calling surveys were only able to verify the presence of mountain quail in Eagle Creek. Lack of observations in other drainages does not necessarily mean that there are no mountain quail in these areas because calling surveys have low response rates. But response was low enough that it was interpreted to indicate a mountain quail population decline in the area (Cassirer 1995).

As part of the research effort to support the relicensing process for the Hells Canyon Complex, Reese and Smasne (1996) searched for mountain quail in areas studied by Ormiston (1966) in

1964 and 1965. In 1966, mountain quail were relatively abundant in the area, but despite significant effort and the help of Ormiston in relocating his old study areas, mountain quail were not detected. This led Reese and Smasne to conclude that mountain quail have been extirpated from Big Canyon Creek or are present in very low numbers (Reese and Smasne 1996.)

Despite declines, the mountain quail continues to inhabit the subbasin in low densities. The mountain quail was observed in the subbasin in 1996 by IPC personnel at Temperance Creek and at higher elevations above Pittsburg Landing (Turley and Edelmann 2001). In 1996, Craig Johnson of the BLM’s Cottonwood Field Office observed 2 adults and 17 juveniles on a road about 0.9 mile above Getta Creek (IDCDC 2001). In 1998, a local chukar hunting guide observed two groups of more than 20 birds along the Snake River. The first was located just downstream of Cottonwood Creek, and the second was just downstream of Corral Creek (IDCDC 2001). The WDFW lists the mountain quail as a resident at the Chief Joseph Wildlife Area near the confluence of the Snake and Grande Ronde rivers (WDFW 2001).

A lack of suitable habitat does not appear to explain the decline of mountain quail numbers in the Hells Canyon area. A landscape-level assessment of mountain quail habitat in the subbasin indicate scattered but relatively widely distributed patches of high-quality habitat (Rocklage and Edelmann 2001). Vegetation structure and plant species composition suggested that good winter habitat was available in Wapshilla, Eagle, Dough, and Chimney creeks and Pruitt Draw and that suitable breeding habitat was found in Eagle, Dough, Chimney, and Corral creeks and Pruitt Draw. Deer, Birch, and China creeks also appeared to provide good wintering habitat (Cassirer 1995). It is thought that the problem may not be with the availability of habitat but that a lack of connectivity between habitat patches inhibits elevational movements up and down the riparian corridor (A. Sondenaa, Nez Perce Tribe, personal communication, 2003). The subbasin is considered a prime location for further research into the reasons for declining mountain quail populations, mountain quail habitat requirements, and the potential release of individuals for mountain quail reintroduction/augmentation (Cassirer 1995, Reese and Smasne 1996, Rocklage and Edelmann 2001).

Columbia Spotted Frog

The Columbia spotted frog (Rana luteiventris) is olive green to brown in color, with irregular black spots. They may have white, yellow, or salmon coloration on the underside of the belly and legs (Engle 2004). Tadpoles are black when small, changing to a dark and then light brown as they increase in size. Columbia spotted frogs are about 1 inch in body length at metamorphosis (Engle 2004). Females may grow to approximately 100 mm (4 inches) snout-to-vent length, while males may reach approximately 75 mm (3 inches) snout-vent length (Nussbaum et al. 1983, Stebbins 1985, Leonard et al. 1993). The Columbia spotted frog was selected as a focal species for this assessment as a representative or wetland habitats with high water quality.

Populations of Columbia spotted frog are found from Alaska and British Columbia to Washington east of the Cascades; eastern Oregon; Idaho; the Bighorn Mountains of Wyoming; the Mary’s, Reese, and Owyhee river systems of Nevada; the Wasatch Mountains; and the western desert of Utah (Green et al. 1997). Genetic evidence (Green et al. 1996) indicates that

Columbia spotted frogs may be a single species with three subspecies or may be several weakly differentiated species.

The USFWS recognizes four distinct population segments (DPS) of Columbia spotted frog based on disjunct distribution: the Wasatch Front DPS (Utah), West Desert DPS (White Pine County, Nevada, and Toole County Utah), Great Basin DPS (southeast Oregon, southwest Idaho, and north-central/northeastern Nevada), and the Northern DPS (eastern Washington, central and northern parts of Idaho, western Montana, northwestern Wyoming, British Columbia, and Alaska) (J. Engle, personal communication, 2004). There is some uncertainty about whether the Columbia spotted frogs that inhabit the Snake Hells Canyon subbasin are part of the Great Basin or Northern population, and more genetic work will need to be done to clarify the issue.

The USFWS ruled on April 23, 1993, that the listing of the Great Basin population of spotted frog was warranted and designated it as a candidate for listing, but the species was precluded from listing due to higher priority species (Federal Register 58[87]:27260). The species remains a candidate for listing under the ESA. The Columbia spotted frog is listed as sensitive by the state of Oregon and as a candidate for state listing in Washington (see section 3.1.2 and Table 14).

The Columbia spotted frog eats a variety of food including arthropods (e.g., spiders and insects), earthworms, and other invertebrate prey (Whitaker et al. 1982). Adult Columbia spotted frogs are opportunistic feeders and feed primarily on invertebrates (Nussbaum et al. 1983). Larval frogs feed on aquatic algae and vascular plants and scavenged plant and animal materials (Morris and Tanner 1969).

The timing of breeding varies widely across the species range, owing to differences in weather and climate. But the first visible activity begins in late winter or spring shortly after areas of ice-free water appear at breeding sites (Turner 1958, Licht 1975, Leonard et al. 1996). Breeding typically occurs in late March or April, but at higher elevations, breeding may not occur until late May or early June (Amphibia Web 2004). Great Basin population Columbia spotted frogs emerge from wintering sites soon after breeding sites thaw (Engle 2001).

Adults exhibit a strong fidelity to breeding sites, with oviposition typically occurring in the same areas in successive years. Columbia spotted frogs have a strong tendency to lay their eggs communally, and it is not uncommon to find 25 or more egg masses piled atop one another in the shallows (Amphibia Web 2004). After a few weeks, thousands of small tadpoles emerge and cling to the remains of the gelatinous egg masses. Newly hatched larvae remain clustered for several days before moving throughout their natal site (USFWS 2002c). In the Columbia Basin, tadpoles may grow to 100 mm (4 inches) total length prior to metamorphosing into froglets in their first summer or fall. At high-elevation montane sites, however, tadpoles barely reach 45 mm (1.77 inches) in total length prior to the onset of metamorphosis in late fall (Amphibia Web 2004). As young-of-the-year transform, many leave their natal sites and can be found in nearby riparian corridors (USFWS 2002c). After breeding is completed, adults often disperse into adjacent wetland, riverine, and lacustrine habitats (Amphibia Web 2004).

Successful egg production and the viability and metamorphosis of Columbia spotted frogs are susceptible to habitat variables such as temperature, depth, pH of water, cover, and the presence/absence of predators (e.g., fishes and bullfrogs) (Morris and Tanner 1969, Munger et al. 1996). Mortality of eggs, tadpoles, and newly metamorphosed frogs is high, with approximately 5% surviving the first winter (D. Pilliod, personal communication, cited in Amphibia Web 2004).

This species is relatively aquatic and rarely found far from water. It occupies a variety of still-water habitats and can also be found in streams and creeks (Hallock and McAllister 2002). Columbia spotted frogs are found in aquatic sites with a variety of vegetation types, from grasslands to forests (Csuti 1997). A deep silt or muck substrate may be required for hibernation and torpor (Morris and Tanner 1969). Reproducing populations have been found in habitats characterized by springs, floating vegetation, and larger bodies of pooled water (e.g., oxbows, lakes, stock ponds, beaver-created ponds, seeps in wet meadows, backwaters) (IDFG et al. 1995, Reaser 1997). Vegetation in the breeding pools is generally dominated by herbaceous species such as grasses, sedges (*Cares* spp.) and rushes (*Juncus* spp.) (Amphibia Web 2004).

Populations of spotted frogs have declined in many areas of their range, and remaining populations tend to be smaller and more isolated than those found historically (see Paul 2004 for details). Population trends were unavailable for the species in the Snake Hells Canyon subbasin, but suitable habitat is well distributed and Columbia spotted frogs have been observed in numerous locations. During surveys of Craig Mountain conducted by Llewellyn and Peterson (1998), spotted frogs were the most commonly observed amphibian. In 1994, over 280 spotted frog adults and 23 pond breeding sites were found at upper-elevation sites in the Craig Mountain area. In July 1995, spotted frog tadpoles were located along the side channels of the Snake River near Craig Mountain. This use was unexpected and occurred at a lower elevation than where Columbia spotted frogs are typically thought to breed. Spotted frogs have also been found in the lower reaches of Deer, Eagle, Captain John, and Maloney creeks. It is hypothesized that frogs use these areas for foraging resting and dispersing but not breeding (Llewellyn and Peterson1998). Suitable habitat for Columbia spotted frog occurs in the Oregon portion of the HCNRA, but use has not yet been well documented (USFS 2003b).

Fragmentation of habitat is considered one of the most significant barriers to spotted frog recovery and population persistence. Recent studies in Idaho indicate that spotted frogs exhibit breeding site fidelity (Patla and Peterson 1996; Engle 2000; Engle and Munger 2000; J. Engle, IDFG, personal communication, 2001). Movement of frogs from hibernation ponds to breeding ponds may be impeded by zones of unsuitable habitat. As movement corridors become more fragmented due to loss of flows within riparian or meadow habitats, local populations will become more isolated (Engle 2000, 2001). Vegetation and surface water along movement corridors provide relief from high temperatures and arid environmental conditions, as well as protection from predators. Loss of vegetation and/or lowering of the water table can pose a significant threat to frogs moving from one area to another. Likewise, fragmentation and loss of habitat can prevent frogs from colonizing suitable sites elsewhere (USFWS 2002c).

Columbia spotted frog habitat fragmentation and degradation can result from land-use activities, including livestock grazing, spring development, agricultural development, urbanization, and mining activities. These activities eliminate vegetation necessary to protect frogs from predators and UV-B radiation; reduce soil moisture; create undesirable changes in water temperature, chemistry and water availability; and can cause restructuring of habitat zones through trampling, rechanneling, or degradation, which in turn can negatively affect the available invertebrate food source (IDFG et al. 1995, Munger et al. 1997, Reaser 1997, Engle and Munger 2000, Engle 2002).

The reduction of beaver populations has also been noted as an important feature in the reduction of suitable habitat for spotted frogs. Other threats to Columbia spotted frog include predation by fishes, bullfrogs, disease, and prolonged drought.

3.5.7 Open Water

Bald Eagle

This Section draws heavily from the species description prepared by Keith Paul (2004). Please see http://www.nwcouncil.org/fw/subbasinplanning/ for additional information on bald eagle biology.

The bald eagle (*Haliaeetus leucocephalus)* was first protected in the lower 48 states by the Bald Eagle Protection Act of 1940; it was federally listed as endangered in 1967. In 1995, the bald eagle was reclassified as threatened in all of the lower 48 States. No critical habitat has been designated for the bald eagle (USFWS 2003c). In 1963, a National Audubon Society survey reported only 417 active nests in the lower 48 states. In 1994, about 4,450 occupied breeding areas were reported (USFWS 2003c). Due to positive trends like this the bald eagle was proposed for delisting on July 6, 1999; a decision on whether to delist the bald eagle is pending (64 FR 36453). The bald eagle is listed as threatened by the states of Oregon and Washington; and are listed as endangered in Idaho (Table 12).

The bald eagle historically ranged throughout North America except extreme northern Alaska and Canada and southern Mexico. Bald eagles can be resident year-round where food is available; otherwise they will migrate or wander to find food. In Oregon, historic bald eagle nests have been documented in 32 of 36 counties. Those counties where historic breeding records did not occur include Sherman, Gilliam, Morrow, and Malheur counties (Isaacs and Anthony 2001). The current range in the lower 48 states has been divided into five recovery areas: Chesapeake Bay, Pacific, Southeastern, Northern States, and Southwestern (USFWS 2003c). The Snake Hells Canyon subbasin lies within the Pacific recovery area.

A recovery plan for the Pacific population of the bald eagle was completed in 1986. The plan identifies the following de-listing goals which are necessary to obtain a self-sustaining population of bald eagles: 1) a minimum of 800 nesting pairs with an average reproductive rate of one fledged young per pair and an average success rate per occupied site of not less than 65 percent over a five-year period, 2) attainment of breeding population goals should be met in at least 80 percent of the management zones, 3) wintering populations should be stable or increasing (USFWS 2003c).

The Pacific recovery area was divided into zones, and the Snake Hells Canyon subbasin is part of the Snake River zone. Recovery goals for the Snake River zone are to: 1) locate, monitor, and protect nesting, roosting, and feeding areas, 2) develop nest site plans for nesting and roost areas, 3) monitor productivity, 4) prevent significant habitat disturbance and direct human interference at nest sites and feeding areas, and 5) re-establish six breeding pairs (USWFS 2003c).

[Bald eagles consume a variety of prey that varies by location and season. Prey are taken alive, scavenged, and pirated (Frenzel 1985, Watson et al. 1991). Fish were the most frequent prey among 84 species identified at nest sites in south-central Oregon, and a tendency was observed for some individuals or pairs to specialize in certain species (Frenzel 1985). Wintering and migrant eagles in eastern Oregon fed on large mammal carrion, especially road-killed mule deer, domestic cattle that died of natural causes, and stillborn calves, as well as cow afterbirth, waterfowl, ground squirrels, other medium-sized and small rodents, and fish. Proportions varied by month and location. Food habitats are unknown for nesting eagles over much of the state (Isaacs and Anthony 2003a) (Paul 2004)]. Reductions in anadromous fish runs are considered a factor limiting the use of the Snake Hells Canyon subbasin by bald eagles (USFS 2003b).

Bald eagles are most abundant in the subbasin in late winter and early spring, because resident breeders (engaged in early nesting activities), winter residents, and spring transients are all present. Nest building and repair occur any time of year, but most often observed from February to June (Isaacs and Anthony unpublished data). Bald eagles are territorial when breeding but gregarious when not (Stalmaster 1987). The size and shape of a defended breeding territory varies widely (1.6 to 13 square miles) depending upon the terrain, vegetation, food availability, and population density of an area (USFWS 2003c). Bald eagles exhibit strong nest-site fidelity (Jenkins and Jackman 1993. Both sexes build the nest, incubate eggs, and brood and feed young (Stalmaster 1987). Egg laying (1-4 eggs) occurs mid-February to late April; hatching late March to late May (after about 35 days of incubation); and fledging late June to mid-Aug (Isaacs and Anthony 2003a). After a month of continued partial parental care the young eagles are on their own, mortality rates tend to be highest in young eagles and can be caused by disease, food shortages, bad weather, or human interference (USFWS 2003c). During the nest building, egg laying and incubating periods, eagles are extremely sensitive and will abandon a nesting attempt if there are excessive disturbances in the area during this time (USFWS 2003c).

Bald eagles nest in forested areas near the ocean, along rivers, and at estuaries, lakes, and reservoirs (Isaacs and Anthony 2001). Eighty-four percent of Oregon nests were within 1 mi (1.6 km) of water (Anthony and Isaacs 1989). Nest sites in forested areas show a strong preference to multi-layered, mature forest stands. Eagles usually nest in mature conifers with gnarled limbs that provide ideal platforms for nests. Ponderosa pine, Douglas fir, and black cottonwood are preferred nest trees in the Pacific recovery area (USFS 2003b).

Wintering eagles in the Pacific Northwest perch on a variety of substrates; proximity to a food source is probably the most important factor influencing perch selection by bald eagles. Favored perch trees are invariably located near feeding areas, and eagles consistently use preferred branches (Stalmaster 1976). Most tree perches selected by eagles provide a good view of the surrounding area (Servheen 1975, Stalmaster 1976), and eagles tend to use the highest perch sites available (Stalmaster 1976; USFWS 1986). Nearly all bald eagles observed in the Craig mountain area were perched in mature ponderosa pine trees along the Salmon and Snake rivers (Cassirer 1995). Dead trees are used by eagles in some areas because they provide unobstructed view and are often taller than surrounding vegetation (Stalmaster 1976). Isolation is also an important feature of bald eagle wintering habitat. In Washington, 98% of wintering bald eagles tolerated human activities at a distance of 300 m (328 yards) (Stalmaster and Newman 1978). However, only 50% of eagles tolerated disturbances of 150 m (164 yards) (USFWS 1986).

Habitat requirements for communal night roosting are different form those for diurnal perching. Communal roosts are invariably near a rich food resource and in forest stands that are uneven-aged and have at least a remnant of the old-growth forest component (Anthony et al. 1982). Close proximity to a feeding area is not the only requirement for night roosting sites, as there are minimum requirements for forest stand structure. In open areas, bald eagles also use cottonwoods and willows for night roosting (Isaacs and Anthony 1983). Most communal winter roosts used by bald eagles offer considerably more protection from the weather than diurnal habitat. Roost tree species and stand characteristics vary considerably throughout the Pacific Northwest (Anthony et al 1982) (USFWS 1986) (Paul 2004)].

The Snake Hells Canyon subbasin is known to provide winter foraging habitat for bald eagles (BLM 2002, USFS 2003b). Bald eagle monitoring has been conducted in the subbasin since 1979. Bald eagle counts over the last 20 years on the Snake River from the mouth of the Grande Ronde River to Temperance Creek have averaged 8.4 and ranged from 3 in 1989 to 18 in 1998, with a generally increasing trend (USFS 2003b). Count data from the lower Hells Canyon area (from the Grande Ronde River to the Clearwater River) also show an increasing trend (+8.47%), with an average of 2.4 birds observed per year (USGS 2003). Bald eagle counts are consistently lower on the Snake River than in adjacent areas with suitable habitat. Craig Johnson, BLM biologist, rated the foraging quality of the analysis area as fair to low fair. His conclusion was primarily due to low and potentially insufficient food availability. This conclusion is supported by the fact that bald eagles were found to concentrate below Hells Canyon Dam to feed on fish that had passed through the turbines (USFS 2003b).

The Snake River corridor is considered marginal potential nesting habitat due to limited forage and the rarity of large trees. Recent surveys have not detected any bald eagle nests within the subbasin (Cassirer 1995, USFS 2003b). One historical bald eagle nest has been reported in the subbasin near the mouth of Captain John Creek (Cassirer 1995). In 1999, a bald eagle nest was located along the Hells Canyon Reservoir just upstream of the subbasin (lower Middle Snake subbasin). A pair of eagles has occupied the nest for the last four years. The presence of this nest lowers the probability of a pair establishing within the Snake Hells Canyon subbasin due to competition for a limited food base (USFS 2003b). The general trend for nest sites located in Oregon has continued on a steady increase and now exceeds the recovery goal. Bald eagles are currently being considered for delisting by the USFWS. Monitoring of potential bald eagle nest sites along the Snake River corridor is conducted at least once a year during the nesting season by biologists from BLM, IPC, and the Payette and Wallowa-Whitman National Forests (USFS 2003b).

The status and distribution of bald eagle populations in the decades before World War II are poorly understood. Declines probably begin in some populations in the 19th century (USFWS 1986). By 1940, the bald eagle had “become rather an uncommon bird” except along the coast and Columbia River, and in Klamath Co. (Gabrielson and Jewett 1940). Habitat loss (cutting of nest trees) and direct persecution (shooting, trapping, poisoning), probably caused a gradual decline prior to 1940. However, the major factor leading to the decline and subsequent listing of the bald eagle was disrupted reproduction resulting from contamination by organochlorine pesticides, particularly DDT (USFWS 2003c).

Between 1945 and 1974 over 4.5 million acres (1.8 million ha) of National Forest in Oregon were sprayed with DDT an agricultural pesticide, (Henny and Nelson 1981). Undocumented quantities were also applied on private forests and agricultural crops, and for mosquito control around municipalities. In the late 1960s and early 1970s, it was determined that dichorophenyl-dichloroetheylene (DDE), the principal breakdown product of DDT, accumulated in the fatty tissues of adult female eagles. It impaired calcium release necessary for egg-shell formation, thus inducing thin-shelled eggs that are not viable, leading to reproductive failure (USFWS 2003c). The deleterious effects of DDT on reproduction (Stalmaster 1987) joined habitat loss and direct persecution as causes of decline through the early 1970's when the population may have reached its historical low. By then, nesting pairs were extirpated in northeastern Oregon (Isaacs and Anthony 2001), where applications of DDT on National Forest land were common and widespread (Henny and Nelson 1981) (Isaacs and Anthony 2003a). On December 31, 1972, DDT was banned from use in the United States (USFWS 2003c).

Loss of habitat, loss of prey and human disturbance are the greatest current threats to bald eagle populations. Actions identified by the Wallowa-Whitman National Forest and currently being implemented in portions of the subbasin that should result in continued improvement in bald eagle habitat include; implementation of management standards for livestock grazing to improve riparian conditions, maintaining snags to provide perches and/or nest trees, restoring fire regimes to maintain large tree species preferred by bald eagles like ponderosa pine and Douglas fir that respond to periodic burns, and continued efforts to protect and restore anadromous fish runs (USFS 2003b). Further development and expansion of these strategies is contained in the Imanha Subbasin Management Plan.

3.5.8 Agriculture, Pastures, and Mixed Environs

Mule Deer

Rocky Mountain mule deer (*Odocoileus hemionus)* are native to the Snake Hells Canyon subbasin and occupy a wide range of habitats. Mule deer are primarily browsers, so most of their diet comprises leaves and twigs of shrubs and trees, particularly during the winter. In the spring and summer, grass and forbs are also an important dietary component (IDFG 2003d). Winter range is a key component of mule deer habitat. Shrub species—including antelope bitterbrush (*Purshia tridentata*), rabbitbrush (*Ericameria* and *Chrysothamnus* spp.), juniper, and mountain mahogany (*Cercocarpus* spp.) that have a high fat content—provide critical nutrition in the critical winter months. Thermal cover, to reduce energy loss, and southfacing slopes, which collect less snow, are also important winter range components. As discussed in the earlier section about elk (see section 3.5.3), the subbasin has been recognized as having some of the most crucial big game winter habitat in the region. Deer and elk persist throughout much of the surrounding area based on the capacity of the Snake River Canyon to provide winter range and support these populations. Noxious weeds, human access, domestic livestock competition, depredation, public land availability, and social carrying capacity have been identified as important factor factors impacting mule deer winter range in the area (Christensen 2001).

The species was chosen as a focal species for the agriculture, pastures, and mixed environs WHT because complaints of mule deer foraging in and damaging agricultural areas is one of the primary factors limiting mule deer population objectives in the area. Oregon's green forage program was created in 1983 to assist landowners who are experiencing damage caused by wildlife and to increase social carrying capacity. The objective of the green forage program is to alleviate or prevent big game damage on private lands while benefiting wildlife by improving forage quality and quantity on public or private lands (ODFW 2001).

Mule deer populations fluctuate in response to both natural and human-influenced factors. Drought conditions reduce forage and cover values, while severe winter weather conditions can result in large losses of deer. Both conditions can cause poor deer condition and result in lower deer survival (ODFW 2001). Changes in habitat also affect mule deer populations. Mule deer are thought to have been less abundant throughout the west prior to European settlement. Historical conditions favored grassland communities and animals such as bighorn sheep and elk. Overgrazing by livestock in the late 1800s and early 1900s resulted in rangelands that were dominated by shrubs and forb species more favorable for deer, and populations increased.

The subbasin contains parts of nine game/wildlife management units in three states. The ODFW manages mule deer in the Chesnimnus, Snake River, and Pine Creek Wildlife Management Units as part of its Wallowa District. The IDFG is responsible for the management of mule deer in Game Management Units 22, 18, 13, 11. The WDFW manages deer in the Couse 181 and Grande Ronde 186 units.

Mule deer population estimates for the Wallowa District have been below the ODFW management objective of 26,800 for many years. Mule deer populations in the area have trended upward for the last five years, from a low of 17,400 in 1996 to 20,000 in 2001 (ODFW unpublished data). Mule deer populations in Washington were also low for many years but are now improving slowly due to recent good forage conditions and mild winters resulting in minimal overwinter mortality and excellent fawn production and survival. The CRP is also credited with increasing deer populations. Asotin County has 40,100 acres enrolled in the program. These large areas of continuous habitat provide excellent forage and fawning areas where little existed before (WDFW 2001).

3.5.9 Caves

Townsend's Western Big-Eared Bat

Townsend's western big-eared bat *(Corynorhinus townsendii townsendii*) is the most abundant of the subspecies of big-eared bats. Two eastern subspecies—the Ozark big-eared bat (*Corynorhinus townsendii ingens*) of Missouri, Oklahoma, and Arkansas and the Virginia big-eared bat (*C. t. virginianus*) of Kentucky, West Virginia, and Virginia—are listed by the USFWS as endangered(NatureServe 2003). The range of the western subspecies encompasses Oregon, Washington, Idaho, Nevada, and California (NatureServe 2003). Population numbers for the western subspecies are also considered very low and decreasing or stable in numbers (USFS 2003c). The Townsend's western big-eared bat has been designated as a species of concern by the state of Idaho, a candidate by the state of Washington, and sensitive-vulnerable by the state of Oregon. It is considered a sensitive species by Regions 1, 4, and 6 of the USFS and BLM (see section 3.1 for details). Townsend's western big-eared bats were chosen as a focal species for this assessment to represent the rare habitat feature of caves, which occur in the Snake Hells Canyon subbasin and support big-eared and many other species of bats.

Townsend’s western big-eared bat activity usually begins well into the night, late relative to other bats. After an initial feeding period, the bat roosts and rests before a later feeding bout (NatureServe 2003). Townsend’s western big-eared bat feeds on various flying insects near the foliage of trees and shrubs; the species relies heavily on moths (Barbour and Davis 1969).

Townsend’s western big-eared bat mating begins in autumn and continues into winter. Ovulation and fertilization are delayed until late winter/early spring. Gestation lasts 2 to 3.5 months, and a litter of one is born in late spring/early summer The young can fly at 2.5 to 3 weeks and are weaned by 6 weeks. Females are sexually mature their first summer, but males are not sexually active until their second year. Females commonly form nursery colonies, generally of up to about 200 (Handley 1959). Individuals generally return to the same maternity roost in successive years (NatureServe 2003).

Townsend’s western big-eared bat maternity and hibernation colonies are typically found in caves and mine tunnels. The species does not use crevices or cracks but rather hangs from the ceiling, generally near the zone of total darkness (Schmidly 1991). It commonly occurs in mesic habitats characterized by coniferous and deciduous forests (Kunz and Martin 1982). Similar species to the Townsend’s western big-eared bat find habitat beneath the bark or in cavities of large-diameter trees (Gellman and Zielinski 1993). The potential for this type of habitat use in the subbasin is currently being studied on the Wallowa-Whitman National Forest. Bats are known to use snags as day roost habitat.

Temperature is a critical factor in selection of the habitat areas used by this species. Caves and mine shafts used for hibernation in winter are cold and generally close to freezing. These bats do not migrate south but may migrate to lower elevations in the Snake Hells Canyon subbasin in the winter. Natural vegetation around cave openings is also very important since it provides a thermal buffer keeping the caves cooler on hot days and warmer in old weather. Maintaining stable temperatures is very important to this species. Known habitat areas should contain buffers of uninterrupted tree and/or shrub canopy (where possible) of 100 feet in order to maintain shelter, foraging, and linkage habitats (USFS 2003c).

Townsend’s big-eared bats have been monitored on the HCNRA from 1984 to the present. One of the six significant maternity colonies of Townsend’s big-eared bats in Oregon occurs within the subbasin, as well as abundant foraging and hibernating habitat. Recent population decreases of nearly 50% have been recorded at two sites along the Snake River corridor (USFS 2003c).

Elimination of human disturbance in nursery and hibernation habitat is considered key to maintaining Townsend’s western big-eared bat populations (and other bat species) in the subbasin. Gating known habitat areas is an effective way to reduce these impacts. Eleven gates are now in place in Hells Canyon. All known areas with bat use and human disturbance are now gated the entire year. This gating will provide protection for Townsend’s big-eared bats during critical hibernaculums and maternity periods. An increase in population numbers is anticipated (USFS 2003c).

3.5.10 Environmental Conditions for Focal and Concern Species

Characterizing the overall habitat requirements of a wildlife species requires the consideration of three interrelated elements: the cover type (or WHTs), structural conditions, and environmental correlates. These features should be viewed as hierarchical in nature, with WHTs occurring at the broadest scale, structural conditions occurring at the stand level, and environmental correlates occurring at a site-specific or local level (Johnson and O'Neil 2001). This section evaluates the elements of habitat most important to the sensitive species in the subbasin. The technical team felt that, while the focal species they selected were good species to use to focus discussions of the issues and habitat concerns of the subbasin, a broader group should be used when identifying important habitat elements for management consideration. For this reason, wildlife species designated as federal or state threatened or endangered, state sensitive, BLM sensitive, USFS sensitive, or Partners in Flight focal species were also included in the following habitat association analysis. This group of 105 species are collectively referred to as "concern species" in the following discussion.

Wildlife Habitat Types

The WHTs and their general vegetative species composition were introduced in section 1.4. As described in section 1.7, land-use activities and human alterations to ecological processes have altered the distribution, distribution, and composition of these WHTs. These changes have influenced the composition and population dynamics of the wildlife communities dependent on the WHTs. Unfortunately, the paucity of historical records and issues of scale make quantifying these changes difficult, and estimates of change should be viewed cautiously. The best attempt at quantifying changes in the distribution of WHTs in the subbasin has been conducted by the Northwest Habitat Institute, and its data are presented in Table 32. Maps showing historical and current distributions of WHTs visible at the scale of the subbasin are shown in Appendix A.

Table 32. Changes in the abundance of WHTs in the Snake Hells Canyon subbasin (modified from NHI 2003)

Habitat Type	Historic (acres)	Current (acres)	Change (acres)	Change (percent)
Montane mixed conifer forest	16,353	33,483	17,130	105
Eastside mixed conifer forest	38,166	115,175	77,009	202
Lodgepole pine forest and woodlands	11,346	1,154	–10,192	–90
Ponderosa pine and woodlands	46,440	110,806	64,366	139
Alpine grasslands and shrublands	0	10,309	10,309	—
Western juniper and mountain mahogany woodlands	0	270	270	—
Subalpine parklands	11,204	0	–11,204	–100
Eastside grasslands (includes shrub-steppe)	422,704	239,834	–182,870	–43
Agriculture, pasture, and mixed environs	0	29,956	29,956	—
Urban and mixed enviorns	0	7,743	7,743	—
Lakes, rivers, ponds, and reservoirs	1,236	3,468	2,232	181
Herbaceous wetlands	0	55	55	—
Eastside riparian wetlands	4,806	0	–4,806	–100

The degree of impact changes in the availability of a WHT will have on a particular species depends on the degree of association a species has with the WHT. A species known to depend on a habitat for part or all of its life history requirements is considered closely associated with that WHT. A species identified as having a close association with a WHT has an essential need for this habitat for its maintenance and viability. Some species may be closely associated with more than one WHT during different times of the year or for different activities. Some species are not closely associated with any WHT but are rather generally associated with a number of WHTs. In this case, the WHTs play a supportive role in the species maintenance and viability, but the species may be more dependent on a particular structural condition (see information about structural condition below; Johnson and O'Neil 2001).

The WHTs that Snake Hells Canyon subbasin concern species were closely associated with during any life stage are displayed in Figure 45. A species may be closely associated with more than one WHT or with a WHT that does not occur in the subbasin. The open water, herbaceous wetland and montane conifer forest WHTs have the greatest total number of closely associated species (Figure 45). Therefore, alterations in these WHTs are likely to have the most widespread impacts on the ecosystem of the subbasin. The broad-scale historic and current WHT data displayed in Table 32 indicate that the abundance of these WHTs has increased within the subbasin. If the availability of habitat were the only factor influencing populations of the wildlife species closely associated with these habitats, their populations could be expected to have increased. However, as illustrated in section 3.5, this is not always the case. Many of the species dependent on these WHTs have experienced population declines, which can be partially explained by the influence of structural condition and habitat elements on wildlife habitat (discussed in the following section), as well as by out-of subbasin conditions (see section 4.2.1).

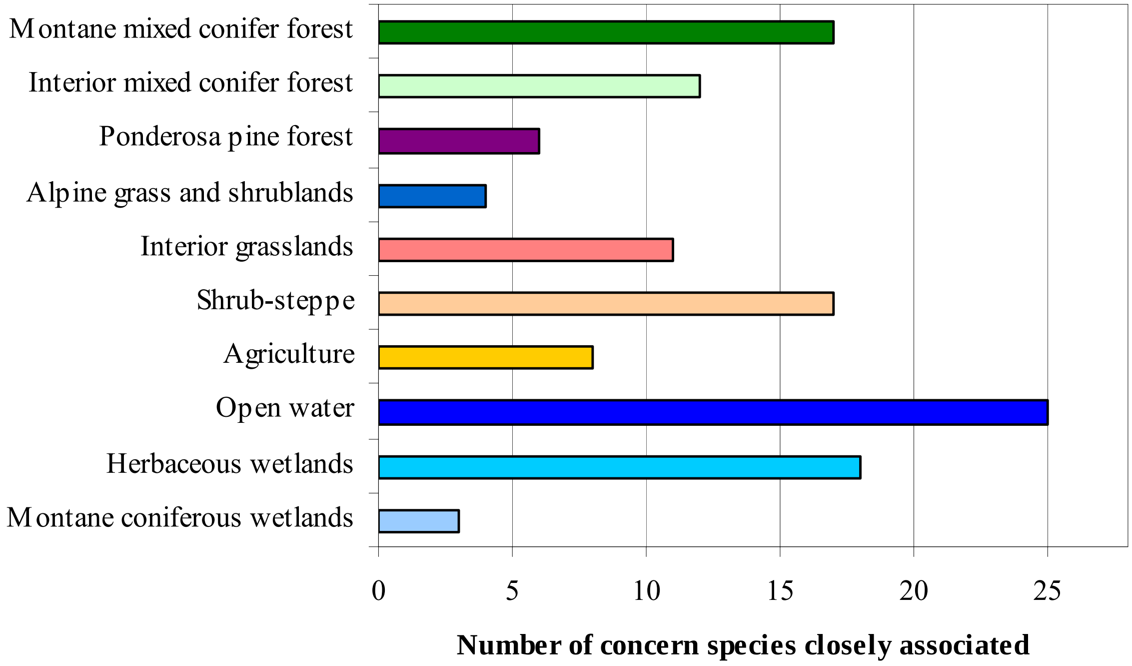


Figure 45. WHTs concern species of the Snake Hells Canyon subbasin are closely associated with.

Table 32 indicates that declines in the availability of the lodgepole pine, subalpine parklands, eastside grasslands, and riparian wetland WHTs have occurred in the subbasin. Some of these changes are likely the result of differences in the spatial scale and mapping techniques at which the historic and current WHT maps were compiled. For instance, subalpine parkland habitats in the subbasin may have declined slightly as a result of fire suppression in higher elevation habitats, but subalpine parkland habitats are still present in the subbasin and have not experienced the dramatic decline indicated by Table 32. Similarly, although riparian wetlands in the subbasin are reduced in extent and quality, they are still present.

Discussions with biological resource experts, as well as review of subbasin-specific literature and results of regional assessments, indicate that the reductions shown for riparian wetlands and interior grasslands are likely the most significant. These habitat types have declined in extent and quality in the subbasin, with impacts to the wildlife species that depend on them. For this reason, degradation and reductions in the extent of these types are considered to be among the primary limiting factors to wildlife in the subbasin. Additionally, declines in ponderosa pine (particularly mature types) have been shown to have occurred in the subbasin by finer-scale analysis conducted by the Cottonwood Field Office of the BLM (2002). Therefore, reduction in mature ponderosa pine habitats was also identified as one of the major limiting factors in the subbasin. See section 4.2.2 for a more detailed discussion of these limiting factors; see also the management plan for objectives and strategies aimed at reducing the impact of these limiting factors on the wildlife populations of the subbasin.

Structural Condition

Structural condition is another important feature determining the use of a habitat by a wildlife species. As with WHTs, a species widely known to depend on a structural condition for part or all of its life history requirements is considered closely associated with that structural condition. A species identified as having a close association with a structural condition has an essential need for this habitat for its maintenance and viability. Grassland, forest, agricultural, and urban habitats all exhibit structural conditions that influence wildlife habitat use. Due to the relatively small amount of agricultural and urban habitats contained in the subbasin, the relatively small number of closely associated species (eight for agriculture but none for urban), and time constraints, wildlife use of different structural conditions in these WHT was not considered.

Forest

Forest structural conditions are based on the following attributes: 1) tree size diameter at breast height, 2) percent canopy cover (or percent grass/forb cover), and 3) number of canopy layers. Johnson and O’Neil (2001) defined 26 different classes of forest structure conditions based on the attributes described in Table 33. Appendix E contains detailed descriptions of the characteristics of the forest structure classes.

Table 33. Attributes used to differentiate forest structure classes (Johnson and O’Neil 2001).

Tree Size (dbh)	
Shrub/Seedling	<1”
Sapling/Pole	1–9”
Small Tree	10–14”
Medium Tree	15–19”
Large Tree	20–29”
Giant Tree	≥30”

Percent Canopy Cover	
Open	10–39%
Moderate	40–69%
Closed	70–100%

Number of Canopy Layers	
Single Story	1 stratum
Multistory	2 or more strata

Twenty-two of the concern species with habitat in the subbasin are closely associated with a forest structural condition for a life activity (Figure 46). All of these species were closely associated with more than one structural condition. In general, the greatest number of species were closely associated with large to giant-sized class forests or early seral structural conditions, but concern species were closely associated with all of the structural conditions (Figure 46). This association illustrates the importance of maintaining a diversity of structural conditions on the landscape.

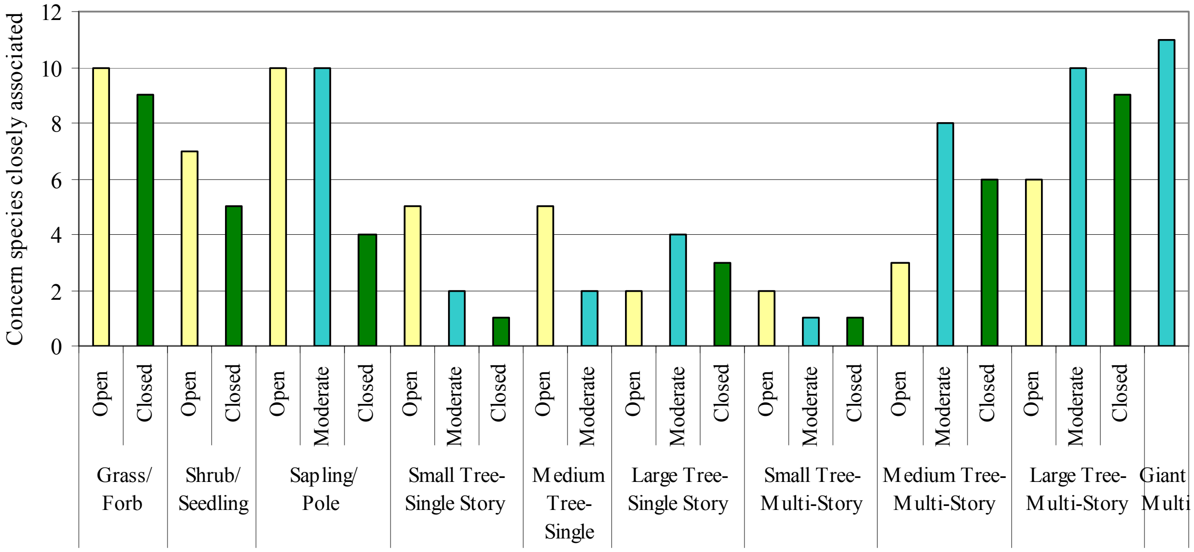


Figure 46. Number of concern species closely associated with forest structural conditions.

Grassland

Grassland structure is determined by 1) shrub height, 2) percent shrub cover (or percent grass/forb cover), and 3) shrub age class. Johnson and O’Neil (2001) defined 20 different classes of grassland structural conditions based on the attributes described in Table 34.

Appendix E contains more detailed descriptions of the characteristics of the grassland structure classes.

Table 34. Attributes used to differentiate grassland structure classes (Johnson and O’Neil 2001.

Shrub Height	
Low	≤1.6 ft
Medium	1.6–6.4 ft
Tall	6.5–16.5 ft

Percent Shrub Cover	
Open	10–69% shrub cover
Closed	70–100% shrub cover

Shrub Age Class	
Seedling/Young	negligible crown decadence
Mature	≤25% crown decadence
Old	26–100% crown decadence

Nineteen of the concern species are closely associated with a grassland structural condition for a life activity (Figure 47). Most of these species were closely associated with more than one structural condition. The greatest number of species were closely associated with grass/forb areas without shrubs. However, concern species were closely associated with a wide variety of grassland structural conditions (Figure 47). Maintaining a diversity of structural conditions and mimicking the natural pattern of distribution to which wildlife species have adapted should be the goal.

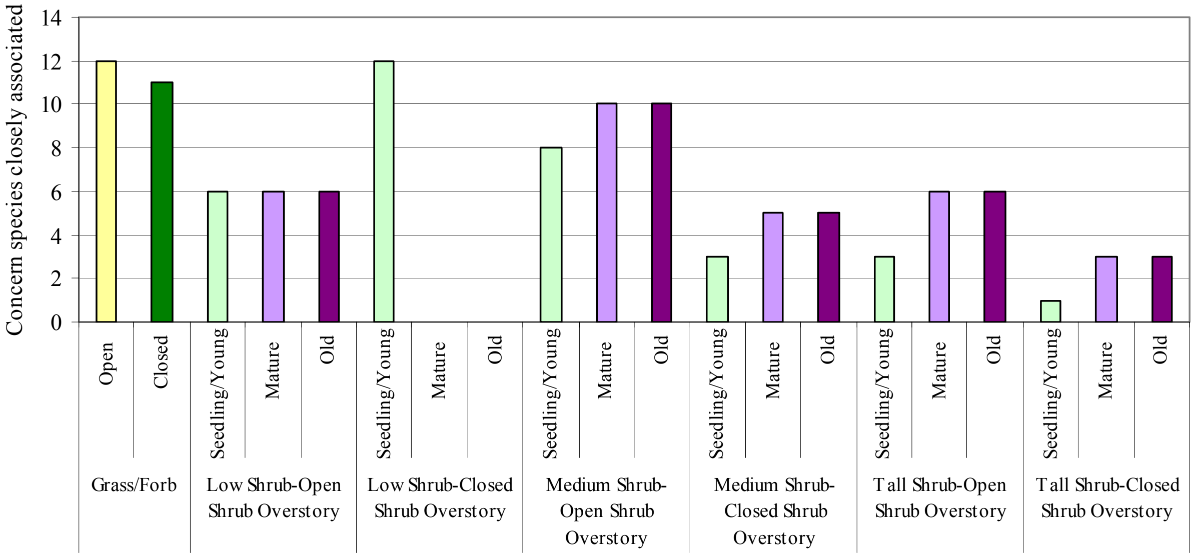


Figure 47. Number of concern species closely associated with grassland structural conditions.

Comparison of historic and current availability of structural conditions

Historic range of variability (HRV) is defined as the natural fluctuation of ecological and physical processes and functions that would have occurred in an ecosystem during a specified previous period of time. The Wallowa-Whitman National Forest has developed an HRV for the subbasin and surrounding area that identifies a range of forest structural stages that was likely to have occurred prior to Euro-American settlement of northeastern Oregon (approximately 1850) (USFS 2003a).

Table 35. Historic range of variability for forested structural stages by biophysical environment.

Biophysical Environment Groups	**Structural Stage (%)**			
	Very early	**Early**	**Mid**	**Late**
Group 1—Alpine fir and lodgepole pine cool-cold/moist	1-10 (10)	5-25 (10)	5-70 (45)	5-70 (35)
Group 2—Alpine fir and lodgepole pine cold/dry	1-10 (10)	5-25 (10)	5-70 (45)	5-70 (35)
Group 3—Alpine fir and lodgepole pine cool/dry	1-10 (10)	5-25 (20)	5-50 (40)	5-60 (30)
Group 4—Grand fir cool/dry	1-10 (10)	5-50 (15)	5-50 (50)	5-60 (25)
Group 5—Douglas-fir warm/dry	1-15 (10)	5-25 (15)	5-55 (50)	5-55 (25)
Group 6—Douglas-fir warm/moist	1-15 (10)	5-25 (15)	10-55 (45)	5-55 (30)
Group 7—Ponderosa pine hot/dry	1-15 (10)	5-25 (15)	5-70 (45)	5-70 (30)
Group 8—Ponderosa pine hot/moist	1-15 (10)	5-25 (15)	5-70 (40)	5-50 (35)

The Wallowa-Whitman National Forest has conducted comparisons of the current structure of portions of the subbasin's forests to the historic range at the scale of a 5th field HUC. Those seral/structural stages determined to be in excess of the HRV by biophysical environment for the watershed were identified as potentially available for treatment. Further analysis on these potentially available acres identified the number of acres having the highest risk for insect and disease infestations as well as those at greatest risk for high-intensity fire. This comparison allowed for vegetative treatment recommendations in the *Hells Canyon National Recreation Area Comprehensive Management Plan*. Comparisons of current data to the HRV were available for two 5th field watersheds in the subbasin: the Snake River Pittsburg watershed and the Snake River Rogersburg watershed. Analysis was conducted in the USFS Management Areas (MAs) where vegetative treatment is permissible. The analysis of the Snake River Rogersburg watershed was combined with two other watersheds that lie outside the subbasin, but conditions are considered to be relatively uniform. Analysis for the other 5th field HUC that falls within the HCNRA, Snake River–Hat Point, is planned within the next couple of years (USFS 2003a). The amount of late/old-structure forest was found to be below the historic range of variability on the Snake River Pittsburg watershed (Table 36). Late/old-structure forests in both watersheds were found to be highly susceptible to insects and disease as a result of forest densities and species composition. Both watershed's mid-seral structures substantially exceeded the HRV and were very susceptible to insects and disease. Comparisons of young sapling areas to the HRV were not conducted, but both watersheds had fewer than 3,000 acres (Table 36).

Table 36. Comparison of current vegetative structure to the historic range of variability for two watersheds in the upper Snake Hells Canyon subbasin (based on USFS 2003a).

Forested Vegetation Structure and Condition	**Snake River-Pittsburg** (MAs 4, 9,11,12)	**Lower Imnaha, Upper Joseph, Snake River-Rogersburg** (MAs 9,10,11)
Total acres late/old structure:	3,640	8,830
Acres of late/old structure in excess of HRV	–3,200	1,650
Acres of late/old highly susceptible to insects and diseases	1,735	2,125
Total acres of early/late to mid-structure:	16,800	16,300
Acres of early/ late to mid-structure in excess of HRV	4,425	2,450
Acres of early/ late to mid-structure highly susceptible to insects and diseases	6,220	1,950
Total acres of young saplings:	2,060	2,900
Acres of young saplings needing precommercial thinning	2,060	2,900

Key Environmental Correlates

Key environmental correlates (KECs) (also termed Habitat Elements) are specific substrates, habitat elements, and attributes of species' environments that are not represented by overall (macro) habitats and vegetation structural conditions. Key environmental correlates are the finest scale features that help to define wildlife habitat. KECs recognize and attempt to qualify the high degree of influence either positive or negative the environmental correlates exert of the realized fitness of a species (Johnson and O'Neil 2001). They include natural elements (both environmental and physical), as well as anthropogenic features and their effects, such as roads, buildings, and pollution. Including these fine-scale attributes of an animal's environment when describing its habitat associations expands the concept and definition of a habitat, a term widely used only to characterize the vegetative community or structural condition occupied by a species (See Appendix J for KEC definitions; Johnson and O'Neil 2001). Failing to address and inventory KECs within these communities and conditions may lead to errors of commission; that is, species may be presumed to occur when in actuality they do not (Johnson and O'Neil 2001).

The technical team reviewed the KECs identified to influence the wildlife species of the subbasin. Based on their understanding of the factors most influencing wildlife populations in the subbasin they identified roads and noxious weeds as limiting factors. These limiting factors are discussed in greater detail in section 4.2.2. The technical team identified strategies for reducing the negative impacts of these KECs on the wildlife populations of the subbasin in the Snake Hells Canyon Subbasin Management Plan.