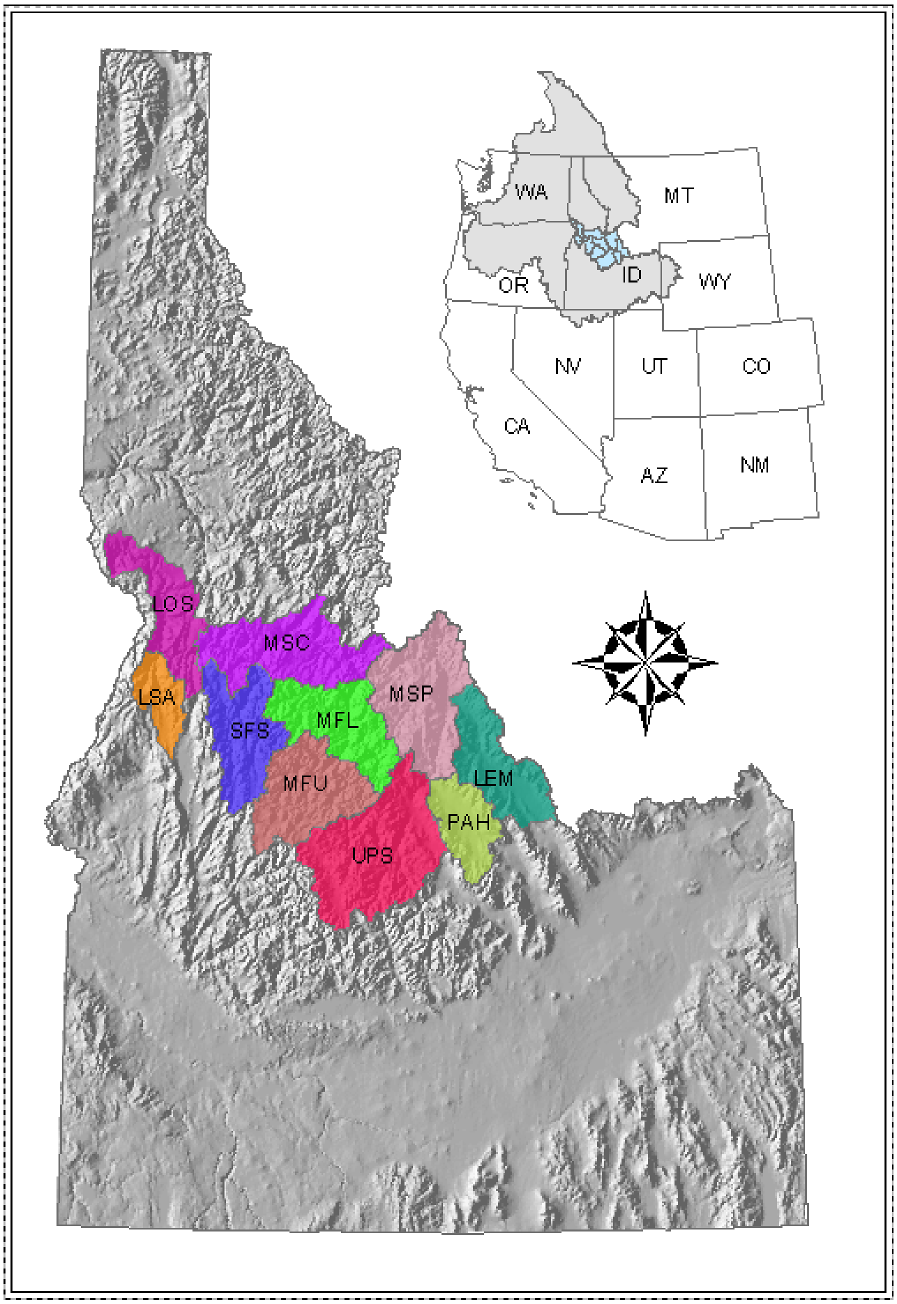
Salmon Subbasin Assessment

Prepared for the
Northwest Power and Conservation Council



May 28, 2004

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1 Overview

1.1 Background

In 1980, Congress authorized the creation of the Northwest Power Planning Council (or NPPC, which in 2003 became the Northwest Power and Conservation Council, or NPCC) to give the states of Idaho, Montana, Oregon, and Washington a political voice in managing the federal hydropower system located in the Columbia River basin. In addition, the NPCC was directed to develop a program—the Columbia River Basin Fish and Wildlife Program—to protect, mitigate, and enhance fish and wildlife communities and populations affected by the Columbia River hydropower system.

In past years, the NPCC and the Columbia Basin Fish and Wildlife Authority (local managers of fish and wildlife resources) reviewed proposals submitted for on-the-ground projects and research. The Bonneville Power Administration then funded approved projects. Recently, independent scientific panels recommended that subbasin plans be developed to better guide the review, selection, and funding of projects that implement the NPCC's Columbia River Basin Fish and Wildlife Program. In an effort to refine this program, a new review and selection process has begun. This process includes subbasin summaries (interim information), assessments, and management plans, which provide a base of information and direction on conditions, limiting factors, and needs in the basin.

Creation of these documents is followed by a rolling review of proposals by an Independent Scientific Review Panel, the Columbia Basin Fish and Wildlife Authority, and the NPCC. Under the rolling provincial review, project proposals from a given subbasin will only be reviewed once every three years.

1.2 Assessment Conceptual Framework

The NPCC has outlined eight scientific principles and four overarching biological objectives to guide the operation of its Columbia River Basin Fish and Wildlife Program. These scientific principles and biological objectives also apply to subbasin documents, including the subbasin assessments, and management plans.

These principles and objectives and null hypotheses frame the assessment of the Salmon subbasin. The overall null hypothesis for the Salmon subbasin states that fish and wildlife species and their habitats are not limited in the Salmon subbasin.

1.2.1 Scientific Principles

Eight scientific principles guide the operation of the NPCC's Columbia River Basin Fish and Wildlife Program. These principles served as the foundation for the fisheries and terrestrial technical teams that were formed to provide input to this technical assessment for the Salmon subbasin. These principles are as follows:

1. The abundance, productivity, and diversity of organisms are integrally linked to the characteristics of their ecosystems.
2. Ecosystems are dynamic and resilient, and they develop over time.
3. Biological systems operate on various spatial and time scales that can be organized hierarchically.
4. Habitats develop through and are maintained by physical and biological processes.
5. Species play key roles in developing and maintaining ecological conditions.

6. Biological diversity allows ecosystems to persist despite environmental variation.
7. Ecological management is adaptive and experimental.
8. Ecosystem function, habitat structure, and biological performance are affected by human actions.

As the NPCC's scientific principles indicate, the relationships of ecosystems, habitats, and populations of fish, wildlife, and plants are very complex. In most cases, these relationships are both undefined and interrelated. Changes resulting from weather, fire, flood, disease, or habitat loss may not only directly reduce or increase fish and wildlife populations but they may also indirectly perturb relationships and interactions between and among fish, wildlife, and their ecosystems to the same or greater extent than the direct effects.

We defined seven limiting factors, or environmental bottlenecks, that may limit fish, wildlife, and their habitats. These factors, in relation to their causes and their manifestations, provide a simplistic working picture of how we evaluated focal populations, focal habitats, and ecosystems in this assessment (Figure 1-1). These limiting factors may act exclusively, such as when a fire eliminates old growth forest habitat necessary for old growth-dependent species such as the fisher (*Martes pennanti*). Or they may act simultaneously or in a composite, such as when aquatic habitat quantity is reduced by water diversion, remaining water in the stream is reduced in quality by increased water temperatures, and population linkage between aquatic species and the amount of water in the stream.

Each limiting factor may manifest itself differently, depending on the status of the species or habitat, the scale of the effect, and the cause of the limiting factor. For example, wolf predation of elk calves may locally limit elk population growth, especially in an area of low habitat quality but will not threaten elk rangewide. In this assessment, our simplistic model suggests causes of limiting factors affecting focal species and habitats and the manifestation of the limiting factor in a focal species, habitat, or ecosystem (Figure 1-1).

Our model is scale independent. It does not represent whether invasive exotic weeds are a competitive or habitat quality limiting factor or both, and it does not imply that fish, wildlife, and ecosystem relationships are as linear and simplistic as shown.

In this assessment, we assume that each of the ecosystems, habitats, and species we assessed originated and functioned optimally prior to anthropogenic influence (Figure 1-2). Pre-anthropogenic optimum function is assumed to be resilience of fish and wildlife systems and sustainability of populations within the range of natural variability. We suggest that increasing anthropogenic effects have exaggerated the limiting factors beyond the range of natural variability and that this pressure has simplified interactions and relationships and reduced the resilience of focal habitats and species, leading to long-term decline (Figure 1-2). Ongoing declines in focal habitats or species have unknown consequences at best and lead to extinction for one or more species at worst.

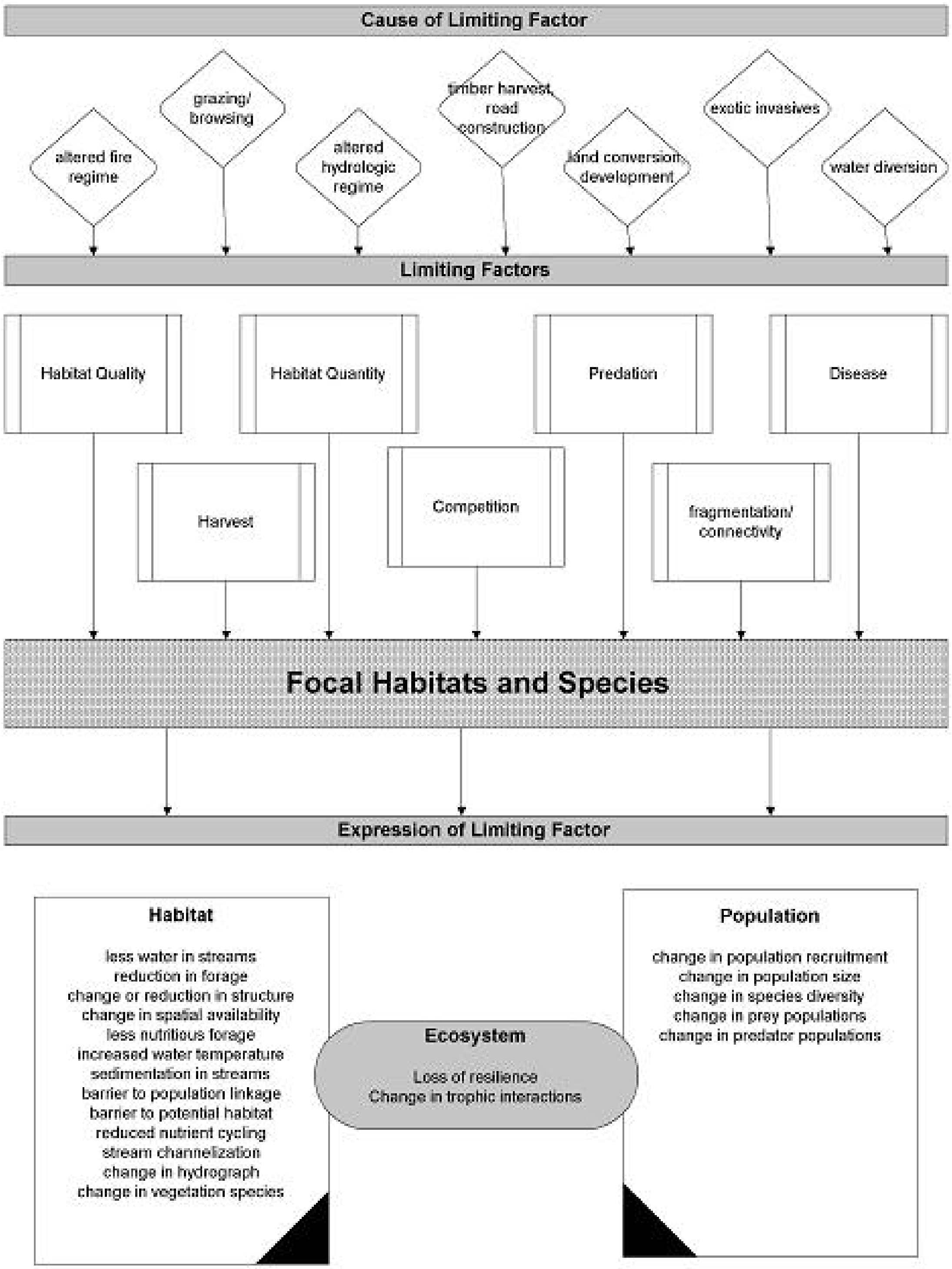
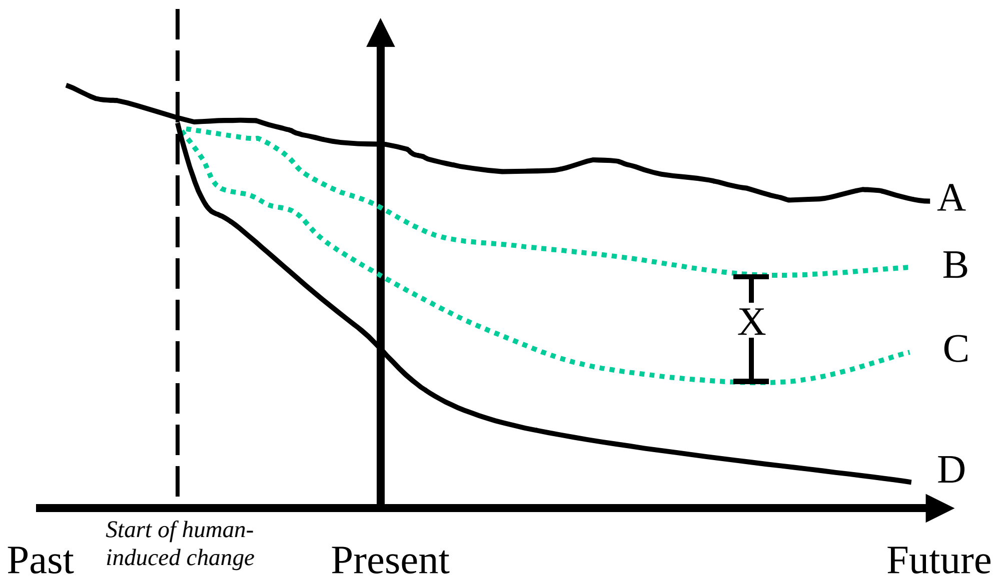


Figure 1-1. Simple model for evaluating relationships between fish and wildlife and their ecosystems for the Salmon subbasin, Idaho.



A = determined by natural, physical, and biological constraints and processes
B = ideal condition that can be achieved within social and political constraints
C = minimum desirable condition for state variable (actual or social thresholds; B to C represents desirable range for state variable)
D = projected trend of focal habitat or species in ecosystem
X = area of predicted sustainability

Figure 1-2. Schematic representation of a sustainable restoration scenario (adapted from National Academy of Sciences, 1992)

Through definition of limiting factors and their causes, we identify strategies to relieve or eliminate the limiting factors and increase the trend and status of focal species, habitats, and ecosystems. We use the best available information to select focal species, define the status of each focal fish and wildlife species or habitat, and then synthesize this information into working hypothesis to direct effective relief of limiting factors. Implementation of management strategies will ideally move the trend or status of focal species or habitats upward toward the acceptable and sustainable levels defined by the biological objectives in the subbasin plan. Monitoring and evaluation of strategy implementation is necessary to test the hypothesis of the management experiment, the effectiveness of the strategy, and increase learning through management actions.

1.2.2 Overarching Biological Objectives

The NPCC has four overarching biological objectives for the 2000 Columbia River Basin Fish and Wildlife Program:

1. A Columbia River ecosystem that sustains an abundant, productive, and diverse community of fish and wildlife.

2. Mitigation across the basin for the adverse effects to fish and wildlife caused by the development and operation of the hydropower system.

3. Sufficient populations of fish and wildlife for abundant opportunities for tribal trust and treaty right harvest and for nontribal harvest.

4. Recovery of the fish and wildlife that are affected by the development and operation of the hydropower system and listed under the Endangered Species Act.

1.2.3 Subbasin Null Hypotheses

Scientific methodology incorporates hypothesis testing by first assuming that a specified action has no effect or impact on the parameter in question. This is called the null hypothesis (Ho). From the subbasin assessment perspective, the broadest null hypothesis states that fish and wildlife species and their habitats are not limited in the Salmon subbasin and the broadest alternative hypothesis (H_A) would state that fish and wildlife species and their habitats are limited by one or more of seven identified limiting factors. More specifically, we begin our assessment with the following null hypotheses.

Hypothesis A

Ho: Habitat quality does not limit the abundance, distribution, life history, and ecological relationships of focal species and habitats.

Hypothesis B

Ho: Habitat quality does not limit the abundance, distribution, life history, and ecological relationships of focal species and habitats.

Hypothesis C

Ho: Population harvest does not limit the abundance, distribution, life history, and ecological relationships of focal species and habitats.

Hypothesis D

Ho: Competition among and between fish and wildlife species and habitats does not limit the abundance, distribution, life history, and ecological relationships of focal species and habitats.

Hypothesis E

Ho: Predation does not limit the abundance, distribution, life history, and ecological relationships of focal species and habitats.

Hypothesis F

Ho: Disease does not limit the abundance, distribution, life history, and ecological relationships of focal species and habitats.

Hypothesis G

Ho: Population and habitat fragmentation and loss of connectivity does not limit the abundance, distribution, life history, and ecological relationships of focal species and habitats.

The alternative or working hypothesis (H_A) is the opposite of the null hypothesis (Ho). It may be developed intuitively or be based on data and information from previous tests or assembled information. The alternative or working hypothesis refuted based on collection of data and information collected using scientific methodology during designed actions.

Our assessment is framed by beginning with seven stated null hypotheses based on our simplistic model (Figure 1-1) and ended by statement of alternative hypothesis H_A developed through synthesis of the information on fish, wildlife, habitats, environmental conditions, and limiting factors we have gathered during the assessment. Monitoring strategies designed to change the influence of the identified limiting factor on focal species or habitats through change or elimination of the cause of the limiting factor can test these working or alternative hypotheses.

1.3 General Description

The Salmon subbasin is unique in the Columbia River basin because it supports a diverse group of the region's wild and naturally reproducing populations of indigenous salmonids and wildlife. Many populations reside in habitat strongholds within the subbasin's large areas of wilderness and roadless areas. These vast wilderness areas are another unique feature of the Salmon subbasin. Public lands account for over 90% of the land area of the subbasin, and the Frank Church–River of No Return Wilderness Area, one of the five wilderness areas within the subbasin, is the largest in the contiguous United States. These large protected areas not only provide refuge for wild salmonids, but serve as habitat strongholds for wildlife, some of which are imperiled or absent across much of their historic range.

1.3.1 Importance to the Region

Despite comprising only 6% of the land area of the Columbia River basin, the Salmon subbasin provides more anadromous fish spawning area than any other subbasin, producing 39% of the spring Chinook salmon, 45% of the summer Chinook salmon, and 25% of the summer steelhead returning to the mouth of the Columbia River (Mallet 1974). Historically, anadromous fish were significant sources of nutrients for other fish species and wildlife in the subbasin. Although many resident salmonid populations in the Salmon subbasin's undeveloped areas are recognized as some of the strongest in the region, the salmon and steelhead trout in these areas that have been listed under the Endangered Species Act (ESA) have struggled to persist upstream of eight hydroelectric dams on the mainstem Columbia and lower Snake rivers, which comprise part of the Federal Columbia River Power System (FCRPS). Anadromous fish productivity is further exacerbated by periods of low ocean productivity. This situation makes it difficult to describe how best to conserve and restore declining salmon and steelhead populations within the subbasin. At present, the focus is largely on restoring habitats within degraded watersheds (off-site measures) as an alternative to fully addressing hydropower system mortality (on-site measures). These off-site and on-site measures to ameliorate the jeopardy posed by the FCRPS are described in the 2000 biological opinion (NMFS 2000) and include breaching lower Snake River dams as a restoration measure for anadromous salmonids if the suite of off-site and on-site measures do not achieve performance standards. Focus on off-site measures is intended to increase in-subbasin survival rates of anadromous salmonids in the Salmon subbasin and will also improve habitat conditions for important populations of resident salmonids and other sensitive fish and wildlife species within the subbasin.

1.3.2 Subbasin Location

The Salmon is one of the largest subbasins in the Columbia River basin and encompasses some of its most pristine terrestrial and aquatic temperate montane ecosystems. The Salmon subbasin, in the northern Rocky Mountains of central Idaho (Figure 1-3), encompasses 10 major watersheds (Figure 1-4). The Salmon River flows 660 km (410 miles) north and west through central Idaho to join the Snake River in lower Hells Canyon.

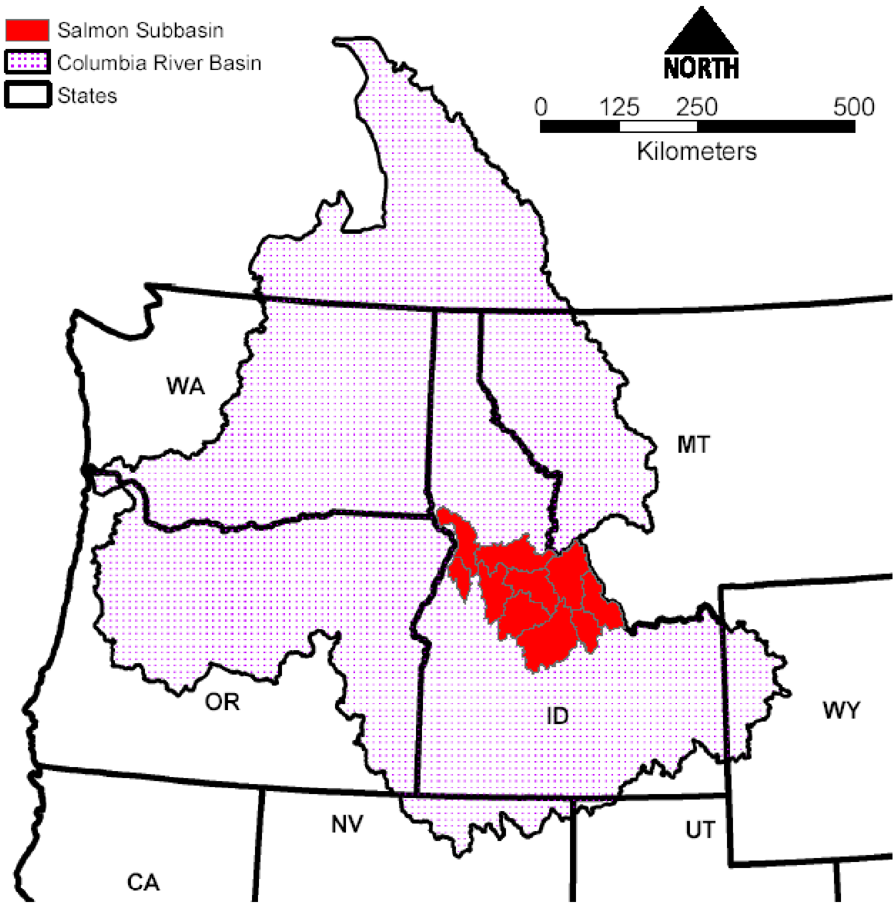


Figure 1-3. Location of the Salmon subbasin, Idaho, within the Columbia River basin.

Most of the subbasin is characterized by an intricate mosaic of moderate- to high-elevation mountain ranges combined with deeply cut valleys of the Salmon River Mountains. The western portion of the subbasin encompasses the northern Seven Devils Mountains and the southern fringe of the Palouse Prairie region. Here, basalt from the Columbia River flow provides the context for contrasting sharp canyonlands and gentle, undulating plateaus. The southeastern portion of the subbasin is punctuated by the high alpine ridges of the Lost River and Lemhi ranges, which are parallel block fault ranges characteristic of Basin and Range terrain of the Great Basin. Elevation within the subbasin ranges from 3,859 m (12,661 ft) on the summit of Mount Borah down to 274 m (2,165 ft) at the mouth of the Salmon River.

1.4 Physical Description

1.4.1 Drainage Area

The Salmon subbasin covers approximately 36,217 square km (13,984 square miles), or 16.7% of the land area of Idaho and 6% of the land area of the Columbia River basin. Ten major hydrologic units (watersheds) occur within the subbasin: the Upper Salmon, Pahsimeroi, Middle Salmon–Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon–Chamberlain, South Fork Salmon, Lower Salmon, and Little Salmon watersheds (Figure 1-4).

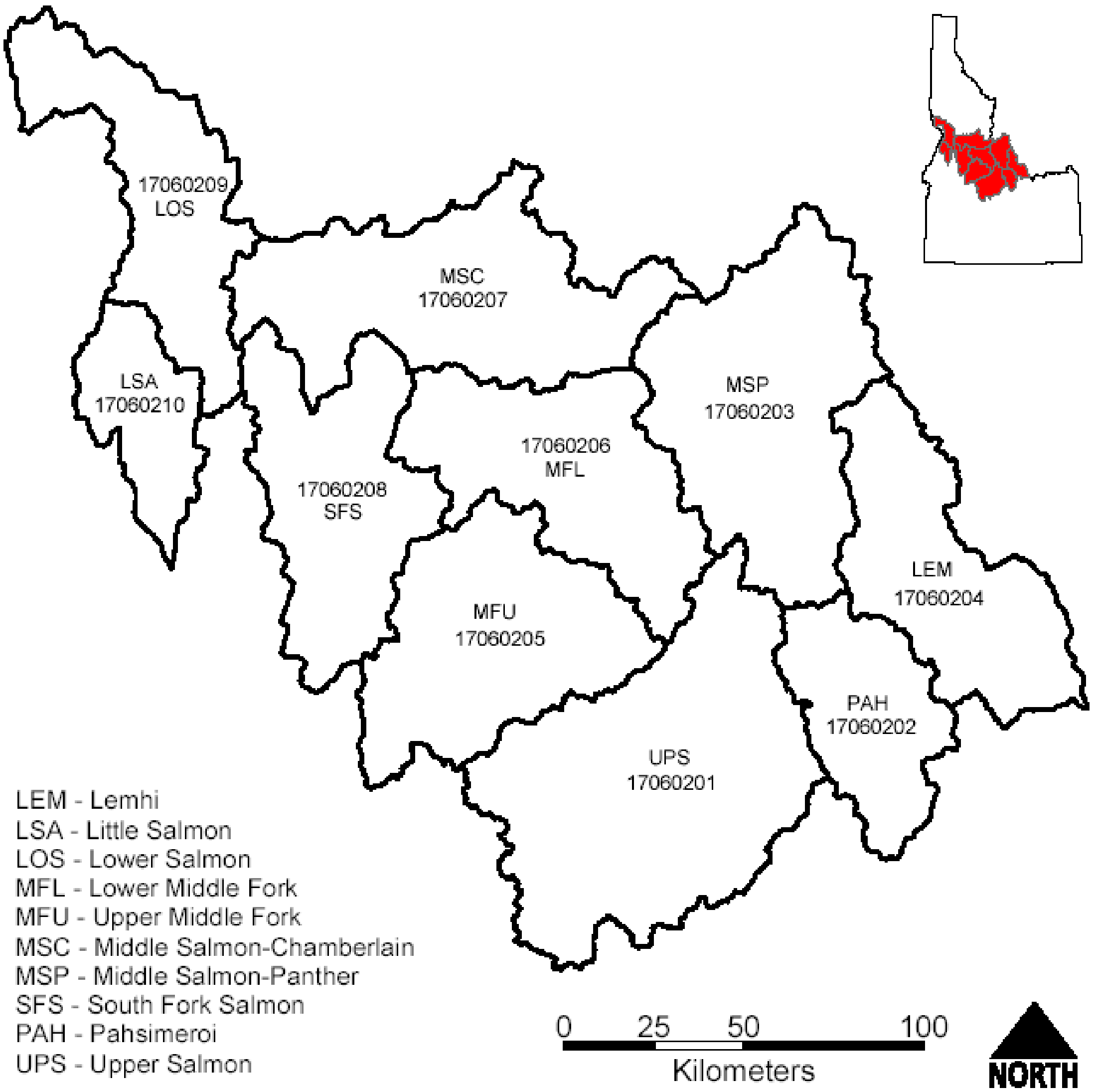


Figure 1-4. Major hydrologic units (watersheds) within the Salmon subbasin, Idaho.

The Salmon subbasin has over 1,900 named streams with a combined length of 15,695 stream kilometers (9,752 miles) (Table 1-1). These streams flow from headwaters in the Beaverhead, Salmon River, Lemhi, Lost River, Sawtooth, and smaller mountain ranges to the mouth of the Salmon River at its confluence with the Snake River in lower Hells Canyon. The largest of the major watersheds is the Upper Salmon; the smallest, the Little Salmon (Table 1-1).

Major rivers, population centers, and major roadways in the Salmon subbasin are shown in Figure 1-5.

Table 1-1. Drainage areas, numbers of named streams, and their total stream kilometers for the 10 major hydrologic units (watersheds) within the Salmon subbasin, Idaho (IFWIS 2003).

Watershed	Acronym	Hydrologic Unit Code	Watershed Area in hectares (acres)	Number of Named Streams	Total Stream Kilometers (Miles)
Upper Salmon	UPS	17060201	627,577 (1,550,777)	261	2,439 (1,516)
Pahsimeroi	PAH	17060202	215,075 (531,462)	68	738 (459)
Middle Salmon–Panther	MSP	17060203	471,292 (1,164,588)	136	1,939 (1,205)
Lemhi	LEM	17060204	326,643 (807,052)	264	1,297 (806)
Upper Middle Fork Salmon	MFU	17060205	389,780 (963,167)	198	1,885 (1,171)
Lower Middle Fork Salmon	MFL	17060206	355,420 (878,262)	341	1,536 (954)
Middle Salmon–Chamberlain	MSC	17060207	443,843 (1,096,760)	215	2,114 (1,314)
South Fork Salmon	SFS	17060208	339,870 (839,837)	210	1,617 (1,005)
Lower Salmon	LOS	17060209	305,088 (753,889)	176	1,446 (899)
Little Salmon	LSA	17060210	143,463 (354,505)	70	684 (425)
Totals			**3,618,051 (8,940,399)**	**1,939**	**15,695 (9,752)**

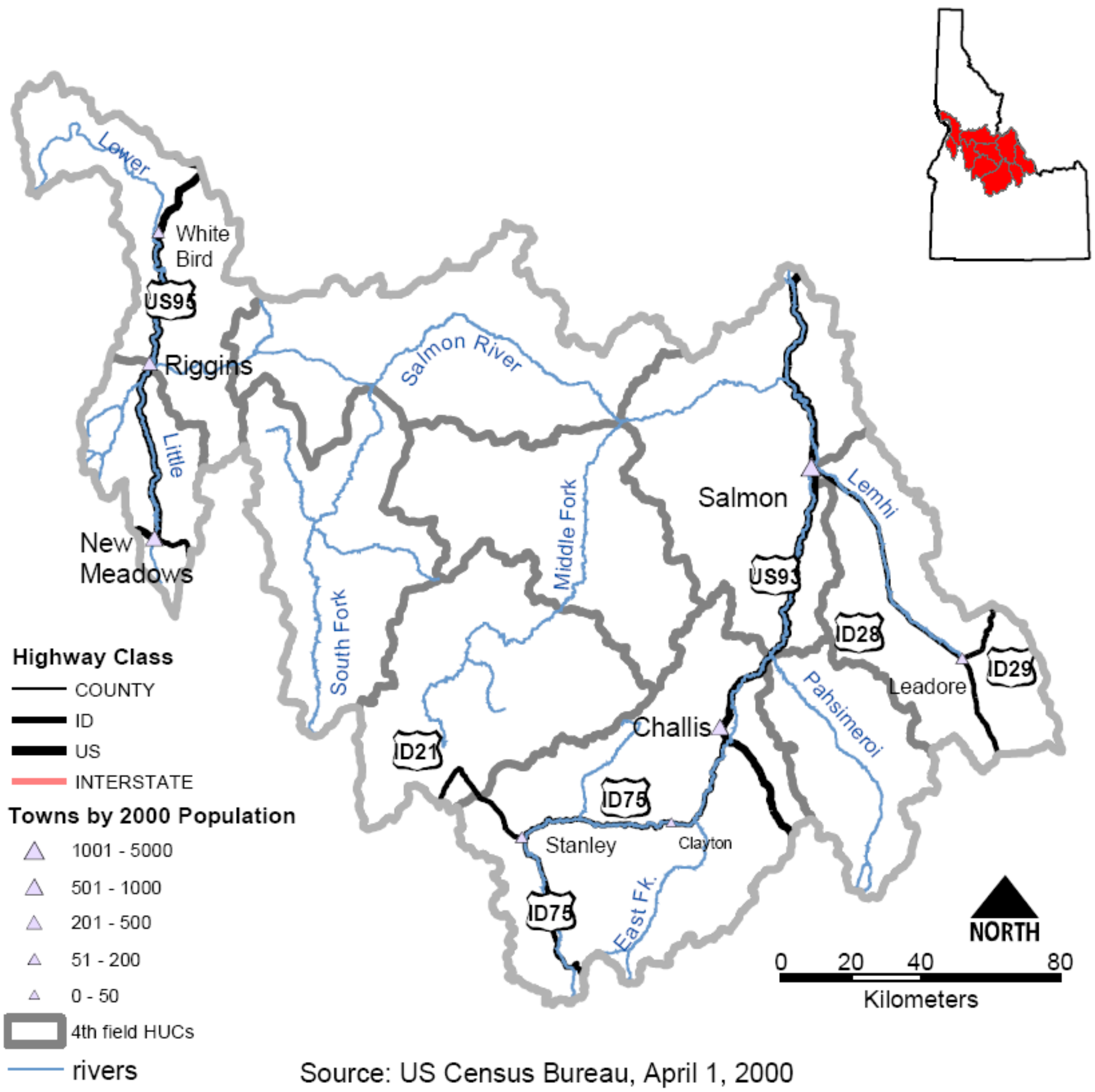


Figure 1-5. Major rivers, population centers, and major roadways in the Salmon subbasin, Idaho.

1.4.2 Geomorphology

The Salmon subbasin lies within the Northern Rocky Mountain and the Columbia Intermontane geomorphic provinces (Ross and Savage 1967). Major geologic formations include Cretaceous calc-alkaline intrusive rocks of the Idaho Batholith, Eocene silicic and basaltic rock of the Challis volcanics, Precambrian feldspathic quartzite, Quaternary alluvial deposits of the Lemhi and Pahsimeroi valleys, and Columbia River flow basalt. Figure 1-6 shows the major geological formations within the Salmon subbasin.

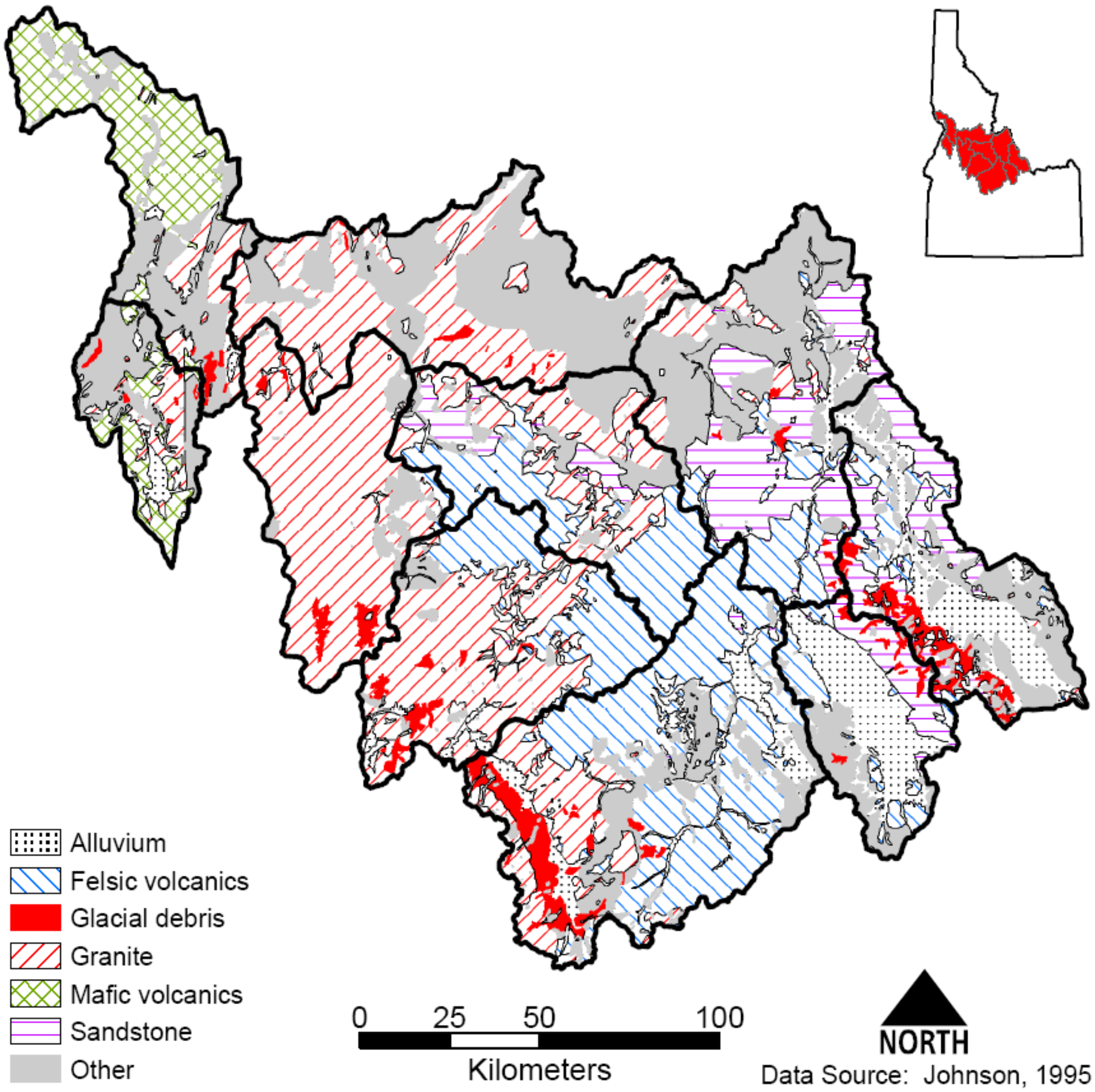


Figure 1-6. Major geological formations within the Salmon subbasin, Idaho (data source: B. Johnson 1995).

Stream erosion since the middle Tertiary period of the Cenozoic era has given rise to topography characterized by relatively narrow, V-shaped valleys, steep valley side slopes, and relatively narrow ridge systems. Major alpine glacier systems formed in the Sawtooth Range, White Cloud Peaks, Boulder Mountains, and, to a lesser extent, the Lost River and Lemhi ranges. Large-scale glacially derived physiographic features (e.g., broad U-shaped valleys) are prominent in the upstream portions of the Upper Middle Fork, Upper Salmon, and Lemhi watersheds (e.g., view the distribution of Pleistocene fluvial glacial debris [Figure 1-6]). Localized evidence of alpine glaciation (e.g., pothole lake systems and glacial cirques) is common and dispersed throughout the subbasin on upper slopes and ridge tops of higher-elevation ridge systems. In these areas, stream erosion has played the predominant role in shaping the physiography of the subbasin. The geomorphology of the eastern Upper Salmon, Pahsimeroi, and Lemhi watersheds is a dramatic exception to this description. The sub-parallel block fault ridges of the Lost River and Lemhi ranges represent the northernmost extent of Basin and Range terrain. In this portion of the subbasin, high mountain peaks rise rapidly from broad, gentle valleys.

Key geologic features within the subbasin are the Idaho Batholith, Challis volcanics, and the Quaternary alluvial deposits of the Pahsimeroi and Lemhi valleys. Soils derived from these parent materials are typically highly erodible. The combination of these soils, steep topography, and climatic stresses gives rise to significant base surface erosion, slumping, and debris avalanche hazards (Megahan 1975, Jensen *et al.* 1997).

1.4.3 Climate

The Salmon subbasin has a broad climatic gradient, from a prevalent Pacific maritime regime in the west to a continental regime in the east. The Pacific maritime-influenced climate of the western portion of the subbasin is primarily affected by the seasonal movement of two opposing weather systems (Ross and Savage 1967). From the late fall to early spring months, the climate is influenced by cool and moist Pacific maritime air. Periodically, this westerly flow of air is interrupted by outbreaks of cold, dry, continental air from Canada normally blocked by mountain ranges to the east. During the summer months, the westerly winds weaken, and a Pacific high-pressure system becomes dominant, resulting in decreased precipitation and more continental climatic conditions. The region is generally characterized by warm summers and mild or cool winters. Across the Salmon subbasin, most precipitation occurs as snow during winter and early spring, while summers are comparatively dry.

The easternmost portion of the subbasin is characterized by warm summers and cold winters. Mean annual precipitation is typically one-half the amount received in the west of the subbasin. The Salmon River Mountains and Sawtooth Range create a rain-shadow effect, allowing only an occasional influx of moisture-laden winter air from the Pacific. Precipitation patterns in the rain shadow, which predominate in the Pahsimeroi and Lemhi watersheds, differ from those found across the rest of the subbasin. In these areas, precipitation frequently occurs in the early summer when convective showers are common; winters are relatively dry.

Geographic differences in the seasonal distribution of precipitation influence the characteristics of terrestrial and aquatic habitats. Occasionally, lengthy frontal rainstorms can produce as much as 25 cm (10 inches) of precipitation. These events are a critical factor in flooding and landslides during winter and spring (Platts 1974). Some areas are snow covered for more than eight months of the year, while other areas receive only minor amounts. Above 1,210 m (3,970 ft), most of the annual precipitation occurs as snow, with maximum accumulation occurring by about the first week in April.

1.5 Biological Description

1.5.1 Fish Species

The Salmon subbasin is known to support 37 species/races of fish, 26 of which are native and 11 nonnative (Table 1-2). Of the 26 native fish species present in the subbasin, 4 are federally listed under the Endangered Species Act (ESA) as threatened (bull trout, spring/summer Chinook salmon, fall Chinook salmon, and steelhead trout) and 1 is listed as endangered (sockeye salmon). A recent broad-scale assessment of the entire Interior Columbia River Basin ecosystem (ICBEMP 1997) found that the Salmon subbasin provides a core of remaining connected habitat for 5 species of salmonids: bull trout, westslope cutthroat trout, redband trout (sympatric with steelhead trout), Chinook salmon, and summer steelhead trout (Lee *et al.* 1997, Thurow 2000). The subbasin contains designated critical habitat for the listed Snake River spring/summer Chinook and sockeye salmon, as well as large connected habitats for Pacific anadromous lamprey, white sturgeon, and other native nongame fishes. Critical habitat for bull trout is proposed in the Salmon subbasin.

Table 1-2. Fish known to inhabit the Salmon subbasin, Idaho. Federally listed species are identified in bold.

Species	Origin[a]	Status[b]	Presence within Major Hydrologic Unit (Watershed)[cd]									
			UPS	PAH	MSP	LEM	MFU	MFL	MSC	SFS	LOS	LSA
Arctic grayling(*Thymallus arcticus*)	I	R	X				X			X		
Bluegill (*Lepomis macrochirus*)	I	O									X	
Bridgelip sucker (*Catostomus columbianus*)	N	C	sw	X	X	X	X			sw	X	X
Brook trout (*Salvelinus fontinalis*)	I	O	X	X	X	X	X	X	X	X	X	X
Bull trout (*Salvelinus confluentus*)	N	T	X	X	X	X	X	X	X	X	X	X
Carp (*Cyprinus carpio*)	I	C				X					X	
Channel catfish (*Ictalurus punctatus*)	I	C									X	
Chiselmouth (*Acrocheilus alutaceus*)	N	C		X	X	X	X					
Fall Chinook (*Oncorhynchus tschawytscha*)	N	T/O								H	X	
Golden trout (*Oncorhynchus aquabonita*)	I	R	X	X				X	X	X		
Kokanee salmon (*Oncorhynchus nerka kennerlyi*)	I	O	X							X		
Lake trout (*Salvelinus namaycush*)	I	R	X							X		
Largescale sucker (*Catostomus macrocheilus*)	N	C	X	X	X	X	X	X	X	X	X	X
Leopard dace (*Rhinichthys falcatus*)	N	U			X							X
Longnose dace (*Rhinichthys cataractae dulcis*)	N	C	sw	X	X	X	X	sw	sw	X	X	sw
Mottled sculpin (*Cottus bairdi semiscaber*)	N	C	sw	X	X	X	X	X	X	X	X	X
Mountain sucker (*Catostomus platyrhynchus*)	N	R	X		X	X				X		sw
Mountain whitefish (*Prosopium williamsoni*)	N	C	X	X	X	X	X	X	X	X	X	X
Northern pikeminnow (*Ptychocheilus oregonensis*)	N	C	X	X	X	X	X	X	X	X	X	sw
Pacific lamprey (*Lampetra tridentata*)	N	S	sw		X	X	H/U	X	X	H/U	X	
Paiute sculpin (*Cottus beldingi*)	N	U			X							X
Peamouth (*Mylocheilus caurinus*)	N	U			X	X						

Species	Origin[a]	Status[b]	Presence within Major Hydrologic Unit (Watershed)[cd]									
			UPS	**PAH**	**MSP**	**LEM**	**MFU**	**MFL**	**MSC**	**SFS**	**LOS**	**LSA**
Rainbow trout (*O. mykiss*) unknown origin	I	C	X	X	X	X	X	X	X	X	X	X
Rainbow x cutthroat trout hybrid	I	C	X		X	X				X	X	
Redband trout (*Oncorhynchus mykiss gibbsi*)	N	S	X	X	X	X	X	X	X	X	X	X
Redside shiner (*Richardsonius balteatus balteatus*)	N	C	sw	X	X	X	X		X	X	X	
Shorthead sculpin (*Cottus confusus*)	N	U	sw	X	X	X	X	sw	sw	sw	X	sw
Slimy sculpin (*Cottus cognatus*)	N	U									U	sw
Smallmouth bass (*Micropterus dolomieu*)	I	C			X						X	
Sockeye (*Oncorhynchus nerka*)	N	E	X									
Speckled dace (*Rhinichthys osculus*)	N	C	sw	X	X	X	X			X	X	X
Spring Chinook (*Oncorhynchus tschawytscha*)	N	T	X	X	X	X	X	X	X	sw/ U	X	X
Summer Chinook (*Oncorhynchus tschawytscha*)	N	T	X	X	X			X	X	X	X	X
Summer steelhead (*Oncorhynchus mykiss*)	N	T	X	X	X	X	X	X	X	X	X	X
Torrent sculpin (*Cottus rhotheus*)	N	C	sw		X			X	X	sw	X	sw
Westslope cutthroat (*Oncorhynchus clarki lewisi*)	N	S	X	X	X	X	X	X	X	X	X	X
White sturgeon (*Acipenser transmontanus*)	N	O			X						X	

[a] Origin: N = native, I = introduced.
[b] Status: C = common, O = occasional, R = rare, S = sensitive, T = threatened, E = endangered, U = unknown.
[c] Presence: X = present, H = historical, sw = Simpson and Wallace (1982), U = unknown.
[d] See Table 1-1 for watershed acronyms.

1.5.2 Wildlife Species

The Salmon subbasin supports a diversity of wildlife (Figure 1-7), including species, like the wolf, that have been extirpated across large portions of their historic geographic ranges. The subbasin is known to support 389 vertebrate species (Appendix 1-1), including 32 wildlife species of concern (Table 1-3).

Federally listed wildlife species that occur in the Salmon subbasin are the Canada lynx (*Lynx canadensis*), gray wolf (*Canis lupus*), northern Idaho ground squirrel (*Spermophilus brunneus brunneus*), and bald eagle (*Haliaeetus leucocephalus*) (Figure 1-8).

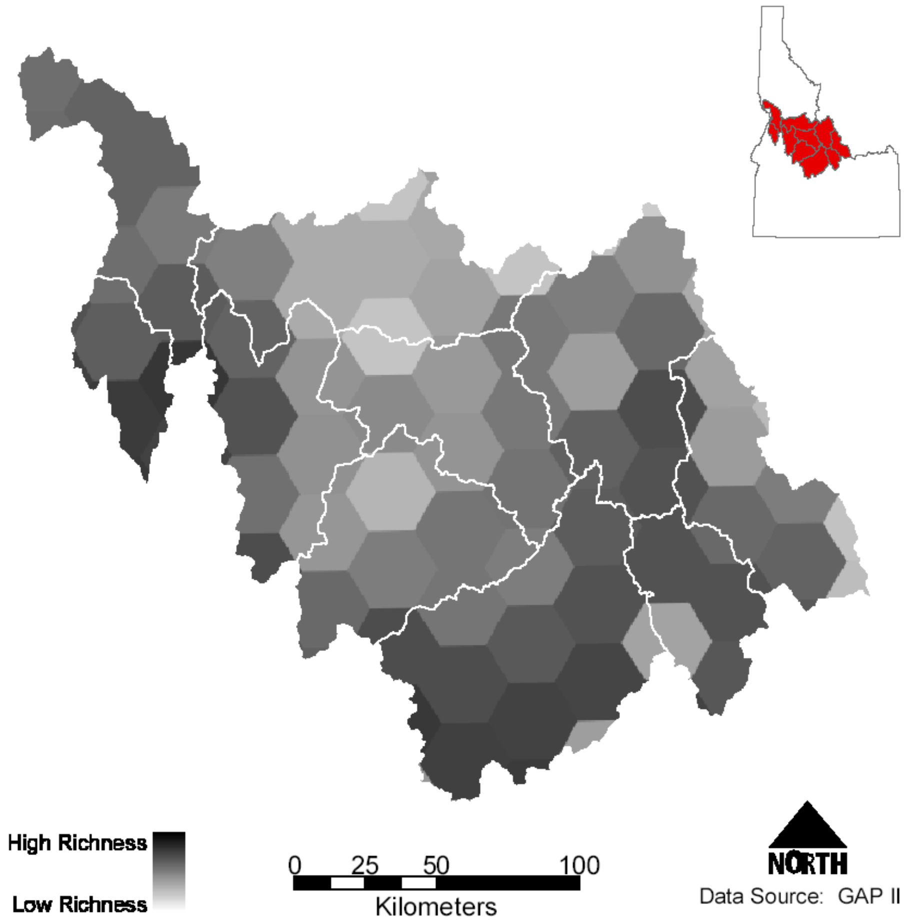


Figure 1-7. Relative vertebrate -species richness where richness was calculated as the number of species predicted to occur within each hexagon.

However, since wolves have been reintroduced within sections of Idaho to establish breeding populations, the gray wolf within this area of the state has been designated as experimental non-essential and its populations are growing. Bald eagles are common visitors to the Salmon River during winter, and numerous nesting pairs occur throughout the upper subbasin.

The peregrine falcon, which was recently delisted, currently nests in the subbasin. The grizzly bear (*Ursus arctos horribilis*), a threatened species, historically occurred throughout the Salmon subbasin but is now extirpated from the area.

The wolverine (*Gulo gulo*) was petitioned for proposal for listing under the ESA and is present in the Salmon subbasin. However, on October 21, 2003, the USFWS determined that there was insufficient data for listing the species. The greater sage grouse (*Centrocercus urophasianus*) and pygmy rabbit (*Brachylagus idahoensis*) were also petitioned for listing and determinations have not yet been made. The yellow-billed cuckoo (*Coccyzus americanus*) is currently a candidate species under the ESA and is present in Lemhi and Custer counties.

Table 1-3. Documented occurrences of federally listed (threatened or endangered) and rare animal species within the major hydrologic units (watersheds) of the Salmon subbasin, Idaho. Federally listed species are identified in bold. Abundance of documented occurrences can be biased toward areas where there have been greater levels of research and other human activity (see Appendix 1-1 for a complete list of vertebrate wildlife species and descriptions of global [G-rank] and state [S-rank] conservation rankings).

Species/Guild	G-Rank/ S-Rank	Documented Occurrences by Watershed[a]									
		UPS	PAH	MSP	LEM	MFU	MFL	MSC	SFS	LOS	LSA
Forest Carnivores											
Fisher (*Martes pennanti*)	G5/S1	3		3		5	1	8	5	14	
Canada lynx (*Lynx lynx)*	G5/S1/ **Threatened**	26	1	19	22	8	3	8	1	2	1
North American wolverine (*Gulo gulo luscus*)	G4T4/S2	39		10	2	20	1	12	4	5	4
Gray wolf (*Canis lupus*)	G4/S1/ **Threatened**										
Small Mammals											
California myotis (*Myotis californicus*)	G5/S1?			2							
Fringed myotis (*Myotis thysanodes*)	G4G5/S1?						1			3	
Kit fox (*Vulpes macrotis*)	G4/S1	1									
Long-eared myotis (*Myotis evotis*)	G5/S3?	2		7	1		1			2	
Long-legged myotis (*Myotis volans*)	G5/S3?	2	1	7			3	1		1	3
Merriam's shrew (*Sorex merriami*)	G5/S2?	1									
Northern Idaho ground squirrel (*Spermophilus brunneus brunneus*)	G2T2/S2/ **Threatened**										3
Pallid bats (*Antrozous pallidus*)	G5/S1?									1	
Pygmy rabbit (*Brachylagus idahoensis*)	G4/S3	4	23		41						
Spotted bat (*Euderma maculatum*)	G4/S2						1				
Townsend's big-eared bat (*Corynorhinus townsendii*)	G4/S2?		1	4			2			6	1
Western pipistrelle (*Pipistrellus hesperus*)	G5/S1?									1	
Western small-footed myotis (*Myotis ciliolabrum*)	G5/S4?	2	1	10	3		1				
Yuma myotis (*Myotis yumanensis*)	G5/S3?	1			2		1				1
Raptors											
Bald eagle (*Haliaeetus leucocephalus*)	G4/S3B,S4N/ **Threatened**	2	1	1	1						
Northern goshawk (*Accipiter gentilis*)	G5/S4	2				1	1	3	1	5	6
Peregrine falcon (*Falco peregrinus anatum*)	G4/S1 delisted 08/99	3		3						2	2
Upland Birds											
Mountain quail (*Oreortyx pictus*)	G5/S2									37	14
Cavity Nesters											

Species/Guild	G-Rank/ S-Rank	Documented Occurrences by Watershed[a]									
		UPS	PAH	MSP	LEM	MFU	MFL	MSC	SFS	LOS	LSA
Black-backed woodpecker (*Picoides arcticus*)	G5/S3	1				1		3			1
Boreal owl (*Aegolius funereus*)	G5/S2	1		3		1		6	4	1	
Flammulated owl (*Otus flammeolus*)	G4/S3B,SZN	1		13				4	1	10	3
Great gray owl (*Strix nebulosa*)	G5/S3			1		5		3			3
Pygmy nuthatch (*Sitta pygmaea*)	G5/S2S3	1								1	1
Three-toed woodpecker (*Picoides tridactylus*)	G5/S3?	5				1		4			
White-headed woodpecker (*Picoides albolarvatus*)	G4/S2B,SZN							1		4	
Migratory Birds											
Long-billed curlew (*Numenius americanus*)	G5/S3B,SZN	1	4		1					2	
Reptiles and Amphibians											
Ringneck snake (*Diadophis punctatus*)	G5/S1?									2	
Western toad (*Bufo boreas*)	G4/S4	2			2				3		
Invertebrates											
Boulder pile mountainsnail (*Oreohelix jugalis*)	G?/SU									2	
Columbia pebblesnail (*Fluminicola fuscus*)	G2G3/S1									2	
Columbia river tiger beetle (*Cicindela columbica*)	G2/S2									13	
Costate mountainsnail (*Oreohelix idahoensis idahoensis*)	G1G3/SU									2	
Lava rock mountainsnail (*Oreohelix waltoni*)	G1G3/SU									1	
Shortface lanx (*Fisherola nuttalli*)	G2/S1									5	
Striate mountainsnail (*Oreohelix strigosa goniogyra*)	G5TU/SU									2	
Whorled mountainsnail (*Oreohelix vortex*)	G1G3/SU									1	

[a] See Table 1-1 for watershed acronyms.

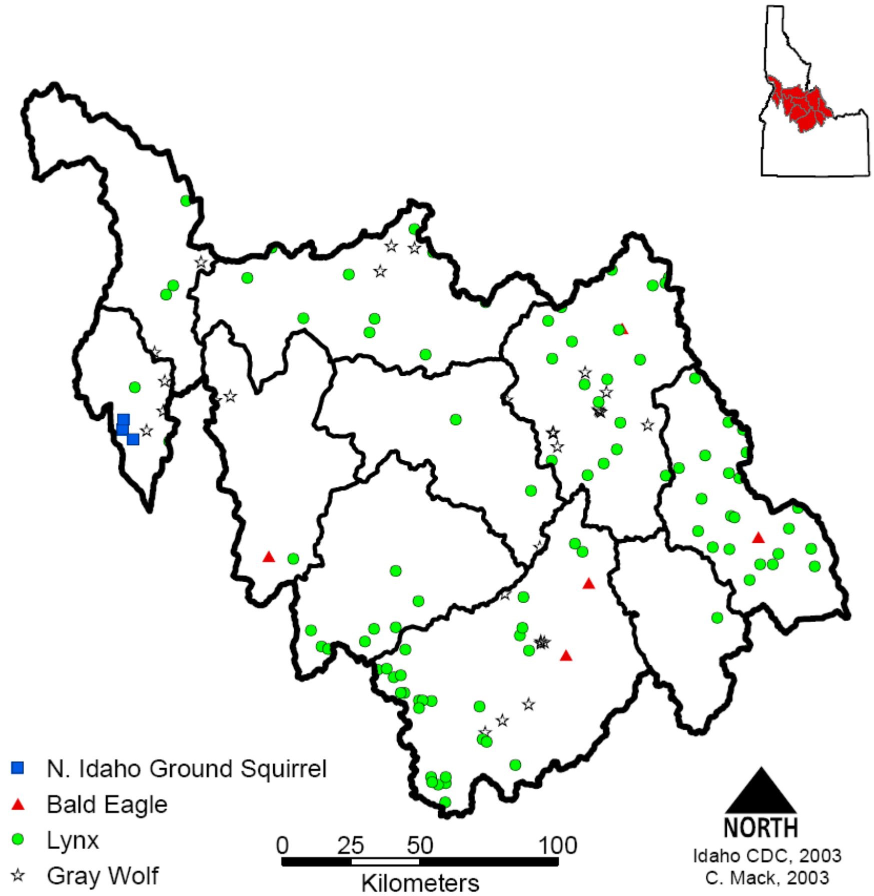


Figure 1-8. Documented occurrences of threatened and endangered species in the Salmon subbasin, Idaho (IDCDC 2003a; C. Mack, Gray Wolf Recovery Coordinator, Nez Perce Tribe personal communication, November 2003.

1.5.2.1 Mammals

Ninety-one mammal species are identified as occurring within the Salmon subbasin (Appendix 1-1), including 9 big game (as classified by IDFG), 4 forest carnivore, and 59 small mammal species. Many of these animals are valued for cultural, recreational, and economic reasons. Information on the distribution and status of small mammals within the subbasin is limited.

1.5.2.2 Birds

The diversity of habitats in the subbasin supports more than 272 bird species (Appendix 1-1), many of which are thought to use the subbasin during at least part of the year. Ninety-two species are yearlong residents, 94 are summer residents, 12 are winter visitors, 63 are migrants, and 11 are classified as accidentals; 229 species breed in the subbasin. The subbasin supports nationally renowned populations of raptors, an abundance of waterfowl, sage grouse, numerous songbirds, and a remnant population of sharp-tailed grouse (*Tympanuchus phasianellus*). Little information is available on the distribution and status of most of these avian species. Important and sensitive breeding landbirds in the Salmon subbasin include the long-billed curlew and pygmy nuthatch.

1.5.2.3 Reptiles and Amphibians

Fourteen species of reptiles and 11 species of amphibians are known or predicted to occur in the Salmon subbasin (Appendix 1-1). Information on their distribution and status in the area is limited. However, an intensive, five-year amphibian study has been conducted in the Bighorn Crags of the Salmon River Mountains, within the Middle Fork Salmon River and main Salmon River drainages. This study documented the distribution, habitat associations, and movements of Columbia spotted frogs (*Rana luteiventris*) and long-toed salamanders (*Ambystoma macrodactylum*) (Pilliod and Peterson 1997, Pilliod and Fronzuto 2002).

1.5.3 Vegetation and Floristic Diversity

Existing vegetation is the plant cover, or floristic composition and vegetation structure, occurring at a given location at the current time (Brohman and Bryant 2003). Potential natural vegetation is the vegetation that would become established if all successional sequences were completed without interference by man under the present climatic and edaphic conditions (Brohman and Bryant 2003). Therefore, potential natural vegetation classifications are based on existing vegetation, successional relationships, and environmental factors (e.g., climate, geology, and soil) considered together. Classification of potential natural vegetation uses information on structure and composition similar to that needed for existing vegetation classification but places greater emphasis on composition and successional relationships (Brohman and Bryant 2003). Existing vegetation classifications and maps provide much of the information needed to do the following:

- Describe the diversity of vegetation communities occupying an area
- Characterize the effect of disturbances or management on species, including threatened and endangered species and community distributions
- Identify realistic objectives and related management opportunities
- Document successional relationships and communities within potential natural vegetation or ecological types
- Streamline monitoring design and facilitate extrapolation of monitoring interpretations
- Assess resource conditions, determine capability and suitability, and evaluate forest and rangeland health
- Assess risks for invasive species, fire, insects, and disease
- Conduct project planning and watershed analysis and predict activity outcomes at the project or land and resource management planning scales
- Encourage more effectively communicate among partners, stakeholders, and neighbors

Existing vegetation information does not itself answer questions about successional relationships, changes over time, historical range of variation, productivity, habitat characteristics, and responses to management actions. These questions can only be addressed by combining information about potential natural vegetation, existing vegetation, and stand history (Brohman and Bryant 2003).

An existing vegetation classification inherently lacks information on the above topics because it only describes the vegetation present at one point in time. The current plant community reflects the history of a site. That history often includes geologic events, geomorphic processes, climatic changes, migrations of plants and animals in and out of the area, natural disturbances, chance weather extremes, and numerous human activities. Because of these factors, existing vegetation seldom represents the potential under current environmental conditions (Brohman and Bryant 2003).

Thirty-two plant association groups of potential natural vegetation occur within the Salmon subbasin (Table 1-4). The potential vegetation types demonstrate that the subbasin is capable of considerable ecosystem diversity, with evergreen coniferous forest and evergreen shrubland ecosystems most abundant. Dominant potential natural vegetation varies widely among watersheds within the subbasin in relation to basic environmental factors of climate and elevation.

Existing vegetative cover types within the subbasin are grouped into 59 classes by watershed (Table 1-5). Major groups of forest plant associations include grand fir (*Abies grandis*) forest, subalpine fir (*Abies lasiocarpa*) forest, subalpine fir forest and woodland, whitebark pine–limberpine (*Pinus albicaulis–Pinus flexilis*) forest and woodland, ponderosa pine (*Pinus ponderosa*) woodland, and Douglas-fir (*Pseudotsuga menziesii*) forest (Hann *et al*. 1997). Mountain hemlock (*Tsuga mertensiana*) forest is a relatively minor component in the subbasin (Hann *et al*. 1997).

Bluebunch wheatgrass (*Pseudoroegneria spicata*, formerly called *Agropyron spicatum*) and Idaho fescue (*Festuca idahoensis*) plant associations occur primarily in the Lower Salmon and Little Salmon watersheds. Wyoming big sagebrush–mountain big sagebrush (*Artemisia tridentata wyomingensis–Artemisia tridentata vaseyana*) and mountain big sagebrush plant associations appear abundant in the Upper Salmon, Pahsimeroi, Middle Salmon–Panther, and Lemhi watersheds.

Table 1-4. Estimated percentage representation of potential natural vegetation for each of 10 major watersheds in the Salmon subbasin, Idaho (ICBEMP 1997)[a]

Potential Natural Vegetation	Percentage (%) of major hydrologic unit (watershed)[b]										Total Area (km^2)
	UPS	PAH	MSP	LEM	MFU	MFL	MSC	SFS	LOS	LSA	
Agropyron Steppe	<1	3		1					13	1	530
Alpine Shrub-Herbaceous	<1			<1		<1	<1	<1			63
Aspen	<1	<1	<1	1	<1		<1	<1	<1	<1	98
Barren (rock)	<1	2		1							80
Big Sage—Cool	14	20	7	14	<1	<1			<1	<1	2,173
Big Sage—Warm			<1								1
Cottonwood Riverine	<1	<1		<1							19
Dry Douglas-fir with Ponderosa Pine	3	6	23	5	7	15	12	6	18	12	3,788
Dry Douglas-fir without Ponderosa Pine	2	1	<1	<1	<1	<1	<1		<1	<1	179
Dry Grand Fir/White Fir	4		6		3	10	22	11	18	29	3,331
Fescue Grassland	<1				<1	<1			4		177

Potential Natural Vegetation	**Percentage (%) of major hydrologic unit (watershed)[b]**										**Total Area (km^2)**
	UPS	**PAH**	**MSP**	**LEM**	**MFU**	**MFL**	**MSC**	**SFS**	**LOS**	**LSA**	
Fescue Grassland with Conifer	9	6	9	16	3	4	<1	<1	12	2	2,369
Grand Fir/White Fir Inland	<1	3	2	8		<1	2	<1	9	25	1,212
Interior Ponderosa Pine	6	10	9	9	<1	2	18	6	10	1	2,754
Juniper	<1	<1	<1	<1		<1					43
Limber Pine	<1	1	<1	<1							50
Low Sage—Xeric	2	<1	2	2	<1						316
Moist Douglas-fir	<1	3	<1	5	<1	<1	3	3	1	3	674
Mountain Big Sagebrush—Mesic—West with Juniper	<1	4	<1	<1							127
Mountain Big Sagebrush—Mesic—East	11	19	5	15	3	6	<1	<1	<1	1	2,231
Mountain Mahogany	<1	<1				<1					9
Mountain Mahogany with Mountain Big Sagebrush	<1	<1	<1	1		<1					95
Mountain Shrub	<1	<1									5
Salt Desert Shrub	<1	<1									7
Saltbrush Riparian									<1		13
Spruce-Fir—Dry with Aspen	<1		<1	<1	<1		<1	<1	<1	4	119
Spruce-Fir—Dry without Aspen	13	3	9	2	15	9	17	15	4	5	3,797
Spruce-Fir—Wet	2		3		4	9	17	19	5	3	2,384
Spruce-Fir (Lodgepole Pine >Whitebark Pine)	19	5	21	10	56	37	5	36	4	11	7,793
Threetip Sagebrush	<1	<1									29
Water								<1	<1	<1	5
Whitebark Pine/Alpine Larch—South	10	11	2	7	7	6	<1	1		<1	1,739

[a] See Appendix 2-1 for more information about Interior Columbia Basin Ecosystem Management Project (ICBEMP1997) data.
[b] See Table 1-1 for watershed acronyms.

Table 1-5. Estimated percentage composition of current vegetation cover types within each of 10 major watersheds in the Salmon subbasin, Idaho (Scott *et al*. 2002).

Current Vegetation Cover Types	**Percentage (%) of major hydrologic unit (watershed)[a]**										**Total Area (km^2)**
	UPS	**PAH**	**MSP**	**LEM**	**MFU**	**MFL**	**MSC**	**SFS**	**LOS[b]**	**LSA**	
Agricultural	2	6	2	9	<1	<1	<1	<1	3	4	833
Alpine Meadow	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	78
Aspen	<1		<1	<1	<1			<1			29
Basin and Wyoming Big Sagebrush	13	17	19	18	3	5	2	<1	<1	<1	3,021

Current Vegetation Cover Types	Percentage (%) of major hydrologic unit (watershed)[a]										Total Area (km^2)
	UPS	PAH	MSP	LEM	MFU	MFL	MSC	SFS	LOS[b]	LSA	
Bitterbrush	<1						<1	<1	<1	1	34
Black Sagebrush Steppe							<1				0
Broadleaf Dominated Riparian	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	97
Cottonwood							<1		<1		1
Curlleaf Mountain Mahogany	<1	3	<1	3	<1	<1	<1	<1	1	<1	281
Deep Marsh	<1				<1		<1				7
Disturbed Grassland							<1		1	<1	49
Disturbed, High	<1		<1		<1	<1	<1			<1	8
Disturbed, Low					<1	<1	<1	<1		<1	5
Douglas-fir	8	8	29	15	26	37	24	22	8	9	6,981
Douglas-fir/Grand Fir							<1	<1	4	2	186
Douglas-fir/Lodgepole Pine	<1		2		3	2	4	2	<1	<1	590
Englemann Spruce							<1		<1		19
Exposed Rock	3	8	<1	2	<1	<1	<1		4	<1	620
Foothills Grassland	<1	<1	<1	<1	<1		<1	<1	5	1	242
Graminoid- or Forb-Dominated Riparian	<1		<1		<1	<1	<1	<1	<1	<1	52
Grand Fir							2	<1	5	4	346
Herbaceous Burn			<1		2	2	2	5	3	3	572
Herbaceous Clearcut	<1		<1		<1		<1	<1	<1	<1	54
Lodgepole Pine	13	1	19	4	23	16	16	18	3	1	4,816
Low-Intensity Urban	<1	<1	<1	<1				<1		<1	26
Low Sagebrush	2	6	<1	4	<1	<1	<1	<1	<1	<1	407
Mesic Upland Shrub									<1		3
Mixed Barren Land							<1		<1	<1	38
Mixed Mesic Forest							4		10	2	482
Mixed Needleleaf/Broadleaf Forest	<1				<1		<1		<1		7
Mixed Riparian (Forest and Nonforest							<1				3
Mixed Subalpine Forest	13	<1	8	<1	12	11	12	11	3	5	3,152
Mixed Whitebark Pine Forest							<1		<1	<1	17
Mixed Xeric Forest			3		<1	<1	6	7	6	16	1,100
Montane Parklands and Subalpine Meadow	2	1	<1	1	3	1	2	3	5	4	746
Mountain Big Sagebrush	12	14	2	18	4	1	<1	1	<1	2	2,055
Mountain Low Sagebrush	6	12	<1	7	<1						887
Mud Flat	<1	<1									1
Needleleaf-Dominated Riparian	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	172
Needleleaf/Broadleaf-Dominated Riparian									<1		4
Perennial Grass Slope	<1	<1	2	<1	2	3	3	2	<1	2	614

Current Vegetation Cover Types	Percentage (%) of major hydrologic unit (watershed)[a]										Total Area (km^2)
	UPS	PAH	MSP	LEM	MFU	MFL	MSC	SFS	LOS[b]	LSA	
Perennial Grassland	<1	5	<1	<1				<1	<1	<1	171
Perennial Ice or Snow									<1	<1	25
Ponderosa Pine			<1	<1	<1	<1	5	4	16	21	1,209
Salt-desert Shrub	<1	<1									28
Shallow Marsh	<1	<1		<1			<1				58
Shrub-Dominated Riparian	1	1	<1	1	2	<1	<1	<1	<1	1	332
Standing Burnt or Dead Timber							<1				1
Subalpine Fir	3	3	2	3	3	2	6	9	2	10	1,433
Subalpine Fir/Whitebark Pine	2		<1		5	4	<1	1			543
Subalpine Pine	13	11	4	8	8	8	1	5	<1	4	2,451
Warm Mesic Shrub	<1	<1	2	<1	3	4	5	5	5	3	945
Water	<1		<1	<1	<1	<1	<1	<1	<1	<1	65
Western Larch							<1		<1	<1	8
Western Larch/Douglas-fir							<1				9
Western Larch/Lodgepole Pine							<1		<1		18
Western Red Cedar									1	<1	38
Western Red Cedar/Grand Fir Forest							<1		3	<1	92
Wet Meadow	<1			<1	<1	<1	<1	<1	<1	<1	41

[a] See Table 1-1 for watershed acronyms.

[b] Cloud and cloud shadow error occurred over 4% of the area (representing approximately 117 km^2) in the Lower Salmon watershed.

Interestingly, montane shrublands were more common in historical forest settings than they are in current period forests. Prior to Euro-American settlement, mixed-severity fires affected large areas of the Salmon subbasin. After decades of fire suppression practices, many current forest stands are overstocked, are dominated by shade-tolerant species, and have multiple canopy layers where they were once more open, single-layered stands, composed of fire-tolerant species (Hann *et al*. 1997).

1.5.4 Rare and Endemic Plants

Eighty plant species within the subbasin are considered rare either globally or statewide, and 77 of these species have been specially designated as either globally rare (ranks G1, G2, and G3) or rare within Idaho (S1 or S2) (IDCDC 2003b, Appendix-1-2). Figure 1-9 shows the distribution of rare plants by type—mosses, ferns, lichens, monocots, and dicots.

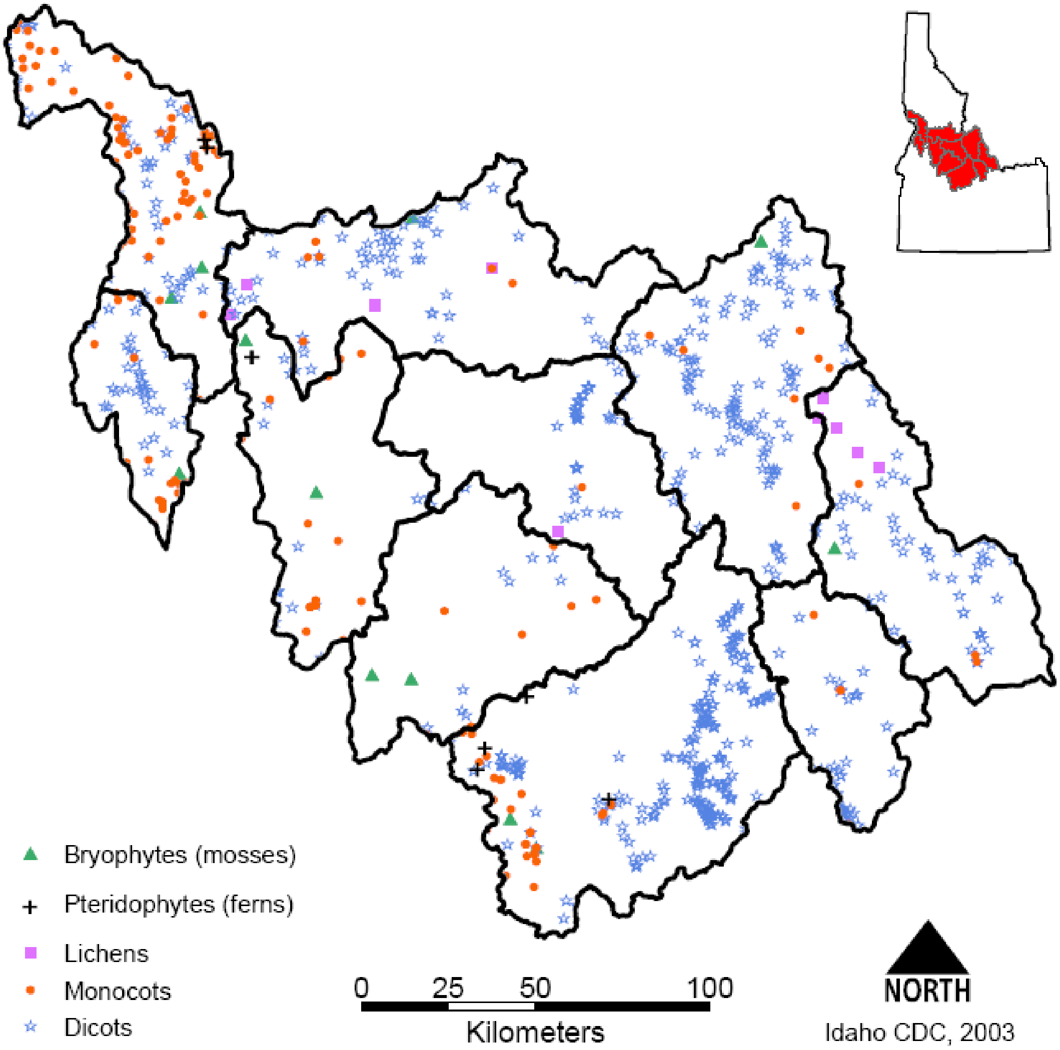


Figure 1-9. Distribution of rare plants in the Salmon subbasin, Idaho (IDCDC 2003b).

Two species in the subbasin are federally listed as threatened under the ESA: MacFarlane's four o'clock (*Mirabilis macfarlanei*) and Spalding's catchfly (*Silene spaldingii*). Four regions of high plant endemism and biodiversity significance occur within the subbasin: Hells Canyon, Stanley Basin/Sawtooth Valley, Challis Endemics area, and east central Idaho mountains and valleys (Marcot *et al*. 1998).

1.6 Social Description

1.6.1 Demographics

The Salmon subbasin comprises portions of eight counties, primarily Custer, Idaho, Lemhi, and Valley, with small peripheral sections of Adams, Blaine, Lewis and Nez Perce counties (Figure 1-10). The subbasin lacks large population centers. The largest communities within the subbasin are the town of Salmon and its surrounding area, with populations of 3,122 and approximately 3,000, respectively. The town of Challis has a population of 909; the Challis community, about 1,200. The town of New Meadows has 533 people; Riggins, 410 (Figure 1-5). Stanley, White Bird, Leadore, and Clayton each have populations near or less than 100. For instance, 27 individuals reside in Clayton. In most cases, the rural population or developed subdivisions contribute significantly to the total population density of each county (U.S. Census Bureau 2001).

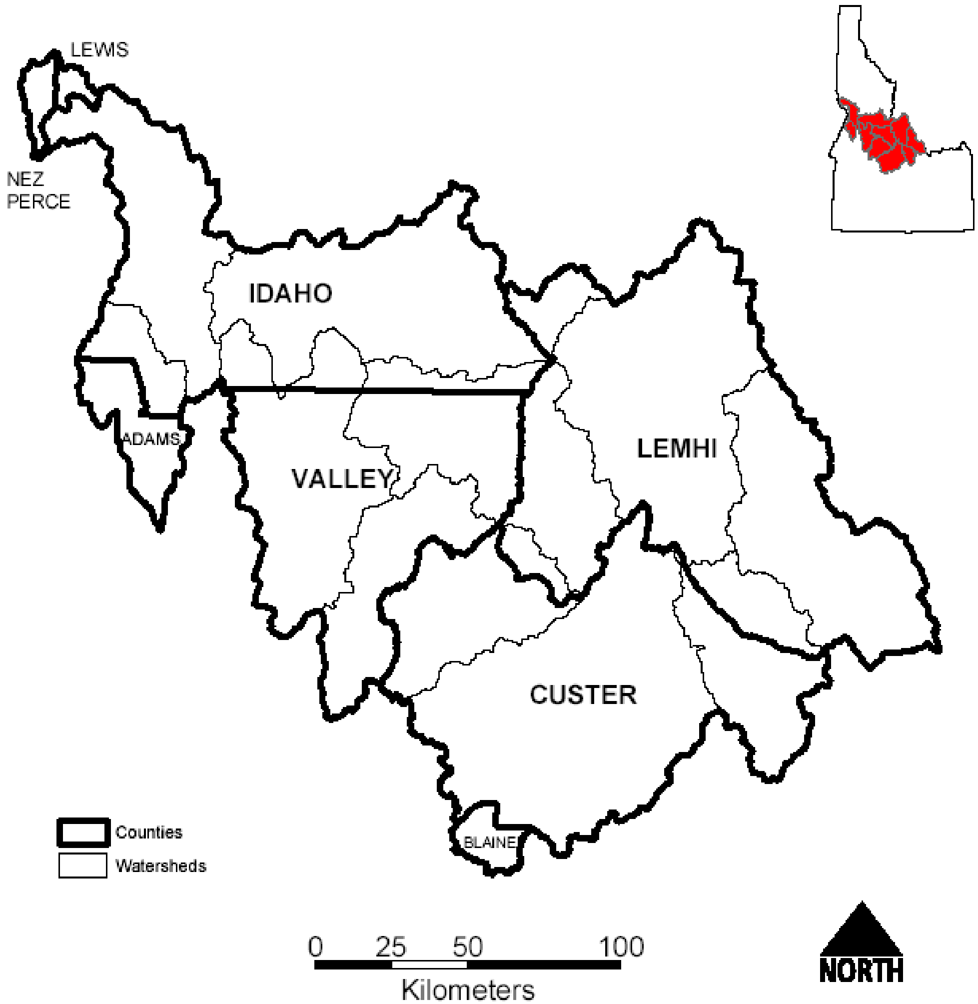


Figure 1-10. Eight counties are combined to form the Salmon subbasin, Idaho. Several counties comprise two or more watersheds.

Urban areas adjacent to the subbasin influence economic trends. These include Lewiston, with nearly 31,000 people; Grangeville, with 3,228; the Sun Valley area, with over 10,000; and the McCall/Cascade area, with over 3,200 people. The inland port at Lewiston and agriculture in the Palouse region to the north influence the economies of Lewiston and Grangeville.

Several Native American tribes have traditionally fished and hunted within the Salmon subbasin. By virtue of the Treaty of 1855, the Nez Perce Tribe has the right to fish in traditional and accustomed sites throughout the subbasin. The Shoshone-Bannock Tribes through the 1868 Fort Bridger Treaty have the right to fish on any unoccupied federal lands. The extent of the Shoshone-Paiute Tribes' fishing right remains unresolved pending anthropological and legal research and evaluation. Several court cases have established the scope and extent of these treaties and the subsequent rights possessed by tribal members.

Historically, cattle ranching, logging, and mining have played important economic roles in the subbasin economy. While wood products continue to sustain some areas, recent years have seen the decline of natural resource-based industries due to a complexity of factors, including environmental standards, sustainability issues, and market issues. Since the 1990s, mining activity has declined in Custer and Lemhi counties. Cattle ranching (cow-calf agriculture) is the dominant economic activity, and ranching and agriculture play important roles in the subbasin. Irrigation projects and diversions are common, and although the number of farms has declined, recent statistical trends indicate an overall increase in farming. However, the number of irrigated acres has changed very little in the past 30 years and has likely declined because of urbanization of ranches near the towns of Salmon and Challis. Grazing pressure has remained relatively constant for over 40 years although there have been some shifts from sheep to cattle. The use of commercial fertilizer has increased due to ranchers growing feed for livestock that are moved from public to private land for part of the year.

Recreation and tourism are important to the region. Within the subbasin, Stanley, Challis, Salmon, and Riggins rely heavily on seasonal recreation, as do the peripheral areas surrounding McCall and Sun Valley. Activities such as whitewater rafting, boating, fishing, hunting, botanizing, hiking, and camping are popular attractions, as are the area's geographic features, including Hells Canyon and the Sawtooth and Seven Devils mountains. Most communities feature annual events that help boost local economies.

Government agencies at all levels, including school districts, are consistently among the top employers in the Salmon subbasin counties. Federal land figures prominently within the subbasin, including land managed by seven National Forests and three Bureau of Land Management field offices.

1.6.2 Ownership and Land-Use Patterns

Public lands account for approximately 90% of the Salmon subbasin, with most of the public land in federal ownership and managed by one of seven National Forests or the Bureau of Land Management (Table 1-6 and Figure 1-11). Public lands within the subbasin are managed to produce wood products, forage for domestic livestock, and mineral commodities and to provide recreation, wilderness, and terrestrial and aquatic habitats. Approximately 9% of the subbasin land area is privately owned. However, when land ownership is calculated within a 50-m (164 ft) buffer of measured streams, the percentage of private land ownership generally increases (Table 1-6). Private lands are primarily in agricultural cultivation and concentrated in valley bottoms within the upper and lower portions of the subbasin.

Land management practices within the subbasin vary among landowners and/or managers. The greatest proportion of National Forest lands are federally designated Wilderness Areas or are areas of low suitability for producing or extracting resource commodities. One-third of the National Forest lands in the subbasin are managed intensively for production of forest, mineral, or range resource commodities. Bureau of Land Management lands in the subbasin are managed for multiple users, with dominant users being ranchers and recreationists, while protecting and enhancing habitats for native species. State of Idaho endowment lands within the subbasin are managed for production of forest, mineral, or range resources.

Table 1-6. Landowner/manager and the associated percentage of area in the Salmon subbasin, Idaho, by major hydrologic unit (watershed) and by 50-m (164 ft) stream buffer.

Landowner/manager	Percentage (%) of watershed[a]										% of subbasin
	UPS	PAH	MSP	LEM	MFU	MFL	MSC	SFS	LOS	LSA	
USDA Forest Service	69.9	45.8	84.5	39.8	99.8	99.7	98.9	98.9	41.0	62.0	77.3
USDI Bureau of Land Management	25.2	43.7	11.0	40.0	0.0	0.0	0.9	0.2	5.0	3.3	12.7
Other	1.1	2.0	0.3	2.5	0.1	0.1	0.1	0.6	4.3	2.9	1.2
Private/Water	3.8	8.5	4.2	17.7	0.1	0.1	0.1	0.4	49.7	31.8	8.9
Total Area (square km)	6,276	2,151	4,704	3,239	3,898	3,554	4,438	3,399	3,051	1,495	36,204
(square miles)	2,423	831	1,816	1,251	1,505	1,372	1,714	1,312	1,178	577	13,978
Landowner/manager	**Percentage (%) of watershed within 50-m (164 ft) stream buffer**										**% of subbasin**
	UPS	**PAH**	**MSP**	**LEM**	**MFU**	**MFL**	**MSC**	**SFS**	**LOS**	**LSA**	
USDA Forest Service	73.6	39.1	81.4	39.1	99.8	99.5	99.2	98.5	41.5	52.4	77.9
USDI Bureau of Land Management	18.6	42.7	10.5	32.2	0.0	0.0	0.6	0.0	6.3	3.8	9.7
USDI National Park Service	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	0.0
State of Idaho	1.0	1.5	0.1	2.2	0.1	0.3	0.0	0.4	3.7	3.1	1.0
Private/Water	6.8	16.8	8.0	26.4	0.0	0.2	0.1	1.1	48.4	40.8	11.4
Total Area (km^2)	241	73	192	128	186	152	210	159	143	67	1,551
(square miles)	93	28	74	49	72	59	81	61	55	26	599

[a] See Table 1-1 for watershed acronyms.

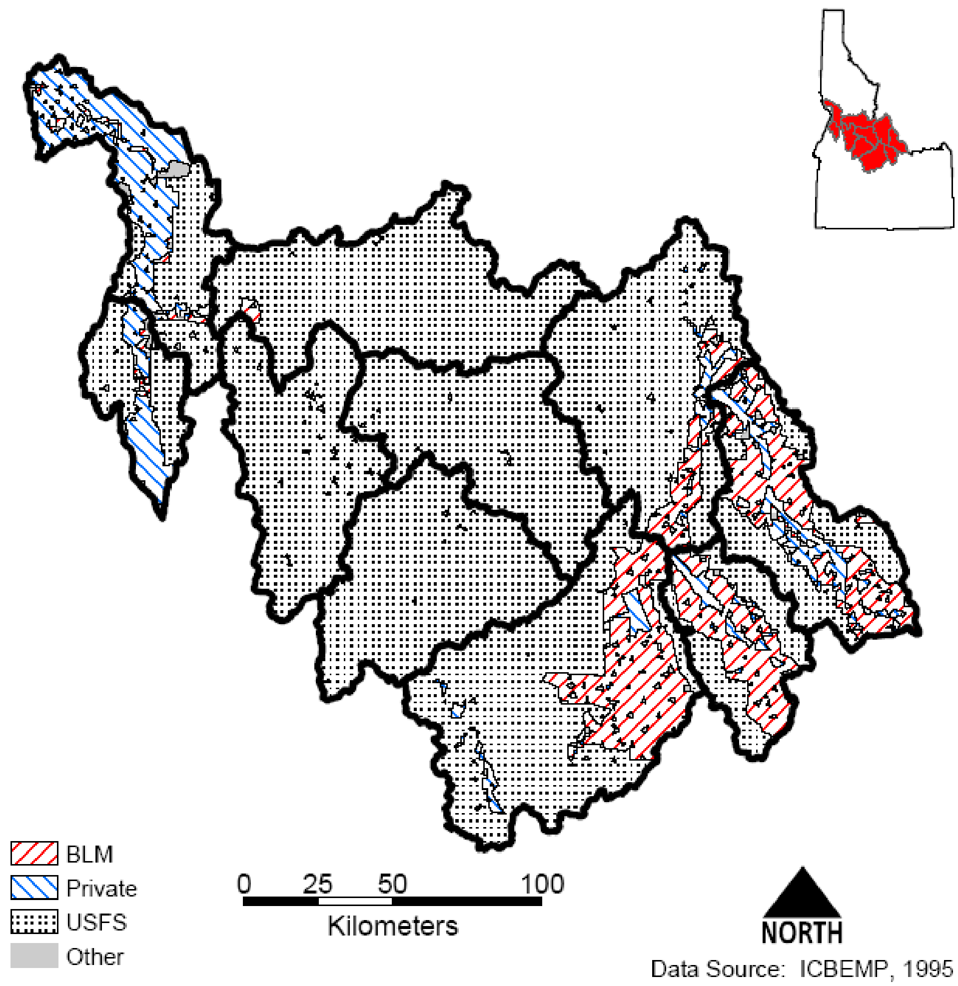


Figure 1-11. Land ownership/management patterns within the Salmon subbasin, Idaho.

1.6.3 Water Diversion Structures and Fish Migration Barriers

No manmade, year-round, total barriers to fish migration currently exist on the Salmon River and its larger tributaries, but partial and seasonal barriers have been created on many of the subbasin streams (Figure 1-12). Partial barriers to anadromous fish exist on the Yankee Fork in the form of acid mine drainage and on the Lemhi, Pahsimeroi, East Fork Salmon, and upper Salmon rivers at irrigation diversions. The lower 3 miles of the Panther Creek is filled with mud, rock, and debris resulting from a cloudburst in 2003. Twenty minor tributaries contain dams that are used for numerous purposes such as irrigation, recreation and fish propagation (NPPC 1990). Many tributaries in the Lemhi and Pahsimeroi watersheds have irrigation diversion structures that create seasonal fish passage barriers.

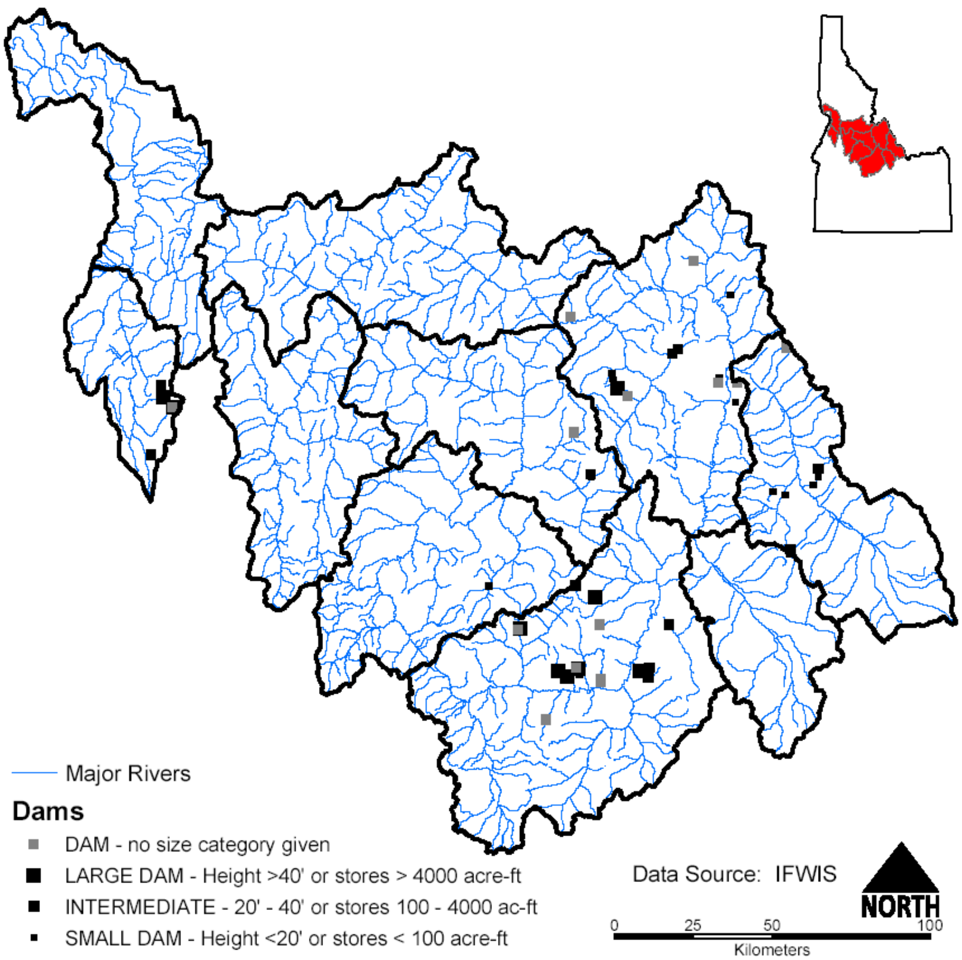


Figure 1-12. Locations of partial and seasonal dams in the Salmon subbasin, Idaho.

Three power-generating dams were constructed on rivers in the Salmon subbasin in the early 1900s but have since been removed: Sunbeam Dam on the mainstem Salmon River immediately upstream from the Yankee Fork confluence, a dam across Big Boulder Creek in the East Fork drainage, and a dam on the lower Lemhi River.

Constructed in 1910 by the Golden Sunbeam Mining Company, Sunbeam Dam remained intact until 1934. It completely blocked adult anadromous fish for most of the period between 1911 and 1934. The original fish ladder, operating in 1911, proved to be completely ineffective. In 1919, a redesigned fish ladder was installed. Completed in 1920, it reportedly passed adult sockeye salmon during its first year of operation. But between 1921 and 1934, fish passage with the redesigned ladder was reported as doubtful. In 1931, Chinook salmon reportedly began negotiating the abandoned power supply tunnel. In 1934, the rock abutment on the south side of the dam was breached with explosives.

The Big Boulder Creek dam in the East Fork Salmon drainage was built in 1925. This dam powered the Livingston mine. The dam was removed by the Shoshone-Bannock tribes in 1991, and they are still working to restore the site.

In 1907, the first hydro dam was constructed on the Lemhi River about 1 mile above the mouth. In 1909, another dam was constructed just below the first dam. These dams isolated the Lemhi River basin except during high water periods. Both structures operated until 1926 when generating operations were consolidated at a newer plant. Hydropower generation ceased in 1950, and the dams were removed sometime between 1953 and 1956. Before the dams were removed, fish were trapped for commercial and hatchery use. Although hatchery personnel attempted to minimize impacts on the run by restocking a portion of the hatchery fish, the combination of the dams, hatchery, and commercial take contributed to the collapse of the fishery. By the late 1930s, the run had dwindled to about 200 fish. After the dams were removed, the fish runs began to increase. From 1960 to 1965, redd counts by the Idaho Department of Fish and Game averaged 1,200 redds (Kiefer *et al*. 1992).

1.6.4 Protected Areas

A diverse range of protected areas is present within the Salmon subbasin. These specially designated areas include wilderness and roadless areas, relatively small ecological reference areas, wild and scenic rivers, national recreation areas, and fishing and hunting access areas (Figure 1-13). Detailed information about these conservation sites and specially managed areas is maintained by federal land managers and the Idaho Conservation Data Center, Idaho Department of Fish and Game.

Fifty-nine relatively small, highly protected ecological reference areas are present within the subbasin. These include U.S. Forest Service Research Natural Areas and Special Interest Areas; Bureau of Land Management Research Natural Areas, Areas of Critical Environmental Concern, and Wilderness Study Areas; and The Nature Conservancy preserves. Research Natural Areas provide pristine, high-quality, representative examples of the important ecosystems within the subbasin. These sites combine with the large tracts of undeveloped land within the subbasin to provide excellent opportunities for research regarding physical and biological ecosystem processes.

In addition to designated wilderness, the Salmon subbasin has an abundance of roadless and little-roaded federal lands that have high ecological integrity. Combined with designated wilderness, these areas account for a substantial portion of the subbasin (Figure 1-14) and serve as habitat strongholds for multiple species of fish and wildlife. Recent federal management direction suggests that unroaded areas might remain in their undeveloped state, although this issue is in dispute and may be resolved through court action. Whatever the ultimate fate of unroaded areas, they are clearly important to the conservation of native fish and wildlife species in the region (ICBEMP 1997).

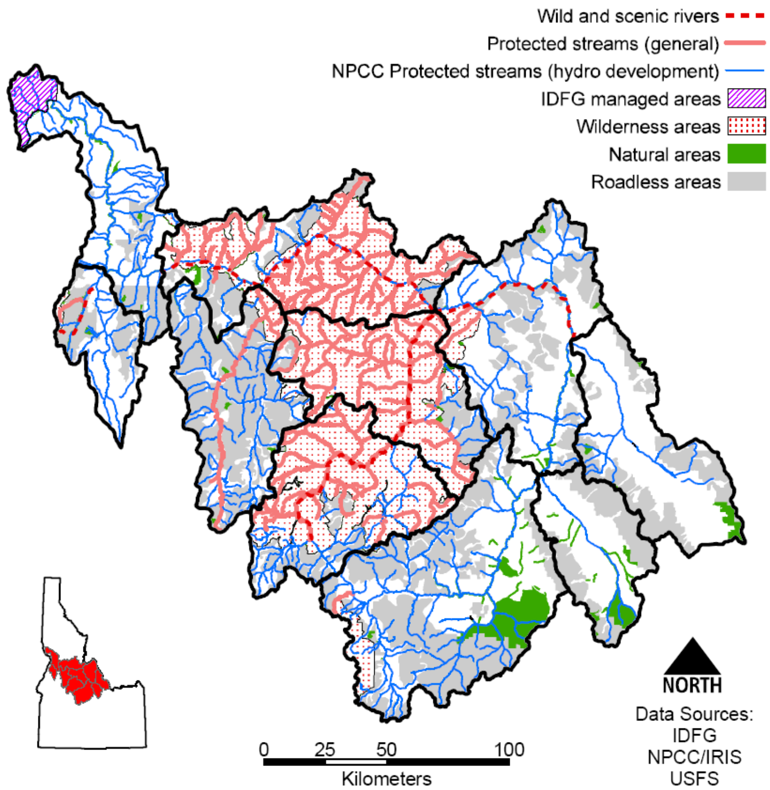


Figure 1-13. Protected areas within the Salmon subbasin, Idaho.

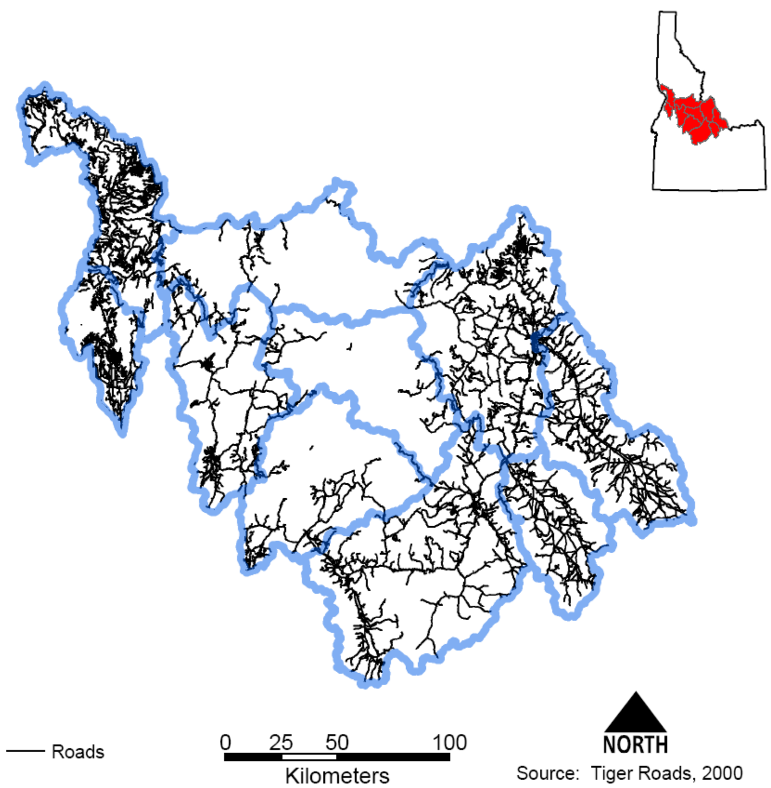


Figure 1-14. Road densities within the Salmon subbasin, Idaho.

1.7 Environmental and Biological Situation

1.7.1 Water Quality

Water quality issues within the subbasin are characterized by prevalent regulatory guidelines such as 1) the location of toxic substance releases, 2) the location of hazardous materials, 3) known point source discharges, and 4) the presence of impaired water bodies. Water quality in many areas of the subbasin is affected to varying degrees by land uses that include livestock grazing, road construction, logging, and mining.

Eighty-nine water bodies in the Salmon subbasin are classified as impaired under the guidelines of section 303(d) of the Clean Water Act (USEPA and IDEQ 1998) (Figure 1-15). The primary parameters of concern are sediments (88 cases), nutrients (17 cases), flow alteration, irregular temperatures, and habitat alteration.

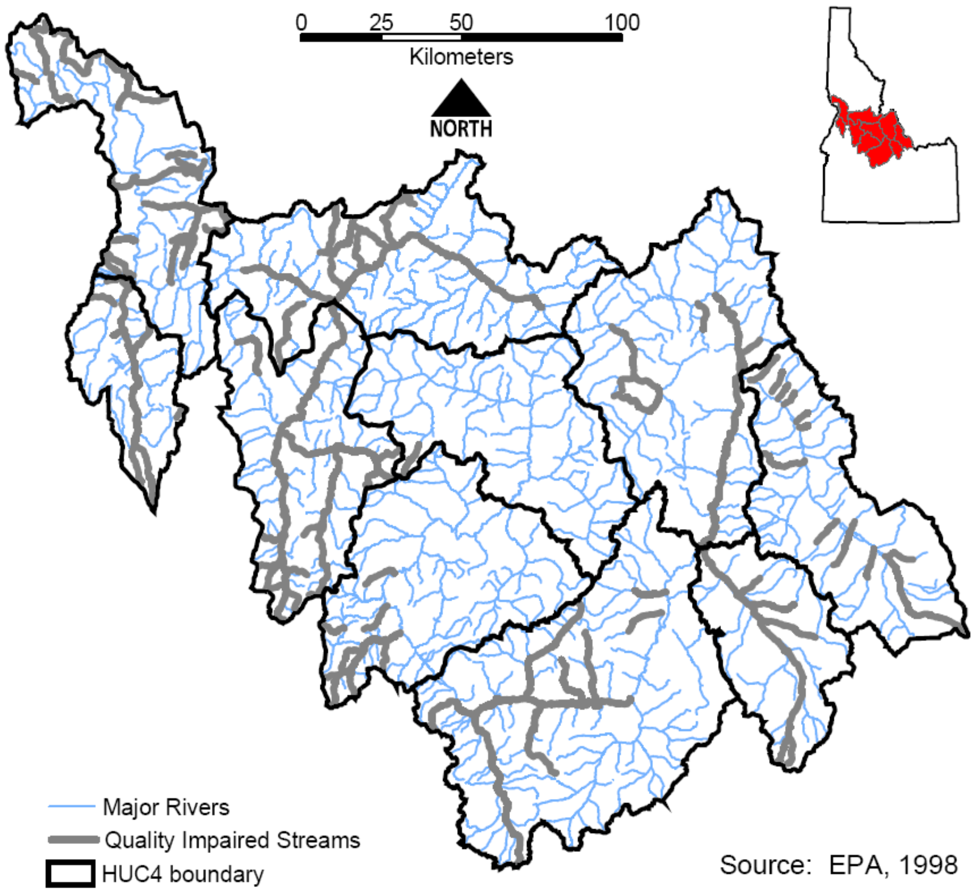


Figure 1-15. Streams in the Salmon subbasin, Idaho, that are included on the 303(d) list.

The EPA lists 10 to 25% of the waters within each of the South Fork Salmon and Lower Salmon watersheds as impaired; 5 to 10% of the waters in the Little Salmon, Pahsimeroi, Middle Salmon–Panther, Lemhi, and Middle Salmon–Chamberlain watersheds are impaired. In the Upper Salmon, Upper Middle Fork Salmon, and Lower Middle Fork Salmon, less than 5% are listed as impaired. Total maximum daily load (TMDL) standards were approved for the Lemhi (IDEQ 1999), Middle Salmon–Panther (IDEQ 2001a), Pahsimeroi (IDEQ 2001b), and Upper Salmon (IDEQ 2003) watersheds. Watershed assessments and TMDL standards are to be developed for the Lower Salmon and Little Salmon watersheds in 2004 and the Middle Fork Salmon watershed in 2005.

Potential for surface water pollution by heavy metals contaminants is localized and associated with mining activity. Six mines within the subbasin have records of toxic substance releases involving the following contaminants and conditions: arsenic, chromium, nitrate compounds, nickel, iron, silver, zinc, cadmium, lead, copper, manganese, mercury, cobalt, 2-mercaptomenzothiazole, chlorine, coliform, solids, and altered basic water chemistry (USEPA 2001a). An additional six mines located within the subbasin show no records of toxic substance releases (USEPA 2001a, 2001b).

A community water system is a public water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents (e.g., in a municipality, subdivision, mobile home park, apartment complex, or nursing home). Community water source facilities are most abundant in the Upper Salmon watershed, with 160, and the Middle Salmon–Panther watershed, with 134 water sources. Documented community water sources are generally less common in the more sparsely populated watersheds. The Lower Salmon watershed has 17 community water sources; Little Salmon, 14; Lemhi, 13; South Fork Salmon, 5; Pahsimeroi, 4; and Middle Salmon–Chamberlain, 3. There are no documented community water sources in the Lower Middle Fork Salmon and Upper Middle Fork Salmon watersheds (IDEQ 2003).

1.7.2 Species Status and Constraints

The Salmon subbasin contains an abundance of streams and lakes, including 5,463 km (3,395 miles) of stream habitat for anadromous fish (StreamNet 2003). Fish habitat quality in the subbasin varies by location, but in general, habitats are of higher quality where there has been little or no watershed development, and they decline in quality where development or resource use has increased (NPPC 2001). Fish that are most productive in valley bottom settings—fish such as stream-type (spring/summer) Chinook salmon or large fluvial adults in resident salmonid populations—have lost a sizeable portion of their historic habitats because of habitat alteration by a variety of human activities. Status of and constraints of nongame and nonsalmonid fishes are unknown due to the lack of basic ecological data for these animals.

The Salmon subbasin also supports an abundance of terrestrial wildlife species, all of which depend in some capacity on the aquatic resources. However, alteration of the hydrologic regime, coupled with other limiting factors such as land-use conversion practices, livestock grazing and browsing, timber harvest, invasive species, and fire suppression, have resulted in changes in wildlife abundance and distribution. For example, land-use conversion activities such as building roads and fencing fields can block migratory wildlife like elk, antelope, and bighorn sheep from water sources. And the removal of vegetation along riparian corridors has reduced the amount of food, nesting habitat, and cover available to wildlife species.

The degree to which watershed and aquatic conditions within the subbasin are degraded from high-integrity or from unaltered conditions is depicted in Figures 1-16 and 1-17. Conditions less favorable to the subbasin's native fish populations are common in all major watersheds except the three dominated by wilderness and roadless areas: the Upper Middle Fork, Lower Middle Fork, and Middle Salmon–Chamberlain watersheds. Areas of high watershed and aquatic integrity are present, but discontinuous, in the other seven major watersheds within the subbasin, where deviations from historic conditions are common and sometimes pronounced.

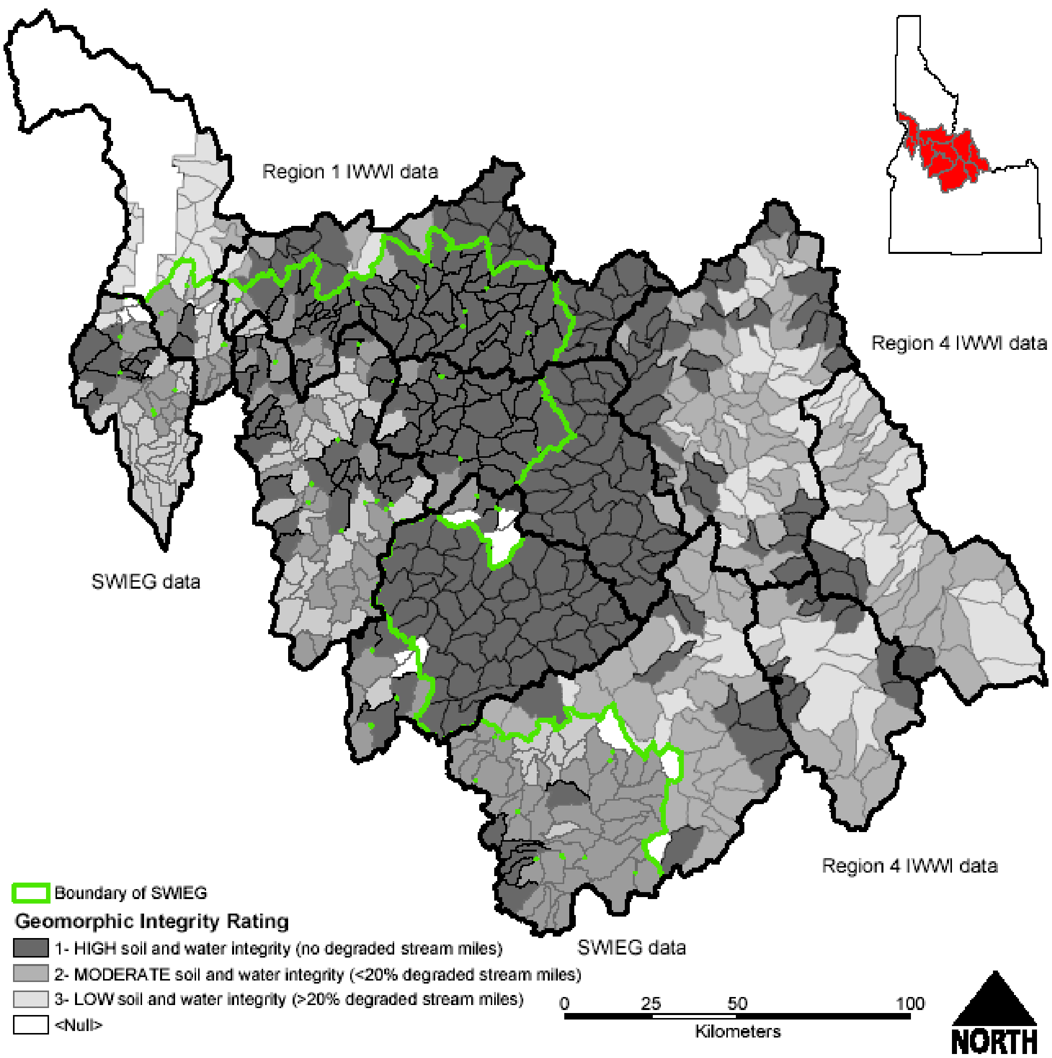


Figure 1-16. Watershed geomorphic integrity within the Salmon subbasin, Idaho (IWWI = Inland West Watershed Initiative and SWIEG = Southwest Idaho Ecogroup). Sources: USDA 2003 and USFS 2003.

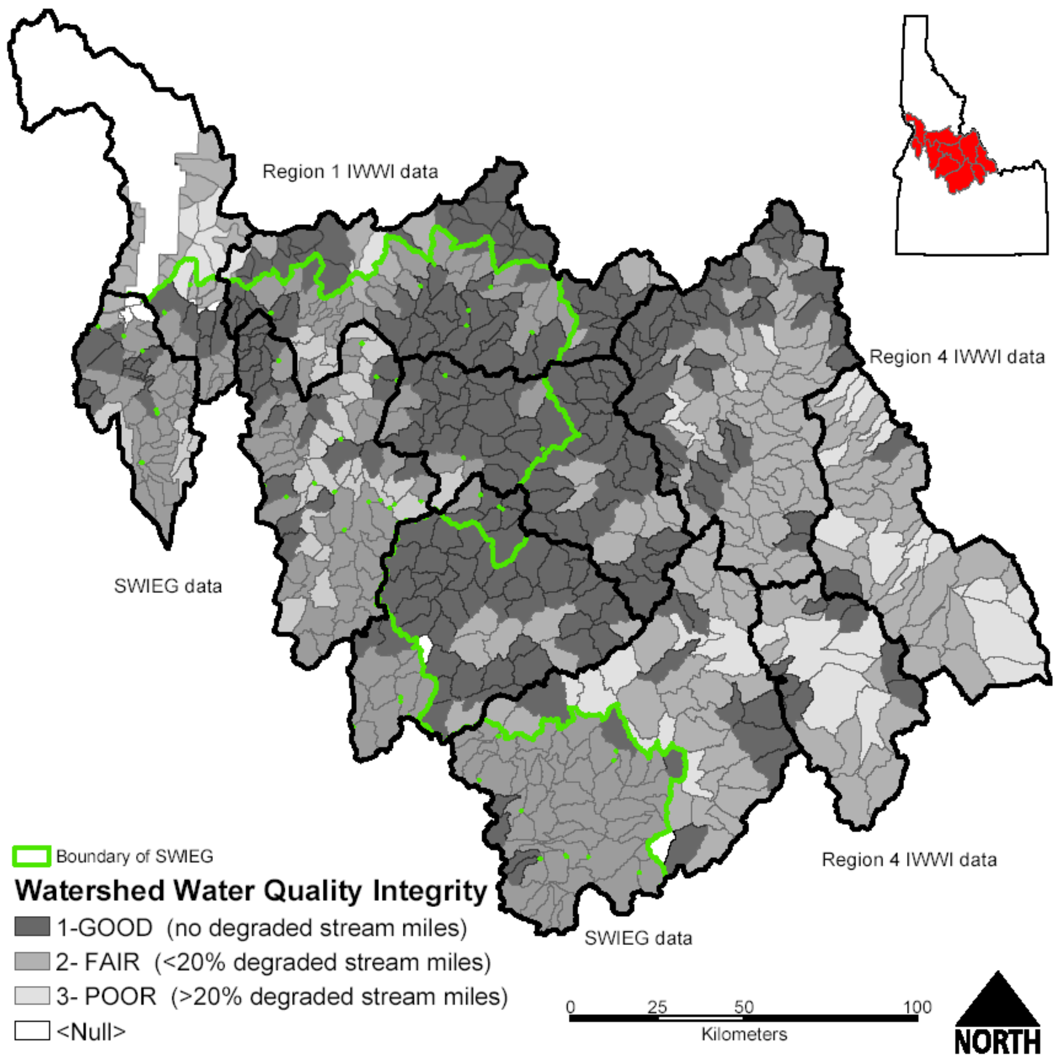


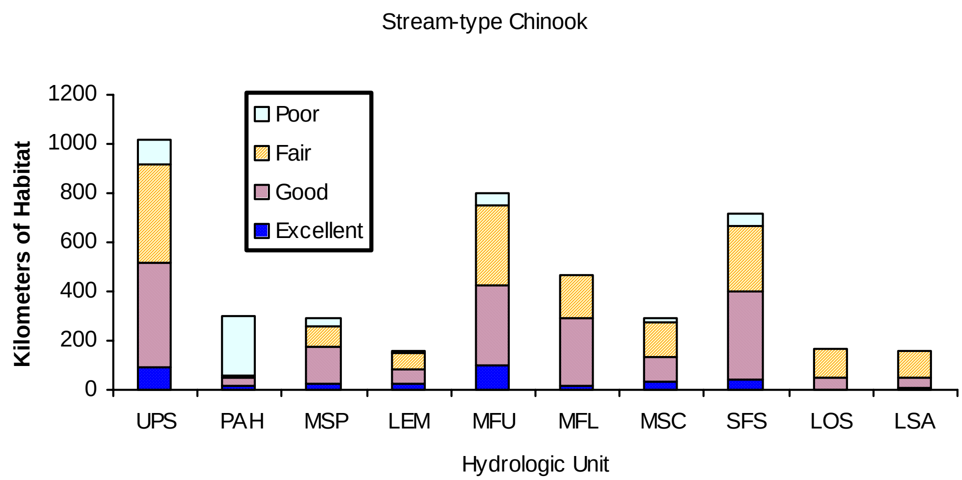
Figure 1-17. Water quality integrity within the Salmon subbasin, Idaho (IWWI = Inland West Watershed Initiative and SWIEG = Southwest Idaho Ecogroup). Sources: USDS 2003 and USFA 2003.

1.7.3 Habitat Status and Constraints

Although many watersheds and streams have been altered in the subbasin, biologists estimate that undeveloped and other areas continue to provide approximately 2,184 km (1,357 miles) of good to excellent habitat for Chinook salmon and about 4,879 km (3,032 miles) of good to excellent habitat for summer steelhead trout (Figure 1-18). Habitat rated good to excellent for Chinook salmon is most abundant in the Upper Salmon, Upper Middle Fork Salmon, South Fork Salmon, and Lower Middle Fork Salmon watersheds. Good to excellent habitat for steelhead is relatively common in each major watershed, with excellent habitat particularly abundant in the Lower Middle Fork, Middle Salmon–Chamberlain, and Upper Middle Fork watersheds.

Despite the abundance of good to excellent habitat in the subbasin, about 63% (1,374 km; 854 miles) of the habitat available for

Chinook salmon has been rated as fair to poor quality. Although habitat ratings of fair and poor quality may reflect natural physical features such as gradient and channel type, much of the fair to poor areas are located in valley bottom settings where good to excellent habitat for Chinook salmon is expected in the absence of human activities and impacts. Lowered habitat quality in valley bottom areas has important implications for aquatic species in many parts of the subbasin because of the naturally (historically) high productivity of these areas as well their importance in connecting habitats and populations. About one-fourth (1,017 km; 632 miles) of the stream habitat available to steelhead has been rated as only fair or poor quality. Degraded habitat is most common in the seven major watersheds that have been most heavily developed.



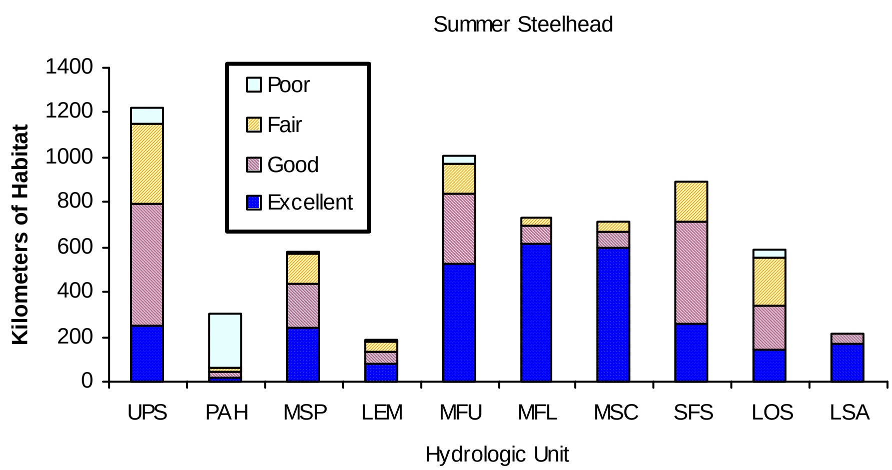


Figure 1-18. Quantity and rated quality of spawning and rearing habitat available to stream-type (spring/summer) Chinook salmon (top) and summer steelhead trout (below) in the Salmon subbasin, Idaho (StreamNet 2003).

Similar to aquatic habitats, relatively pristine wildlife habitat occurs within the core of large tracts of high-quality wilderness and roadless areas in the subbasin. Wildlife habitats also tend to be more modified or degraded in the major watersheds that have broad valleys and easier access for humans and development, such as the Little Salmon, Lower Salmon, Pahsimeroi, and Lemhi watersheds.

1.7.4 Disturbance

Alterations in ecosystem processes have resulted in changes in the distribution, quality, and quantity of fish and wildlife habitats within the subbasin. The Interior Columbia River Basin assessment (ICBEMP 1997) concluded that historic development of the Interior Columbia River Basin over the last 150 years has greatly altered ecological processes to the detriment of many native species of fish and wildlife. Land and water use practices contributing to these changes included unrestricted or little-restricted livestock grazing, road construction, timber harvest and fire management, certain intensive agricultural practices, placer and dredge mining, dam construction, and stream channelization. The decline of anadromous fish runs to the Salmon subbasin impact both aquatic and terrestrial food webs due to the loss of marine-derived nutrients and associated organic materials to the system (Cederholm *et al*. 1999; Gresh *et al*. 2000; Bilby *et al*. 2001). These watershed disturbances have caused risks to ecological integrity by reducing biodiversity and threatening riparian-associated wildlife species across broad geographic areas. Some land-use practices such as grazing and timber harvest have been modified in recent years, but historic impacts continue to negatively affect the ecological integrity of specific areas.

1.7.5 Noxious and Invasive Exotic Weeds

Noxious weeds and invasive exotic plant species are spreading within the Salmon subbasin (Figure 1-19). Thirty-five noxious weed species are currently known or expected within the subbasin (Table 1-7). Roads, trails, and rivers tend to act as primary conduits for the spread and establishment of noxious and invasive exotic plants. Their spread and establishment in the Salmon subbasin is partly due to lack of natural population controls in the new environments and to the prolific seed production common for most noxious weeds. Site vulnerability to noxious and invasive exotic weed invasion varies with the site’s vegetative productivity and the site’s similarity to the invader’s native habitat (Boise National Forest 2000).

Introduced plants in the subbasin often out-compete native plant species and alter ecological processes, reducing habitat suitability (Quigley and Arbelbide 1997). Noxious and invasive exotic weeds have infested grasslands and transportation corridors in the subbasin and can negatively impact plant and animal biodiversity, natural ecological processes (fire, hydrology, and soil development), and the quality and availability of livestock and wildlife forage (Olson 1999). For instance, elk tend to use areas infested with spotted knapweed less frequently than they use uninfested areas (Sheley and Petroff 1999). Noxious and invasive exotic weeds may also invade riparian areas, competing with desirable vegetation.

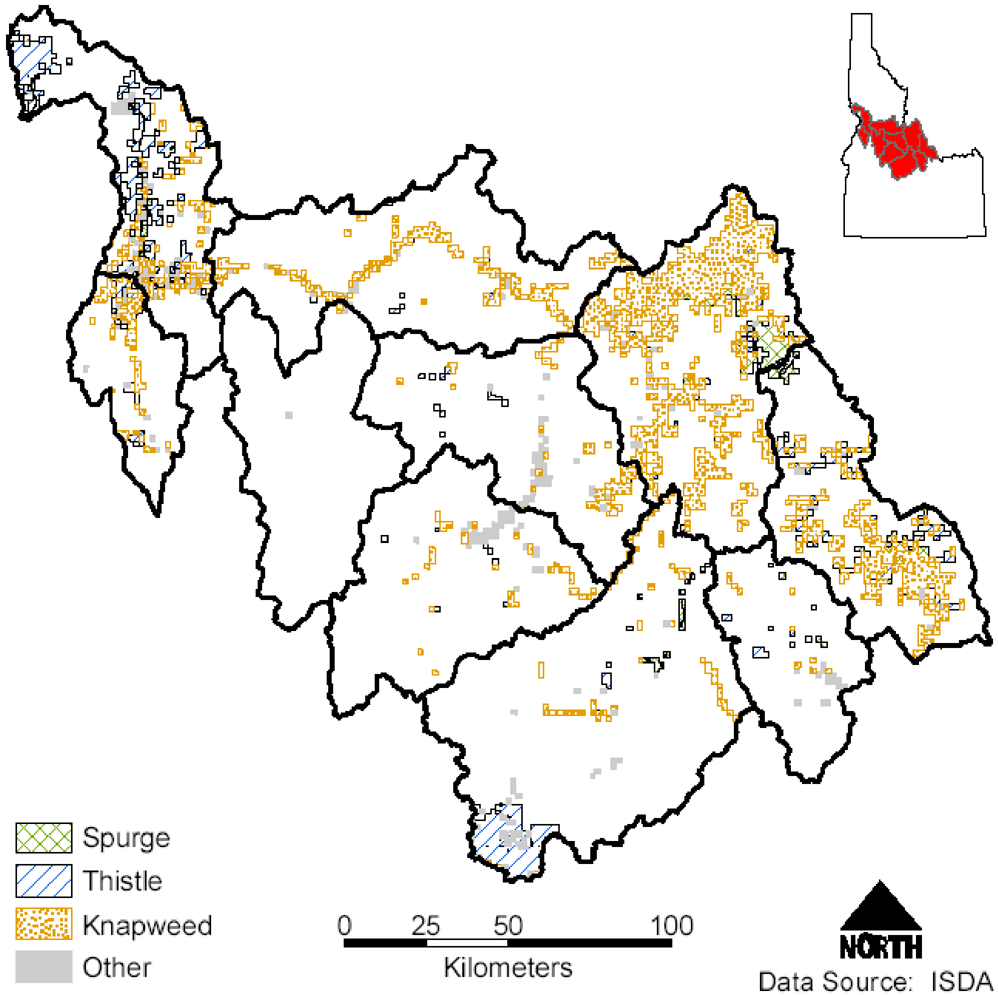


Figure 1-19. Distribution of noxious and invasive exotic weeds in the Salmon subbasin, Idaho.

The highest priority for treatment is given to new invading species and rapidly spreading invading species. These include diffuse and spotted knapweed (*Centaureai diffusa* and *C. maculosa*, respectively), rush skeletonweed (*Chondrilla juncea*), yellow starthistle (*Centaurea solstitialis*), dalmatian toadflax (*Linaria dalmatica*), and leafy spurge (*Euphorbia esula*). A large infestation of yellow toadflax occurs at Patterson in the Pahsimeroi watershed. Most of the rush skeletonweed is found in the Upper and Lower Middle Fork Salmon and South Fork Salmon watersheds.

Exotic species that are not currently listed in Idaho as noxious weeds, but that pose significant threat to the subbasin houndstongue (*Cynoglossum officinale*) and sulfur cinquefoil (*Potentilla recta*). Cheatgrass (*Bromus tectorum*), also not currently listed as a noxious weed in the state, is an invasive grass known to provide less nutrition to herbivorous wildlife species than native grasses and to shorten fire return intervals (Quigley and Arbelbide 1997).

Table 1-7. Presence of invasive exotics by watershed in the Salmon subbasin, Idaho (ISDA 2003).

Species	**UPS**[a]	**PAH**	**MSP**	**LEM**	**MFU**	**MFL**	**MSC**	**SFS**	**LOS**	**LSA**
Black henbane (*Hyoscyamus niger*)	X	X	X	X	X	X	X	X	X	X
Buffalobur (*Solanum rostratum*)						X	X	X	X	X
Canada thistle (*Cirsium arvense*)	X	X	X	X	X	X	X	X	X	X
Common crupina (*Crupina vulgaris*)					X	X	X	X	X	X
Dalmatian toadflax (*Linaria genistifolia* ssp. *dalmatica*)	X	X	X	X	X	X	X	X	X	X
Diffuse knapweed (*Centaurea diffusa*)	X	X			X	X	X	X	X	X
Dyer's woad (*Isatis tinctoria*)		X	X	X		X	X	X	X	X
Field bindweed (*Convolvus arvensis*)	X	X	X	X	X	X	X	X	X	X
Hoary cress (*Cardaria draba*)	X	X	X	X	X	X	X	X	X	X
Johnsongrass (*Sorghum halpense*)		X	X	X		X	X	X	X	X
Jointed goatgrass (*Aegilops cylindrica*)		X	X	X	X	X	X	X	X	X
Leafy spurge (*Euphorbia esula*)	X	X	X	X	X	X	X	X	X	X
Matgrass (*Nardus stricta*)										
Meadow hawkweed (*Hieracium pratense*)						X	X	X	X	X
Meadow knapweed (*Centaurea pratensis*)										
Milium (*Milium vernale*)					X	X	X	X	X	X
Musk thistle (*Carduus nutans*)					X	X	X	X	X	X
Orange hawkweed (*Hieracium aurantiacum*)					X	X	X	X	X	X
Perennial pepperweed (*Lepidium latifolium*)									X	
Perennial sowthistle (*Sonchus arvensis*)	X	X	X	X	X	X	X	X		
Poison hemlock (*Conium maculatum*)	X	X	X	X	X	X	X	X	X	X
Puncturevine (*Tribulus terrestris*)	X	X	X	X						
Purple loosestrife (*Lythrum salicara*)								X	X	X
Rush skeletonweed (*Chondrilla juncea*)	X	X	X	X	X	X	X	X	X	X
Russian knapweed (*Acroptilon repens*)	X	X	X	X	X	X	X	X	X	X
Scotch broom (*Cytisus scoparius*)						X	X	X	X	X
Scotch thistle (*Onopordum acanthium*)	X	X	X		X	X	X	X	X	X
Silverleaf nightshade (*Solanum elaegnifolium*)						X	X	X	X	X
Skeletonleaf bursage (*Ambrosia tomentosa*)	X								X	
Spotted knapweed (*Centaurea maculosa*)	X	X	X	X	X	X	X	X	X	X
Syrian beancaper (*Zygophyllum fabago*)									X	
Tansy ragwort (*Senecio jacobaea*)					X	X	X	X	X	X

Species	UPS[a]	PAH	MSP	LEM	MFU	MFL	MSC	SFS	LOS	LSA
Toothed spurge (*Euphorbia dentata*)						X	X	X	X	X
Yellow starthistle (*Centaurea solstitialis*)	X					X	X	X	X	X
Yellow toadflax (*Linaria vulgaris*)	X	X	X	X	X	X	X	X	X	X

[a] See Table 1-1 for watershed acronyms.

2 Subbasin Biological Resources

This assessment considers the complex environmental linkages found within ecosystems and uses a multi-species approach. Although the emphasis of this Salmon subbasin assessment is on aquatic species, we consider the direct and indirect changes in aquatic habitats that can and do affect the terrestrial environment and vice versa. The challenge is considering the numerous roles of each species in the environment and the consequences of changes to, elimination of, or decreases in one habitat and/or species on other habitats and species. To consider these roles and consequences, we evaluated the ecological functions and relationships of species and habitats (IBIS 2003). This section provides an overview of the Salmon subbasin ecosystem and working hypotheses of the ecological roles of fish and wildlife in the subbasin, focuses on focal habitats and species chosen by the terrestrial and fisheries technical teams, and discusses the limiting factors affecting habitats and wildlife populations within the subbasin and its ecosystem.

This assessment focuses on eight habitats and their associated focal species (Figure 2-1 and Table 2-1). Although we separate discussions of aquatic and terrestrial habitats and species, we attempt to recognize the hierarchical relationships between focal habitats, focal vegetation species, and focal wildlife species. Both aquatic and terrestrial resources sections describe the physical and biological features of a focal habitat.

Focal habitats describe a combination of unique vegetative characteristics, dominant plant species, or successional stages with important ecological ties to fish and wildlife (e.g., old growth).

Focal habitats may also be composed of specific environmental elements integral to the viability of fish and wildlife populations (e.g., snags and caves). One or more of the following criteria were used to identify focal habitats for this assessment:

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

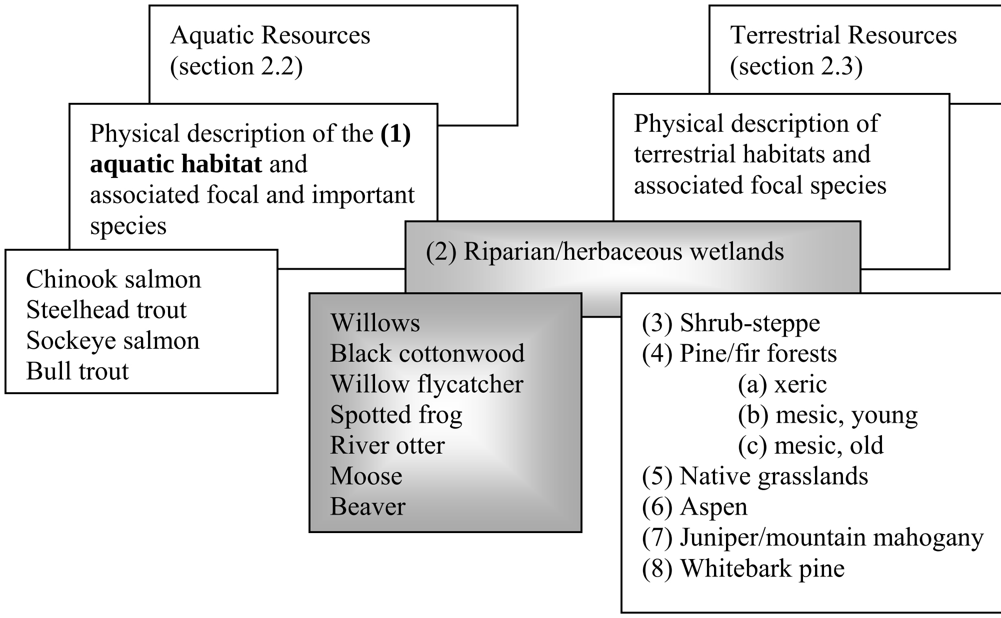


Figure 2-1. Relationships of aquatic and terrestrial resources based on the eight focal habitats defined in the Salmon subbasin assessment. The riparian/herbaceous wetlands habitat is a direct link between the aquatic and terrestrial resources. Willow and cottonwood plant species function to provide cover, food, shelter, and streambank stability for both aquatic and terrestrial resources. The beaver is especially important to aquatic and riparian/herbaceous wetland habitats since it creates and maintains waterways and affects hydrography.

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

Table 2-1. Focal habitats and species associated with those focal habitats in the Salmon subbasin, Idaho. Three focal habitat subtypes are listed for the pine/fir forest category.

Focal Habitat	Focal Species	Species Key Roles in Maintaining Ecological Conditions
Aquatic	Chinook salmon (threatened under the ESA)	Provides substantial nutrient source (including carbon, nitrogen and phosphorous) from decaying adult carcasses. Adults, carcasses, eggs, and juveniles provide food for other fish, birds, and mammals. Spawning activity results in mobilization of fine sediment. Areas used year after year for spawning may maintain coarser sediments than surrounding areas.
	Steelhead trout (threatened under the ESA)	Provides substantial nutrient source (including carbon, nitrogen, and phosphorous) from decaying adult carcasses. Adults, carcasses, eggs, and juveniles provide food for other fish, birds, and mammals. Spawning activity results in mobilization of fine sediment. Areas used year after year for spawning may maintain coarser sediments than surrounding areas.
	Sockeye salmon (endangered under the ESA)	Provides substantial nutrient source (including carbon, nitrogen, and phosphorous) from decaying adult carcasses. Adults, carcasses, eggs, and juveniles provide food for other fish, birds, and mammals. Spawning activity results in mobilization of fine sediment. Areas used year after year for spawning may maintain coarser sediments than surrounding areas.
	Bull trout (threatened under the ESA)	Top aquatic predator that maintains prey flight and wariness and cycles nutrients. Spawns in very cold headwater areas.
Riparian/herbaceous wetlands	Willows (general)	Provide cover, food, bank stability, shading, nutrient cycling, filtering, and nesting substrate.
	Peachleaf willow	Tolerant of poor drainage and prolonged flooding.
	Geyer's willow	Elk and moose eat Geyer's willow.
	Booth's willow	Useful in stabilizing streambanks and providing erosion control on severely disturbed sites.
	Drummond's willow	Moose consume large amounts of Drummond's willow during winter.
	Black cottonwood	Provides cover, food, bank stability, shading, nutrient cycling, filtering, nesting substrate, and roosting.
	Columbia spotted frog	Prey for primary or secondary predators; aids in physical transfer of substances for nutrient cycling (carbon, nitrogen, phosphorous, etc.); insectivorous predator (impacts insect populations).
	Willow flycatcher	Migratory species: prey for primary or secondary predators; insectivorous predator; nutrient cycling (energy transfer).

Focal Habitat	Focal Species	Species Key Roles in Maintaining Ecological Conditions
	River otter	Creates trails (possibly used by other species); uses burrows dug by other species (secondary burrow user); controls aquatic vertebrate populations (through predation or displacement).
	Moose[a]	See juniper/mountain mahogany focal habitat.
	Beaver (the only species that actively creates waterways)	Prey for primary or secondary predator; creates trails (possibly used by other species); primary burrow excavator (fossorial or underground burrows); aids in physical transfer of substances for nutrient cycling (carbon, nitrogen, phosphorus, etc.); physically affects (improves) soil structure, aeration (typically by digging); impounds water by creating diversions or dams; creates ponds or wetlands by building physical barriers; creates standing dead trees (snags).
Shrub-steppe	Sagebrush (general)	Provides food, cover, and nesting substrate, especially for sage-steppe obligates; sometimes protects other native forbs and grasses from overgrazing (when in the interface); drives what other kinds of vegetation occur; stabilizes soil; tolerates drought.
	Greater sage-grouse	Prey for secondary or tertiary consumer (primary or secondary predator); disperses seeds.
	Pygmy rabbit	Prey for secondary or tertiary consumer (primary or secondary predator); primary burrow excavator (creates burrows); uses burrows dug by other species (secondary burrow user); creates runways (possibly used by other species); physically affects (improves) soil structure, aeration (typically by digging).
	Mule deer[a] (migrates to juniper/ mountain mahogany habitat in winter)	Creates trails (possibly used by other species); uses trails created by other species; herbivory on trees, shrubs, grasses, and forbs that may alter vegetation structure and composition; prey species for carnivores.
Pine/fir forest (dry, mature) Subtypes Xeric, old forest (ponderosa pine/Douglas-Fir) Mesic, young forest Mesic, old forest	Pileated woodpecker (mesic, mixed conifer forest)	Primary cavity excavator in snags or live trees; physically fragments downed wood; provides nest holes for suite of secondary cavity nesters; primary predator of wood-boring insects.
	White-headed woodpecker (xeric, old forest)	Transports viable seeds, spores, plants, or animals; disperses seeds/fruits (through ingestion); primary cavity excavator in snags or live trees; physically fragments and breaks downed wood.
	Flammulated owl (xeric, old forest)	Prey for secondary or tertiary consumer (primary or secondary predator); secondary cavity user; primary consumer of insects (moths, beetles).

Focal Habitat	Focal Species	Species Key Roles in Maintaining Ecological Conditions
	Marten (mesic, mixed conifer old forest; representative of downed wood component of older forests)	Affects terrestrial vertebrate populations (through predation or displacement); transports viable seeds, spores, plants, or animals; disperses seeds/fruits (through ingestion or caching); uses cavities created by other species (secondary burrow user); uses runways created by other species).
	Snowshoe hare	Prey for secondary or tertiary consumer (primary or secondary predator); uses burrows dug by other species (secondary burrow user); creates runways (possibly used by other species); herbivory on trees or shrubs that may alter vegetation structure and composition (browsers).
	Lynx (threatened under the ESA)	Apex predator; indicator of specific habitat elements; uses runways created by other species.
Native grasslands	Vesper sparrow	Prey for secondary or tertiary consumer (primary or secondary predator); transports viable seeds, spores, plants, or animals; disperses seeds/fruits (through ingestion).
	Rocky Mountain elk[a] (migrates to juniper/ mountain mahogany habitat in winter)	Prey for secondary or tertiary consumer (primary or secondary predator); creates trails (possibly used by other species); uses trails created by other species; transports viable seeds, spores, plants, or animals; disperses fungi; physically fragments downed wood; herbivory on trees or shrubs that may alter vegetation structure and composition.
	Bighorn sheep[a] (migrates to juniper/ mountain mahogany habitat in winter)	Prey for secondary or tertiary consumer (primary or secondary predator). Herbivory may alter vegetation structure and composition.
Aspen	Quaking aspen	Provides food, cover, and nesting; important for certain cavity nesters; has a high food value. Provides important breeding, foraging, and resting habitat for a variety of birds and mammals. Important mid-seral species.
Juniper/mountain mahogany	Mountain mahogany	Provides cover and forage for big game, especially in winter; has some stabilization properties; tolerant of heat and drought. Curl-leaf mountain mahogany is very palatable to bighorn sheep; helps stabilize soil in disturbed areas such as roadcuts and mine spoils.
	Moose[a] (indicator of riparian areas but uses mahogany habitat in the winter)	Prey for secondary or tertiary consumer (primary or secondary predator); herbivory on trees or shrubs that may alter vegetation structure and composition (browsers).
	Rocky Mountain elk[a]	See native grasslands focal habitat.
	Mule deer[a]	See shrub-steppe focal habitat.

Focal Habitat	Focal Species	Species Key Roles in Maintaining Ecological Conditions
	Bighorn sheep[a]	See native grasslands focal habitat.
Whitebark pine	Whitebark pine	Provides forage for bears and other species. Survives where tree growth is limited and provides hiding and thermal cover for wildlife.
	Clark's nutcracker (keystone species in Whitebark Pine regeneration)	Prey for secondary or tertiary consumer (primary or secondary predator); disperses seeds/fruits (through ingestion or caching).
	Black bear	Primary burrow excavator (fossorial or underground burrows) and uses burrows dug by other species (secondary burrow user); creates trails (possibly used by other species) and uses trails created by other species; controls terrestrial vertebrate populations (through predation or displacement); disperses seeds/fruits (through ingestion or caching).
	Grizzly bear (threatened under the ESA)	Primary burrow excavator (fossorial or underground burrows); uses trails created by other species; controls terrestrial vertebrate populations (through predation or displacement); disperses seeds/fruits (through ingestion or caching); creates feeding opportunities (other than direct prey relations).

[a] The species migrates between different focal habitats.

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

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

In the Salmon subbasin, one aquatic species is listed as endangered, while three aquatic species and seven terrestrial species are listed as threatened under the Endangered Species Act of 1973 (ESA)[1] (Table 2-2). All four ESA-listed fish species are included as focal species in the assessment. Sockeye salmon (*Oncorhynchus nerka*) is listed as endangered, and Chinook salmon (*O. tschawytscha*), steelhead (*O. mykiss*), and bull trout (*Salvelinus confluentus*) are listed as threatened species. Since the lynx (*Lynx canadensis*) and grizzly bear (*Ursus arctos horribilis*) are strongly associated with unique habitats, these listed species were identified as focal species in the terrestrial portion of the subbasin assessment. The remaining species listed under the ESA were not included as focal species for the focal habitats, but they are included in the assessment (see section 2.3.8) since they may affect future management actions or projects.

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

Two primary sources of information used in this assessment include the Interior Columbia Basin Ecosystem Management Project (ICBEMP)[2] data set and the Geographic Approach to Planning (GAP)[3] data set. The ICBEMP data set supplied information on the potential (i.e., historical) vegetation coverage, while the GAP II data set (Scott *et al*. 2002) supplied information on current coverage. With any remotely derived information, such as the GAP II data set, there is some degree of uncertainty. In GAP II, spatial and spectral resolutions, temporal constraints, cloud cover, and geometric correction accentuated uncertainty. For this assessment, the most important habitats are the aquatic, riparian, and herbaceous wetlands. However, GAP II did not assess riparian areas (see Appendix 2-1). Because riparian habitats are a focal habitat and are more critical because of their link between terrestrial and aquatic environments, obtaining reliable information on the quantity and quality of the riparian and herbaceous wetlands in the Salmon subbasin is of foremost importance.

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[2] More than 300 different geographic information system (GIS) data layers or themes were compiled or created in support of the ICBEMP assessment and development of the environmental impact statement. In addition numerous databases were created. The U.S. Forest Service Pacific Northwest Research Station serves as custodian of project data. These data can be downloaded from the ICBEMP web site. This web site is maintained by the U.S. Forest Service and Bureau of Land Management, Interior Columbia Basin Ecosystem Management Project.

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

Table 2-2. Species listed under the Endangered Species Act that occur in the Salmon subbasin, Idaho.

Species	Status	Date	Protective Regulations
Fish			
Chinook Salmon (*Oncorhynchus tschawytscha*) Snake River fall Snake River spring/summer	threatened	April 22, 1992	57 Federal Register (FR) 14653
Snake River basin steelhead (*O. mykiss*)	threatened	August 18, 1997	62 FR 43937
Snake River sockeye salmon (*O. nerka*)	endangered	November 20, 1991	56 FR 58619
Bull trout (*Salvelinus confluentus*)	threatened	November 1, 1999	64 FR 58910
Birds			
Bald eagle (*Haliaeetus leucocephalus*)	endangered threatened	March 11, 1967 July 12, 1995	32 FR 4001 60 FR 35999
Mammals			
Lynx (*Lynx canadensis*)	threatened	March 24, 2000	65 FR 16051
Grizzly bear (*Ursus arctos horribilis*)	endangered threatened	March 11, 1967 July 28, 1975	32 FR 4001 40 FR 31734
Wolf (*Canis lupus*)	Threatened (experimental population)[4]	March 11, 1967 November 18, 1994 November 22, 1994	32 FR 4001 59 FR 60252 59 FR 60266
Northern Idaho ground squirrel (*Spermophilus brunneus brunneus*)	threatened	April 5, 2000	65 FR 17779
Plants			
Spalding's catchfly (*Silene spaldingii*)	threatened	October 10, 2001	66 FR 51597
MacFarlane's four-o'clock (*Mirabilis macfarlanei*)	threatened	March 15, 1996	61 FR 10693

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

2.1 Key Ecological Functions of Fish and Wildlife Species

2.1.1 Overview

2.1.1.1 Key Ecological Functions and Environmental Correlates

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

An example of the complexity of fish and wildlife communities and their dependence on one another is the annual migration of anadromous fish to the Salmon subbasin. Recent research on salmon carcasses strongly emphasizes that salmon are a keystone species and both aquatic and terrestrial organisms depend on them (Gross *et al.* 1998, Schmidt *et al.* 1998, Cederholm *et al.* 1999, Gresh *et al.* 2000). The presence of salmon carcasses increases aquatic macroinvertebrate biomass and taxonomic richness (Piorkowski 1995, Minakawa 1997). These increases can provide for more food and indirect benefits to riparian obligate and insectivorous wildlife. The increased growth rates of juvenile resident and salmonid fish in watersheds with anadromous fish may also benefit avian and mammalian predators of these fish. The fact that salmon played a key role in these systems but are now functionally missing in the Salmon subbasin most certainly affects the distribution and abundance of many terrestrial and avian species in the Salmon subbasin (Ben-David *et al*. 1998).

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

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

2.1.1.2 Functional Specialists and Generalists

In the Salmon subbasin, the frequency of species by number of KEF categories is roughly characterized by a distribution right skewed frequency (Figure 2-2). Species with fewer KEF categories are functional specialists, performing only a few functions within their ecosystems. The species with many KEF categories tend to be functional generalists: they perform many functions. We identified 60 functional specialist species in the Salmon subbasin (Appendix 2-2). The lynx (*Lynx canadensis*) is the only focal species identified as a functional specialist. Eight species were identified that performed only one key environmental function in the Salmon subbasin (Figure 2-2). These species are the black swift (*Cypseloides niger*), common nighthawk (*Chordeiles minor*), common poorwill (*Phalaenoptilus nuttallii*), harlequin duck (*Histrionicus histrionicus*), merlin (*Falco columbarius*), rough-legged hawk (*Buteo lagopus*), turkey vulture (*Cathartes aura*), and ringneck snake (*Diadophis punctatus*) (Appendix 2-2). Only one species performs 14 or more environmental functions, the black bear (*Ursus americanus*). The majority of the species in the Salmon subbasin perform between three and seven key environmental functions (Figure 2-2).

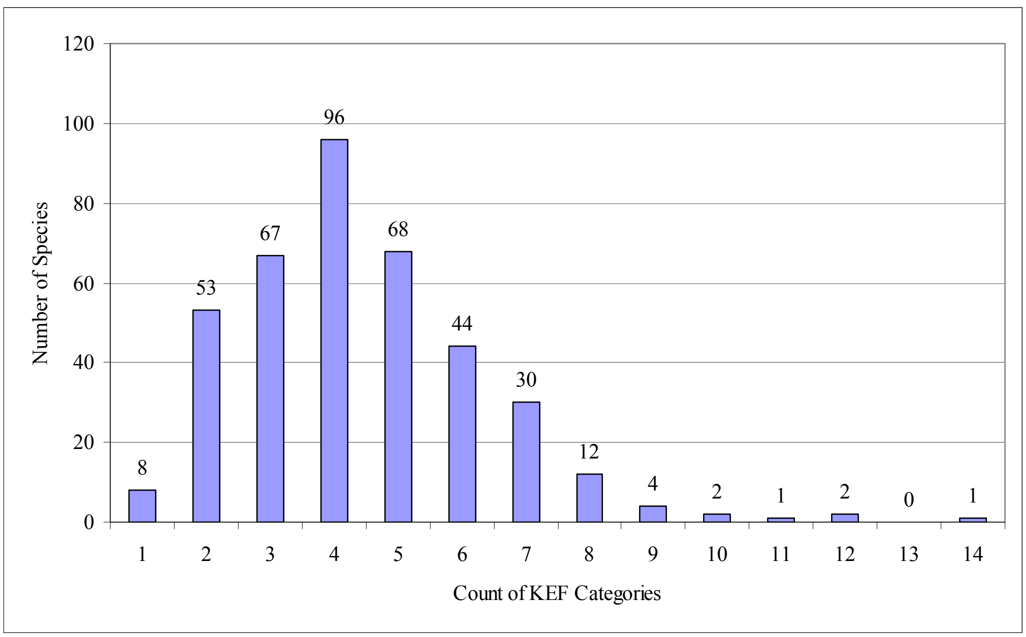

Figure 2-2. Frequency histogram showing the count of vertebrate wildlife species in the Salmon subbasin by number of categories of key ecological functions (KEFs) that they perform (source: IBIS 2003).

2.1.1.3 Functional Richness

We also determined the functional richness in the Salmon subbasin by counting the total number of KEF categories in a community (IBIS 2003). The wildlife habitats in the Salmon subbasin appear more or less equally functionally rich (Appendix 2-2), with between 35 and 45 species per wildlife habitat. The most functionally rich communities are the riparian and herbaceous wetland areas. Forested habitats are slightly greater in the functional richness than shrub-steppe or grassland habitats.

2.1.1.4 Trophic Levels

Evaluation of KEFs can also be used to depict general trophic structures of communities and identify species that aid in the physical transfer of substances for nutrient cycling. In the Salmon subbasin, 207 wildlife species (53%) are categorized as primary consumers, 350 (90%) are secondary consumers (primary predators), and 9 (2%) are tertiary consumers (secondary predators) (Figure 2-3). Bird species appear to play a proportionally greater role across the trophic levels. Other minor trophic categories include carrion feeders (6%, mostly birds and mammals), cannibalistic feeders (1%, amphibians and mammals), and coprophagous feeders (feeding on excrement) (1.5%, all mammals). All amphibian species, with the exception of the inland tailed frog (*Ascaphus montanus*), assist with nutrient cycling. Eight bird species and 13 mammalian species, composed mostly of bats and the beaver (*Castor canadensis*), also assist with nutrient cycling in their habitats.

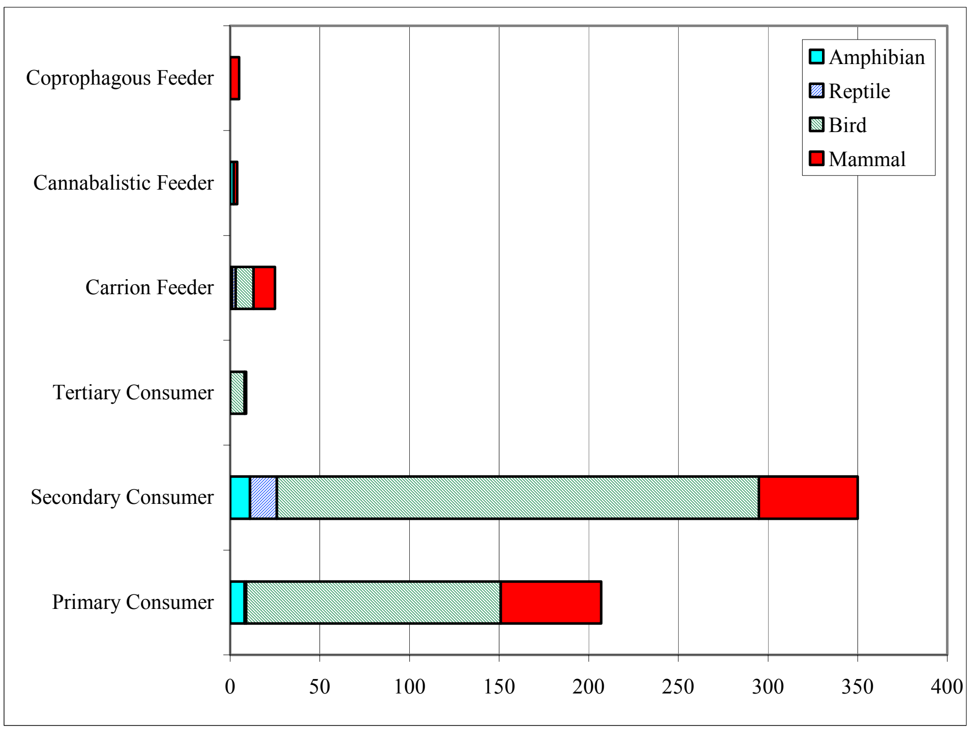

Figure 2-3. Trophic level functions of wildlife in the Salmon subbasin (source: IBIS 2003). Note that some species are included in more than one category.

We evaluated all 27 categories of organismal relationships within wildlife communities in the Salmon subbasin (Appendix 2-2). Five species of birds serve as pollination vectors for plants (Figure 2-4). Among terrestrial vertebrates, mammals are the sole dispersers of fungi and lichens, and both birds and mammals disperse seeds and fruits. Fourteen bird species and one mammalian species act as primary cavity excavators, serving 27 bird and 6 mammalian secondary cavity-using species. Birds and mammals create roosting, denning, or nesting structures in aerial, ground, and aquatic environments that other amphibian, reptile, bird, and mammal species also use (Figure 2-4).

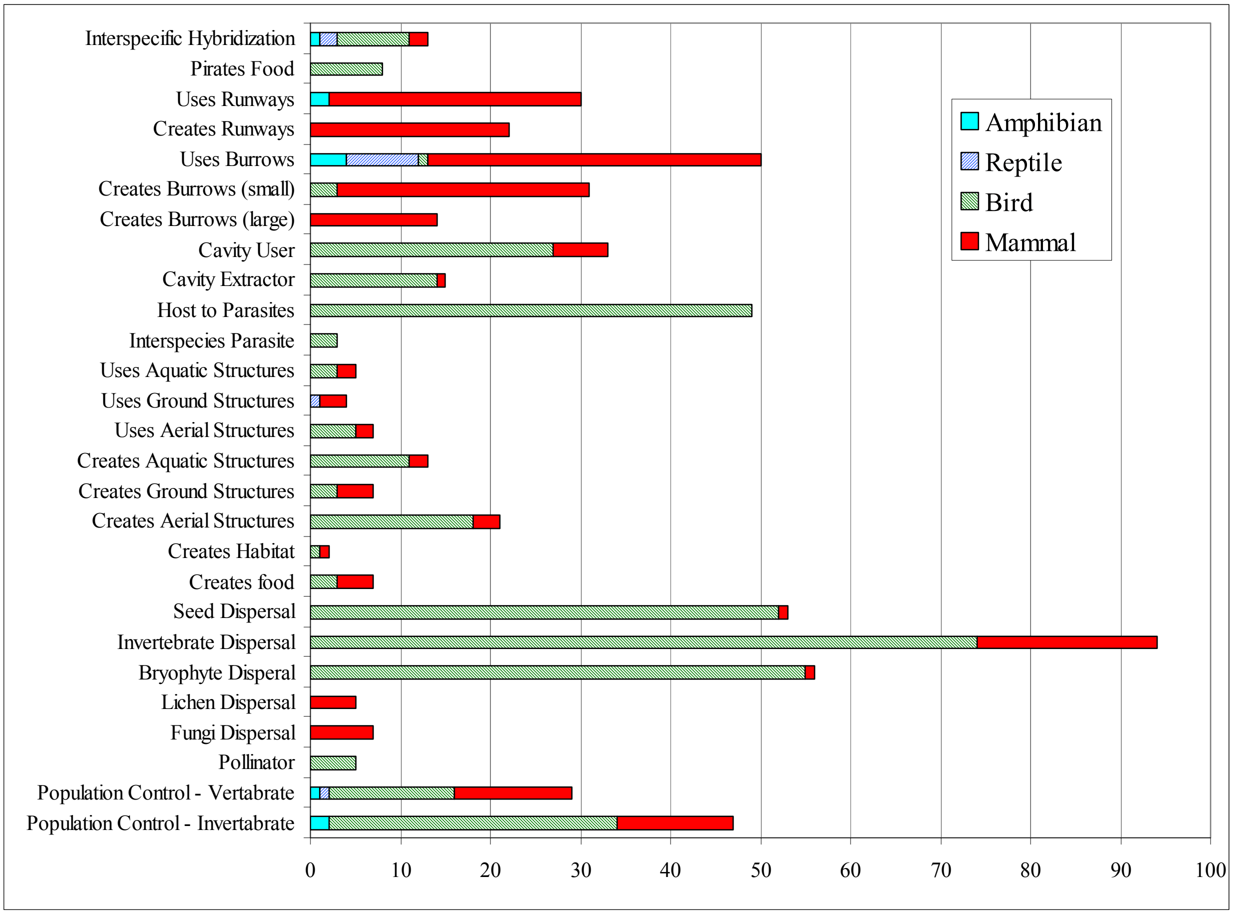

Figure 2-4. Organismal functional relations of wildlife in the Salmon subbasin, Idaho (source: IBIS 2003).

2.1.1.5 Total Functional Diversity

Total functional diversity is functional richness weighted by functional redundancy (Brown 1995). Our estimation of change in total functional diversity in the Salmon subbasin from the historical to current conditions (circa 1850 to 2000) suggests that significant decreases in total functional diversity have occurred in the Lemhi, Pashsimeroi, Middle Salmon–Panther, Upper Salmon, Lower Salmon, and Little Salmon watersheds (Figure 2-5). However, some areas within the Upper and Lower Middle Fork Salmon watersheds have significantly increased in total functional diversity. These increases might be explained by changes in habitats due to either natural or anthropogenic causes. Analysis of functional richness for different habitats demonstrates that riparian and forested habitats had greater functional richness than other habitats such as grasslands or shrub-steppe. Areas in the Salmon subbasin that have increased total functional diversity may be areas that were once more open grassland or shrub-steppe types but are now more forested as a result of modern fire suppression or have more riparian areas as a result of no livestock grazing. Increases in total functional diversity may result from species abandoning or being eliminated from areas of high anthropogenic disturbance and being more commonly found in roadless or wilderness areas (Figure 1-13 and Figure 1-14) and relatively intact watersheds (Figure 1-16 and Figure 1-17). These species might include wolves, black bears, Chinook salmon, and riparian species.

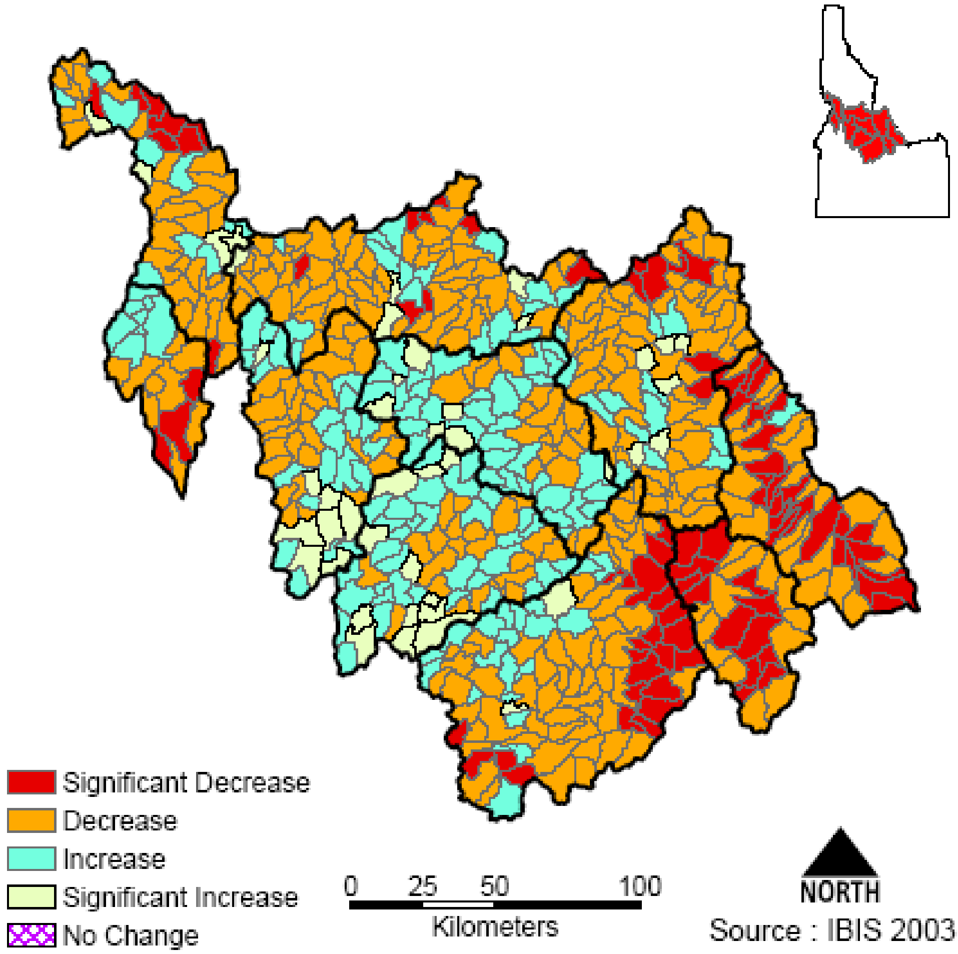

Figure 2-5. Change in total functional diversity from historical to current conditions (circa 1850 to 2000) in the Salmon subbasin by 6th field hydrologic units (IBIS 2003).

2.1.1.6 Functional Profiles

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

To illustrate the functional profiles in the Salmon subbasin, we compared the number of

KEF categories by wildlife habitats among the habitats (Figure 2-6 and Figure 2-7). Overall, riparian/herbaceous wetland habitats appear to have the greatest number of species performing the greatest number of ecological functions. There are a few exceptions: the native grassland habitat has a greater number of coprophagous species (KEF category 1.1.6) (Figure 2-6) and species that burrow and use burrows (categories 3.11.1, 3.11.2, 3.12) (Figure 2-7), and shrub-steppe habitat has more species that physically improve soil structure and aeration by digging.

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

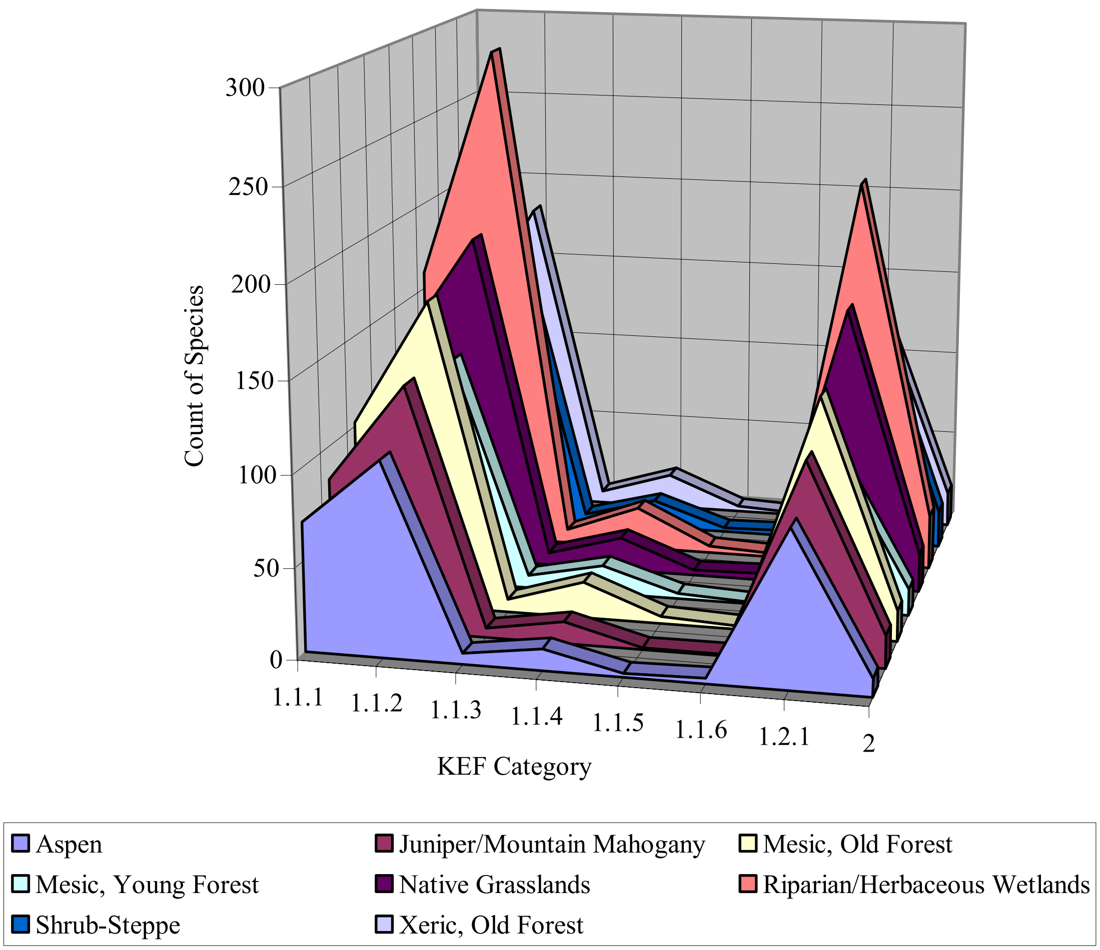

Figure 2-6. Relative degree of functional redundancy in trophic levels by focal habitats in the Salmon subbasin, Idaho (source: IBIS 2003) (see Appendix 2-2 for KEF category definitions).

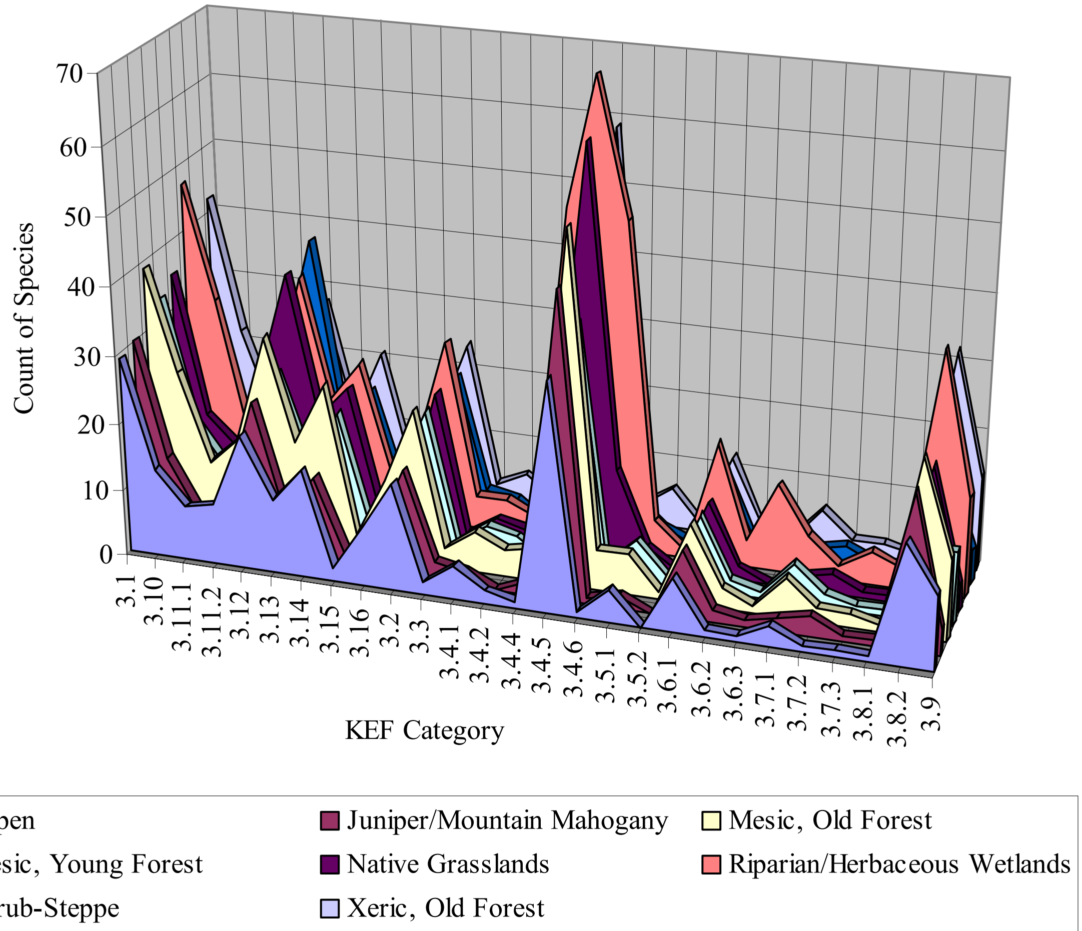

Figure 2-7. Relative degree of functional redundancy in organismal relationships by focal habitats in the Salmon subbasin, Idaho (source: IBIS 2003) (see Appendix 2-2 for KEF category definitions).

2.1.1.7 Critical Functional Link Species

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

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

The beaver, one of the wildlife focal species for the Salmon subbasin assessment, is also a critical functional link species for several habitats because it is the only species that functions to impound water by creating diversions or dams. Other wildlife focal species that also perform critical functional link roles in certain habitats in the Salmon subbasin are the black bear, grizzly bear, Rocky Mountain elk (*Cervus elaphus nelsoni*), snowshoe hare (*Lepus americanus*) and moose (*Alces alces*) (Appendix 2-2). Anadromous fish play critical functional roles in the subbasin, primarily as a source of nutrients for other species (Table 2-3).

2.1.2 Focal Species

We summarized KEFs and KECs for each of the wildlife species identified as a focal species in the Salmon subbasin (Figure 2-8 and Figure 2-9). Wildlife species that have high KEF counts are considered to be generalists in their environment, while species that have low KEF counts are considered to be specialists (Figure 2-8). Species that have high KEC counts are considered to be robust in that they can more easily adapt to changes in their environment than species with low KEC counts (Figure 2-9). From the focal species list for the Salmon subbasin, both the black bear and beaver appear to be more resilient to changes in their environment than some other species because they both have high KEF and KEC counts. The focal species most susceptible to changes in their environment are the lynx, flammulated owl (*Otus flammeolus*), and Clark's nutcracker (*Nucifraga columbiana*).

Bighorn sheep (*Ovis canadensis*), moose, and the river otter (*Lutra canadensis*) are focal species with relatively low KEF counts (i.e., specialists), but they have relatively high KEC counts (Figure 2-8 and Figure 2-9). These high KEC counts mean that these species are also capable of adapting to changes in their environment. Bighorn sheep and moose are known to migrate to different habitats, so although they may be functional specialists, they can move from one habitat another to adapt to changes. The river otter is also a specialist in that it specializes in capturing fish, but it uses different foraging techniques in different areas and at different times of the year. The otter uses both the aquatic and the riparian/herbaceous wetland habitats.

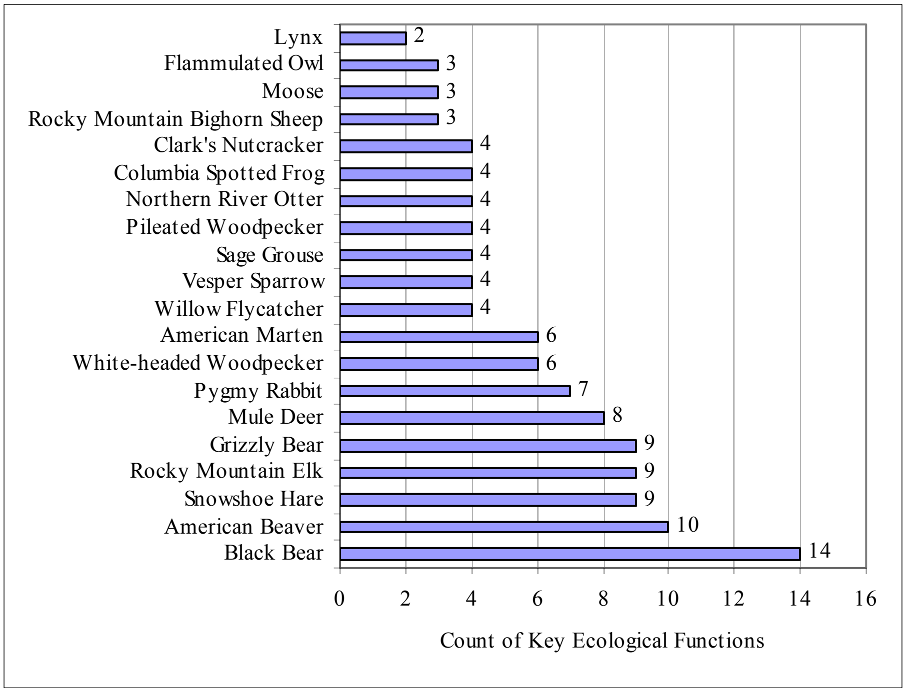

Figure 2-8. Number of key ecological functions (KEFs) by focal wildlife species in the Salmon subbasin, Idaho (IBIS 2003).

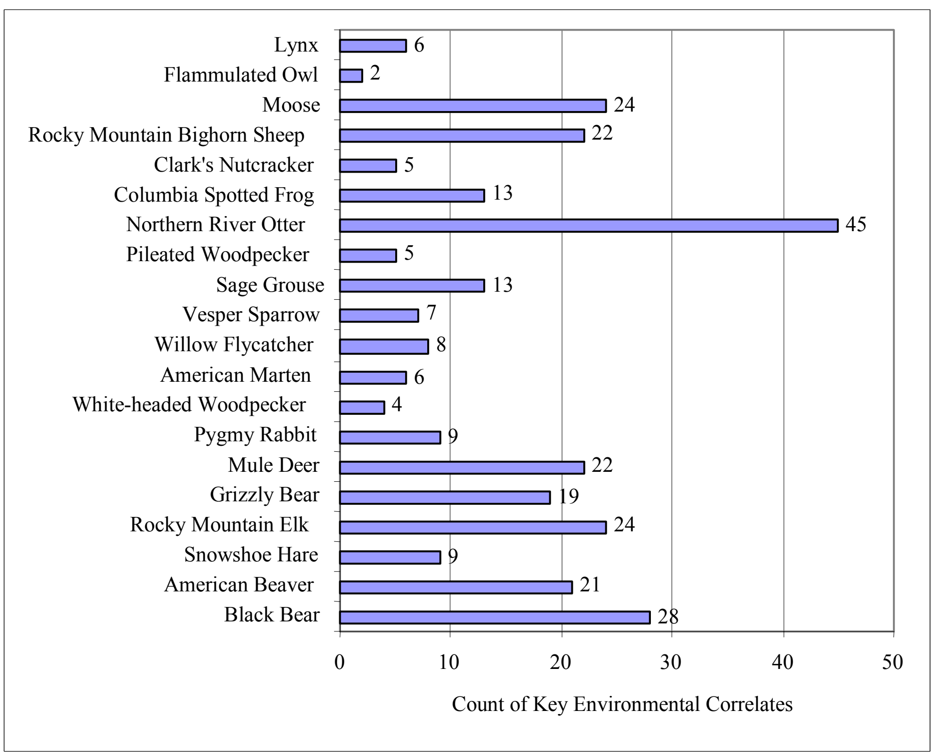

Figure 2-9. Number of key environmental correlates (KECs) by focal wildlife species in the Salmon subbasin, Idaho (IBIS 2003).

To evaluate where ecological functions and roles of a few wildlife and fish species might overlap, we assessed the focal species for direct associations with aquatic environments (Figure 2-10) and with salmonids (Table 2-3). The species associated with aquatic environments include the bighorn sheep, river otter, mule deer (*Odocoileus hemionus*), moose, Columbia spotted frog (*Rana luteiventris*), black bear, marten, and beaver. KEC counts for these species reveal that the otter, black bear, and beaver would be better adapted to changes in their environment, while bighorn sheep and martens appear less adaptive to changes in their aquatic environments. Overall, the otter seems able to use both the aquatic and terrestrial habitats equally, whereas the Columbia spotted frog relies more on the aquatic environment than on the terrestrial environment (Figure 2-10).

The willow flycatcher (*Empidonax traillii adastus*) was not categorized under the IBIS data set as having a direct association with the aquatic environment, even though the species was chosen as a focal species because it is considered an indicator species of riparian habitat and sensitive to disturbance. The exclusion of the willow flycatcher might be due in part to the classification and categorization of the species in the IBIS data set. These discrepancies and certain redundancies are likely due to limits of the IBIS data set. However, we continued with this data set because it uses the best available information and applies it consistently across the large assessment area to describe the complex roles and functions of species in their environment.

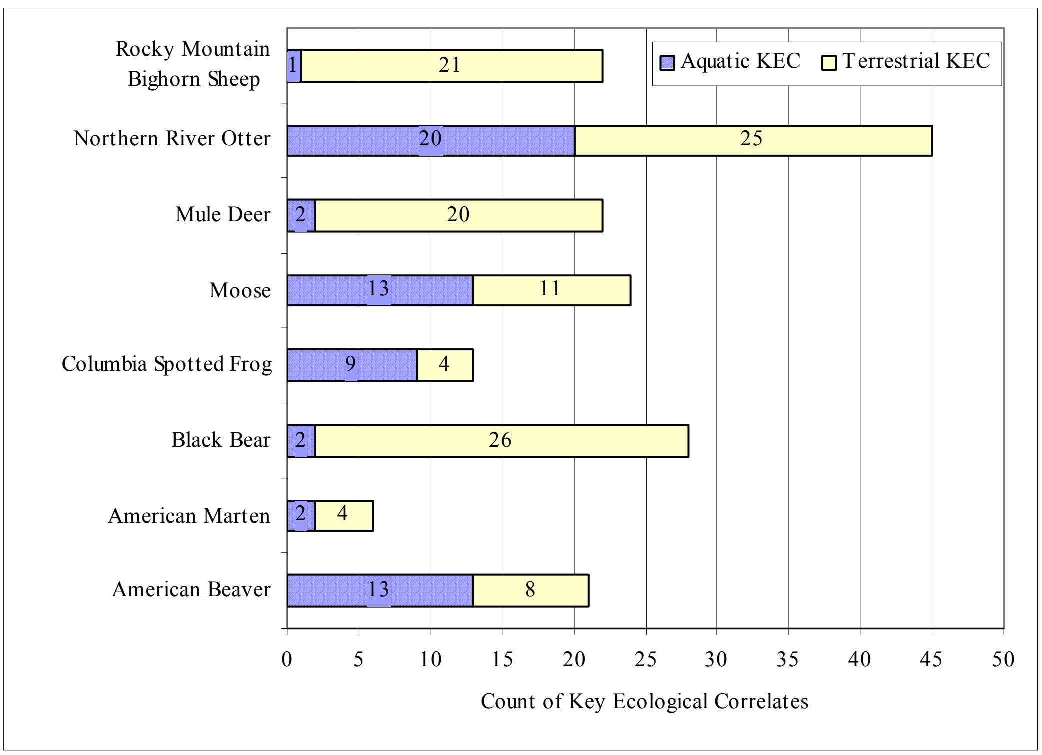

Figure 2-10. Number of key environmental correlates (KECs) by focal species associated with aquatic environments in the Salmon subbasin (IBIS 2003).

In the Salmon subbasin, 87 wildlife species are associated with salmonids (Table 2-3). Five bird species and 3 mammals have strong relationships to salmon. Twenty-five birds, 6 mammals, and 1 amphibian all have recurrent relationships to salmon.

Four focal wildlife species are associated with salmonids. The willow flycatcher has an indirect association with salmon: the bird opportunistically feeds on insects that appear on fish carcasses. The black bear, grizzly bear, and marten all have direct relationships with salmonids: the marten rarely feeds on carcasses and the bears recurrently feed on both spawning adults and carcasses.

Table 2-3. Salmonid-related species (i.e., those species that eat salmonids) for the Salmon subbasin, Idaho (source: IBIS 2003).

Common Name	Scientific Name	Relationship Type	Salmonid Stage
Amphibians			**(Total Number: 1)**
Idaho giant salamander	*Dicamptodon aterrimus*	Recurrent	Incubation: eggs and alevin
		Recurrent	Freshwater rearing: fry, fingerling, and parr
Birds			**(Total Number: 62)**
Common loon	*Gavia immer*	Recurrent	Freshwater rearing: fry, fingerling, and parr
		Rare	Carcasses
		Recurrent	Salt water: smolts, immature adults, and adults
Pied-billed grebe	*Podilymbus podiceps*	Recurrent	Freshwater rearing: fry, fingerling, and parr
Horned grebe	*Podiceps auritus*	Rare	Salt water: smolts, immature adults, and adults
		Rare	Incubation: eggs and alevin
Red-necked grebe	*Podiceps grisegena*	Rare	Carcasses
		Rare	Salt water: smolts, immature adults, and adults
Western grebe	*Aechmophorus occidentalis*	Rare	Carcasses
		Recurrent	Salt water: smolts, immature adults, and adults
		Recurrent	Freshwater rearing: fry, fingerling, and parr
Clark's grebe	*Aechmophorus clarkii*	Recurrent	Salt water: smolts, immature adults, and adults
American white pelican	*Pelecanus erythrorhynchos*	Recurrent	Freshwater rearing: fry, fingerling, and parr
Double-crested cormorant	*Phalacrocorax auritus*	Recurrent	Freshwater rearing: fry, fingerling, and parr
		Recurrent	Salt water: smolts, immature adults, and adults
Great blue heron	*Ardea herodias*	Recurrent	Freshwater rearing: fry, fingerling, and parr
		Recurrent	Salt water: smolts, immature adults, and adults
Great egret	*Ardea alba*	Rare	Salt water: smolts, immature adults, and adults
		Rare	Freshwater rearing: fry, fingerling, and parr
Snowy egret	*Egretta thula*	Rare	Freshwater rearing: fry, fingerling, and parr
Black-crowned night-heron	*Nycticorax nycticorax*	Recurrent	Salt water: smolts, immature adults, and adults
		Recurrent	Freshwater rearing: fry, fingerling, and parr
Turkey vulture	*Cathartes aura*	Recurrent	Carcasses
Trumpeter swan	*Cygnus buccinator*	Rare	Incubation: eggs and alevin
		Rare	Carcasses
		Rare	Freshwater rearing: fry, fingerling, and parr
Mallard	*Anas platyrhynchos*	Rare	Incubation: eggs and alevin
		Rare	Carcasses

Common Name	Scientific Name	Relationship Type	Salmonid Stage
Green-winged teal	*Anas crecca*	Rare	Incubation: eggs and alevin
Canvasback	*Aythya valisineria*	Rare	Carcasses
Greater scaup	*Aythya marila*	Rare	Incubation: eggs and alevin
		Rare	Carcasses
Harlequin duck	*Histrionicus histrionicus*	Indirect	Carcasses
		Strong, consistent	Salt water: smolts, immature adults, and adults
		Strong, consistent	Incubation: eggs and alevin
Surf scoter	*Melanitta perspicillata*	Rare	Salt water: smolts, immature adults, and adults
		Rare	Carcasses
Common goldeneye	*Bucephala clangula*	Recurrent	Incubation: eggs and alevin
		Recurrent	Carcasses
		Recurrent	Freshwater rearing: fry, fingerling, and parr
		Rare	Salt water: smolts, immature adults, and adults
Barrow's goldeneye	*Bucephala islandica*	Recurrent	Incubation: eggs and alevin
		Recurrent	Carcasses
		Recurrent	Freshwater rearing: fry, fingerling, and parr
		Rare	Salt water: smolts, immature adults, and adults
Hooded merganser	*Lophodytes cucullatus*	Rare	Incubation: eggs and alevin
		Rare	Freshwater rearing: fry, fingerling, and parr
		Rare	Carcasses
Common merganser	*Mergus merganser*	Recurrent	Carcasses
		Strong, consistent	Incubation: eggs and alevin
		Strong, consistent	Freshwater rearing: fry, fingerling, and parr
		Strong, consistent	Salt water: smolts, immature adults, and adults
Red-breasted merganser	*Mergus serrator*	Recurrent	Salt water: smolts, immature adults, and adults
		Recurrent	Incubation: eggs and alevin
		Recurrent	Freshwater rearing: fry, fingerling, and parr
Osprey	*Pandion haliaetus*	Strong, consistent	Salt water: smolts, immature adults, and adults
		Strong, consistent	Freshwater rearing: fry, fingerling, and parr
		Strong, consistent	Spawning: fresh water
Bald eagle	*Haliaeetus leucocephalus*	Indirect	Incubation: eggs and alevin
		Indirect	Salt water: smolts, immature adults, and adults
		Indirect	Freshwater rearing: fry, fingerling, and parr
		Strong, consistent	Salt water: smolts, immature adults, and adults
		Strong, consistent	Spawning: fresh water
		Strong, consistent	Carcasses
		Indirect	Carcasses
Red-tailed hawk	*Buteo jamaicensis*	Rare	Carcasses
Golden eagle	*Aquila chrysaetos*	Recurrent	Carcasses
		Recurrent	Spawning: fresh water
Gyrfalcon	*Falco rusticolus*	Indirect	Salt water: smolts, immature adults, and adults
		Indirect	Carcasses
		Indirect	Freshwater rearing: fry, fingerling, and parr

Common Name	Scientific Name	Relationship Type	Salmonid Stage
Peregrine falcon	*Falco peregrinus*	Indirect	Salt water: smolts, immature adults, and adults
		Indirect	Freshwater rearing: fry, fingerling, and parr
		Indirect	Carcasses
Killdeer	*Charadrius vociferus*	Indirect	Carcasses
Greater yellowlegs	*Tringa melanoleuca*	Rare	Incubation: eggs and alevin
Spotted sandpiper	*Actitis macularia*	Indirect	Carcasses
Franklin's gull	*Larus pipixcan*	Rare	Freshwater rearing: fry, fingerling, and parr
Bonaparte's gull	*Larus philadelphia*	Recurrent	Salt water: smolts, immature adults, and adults
		Recurrent	Incubation: eggs and alevin
		Recurrent	Carcasses
Ring-billed gull	*Larus delawarensis*	Recurrent	Freshwater rearing: fry, fingerling, and parr
		Recurrent	Carcasses
		Recurrent	Salt water: smolts, immature adults, and adults
California gull	*Larus californicus*	Recurrent	Carcasses
		Recurrent	Salt water: smolts, immature adults, and adults
Herring gull	*Larus argentatus*	Recurrent	Salt water: smolts, immature adults, and adults
		Recurrent	Carcasses
		Recurrent	Freshwater rearing: fry, fingerling, and parr
Caspian tern	*Sterna caspia*	Strong, consistent	Salt water: smolts, immature adults, and adults
		Strong, consistent	Freshwater rearing: fry, fingerling, and parr
		Recurrent	Salt water: smolts, immature adults, and adults
Common tern	*Sterna hirundo*	Recurrent	Freshwater rearing: fry, fingerling, and parr
Forster's tern	*Sterna forsteri*	Recurrent	Freshwater rearing: fry, fingerling, and parr
		Recurrent	Salt water: smolts, immature adults, and adults
Snowy owl	*Nyctea scandiaca*	Indirect	Freshwater rearing: fry, fingerling, and parr
Belted kingfisher	*Ceryle alcyon*	Recurrent	Freshwater rearing: fry, fingerling, and parr
		Recurrent	Spawning: fresh water
		Recurrent	Salt water: smolts, immature adults, and adults
Willow flycatcher	*Empidonax traillii*	Indirect	Carcasses
Gray jay	*Perisoreus canadensis*	Rare	Carcasses
Steller's jay	*Cyanocitta stelleri*	Recurrent	Carcasses
Black-billed magpie	*Pica pica*	Recurrent	Freshwater rearing: fry, fingerling, and parr
		Recurrent	Carcasses
American crow	*Corvus brachyrhynchos*	Recurrent	Freshwater rearing: fry, fingerling, and parr
		Recurrent	Carcasses
Common raven	*Corvus corax*	Recurrent	Spawning: fresh water
		Recurrent	Carcasses
		Recurrent	Freshwater rearing: fry, fingerling, and parr
Tree swallow	*Tachycineta bicolor*	Indirect	Carcasses
Violet-green swallow	*Tachycineta thalassina*	Indirect	Carcasses
Northern rough-winged swallow	*Stelgidopteryx serripennis*	Indirect	Carcasses
Bank swallow	*Riparia riparia*	Indirect	Carcasses

Common Name	Scientific Name	Relationship Type	Salmonid Stage
Cliff swallow	*Petrochelidon pyrrhonota*	Indirect	Carcasses
Barn swallow	*Hirundo rustica*	Indirect	Carcasses
Winter wren	*Troglodytes troglodytes*	Rare	Carcasses
American dipper	*Cinclus mexicanus*	Recurrent	Freshwater rearing: fry, fingerling, and parr
		Recurrent	Incubation: eggs and alevin
		Recurrent	Carcasses
		Indirect	Carcasses
American robin	*Turdus migratorius*	Rare	Incubation: eggs and alevin
Varied thrush	*Ixoreus naevius*	Rare	Carcasses
		Rare	Incubation: eggs and alevin
Spotted towhee	*Pipilo maculatus*	Rare	Carcasses
Song sparrow	*Melospiza melodia*	Rare	Carcasses
Mammals			**(Total Number: 22)**
Masked shrew	*Sorex cinereus*	Indirect	Carcasses
		Rare	Carcasses
Vagrant shrew	*Sorex vagrans*	Rare	Carcasses
		Indirect	Carcasses
Montane shrew	*Sorex monticolus*	Indirect	Carcasses
		Rare	Carcasses
Water shrew	*Sorex palustris*	Recurrent	Incubation: eggs and alevin
		Recurrent	Carcasses
		Recurrent	Freshwater rearing: fry, fingerling, and parr
		Indirect	Carcasses
Northern flying squirrel	*Glaucomys sabrinus*	Rare	Carcasses
Deer mouse	*Peromyscus maniculatus*	Rare	Carcasses
Coyote	*Canis latrans*	Recurrent	Carcasses
Gray wolf	*Canis lupus*	Recurrent	Carcasses
		Recurrent	Spawning: fresh water
Red fox	*Vulpes vulpes*	Rare	Carcasses
Black bear	*Ursus americanus*	Strong, consistent	Carcasses
		Strong, consistent	Spawning: fresh water
Grizzly bear	*Ursus arctos horribilis*	Strong, consistent	Spawning: fresh water
		Strong, consistent	Carcasses
Raccoon	*Procyon lotor*	Recurrent	Freshwater rearing: fry, fingerling, and parr
		Recurrent	Carcasses
American marten	*Martes americana*	Rare	Carcasses
Fisher	*Martes pennanti*	Rare	Carcasses
Long-tailed weasel	*Mustela frenata*	Rare	Carcasses
Mink	*Mustela vison*	Recurrent	Freshwater rearing: fry, fingerling, and parr
		Recurrent	Carcasses
		Recurrent	Spawning: fresh water
Wolverine	*Gulo gulo*	Rare	Carcasses
Striped skunk	*Mephitis mephitis*	Rare	Carcasses
Northern river otter	*Lutra canadensis*	Strong, consistent	Freshwater rearing: fry, fingerling, and parr
		Strong, consistent	Spawning: fresh water

Common Name	Scientific Name	Relationship Type	Salmonid Stage
		Strong, consistent	Carcasses
Mountain lion	*Puma concolor*	Rare	Spawning: fresh water
Bobcat	*Lynx rufus*	Recurrent	Spawning: fresh water
		Recurrent	Carcasses
White-tailed deer (eastside)	*Odocoileus virginianus ochrourus*	Rare	Carcasses
Reptiles			**(Total Number: 2)**
Western terrestrial garter snake	*Thamnophis elegans*	Rare	Freshwater rearing: fry, fingerling, and parr
Common garter snake	*Thamnophis sirtalis*	Rare	Freshwater rearing: fry, fingerling, and parr
Total Species			**87**

Using the IBIS data set and known species distribution in the Salmon subbasin, we determined the percentage of change in total functional diversity for each of the focal species in their respective focal habitats (Figure 2-11). Even though species are capable of occupying the entire area of a particular focal habitat, they will often occupy only a certain percentage. So, over the total area for a focal habitat, some areas will show increases in the total functional diversity, while other areas will see decreases. For instance, of the total grassland area available to bighorn sheep in the Salmon subbasin, about 60% of the area has seen a decrease in total functional diversity, and about 5% of the area has seen a significant increase. Overall, the total functional diversity of the focal species in the Salmon subbasin has declined for the six focal habitats for which they were evaluated. The total functional diversity of greater sage grouse (*Centrocercus urophasianus*) in the shrub-steppe habitat has significantly declined, with only a small percentage of the area showing increases in occurrences.

The same approach can be applied to understanding the changes in total functional diversity for each of the focal habitats in the Salmon subbasin (Figure 2-12). All of the focal habitats, with the exception of whitebark pine habitat, have seen significant amounts of decline in total functional diversity.

Decreases in total functional diversity in both focal species and focal habitats suggest an overall decline in habitat quality and quantity in the Salmon subbasin. By proportion of their total area affected, focal habitats most in decline and appearing to be in critical need of mitigation include the juniper/mountain mahogany, shrub-steppe, and native grasslands types. Riparian/herbaceous wetland habitats are difficult to assess because their total areas have not been quantified (Appendix 2-1). Still, technical team members have suggested the riparian/ herbaceous wetlands in the Salmon subbasin are of foremost importance to fish and wildlife. Juniper/mountain mahogany habitats have declined generally by 92% in the subbasin, while shrub-steppe has declined by 91%. Native grasslands have declined in the Salmon subbasin by 78% (Figure 2-12).

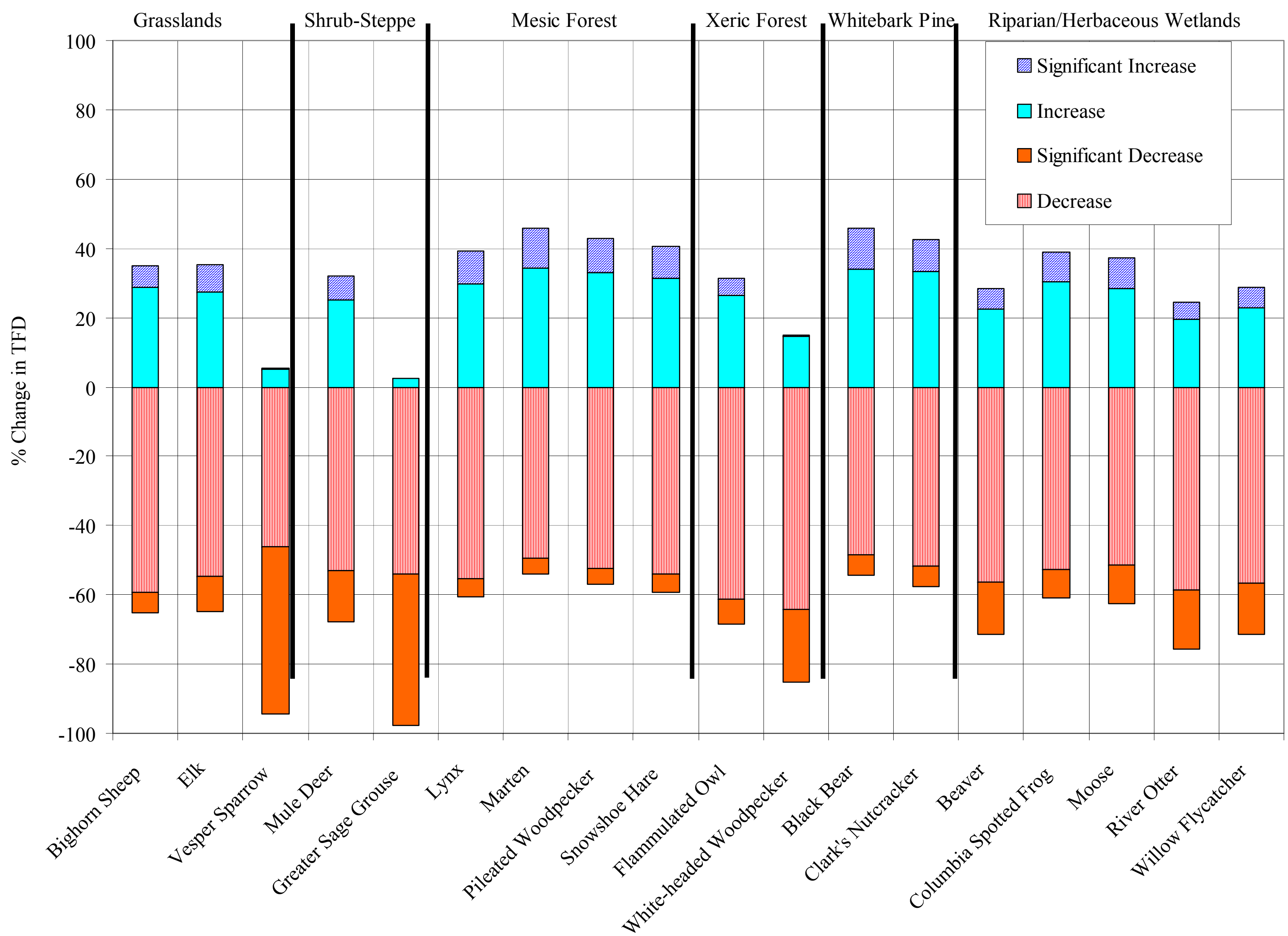

Figure 2-11. **Percentage of change in total functional diversity (TFD) for terrestrial focal species by respective focal habitats in the Salmon subbasin, Idaho.**

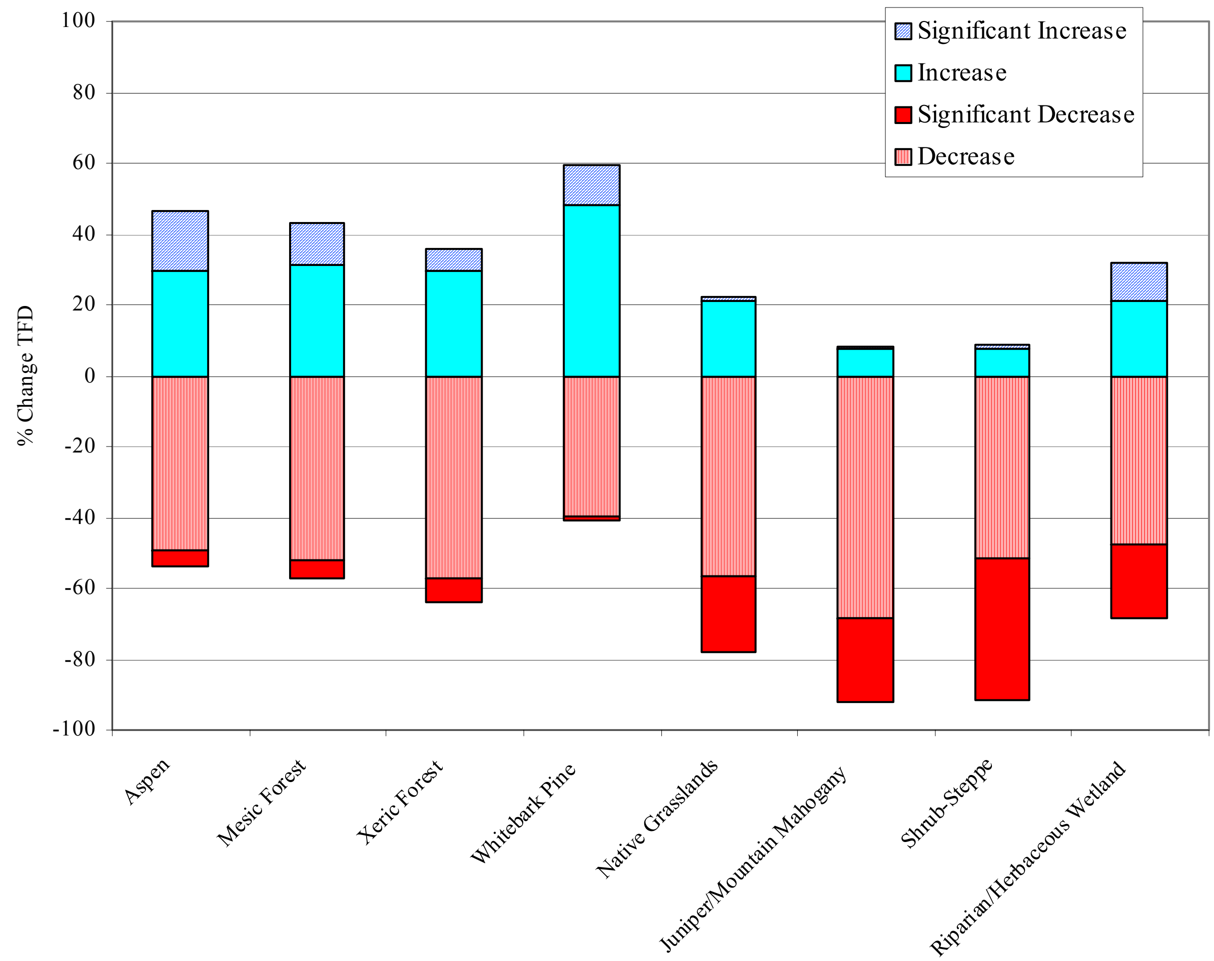

Figure 2-12. Percentage of change in total functional diversity (TFD) for each of the terrestrial focal habitats in the Salmon subbasin, Idaho.

Not surprisingly, focal species closely related to shrub-steppe and native grassland habitats also show significant declines in their total functional diversity. The greater sage grouse, in particular, has seen a 97% decline in total functional diversity in the shrub-steppe habitat. The vesper sparrow (*Pooecetes gramineus*) has seen a 94% decline in total functional diversity in the native grassland habitats of the Salmon subbasin (Figure 2-11). Riparian areas, while experiencing declines (Figure 2-12), likely have not demonstrated greater declines than the above habitats due to their more widespread distribution and higher condition in protected areas than focal habitats such as shrub-steppe and juniper/mountain mahogany.

2.2 Aquatic Resources

Management emphasis and data collection on fishes in the Salmon subbasin and elsewhere in the region tend to be focused on salmonids due to their historical dominance, social value, and general association with higher-quality habitats. The presence of these species is generally considered an indicator of high-quality aquatic ecosystems and habitats. Assessments of native salmonids across watersheds throughout the Columbia River basin suggest that the Salmon subbasin contains a large portion of the occupied anadromous salmonid habitat and a high proportion of species strongholds relative to other subbasins in the region (ICBEMP 1997). Many of the watersheds within the subbasin support strong populations of one or more native species of non-anadromous salmonids, including populations with large fluvial (migratory) adults.

Strong non-anadromous salmonid populations within the Salmon subbasin provide important evidence that factors outside the subbasin may keep native anadromous populations below their potential within the subbasin. The abundance of resident salmonid strongholds in the Salmon subbasin is related to natural features, the abundance of relatively less developed and intact watersheds, and a high historical diversity of these fish within the subbasin (ICBEMP 1997). However, anadromous salmonids are struggling to persist even in the best habitats available to them within the subbasin.

2.2.1 Focal Species

Focal species for the aquatic portion of this assessment were chosen according to guidelines provided by the Northwest Power and Conservation Council (NPCC, formerly the Northwest Power and Planning Council or NPPC [2001]). These guidelines suggested inclusion of species that met the following criteria in order of importance: 1) designation as a federally listed endangered or threatened species, 2) ecological significance, 3) cultural significance, and 4) local significance. Further direction from the Independent Science Review Panel was to use no more than five focal species for the assessment. Based on the above guidelines, the fisheries technical assessment team chose the following focal species: 1) Snake River sockeye salmon, the only fish federally listed as endangered in the subbasin; 2) Snake River Chinook salmon; 3) Snake River steelhead and 4) bull trout. The latter three species are all federally listed as threatened. Focal species, additional species considered important (but not chosen as focal species), and introduced species of interest are reported in Table 2-4.

The watershed was chosen as the organizational unit for focal species discussions. The watershed is thought to be the appropriate unit to consider when dealing with aquatic species because the condition of an aquatic ecosystem is dependent on the land and water management within the watershed (Doppelt *et al*. 1993). Within each watershed, the discussion may further be broken down by populations of focal species, as identified by the Interior Columbia Technical Recovery Team (the acronym TRT is sometimes used in figures) (ICTRT 2003). Bull trout populations delineations are identified by the U.S. Fish and Wildlife Service (2002).

Considerable information on salmon and steelhead in the Salmon subbasin was compiled and presented in the stock summary report (Kiefer *et al*. 1992). Data from that effort were used as appropriate; however, we did not attempt to recreate the previous effort.

Table 2-4. Focal, important, and nonnative species in the Salmon subbasin identified by the fisheries technical assessment team.

Focal Species	Important Species	Nonnative Species
Chinook salmon	Pacific lamprey	Brook trout
Steelhead	White sturgeon	Smallmouth bass
Bull trout	Westslope cutthroat trout	
Sockeye salmon		

2.2.1.1 Chinook Salmon (*Oncorhynchus tschawytscha*)

2.2.1.1.1 Conservation Status

Spring, summer, and fall Chinook salmon (*O. tschawytscha* [Walbaum in Artedi, 1792]) in the Salmon subbasin are part of the Snake River Chinook salmon Evolutionarily Significant Unit (ESU)[5] that were listed as threatened under the ESA on April 22, 1992 (57 Federal Register [FR] 14653). Snake River spring and summer Chinook salmon are listed together under the ESA as an ESU, separate from the fall Chinook salmon ESU. Snake River fall Chinook salmon are considered distinct from other Chinook salmon due to their differences in genetic and life history characteristics.

Critical habitat was designated for spring and summer Chinook salmon in 1993 (58 FR 68543), and revised on October 25, 1999 (64 FR 57399) to exclude areas above Napias Creek Falls (in the Middle Salmon–Panther hydrologic unit). Critical habitat was designated for fall Chinook salmon on December 28, 1993 (58 FR 68543). On August 18, 1994, NOAA Fisheries (sometimes referred to as NMFS) reclassified the Snake River spring, summer, and fall runs of Chinook salmon from threatened to endangered status under an emergency provision of the ESA (59 FR 54840). This provision lapsed on May 26, 1995, and the status of these runs returned to threatened.

The Interior Columbia Technical Recovery Team identified 22 individual populations of Chinook salmon in the Salmon subbasin. Best available information on genetics, spawning distribution, life history variation, morphology, and habitat were used to identify individual populations.

2.2.1.1.2 Life History

Three "races" of stream-type Chinook salmon (or subspecies, depending on nomenclature) enter the Salmon subbasin from the Pacific Ocean and are classified based on date of passage over Bonneville Dam on the Columbia River and differences in their life histories (Figure 2-13). Spring Chinook cross Bonneville Dam between March 1 and May 31, while summer Chinook cross between June 1 to July 31. Upriver fall

[5] The policy by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) stipulates that a salmon population (or group of populations) will be considered "distinct" for purposes of the ESA if it represents an Evolutionarily Significant Unit (ESU) of the biological species. An ESU is defined as a population that 1) is reproductively isolated from conspecific populations and 2) represents an important component in the evolutionary legacy of the species. (Waples 1991.)

Chinook salmon migrate over the Bonneville Dam between August 1 to November 15, with peak numbers counted in early September. Chinook salmon are anadromous (as adults, they migrate from the marine environment into the freshwater rivers and streams of their birth) and semelparous (they die after spawning). Fall Chinook return as adults in the late summer or fall (Figure 2-13) and spawn almost immediately after reaching their natal streams (Healy 1991). Currently, fall Chinook in the Salmon subbasin use only the lower reach of the mainstem Salmon River. Evidence suggests that fall Chinook salmon historically spawned in the lower section of the South Fork Salmon River (D. Burns, Payette National Forest, letter to NMFS, 1992). Juvenile fall Chinook migrate as subyearlings, usually several months after emerging as fry, although timing of emigration is variable (Reimers and Loeffel 1967).

Spring/summer Chinook adults enter fresh water in the spring and summer and delay spawning for several months, using holding cover in areas near the spawning grounds. Juvenile spring/summer Chinook migrate as yearlings after overwintering in the river environment (Figure 2-13). Spring/summer Chinook salmon are present throughout the Salmon subbasin. Although spring/summer types of Chinook salmon may occupy the same streams, they can be genetically distinct and show heritable behavioral differences (Taylor and Larkin 1986, Taylor 1988). Spring and summer Chinook salmon spend one to four years in the ocean prior to returning, with 2- and 3-ocean fish making up the majority of the returns. Kiefer *et al.* (2002) used dorsal fin cross sections to determine the ocean age of adult spring/summer Chinook salmon in the Snake River basin. They reported that the proportion of 2-ocean adult returns varied from 10% in 1998 to 93% in 2001 and the proportion of 3-ocean adult returns varied from 3% in 2001 to 80% in 1998, though low sample sizes may affect inferences from 1998 data (Figure 2-14 and Figure 2-15).

Female Chinook salmon tend to dig their nests or “redds” in deep, swift water and protect their eggs by covering them with river rock. Generally, the size of gravel chosen depends on the size of the female parent (larger females may use larger substrate). Eggs have the maximum survival in water with a temperature less than 14 °C (range 10–15 °C) (Moyle 1976). The embryos incubate and hatch as alevins (a larval life stage dependent on food stored in a yolk sac) within the redd and remain in the gravel until they have used up all of their yolk supply. At this point, the young juveniles are called “fry.” Water temperature is the primary determinant in the rate of embryo development and timing of fry emergence from the gravel (Beacham and Murray 1989). Chinook salmon in the Salmon subbasin emerge from the gravel in the spring. Juveniles of the fall Chinook race migrate as subyearlings whereas juveniles of summer and spring races generally migrate as yearlings.

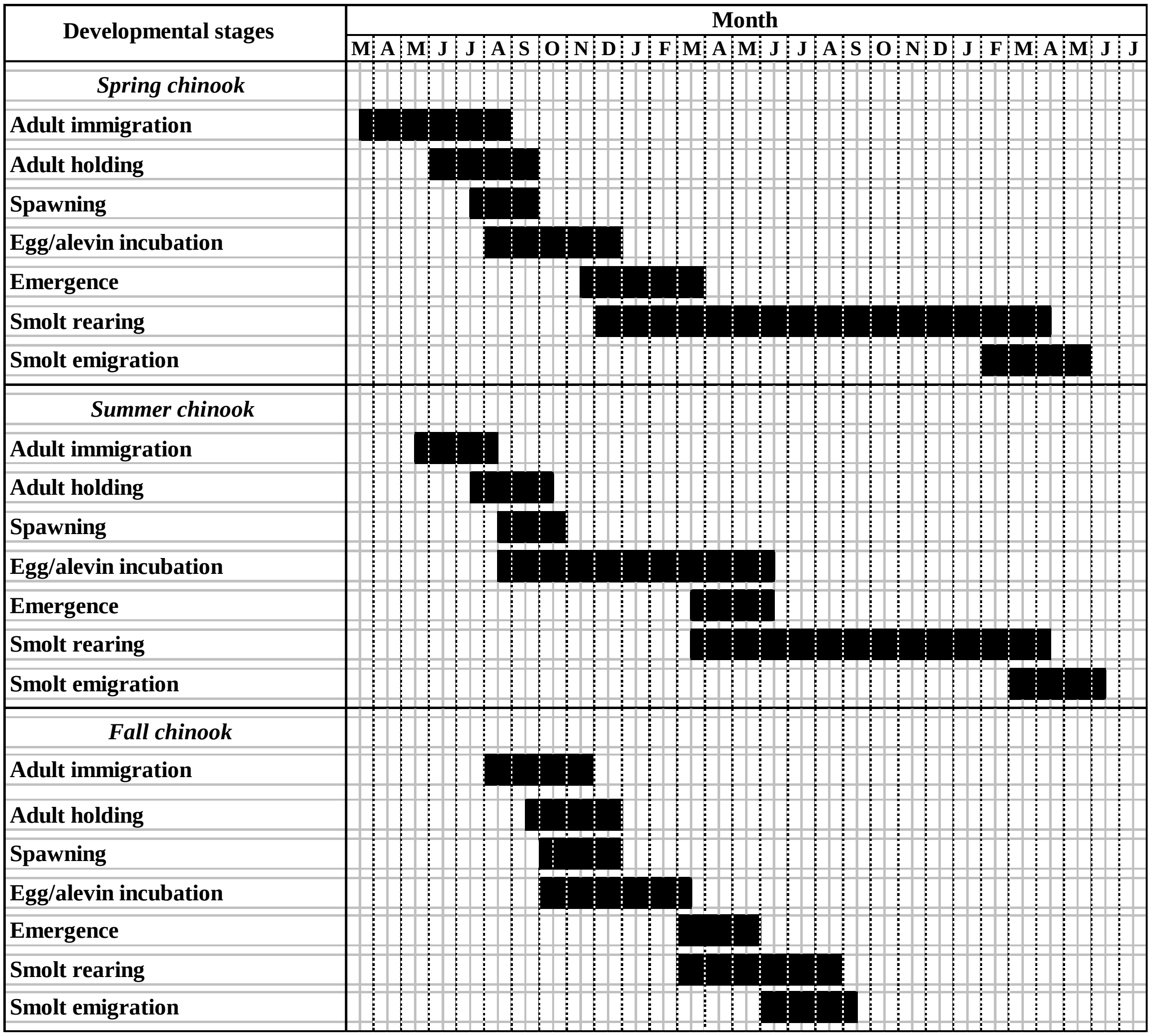

Figure 2-13. Freshwater life histories for natural/wild stream-type (spring, summer, and fall) Chinook in the Salmon subbasin, Idaho (sources: Walters *et al*. 2001, WDFW and ODFW 2002).

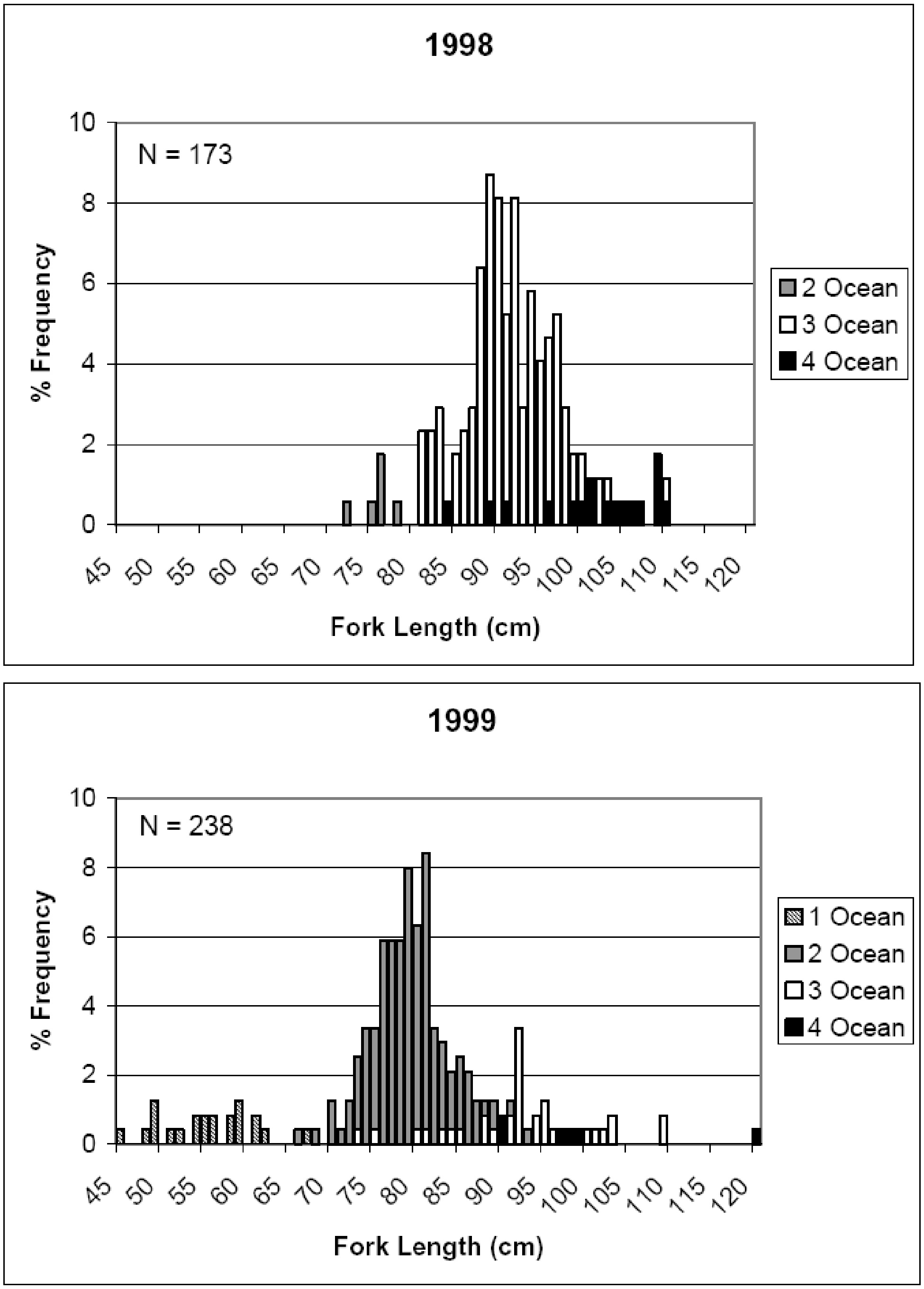

Figure 2-14. Fork lengths of Snake River wild Chinook salmon carcasses and ocean ages determined from dorsal fin cross sections, 1998 and 1999. Fish less than 70 cm (28 in) were not sampled in 1998 (Kiefer *et al*. 2002).

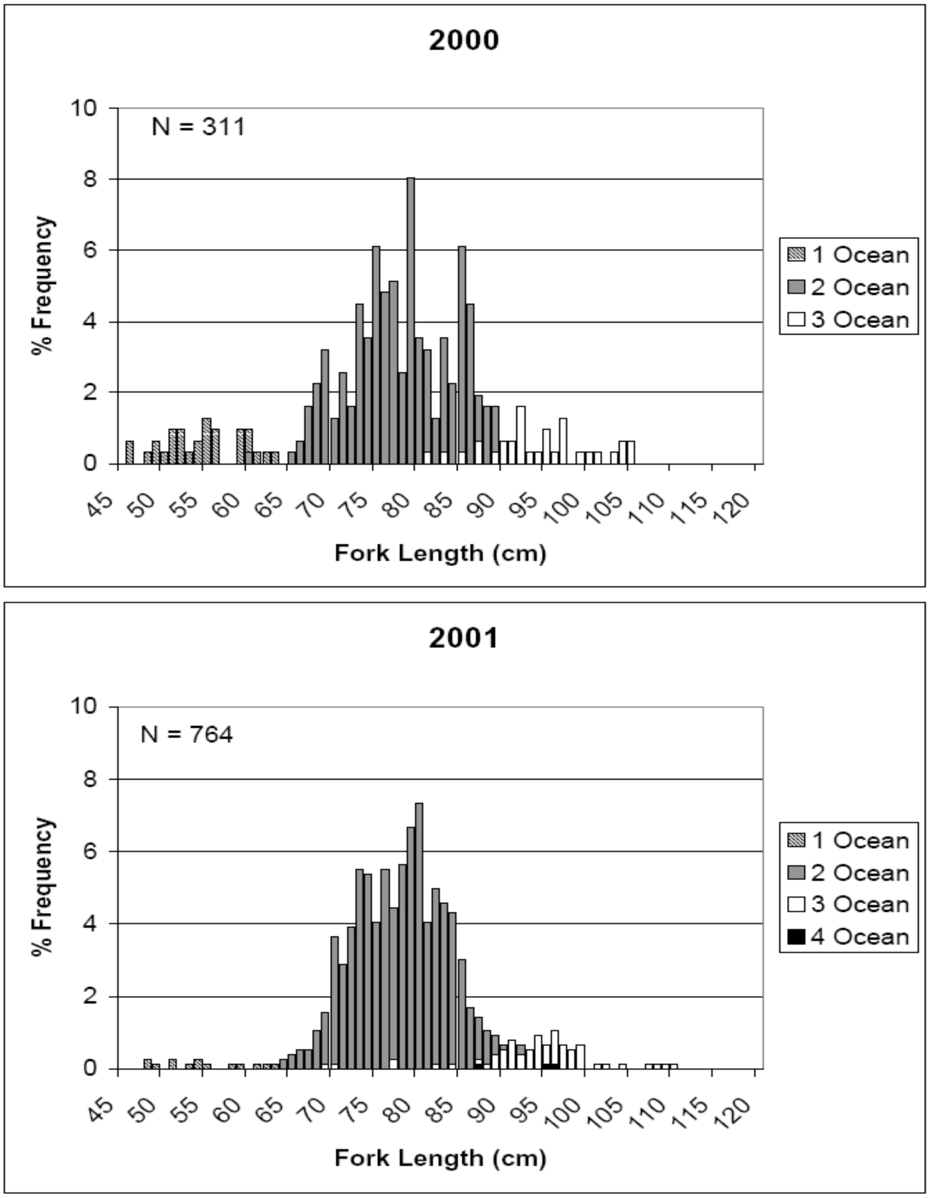

Figure 2-15. Fork lengths of Snake River wild Chinook salmon carcasses and ocean ages determined by dorsal fin cross-section aging, 2000 and 2001 (Kiefer *et al*. 2002).

The initiation of migration is preceded by the parr to smolt transformation known as smoltification (Folmar and Dickhoff 1980). Juveniles (i.e., parr) transform from a stage in their life history adapted for stream inhabitation to a stage adapted for downstream migration and eventually saltwater inhabitation (i.e., smolts). Smoltification is a complex and coordinated series of morphological, physiological, and behavioral changes and events to ready fish for entry into salt water at the appropriate time. Several factors influence the downstream migration rate of smolts. Water velocity is the primary factor. River velocity related to flow is an important factor in predicting migration rates for smolts in the Columbia and Snake rivers (Berggren and Filardo 1993).

Smolts in the Salmon subbasin migrate between 1,127 km (700 miles) and 1,529 km (950 miles) downstream every spring to reach the Pacific Ocean. After passing through the estuary, the fish carry out most of their growth in the ocean. Chinook salmon from the Salmon subbasin return after one to four years in the ocean, with the majority spending two or three years in the ocean. Adults then return to their natal streams or lakes (although some straying is common [Quinn 1984]) and die shortly after spawning, thereby completing their life cycle.

2.2.1.1.3 Population Trends and Distribution

Historical Subbasin Level Population Trends and Productivity

Although the historical size of the Snake River Chinook salmon population is difficult to estimate, Chapman (1986) estimated that between 2.3 and 3.0 million adult spring/summer Chinook salmon returned to the Columbia River between 1881 and 1895. Declines in Columbia River salmon populations began at the end of the 1800s as a result of overfishing. By the early 1900s, however, environmental degradation from mining, grazing, logging, and agriculture had caused substantial declines (Fulton 1968, Netboy 1974). Construction of dams on the mainstem Snake and Columbia rivers further reduced the distribution and abundance of Snake River Chinook salmon and their escapement to the Salmon River (Irving and Bjornn 1981). The total annual production of spring/summer Chinook salmon from the Snake River was estimated at 1.5 million fish during the late 1800s (NMFS 1995). By the mid-1950s, the harvest of adult spring/summer and fall Chinook salmon had greatly declined throughout the Columbia River basin from historical levels, suggesting significant declines in the number of returning adults (Figure 2-16). Fulton (1968) estimated that an average of 125,000 adults per year entered Snake River tributaries from 1950 through 1960. Raymond (1988) estimated that the combined annual returns averaged 100,000 wild fish from 1964 through 1968. In another analysis, the average run of Snake River fish over McNary Dam from 1954 through 1961 and over Ice Harbor Dam from 1962 through 1969 was reported to be 90,919 fish (CBFWA 1990). In the mid-1900s, the Salmon subbasin produced an estimated 39% of the spring and 45% of the summer Chinook salmon that returned as adults to the mouth of the Columbia River (Mallet 1974, CBFWA 1990). Although there is no historical record of large-scale spawning by fall Chinook in the Salmon River, it is assumed that some spawning occurred when adult escapement was high and environmental conditions were favorable (USFWS 1999a). Spring/summer and fall Chinook salmon returns began steadily declining in the 1970s, reaching low points in the mid-1990s before rebounding slightly in 2000 (Figure 2-17).

Spring/summer Chinook are widely distributed throughout the subbasin (Figure 2-18). Fall Chinook are currently found only in the lower mainstem Salmon River (Figure 2-19). Portions of the Upper Salmon, Pahsimeroi, Lemhi, Middle Salmon Panther, South Fork Salmon and Little Salmon watersheds are inaccessible to Chinook Salmon due to physical blockage, dewatering or severe water quality limitation. Information on blocked habitat represents survey and local knowledge compiled during fisheries technical assessment team meetings and may represent complete or seasonal blockage from nonnatural causes.

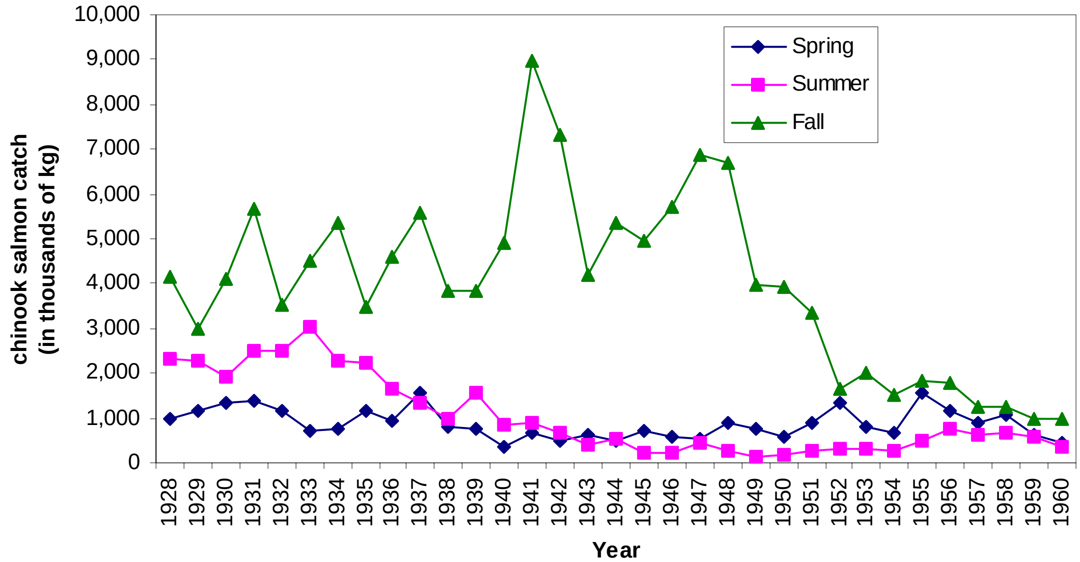

Figure 2-16. Catch by weight of spring, summer, and fall Chinook salmon in the Columbia River by season, 1928–1960 (source: Fulton 1968).

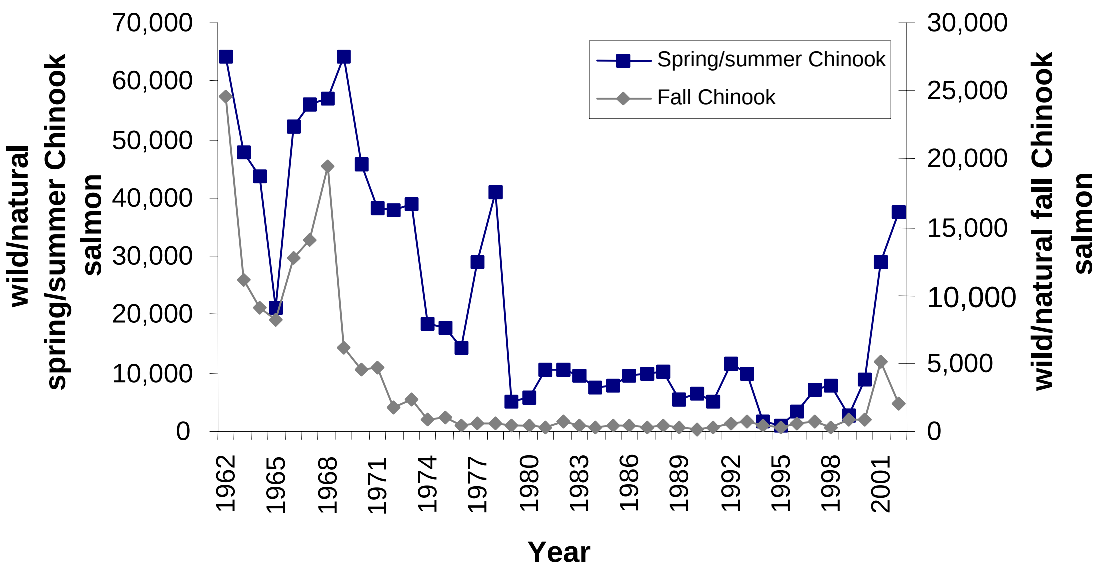

Figure 2-17. Counts of wild/natural spring/summer and fall Chinook salmon at the uppermost dam on the Snake River, 1962–2003 (Technical Advisory Committee 2003a [data from 2000, 2001, and 2002 are preliminary]). The uppermost dam is indicated by years: 1962–1968 Ice Harbor, 1969 Lower Monumental, 1970–1974 Little Goose, and 1975–2002 Lower Granite.

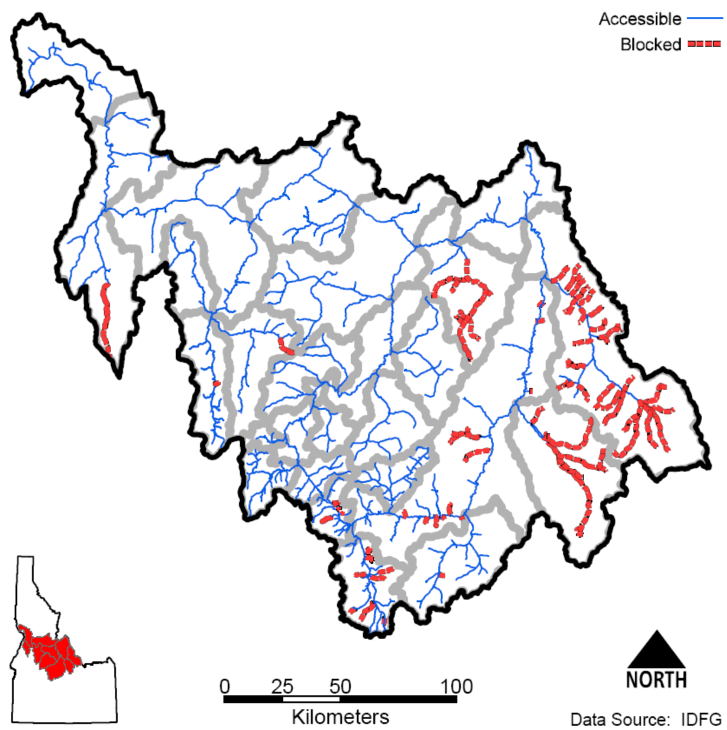

Figure 2-18. Distribution and blocked habitat of spring/summer Chinook salmon within the Salmon subbasin, Idaho.

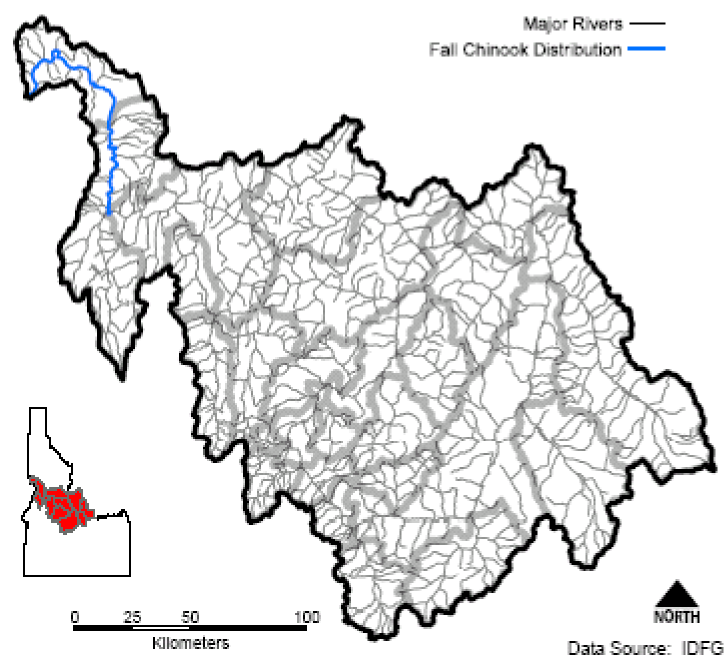

Figure 2-19. Current distribution of fall Chinook salmon within the Salmon subbasin, Idaho (data from Garcia 2002).

The status of Chinook salmon populations in Idaho have been monitored using a standardized system of redd counts since 1957 (Hassemer *et al*. 1997). The total number of spring/summer Chinook salmon redds counted in these area surveys ranged from a high of 11,704 in 1957 to a low of 166 in 1995 (Figure 2-20) (Elms-Cockrum 2001). Land management activities have affected habitat quality for the species in many areas of the subbasin, but spawner abundance declines have been common to populations in both high-quality and degraded spawning and rearing habitats (IDFG 1998).

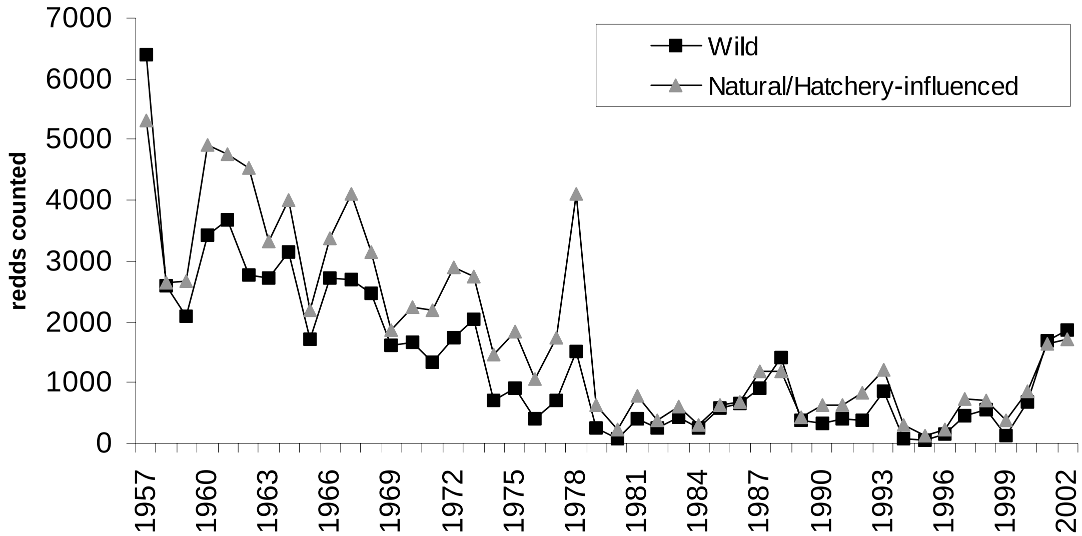

Figure 2-20. Total number of spring/summer Chinook salmon redds counted in IDFG standard spawning ground surveys in the index areas of the Salmon subbasin, 1957–2002 (StreamNet 2003).

Kucera *et al*. (in review) reported that all five “index populations” (spawning aggregations) of stream-type Chinook in the Salmon subbasin exhibited highly significant ($P < 0.01$) declines in abundance during the period 1957 to 2000 (Figure 2-21). These index populations include fish that spawn in specific areas of the Middle Fork and South Fork Salmon watersheds. Population growth rates (λ) estimated by NMFS (2000) for these populations during the 1990s were all substantially less than needed for the fish to replace themselves: Poverty Flats ($\lambda = 0.757$), Johnson Creek ($\lambda = 0.815$), Bear Valley/Elk Creek ($\lambda = 0.812$), Marsh Creek ($\lambda = 0.675$), and Sulphur Creek ($\lambda = 0.681$). Many wild populations of stream-type Chinook in the Salmon subbasin are now at remnant status. Annual redd counts for the index populations have dropped to zero three times in Sulphur Creek and twice in Marsh Creek, and zero counts have been observed in spawning areas elsewhere within the Salmon subbasin. Coinciding with the decreasing trend in redd abundance was an increasing and strong trend of synchrony of abundance between populations (Isaak *et al*. 2003). Low levels of synchrony among populations is thought to be beneficial to long-term persistence (Sutcliffe *et al*. 1997), while high levels of synchrony are thought to decrease the probability of metapopulation persistence and result in simultaneous extirpations when abundances are low (Heino *et al*. 1997). All the Chinook populations in the Salmon subbasin are in significant decline, at low levels of abundance, and at high risk of localized extinction (Kucera and Blenden 1999, Oosterhout and Mundy 2001).

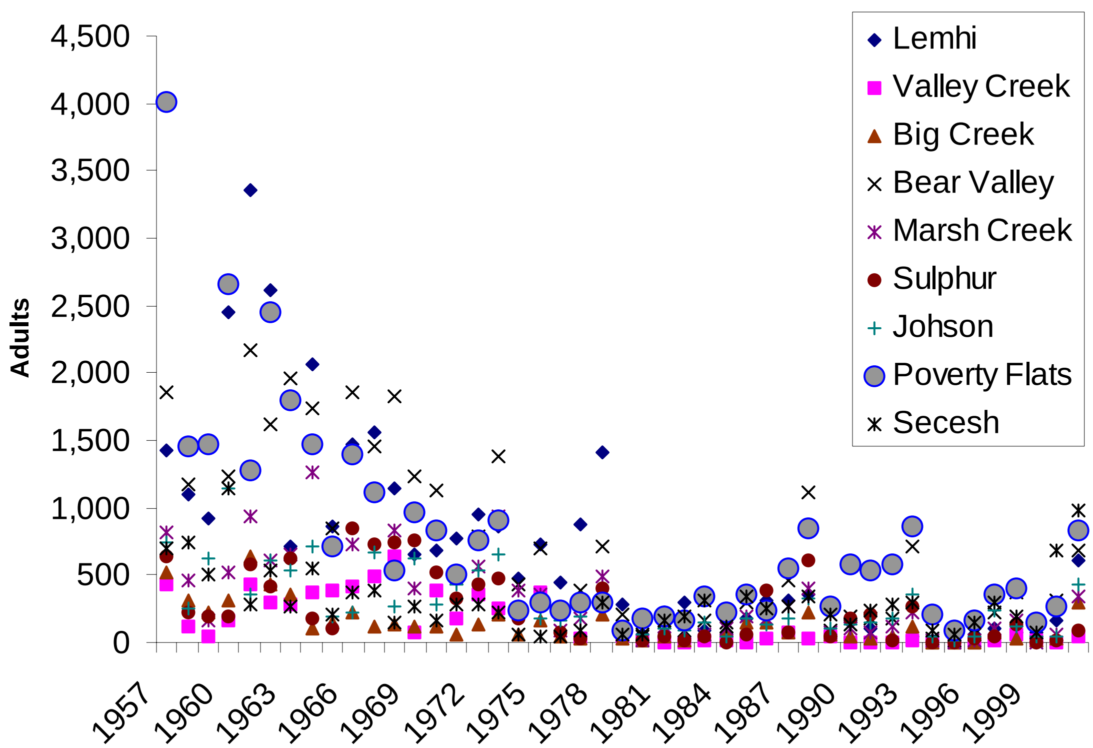

Figure 2-21. Estimated annual spawner abundance (run reconstruction data from index redd counts) for spring/summer Chinook salmon in the Salmon subbasin, Idaho, 1957–2001 (IDFG data from methods in Beamesderfer *et al*. 1997).

Analysis of recent stock-recruitment data (Kiefer *et al.* 2001) indicates that much of the freshwater spawning/rearing habitat of Snake River spring/summer Chinook salmon is still productive based on smolts/female data estimated at Lower Granite Dam. The average production for brood years 1990 through 1998 was 243 smolts/female.

Current Watershed Level Population Abundance and Productivity

Twenty-two Chinook populations in the Salmon subbasin are identified based on genetics, spawning distribution, life history demographics, and habitat use (ICTRT 2003) (Table 2-5 and Figure 2-22). Individual populations within a basin were identified by five-letter codes combining the basin code and the individual population name. For example, South Fork Secesh River population is noted as SFSEC (Table 2-5). Population codes are used for these populations throughout the remainder of the document.

Table 2-5. Populations of spring/summer Chinook salmon identified in the Salmon subbasin by the Interior Columbia Technical Recovery Team (ICTRT 2003).

Watershed	Population Name	Population Code
South Fork Salmon	Secesh River	SFSEC
	South Fork Salmon River	SFMAI
	East Fork South Fork Salmon River/Johnson Creek	SFEFS
Salmon River tributaries	Chamberlain Creek	SRCHA
	Little Salmon River	SRLSR
Middle Fork Salmon	Bear Valley Creek/Elk Creek	MFBEA
	Big Creek	MFBIG
	Camas Creek	MFCAM
	Middle Fork Salmon River below Indian Creek	MFLMA
	Pistol Creek	MFPIS
	Marsh Creek	MFMAR
	Sulphur Creek	MFSUL
	Loon Creek	MFLOO
	Middle Fork Salmon River above Indian Creek	MFUMA
Upper Salmon	Valley Creek	SRVAL
	Lemhi River	SRLEM
	North Fork Salmon River	SRNFS
	Pahsimeroi River	SRPAH
	East Fork Salmon River	SREFS
	above Redfish Lake	SRUMA
	below Redfish Lake	SRLMA
	Yankee Fork	SRYFS

Recent changes in population abundance of Chinook salmon in the Salmon subbasin have been measured using redd counts, adult monitoring, parr monitoring, and juvenile trapping. Redd locations within a watershed were plotted from global positioning system (GPS) locations to identify important spawning habitat as evidenced by use for each population where available. Percent carrying capacity (abbreviated PCC in figures) estimates were provided where possible as an index of juvenile carrying capacity. Percent carrying capacity estimates were calculated according to NPCC standard density methods (NPCC 1989) using yearly parr density information estimated from snorkeling in July and August and grouped by Rosgen channel type (Petrosky and Holubetz 1986). Percent carrying capacity estimates were adjusted for parr–smolt survival and were provided only where at least five parr sampling locations were available in each channel type. Percent carrying capacity estimates are complicated by numerous factors including incomplete knowledge of how all the factors that influence carrying capacity (such as habitat quality, interspecific interactions, space limitations, food availability, productivity, and others) interact to determine an actual stream's carrying capacity. Carrying capacity likely varies from year to year as the abovementioned factors change; therefore, percent carrying capacity.

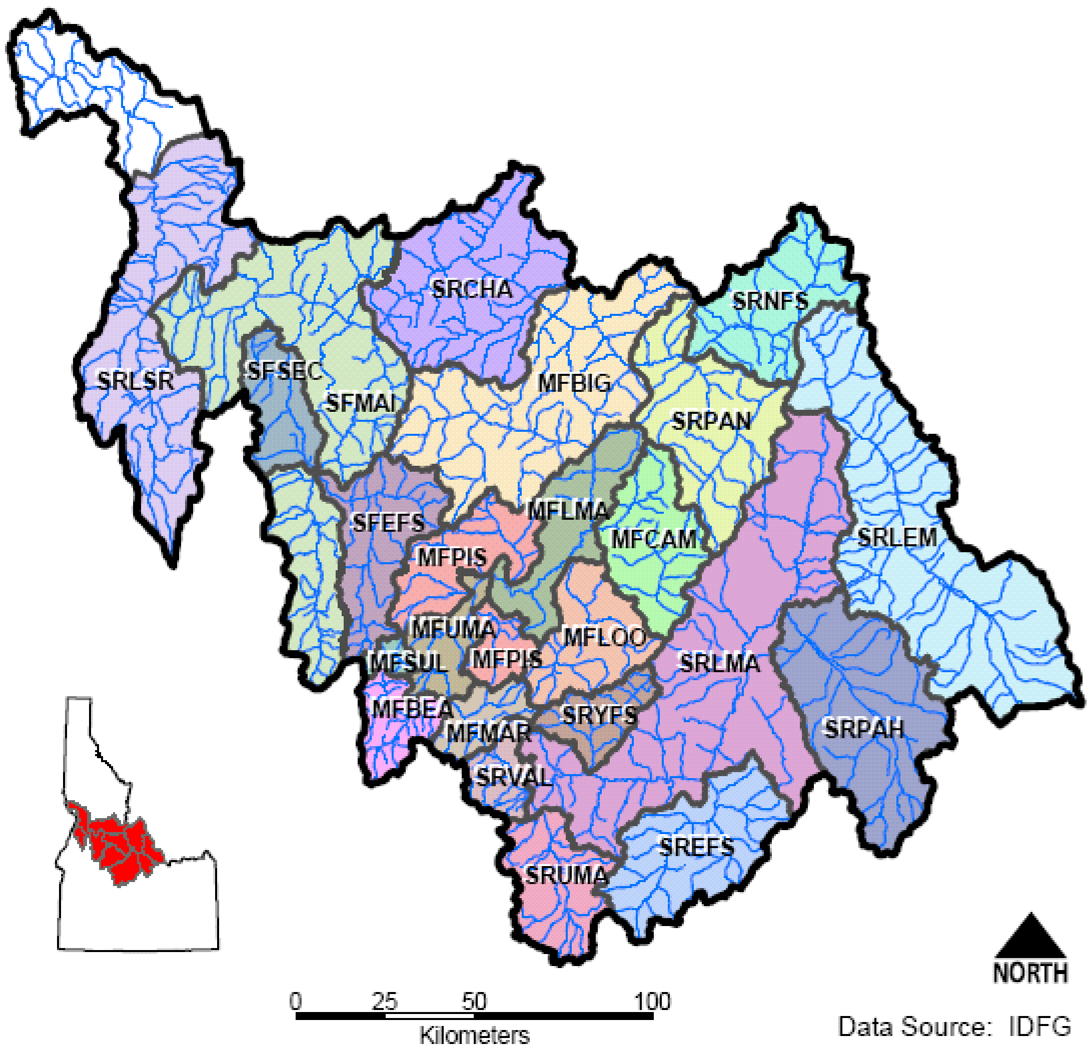

Figure 2-22. Populations of spring/summer Chinook salmon identified in the Salmon subbasin by the Interior Columbia Technical Recovery Team (ICTRT 2003).

Upper Salmon—Chinook salmon of the upper Salmon River migrate farther inland than any other runs of Chinook salmon in the lower 48 states, traveling more than 1,450 km (900 miles) to spawn and rear at over 1830 m (6000 feet) above sea level. Five individual populations were identified in the Upper Salmon watershed by the Interior Columbia Technical Recovery Team (Figure 2-23). The Valley Creek (SRVAL), West Fork/Yankee Fork

(SRYFS), East Fork (SREFS), and Upper Main (SRUMA) populations are located entirely within the Upper Salmon watershed. The population boundaries of the Lower Main (SRLMA) extend into the Middle Salmon–Panther watershed. Chinook salmon populations in the Upper Salmon are classified as a mix of wild and natural. Redd count trends for populations in the Upper Salmon are similar from 1992 to 2001, with the lowest counts for all populations occurring in 1995 and peaks occurring in 1993 and 2001 (Figure 2-24). Spawning was widespread in the Upper Salmon watershed (Figure 2-25).

Estimates of percent carrying capacity indicate that densities have been well below the estimated carrying capacity for the SRUMA population (Figure 2-26).

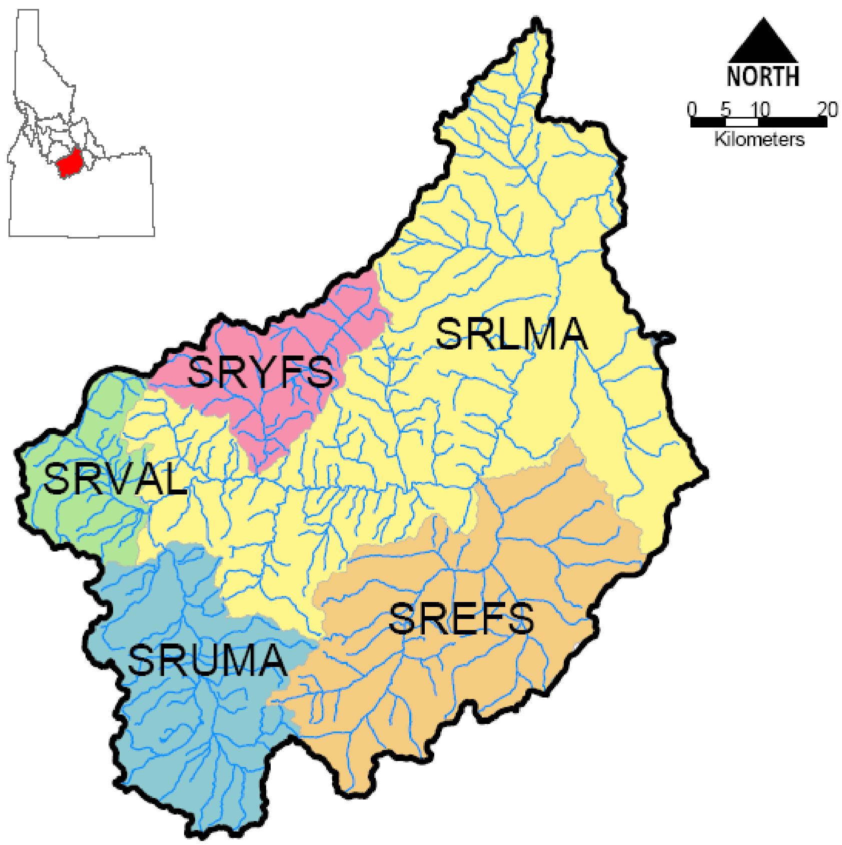

Figure 2-23. Populations of spring/summer Chinook salmon identified in the Upper Salmon watershed by the Interior Columbia Technical Recovery Team. The Lower Main population is also in the Middle Salmon–Panther watershed.

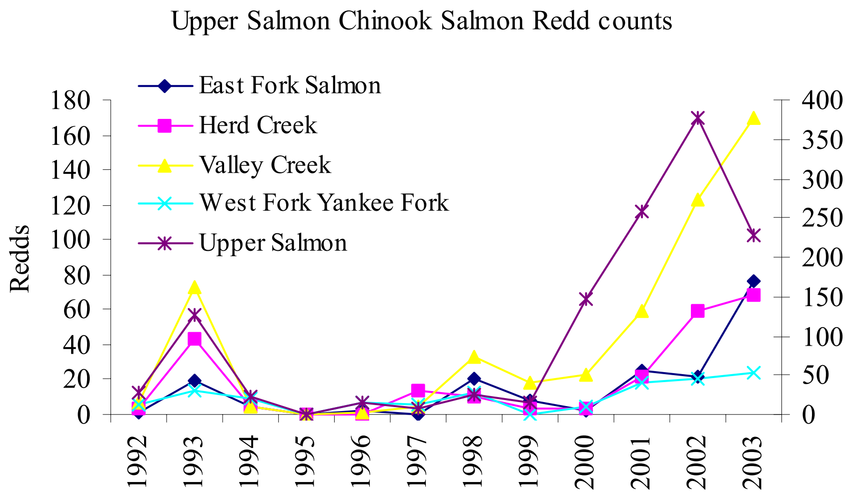

Figure 2-24. **Redd counts in the Upper Salmon Watershed Chinook salmon populations from the index area trend monitoring conducted as part of Idaho supplementation studies. (Walters *et al*. 1999, Lutch and Leth 2003; IDFG unpublished data, Shoshone-Bannock Tribes unpublished data).**

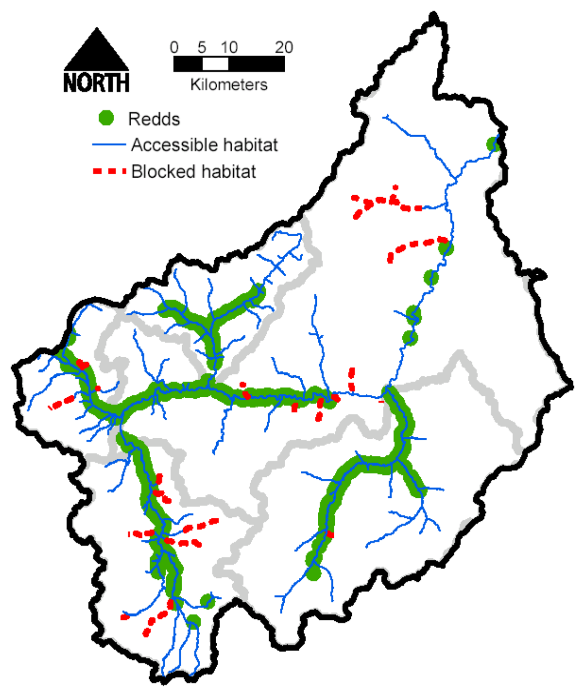

Figure 2-25. **Distribution of Chinook salmon redds and blocked habitat in the Upper Salmon watershed.**

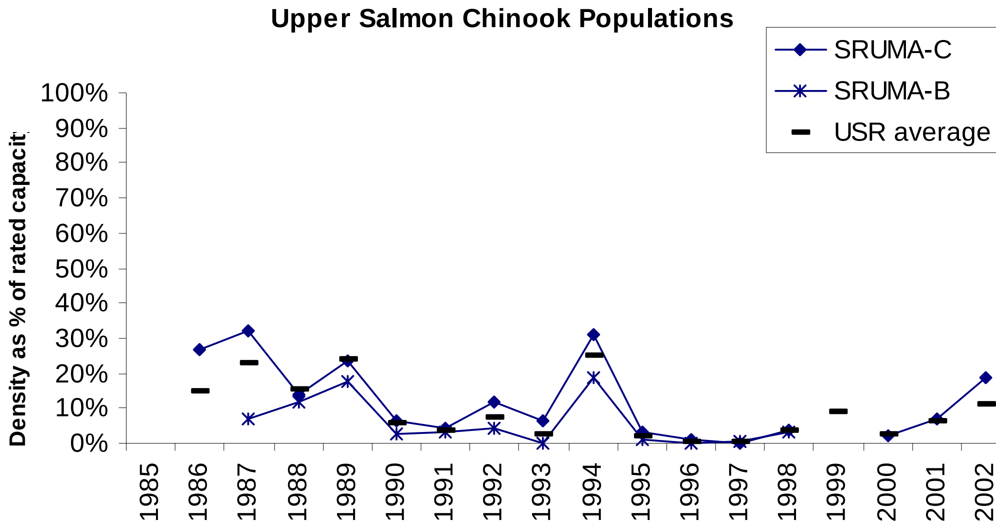

Figure 2-26. Average Chinook salmon parr density as a percentage of rated carrying capacity by population code and channel type for Upper Salmon populations. Averages were calculated for the Salmon River Upper Main (SRUMA) population by B or C channel when sample sizes were greater than five. The Upper Salmon River average was calculated from all samples in the Upper Salmon watershed for a given year. Information is provided as an index of carrying capacity only.

Pahsimeroi—Summer Chinook salmon are native to the Pahsimeroi drainage, but information describing the original stock is limited (Kiefer *et al*. 1992). The Interior Columbia Technical Recovery Team identified only one Chinook salmon population in the Pahsimeroi watershed (SRPAH). Chinook salmon in the Pahsimeroi and Lemhi rivers exhibit a variation in juvenile life history from other Salmon River populations. Both populations exhibit age 0 smolting (in addition to age 1 smolting) by a variable subset of the juveniles in any brood year. Chinook salmon spawning/rearing is concentrated in the lower end of the Pahsimeroi River, while a substantial amount of habitat is blocked (Figure 2-27). Based on available habitat and salmon life history, Chinook salmon probably occupied the mainstem Pahsimeroi River, Big Springs Creek, and several smaller springs (Idaho Soil Conservation Commission 1995). The run is classified as natural because of sustained hatchery Chinook influence on natural production (Kiefer *et al*. 1992). Redd counts in the Pahsimeroi River followed trends similar to those for counts in the Upper Salmon watershed, with low counts in 1995 and peak counts in 1993 and 2001 (Figure 2-28).

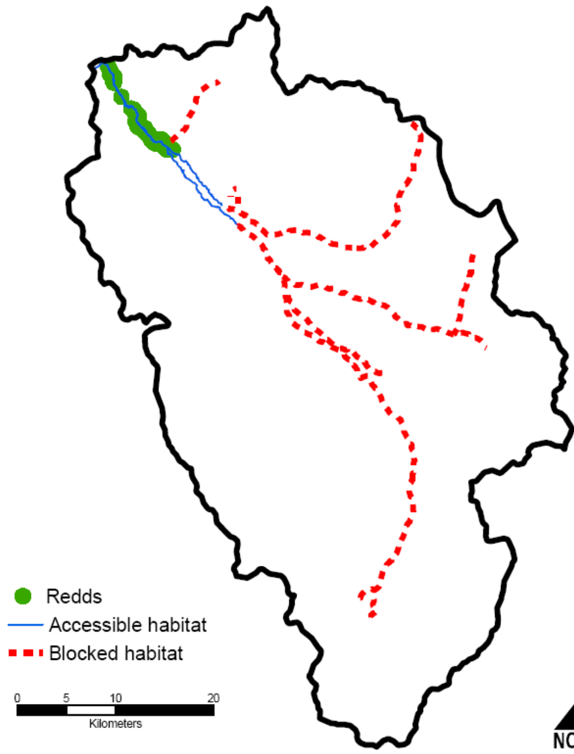

Figure 2-27. **Distribution of Chinook salmon redds and location of inaccessible habitat in the Pahsimeroi River watershed.**

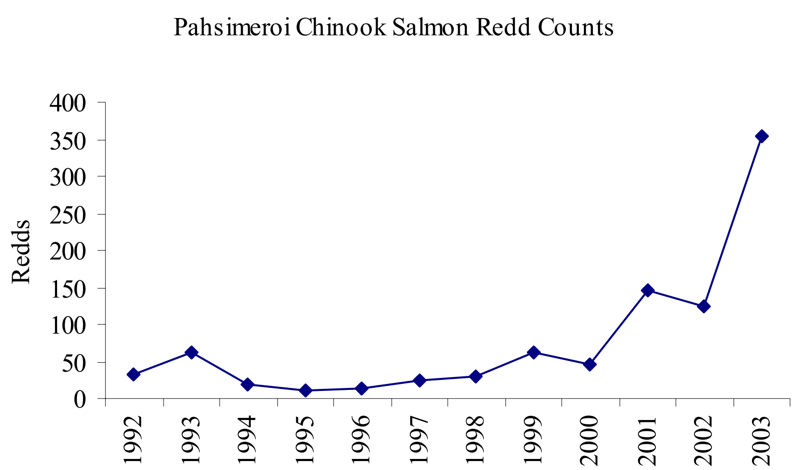

Figure 2-28. **Number of redds counted by year in the Pahsimeroi River from index area trend monitoring conducted as part of Idaho supplementation studies (Walters *et al*. 1999, Lutch *et al*. in review).**

the Lemhi watershed has been maintained primarily by natural production, with fish spawning mostly upstream of Hayden Creek (Figure 2-29). The Interior Columbia Technical Recovery Team identified only one

Chinook population in the Lemhi watershed. A substantial amount of spawning/rearing habitat in the Lemhi River is currently inaccessible due to tributary dewatering. Redd counts in the Lemhi River followed trends similar to those seen in the Upper Salmon and Pahsimeroi watersheds, with the lowest count in 1995, a minor peak in 1997, and a substantial increase in 2001 (Figure 2-30). Hatchery augmentation from Hayden Creek ended in 1982. Summer Chinook salmon, thought to be present historically, are extirpated from the watershed (Bjornn 1978).

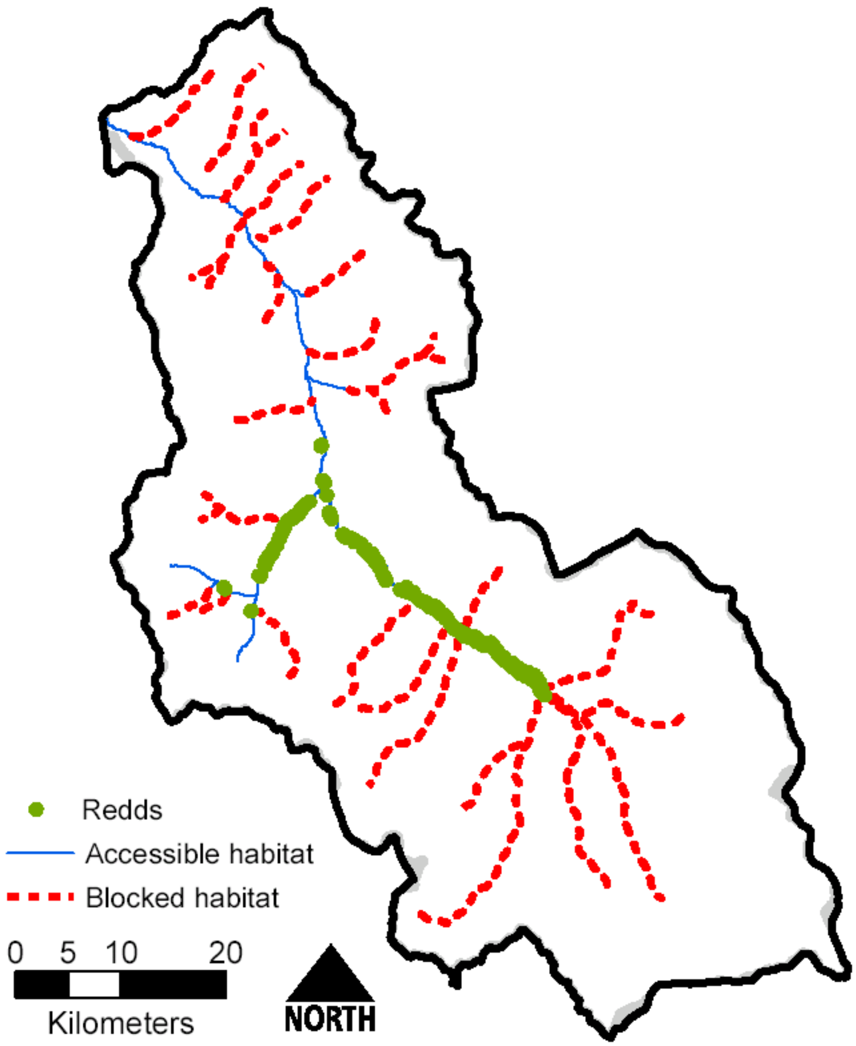

Figure 2-29. Distribution of Chinook salmon redds and location of inaccessible habitat for Chinook salmon in the Lemhi watershed.

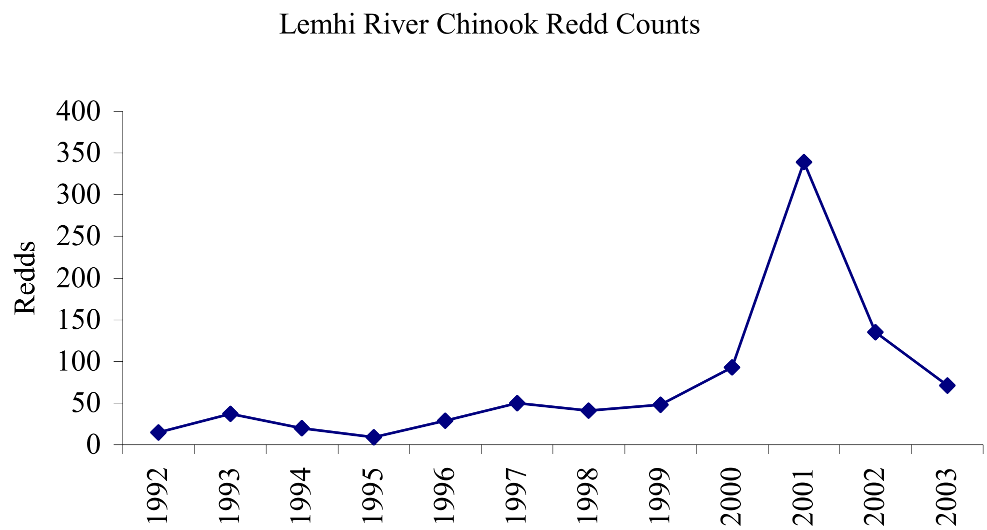

Figure 2-30. Chinook salmon index area redd counts by year for the Lemhi River (51.7 km).

Middle Fork Salmon River is classified as wild as part of the Wild and Scenic River System. Most of the land area (>95%) is within the boundary of the Frank Church–River of No Return Wilderness Area. Prior to becoming wilderness area in 1980, the land was managed as a primitive area from 1930 to 1980. Road and trail densities are low, and most tributaries are in relatively pristine condition. Portions of several spawning tributaries (Bear Valley, Marsh, Camas, Marble, Big, and Loon creeks) are outside the wilderness area are recovering from legacy effects of mining and grazing (Kiefer *et al.* 1992). Middle Fork spring Chinook salmon are classified as a wild run (little or no hatchery influence), exhibiting a strong age 5 adult return component. The summer Chinook run currently constitutes a minor component of the runs in this watershed. Historically, the Middle Fork is reported to have supported 27% of Idaho's sport harvest of Chinook salmon (Mallet 1974). This estimate was made at a time when the runs had already been substantially depressed by fisheries outside the Salmon subbasin and by a variety of disturbances within other areas of the subbasin.

The Interior Columbia Technical Recovery Team identified 10 Chinook salmon populations in the Upper and Lower Middle Fork watersheds (Figure 2-31). Intensive aerial surveys of spring/summer Chinook redd distribution, supplemented by ground counts, have occurred yearly from 1995 through 2002. Chinook salmon redds were extensive throughout the Upper and Lower Middle Fork watersheds over the study period in areas of suitable spawning habitat except for Yellowjacket Creek (MFCAM population), which was relatively unused compared with other areas in these two watersheds (Figure 2-32). The relative scarcity of redds in Yellowjacket Creek may reflect a localized extirpation from overfishing in the area or legacy mining effects to water quantity or quality. Abundance of redds varied from a low of 21 in 1995 to over 1,500 in 2001 and 2002 (Figure 2-33). All populations sampled from 1985 to 2002 have remained below the estimated 50% juvenile carrying capacity (except Marsh Creek B in 1994), with substantial declines by all populations in 1995, 1996, and 1997 (Figure 2-34).

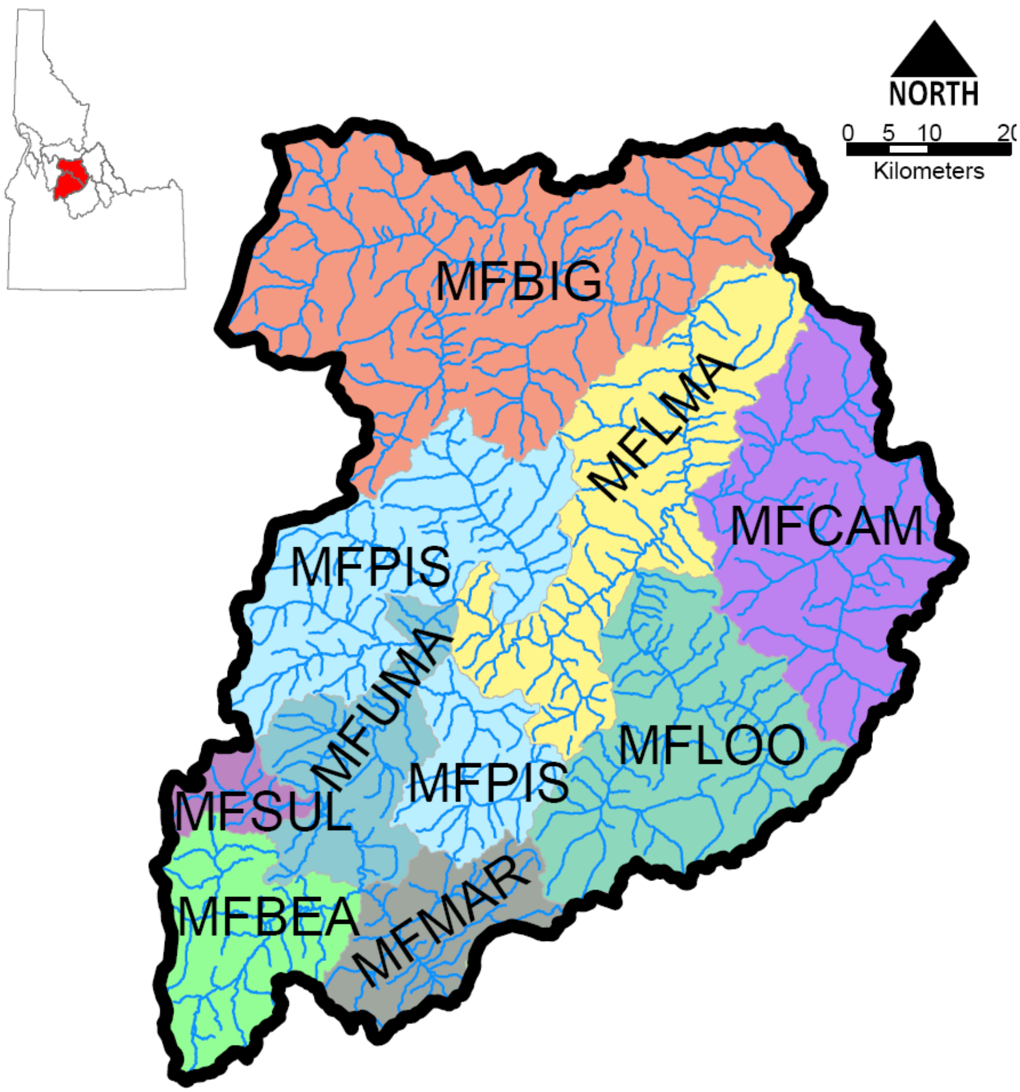

Figure 2-31. Chinook Salmon populations identified in the Upper and Lower Middle Fork Salmon watersheds by the Interior Columbia Technical Recovery Team (ICTRT 2003). A portion of the Big Creek population (MFBIG) is also in the Middle Salmon–Chamberlain watershed.

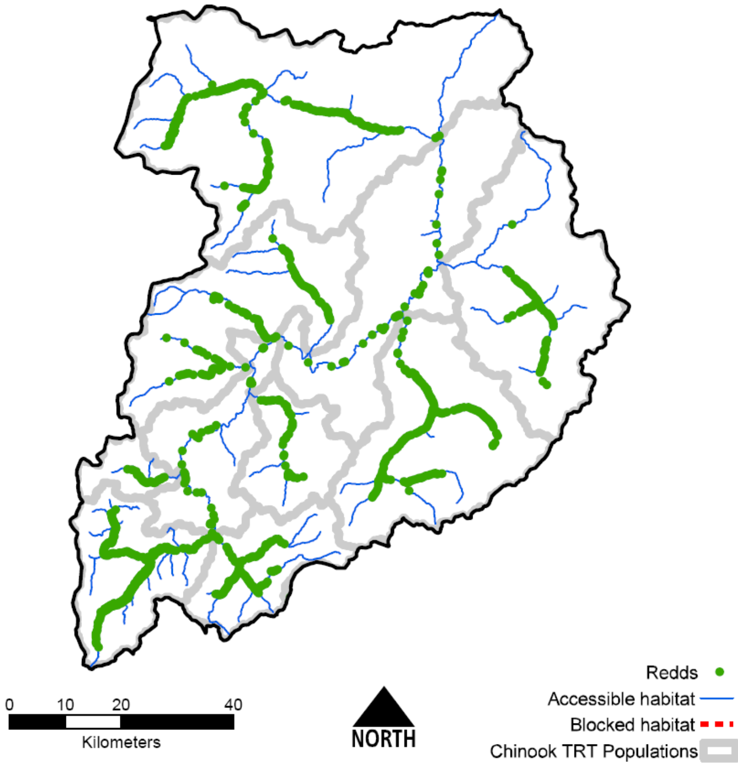

Figure 2-32. Distribution of redds for Chinook salmon populations in the Upper and Lower Middle Fork Salmon watersheds from 1995 to 2002. Counts were from extensive aerial surveys supplemented with ground counts (Russ Thurow, Rocky Mountain Research Station, unpublished data).

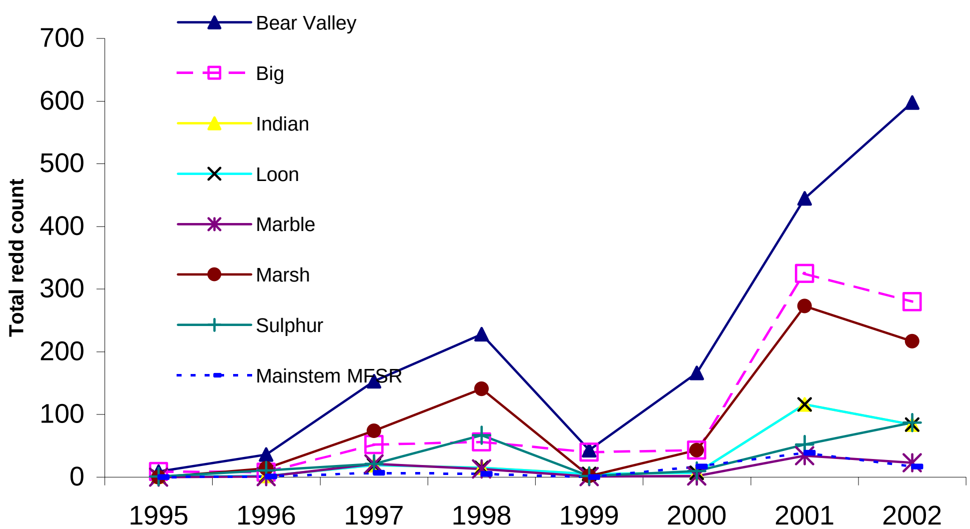

Figure 2-33. Chinook salmon redd counts by drainage in the Middle Fork Salmon River from 1995 to 2002. Counts were from extensive aerial surveys supplemented with ground counts (Russ Thurow, Rocky Mountain Research Station, unpublished data).

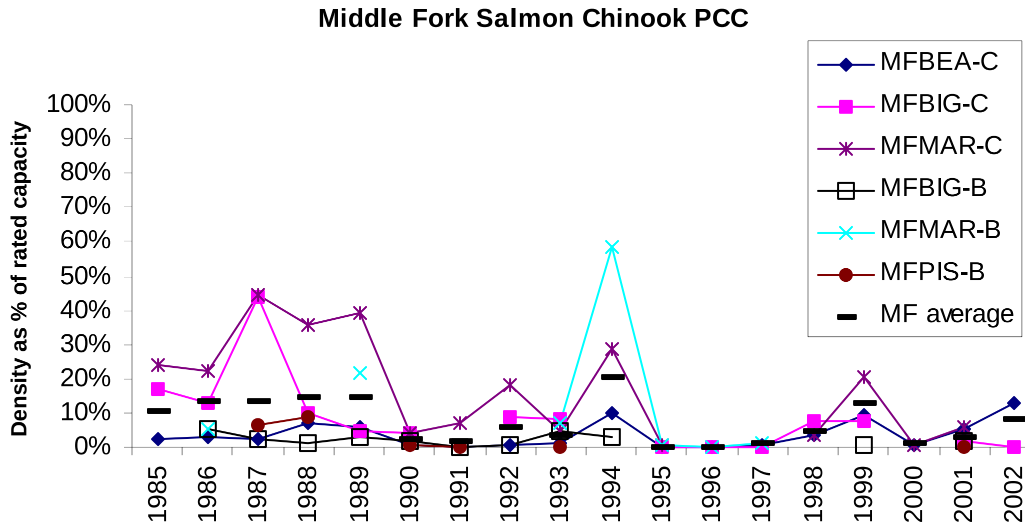

Figure 2-34. Average Chinook salmon parr density as percent of rated carrying capacity by population code and channel type for Middle Fork Salmon River populations. Averages were calculated for individual populations by B or C channel when sample sizes were greater than five. Middle Fork average was calculated from all samples. Information is provided as an index of carrying capacity only.

Middle Salmon–Panther—The Interior Columbia Technical Recovery Team identified two populations (SRPAN and SRNFS) in the Middle Salmon–Panther watershed, as well as portions of two other populations (SRLMA and SRLEM) (Figure 2-35). The Middle Salmon–Panther Creek watershed contains two historical areas of Chinook spawning habitat: the Panther Creek drainage and the North Fork Salmon River (Figure 2-36). Chinook salmon were extirpated from the Panther Creek drainage in the 1960s. Habitat in the Panther Creek watershed was listed as inaccessible due to water quality contamination from the Blackbird Mine. Redd counts in the North Fork Salmon River follow trends similar to those for other areas upstream, with lowest counts observed in 1995 and peaks observed in 1993, 1997 and 2001 (Figure 2-37). No quantitative estimates of spawning for small tributaries in the watershed are available.

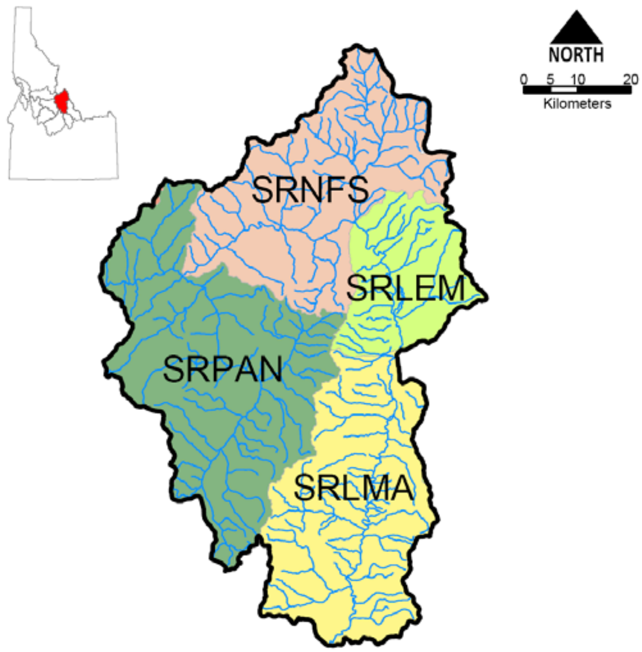

Figure 2-35. Chinook salmon populations identified in the Middle Salmon–Panther watershed by the Interior Columbia Technical Recovery Team (ICTRT 2003).

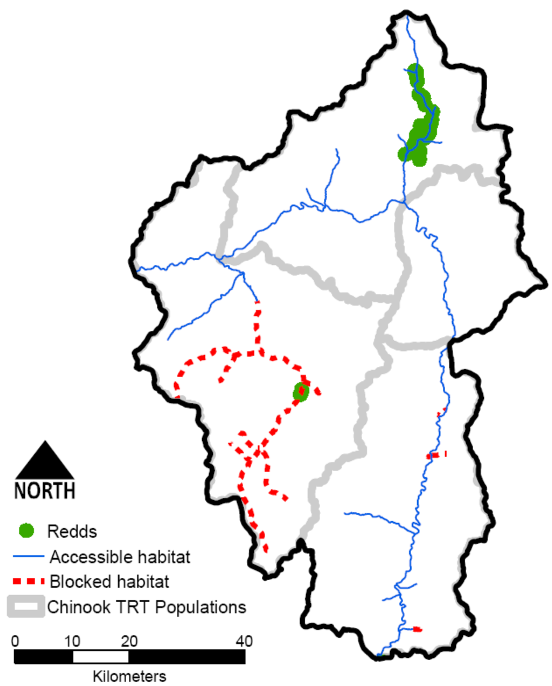

Figure 2-36. Distribution of redds and location of inaccessible habitat in the Middle Salmon–Panther watershed. Habitat indicated as blocked is Panther Creek where water quality is limited although it is not physically blocked. The single redd location in the Panther Creek drainage was from fish transported to and released in the drainage for sport and tribal harvest.

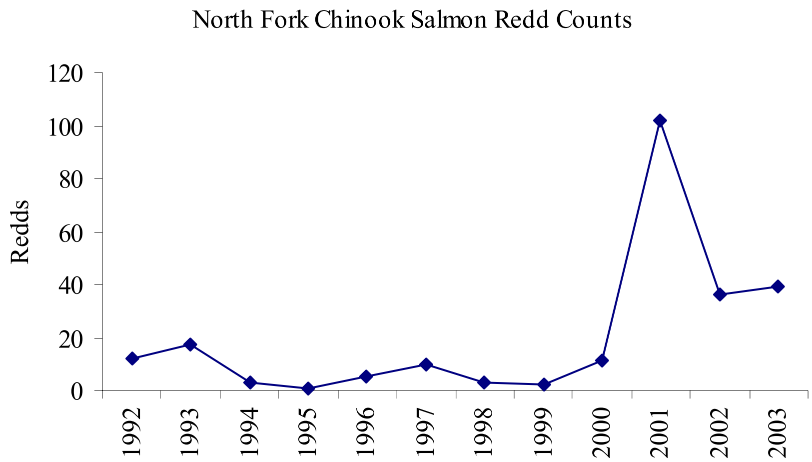

Figure 2-37. Chinook salmon redd count data from the index area on North Fork Salmon River.

Middle Salmon–Chamberlain—Chinook salmon spawn in some of the larger tributaries in the middle section of the mainstem Salmon River, such as Bargamin and Chamberlain creeks. Chinook salmon spawning was also documented historically in Horse Creek. It has not been confirmed whether the Chinook in this portion of the subbasin are a spring or summer run. For management purposes they are classified and managed as wild spring run. Hatchery Chinook salmon have not been outplanted anywhere within the Middle Salmon–Chamberlain watershed (Kiefer *et al*. 1992). Three Chinook populations are found in the Middle Salmon–Chamberlain watershed. The Chamberlain (SRCHA) population is located entirely within the watershed, and portions of the Big Creek (MFBIG) and South Fork Main (SFMAI) populations are partially located in the watershed (Figure 2-38). Redd distribution (Figure 2-39) information is from the index area located on Chamberlain Creek and does not represent a thorough inventory of spawning areas within the drainage. Parr density information as percent carrying capacity (Figure 2-40) reflects very low densities, which are likely the result of information being available only in B channel-type habitat that is less preferred habitat by Chinook parr than C channel types.

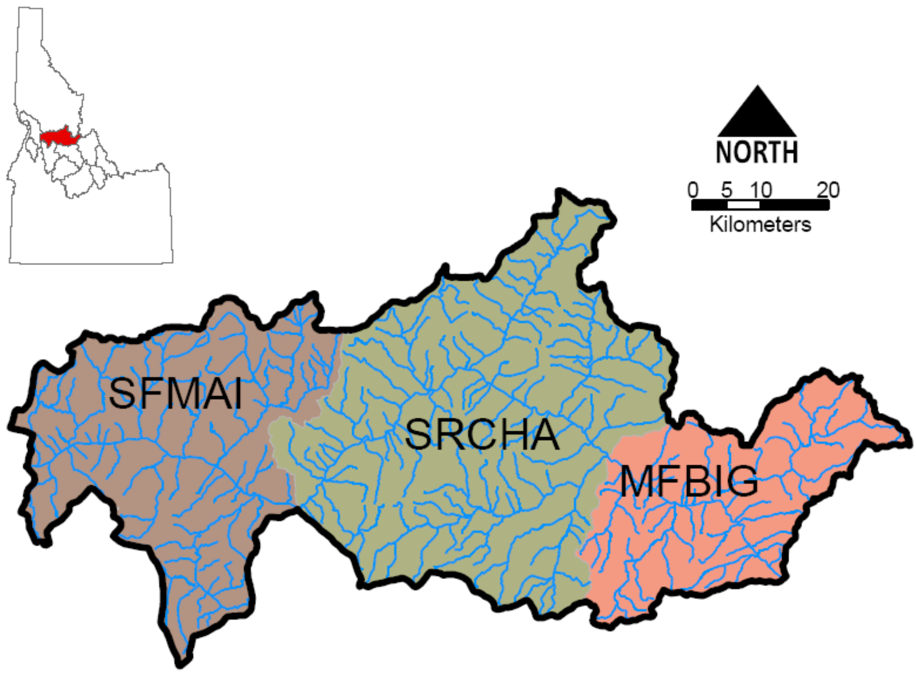

Figure 2-38. Chinook salmon populations identified in the Middle Salmon–Chamberlain watershed by the Interior Columbia Technical Recovery Team (ICTRT 2003).

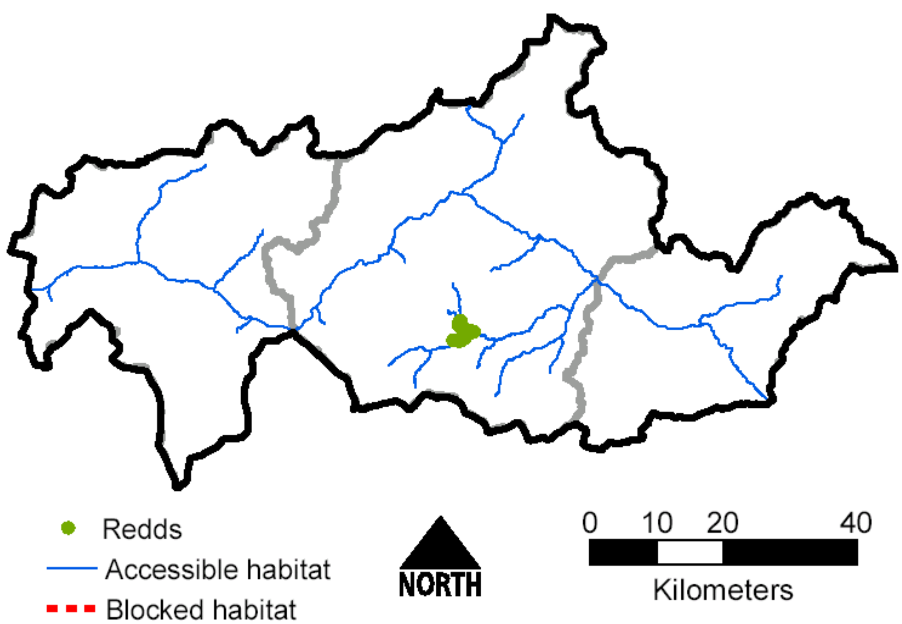

Figure 2-39. Known locations of Chinook salmon redds within the index area in the Middle Salmon–Chamberlain watershed.

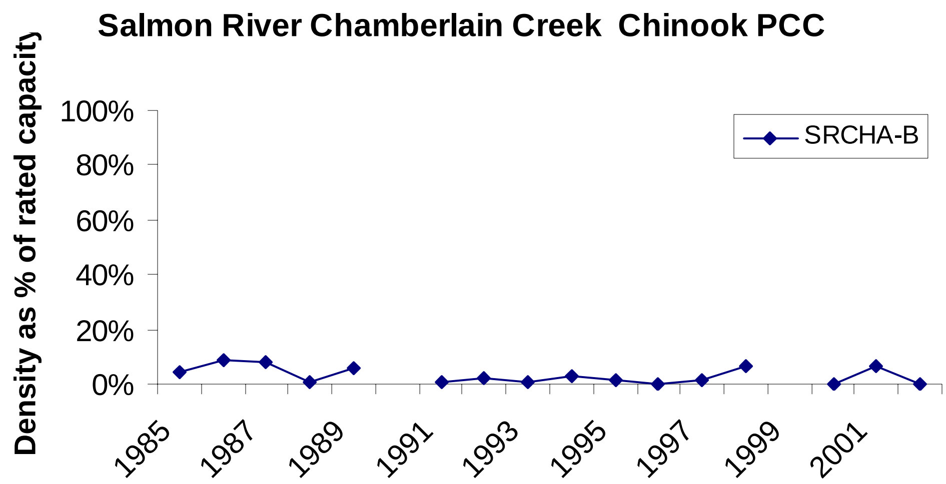

Figure 2-40. Chinook salmon parr density as percent of rated carrying capacity for B channel types in Chamberlain Creek for years with sample sizes greater than five. Information is provided as an index of carrying capacity only.

South Fork Salmon—The South Fork Salmon Chinook populations are primarily a summer run. Historically, the South Fork Salmon River produced 60 to 70% of the annual adult summer Chinook salmon return to Idaho (IDFG 1992a). Salmon fishing was a major economic resource in the South Fork prior to 1965, and anglers harvested 1,700 to 4,000 wild salmon annually (IDFG 2001). Sport fishing harvest for wild salmon ended in 1975. Salmon fishing supported by hatchery returns was reinitiated in 1997. Sport and tribal fishing seasons were held in 1997 (Appeson and Wilson 1998) and then again from 2000 to 2003 (Apperson 2003, Dyson and Apperson in preparation).

The Interior Columbia Technical Recovery Team (ICTRT 2003) identified three populations in the South Fork Salmon watershed (Figure 2-41). The Secesh River (SFSEC) and East Fork South Fork (SFEFS) populations are completely within the boundaries of the South Fork Salmon watershed. The South Fork Main (SFMAI) population boundaries extend into the Middle Salmon–Chamberlain watershed. Evidence suggests that fall Chinook salmon historically spawned in the lower section of the South Fork Salmon River (D. Burns, Payette National Forest, letter to NMFS, 1992). Currently, fall Chinook salmon are extirpated from the South Fork Salmon drainage.

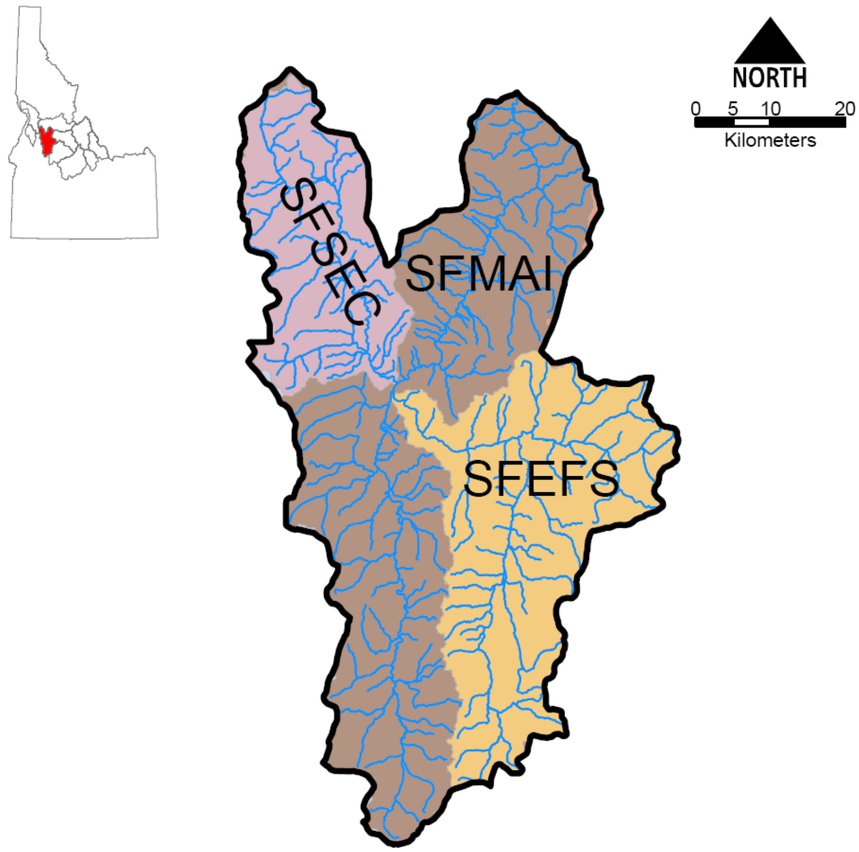

Figure 2-41. Chinook salmon populations identified in the South Fork Salmon watershed by the Interior Columbia Technical Recovery Team (ICTRT 2003). The boundaries of the South Fork Main population (SFMAI) extend into the Middle Salmon–Chamberlain watershed.

Known redd locations for Chinook salmon are indicated on Figure 2-42. Areas downstream of known redd locations are generally considered less favorable spawning habitat for Chinook salmon due to higher gradients and larger substrate. Trends in redd abundance for the main South Fork Salmon River are markedly different from those of upstream spring Chinook (Figure 2-43). Redd counts in the South Fork Salmon River are likely affected by spawning of hatchery Chinook salmon whereas the Secesh River redd counts would be affected by hatchery fish only through straying. Parr densities as percent of rated carrying capacity have averaged below 60% for the South Fork Salmon watershed (Figure 2-44). Estimates of percent carrying capacity that are greater than 100% for the East Fork South Fork in 1987 and 1988 are likely the result of releases of unmarked hatchery parr.

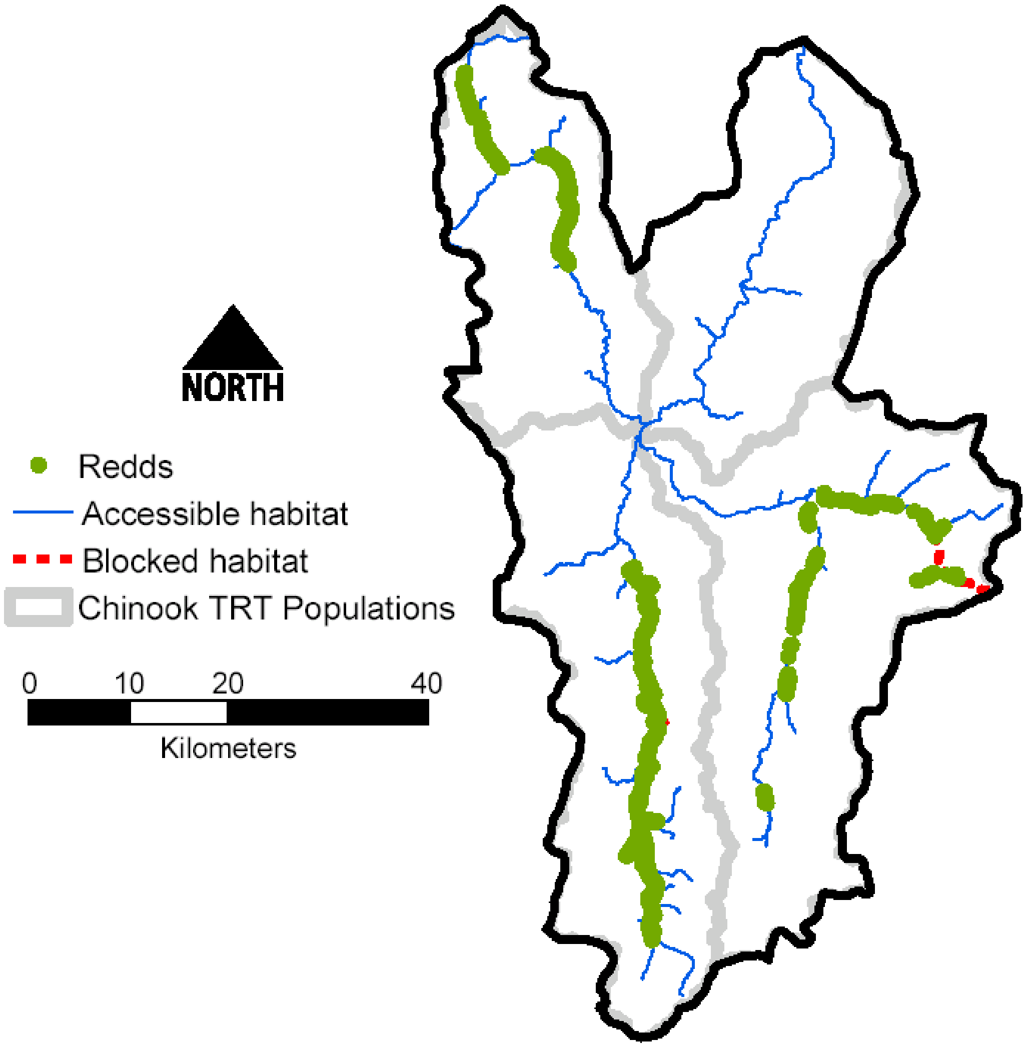

Figure 2-42. Distribution of redds in 2003 within the South Fork Salmon watershed.

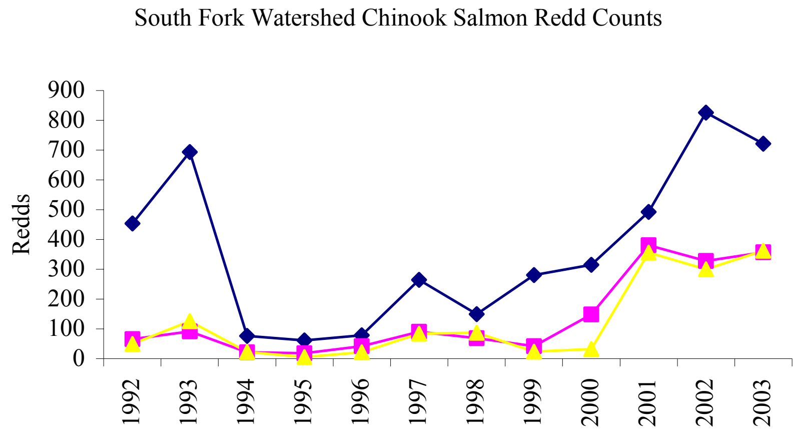

Figure 2-43. **Redd counts in index areas of the South Fork Salmon watershed for the South Fork Main, South Fork Secesh and South Fork Johnson Creek salmon populations. Distances surveyed varied by year and by location (South Fork Salmon 1992 to 1996–29.2 km, 1997 and 1998–20.2 km, 1999–22.6 km, 2000 to 2001–24.5 km; Secesh River 1991 to 1996–10.3 km, 1997 to 2001–32.1 km).**

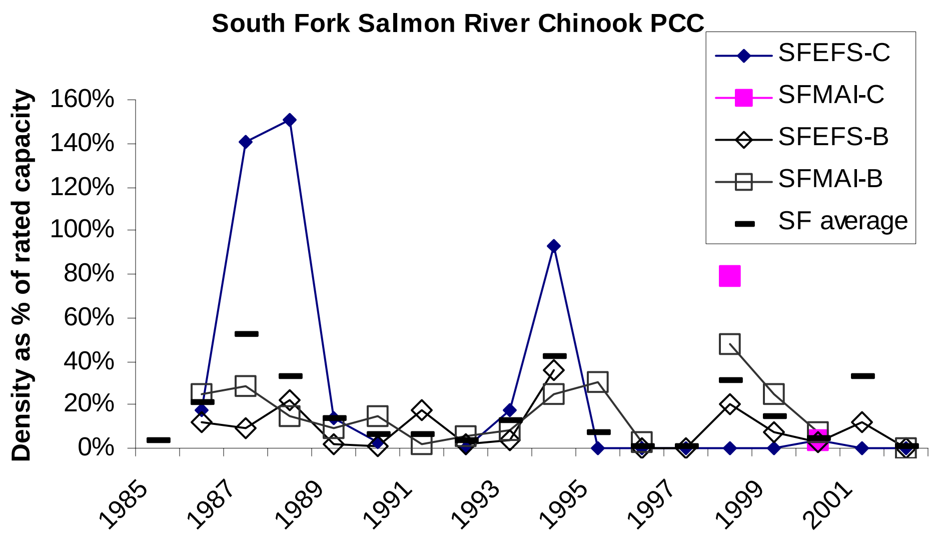

Figure 2-44. **Average Chinook salmon parr density as percent of rated carrying capacity by population code and channel type for South Fork Salmon River populations. Averages were calculated for individual populations by B or C channel when sample sizes were greater than five. South Fork average was calculated from all samples. Information is provided as an index of carrying capacity only.**

Lower Salmon—Two races of Chinook salmon exist in the Lower Salmon watershed. Fall Chinook spawn in the mainstem Salmon River, and tributary spawning fish are believed to be spring run. For management purposes, the spring run is classified as wild. Known naturally producing populations of these fish exist in Slate and White Bird creeks, and occasionally juveniles are found in other tributaries. Although no spring/summer Chinook salmon of hatchery origin have been stocked anywhere in the Lower Salmon watershed, average stray rates of 21% (Lutch *et al*. 2003) for hatchery Chinook salmon adults were reported over a three-year period. These hatchery fish were identified by their clipped adipose fins (termed “ad-clipped fish”). The closest source of these marked adults is Rapid River Fish Hatchery in the Little Salmon watershed. The Interior Columbia Technical Recovery Team aggregated the Chinook populations in the Lower Salmon with the Little Salmon River (SRLSR) and South Fork Main (SFMAI) populations (Figure 2-45). Redd counts for the SRLSR population were available for the Slate Creek area only (Figure 2-46). The Lower Salmon contains the only remaining spawning population of fall Chinook salmon in the Salmon subbasin, which is considered to be part of the Snake River population by the Interior Columbia Technical Recovery Team. The increase in redds in the Salmon River mirrors trends of adult returns to the Snake River, possibly indicating straying by Snake River fish (Table 2-6).

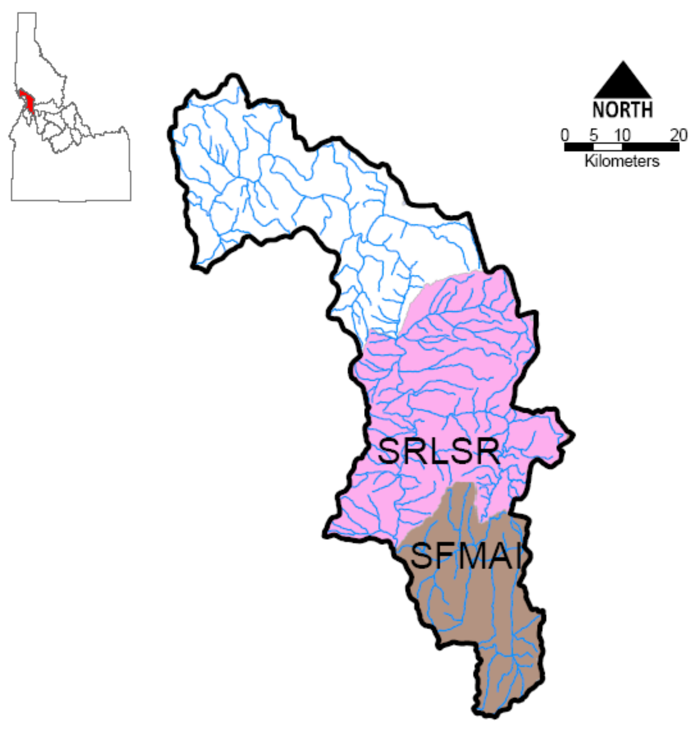

Figure 2-45. Chinook salmon populations identified in the Lower Salmon watershed by the Interior Columbia Technical Recovery Team (ICTRT 2003). Both populations in the Lower Salmon watershed are part of populations in other watersheds. The Little Salmon (SRLSR) population boundary extends into the Little Salmon watershed and the South Fork Main (SFMAI) population extends into the South Fork Salmon watershed.

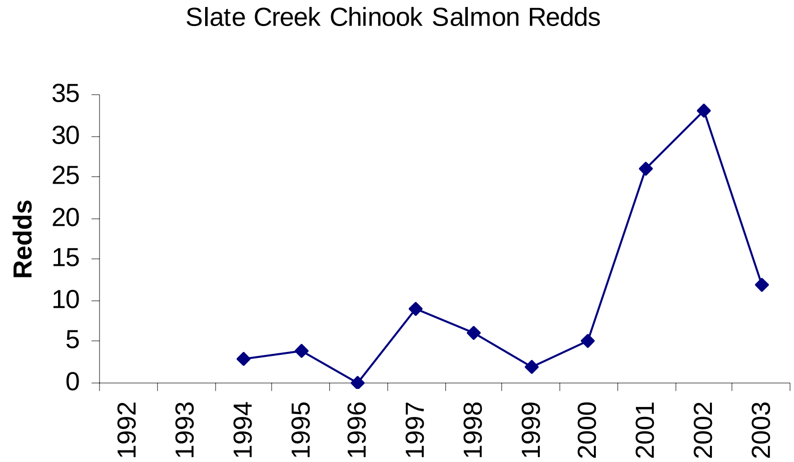

Figure 2-46. Redd counts in index areas of Slate Creek. Distances surveyed varied by year (1991 to 1996–5.5 km, 1997–15 km, 1998–28.6 km, 1999 to 2003–34.6 km).

Table 2-6. Fall Chinook salmon redds counted in the Salmon River during aerial searches, by river kilometer (RK) and year. Snake River fall Chinook salmon redd counts from aerial surveys are provided for comparison. Maximum upstream distance surveyed varied from 134 to 215 RK (USFWS *et al.* 2003).

General Location	Year										
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Maximum search distance (RK)	140	156	215	168	140	134	168	155	155	168	168
Above Cottonwood Creek (RK 24.1)	1						1			2	
Below Bentz Cabin (RK 25.7)				1	1					3	
Below Pine Bar (RK 41.8)				1							
Below Telcher Creek and Bingham Ridge (RK 49.9)		1					1			1	
About 1 mile below Anderson Ranch (RK 56.3)						1				1	
Slate Creek Boat Ramp (RK 104)							1			9	24
Above mouth of Little Salmon River (RK 140)			1							6	5
Above Berg Creek (RK 146.5)		2									2
Total redds in Salmon River	1	3	1	2	1	1	3	0	0	22	31
Total Snake River redds	47	60	53	41	71	49	135	273	255	535	878

Little Salmon—Only one Chinook salmon population (SRLSR) was identified in the Little Salmon River drainage (Figure 2-47). Spring Chinook salmon were brought to the Little Salmon River in 1964, as mitigation for the lost run and fishery in the Snake River when the Hells Canyon complex of dams (Brownlee, Oxbow, and Hells Canyon) was constructed. Rapid River (large tributary to the Little Salmon) has a run of wild summer Chinook. The most consistent sport and tribal harvests in the Salmon subbasin in the past two decades have occurred on the hatchery-produced spring Chinook salmon in the Little Salmon River (Hassemer 1991; Janssen 1992, 1993; Janssen and Kiefer 1998, 1999). No redd count or distribution information is available for this population.

Figure 2-47. Distribution of spring/summer Chinook salmon in the Little Salmon River (ICTRT 2003).

2.2.1.2 Steelhead (Oncorhynchus mykiss)

2.2.1.2.1 Conservation Status

Summer steelhead, an anadromous form of redband trout, are native to the Salmon subbasin (Behnke 1992). The Snake River steelhead (*O. mykiss* [Walbaum, 1792])[6], of which spawning populations in the Salmon subbasin are a part, was listed as threatened under the ESA on August 18, 1997 (62 FR 43937). NOAA Fisheries first designated the critical habitat for the Snake River steelhead on February 16, 2000 (65 FR 7764. This designation was withdrawn on April 30, 2002. Known populations of resident redband trout (above natural

[6] Formerly *Salmo gairdneri* [Richardson, 1836]. The species *Oncorhynchus mykiss* probably consists of multiple subspecies, none of which have been formally recognized. The most recently published treatise on the species, Behnke (1992), proposed three subspecies: *O.m. irideus*, or coastal rainbow and steelhead; *O.m. gairdneri,* or inland Columbia Basin redband and steelhead; and *O.m. newberrii*, or Oregon Basin redband trout.

barriers) in the subbasin are excluded from listing.

2.2.1.2.2 Life History

Steelhead have the greatest diversity of life history patterns of any Pacific salmonid species. Steelhead can spend up to four years in fresh water prior to smoltification and then live up to three years in salt water prior to first spawning. Steelhead also have the ability to spawn more than once (iteroparity), whereas all other species of *Oncorhynchus*, (except cutthroat trout [*O. clarki*]) spawn once and then die (semelparity). The frequency of multiple spawnings in steelhead populations is variable both within and among populations (Childerhouse and Trim 1979). Scale analysis conducted in the Clearwater River, Idaho, indicated a repeat spawning rate of approximately 2% in 1952 (Whitt 1954), when only two dams impeded their migration. Repeat spawning rates averaging 1.6% have been documented for wild summer steelhead populations in the Yakima River subbasin (above four mainstem dams) (Hockersmith *et al.* 1995).

The presence of resident and anadromous forms of *O. mykiss* makes steelhead life history very complex. The degree of gene flow between life history forms of different fish is known to be highly variable (Wilson *et al*. 1985, Ehlinger and Wilson 1988, Foote *et al*. 1989, Verspoor and Cole 1989, Zimmerman and Reeves 2000, Pettersson *et al*. 2001). Life history appears to be plastic in many salmonids, as indicated by the production of anadromous returns from resident populations and vice versa (Foote *et al*. 1989, Rieman *et al*. 1994). Additionally, the presence of resident forms of *O. mykiss* complicates juvenile sampling efforts since there is no way to differentiate the two life history forms until migration actually occurs.

Steelhead are generally split into two runs: "winter" steelhead return as adults between November and April, and "summer" steelhead return as adults between May and October (Withler 1966). Variations in migration timing exist between populations, although there is considerable overlap. Coastal streams are dominated by winter steelhead, whereas inland steelhead of the Columbia River basin are almost exclusively summer steelhead. The only steelhead found in the Salmon subbasin are summer steelhead (Pevin 1990).

Two races have been recognized in this species, and both occur in the Salmon subbasin: A-run and B-run. These designations are based on the observation of a bimodal migration of adult steelhead at Bonneville Dam and differences in age and adult size. The A-run fish are smaller than B-run fish and, on average, have a shorter freshwater and ocean residence; they generally begin their upriver migration earlier in the year. The B-run fish are relatively larger, spend more time rearing in both fresh and salt water, and begin their upriver migration later in the year. Although both run types are present in the Salmon subbasin, it is unclear whether the life history and body size differences observed upstream are correlated back to the groups forming the bimodal migration observed at Bonneville Dam. Furthermore, the relationship between patterns observed at the dams and distribution of adults in spawning areas throughout the basin are not well understood. The A-run steelhead are believed to occur throughout the steelhead-bearing streams of the Snake River basin; additionally, inland Columbia River steelhead outside the Snake River basin are also considered A-run. The B-run steelhead are thought to be produced only in the Clearwater, Middle Fork Salmon, and South Fork Salmon rivers.

Steelhead typically spawn between March and June. Depending on water temperature, steelhead eggs may incubate in redds for 1.5 to 4 months before hatching as alevins. Following yolk-sac absorption, alevins emerge from the gravel as fry and begin actively feeding. Young juvenile steelhead rear in fresh water from one to four years and then migrate to the ocean as smolts (Withler 1966).

Although steelhead can spend up to three years in the ocean, the majority of them spend two years in salt water before returning to fresh water as adults (Pevin 1990). A small percentage of steelhead return to the ocean after spawning, coming back to fresh water the following year to spawn again.

Steelhead are widely distributed throughout the Salmon subbasin (Figure 2-48) and follow a general pattern of key life history events (Figure 2-49). Areas shown as blocked habitat indicate complete or seasonal blockage due to dewatering or impassable culverts or other nonnatural features. Information was compiled during fisheries technical assessment team meetings and represents survey information and local knowledge

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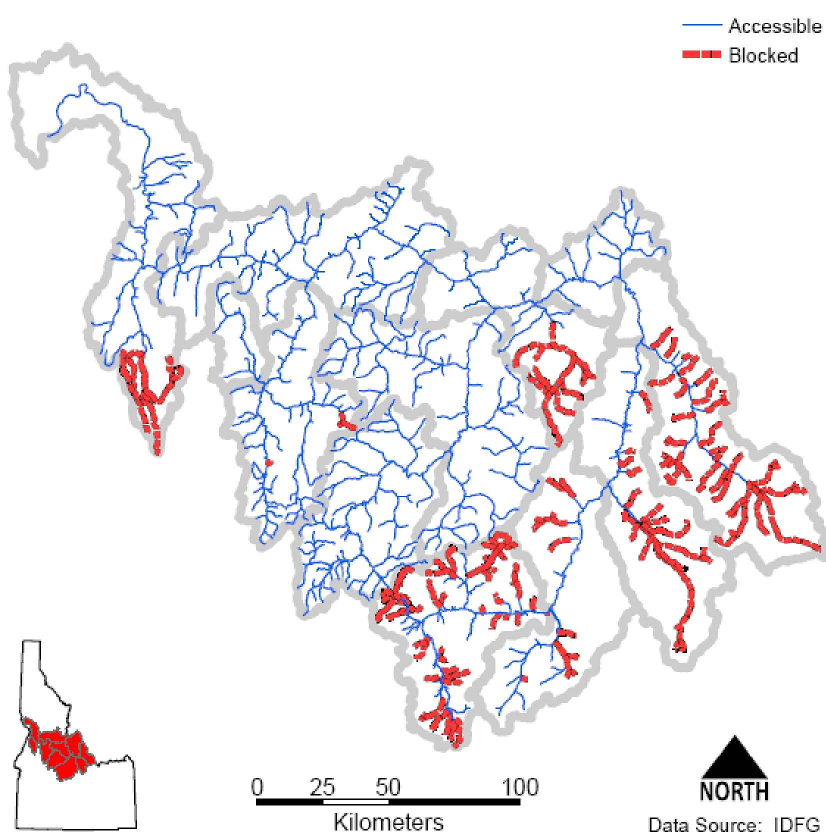

Figure 2-48. Distribution and blocked habitat of summer steelhead within the Salmon subbasin, Idaho.

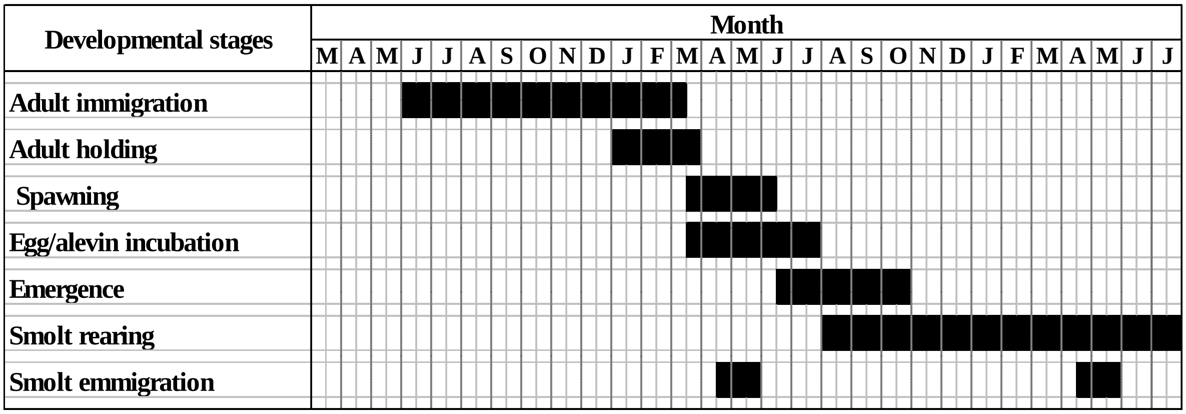

Figure 2-49. Freshwater life history for natural/wild summer steelhead in the Salmon subbasin, Idaho.

2.2.1.2.3 Population Trends and Distribution

The Columbia River basin is the world's largest producer of steelhead (Netboy 1980, Light 1987). One estimate of the pre-European settlement steelhead run in the entire Columbia River basin was about two million fish (NPPC 1986). Mallet (1974) estimated that, historically, 25% of these fish originated in the Salmon subbasin.

The completion of Ice Harbor Dam (1962) was the first opportunity to count adult steelhead returning to Snake River tributaries. Wild steelhead abundance declined steadily from 1962 to 1976, and abundance was depressed but stable during the late 1970s and 1980s (Figure 2-50). Wild steelhead abundance in 1993 through 1996 was the lowest ever recorded.

Historically, steelhead were widespread in the Salmon subbasin. Spawning occurred in the mainstem rivers and smaller tributaries. Wild B-run steelhead occur in the Middle and South Forks of the Salmon River, which are managed as wild fish sanctuaries (no direct hatchery influence). Wild A-run fish spawn throughout the remainder of the subbasin.

Steelhead initiate spawning just prior to spring runoff in the Salmon subbasin. This timing results in an inability to estimate numbers of spawners or redds on the spawning grounds with methods for counting Chinook salmon in the subbasin. Spawner surveys, which have been conducted generally, have been useful for identifying principal spawning areas. Limited spawner escapement information is available from hatchery weirs. Lack of tributary specific adult abundance and distribution information for both A- and B-run steelhead severely limits the ability to manage ESA-listed steelhead in the Salmon subbasin.

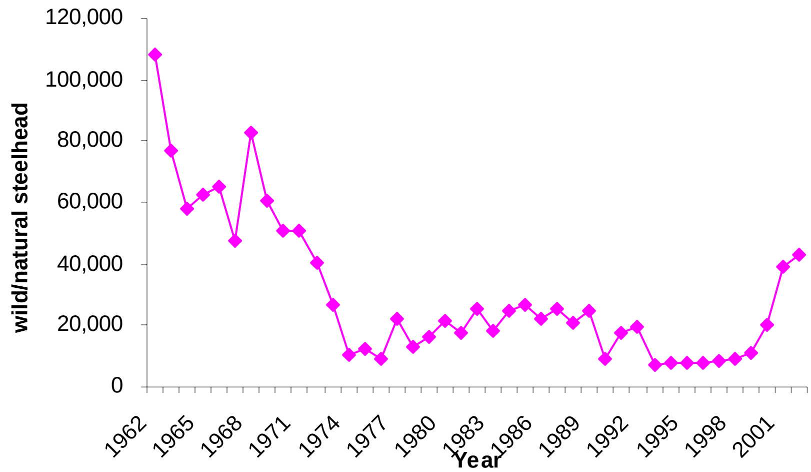

Figure 2-50. Wild/natural steelhead counts at the uppermost Dam on the Snake River, 1962–2003 (Technical Advisory Committee 2003a). The uppermost dam is indicated by years: 1962–1968 Ice Harbor, 1969 Lower Monumental, 1970–1974 Little Goose, and 1975–2002 Lower Granite.

Current Watershed Level Abundance and Productivity

Twelve steelhead populations in the Salmon subbasin are identified based on genetics, spawning distribution, life history demographics, and habitat use (ICTRT 2003) (Table 2-7 and Figure 2-51). Individual populations within a watershed were identified by five-letter codes combining the basin code and the individual population name. For example, the South Fork Secesh River population is noted as SFSEC (Table 2-7). Population codes are used for these populations throughout the remainder of the document.

Steelhead redd counts were conducted for some streams in the Salmon subbasin from 1987 to 1998. Due to the difficulty in collection, unknown accuracy of the method, and other issues, the decision was made to focus on juvenile abundance as an index of productivity rather than on continuing redd counts. The accuracy and utility of steelhead redd counts were never fully investigated as a management tool. Data for B-run steelhead populations in the Salmon and Selway rivers did pick up the fluctuations of adult abundance observed at Lower Granite Dam (Charlie Petrosky, IDFG, personal communication). Available steelhead redd count data for the Salmon subbasin is presented in Appendix 2-3.

Table 2-7. Populations of summer steelhead identified in the Salmon subbasin by the Interior Columbia Technical Recovery Team (ICTRT 2003).

Watershed	Population	Population Code
Little Salmon and Lower Salmon	Little and Lower Salmon	SRLSR
South Fork Salmon	South Fork Main	SFMAI

	Secesh River	SFSEC
Middle Salmon–Chamberlain	Chamberlain Creek	SRCHA
Middle Fork Salmon	Big, Camas, and Loon creeks	MFBIG
	Upper Middle Fork	MFUMA
Middle Salmon–Panther	Panther Creek	SRPAN
	North Fork Salmon River	SRNFS
Lemhi	Lemhi	SRLEM
Pahsimeroi	Pahsimeroi	SRPAH
Upper Salmon	East Fork Salmon River	SREFS
	Salmon River Upper Mainstem	SRUMA

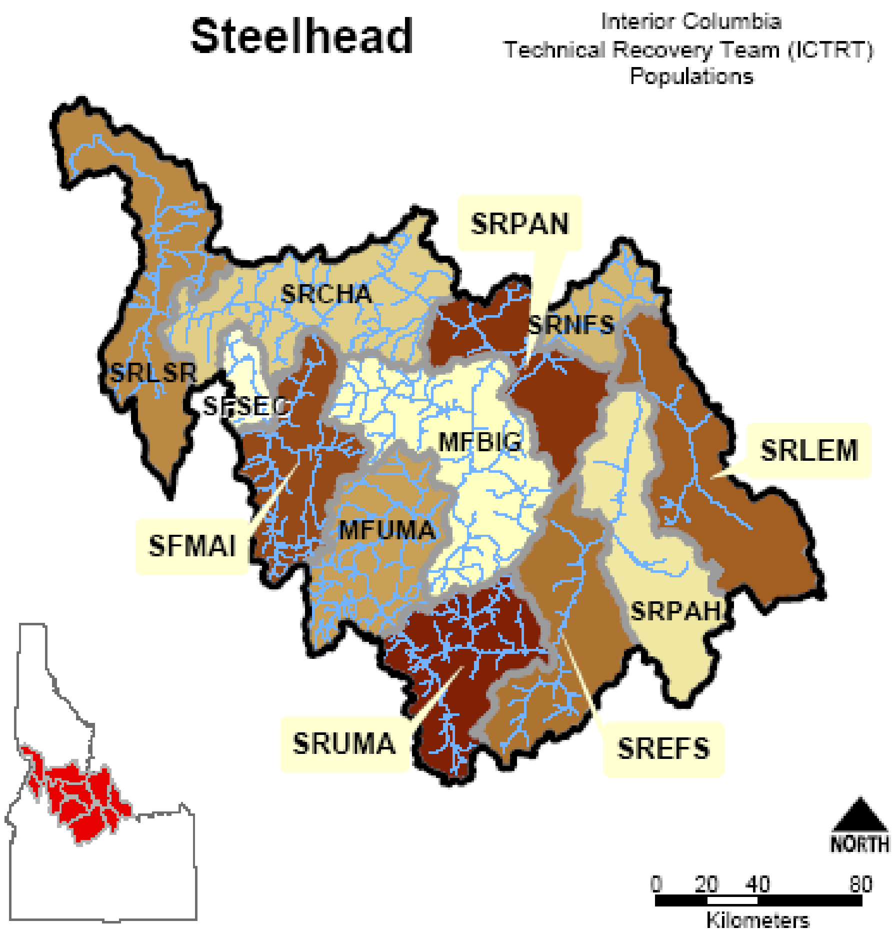

Figure 2-51. Populations of steelhead identified in the Salmon subbasin by the Interior Columbia Technical Recovery Team (ICTRT 2003).

Upper Salmon—Two steelhead populations were identified in the Upper Salmon watershed (Figure 2-52). From the mouth of the East Fork Salmon River upstream, including tributaries, all steelhead are grouped into the Salmon River Upper Mainstem (SRUMA) population. All steelhead in the East Fork Salmon River and mainstem Salmon River and tributaries downstream to the watershed boundary are part of the East Fork Salmon River (SREFS) population. Both populations are classified as A-run. Adult abundance information for these populations is limited to information from hatchery weirs located on the upper Salmon River and East Fork Salmon River. Both weirs are high in the drainages and intercept only a small portion of the wild spawning populations. Both populations have remained below 50 adults for all years on record except the 2002 return to Sawtooth Fish Hatchery, which approached 100 adults (Figure 2-53). Age 1 parr density was low during the early 1990s but has increased in recent years (Figure 2-54).

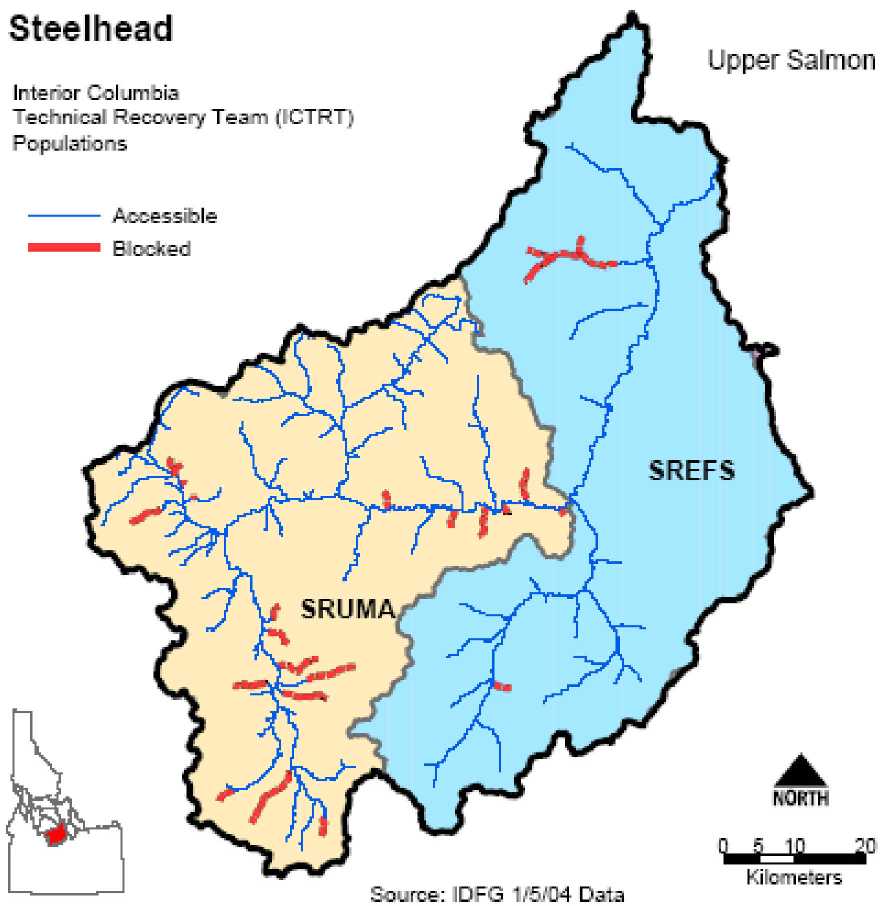

Figure 2-52. Steelhead populations identified in the Upper Salmon watershed by the Interior Columbia Technical Recovery Team (ICTRT 2003).

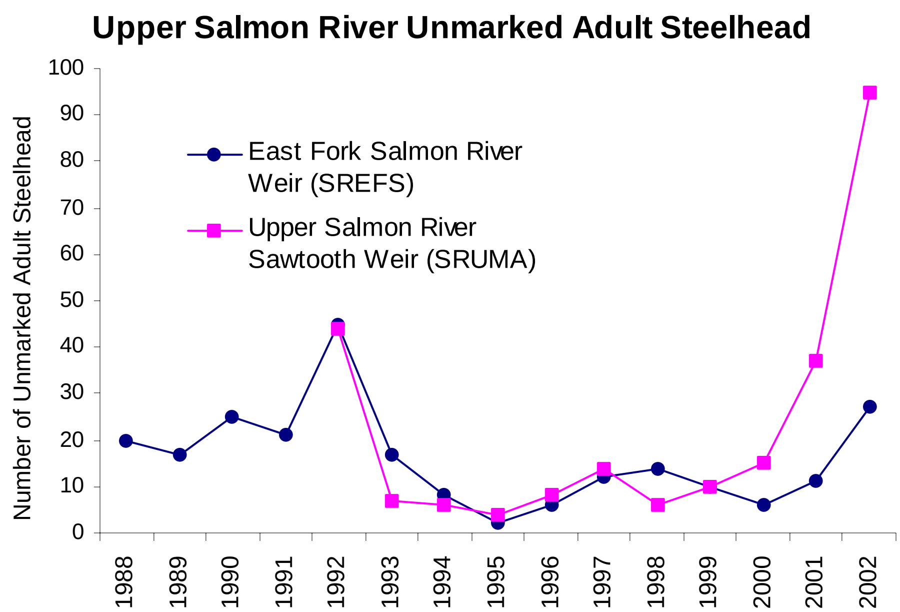

Figure 2-53. Unmarked steelhead captured at the East Fork Salmon River and Sawtooth Fish Hatchery adult weirs in the Upper Salmon watershed.

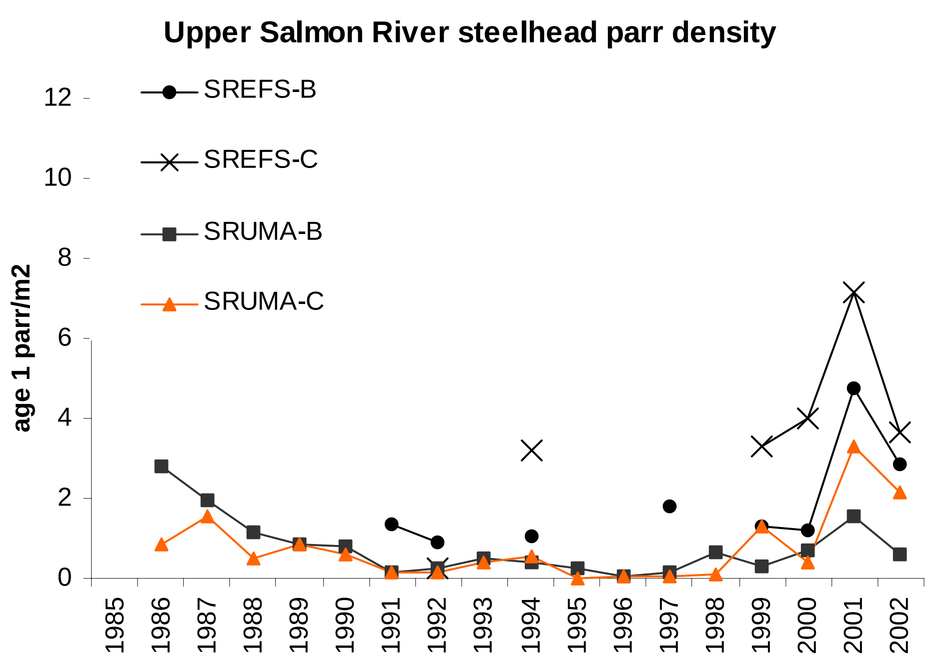

Figure 2-54. Steelhead age 1 parr density by channel type for steelhead populations in the Upper Salmon watershed. Averages were calculated for years and channel types with sample sizes greater than three.

Pahsimeroi—Only one steelhead population was identified in the Pahsimeroi watershed (Figure 2-55). Adult abundance from 1986 to 2003 has varied from a low of 17 adults to over 450 (Figure 2-56). Steelhead parr densities are available for the Pahsimeroi watershed only for recent years (Figure 2-57). Densities for age 1 steelhead parr have ranged from some of the lowest observed in the subbasin to some of the highest observed.

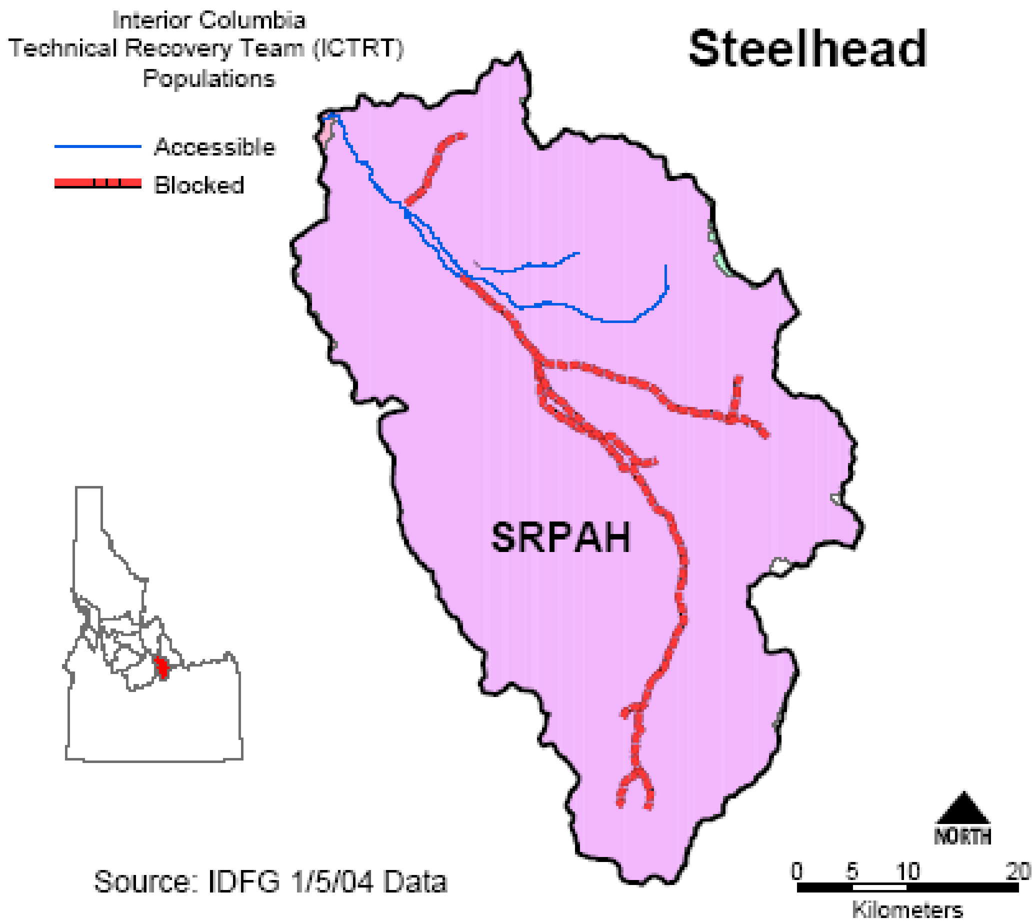

Figure 2-55. Steelhead populations (ICTRT 2003) and blocked habitat for the Pahsimeroi watershed.

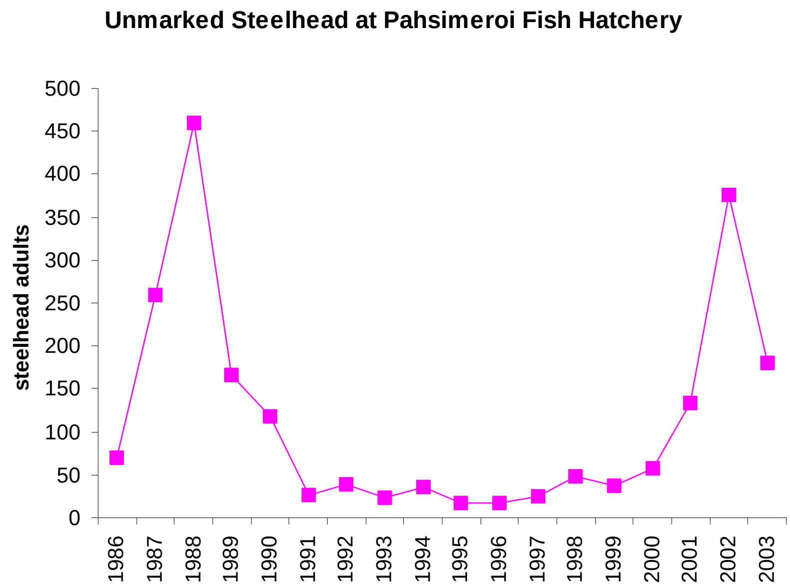

Figure 2-56. Unmarked steelhead adults trapped at Pahsimeroi Fish Hatchery for 1986 through 2003.

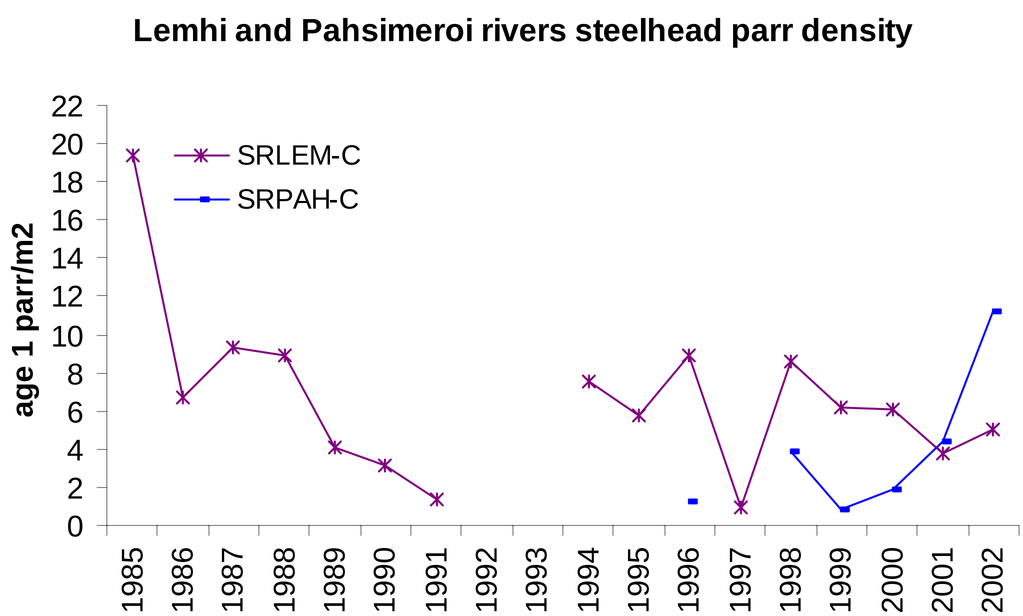

Figure 2-57. Steelhead age 1 parr density by channel type for steelhead populations in the Lemhi and Pahsimeroi River watersheds. Averages were calculated for years and channel types with sample sizes greater than three.

Lemhi (SRLEM) population was identified in the Lemhi watershed (Figure 2-58). Steelhead parr densities in the Lemhi River have been highly variable over time (Figure 2-57). Densities greater than 5 parr/m^2 have been recorded for most years.

Figure 2-58. Steelhead populations in the Lemhi watershed (ICTRT 2003) and blocked habitat.

Middle Fork Salmon—Two steelhead populations were identified in the Lower and Upper Middle Fork Salmon watersheds (Figure 2-59). The Middle Fork Upper Main population (MFUMA) includes fish spawning in tributaries and the mainstem upstream of Loon Creek. The Middle Fork Big Creek Population (MFBIG) including fish spawning in the lower mainstem Middle Fork Salmon River and tributaries up to and including Loon Creek. Both populations are classified as B-run. Steelhead parr densities for populations in sampled areas of the Middle Fork Salmon River have generally been less than 4 parr/m^2 (Figure 2-60). Densities were lowest in the early 1990s but have increased in recent years.

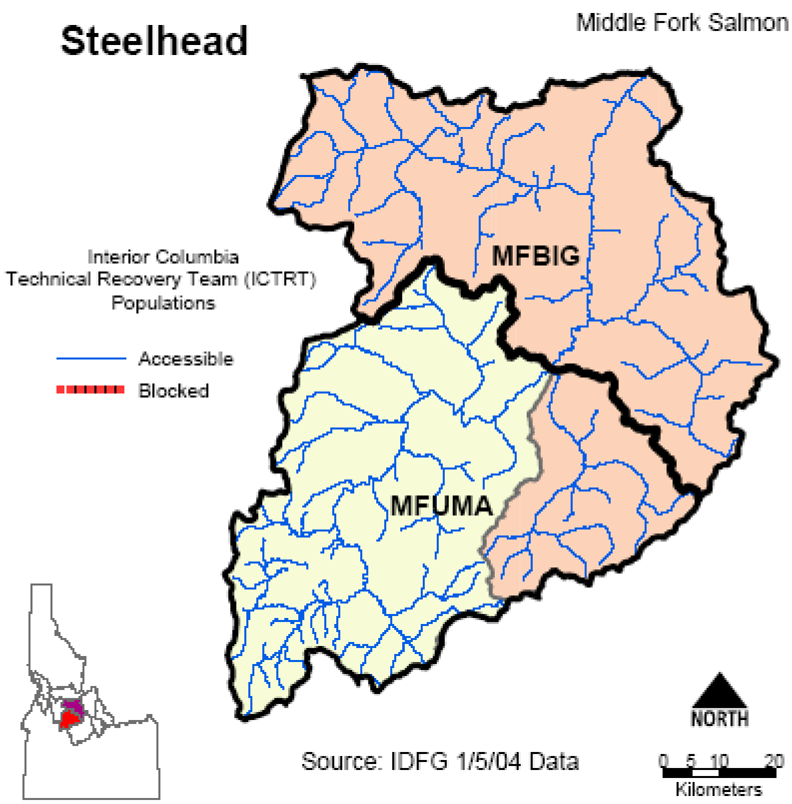

Figure 2-59. Steelhead populations identified in the Lower and Upper Middle Fork Salmon watersheds by the Interior Columbia Technical Recovery Team (ICTRT 2003).

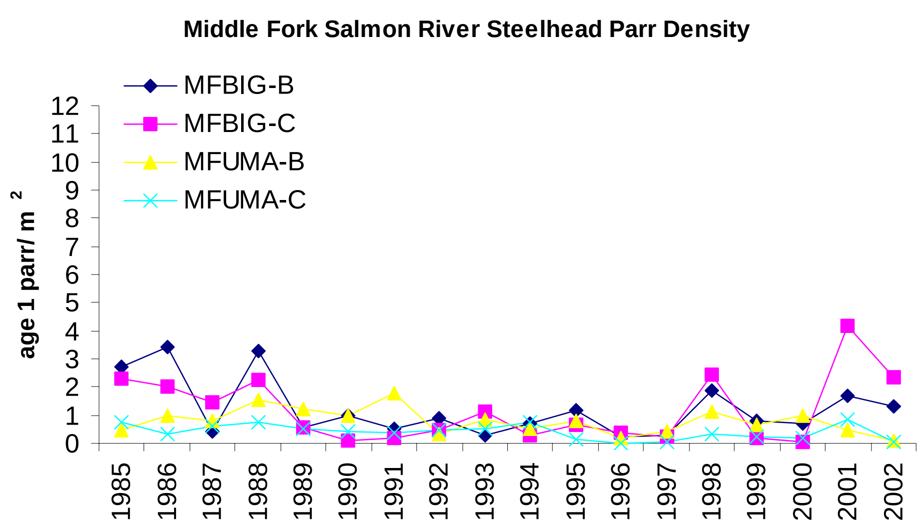

Figure 2-60. Steelhead age 1 parr density by channel type for steelhead populations in the Upper and Lower Middle Fork Salmon watersheds. Averages were calculated for years and channel types with sample sizes greater than three.

Middle Salmon–Chamberlain—Two steelhead populations were identified in the Middle Salmon–Chamberlain watershed (Figure 2-61). The Salmon River Chamberlain population (SRCHA) includes Chamberlain, French, Sheep, Crooked, Bargamin, and Sabe creeks and Wind River. No adult information is available for this population, and Age 1 steelhead parr densities were available only for Chamberlain Creek. Parr densities have fluctuated between 2 and 6 parr/m^2 in recent years (Figure 2-62). The upstream area of this watershed encompasses the lower end of the Salmon River Panther (SRPAN) population. Both populations are classified as A-run.

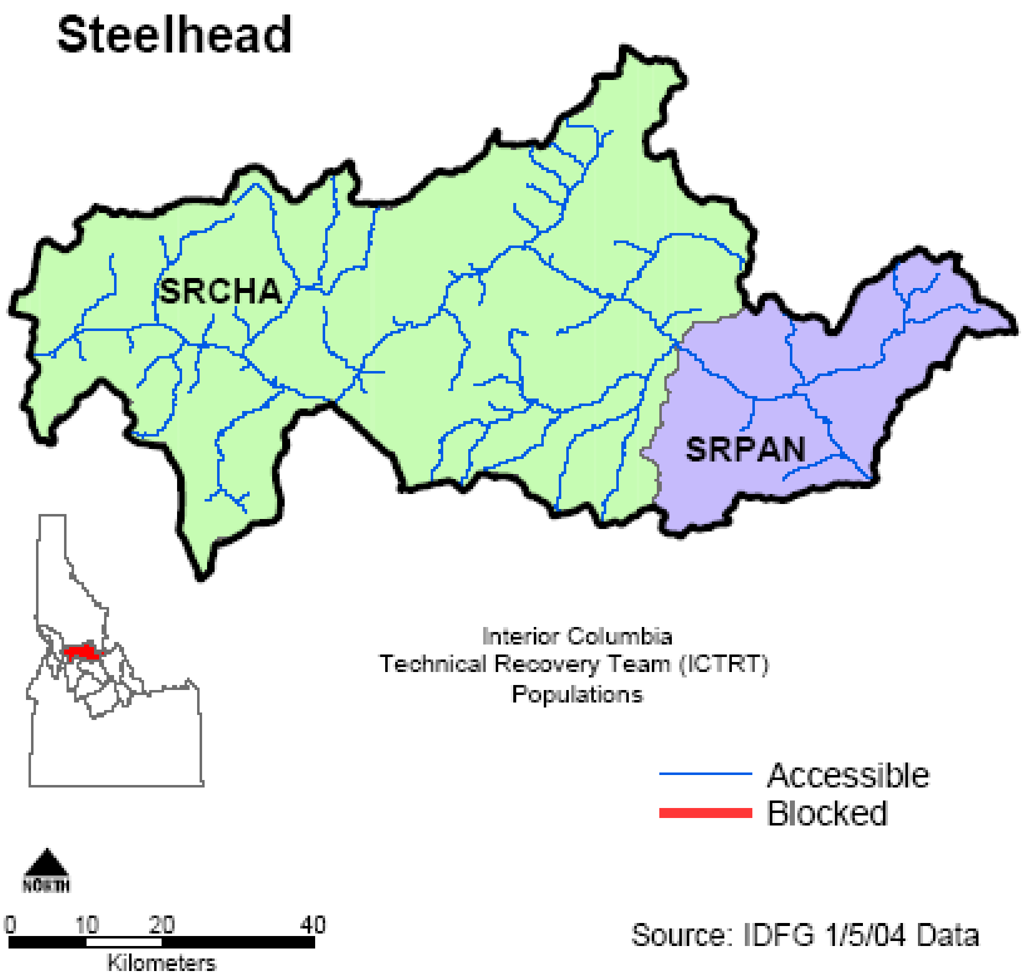

Figure 2-61. Steelhead populations in the Middle Salmon–Chamberlain watershed (ICTRT 2003) and blocked habitat.

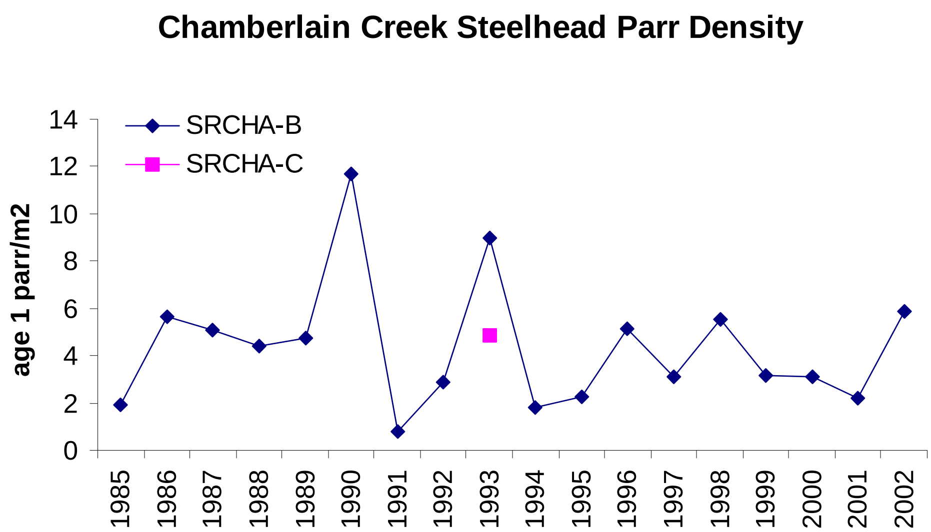

Figure 2-62. Steelhead age 1 parr density by channel type for steelhead populations in Chamberlain Creek in the Middle Salmon–Chamberlain watershed. Averages were calculated for years and channel types with sample sizes greater than three.

Salmon–Panther watershed contains one population entirely and parts of three other steelhead populations (Figure 2-63). The Salmon River North Fork Salmon (SRNFS) population includes the North Fork Salmon River and all tributaries downstream to the mouth of Panther Creek. The Salmon River Panther Creek (SRPAN) population includes the Panther Creek drainage and the mainstem Salmon River and tributaries downstream to the watershed boundary. The Salmon River Pahsimeroi (SRPAH) population includes the mainstem and all tributaries from the Pahsimeroi River to the mouth of the Lemhi. The Salmon River Lemhi (SRLEM) population includes the mainstem and tributaries from the mouth of the Lemhi River to the mouth of the North Fork Salmon River. These populations are classified as A-run. Adult and parr density information were unavailable for the Middle Fork–Panther watershed.

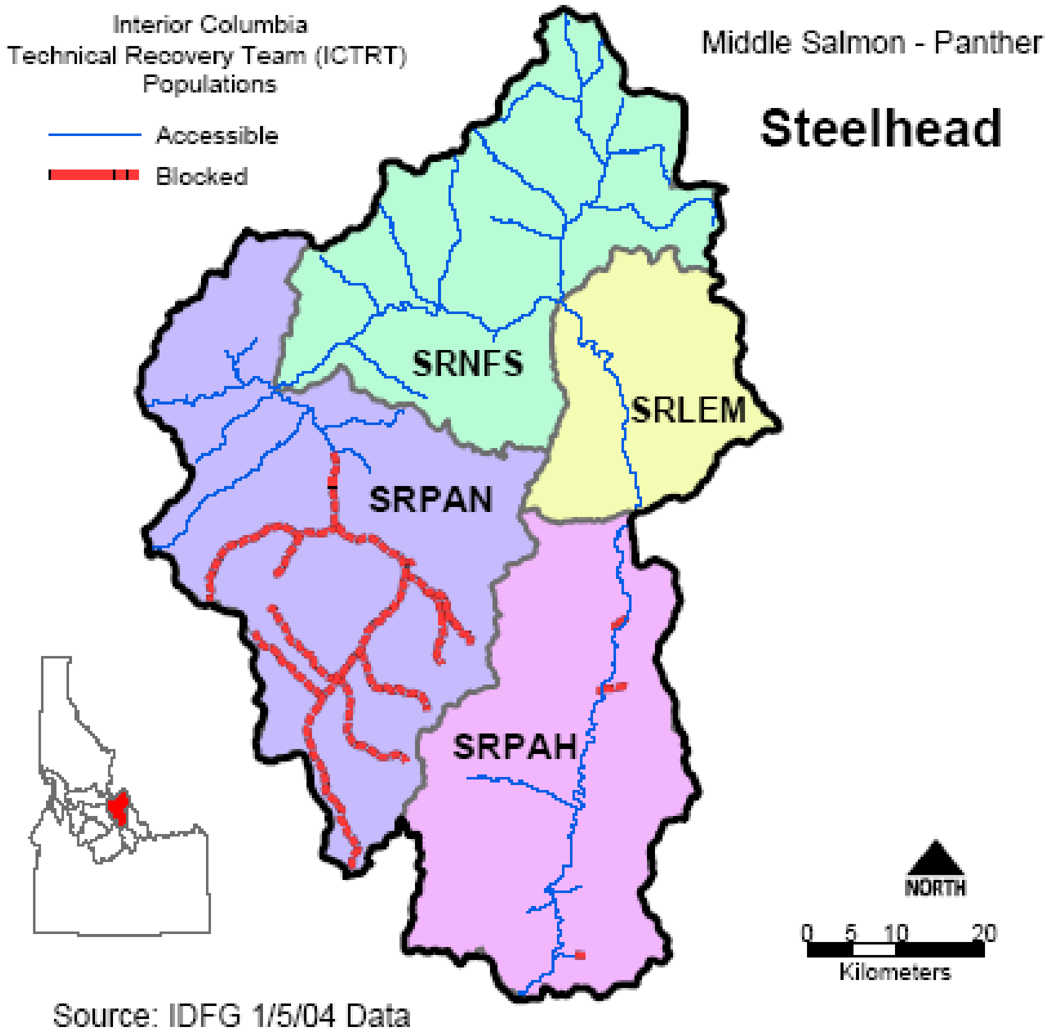

Figure 2-63. Steelhead populations identified in the Middle Salmon–Panther watershed (ICTRT 2003). Habitat indicated as blocked is in Panther Creek, where water quality is limited, but the stream is not physically blocked.

South Fork Salmon—Two steelhead populations have been identified in the South Fork Salmon watershed (Figure 2-64). The South Fork Salmon River Main (SFMAI) population includes the East Fork South Fork and all tributaries to the South Fork Salmon River except the Secesh River. Steelhead in the Secesh River were identified as a separate population (SFSEC). Populations in the South Fork Salmon watershed are classified as B-run. No adult abundance information was available for steelhead in this watershed. Steelhead parr densities for populations in the South Fork Salmon watershed have been increasing in B channel types and stable or slightly decreasing in C channel types (Figure 2-65).

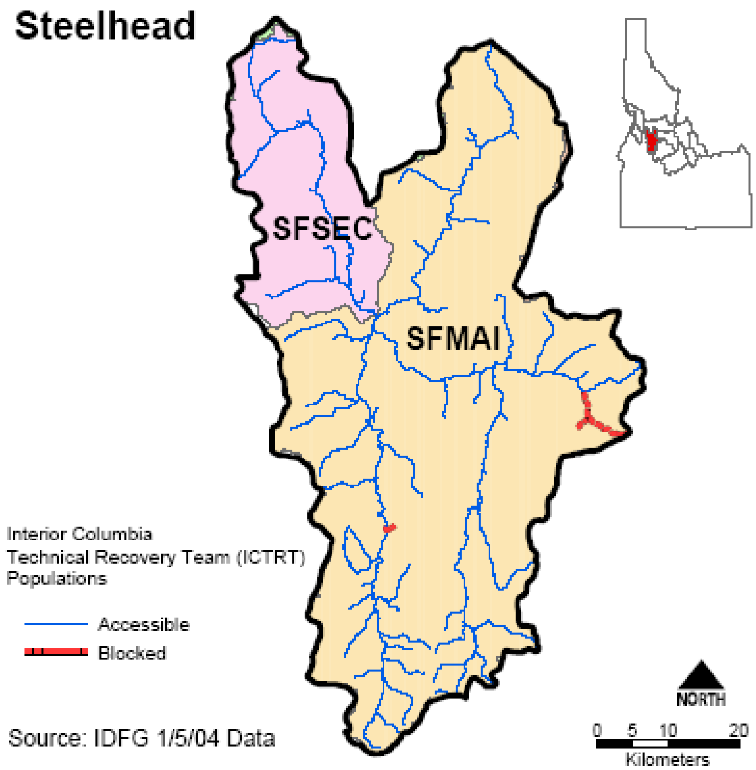

Figure 2-64. Steelhead populations identified in the South Fork Salmon watershed by the Interior Columbia Technical Recovery Team (ICTRT 2003).

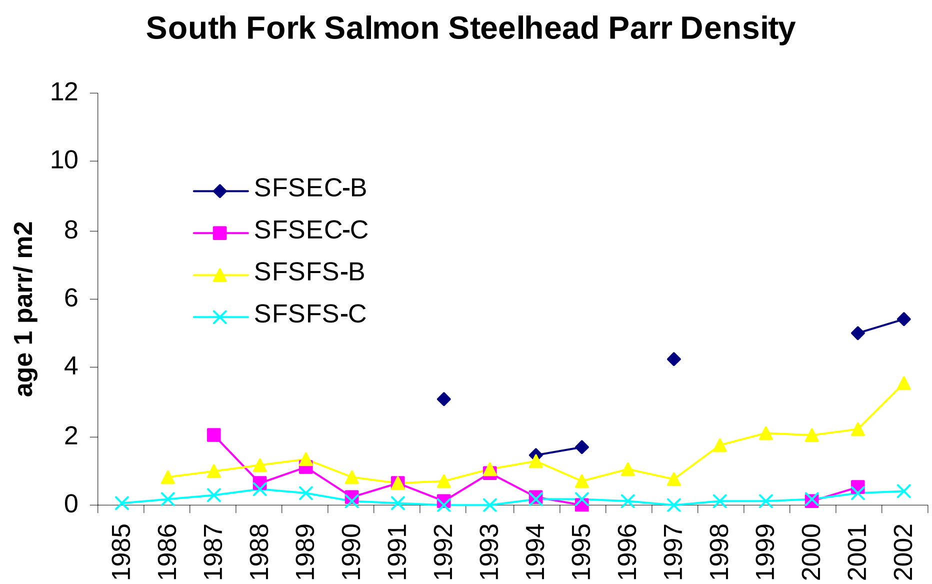

Figure 2-65. Steelhead age 1 parr density by channel type for steelhead populations in the South Fork Salmon watershed. Averages were calculated for years and channel types with sample sizes greater than three.

Lower Salmon and Little Salmon—Two populations of steelhead were identified in the Lower Salmon and Little Salmon watersheds. The Salmon River Little and Lower Salmon River (SRLSR) population includes the Little Salmon watershed and the Lower Salmon River drainage downstream. The Salmon River Chamberlain Creek (SRCHA) population extends into the Lower Salmon watershed (Figure 2-66). Steelhead returning to the Rapid River drainage are counted at the Rapid River Fish Hatchery weir. This population is the only source of population-specific adult abundance data for which a significant portion of the adults in a population were sampled. Abundance has ranged from a high of 221 adults in 1972 to a low of 11 adults in 1999 (Figure 2-67). Density of age 1 parr in the Little Salmon River has been stable over the last 17 years (Figure 2-68) despite the steady decline in adult abundance over the same period.

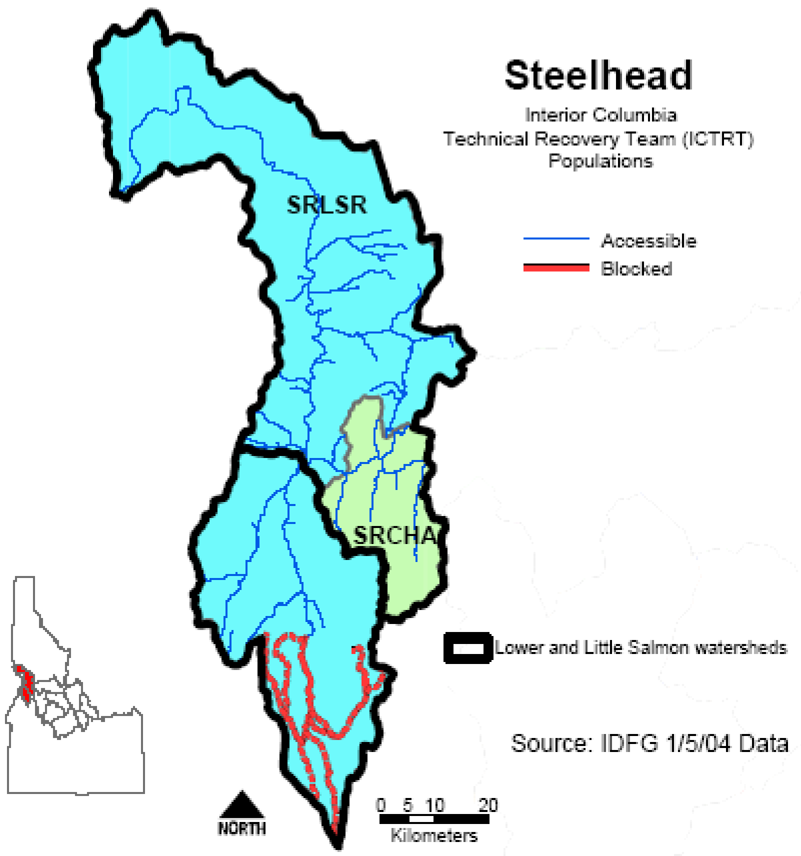

Figure 2-66. Steelhead populations identified in the Little and Lower Salmon watersheds (ICTRT 2003) and blocked habitat.

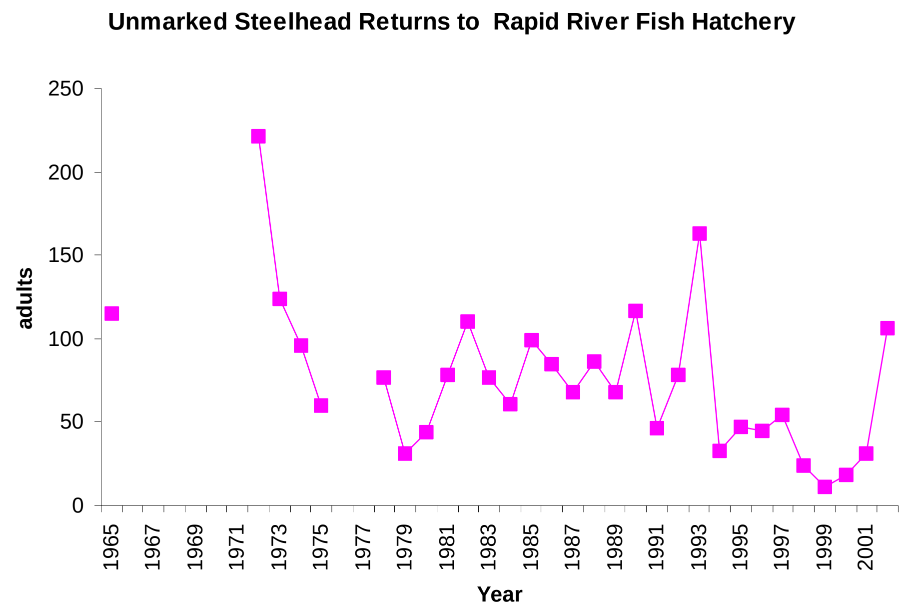

Figure 2-67. Unmarked adult steelhead returns to Rapid River Fish Hatchery weir from 1965 to 2001.

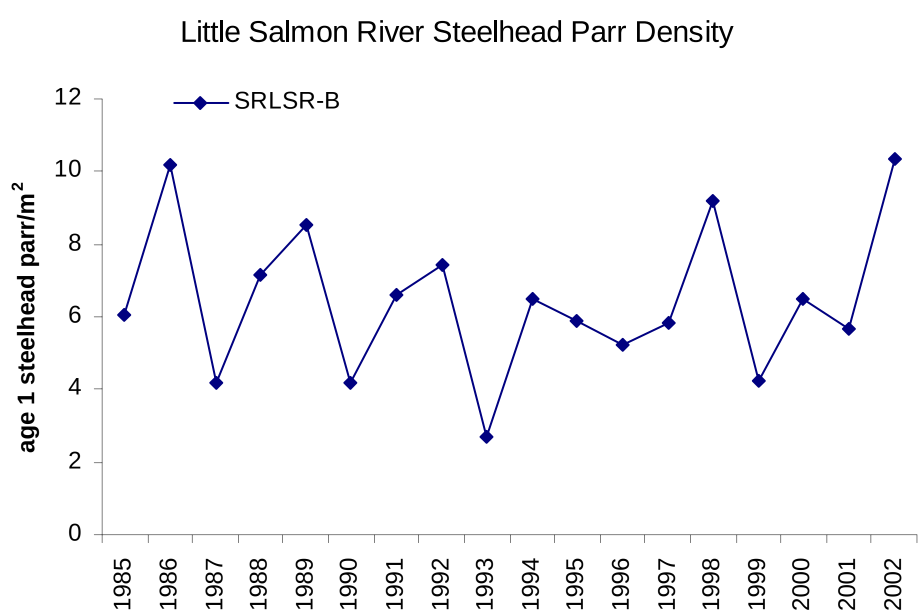

Figure 2-68. Steelhead age 1 parr density by channel type for steelhead populations in the Little Salmon watershed. Averages were calculated for years and channel types with sample sizes greater than three.

2.2.1.3 Bull Trout (*Salvelinus confluentus*)

2.2.1.3.1 Conservation Status

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

2.2.1.3.2 Life History

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

The size and age of bull trout is variable, depending on life history strategy. Resident bull trout tend to be small, averaging 20 cm (8 inches) in length and rarely exceeding 30 cm.(12 inches). Adults that migrate to larger downstream rivers average about 40 cm (16 inches) and often exceed 61 cm (24 inches) (Goetz 1989). Maximum sizes are reached in large lakes and reservoirs where adults can grow to over 69 cm (27 inches) in length and 10 kg (22 lbs) in weight (McPhail and Baxter 1996). Under appropriate conditions, bull trout regularly live to ten years. Under exceptional circumstances, they reach ages in excess of 20 years (Fraley and Shepard 1989, McPhail and Baxter 1996). Bull trout normally reach sexual maturity in four to seven years.

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

Depending on water temperature, egg incubation is normally 100 to 145 days (Pratt 1992). Water temperatures of 1.2 to 5.4 °C (34.2-41.7 °F) have been reported for incubation, with an optimum (i.e., best embryo survivorship) temperature reported to be from 2 to 4 °C (35.6-39.2 °F) (Fraley and Shepard 1989, McPhail and Baxter 1996).

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

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

2.2.1.3.3 Population Trends and Distribution

Bull trout are well distributed throughout most of the Salmon subbasin in 125 identified local populations located within 10 core areas (Figure 2-69). Seasonal barriers isolate many small populations of bull trout, and some bull trout populations in the subbasin are locally depressed. Population information is extremely limited.

Bull trout appear to have very specific habitat requirements (Fraley and Shepard 1989; Goetz 1989; Pratt 1992; Rieman and McIntyre 1993, 1996; Rieman *et al*. 1997; Watson and Hillman 1997). Habitat components that particularly influence their distribution and abundance include water temperature, cover, channel form and stability, spawning and rearing substrate conditions, and migratory corridors. Relatively cold water temperatures are characteristic of bull trout habitat. Water temperatures above 15 °C (59 °F) are believed to limit their distribution, and although adults have been observed in large rivers throughout the Columbia River basin in water temperatures up to 20 °C (68 °F), Gamett (1999) documented steady and substantial declines in bull trout abundance in stream reaches where water temperature ranged from 15 to 20 °C (59 to 68 °F). Thus, water temperature may partially explain the generally patchy distribution of bull trout in a watershed. In large rivers, bull trout are often observed “dipping” into the lower reaches of tributary streams, and it is suspected that cooler waters in these tributary mouths may provide important thermal refugia, allowing them to forage, migrate, and overwinter in waters that would otherwise be, at least seasonally, too warm. Spawning areas are often associated with cold springs, groundwater infiltration, and the coldest streams in a given watershed.

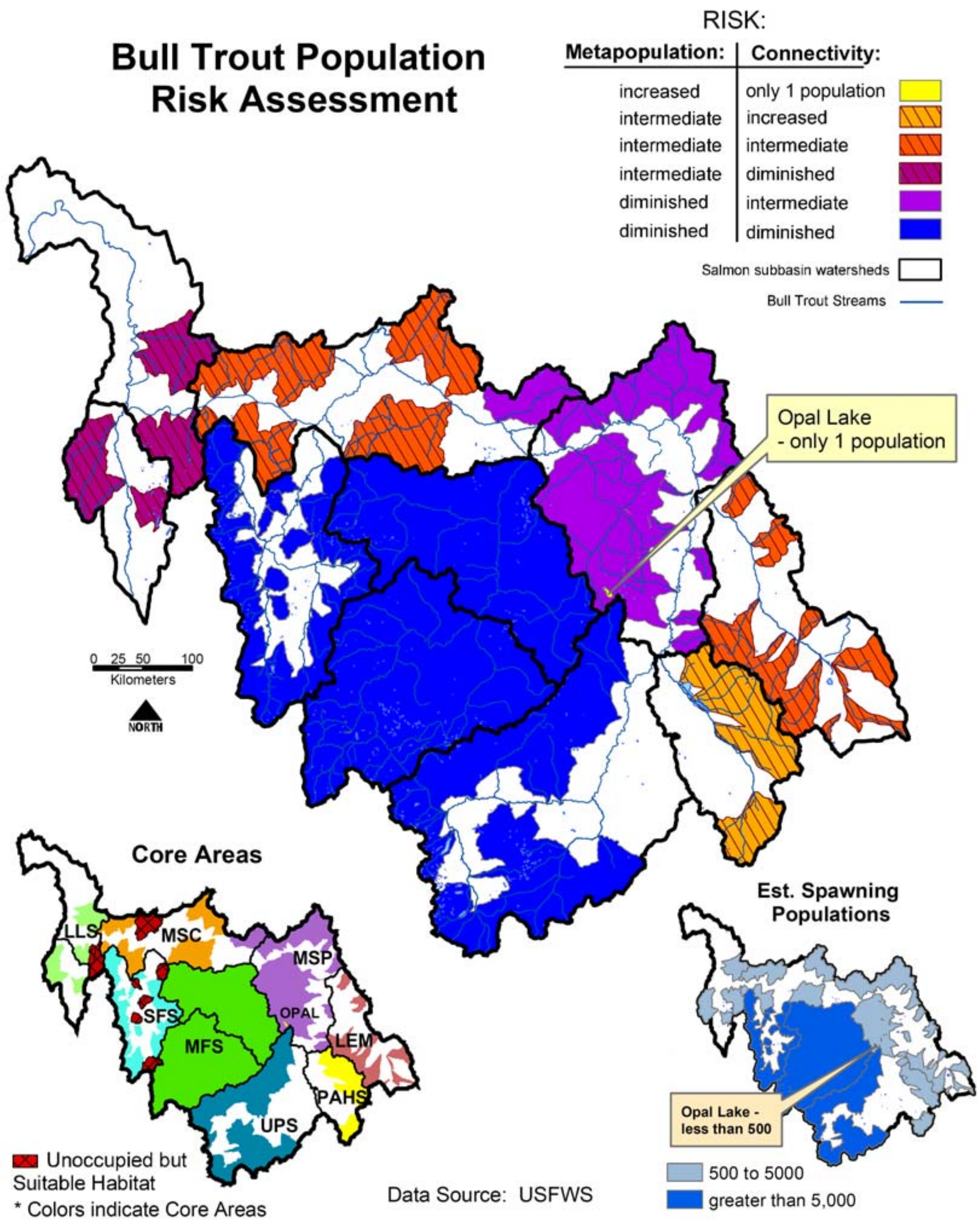

Figure 2-69. **Draft bull trout local and potential populations identified by the Bull Trout Recovery Team.**

Upper Salmon—Both resident and migratory or fluvial bull trout are present in the Sawtooth Valley (USFS 1999a) (Figure 2-69). The Alturas Lake inlet has adfluvial bull trout and one of the largest local populations in the Sawtooth Valley (USRITAT 1998). Adfluvial bull trout are also present in Redfish Lake (USRITAT 1998, USFS 1999a). Bull trout were observed in the lower and middle reaches of Fourth of July Creek (USFS 1999a). During a reconnaissance survey in 1978, many bull trout were found in upper Warm Springs Creek (USFS 1999a). Bull trout are found in the Valley Creek area and are most persistent in headwater segments of several drainages (USFS 1999b). A migratory form of bull trout may have existed upstream in Stanley Lake Creek but it is not currently present (USFS 1999b). Snorkel inventories conducted by the U.S. Forest Service for bull trout in the Yankee Fork Salmon River detected the greatest densities of fish in slow water habitats near headwater reaches (USRITAT 1998). High densities of bull trout have been documented in tributaries to the East Fork Salmon River in Big Boulder, Herd, and Warms Spring creeks (Anderson *et al.* 2002). Mainstem Challis Creek contains bull trout; however, bull trout occupancy is unknown in its tributaries (USRITAT 1998). West Fork Morgan Creek and several tributaries contain bull trout (Paddy Murphy, IDFG personal communication). Bull trout generally move into spawning tributaries beginning in August and spawn in mid- to late September and October within the Upper Salmon River Core Area. However, in the headwaters of the Salmon River, spawning has been documented in early August (USRITAT 1998).

Pahsimeroi—Bull trout in the Pahsimeroi watershed are found in most of the tributaries that drain the eastern, southern, and northeastern portion of the area (BLM and USFS 2001) (Figure 2-69). These tributaries include the Pahsimeroi River above and below Big Creek, as well as Little Morgan, Tater, Morse, Falls, Patterson, Big, Meadow, Big Ditch, Goldburg, Big Gulch, Burnt, Inyo, and Mahogany creeks (NPPC 2001, IDFG 2002). The mainstem Pahsimeroi River serves as a migratory corridor for fish to access the mainstem Salmon River (BLM and USFS 2001). Patterson Creek, which is called Big Springs Creek when it runs parallel to the mainstem Pahsimeroi River, is used for overwintering by bull trout (USFWS 2002). Migratory bull trout are absent from Ditch and Tater creeks. Recent investigations (2001–2003) on U.S. Forest Service lands in the Pahsimeroi watershed found bull trout in 89% of the sampling sites with perennial water and in nearly all of the streams that contain fish. It was noted that bull trout were in relatively high abundance (Bart Gamett, U.S. Forest Service Salmon–Challis District, personal communication).

Lemhi—Bull trout are present in the Lemhi River and in Big Eightmile, Little Eightmile, Big Timber, Little Timber, Eighteenmile, Geertson, Hawley, Hayden, Deer, Cooper, McGinty, Short, Wright, Big Bear, Big Springs, Reservoir, Wildcat, Frank Hall, Canyon, Dairy, Deer, Little Bear, Kenny, Bohannon, Kirtley, Kadletz, Little Eighteenmile, Mill, Patte, Cooper, Stoud, Bray, Sandy, and Texas creeks and their tributaries (BLM 1998, NPCC 2001, IDFG 2002). Most bull trout are found in isolated resident populations (USFWS 1999b). Local residents have noted large numbers of stunted bull trout in Geertson Creek; no fluvial population was found (USRITAT 1998). The mainstem Lemhi River contains fluvial bull trout, although connectivity between the tributaries and the Lemhi River is reduced because of migration barriers (BLM and USFS 1998). Hayden Creek has year-round connectivity to the Lemhi River and contains a fluvial population (BLM and USFS 1998). A fluvial population is also present in Kenny Creek and the upper Lemhi River (USFWS 1999b).

Middle Fork Salmon—Abundance information for bull trout is incomplete for these watersheds, although it is estimated that 28 local populations exist in this core area (USFWS 2002) (Figure 2-69). In Bear Valley Creek near the Middle Fork Salmon River headwaters, the local populations were considered strong in Cache and Elk creeks, suppressed in Bearskin Creek, and weak in upper and lower Bear Creek (SBNFTG 1998a). This area contains some of the strongest local bull trout populations in the Pacific Northwest (NPCC 2001). Bull trout were documented in upper Camas, Marble, and upper Wilson creeks in 1980 to 1983 (Thurow 1985). In the Big and Marble creek drainages, the Payette National Forest provided documentation of bull trout in Marble, Big, Rush, Cabin, Monumental, Crooked, Beaver, Hand, Boulder, Smith, Logan, and Belvidere creeks (Wagoner and Burns 1998, 2001).

Middle Salmon–Chamberlain—Spawning bull trout are found in Chamberlain, Sabe, Bargamin, Warren, and East Fork Fall (CBBTTAT 1998a, NPCC 2001), Wind River, California, Big Squaw, and Sheep creeks (USFS 2002, USFWS 2002) (Figure 2-69). Bull trout spawning and rearing occur in the upper reaches of the creeks, and subadult and adult rearing occurs in the remainder of the drainages. Some of the rivers in this core area may not have documented spawning and rearing; however, the mouth of the river on the mainstem Salmon River up to a barrier (e.g., Big Mallard, Little Mallard, and Rhett creek) is used by bull trout for foraging and rearing (CBBTTAT 1998a). The East Fork Fall Creek contains a resident population upstream of a barrier 0.19 km above its confluence with the Salmon River. The Warren Creek drainage also contains bull trout isolated from the mainstem Salmon River. Bull trout have also been found in the dredge-mining ponds located along Warren Creek (USFWS 2002).

Middle Salmon–Panther—Bull trout have been documented in several creeks, including Allison, Poison, McKim, Cow, Iron, Twelvemile, Lake, Williams, Carmen, Freeman, Moose, Sheep, Twin Boulder, East Boulder, Pine, Spring, Indian, Corral, McConn, Squaw, Hat, and Owl creeks (USFS 1998a, NPCC 2001, USFWS 2002) (Figure 2-69). They are also present in the mainstem Salmon and North Fork Salmon rivers and in multiple streams in the Panther Creek drainage (USFS 1998b). A low number of bull trout exist in the Panther Creek drainage (USFWS 1999c). Connectivity to Panther Creek and interactions between resident populations in Napias and upper Deep creeks have been reduced or eliminated by migration barriers. Connectivity among resident populations is unobstructed in other portions of the Panther Creek drainage, including Woodtick, Porphyry, and Moyer creeks and the headwaters of Panther Creek (USFWS 1999c).

South Fork Salmon—In the 1980s, both resident and fluvial populations of bull trout were documented in the mainstem South Fork Salmon River and in 18 of the tributaries (SBNFTG 1998a) (Figure 2-69). Bull trout are widely distributed in the South Fork Salmon watershed with highest numbers in the East Fork South Fork Salmon and Secesh rivers (NPCC 2001). Warm Lake supports low numbers of bull trout (SBNFTG 1998b). Overwintering fluvial bull trout were observed in the lower South Fork Salmon River from the Sheep Creek confluence downstream to the mouth of the South Fork Salmon River. Bull trout also overwintered in the mainstem Salmon River from the Elkhorn Creek confluence upstream to Big Mallard Creek (Hogen 2001). The Lower Salmon Technical Team also indicated bull trout use of Loon Lake and the area known as the Yellowpine Pit.

Lower Salmon—The mainstem Salmon River provides for migration, adult and subadult foraging (Figure 2-69), rearing, and wintering habitat. Slate, John Day, and Partridge creeks contain spawning and rearing bull trout (CBBTTAT 1998a, USFS 2002). The Lower Salmon Technical Team also indicated bull trout use of Lake Creek and Warren Creek.

Little Salmon—The Little Salmon River provides for foraging/adult rearing habitat and connectivity between local populations in the core area (Olson and Burns 2001). Hard, Lake, and Boulder creeks and Rapid River contain spawning and rearing bull trout (CBBTTAT 1998a, USFS 2002) (Figure 2-69). Annual runs of fluvial bull trout in the Rapid River drainage have been monitored since 1973, and bull trout abundance data have been collected since 1992. The number of redds located in the headwaters of Rapid River were the greatest, at 33, in 1994, while the lowest numbers (13) were found in 1993. The number of adults passing upstream of a trap near the mouth of Rapid River were the greatest, at 359 adults, in 2001, but lowest, at 112 adults, in 1998 (Thurow and Guzevich 2001).

*2.2.1.4 Sockeye Salmon (**Oncorhynchus nerka**)*

2.2.1.4.1 Conservation Status

Snake River sockeye salmon (*O. nerka* [Walbaum, 1792]) were listed as endangered under the ESA on November 20,1991 (56 FR 58619). Snake River sockeye salmon were listed as an Evolutionarily Significant Unit (ESU) due to their uniqueness as the southernmost spawning population that also travels the farthest inland (> 1,400 km) and to the highest elevation (> 1,980 m) of any sockeye salmon population in the world. Prior to their listing as endangered, the Snake River Sockeye Salmon Captive Broodstock Program was started. Under NOAA Fisheries' interim policy on artificial propagation (58 FR 17573), the progeny of fish from a listed population that are propagated artificially are considered part of the listed species and protected under the ESA. So, although not specifically designated in the 1991 listing, Snake River sockeye salmon produced in the captive broodstock program are included in the listed ESU.

Waples *et al.* (1991) described Snake River sockeye salmon as a prime example of a species on the threshold of extinction. At the time of listing, Redfish Lake, located in the upper Salmon River basin, contained the only remaining population of sockeye salmon in the Snake River basin. The entire mainstem Salmon River was designated as critical habitat for sockeye salmon on December 28, 1993 (57 FR 68543), but all spawning and rearing habitat is located in the upper Salmon subbasin.

2.2.1.4.2 Life History

The life history of sockeye salmon is the most variable of all the Pacific salmon, with a wide variety of adaptations for specialized conditions. Sockeye salmon life history differs from other Pacific salmon in their use of lakes for the early freshwater rearing. In addition to the anadromous form, two additional life history forms of *O. nerka* are recognized, kokanee commonly exist in landlocked and anadromous accessible waters and residual sockeye salmon (the nonmigratory form) associated with anadromous populations (Burgner 1991). Kokanee are reproductively isolated from anadromous populations where they occur together. Residual sockeye salmon are not reproductively isolated from anadromous adults.

Life history of sockeye salmon in Redfish Lake was first documented by Bjornn *et al*. (1968) and has been continually monitored since listing (Johnson 1993, Kline 1994, Kline and Younk 1995, Kline and Lamansky 1997, Hebdon *et al.* 2000). Juvenile sockeye salmon rear one to two years in the lake prior to smoltification. Outmigration of sockeye salmon smolts from Redfish Lake begins in early April, is completed by mid-June, and peaks in mid-May. Smolts are either age 1 or age 2, and the percentage of each varies between 2 and 98%. No pattern in the timing of migration is apparent between age 1 and age 2 smolts. Fork lengths of smolts varies from 45 to over 120 mm. Adult sockeye salmon arrive at the trap on Redfish Lake Creek between mid-July and early September. Spawning takes place on the lake shoreline from late September through November, peaking in mid-October. Aging with otoliths indicates that returning adults are primarily 2-ocean, with only an occasional 1- or 3-ocean adult returning. Sex ratios of returning adults are nearly equal.

Sockeye salmon are opportunistic feeders, preying on insects, copepods, euphausiids, fish larvae, amphipods, and decapod larvae and on crustaceans, squid, and small fishes offshore.

2.2.1.4.3 Population Trends and Distribution

Historically, Snake River sockeye salmon were found in headwater lakes along tributaries of the Snake River, including five lakes in the upper Salmon River drainage, Payette Lake on the North Fork Payette River, and Wallowa Lake on the Grand Ronde River. Sockeye salmon may have used Warm Lake (South Fork Salmon River). Within the upper Salmon subbasin, sockeye salmon were found in Redfish, Alturas, Pettit, Stanley, and possibly Yellowbelly lakes (Chapman *et al*. 1990). Sockeye salmon were blocked from returning to Stanley, Yellowbelly, and Pettit lakes after barriers were installed following chemical treatments with piscicides. The Alturas Lake population was extirpated due to dewatering of Alturas Lake Creek during juvenile and adult migration (Chapman *et al*. 1990).

Snake River sockeye salmon populations declined dramatically after 1956 (Figure 2-70). By the 1980s, only Redfish Lake supported a remnant anadromous run (Kline 1994, Kline and Younk 1995, Kline and Lamansky 1997, Hebdon *et al.* 2000). These fish are found seasonally along the migratory corridor between the lake and the mouth of the Salmon River.

Historical accounts of sockeye salmon abundance in the Sawtooth Valley are scarce. Recent investigations by Bruce Finney, University of Alaska Fairbanks (personal communication to Stanley Basin Sockeye Technical Oversight Committee, January 17, 2001) used Sawtooth Valley lake sediment records of nitrogen-stable isotopes and biological indicators to reconstruct sockeye salmon abundance dating back 3,000 years. These data also suggest that, prior to 1910, 20,000 to 40,000 sockeye salmon once returned to the Stanley River basin.

In the late 1800s, Evermann (1896) made observations on the distribution and abundance of sockeye salmon in Stanley Basin lakes. Although not quantitatively described, Evermann (1896) reported observing sockeye salmon in Alturas, Pettit, and Stanley lakes. He reported that there were even plans to construct a cannery on Redfish Lake to process sockeye salmon. Sunbeam Dam constituted a complete blockage for sockeye salmon from 1911 to 1934 (see section 1.6.3 for additional information). After the breach of Sunbeam Dam, adult sockeye salmon escapement to Redfish Lake was monitored from 1954 to 1966. During these years, escapement ranged from a low of 11 fish to a high of 4,361 fish in 1955 (Bjornn *et al.* 1968). By 1962, sockeye salmon were no longer returning to Stanley, Pettit, and Yellowbelly lakes (Chapman *et al.* 1990). Since 1990, only 16 wild adult sockeye salmon have returned to Redfish Lake. Finney (personal communication to Stanley Basin Sockeye Technical Oversight Committee, January 17, 2001) estimated that 10 to 30% of the total, annual nutrification of Redfish Lake was provided by anadromous sockeye salmon. Starting in 1999, adults produced through the captive broodstock program began returning. In 2000, over 200 adult sockeye salmon returned to the Stanley Basin. Adult returns since 1999 have been in the mid-20s, except for 2003 when only two adults returned. All returning adults since 1999 are attributed to releases from the captive broodstock program. Numbers of unmarked sockeye salmon smolts at Redfish Lake Creek declined precipitously from 1991 to 1997. The release of adults for natural spawning in 2000 contributed to the large outmigrations of 2002 and 2003 (Figure 2-71).

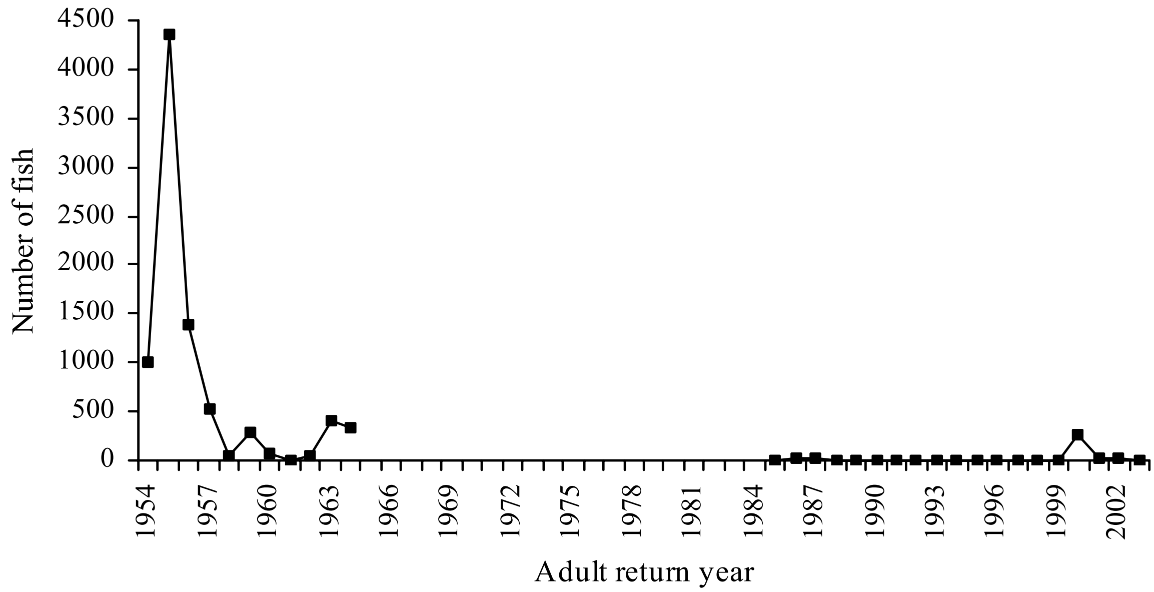

Figure 2-70. Adult sockeye salmon returning to the upper Salmon River, 1954–1966 and 1985–2003 (IDFG annual counts) (Kiefer *et al*. 1992). The first marked returns from captive broodstock occurred in 1999.

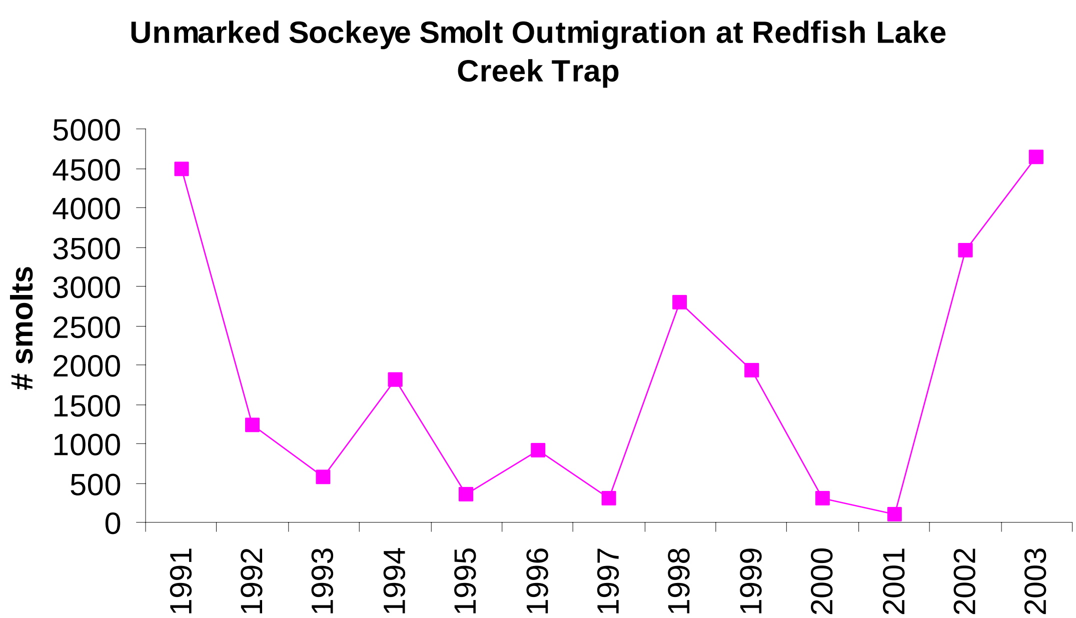

Figure 2-71. Unmarked sockeye salmon smolts estimated at the trap on Redfish Lake Creek from 1991 to 2003. Age 1 and age 2 fish were combined.

2.2.2 Artificial Propagation

Artificial production in the Columbia River basin is subject to a variety of legal mandates. The management objectives of these various legal mandates are all equally important. The array of objectives of these programs often overlap and, in some cases, may conflict if not managed properly. Some of the issues that direct artificial-production activities in the Columbia River basin (and therefore in the Salmon subbasin) are tribal treaty fishing rights, *U.S. v. Oregon* litigation, Northwest Power Act, ESA, *Lower Snake River Compensation Plan*, and Mitchell Act.

Artificial-production programs are understood best when viewed as one of multiple tools available for addressing management and biological problems. For purposes of subbasin planning, the NPCC (2000) indicated that "Artificial production and other non-natural interventions should be consistent with the central effort to protect and restore habitat and avoid adverse impacts to native fish and wildlife species." The current federal policy for artificial propagation of Pacific salmon and steelhead is that it can be one of the conservation tools used to help achieve recovery of ESA-listed fish species, but that hatcheries are not a substitute for conservation of the species in its natural habitat. For this reason, NOAA Fisheries' current ESA risk analyses for salmon and steelhead ESUs focus on "natural" fish (defined as the progeny of naturally spawning fish) and whether the natural populations can be considered self-sustaining without regular infusions of hatchery fish.

The NPCC's Artificial Production Review and Evaluation (APRE) identified eight hatchery programs for Chinook salmon and four hatchery programs for steelhead that were operating in the Salmon subbasin (Table 2-8). Programs were divided into three categories based on their purposes:
1) conservation and restoration,
2) research, and 3) harvest. All programs in the subbasin raised Chinook salmon listed as threatened under the ESA, except the Rapid River Fish Hatchery program, which raises a nonlisted stock.

In general, hatchery programs for Chinook salmon in the Salmon subbasin were often associated primarily with fishery compensation and mitigation programs and secondarily with conservation activities focused on rebuilding populations and providing harvest opportunity. Most steelhead programs in the Salmon subbasin raised nonlisted stocks, with the main purpose being to provide harvest opportunity. The East Fork Salmon River integrated program raises listed steelhead and was had conservation and restoration as main purposes. The APRE (NPCC 2003) determined that, generally speaking, upper Columbia River basin hatcheries are newer (compared with lower Columbia River basin hatcheries) and more likely to be viewed as experimental and associated with research and monitoring programs. A brief description of the artificial-production programs operating in the Salmon subbasin for Chinook and sockeye salmon and steelhead follows. Detailed information on each program is available in the hatchery genetic management plans (HGMPs (Appendices 2-4 through 2-18).

Spring Chinook Salmon—Three programs in the Salmon subbasin focus on spring Chinook salmon. The Upper Salmon Sawtooth spring Chinook program is part of the *Lower Snake River Compensation Plan*, a goal of which is to return approximately 19,445 adult spring Chinook salmon to the project area above Lower Granite Dam to mitigate for survival reductions resulting from construction and operation of the four lower Snake River dams. Initial facility plans identified production targets of 1.3 million smolts released in the Salmon River at the Sawtooth Fish Hatchery; 700,000 smolts in the East Fork Salmon River; and 300,000 smolts in Valley Creek, a tributary to the Salmon River. Adult return targets were 11,310 adults to the Sawtooth Fish Hatchery, 6,090 adults to the East Fork Salmon River, and 2,045 adults to Valley Creek (all based on a smolt-to-adult return rate of 0.87%). The Valley Creek component of the program has never been implemented. The East Fork Salmon River component was terminated in 1998.

The Lemhi, East Fork Salmon, and West Fork/Yankee Fork Salmon river programs collectively make up the Captive Rearing Project for Salmon River Chinook salmon. The IDFG initiated the captive rearing project to investigate a strategy of preventing cohort collapse by providing captively reared adult spawners to the natural environment. The objectives of this program are to 1) develop and implement culture practices and facility modifications necessary to rear Chinook salmon to adulthood so that they possess morphological, physiological, and behavioral characteristics similar to wild fish and 2) evaluate the spawning behavior and success of these fish under natural conditions in their natal streams. The success of the program depends on developing culture techniques to produce adult Chinook salmon possessing the desired characteristics (defined above) to successfully interact and breed with wild conspecifics or other captively reared individuals.

Captive populations for this project are sourced from the progeny of naturally spawning wild adults and reared to maturity at research facilities in Idaho and Washington before being returned to Idaho where they are generally released to spawn naturally. The program incorporates approximately 300 eyed-eggs collected annually from each of the study streams included in the program to establish captive culture groups. Following collection, fish are reared exclusively in fresh water at Eagle Fish Hatchery (Eagle, Idaho) until they reach the smolt stage. At this stage, most of each cohort (≥ 70%) is transferred to a seawater rearing facility (NOAA Fisheries Manchester Marine Experiment Station, Manchester, Washington). As fish mature, they are transported back to Eagle Fish Hatchery where they undergo a period of freshwater maturation before they are released into their natal streams and allowed to reproduce naturally or spawned at the Eagle facility to investigate important reproductive variables. The majority of adult Chinook salmon produced in the captive rearing program are released into their natal streams and allowed to reproduce naturally. After release, these fish are monitored daily to assess their reproductive behavior and success.

Idaho Power Company owns and funds the operation of Rapid River Fish Hatchery, located in the Little Salmon River watershed. This facility was constructed in 1964 as part of Idaho Power's mitigation for spring Chinook salmon lost to construction and operation of Brownlee, Oxbow, and Hells Canyon dams on the Snake River. The IDFG operates the facility under contract. Spring Chinook salmon from the middle Snake River were transplanted as the broodstock source for this program. The goal of this program is to produce 3 million smolts annually for release. Recent Chinook returns from Rapid River Fish Hatchery (Figure 2-72) have produced fish for sport and tribal harvest.

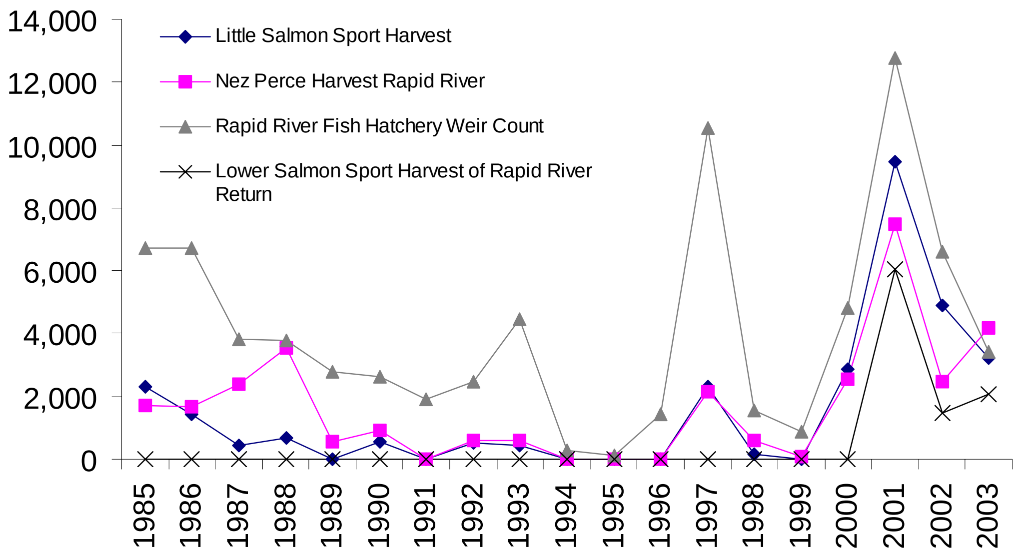

Figure 2-72. Hatchery spring Chinook salmon harvest and return to Rapid River Fish Hatchery in the Little Salmon River watershed, Idaho.

Summer Chinook Salmon—Three artificial-production programs in the Salmon subbasin are used to raise summer Chinook (Figure 2-73 shows hatchery spring/summer returns at Snake River dams). The Salmon River summer Chinook program at McCall Fish Hatchery is part of the *Lower Snake River Compensation Plan*, a goal of which is to return 8,000 summer Chinook salmon above Lower Granite Dam to mitigate for survival reductions resulting from construction and operation of the four lower Snake River dams.

The Johnson Creek summer Chinook program is operated by the Nez Perce Tribe. The goal of this project is to prevent the extinction of the Johnson Creek summer Chinook population and begin its rebuilding through supplementation. To achieve this goal, 100,000 Chinook salmon smolts are reared in a Nature's concept hatchery program for releases back into Johnson Creek. Supplementation under this project is planned for a minimum of five full salmon generations or 25 years. Overall, the project will evaluate the benefits of the Nature's concept in rearing and acclimated releases. This concept may include supplementation initiatives such as captive broodstock and cryopreservation, in conjunction with portable, low-capital techniques for holding adults, acclimating juveniles, and converting existing artificial-production facilities to produce smolts and or other approaches as necessary to increase the population.

Idaho Power Company owns and funds the operation of Pahsimeroi Fish Hatchery, located in the Pahsimeroi River watershed. This facility was constructed in the mid-1960s as part of Idaho Power's mitigation for spring Chinook salmon lost to construction and operation of Brownlee, Oxbow, and Hells Canyon dams on the Snake River. The IDFG operates the facility under contract and produces steelhead. No spring Chinook salmon were raised or released from this facility after 1987. The goal of this program is to produce one million summer Chinook smolts annually for release.

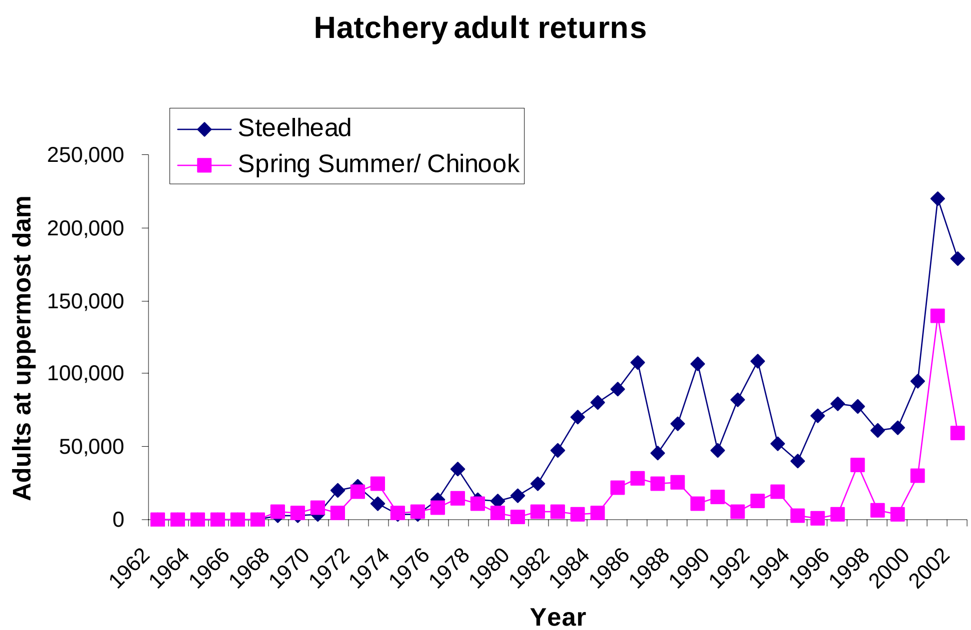

Figure 2-73. Hatchery adult steelhead and spring/summer Chinook salmon counts at the uppermost dam on the Snake River from 1962 through 2003 (Technical Advisory Committee 2003a; data from 2000, 2001, 2002 is preliminary). The uppermost dam is indicated by years: 1962–1968 Ice Harbor, 1969 Lower Monumental, 1970–1974 Little Goose, and 1975–2002 Lower Granite.

Summer Steelhead—The *Lower Snake River Compensation Plan* has three steelhead programs in the Salmon River basin, the Salmon River A-run steelhead program (Sawtooth Hatchery Steelhead A-run), the East Fork Integrated Steelhead Program, and the Salmon River Basin B-run program (Dworshak Hatchery Steelhead B-run). The goal of the *Lower Snake River Compensation Plan* is to return approximately 25,000 adult steelhead to the project area above

Lower Granite Dam to mitigate for survival reductions resulting from construction and operation of the four lower Snake River dams. The LSRCP steelhead programs in the Salmon River subbasin are managed and integrated with Idaho Power Company steelhead hatchery programs. The Salmon River A-run steelhead program was designed as an Isolated Harvest Program. However, some broodstock management, eyed-egg production, and smolt production may occur to support ongoing Shoshone-Bannock Tribes streamside and in stream incubation programs and smolt release programs for natural production augmentation.

The East Fork Salmon natural steelhead program is an integrated recovery program. The goal of this program is to determine whether hatchery propagation can be used to increase natural fish abundance (e.g., supplementation). It was designed as a small-scale supplementation experiment to spawn a portion of locally returning, naturally produced steelhead. Sufficient broodstock are collected (when adult return numbers are adequate) to produce up to 50,000 smolts. Ideally, no more than 50% of unmarked steelhead adults are retained at the East Fork Salmon River satellite for broodstock purposes. Spawning takes place at the East Fork Salmon River satellite facility operated by the Sawtooth Fish Hatchery. Egg incubation through the eyed stage of development occurs at the Sawtooth Fish Hatchery. Eyed-eggs are then shipped to the Magic Valley Fish Hatchery.

The Salmon River B-run steelhead program was developed specifically for fishery enhancement and was not intended to address supplementation objectives. The original management intent was for it to stand alone without the continual infusion of B-run steelhead juveniles produced in the Clearwater River basin. However, this objective has not been met. The B-run steelhead smolts from this program are released in the Little Salmon River, the East Fork Salmon River, Squaw Creek (tributary to the Salmon River), and Squaw Creek Pond. Hatchery-produced, B-run adult steelhead that return to the East Fork Salmon River trap and to Squaw Creek Pond are spawned at the East Fork Salmon River trap. Sawtooth Fish Hatchery, located in the Upper Salmon watershed, is the only facility in the Salmon subbasin that participates in the B-run steelhead program. The out-of-subbasin facilities that are associated with this program are the Magic Valley Fish Hatchery, Clearwater Fish Hatchery, and Dworshak National Fish Hatchery.

Idaho Power Company owns and funds the operation of Pahsimeroi Fish Hatchery, located in the Pahsimeroi River watershed. The facility was constructed in the mid-1960s as part of the Idaho Power's mitigation for anadromous fish production lost to construction and operation of Brownlee, Oxbow, and Hells Canyon dams on the Snake River. The IDFG operates the facility under contract and produces summer chinook salmon and steelhead. The goals for the Pahsimeroi steelhead program are to release approximately 200,000 pounds of steelhead smolts annually in the Salmon subbasin.

Sockeye Salmon—Due to precipitous declines in the numbers of returning adults, the captive broodstock program for Snake River sockeye salmon was started in 1991. The near-term goals for the program are to conserve the genetic resources of the population using captive broodstock technology, prevent extinction, and address demographic and ecological risks associated with extremely low population abundance. The captive broodstock program is coordinated by the Stanley Basin Sockeye Technical Oversight Committee (SBSTOC), which is composed of biologists representing the IDFG, Shoshone-Bannock Tribes, NOAA Fisheries, and University of Idaho. Bonneville Power Administration is the coordinating and funding agency for sockeye salmon recovery actions in the subbasin. Waples (1991) described Snake River sockeye salmon as a prime example of a species on the threshold of extinction. Sockeye salmon would now be extinct in Idaho without the efforts of the captive broodstock program (Hebdon *et al*. in press).

Bull Trout—There are no artificial propagation programs for bull trout in the Salmon subbasin.

Resident Trout—The *Lower Snake River Compensation Plan* rainbow trout program is mitigation for the loss of angler days brought about because the four lower Snake River dams inundated about 140 miles of spawning habitat. The mitigation goal for this program is to produce approximately 50,000 fingerling rainbow trout (approximately 3,333 pounds or 1,512 kg) for planting in the lower 100 miles (161 km) of the Salmon River and the lower 70 miles (113 km) of the Clearwater River in Idaho. The HGMP for this program is attached in Appendix 2-3.

Table 2-8. Chinook salmon and steelhead artificial propagation programs in the Salmon subbasin identified in the NPCC's APRE process. An integrated program uses an open production cycle in which the hatchery population is combined with the natural population to form a single aggregate population. A segregated stock is intended to have minimal influence from and on surrounding natural stocks; interbreeding between hatchery and wild fish is minimized.

Program	Operator	Cooperator	Funding Source	Purpose	Type	Maximum Release (number and life stages)	Stock Status
Lemhi River Spring Chinook (Chinook Captive Rearing Program)	IDFG	SBT, NOAA, UI	BPA	C,R	integrated	50 K eggs, 200 adults	threatened
East Fork Salmon River Spring/Summer Chinook (Chinook Captive Rearing Program)	IDFG	SBT, NOAA, UI	BPA	C,R	integrated	50 K eggs, 200 adults	threatened
West Fork Yankee Fork Salmon River Spring/Summer Chinook (Chinook Captive Rearing Program).	IDFG	SBT, NOAA, UI	BPA	C,R	integrated	50 K eggs, 200 adults	threatened
Upper Salmon Sawtooth Spring Chinook	IDFG	USFWS, COE, IPC	USFWS	H,C,R	integrated	1.1M smolts	threatened
Rapid River Hatchery Spring Chinook	IDFG	IPC, NPT	IPC	H,R	segregated	3 M smolts	not listed
Johnson Creek Summer Chinook	NPT	BPA, IDFG, USFWS	IPC, USFWS, COE	C,H	integrated	110 K smolts	threatened
McCall Summer Chinook	IDFG	NPT	USFWS	H,C,R	integrated	300 K eggs, 64 K parr, 1 M smolts	threatened
Pahsimeroi Summer Chinook	IDFG	USFWS	IPC, USFWS	H,C,R	integrated	1.0 M smolts	threatened
Salmon River Basin B-run Steelhead program (Dworshak Hatchery Steelhead B-Run)	IDFG	USFWS, COE	USFWS	H	segregated	1.0 M	not listed
Pahsimeroi Hatchery Steelhead A-run	IDFG	IPC, USFWS, SBT	IPC, USFWS	H	segregated	3.4 M smolts	not listed
Sawtooth Hatchery Steelhead A-run	IDFG	SBT, USFWS, COE, IPC	USFWS	H	segregated	300 K eggs, 3.0 M smolts	not listed
East Fork Integrated Steelhead	IDFG	USFWS, NOAA, SBT, CRT	USFWS	C,R	integrated	50 K smolts	listed

IDFG=Idaho Fish and Game, SBT=Shoshone-Bannock Tribes, NPT=Nez Perce Tribe, BPA=Bonneville Power Administration, NOAA=National Oceanic and Atmospheric Administration Fisheries, UI=University of Idaho, USFWS=U.S. Fish and Wildlife Service *Lower Snake River Compensation Plan*, IPC=Idaho Power Company, CRT=Columbia River Treaty Tribes, C=conservation and restoration, R=research and education, H=harvest, K=thousand, M=million

2.2.3 Disease Issues

In a review of wild and managed Atlantic salmon populations, Harris (1998) indicated that few pathogens have caused significant disease epidemics in the wild. Hedrick (1998) indicated that effects of diseases on hatchery populations of cultured fish are well studied but less clear in wild populations. The pattern of disease monitoring and detection in the Salmon subbasin is similar to that for other areas where most disease sampling is concentrated on adults collected for hatchery broodstock, juveniles released from the hatchery, and captive populations. Sampling of wild fish is done incidentally to other sampling or directed at populations where hatchery juveniles are released and have the opportunity to interact with wild fish. Factors that influence the dispersal of disease in fish populations are rarely studied quantitatively. However, factors that have proven important to disease transmissions in other systems are likely important to the transmission of diseases in fish populations, including 1) pathogenicity, 2) duration of infection, 3) density of the host population, 4) development of immunity, and 5) efficacy of therapeutants (Reno 1998). No population-level impacts have been attributed to disease outbreaks for aquatic focal species in the Salmon subbasin.

Chinook Salmon—All Chinook salmon adults used for hatchery broodstock are tested for the presence of bacterial kidney disease (BKD) and a representative sample for Infectious Hematopoietic Necrosis Virus (IHNV). The presence of IHNV results in the culling of eggs from the infected female. Sampling for *Myxobolus cerebralis* (whirling disease) and other pathogens is done on a representative number of hatchery adults and juveniles.

The presence of IHNV is routinely demonstrated at the Dworshak National Fish Hatchery, but it is rarely detected in IDFG facilities and has not been documented in adults from the captive rearing program. However, an epizootic in 2002 occurred at Sawtooth Fish Hatchery in juvenile Chinook salmon in culture prior to their release. The only sampling performed on naturally spawning adults documented the presence of IHNV in 1 of 121 adults sampled in the upper Salmon River during 2002 and 2003.

Monitoring and treatment of BKD in fish in culture have been substantially improved in the last 14 years. Culling of eggs from highly infected females and prophylactic treatment with erythromycin have nearly eliminated BKD-caused mortalities of juvenile Chinook salmon in culture.

Whirling disease is endemic in the Salmon subbasin. Susceptibility of juvenile Chinook salmon to whirling disease is dependent on size and timing of exposure. Effects of whirling disease on fish in culture are minimized by rearing juveniles on pathogen-free well water and preventing exposure until juveniles have exceeded the threshold size for infection. Juveniles and adults are exposed to whirling disease infection during migration through the Salmon River (Cavender *et al.* 2003), and 10% of returning adults are known carriers. Recently, prespawning mortality of Chinook salmon adults collected for broodstock at the South Fork Salmon trap and Rapid River Fish Hatchery has approached 35% ,with the cause unknown. Susceptibility of Chinook salmon under culture conditions is considered moderate for IHNV, BKD, and whirling disease.

Steelhead—Most steelhead adults used for hatchery broodstock are tested for the presence of IHNV and BKD. The presence of IHNV results in the culling of eggs from the infected female. Examinations for whirling disease and other pathogens are done on representative numbers of hatchery adults and juveniles. Whirling disease is present in the upper Salmon subbasin. Rearing on pathogen-free well water minimizes effects of whirling disease on fish in culture, and juvenile steelhead are free from whirling disease infection at release. Smolts and adults are exposed to whirling disease during migration through the Salmon River (Cavender *et al*. 2003), and 15% of returning adults are known carriers. Susceptibility of steelhead under culture conditions is considered high for IHNV, low for BKD, and high for whirling disease.

Sockeye Salmon—Persistence of the Snake River sockeye salmon population is dependent on the captive broodstock program. Consequently, disease monitoring for fish in culture and wild fish is higher than for other stocks. All mortalities in culture are necropsied and sampled for disease, as are all fish used for broodstock. A large portion of returning anadromous adults are captured and brought into facilities for broodstock production, providing additional opportunities for disease sampling. Presmolt groups are tested for pathogens prior to release and again at outmigration. Naturally produced juvenile sockeye salmon smolts are sampled at outmigration, and kokanee are sampled in the fall during midwater trawl sampling conducted in lakes where sockeye salmon are released. No whirling disease infection has been found in outmigrating smolts, but 30% of the returning adults are carriers, suggesting exposure in the migration corridor (Cavender *et al.* 2003). In culture, this population of sockeye salmon is known to be extremely susceptible to IHNV and highly susceptible to BKD. There is no exposure to whirling disease from well water under current culture conditions. Whirling disease was detected for the first time in kokanee trawled from Alturas Lake in 2003. Parvicapsula, a new parasite, has been detected in returning adults recently.

Bull Trout—Bull trout are known to be susceptible to BKD and whirling disease under laboratory conditions. However, whirling disease has not been detected in bull trout in Idaho. Sampling for BKD has been performed on bull trout, but the methodology that is used for Chinook/steelhead sampling is questionable for detection of BKD in bull trout. Limited examinations of bull trout in Idaho for IHNV have been negative. Because there are no culture programs for bull trout in Idaho, all sampling has been performed on wild fish.

2.2.4 Important Species

2.2.4.1 Pacific Lamprey (*Lampetra tridentata*)

The Salmon subbasin supports a remnant population of native anadromous Pacific lamprey. Their historical distribution within the subbasin and elsewhere in Idaho is similar to that of salmon and steelhead (Simpson and Wallace 1982). The earliest documented occurrences of anadromous lamprey in Idaho were in the Snake River near Lower Salmon Falls and downstream near Lewiston (Gilbert and Evermann 1894). In the Salmon subbasin, observations of Pacific lamprey have occurred for the past 50 years. In the late 1950s to early 1960s, thousands of larval lamprey (ammocoetes) were observed in the Lemhi River and common in irrigation canals off the Salmon River near Challis (S. Gebhards, personal communication, 1995). From 1970 through 2000, small numbers of lamprey were observed or collected at several locations in the Salmon subbasin (Table 2-9). Aside from this anecdotal information, little is known about the current status and distribution of Pacific lamprey.

Culturally important to native tribes, Pacific lamprey were also popular because of their oily flesh and their use as sturgeon bait (Gilbert and Evermann 1894). Ecologically, they are an important food for white sturgeon, and the carcasses of spawned adults provide nutrients to tributaries that also rear salmon and steelhead (Kan 1975).

General life history and habitat descriptions for this species can be found in several sources, which are summarized in Close (2000). In Idaho, Hammond (1979) described biology of lamprey larvae in selected streams. Ammocoetes collected in the Salmon subbasin were larger than those found in the Clearwater subbasin, and Hammond (1979) theorized that something other than size triggers transformation and migration to the ocean.

Throughout their range in the Columbia River basin, Pacific lamprey have declined to only a remnant of their pre-1940s populations. Lower Snake Dam counts numbered over 30,000 in the late 1960s but have declined to fewer than 500 fish in recent years (Table 2-10). Currently, an estimated 3% of the anadromous lamprey that pass Bonneville Dam are counted at Lower Granite Dam (Close 2000). Although the species may be considered widespread and abundant rangewide, based on these declines, the State of Idaho considers the Pacific lamprey to be imperiled.

Factors that may be affecting declines in Pacific lamprey abundance include problems with habitat and the migratory corridor (Close *et al.* 1995). Ammocoete abundance can be affected by water temperature and other physical characteristics during early development (Potter *et al.* 1986, Young *et al.* 1990).

Availability and accessibility of suitable spawning habitat may limit the amount of lamprey reproduction. Factors influencing survival of early life history stages of lamprey may be critical to determining recruitment to the population (Houde 1987).

Within the Salmon subbasin, limiting factors include water withdrawals, irrigation canals, and habitat disturbance. Low flows, poor riparian conditions, and resultant high water temperatures reduce the quality and quantity of adult spawning and juvenile rearing areas (Close 2000). Downstream of the subbasin, the major limiting factors for ammocoetes and macrothalmia (juvenile life stage) are passage and bypass mortalities at mainstem Snake and Columbia dams, as well as migration delays through the reservoirs (Hammond 1979). For adults, the primary limiting factor is higher water velocities in the adult fish ladders and migration systems at mainstem dams. Adults have extreme difficulty negotiating the weir orifices in fish ladders (T. Bjornn, cited in Close 2000).

Success in rehabilitating Pacific lamprey could depend on whether the species exhibits homing behavior to natal streams (Stone *et al.* 2001). Their counterparts, the sea lamprey (*Petromyzon marinus*), do not home to natal streams (Bergstedt and Seelye 1995) but respond instead to a bile acid-based larval pheromone released by conspecific larval lamprey (Bjerselius *et al.* 2000). If Pacific lamprey do exhibit homing behavior, it may be necessary to recognize evolutionarily ecologically significant units (ESUs) in any rehabilitation effort, instead of focusing on the metapopulation level.
Inventory work is needed to determine its present range and population status (IDFG 1996, 2001).

Table 2-9. Documented observations of Pacific lamprey within the Salmon subbasin, Idaho.

Hydrologic Unit	Watershed	Year	Observation Type	Number and lifestage	Reference
UPS (201)	Salmon River	1973	Observation	1 ammocoete	IDFG FIS database 2001
PAH (202)	—	—	—	—	—
MSP (203)	Salmon River	1977	Collection	35 ammocoetes	Hammond 1979
	Canals off Salmon River	Late 1950s–early 1960s	Observation	Several thousand ammocoetes	S. Gebhards, IDFG retired, personal communication 1995
LEM (204)	Lemhi River	1957–1958	Observation	Several thousand ammocoetes	S. Gebhards, IDFG retired, personal communication 1995
MFU (205)	Salmon River near Pistol Creek	1979	Observation	1 adult	R. Thurow, USFS, personal communication 2001
MFL (206)	Salmon River beaches below Big Creek	1959–1960	Observation	ammocoetes and a few adults	J. Mallet, IDFG retired, personal communication 2001
	Salmon River beaches between Big Creek and	1979	Observation	10 ammocoetes[a]	R. Thurow, USFS, personal communication 2001
		1981–1983		ammocoetes[a]	
		1983-1997		ammocoetes[a]	
	Salmon River just below Stoddard Creek	1997	Observation	1 ammocoete[a]	R. Thurow, USFS, personal communication 2001
	Salmon River at Hospital Bar Hotsprings	2001	Observation	1 dead ammocoete	B. Leth, IDFG, personal communication 2001
MSC (207)	—	—	—	—	—
SFS (208)	South Fork Salmon River near Warm Lake	1977	Collection	23 ammocoetes	Hammond 1979
	Near Reed ranch suctioned while removing sediment	1987-1988	Collection	3 ammocoetes	J. Lund, USFS retired, personal communication 2001
LOS (209)	Mainstem Salmon	1984	Collection-juvenile smolt trap	16 ammocoetes	E. Buettner, IDFG, personal communication 2001
		1987		3 ammocoetes	
		1993		109 ammocoetes	
		1995		2 ammocoetes	
		1996		1 ammocoetes	
		1999		1 ammocoetes	
LSA (210)	—	—	—	—	—

[a] Ammocoetes dug out of sandy beaches

Table 2-10. Counts of Pacific lamprey in fish ladders at mainstem dams between the Pacific Ocean and Salmon subbasin, Idaho (Source: Fish Passage Center, www.fpc.org/adult.html).

Dam	Early 1960s	1996	1997	1998	1999	2000	2001	2002
Bonneville	350,000	—	20,891	—	—	19,002	27,947	100,476
The Dalles	300,000	—	6,066	—	—	8,050	9,061	23,417
John Day	*no dam*	—	9,237	—	—	6,282	4,005	26,821
McNary	25,000	—	—	—	—	1,103	2,539	11,282
Ice Harbor	50,000	737	668	—	—	315	203	1,127
Lower Monumental	*no dam*	—	—	—	—	94	59	284
Little Goose	*no dam*	—	—	—	—	4	104	365
Lower Granite	*no dam*	490	1,122	—	—	28	27	128

2.2.4.2 White Sturgeon (*Acipenser transmontanus*)

White sturgeon in Idaho are classified by the IDFG as a species of special concern (IDFG 2001). The Bureau of Land Management considers white sturgeon a sensitive species, and the Snake River white sturgeon is a federal species of special concern (IDFG fish status, unpublished). The *Snake River White Sturgeon Conservation Plan* (PSMFC 1992) provides life history, habitat needs, and conservation issues concerning all Pacific Coast white sturgeon populations.

White sturgeon have been reported as far upstream as the Town of Salmon. Current documented distribution extends from the mouth to river kilometer (RK) 96.5 (Everett and Tuell 2003). A total of 77 white sturgeon were captured in the lower Salmon River between 1997 and 2001. Sturgeon ranged in size from 66 to 244 cm and averaged 165 cm total length. Sturgeon sampled in the lower Salmon River were significantly larger ($P < 0.05$) than fish in either the free-flowing Snake River or Lower Granite Reservoir. Movement information from a limited number of radio/acoustic-tagged white sturgeon in the Salmon River ($n = 7$) indicated an average movement of 1.3 km, with a range of 0 to 13.7 km. Setline catch per unit effort from systematic sampling ranged from 0 to 6.6 sturgeon per 1,000 hours of effort (Everett et al. 2003). Results of limited sampling conducted by the IDFG since 1991 indicate some movement between the Snake and Salmon rivers (L. Barrett, personal communication).

The Salmon River is the only unregulated stream in Idaho that supports white sturgeon. Natural flow conditions are key to successful spawning of the species. White sturgeon are susceptible to overexploitation by harvest due to a population's dependence on a slowly maturing and long-lived spawning life history. A minor catch-and-release sport fishery for white sturgeon exists in the lower Salmon River (IDFG 1992b). Sport harvest was closed throughout the Snake River drainage in 1970. Idaho's current management strategy for white sturgeon throughout the Salmon River prioritizes conservation.

Traditionally, the Nez Perce people harvested white sturgeon in the Salmon River for subsistence. Tribal harvest is now severely limited as a result of low sturgeon numbers. Sampling conducted by Nez Perce tribal biologists in 1999 and 2000 documented subadult and adult fish between the mouth of the Salmon River and Hammer Creek. In 2000, eggs were sampled between RK 54 and RK 84 (Hammer Creek) (Tuell and Everett 2000). Additional data are needed to assess the status of white sturgeon in the Salmon River, including this population's relationship with Snake River population(s).

2.2.4.3 Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*)

The native westslope cutthroat subspecies occurs in watersheds throughout the Salmon subbasin (Figure 2-74). Although the subspecies is still widely distributed and estimated to occur in 85% of its historical range (Lee *et al*. 1997), Rieman and Apperson (1989) contend that viable populations exist in only 36% of its historical range. Most strong populations are associated with roadless and wilderness areas. Westslope cutthroat trout are currently listed as federal and state (Idaho) species of concern and sensitive species by the U.S. Forest Service and Bureau of Land Management; they were proposed for listing under the ESA. On April 5, 2000, the U.S. Fish and Wildlife Service announced its 12-month finding regarding the petition it had received to list the westslope cutthroat trout as threatened throughout its range under the ESA. The U.S. Fish and Wildlife Service concluded, after review of all available scientific and commercial information, that the listing of westslope cutthroat trout was not warranted.

Current distribution and abundance of westslope cutthroat trout are restricted, compared with historical conditions (Liknes and Graham 1988, Rieman and Apperson 1989, Behnke 1992). In Idaho, populations considered strong remain in 11% of the historical range, and it has been suggested that genetically pure populations inhabit only 4% of this range (Rieman and Apperson 1989), although genetic inventories that would support such a low figure have not been conducted. Many populations have been isolated due to habitat fragmentation from barriers such as dams, diversions, roads, and culverts. Fragmentation and isolation can lead to some populations' loss of persistence (Rieman *et al*. 1993). Estimated probabilities of persistence for westslope cutthroat indicate that populations with fewer than 2,000 individuals show a marked increase in stochastic risks (extinction from chance events) (McIntyre and Rieman 1995). Because of the high risk of these populations to chance events, conservation of the subspecies will likely require the maintenance and restoration of well-distributed, connected habitats.

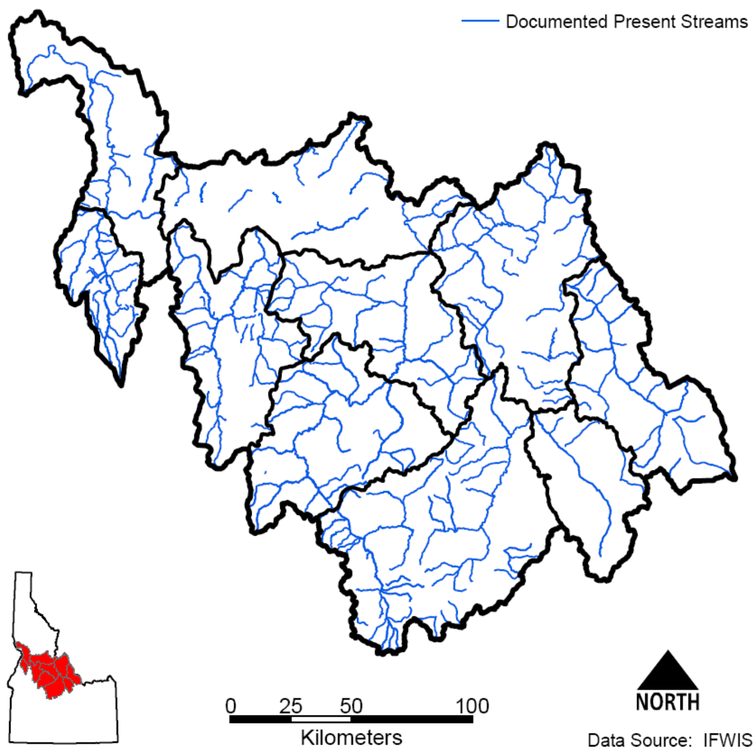

Figure 2-74. Distribution of westslope cutthroat trout within the Salmon subbasin, Idaho.

For the last several decades, the IDFG has been stocking predominantly westslope cutthroat in its mountain lake program in lieu of nonnative trout species. Because many of these lakes did not have trout present naturally, stocking may have resulted in a local range expansion and possible compromised genetic purity where subspecies other than westslope were placed. The current state fish management plan (IDFG 2001) notes that sterile fish will be stocked to reduce potential for hybridization.

Westslope cutthroat trout in the Salmon subbasin have been documented to exhibit fluvial and resident life histories (Bjornn and Mallet 1964; Bjornn 1971, cited in Behnke 1992), and adfluvial behavior is suspected. Age at maturity ranges from three to five years (Simpson and Wallace 1982). Westslope cutthroat trout are spring tributary spawners, with spawning commencing in April and May, depending on stream temperatures and elevation. Adult fluvial fish ascend into tributaries in the spring and typically return to mainstem rivers soon after spawning is complete (Behnke 1992).

Overfishing has been identified by several researchers as a factor in the decline of westslope cutthroat (Behnke 1992). This subspecies is extremely susceptible to angling pressure. Rieman and Apperson (1989) documented a dispensatory effect in fishing (mortality increases as population size decreases) and speculated that uncontrolled harvest could lead to elimination of some populations. However, cutthroat populations have been protected via catch-and-release regulations in large portions of the Salmon subbasin since the 1970s, and no harvest of cutthroat has been permitted in mainstem rivers since 1996. Rieman and Apperson (1989) reported 400 to 1,300% increases in westslope cutthroat populations following implementation of special fishing regulations.

Habitat loss and degradation are other important factors in the decline of westslope cutthroat. In an Idaho study, among depressed populations of cutthroat, habitat loss was the main cause of decline in 87% of the stream reaches evaluated, based on a qualitative study of biologists' best judgment (Rieman and Apperson 1989). Land management practices have contributed to disturbance of streambanks and riparian areas, as well as vegetation loss in upland areas, which result in altered stream flows, increased erosion and sediment, and increased temperature.

Brook trout are thought to have replaced westslope cutthroat in some headwater streams (Behnke 1992). The mechanism is not known, but it is thought that brook trout may displace westslope cutthroat or take over when cutthroat have declined from some other cause. In drainages occupied by both westslope cutthroat and rainbow trout segregation may occur, with cutthroat confined to the upper reaches of the drainage. However, segregation does not always occur, and hybridization has been documented (Rieman and Apperson 1989).

2.2.5 Nonnative Species

Brook trout are native to eastern North America. They were introduced into Idaho in the 1800s and are present throughout the Salmon subbasin. Brook trout can be locally abundant, but abundance varies significantly throughout the subbasin (Levin *et al*. 2002). A recent study of brook trout invasion rates in the South Fork Salmon River determined that, although brook trout are expanding their range in some drainages, no large-scale invasion is occurring (Adams *et al*. 2002). Brook trout may displace native salmonids, prey on juveniles, and hybridize with bull trout.

Smallmouth bass are native to east-central North America. They were introduced in Idaho to increase sport-fishing opportunities. In the Salmon subbasin, smallmouth bass are restricted to the lower mainstem Salmon River, but have been found as far as the town of Salmon. Smallmouth bass are largely piscivorous as adults. No information exists on population numbers of smallmouth bass in the subbasin, nor are there estimates of salmonid consumption by smallmouth bass in the subbasin.

2.3 Terrestrial Resources

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

The terrestrial assessment team identified seven focal habitats for the Salmon subbasin (Table 2-11). Using the criteria from Section 2.0, as a starting point the technical team initial discussions were based primarily upon a list of 24 habitat classifications derived from the IBIS database. Both technical teams focused on different habitat classifications due to the distinct differences between Upper and Lower Salmon subbasin habitats. Focal habitat discussions evolved over the course of four meetings as both upper and lower technical teams settled upon habitat classification questions that incorporated multiple species benefits as well as addressing high conservation priorities.

Appendix 2-19 includes detailed descriptions of all the focal habitats. The mesic, old forest habitat occupies the greatest amount of area in the subbasin, while the aspen habitat occupies the least (Table 2-11). Shrub-steppe habitats are primarily found in the southern and eastern areas of the subbasin (Figure 2-75 and Figure 2-76 show historical and current distributions, respectively). Aspen, riparian/herbaceous wetlands, and juniper/mountain mahogany habitats are scarce throughout the subbasin, appearing only in fragmented allotments (Table 2-11 and Figure 2-76).

Table 2-11. Percent representation of the current focal habitats, by major watershed, for the Salmon subbasin, Idaho (source: GAP II, Scott *et al.* 2002).

Focal Habitat	Major Hydrologic Unit (watershed)[a]										Total Area (km^2)
	UPS	PAH	LEM	MFU	MFL	MSC	MSP	SFS	LOS	LSA	
Riparian/herbaceous wetlands	?	?	?	?	?	?	?	?	?	?	?
Shrub-steppe	33	50	47	7	6	3	22	2	<1%	3	6,433
Forest	52	23	31	75	77	80	67	79	59	75	22,746
Native grasslands	8	16	13	8	8	12	6	14	31	16	1,027
Aspen	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	35
Juniper/mountain mahogany	2	5	2	2	3	4	2	2	6	3	281
Whitebark pine	2	<1%	<1%	5	4	<1%	<1%	1	<1%	<1%	560

[a] See Table 1-1 for watershed acronyms.

We estimated changes in the focal habitats from historical conditions in the Salmon subbasin (Table 2-12). The data suggest that the areas for all focal habitats, with the exception of shrub-steppe, juniper/mountain mahogany, and riparian, have declined (Table 2-11 and Table 2-12). The juniper/mountain mahogany habitat appears to have increased in total area from 281 to 729 km^2. Although riparian is the most important focal habitat, the riparian/ herbaceous wetland habitats have not been assessed in the GAP II dataset (Appendix 2-1). Therefore, it is impossible to quantify the percentage of change in this habitat between historical and current conditions (Table 2-12). However, anecdotal information suggests that riparian/ herbaceous wetland habitats have declined from historical conditions.

Historical records of habitats in the Salmon subbasin indicate that much of the subbasin was forested with large grasslands in the Lower Salmon, Middle Salmon–Panther, Lemhi, Pahsimeroi, and Upper Salmon watersheds (Figure 2-75). Current records of habitats suggest that these grasslands have declined since historical times, and they have apparently almost disappeared in the Lower Salmon watershed (Figure 2-76).

Table 2-12. Percent changes in area (km^2) from historical to current conditions for the focal habitats, by watershed, in the Salmon subbasin. (Based on ICBEMP historical and GAP II vegetation classifications. There is no reliable information on the current distribution of riparian/herbaceous wetland area in the Salmon subbasin. See Appendix 2-1 for data limitations.)

Focal Habitat	Percent Change from Historical to Current Conditions by Major Hydrologic Unit (watershed)										Total Area (km^2)
	UPS	PAH	LEM	MFU	MFL	MSC	MSP	SFS	LOS	LSA	
Riparian/herbaceous wetlands	?	?	?	?	?	?	?	?	?	?	?
Shrub-steppe	14	13	46	133	–4	155	46	668	–72	74	29
Forest	4	–29	–22	–13	–7	–18	–10	–19	–14	–20	–13
Native grasslands	–82	–38	–91	–48	–23	437	–76	310	–79	-9	–67
Aspen	–62	–96	–94	1,142	100	–41	–76	19	–32	–100	–64
Juniper/mountain mahogany	39	646	1,543	100	153	100	66	100	100	100	448
Whitebark pine	–79	–100	–100	–36	–34	–27	–42	–3	–78	–98	–68
Other	916	703	985	100	1,951	7,496	220,370	23,730	100	100	2,701

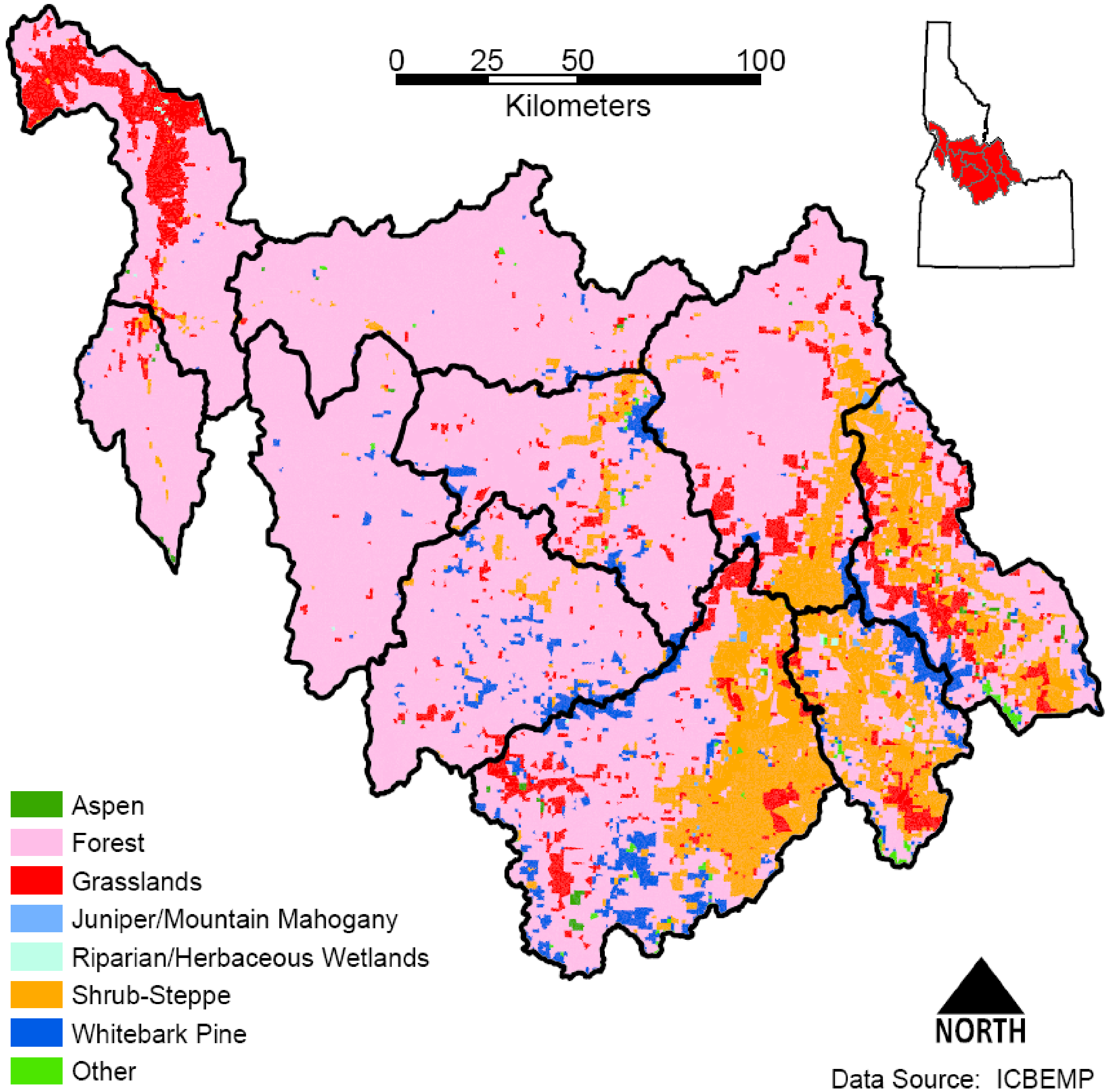

Figure 2-75. Historical distribution of the focal habitats in the Salmon subbasin, Idaho.

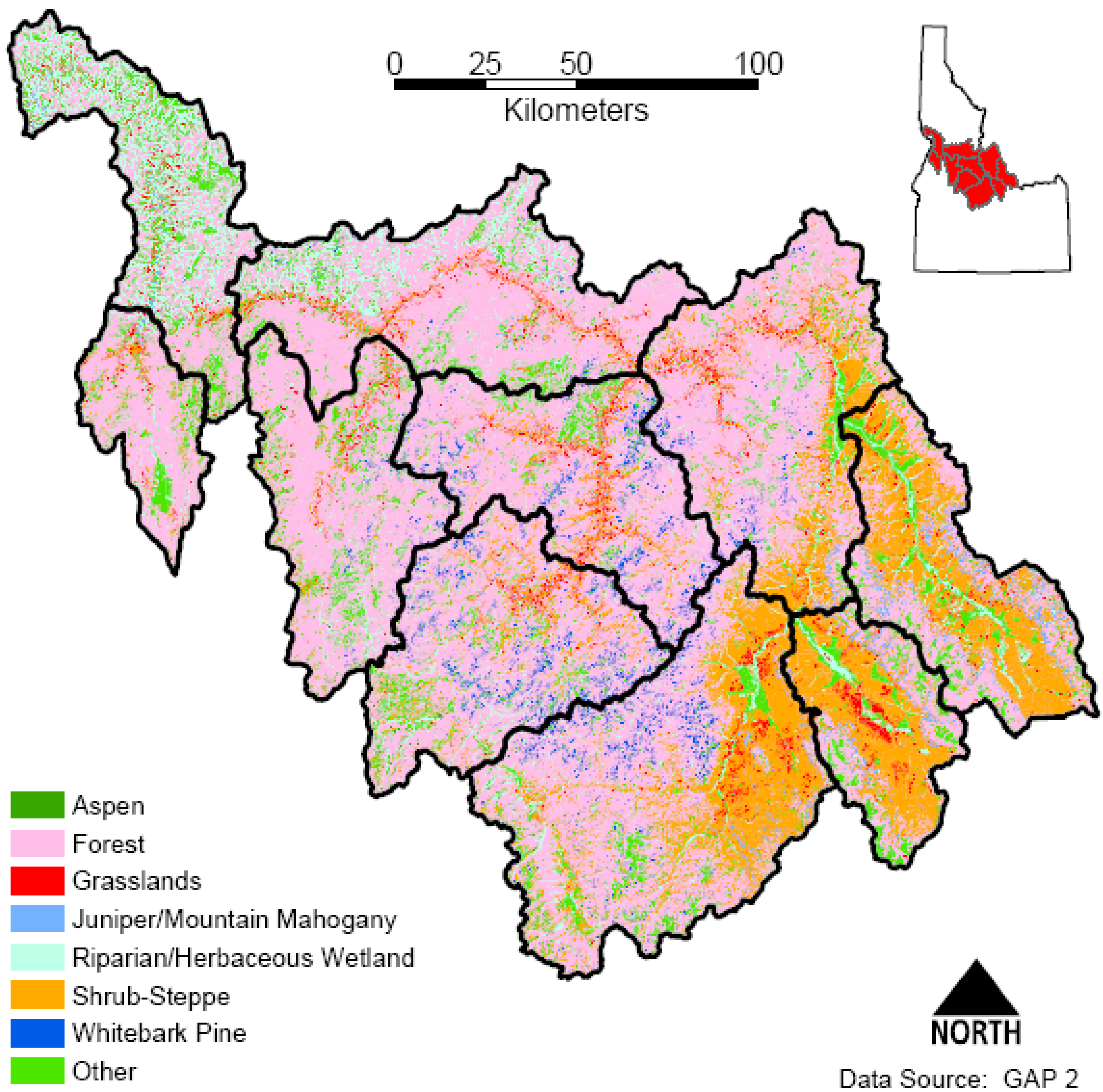

Figure 2-76. Current distribution of the focal habitats in the Salmon subbasin, Idaho (Source: GAP II, Scott *et al*. 2002).

2.3.1 Riparian/Herbaceous Wetlands

2.3.1.1 Description

By virtue of its high productivity, diversity, continuity, and critical contributions to both aquatic and terrestrial ecosystems, riparian and herbaceous wetland habitat in the subbasin (Figure 2-77) is vital to its fish and wildlife resources. Riparian areas contain elements of both aquatic and terrestrial ecosystems that mutually influence each other and occur as transitions between aquatic and upland habitats. One hundred fourteen bird species are documented to use the habitat, 61 of which use it as primary habitat (IDPIF 2000). Thirteen of these bird species are classified as high-priority species (IDPIF 2000). Nearly one-quarter of the Salmon subbasin's terrestrial vertebrate species use this habitat for essential life activities (IBIS 2003).

Figure 2-77. Estimated distribution of riparian/herbaceous wetlands in the Salmon subbasin, Idaho (Source: GAP II, Scott *et al*. 2002).

Riparian habitat forms natural corridors that are important travel routes between foraging areas, breeding areas, and seasonal ranges. These corridors also provide protected dispersal routes for young. However, riparian habitat is limited geographically and vulnerable to loss and degradation through human activities and land uses. Since the arrival of settlers in the early 1800s, at least 50%, and as much as 90%, of riparian habitat in Idaho has been lost or extensively modified (Saab and Groves 1992). Forested riparian habitat has an abundance of snags that are critical to cavity-nesting birds and mammals and to many insectivorous birds. Downed logs are common and provide cover and resting habitat for amphibians, reptiles, and small mammals. Intact riparian habitat has well-developed vegetation, usually with multiple canopy layers. Each layer consists of unique habitat niches that together support a diversity of bird and mammal species. The value of wetland functions not related to wildlife may exceed their value as wildlife habitat. Fifty-six percent of the wetlands in Idaho have been lost in the past 200 years (Dahl 1990). Wetlands are among the most important habitats for birds supporting a large number of species and individuals, including many high-priority species (IDPIF 2000). Protecting riparian habitat may yield the greatest gains for fish and wildlife across the landscape while involving the least amount of area.

2.3.1.2 Focal Species

Black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), four species of willow (*Salix* spp.), and five vertebrate species were selected as focal species for the riparian/herbaceous wetland areas by the terrestrial assessment team. The ecological roles of the cottonwoods and willows are to provide cover, food, bank stability, shading, nutrient cycling, filtering, and nesting substrate. The ecosystem and wildlife using the shrub layer depend on the health of the willows and cottonwoods.

Focal wildlife species for riparian/herbaceous wetland habitats include the Columbia spotted frog (*Rana luteiventris*), willow flycatcher (*Empidonax traillii adastus*), river otter (*Lutra canadensis*), moose (*Alces alces*), and beaver (*Castor canadensis*) (Table 2-13 and Appendix 2-20). All of the focal wildlife species are found in riparian areas throughout the Salmon subbasin. The beaver is especially important to riparian and herbaceous wetland habitats because this species can create waterways and wetland habitats.

Table 2-13. Status and life history information for vertebrate focal species selected for riparian/herbaceous wetland habitats in the Salmon subbasin, Idaho. See Appendix 2-20 for detailed life history and biological information for each of the focal species. Note that the moose migrates between riparian/herbaceous wetlands and juniper/mountain mahogany focal habitats.

Status or Life History Information	Focal Species				
	Columbia Spotted Frog	Willow Flycatcher	River Otter	Beaver	Moose
Conservation Status	State species of special concern; anticipated ESA candidate	Protected nongame species	Protected nongame species; critically imperiled within the State of Idaho because of extreme rarity	State game species	State game species
Population Status	The main population in the Salmon subbasin appears to be widespread and abundant.	Demonstrably widespread, abundant and secure; bird-banding data show downward trend in the West	Not rare and apparently secure, but with cause for long-term concern	Demonstrably widespread, abundant, and secure	Not rare and apparently secure, but with cause for long-term concern
Age at First Reproduction	Within 2 years at lower elevations and 4 to 6 years at higher elevations	First breeds as 1 year old and annually thereafter	Females breed at about 2 years; males breed between 5 and 7 years	Between 2 and 3 years	Capable of reproducing at 16 months; however, females usually produce first calf at 2 to 3 years; moose reach full maturity at 5 or 6 years, with maximum fecundity of 10 to 11 years
Frequency of Reproduction	Iteroparous; breeding is explosive (as opposed to season-long), occurring only in the first few weeks following emergence.	Iteroparous; one brood per season, except in cases of predation or nest lost.	Iteroparous with delayed implantation; after conception, the fertilized egg remains floating in the uterus for about 9 months. The egg then implants in the uterine wall, and following a gestation period of about 60 days, the young are born nearly 1 year after conception.	Iteroparous; only the colony's dominant female breeds, producing 1 litter a year.	Iteroparous; annual breeders

Status or Life History Information	Focal Species				
	Columbia Spotted Frog	**Willow Flycatcher**	**River Otter**	**Beaver**	**Moose**
Number of Offspring/ Fecundity	Tadpoles emerge from egg masses; 600 to 1,500 eggs per egg mass; females lay up to 50 egg masses per season	3 to 4 eggs per clutch; seasonal fecundity mean of 4.26 ± 0.05 SE eggs laid/season/female	Range of 1 to 6 pups per litter, with 2 to 3 pups most common	Average litter size varies from 2 to 3 kits	One calf; occasional twinning occurs if females receive more than adequate nutrition
Lifespan/ Longevity	9 to 13 years	5 to 7 years	25 years in captivity and about 15 years in the wild	Up to 11 years in the wild, and 15 to 21 years in captivity	Average 16 years (range 15–25 years)
Predators	Waterbirds, sandhill cranes, and herons; nonindigenous bullfrogs and fish	Cooper's hawk, great horned owl, red squirrel, fox, and striped skunk. Most nest predation is believed to be mammalian, including the long-tailed weasel, mink, and voles. Mule deer may trample some nests; cattle may trample in areas where grazing occurs.	Have few natural enemies, especially while they are in water. On land, young are vulnerable to a variety of predators.	Few natural predators; however, in certain areas, they may face predation pressure from wolves, coyotes, lynx, fishers, wolverines, and occasionally bear. Minks, otters, hawks, and owls periodically prey on kits. Humans kill beaver for their fur.	Include humans, wolves, grizzly bear, and black bear
Diet	Opportunistic forager that eats wide variety of insects, as well as different mollusks, crustaceans, and arachnids. Larvae eat algae, organic debris, plant tissue, and minute water-borne organisms.	Insectivore and frugivore (i.e., fruit eater); eats mostly Hymenoptera (bees, wasps and ants), some Coleoptera (beetles), Diptera (flies), Lepidoptera (butterflies, moths), and Hemiptera (true bugs)	Opportunistic feeders; fish make up the greatest portion of the diet. Other foods include amphibians, insects, mammals, and birds. Foods and foraging techniques vary in different areas and at different times of year. In murky water, otters use their whiskers to locate prey.	Appear to prefer herbaceous vegetation to woody vegetation during all seasons if it is available.	Most commonly browse several species, including alder, cottonwood, willow, birch, aspen, and balsam fir. Also eat various species of mushrooms, sedges, grasses, lichens, and forbs. Some preferred aquatic species include water horsetail, burreed, and pondweed.

Status or Life History Information	**Focal Species**				
	Columbia Spotted Frog	**Willow Flycatcher**	**River Otter**	**Beaver**	**Moose**
Trophic Relationships	Heterotrophic consumer, primary (aquatic herbivore) and secondary consumer (aquatic and terrestrial invertebrates), feeds in water on decomposing benthic substrate	Heterotrophic consumer, primary and secondary consumer	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore)	Heterotrophic consumer, primary consumer (aquatic herbivore and foliovore (leaf eater), bark/cambium/bole feeder, browser (leaf and stem eater)	Heterotrophic consumer, primary consumer (herbivore), foliovore (leaf eater), aquatic herbivore, browser (leaf and stem eater), grazer (grass and forb eater)

2.3.2 Shrub-Steppe

2.3.2.1 Description

Shrub-steppe habitat (Figure 2-78) was given the highest conservation priority based on trends in bird populations (Saab and Rich 1997). Shrubland birds show the most consistent population declines over the last 30 years of any group of bird species (Paige and Ritter 1999). Comparatively high fish and wildlife density and species diversity characterize shrub-steppe habitat. Approximately 100 bird species and 70 mammal species can be found in sagebrush habitats. Some of these are sagebrush obligates or near obligates. Sagebrush and the native perennial grasses and forbs of the shrub-steppe are important sources of food and cover for wildlife. Native perennial bunchgrass species serve a keystone role in the maintenance of vegetative and watershed stability and resilience to disturbance events and environmental change. Loss of the abundance and vigor of bunchgrass triggers the decay of watershed integrity and reduces the capability of these sites to provide wildlife habitat and commercial resource values (Rust *et al*. 2000). This habitat provides important wildlife breeding habitat and seasonal ranges.

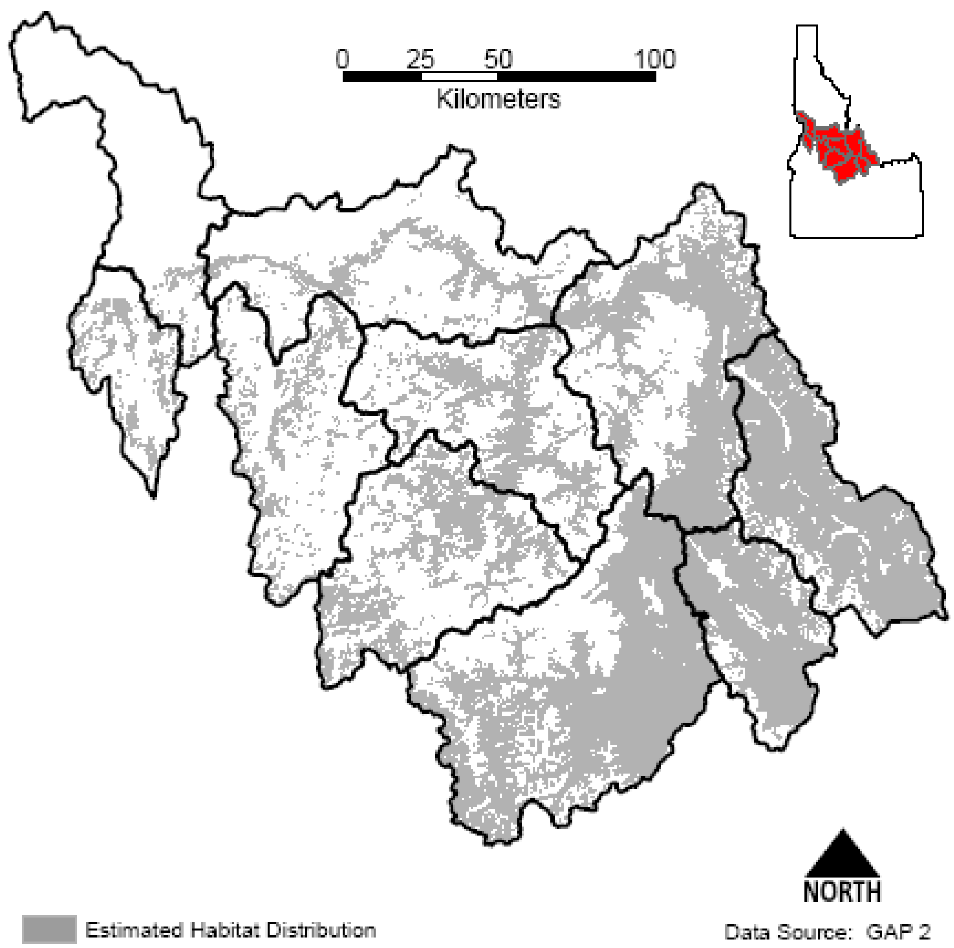

Figure 2-78. Estimated distribution of shrub-steppe habitat in the Salmon subbasin, Idaho (Source: GAP II, Scott *et al*. 2002).

2.3.2.2 Focal Species

Three sagebrush species—Wyoming big sage (*Artemisia tridentata* ssp. *wyomingensis*), mountain big sage (*Artemisia tridentata* var. *vaseyana*), and black sage (*Artemisia nova*)—and three vertebrate species—the greater sage-grouse (*Centrocercus urophasianus*), pygmy rabbit (*Brachylagus idahoensis*) and mule deer (*Odocoileus hemionus*)—were selected as focal species for the shrub-steppe habitat (Table 2-14 and Appendix 2-20).

Different species of sagebrush provide food, cover, and nesting substrate, especially for sage-steppe obligates, such as the greater sage grouse and pygmy rabbit, during the winter months. The sagebrush sometimes protects other native forbs and grasses from overgrazing and acts to stabilize soil. Sagebrush species also tend to be tolerant of drought and cycle nitrogen.
Mule deer migrate between the shrub-steppe and native grassland habitats (Figure). Native grasslands are particularly important winter range for mule deer (Figure 2-79)

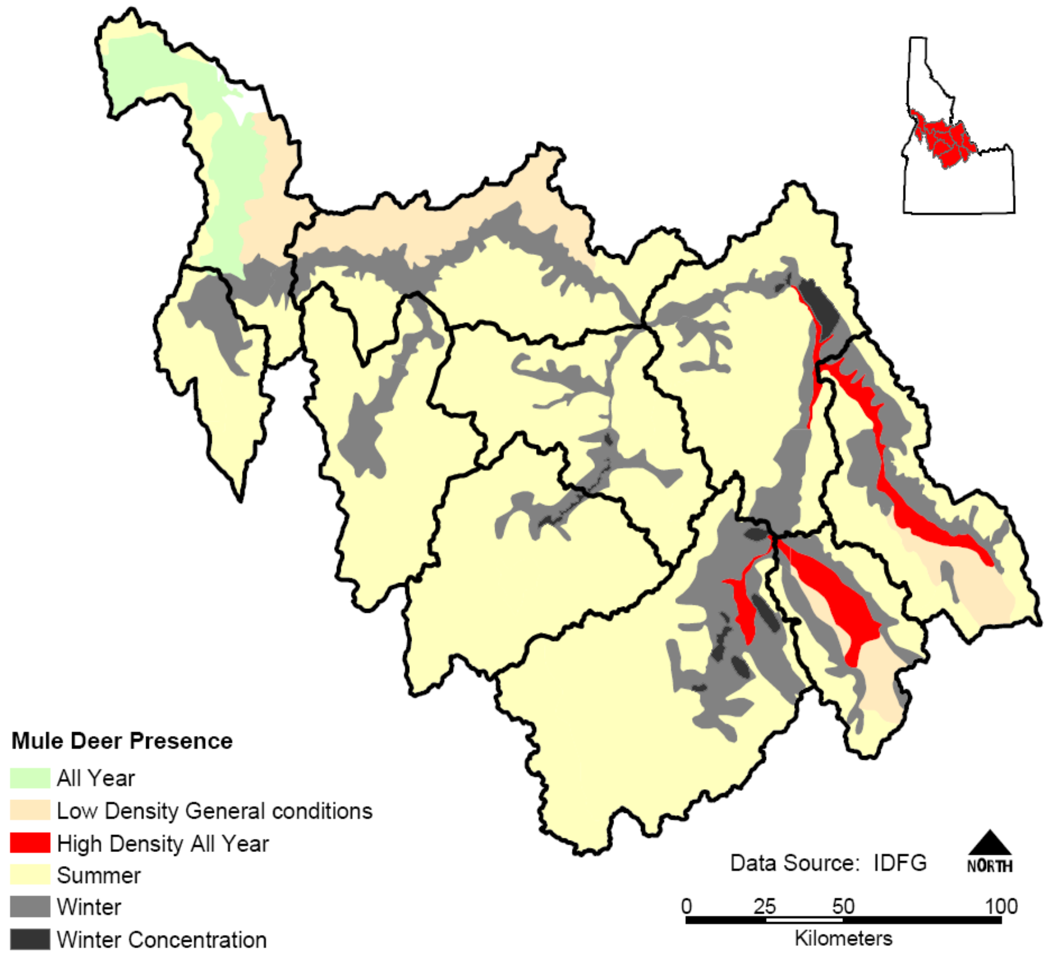

Figure 2-79. Mule deer occurrence and areas of relative abundance in the Salmon subbasin, Idaho.

Table 2-14. Status and life history information for vertebrate focal species selected for shrub-steppe habitat in the Salmon subbasin, Idaho. See Appendix 2-20 for detailed life history and biological information for each of the focal species. Note that the mule deer migrates between shrub-steppe and juniper/mountain mahogany focal habitats.

Status or Life History Information	Focal Species		
	Greater Sage-grouse	**Pygmy Rabbit**	**Mule Deer**
Conservation Status	State game species	State species of special concern	State game species
Population Status	Not rare and apparently secure, but with cause for long-term concern	Imperiled because of rarity and other factors that make the species demonstrably very vulnerable to extinction	Demonstrably widespread, abundant, and secure
Age at First Reproduction	Females are sexually mature their first fall and nest the following spring (Patterson 1952); males are sexually mature the spring following their first winter.	Capable of breeding when they are about 1 year old (Wilde and Keller 1978, Green and Flinders 1980a)	Females usually breed at 2 years, while males may not mate until they are at least 3 or 4 years old due to competition with older males.
Frequency of Reproduction	Iteroparous; hens attempt to raise one brood in a season (Girard 1937)	Iteroparous; a maximum of 3 litters are produced per year (Green and Flinders 1980a)	Iteroparous; breed annually
Number of Offspring/ Fecundity	Hens incubate 7 to 15 eggs for about 25 to 27 days (Connelly *et al*. 1991). After hatching, chicks wait until they are dry before leaving the nest.	An average of 6 young are born per litter.	Mature females commonly have twins, while yearlings have only single fawns.
Lifespan/ Longevity	Are thought to live up to 10 years in the wild, but in one study, the average life span in both hunted and protected populations was 1 to 1.5 years; in another study, 3 to 4 years was considered old.	Unknown, but the mortality of adults is highest in late winter and early spring.	Female can live as long as 22 years, while males may live as long as 16 years.
Predators	Raptors and crows are the primary predators, while coyotes, bobcats, minks, badgers, and ground squirrels are the most important ground predators.	Weasels are the principal predators. The coyote, red fox, badger, bobcat, great horned owl, and northern harrier also prey on them.	Predators include humans, domestic dogs, coyotes, wolves, black bears, grizzly bears, mountain lions, lynx, bobcats, and golden eagles.
Diet	Sagebrush, grasses, forbs, and insects comprise the annual diet	The primary food is big sagebrush, which may comprise up to 99% of the food eaten in winter. Grasses and forbs are also eaten from mid- to late-summer.	Primarily browsers, feeding on several thousand different plant species across their range (Snyder 1991a)

Status or Life History Information	Focal Species		
	Greater Sage-grouse	Pygmy Rabbit	Mule Deer
Trophic Relationships	Heterotrophic consumer, primary consumer (aquatic herbivore and foliovore), flower/bud/catkin feeder, frugivore (fruit eater), secondary consumer (primary predator or primary carnivore of terrestrial invertebrates)	Heterotrophic consumer, primary consumer (herbivore and foliovore), browser (leaf, stem eater), grazer (grass, forb eater), coprophagous	Heterotrophic consumer, primary consumer (herbivore and foliovore), browser (leaf, stem eater), grazer (grass, forb eater), fungivore (fungus feeder)

2.3.3 Pine/Fir Forests

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

2.3.3.1.1 Description

The xeric, old forest habitat (Figure 2-80) is significantly less in extent than it was prior to 1900 in the Salmon subbasin (Quigley and Arbelbide 1997). Quigley and Arbelbide (1997) included much of this habitat in their Dry Forest potential vegetation group, which they concluded has departed from natural succession and disturbance conditions. The greatest structural change in this habitat is the reduced extent of the late seral, single-layer condition (4–24% canopy cover and greater than 53 cm diameter at breast height [dbh]). These types primarily occur at low elevations on south and west aspects. Some slopes in the drier habitats are steep. Important components of this habitat are large downed material, snags, and decadence.

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

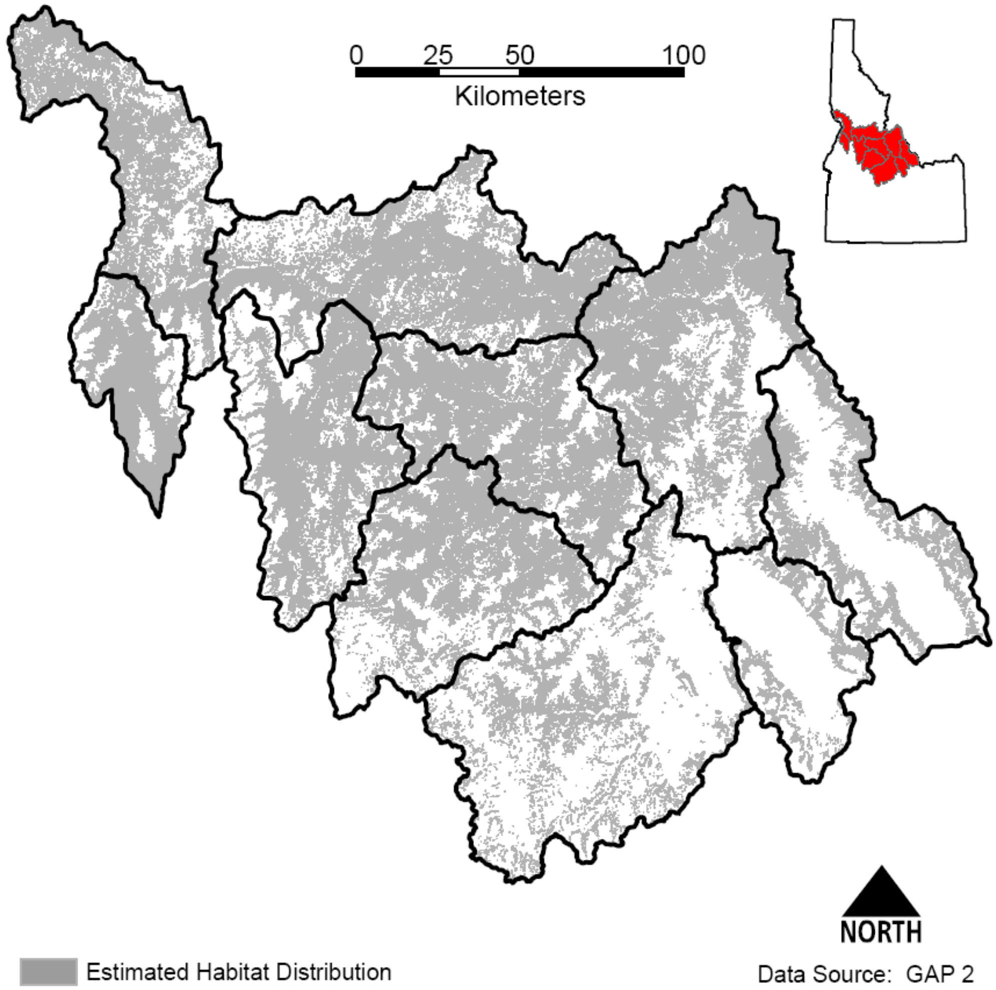

Figure 2-80. Xeric old forest (ponderosa pine/Douglas-fir) distribution in the Salmon subbasin, Idaho (Source: GAP II, Scott *et al*. 2002).

2.3.3.1.2 Focal Species

Two vertebrate species—the white-headed woodpecker (*Picoides albolarvatus*) and flammulated owl (*Otus flammeolus*)—were chosen as focal species for the xeric, old forest habitat in the Salmon subbasin (Table 2-15 and Appendix 2-20). The white-headed woodpecker appears to subsist largely on vegetable matter, with ponderosa pine seeds comprising about 50 to 90% of its diet; the remainder is made up of ants, beetles, other insects, and spiders (Beal 1911, Ligon 1973). This species is an important transporter of viable seeds and indicates whether large-diameter ponderosa pine is present. The flammulated owl is an insectivore, and its favored areas are open aspen or ponderosa pine forests where the summers are dry and warm, the insect abundance or diversity is high, and nesting cavities are available (McCallum *et al*. 1994). Changes in forest structure may also change insect abundance, thereby impacting flammulated owl populations.

Table 2-15. Status and life history information for focal species selected for the xeric, old forest habitat in the Salmon subbasin, Idaho. See Appendix 2-20 for detailed life history and biological information for each of the focal species.

Status or Life History Information	Focal Species	
	White-headed Woodpecker	**Flammulated Owl**
Conservation Status	State species of special concern	State species of special concern
Population Status	Rare or uncommon but not imperiled	Rare or uncommon but not imperiled
Age at First Reproduction	Unknown	Unknown; females probably breed in first year.
Frequency of Reproduction	Iteroparous; annual breeder	Iteroparous; breeds annually; one brood per year; replacement clutches are rare.
Number of Offspring/ Fecundity	Fledge about 3 to 5 young every year	Generally lay 2 to 4 eggs
Lifespan/ Longevity	Unknown	Although the maximum-recorded age for a wild owl is only about 8 years, their life span is probably longer than this.
Predators	Chipmunks are known to prey on the eggs and nestlings of white-headed woodpeckers (Garrett *et al*. 1996). There is also predation by the great horned owl on adult white-headed woodpeckers.	Predators such as red squirrels, cats, and bear raid flammulated owl nests. Adults are also subject to predation by the Cooper's hawk and great horned owl.
Diet	Appears to subsist largely on vegetable matter, with about 50 to 90% of the diet comprised of ponderosa pine seeds; the remainder is made of ants, beetles, other insects, and spiders	Nocturnal arthropods like owlet moths, beetles, crickets, grasshoppers, caterpillars, centipedes, millipedes, spiders, and scorpions (McCallum 1994)
Trophic Relationships	Heterotrophic consumer, primary consumer (herbivore), spermivore (seed eater), secondary consumer (primary predator or primary carnivore of terrestrial invertebrates)	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore of terrestrial invertebrates)

2.3.3.2 Mesic Forest

2.3.3.2.1 Description

The mesic forest habitats (Figure 2-81) are characterized by either moderately warm or cool, moist habitats on northerly exposures. Early seral forest size classes include herbaceous shrub, seedling, sapling, and pole size classes. Mid-seral forest size classes are those trees between 22 and 53 cm (9-21 inches) dbh. Species characteristic of the warmer habitats include grand fir, Douglas-fir, lodgepole pine (*Pinus contorta*), Engelmann spruce (*Picea engelmannii*), and occasionally ponderosa pine and western larch (*Larix occidentalis*). Understories range from beargrass (*Xerophyllum tenax*) and huckleberry (*Gaylussacia* spp.) to more diverse shrub and forb understories.

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

Fire exclusion has reduced early seral habitat conditions. Climax meadow and early seral habitats at both low and higher elevations, which were once maintained by fire, have decreased, resulting in reduced forage for ungulates. Shrublands have also declined. Recently burned habitats that provide unique elements—insect infestations, standing and down dead wood components, and early seral forage—are absent due to fire exclusion. Mesic old growth is characterized by stands of trees in mesic habitats that average greater than 53 cm (21 inches) dbh or that existed in the 1930s. These habitats are characterized by either moderately cool and xeric grand fir or moderately warm and moist grand fir habitats. See descriptions in the section above about mesic young forest.

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

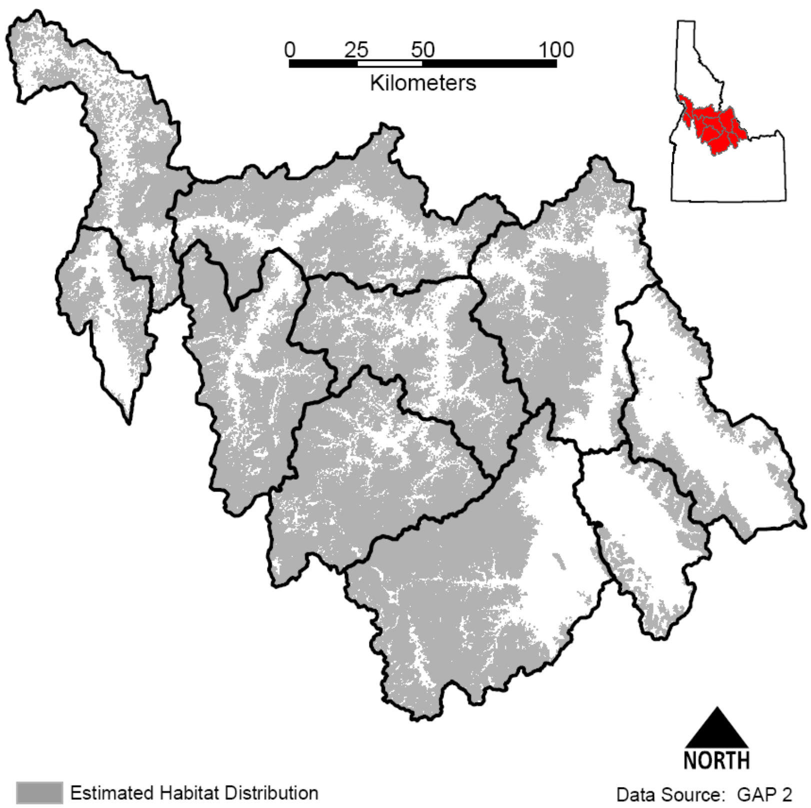

Figure 2-81. Mesic forest distribution in the Salmon subbasin, Idaho (Source: GAP II, Scott *et al*. 2002).

2.3.3.2.2 Focal Species

Mesic forest focal species in the Salmon subbasin include the pileated woodpecker (*Dryocopus pileatus*), American marten (*Martes americana*), snowshoe hare (*Lepus americanus*), and lynx (*Lynx canadensis*) (Table 2-16 and Appendix 2-20). As a large, nonmigratory insectivore, the pileated woodpecker may provide an important role in controlling insect outbreaks, particularly those of tree beetles. The marten prefers to inhabit dense, old growth conifer and mixed stands that have sufficient understory to support various rodents, such as mice (Cricetids) and voles (Microtines), their major food source. The snowshoe rabbit and lynx require a mix of early and late seral habitats to meet their food and cover needs. The presence of cover, the primary determinant of habitat quality for snowshoe hares, is more significant than food availability (Carreker 1985). However, lynx can be managed by managing for snowshoe hare, their primary prey.

Table 2-16. Status and life history information for focal species selected for mesic forest habitats in the Salmon subbasin, Idaho. See Appendix 2-20 for detailed life history and biological information for each of the focal species.

Status or Life History Information	Focal Species			
	Pileated Woodpecker	American Marten	Snowshoe Hare	Lynx
Conservation Status	Protected nongame species	State game species	State game species	Listed threatened under the ESA; species of special concern in the State of Idaho; even though the species is still legally listed as a game species, no hunting or trapping of lynx occurs in Idaho.
Population Status	Not rare and apparently secure, but with cause for long-term concern	Not rare and apparently secure, but with some cause for long-term concern	Demonstrably widespread, abundant, and secure	Critically imperiled because of extreme rarity and dependence on snowshoe hare population
Age at First Reproduction	Breeds after first year (Bull and Meslow 1988)	Breeds the year after birth or in the second year	Breeds during spring following birth	Some females can breed as yearlings (Snyder 1991b).
Frequency of Reproduction	Iteroparous; annual breeder; one brood per season	Iteroparous; breeds annually	Iteroparous; each male mates with several females, and the female can produce 2 or 3 litters per year, beginning in March.	Iteroparous; breeds annually; prey scarcity may suppress breeding (Groves *et al*. 1997)
Number of Offspring/ Fecundity	Clutch size ranges from 1 to 6, 4 young being the most common.	2 to 5 young (average 3–4, less when food is scarce)	1 to 6 young (average 3) per litter	3 to 4 kittens per litter

Status or Life History Information	Focal Species			
	Pileated Woodpecker	American Marten	Snowshoe Hare	Lynx
Lifespan/ Longevity	Lives for at least nine years in the wild (Hoyt and Hoyt 1951, Hoyt 1952), but life span is thought to be greater than this (Bull and Jackson 1995).	Unknown	Mortality is high for the young hares; only about 30% reach one year. Those survivors will live for about 2 years on average.	Maximum lifespan is between 15 and 18 years in captivity (Snyder 1991b).
Predators	Include the northern goshawk, Cooper's hawk, red-tailed hawk, great horned owl, American marten, and gray fox	Include bear, mountain lion, lynx, bobcat, coyote, gray wolf, great-horned owl, and eagles	The snowshoe hare is a major prey item for a number of predators. Some of the major predators include the lynx, bobcat, marten, long-tailed weasel, minks, foxes, coyote, gray wolf, mountain lion, golden eagle, crow, raven, owls, and hawks.	Include humans, mountain lions, bear, and other lynx
Diet	Feeds on insects, primarily carpenter ants and wood-boring beetle larvae; also eats wild fruits and nuts.	Mice and voles are the major food source. Other small mammal prey include ground squirrels, flying squirrels, chipmunks, and snowshoe hares; they also eat insects, various fruits and nuts, and passerine birds.	Eats a variety of plant materials; forage type varies with season. Succulent green vegetation is consumed when available from spring to fall; after the first frost, buds, twigs, evergreen needles, and bark form the bulk of the snowshoe hare diet until spring greenup.	Preys primarily on the snowshoe hare. Diet also includes ducks, upland game birds (especially grouse), and various forest rodents, including squirrels. Also feeds on deer, moose, and caribou carcasses. Saunders (1963) reported that lynx are able to kill these large mammals.
Trophic Relationships	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore of terrestrial invertebrates)	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore), vertebrate eater (consumer or predator of herbivorous vertebrates and terrestrial invertebrates), ovivorous (egg eater)	Heterotrophic consumer, primary consumer (herbivore),; foliovore (leaf eater), bark/cambium/bole feeder, browser (leaf and stem eater), grazer (grass and forb eater), and coprophagous	Heterotrophic consumer, secondary consumer (primary predator or primary carnivore), vertebrate eater (consumer or predator of herbivorous vertebrates)

2.3.4 Native Grasslands

2.3.4.1 Description

Quigley and Arbelbide (1997) concluded that fescue (*Festuca* spp.)–bunchgrass (*Poa* spp.) and wheatgrass (*Pseudoroegneria* spp.)–bunchgrass cover types that make up the native grassland habitat in the Salmon subbasin (Figure 2-82) have significantly decreased since pre-1900, while exotic forbs and annual grasses have significantly increased since pre-1900. Fifty percent of the plant associations recognized as components of grassland habitat listed in the National Vegetation Classification are considered imperiled or critically imperiled (Anderson *et al*. 1998). Overgrazing by cattle near the end of the last century extensively altered these ecosystems. The native bunchgrasses, not generally tolerant of grazing, sustained high mortality when grazed heavily in spring. Wildfires, once common in these grasslands, are far less frequent today since grazing has left less residual grass to carry fires and land management agencies maintain fire-suppression policies. Both grazing and fire suppression favored shrub species over grasses and accelerated soil erosion.

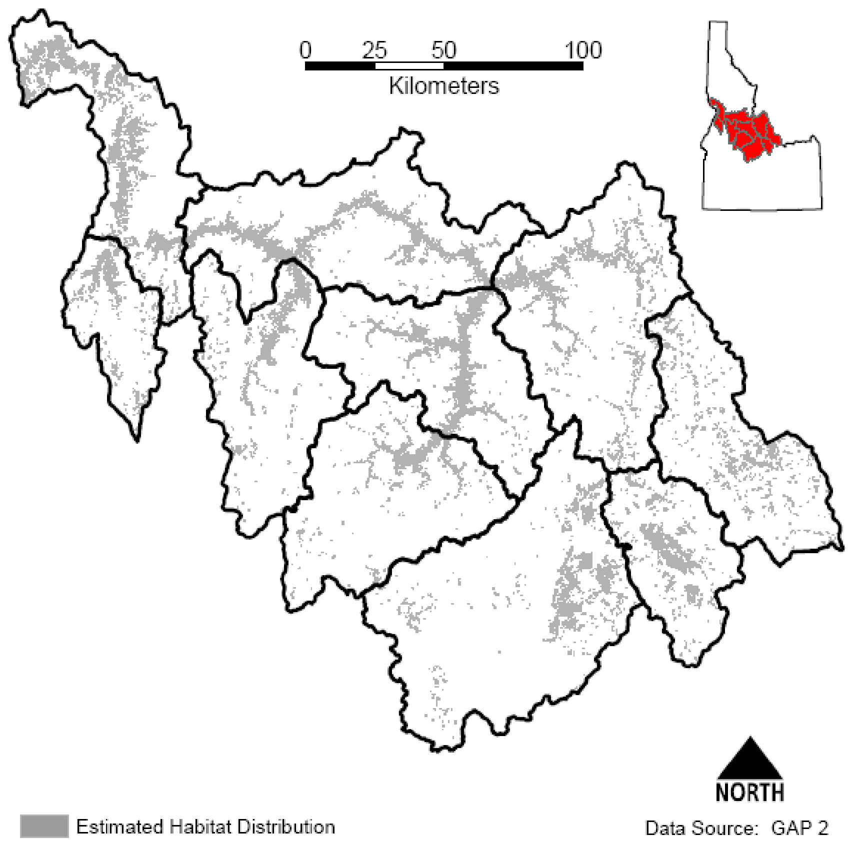

Figure 2-82. Estimated distribution of native grassland habitat in the Salmon subbasin, Idaho (Source: GAP II, Scott *et al*. 2002).

Site conditions have been permanently altered, and exotic Eurasian annual grass species such as cheatgrass (*Bromus tectorum*) have aggressively colonized vast areas. In some areas, conversion to annual grasses has led to a shorter, more intense fire regime, especially in association with sagebrush. Grazing continues to be widespread in these grasslands, and the colonization by cheatgrass and expansion of big sagebrush at the expense of native perennial grasses is expected to continue. Other weeds with significant impacts in grassland habitats of the Salmon subbasin include spotted knapweed (*Centaurea biebersteinii*), diffuse (or white) knapweed (*C. diffusa*), leafy spurge (*Euphorbia esula*), poison hemlock (*Conium maculatum*) (Karl *et al*. 1996), rush skeletonweed (*Chondrilla juncea*) and yellowstarthistle (*Centaurea solstitialis*) (Table 1-7).

Extensive amounts of land are also being converted to agricultural production. Once these ecosystems are converted, there is only limited potential for conversion to native grasslands, either mechanically or by removal of livestock. The presettlement mosaic of cool-season bunchgrasses and deep-rooted shrubs may now be one of the rarest ecosystems in the West.

2.3.4.2 Focal Species

Focal wildlife species for native grasslands include the vesper sparrow (*Pooecetes gramineus*), Rocky Mountain elk (*Cervus elaphus nelsoni*) and Rocky Mountain bighorn sheep (*Ovis canadensis* ssp. *canadensis*) (Table 2-17 and Appendix 2-20).

In the Salmon subbasin, mule deer, elk, and bighorn sheep herds move to lower elevations in winter to feed. The native grassland habitats in the Lower Salmon and Little Salmon watersheds are particularly important winter range for mule deer (Figure 2-79) and elk (Figure 2-83). In winter, bighorn sheep also migrate to native grassland habitats, using well-defined territories (Figure 2-84) and changing elevational gradients as conditions warrant.

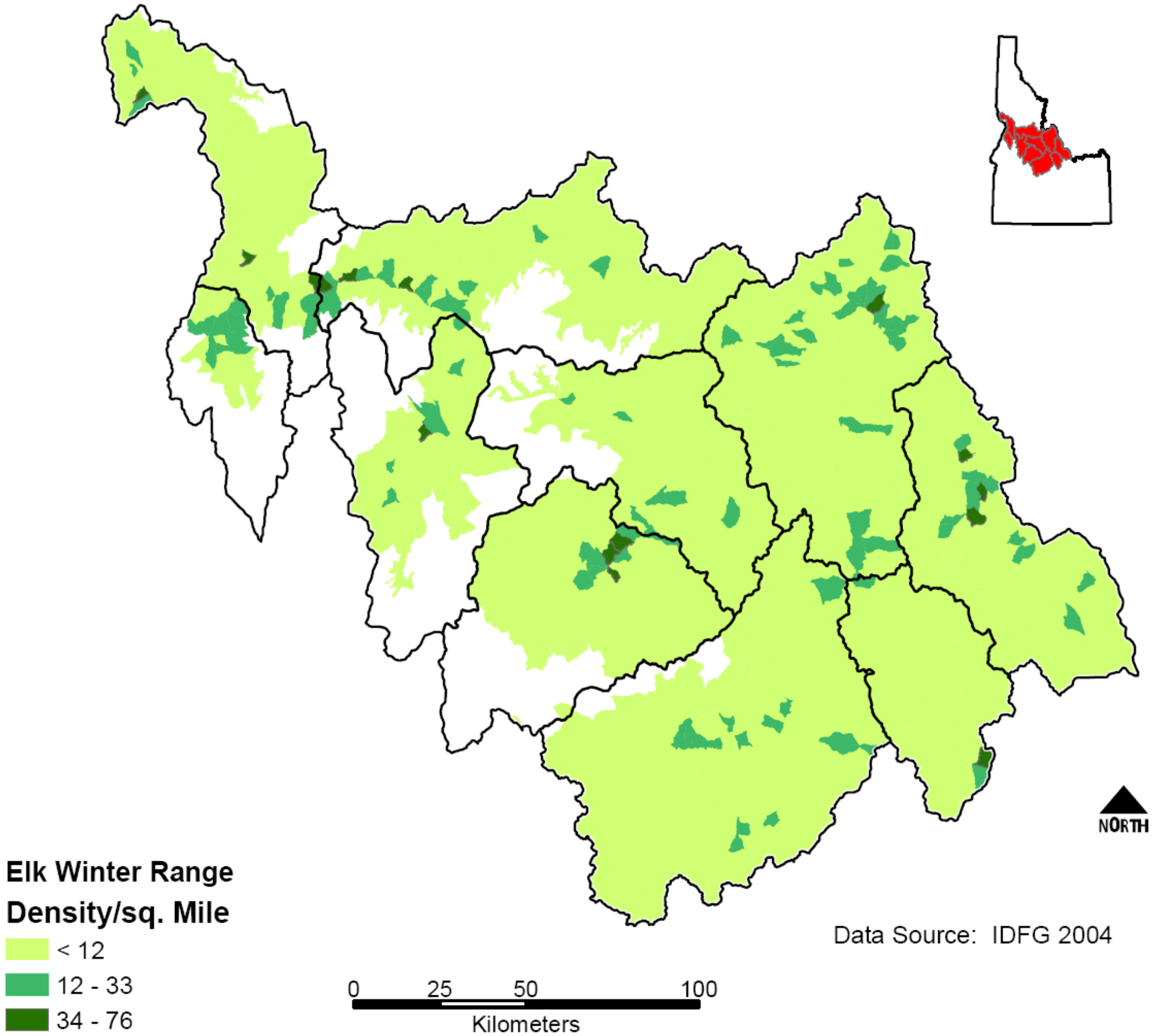

Figure 2-83. Winter range population estimates for Rocky Mountain elk in the Salmon subbasin, Idaho (IDFG unpublished 2004, source: aerial survey data collected during 1984-2003).

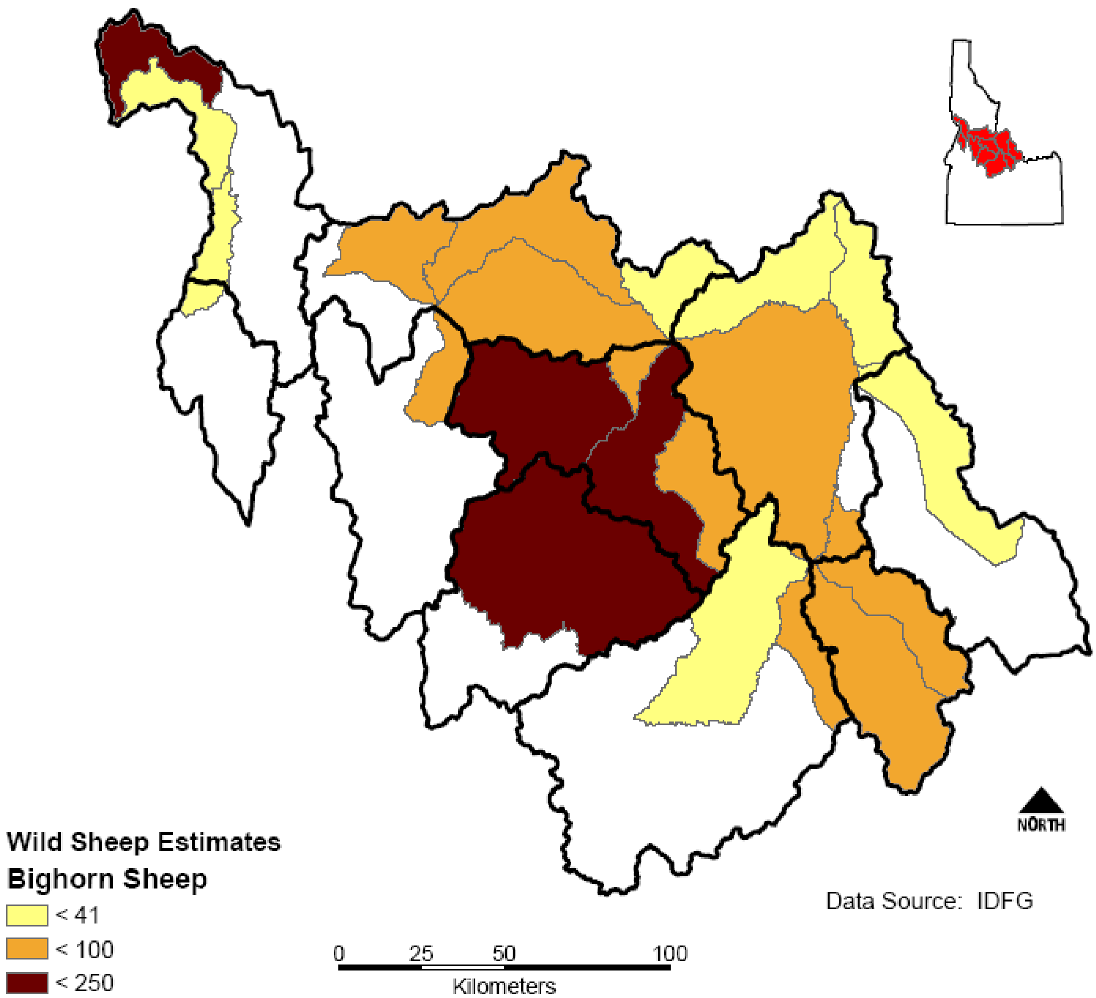

Figure 2-84. Bighorn sheep population areas in the Salmon subbasin, Idaho. Confidence level in the estimates is approximately 80%.

Table 2-17. Status and life history information for vertebrate focal species selected for native grassland habitat in the Salmon subbasin, Idaho. See Appendix 2-20 for detailed life history and biological information for each of the focal species. Note that the elk and bighorn sheep migrate between native grasslands and juniper/mountain mahogany focal habitats.

Status or Life History Information	Focal Species		
	Vesper Sparrow	Rocky Mountain Elk	Bighorn Sheep
Conservation Status	Protected nongame species	State game species	State game species; only California bighorn sheep south of the Snake River in Idaho are designated as sensitive species
Population Status	Not rare and apparently secure, but with cause for long-term concern	Demonstrably widespread, abundant, and secure	Not rare and apparently secure but with cause for long-term concern

Status or Life History Information	Focal Species		
	Vesper Sparrow	Rocky Mountain Elk	Bighorn Sheep
Age at First Reproduction	First breeds as a second-year bird (i.e., first spring after hatching)	Females breed at 2 years of age	Most bighorn sheep become mature at about 2.5 years. Very old ewes generally do not breed.
Frequency of Reproduction	Iteroparous; annual breeders with 1 to 2 clutches per year, occasionally 3	Iteroparous; annual breeders	Iteroparous; annual breeders
Number of Offspring/ Fecundity	Average clutch size is 3 to 4 young (range 2–6).	Usually a single calf, but twins are common	Ewes give birth to one lamb per year, with some giving birth to two lambs.
Lifespan/ Longevity	Known to live past 7 years.	Potential lifespan is 20 years.	Individuals that live past 8 or 9 years may live to 15 to 17 years, but 10 to 12 years is more common.
Predators	Predators include prairie falcon, red fox, skunks, and raccoons. Crows, snakes, and mammals take eggs.	Predators include humans, wolves, coyotes, black bears, grizzly bears, and mountain lions.	Bighorn sheep are an incidental food item in the diet of grizzly or black bears and wolverines and are generally eaten only as carrion. Wolves, coyotes, mountain lions, and bobcats are other predators of bighorn sheep.
Diet	Eats various invertebrates and insects, including spiders, beetles, grasshoppers, and caterpillars, during the breeding season. Consumes grass seeds, weed seeds, and waste grains in all seasons.	Some populations prefer to graze, while others rely more heavily on browse. Grasses and forbs are preferred during spring and early summer; woody browse is preferred during winter.	Graze primarily on grasses and forbs, but eat other vegetation, depending on availability. Prefer green forage and move up- or downslope or to different aspects for more palatable forage. Eat sedges and a variety of grasses, including bluegrasses, wheat grasses, bromes, and fescues. Browse species include sagebrush, willow, rabbitbrush, curl-leaf mountain mahogany, winterfat, bitterbrush, and green ephedra. Forbs include phlox, cinquefoil, twinflower, and clover.
Trophic Relationships	Heterotrophic consumer, primary consumer (herbivore), spermivore (seed eater), secondary consumer (primary predator or primary carnivore of terrestrial invertebrates)	Heterotrophic consumer, primary consumer (herbivore), browser (leaf, stem eater), grazer (grass, forb eater), fungivore (fungus feeder)	Heterotrophic consumer, primary consumer (herbivore), grazer (grass, forb eater)

2.3.5 Aspen

The widespread distribution of quaking aspen (*Populus tremuloides*) forests on the region's high plateaus and mountain ranges and their importance to many wildlife species make these forests a significant biotic community in the basin. Aspen stands are in decline across the West, and very few stands appear in the Salmon subbasin (Figure 2-85). The combination of modern fire suppression and a steady increase in elk herbivory has prevented aspen regeneration in many forests; conifer understories are now widely overtopping aspen stands (CPLUHNA 2003).

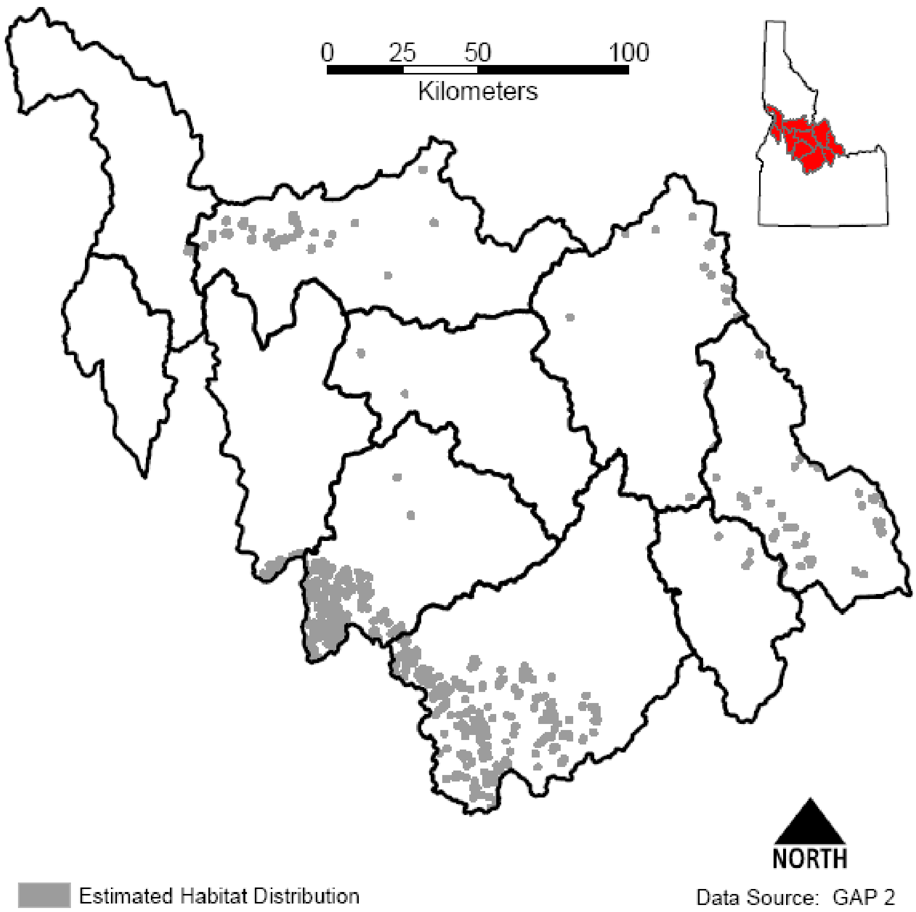

Figure 2-85. Estimated distribution of aspen habitat in the Salmon subbasin, Idaho.

The understory of most aspen communities is luxuriant when compared with those of associated coniferous forests, resulting in greater animal diversity. Understory vegetative diversity is dependent on the localized moisture regime (CPLUHNA 2003). Because aspen stands are so different from conifer stands, they are very important for landscape diversity and wildlife habitat.

Although aspen stems are short lived and snags do not stand long, the wood is soft, often decayed, and therefore useful to snag- and cavity-dependent species.

Many wildlife species use and depend on the aspen to provide food, cover, and nesting or roosting opportunities. Aspen is important for certain cavity nesters because it has a high

food value. Young stands generally provide the most forage. Quaking aspen crowns can grow out of reach of large ungulates in six to eight years (Patton and Jones 1977). Although many animals browse on quaking aspen year-round, it is especially valuable during fall and winter when protein levels are high relative to other forage species (Tew 1970).
Quaking aspen is palatable to all browsing livestock and wildlife species (DeByle 1985). The buds, flowers, and seeds are palatable to many bird species including numerous songbirds and grouse. Elk browse on quaking aspen year-round, feeding on bark, branch apices, and sprouts. Quaking aspen is important forage for mule and white-tailed (*Odocoileus virginianus*) deer. Deer consume the leaves, buds, twigs, bark, and sprouts. New growth on burns or clearcuts is especially palatable to deer. Quaking aspen is valuable moose forage for much of the year (Brinkman and Roe 1975).

2.3.6 Western Juniper/Mountain Mahogany Woodlands

2.3.6.1 Description

Mountain mahogany habitats are an integral component of wildlife seasonal ranges within the basin. Curl-leaf mountain mahogany (*Cercocarpus ledifolius*) is an excellent food source for all classes of browsing animals in both summer and winter (Stanton 1974, Davis 1990); it is one of the few forage species that meets or exceeds the protein requirements for wintering big game animals (Davis 1990). Juniper (*Juniperus occidentalis*) and mountain mahogany woodlands have a limited distribution in the Salmon subbasin (Figure 2-86) and are very vulnerable to habitat alteration. These woodlands occur at high elevations on xeric southerly aspects on low-productivity sites. Habitat development occurs at geologic timescales. One-third of Pacific Northwest mountain mahogany community types listed in the National Vegetation Classification are considered imperiled or critically imperiled (Anderson *et al*. 1998).

2.3.6.2 Focal Species

The focal species for the western juniper/mountain mahogany woodlands include mountain mahogany, moose, rocky mountain elk and mule deer. Moose were choosen as a focal species in this assessment because they are an indicator of riparian areas but use the mahogany habitat in the winter (see section 2.3.1.2). Elk (Figure 2-83 , section 2.3.4.2) and mule deer (Figure 2-79, section 2.3.2.2) also use the mahogany habitat in the winter.

Mountain mahogany is very palatable to bighorn sheep and mountain goats (*Oreamnos americanus*) (Dittberner and Olson 1983). In mature stands, much of the curl-leaf mountain mahogany foliage is out of reach of browsing animals, but it still provides excellent winter cover for wildlife such as elk, mule deer, and bighorn sheep (Stanton 1974).

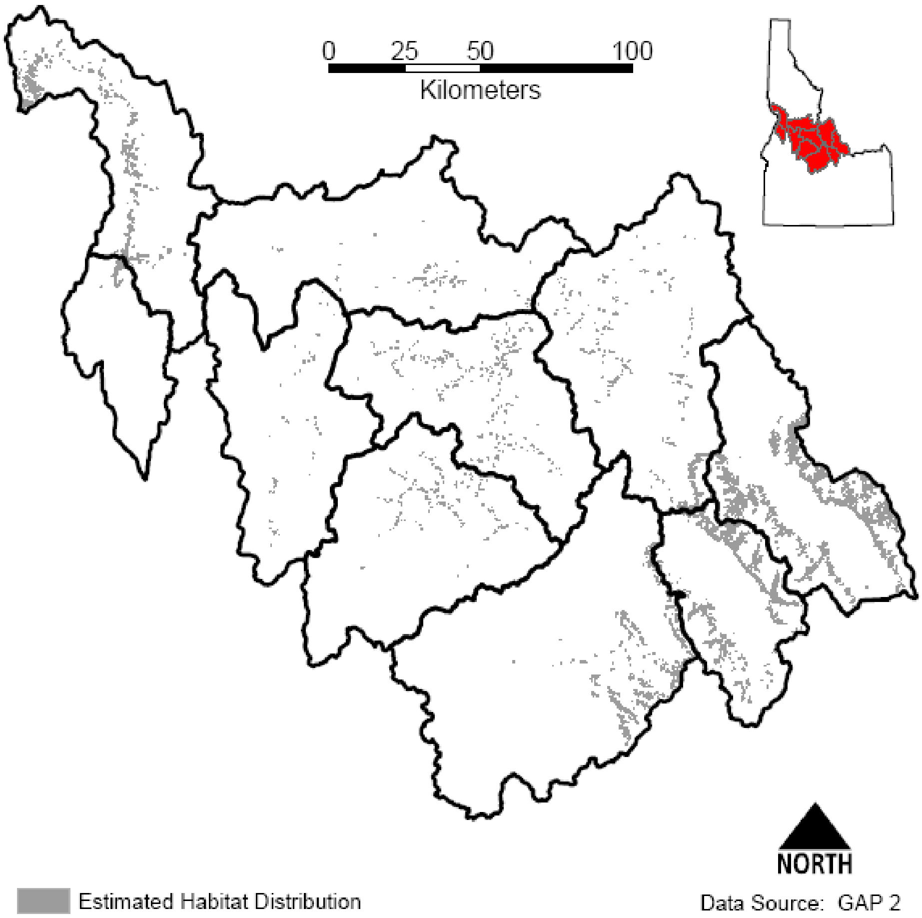

Figure 2-86. Juniper/mountain mahogany woodland habitats in the Salmon subbasin, Idaho.

2.3.7 Whitebark Pine

2.3.7.1 Description

As mentioned earlier, whitebark pine habitats have fire-dependent ecological characteristics with several obligate or near-obligate wildlife species such as the Clark's nutcracker. Whitebark pine habitats provide important wildlife seasonal ranges and a high-value seed crop for wildlife. In addition, whitebark pine is a culturally significant food source for Native Americans. Whitebark pine seeds are a preferred food of the threatened grizzly bear (*Ursus arctos horribilis*) and many other mammals and birds.

An assessment of the Interior Columbia Basin found that the area of whitebark pine cover types has declined 45% since pre-1900 (Keane 1995). Most of this loss occurred in the more productive, seral whitebark pine communities; 98% of them have been lost. Practically all the remaining whitebark pine stands are old. Whitebark pine is reported to be functionally extinct on the Mallard Larkins Pioneer Area in the Idaho Panhandle National Forest (Zack 1995). The majority of the whitebark pine forests in the Salmon subbasin are located in the Upper Salmon, Lower Salmon, and Middle Fork Salmon watersheds (Figure 2-87).

Sixty years of fire suppression have advanced forest succession at the expense of seral whitebark pine communities. Successional replacement due to fire exclusion is a major cause of whitebark pine decline (Keane *et al*. 1994). Whitebark pine cannot maintain its functional role in mountain ecosystems unless areas suitable for its regeneration are available across the landscape (Kendall 2003).

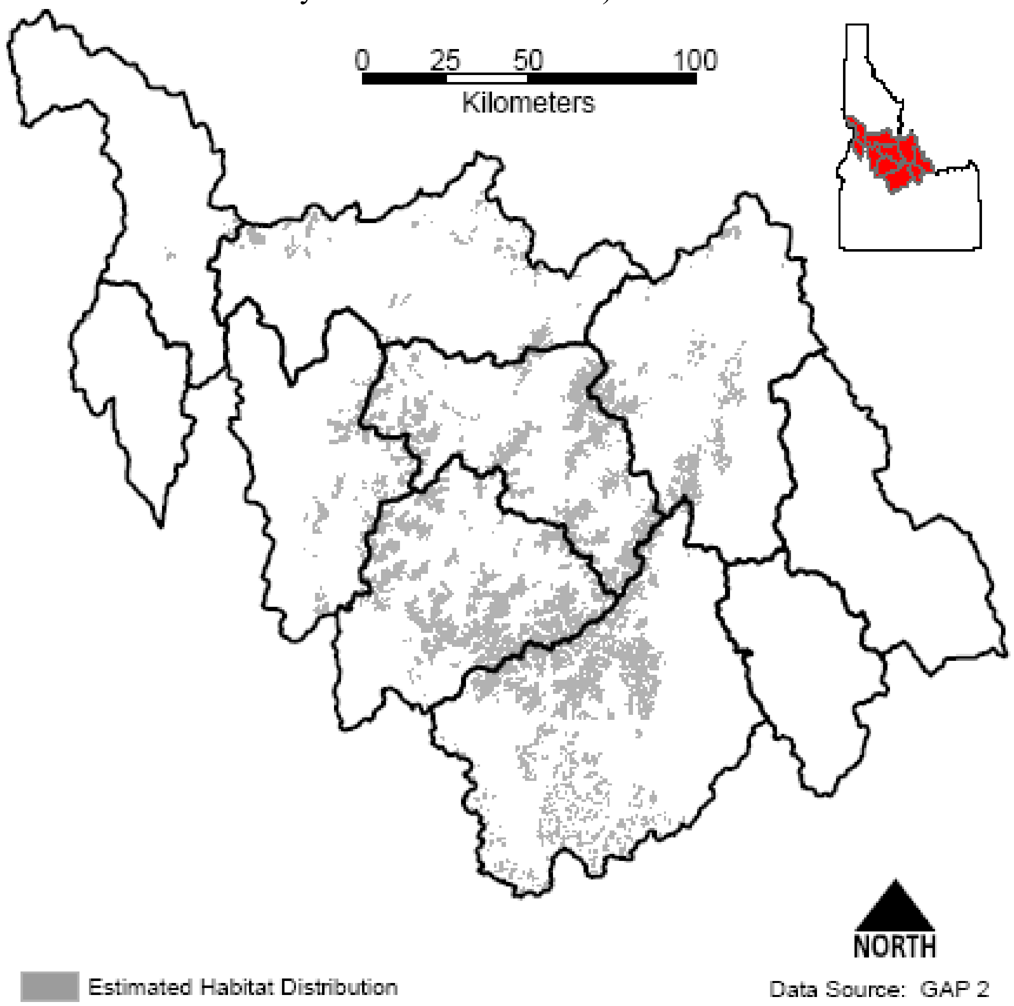

Figure 2-87. Whitebark pine habitat in the Salmon subbasin, Idaho.

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

2.3.7.2 Focal Species

Species identified as focal species for whitebark pine habitat in the Salmon subbasin include the Clark's nutcracker (*Nucifraga columbiana*), black bear (*Ursus americanus*) and grizzly bear (*Ursus arctos horribilis*) (Table 2-18 and Appendix 2-20). All three of these wildlife species eat whitebark pine seeds. Several pines, including the whitebark pine, depend on the Clark's nutcracker for seed dispersal. In turn, the pine seeds are the primary food for both nutcracker adults and nestlings. Bears are also known to regularly eat pine seeds in the spring and fall. Most whitebark pine seed eaten by grizzly and black bears are from red squirrel cone caches. Rodents—such as red squirrels (*Tamiasciurus hudsonicus*), ground squirrels (*Spermophilus* spp.), and chipmunks (*Tamias* spp.)—store large quantities of intact cones in middens at the base of trees or underground in caches.

Table 2-18. Status and life history information for vertebrate focal species selected for whitebark pine habitat in the Salmon subbasin, Idaho. See Appendix 2-20 for detailed life history and biological information for each of the focal species.

Status or Life History Information	Focal Species		
	Clark's Nutcracker	**Black Bear**	**Grizzly Bear**
Conservation Status	Protected nongame species	State game species	Listed as Threatened under the ESA
Population Status	Demonstrably widespread, abundant, and secure	Demonstrably widespread, abundant, and secure	Critically imperiled because of extreme rarity and because factors in its biology make it especially vulnerable to extinction
Age at First Reproduction	First breeding in second winter/spring	Females reach sexual maturity at 3 to 4 years; males, a year or so later	The age of maturity for females is between 5 and 8 years.

Status or Life History Information	Focal Species		
	Clark's Nutcracker	Black Bear	Grizzly Bear
Frequency of Reproduction	Iteroparous; annual breeder unless cone crop of major seed sources failed the previous fall; one clutch per season	Iteroparous; cubs may be weaned at 6 to 8 months, but they remain with their mothers for a 1.5 years. Consequently, the most often that female black bears can mate, unless they lose their cubs prematurely, is every 2 years.	Iteroparous; grizzly bears breed between May and July, usually in 2- to 4-year intervals.
Number of Offspring/ Fecundity	Overall range is 2 to 6 young (average 2–3 young)	Litter size ranges from 1 to 5 cubs, but 2 to 3 cubs is the average.	Litter size varies from 1 to 4 cubs, with 2 cubs being the most common.
Lifespan/ Longevity	Known to live up to 17 years	Average longevity in the wild is 10 years; some individuals reach 20 to 25 years.	The average life span is 25 years, or more in captivity.
Predators	Little information; predation by raptors	Predators include humans, grizzly bear, and other black bear. Coyotes may prey on cubs.	Predators include humans and other grizzly bear.
Diet	Pine seeds are the primary food for both the adults and nestlings, although the bird is known to eat insects, acorns, berries, snails, carrion, and sometimes eggs of small birds. The bird is also aggressive enough to prey on small vertebrates, such as ground squirrels, chipmunks, and voles.	Eat a wide variety of foods, relying most heavily on grasses, herbs, fruits, and mast. They also feed on carrion and insects such as carpenter ants, yellow jackets, bees, and termites. They sometimes kill and eat small rodents and ungulate fawns. Also eat salmon.	Eat primarily grasses, forbs, roots, tubers, and fruits. They also eat carrion, grubs, insects (particularly army cutworm moths and ladybird beetles), fish, small rodents, various bird species, and garbage. Adult males also prey on subordinate grizzly bear and on black bear.
Trophic Relationships	Heterotrophic consumer, primary consumer (herbivore), spermivore, frugivore, secondary consumer (primary predator or primary carnivore of terrestrial invertebrates), ovivorous (egg eater)	Heterotrophic consumer, primary consumer (herbivore), bark/cambium/bole feeder, spermivore, grazer (grass, forb eater), frugivore, secondary consumer (primary predator or primary carnivore of terrestrial invertebrates and vertebrates), ovivorous (egg eater), carrion feeder, cannibalistic	Heterotrophic consumer, primary consumer (herbivore), spermivore, frugivore, root feeder, secondary consumer (primary predator or primary carnivore of terrestrial invertebrates and vertebrates), piscivorous (fish eater), carrion feeder, cannibalistic

2.3.8 Threatened and Endangered Species

The Endangered Species Act (ESA) and other federal regulations have significant implications for landscape management on public and private lands in the Columbia River Basin. While these laws are intended to protect and recover individual species near extinction, the quantity and quality of many habitats across the U.S. are in decline and new species continue to be listed under ESA. Practices of managing wildlife and their habitat on a species-by-species basis sometimes fail to recognize the importance of biological diversity, or "biodiversity," to the health of the ecosystem (Wheeler 1996). The protection of a threatened or endangered species often results in the protection of small parcels of habitats. Sometimes other non-listed species benefit from the protection of a listed species. But this type of wildlife and fish management may lead to fragmented populations, and is reactive to problems rather than proactive.

Therefore, for terrestrial assessment purposes, the technical teams opted to base the assessment and management plan upon an ecosystem-based approach with an emphasis upon focal habitats and a select number of focal species within these habitats. This habitat-based assessment places greater emphasis upon key habitats and their functional components, and less emphasis upon selected focal species. An artifact of this approach is the perception that threatened, endangered, candidate or sensitive (TECS) species are being overlooked or ignored. The technical teams recognized the significant role TECS species have in the ecosystem structure and function; however, the technical teams also felt that some TECS species were inappropriate choices as focal species for the following reasons:

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

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

2.3.8.1 Bald Eagle **(Haliaeetus leucocephalus*)***

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

An opportunistic forager, the bald eagle eats a variety of mammalian, avian, and reptilian prey but prefers fish to other food types. It often scavenges prey items when available, pirates food from other species when it can, and captures its own prey only as a last resort. Bald eagles are capable of breeding in their fifth year of life but may not start to breed until they are six or seven years old.

Typically, a female lays 1 to 3 eggs per season. Bald eagles can live up to 28 years in the wild.

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

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

2.3.8.2 Gray Wolf (Canis lupus)

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

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

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

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

2.3.8.3 Northern Idaho Ground Squirrel (Spermophilus brunneus brunneus)

The northern Idaho ground squirrel was listed as a threatened species on April 5, 2000 (66 FR 17779). One of the rarest of North American ground squirrels, this species inhabits 24 sites in the Little Salmon watershed (i.e., Adams and Valley counties). The current population of northern Idaho ground squirrels is estimated at about 200 to 250 individuals. The squirrel is at risk of extinction primarily because of habitat loss and fragmentation. Other factors impacting the squirrel's survival are competition with Columbian ground squirrels (*Spermophilus columbianus*) and recreational shooting. The northern Idaho ground squirrel emerges from hibernation in late March or early April and within two weeks begins searching for a mate. Female squirrels produce between 2 and 10 young. Female northern Idaho ground squirrels are known to live for up to eight years, while males die at a younger age due to behavior associated with reproductive activity.

- **Trophic Relationships**—heterotrophic consumer; primary consumer (herbivore); granivorous (eats small seeds and grain); grazer (bluegrass); consumer of roots, bulbs, leaf stems, flower heads
- **Key Ecological Role**—is prey for secondary or tertiary consumer (primary or secondary predator), is a primary burrow excavator (fossorial or underground burrows), creates and uses trails (possibly used by other species), disperses seeds/fruits (through ingestion or caching), disperses vascular plants, physically affects (improves) soil structure and aeration (typically by digging)

2.3.8.4 Spalding's Catchfly (*Silene spaldingii*)

Spalding's catchfly is a member of the pink carnation family (Caryophyllaceae). A long-lived perennial herb, it ranges in height from 20 to 61 cm. Reproduction is by seed only. The plant was listed as a threatened species on October 10, 2001 (66 FR 51597). The listing did not include a designation of critical habitat. Seven populations occur in Idaho in the Lower Salmon and Middle Salmon–Chamberlain watersheds (i.e., Idaho, Lewis, and Nez Perce counties).

The plant is typically associated with grasslands dominated by native perennial grasses such as Idaho fescue (*Festuca idahoensis*) or rough fescue (*F. scabrella*). Other associated species include bluebunch wheatgrass (*Pseudoroegneria spicata*), snowberry (*Symphoricarpos albus*), Nootka rose (*Rosa nutkana*), yarrow (*Achillea millefolium*), prairie smoke avens (*Geum triflorum*), sticky purple geranium (*Geranium viscosissimum*), and arrowleaf balsamroot (*Balsamorhiza sagittata*). Scattered individuals of ponderosa pine may also be found in or adjacent to Spalding's catchfly.

Many Spalding's catchfly populations are isolated from other populations by large distances, and the majority of the populations occur at scattered localities separated by habitat that is not suitable for this species. Most of the remaining sites that support Spalding's catchfly are small and fragmented, and existing sites are vulnerable to impacts from grazing, trampling, herbicide use, competition with nonnative vegetation, and urban and agricultural development.

2.3.8.5 MacFarlane's Four-o'clock (*Mirabilis macfarlanei*)

MacFarlane's four-o'clock was first listed as an endangered species on October 26, 1979 (44 FR 61912). Only three populations were known at that time, with a total of 20 to 25 individual plants. The species was threatened by several factors, including trampling, exotic and invasive species collecting, livestock grazing, disease, and insect damage. After the species was listed, additional populations were discovered, and populations on public lands were actively managed and monitored. Consequently, the plant was downlisted to a threatened status on March 15, 1996 (61 FR 10693). MacFarlane's four-o'clock is a long-lived herbaceous perennial with a deep-seated, thickened root. Individual plants have been observed to live over 20 years. In addition to reproducing by seed, plants reproduce clonally from a thick, woody tuber that sends out many shoots (collectively called a genet).

MacFarlane's four-o'clock occurs in river canyon grassland habitats that are characterized by regionally warm and dry conditions. Habitat for MacFarlane's four-o'clock generally consists of bunchgrass communities dominated by bluebunch wheatgrass (*Pseudoroegneria spicata*). Associated grass species include sand dropseed (*Sporobolus cryptandrus*), red three-awn (or Fendler three-awn, *Aristida longiseta*), and Sandberg bluegrass (*Poa secunda*). Additional species that may be found in MacFarlane's four-o'clock habitat include yarrow (*Achillea millefolium*), pale alyssum (*Alyssum alyssoides*), soft brome (*Bromus moths*), cheatgrass (*B. tectorum*), netleaf hackberry (*Celtis reticulata*), rabbitbrush (*Ericameria nauseosa*), and smooth sumac (*Rhus glabra*).

All currently known populations of MacFarlane's four-o'clock in Idaho occur in Idaho County. As part of the 1985 recovery plan objectives, one new population was established at Lucile Caves along the Salmon River canyon. This colony appears to be stable. In the Hells Canyon National Recreation Area, three MacFarlane's four-o'clock sites monitored from 1990 to 1995 appear to be stable (Kaye 1995). Improved livestock management by the U.S. Forest Service and Bureau of Land Management has reduced impacts to MacFarlane's four-o'clock from livestock grazing on federal lands (C.A. Johnson 1995).

2.3.9 Environmental Conditions

Natural ecosystems are enormously intricate. The complex mosaic of habitats within the Interior Columbia Basin and the Salmon subbasin results from the interaction of soil and vegetative characteristics, climate, wind, fire, wildlife, and human activity. All of these variables contribute to the "proper" functioning of these systems (Carey *et al*. 1996).

An ecosystem is defined as the physical environment and the community of plants, animals, and other living organisms in that environment. The physical environment determines in many ways what the ecosystem is or can be. The Salmon subbasin's natural physical features change considerably over the length and breadth of its entire area. The climate, geology, and geomorphology of the Salmon subbasin are described in section 1 of the assessment.

Over the past century, humans have become an increasingly significant factor in how the Salmon subbasin ecosystem functions by altering how the original disturbance factors affect ecological processes. As anthropogenic activities have modified the pathways and patterns of ecosystem development and succession, the structure of the system has been simplified (Carey *et al*. 1996). Simplification and loss of diversity have in turn led to the loss or threatened loss of plant, animal, and fish species, but also the ability of the land and waters to provide continued, predictable flows of resources that contribute to both traditional and current human values and demands (USFS 1996).

We evaluated the Salmon subbasin at the watershed scale for four focal aquatic species, and nine focal terrestrial habitats. The watershed was chosen as the organizational unit for focal species discussions because it is the most appropriate unit for evaluating both aquatic and terrestrial issues at a scale that is biologically and managerially significant (Doppelt *et al*. 1993).

2.3.9.1 Upper Salmon

Aquatic Habitat—Various land uses increase water temperatures and degrade habitat quality in the upper Salmon River. About 89% of this core area is in public ownership, and the federal government manages most of this public land. Several tributaries such as Indian and Colson creeks suffer from increased sedimentation due to road construction and logging, as well as improperly placed culverts. Grazing and irrigation withdrawals have impacted some streams. Although most of the mainstem Salmon River downstream of Challis is a migration corridor or wintering area, it does not rear juvenile salmonids because of high summer temperatures. The Challis area marks the first major area where mainstem Salmon River water is used for irrigation. The diversion of water for irrigation and its subsequent return is a major factor contributing to decreased water quality and clarity and increased temperatures in the mainstem Salmon River downstream of Challis. All water in Iron, Challis, and Squaw creeks is appropriated.

Historical patented mining and associated roads continue to deliver sediment to upper Salmon River headwater streams (USFS 1999a). Historical dredge mining has left unconsolidated dredge tailings in the lower Yankee Fork River (USRITAT 1998, USFS 1999c). Debris torrents in 1940, 1963, and 1998 have changed the Slate Creek watershed. The historic Hoodo Mine may emit toxins into Slate Creek. Just downstream of Slate Creek, the historic Clayton Silver Mine and Mill dewatered Kinnikinic Creek; however, cleanup efforts have been completed by the U.S. Environmental Protection Agency (USRITAT 1998). The Thompson Creek Mine, covering 996 hectares, straddles the hydrographic divide between Thompson and Squaw creeks (USRITAT 1998). Waste dumps are in the headwaters of Pat Hughes and Buckskin creeks. The historic tungsten mill site and its associated Scheelite Jim Mine are on Thompson Creek. Water quality in the watershed is impacted from the acid mine drainage from the Scheelite Jim Mill site. In the East Fork Salmon River drainage, the Livingston Mine on Big Boulder Creek has affected the river channel (USRITAT 1998). The mine continues to deliver sediment to the East Fork Salmon River.

Riparian/Herbaceous Wetlands—One of the most quantifiable impacts to wetland habitats in the Upper Salmon watershed results from various forms of water development and/or conversion within the floodplain. Eighty-eight points of water diversion have been constructed in the Upper Salmon watershed for various purposes. The Upper Salmon watershed is located within the protected areas of the Salmon subbasin, so anthropogenic influences are less pronounced. Nevertheless, data limitations prevent us from accurately or precisely quantifying the direct and indirect losses of riparian/herbaceous wetland habitat in the Upper Salmon watershed.

Shrub-Steppe—Shrub-steppe habitats currently comprise 33% of the landscape in the Upper Salmon watershed. Based on the best estimates, this percentage is an increase of nearly 14% from historical conditions. Increases in shrub-steppe habitat in the Upper Salmon watershed may largely be attributed to the altered fire regime, which allows the shrub component of grassland habitats to expand at the expense of native grasslands. The quality of remaining shrub-steppe habitat is severely reduced from that of historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forest—Pine/fir forests are the most encompassing habitats in the Upper Salmon watershed. Data limitations pertaining to historical acreages of forested habitats prevent a precise quantification of habitat losses (Appendix 2-1). In the Upper

Salmon watershed, the focal habitat components of the pine/fir forests comprise 52% of the landscape. This percentage is an estimated increase of 4% from historical conditions. The quality of the pine/fir forests has shifted from a mix of seral stages to a young seral-dominated habitat. Late seral stages were preferentially harvested, and once under management, stands are not permitted to reach late stages. Young seral stages have higher stem density, lower diversity and cover of understory species, and fewer large-diameter snags and downed wood.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of ponderosa pine habitat. Historically, this habitat was mostly open and park-like, with relatively few undergrowth trees, and was the predominant landscape feature. Timber harvest activities in the watershed during the last century selectively harvested the mature stands, while other factors limited the reestablishment of normal forest successional processes. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that gives the habitat a more closed, multi-layered canopy. Fire suppression has led to a buildup of fuels that increases the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover and tends to favor shrub and conifer species.

The mesic, mature forest component of the pine/fir forest habitat was assessed in terms of Interior mixed conifer habitat. This habitat has been most affected by timber harvesting and fire suppression. Timber harvesting has focused on taking large shade-intolerant species in mid- and late seral forests, leaving shade-tolerant species. Fire suppression enforces these logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and are composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently 70% more abundant than during historical conditions (IBIS 2003). Late seral forests of shade-intolerant species are now essentially absent. Early seral forest abundance is similar to that found historically, but such forest lacks snags and other legacy features. In the Upper Salmon watershed, the mesic, mature forest component has also been nearly lost due to timber harvest and fire regime alteration.

The mesic, immature forest component was assessed in terms of lodgepole pine habitat. This habitat typically reflects early successional forest vegetation that originated with fires. Most lodgepole pine forests are early to mid-seral stages initiated by fire. Fire suppression has left many single-canopy lodgepole pine habitats unburned to develop into more multi-layered stands. Without fires and insects, stands become more closed-canopy forest with sparse undergrowth. Because lodgepole pine cannot reproduce under its own canopy, old, unburned stands are replaced by shade-tolerant conifers. Currently, much of this pine/fir forest component is decadent and highly susceptible to insect infestation and/or catastrophic fire due to high fuel loads.

Native Grassland—Native grassland habitat currently comprises 8% of the landscape in the Upper Salmon watershed. This percentage reflects a decrease of 82% from historical conditions. Most of these reductions are attributable to habitat conversion to dryland or irrigated agriculture. Fire suppression has allowed forests and shrub-steppe habitats to encroach on grassland types and, therefore, is causing these estimated losses.

Aspen—Aspen habitat is a patchily distributed resource in the Upper Salmon watershed. Aspen habitat is not a significant component of the landscape in the watershed; it currently comprises less than 1% of that landscape. Aspen habitats have decreased an estimated 62% from historical conditions in the Upper Salmon watershed.
Western Juniper/Mountain Mahogany—The western juniper/mountain mahogany woodland habitat is an insignificant vegetative element in the Upper Salmon watershed, amounting to just 2% of the current habitat. The western juniper component of the habitat is at the northern periphery of its range in the Salmon subbasin. However, it continues to expand in range due in large part to an altered fire regime: the longer fire-return intervals give junipers a competitive advantage over the shrub/forb vegetation. According to the best available information, the western juniper component has increased 39% from historical conditions. The mountain mahogany component is not a significant vegetative element in the southern Upper Salmon watershed.
Whitebark Pine—Whitebark pine habitats are broadly distributed across the Upper Salmon watershed at alpine and subalpine elevations and comprise an estimated 2% of the habitat in the watershed. According to the best available information, whitebark pine habitat has declined 79% from historical conditions due to blister rust and an altered fire regime.

2.3.9.2 Pahsimeroi

Aquatic Habitat—Over a century of livestock grazing and instream flow alterations have substantially altered the species diversity, structure, composition, and connectivity of the riparian zones in the Pahsimeroi watershed. In the Pahsimeroi River valley, no tributaries are connected throughout the entire year to the mainstem Pahsimeroi River because of water diversions. Approximately 61% of the drainages within the watershed currently have altered riparian vegetation conditions based on stream functionality and/or plant community type assessments" (USDI and USDA 2001). Patterson Creek may have degraded water quality from zinc leaking downstream of the IMA Mine, an abandoned tungsten mine. Most of these altered riparian communities exist in the lower portions of the watershed, overlapping areas of occupied Chinook and steelhead habitat.
Riparian/Herbaceous Wetlands—The most significant impacts to wetland habitats in the Pahsimeroi watershed result from various forms of development and/or conversion within the floodplain. Nearly 700 points of water diversion have been constructed in the Pahsimeroi watershed for dryland irrigation. The diversions have significant ramifications to hydrologic processes in the watershed. Other forms of development and/or land conversion within the 50- and 100-year floodplains impact wetland habitat quantity and quality. Data limitations prevent us from accurately or precisely quantifying the direct and indirect losses of riparian/herbaceous wetland habitat in the Pahsimeroi watershed.

Shrub-Steppe—Shrub-steppe habitats currently comprise 50% of the landscape in the Pahsimeroi watershed. Based on the best estimates, this percentage is an increase of nearly 13% from historical conditions. Shrub-steppe habitat increases in the Pahsimeroi watershed may largely be attributed to the altered fire regime, which allows the shrub component of grassland habitats to expand at the expense of native grasslands. The quality of remaining shrub-steppe habitat is severely reduced from historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forest—Pine/fir forests are the most encompassing habitats in the Pahsimeroi watershed. Data limitations pertaining to historical acreages of forested habitats prevent us from precisely quantifying habitat losses (Appendix 2-1). However, based on the best available data, the focal habitat components of pine/fir forests comprise 31% of the Pahsimeroi watershed. This percentage is a decrease of 22% from historical conditions. The quality of the pine/fir forests has shifted from a mix of seral stages to a young seral-dominated habitat. Late seral stages were preferentially harvested, and once under management, stands are not permitted to reach late stages.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of ponderosa pine habitat. However, ponderosa pine is not a significant vegetative element in the Pahsimeroi watershed. Douglas-fir is the most representative species of xeric, mature forests in the Pahsimeroi watershed. Historically, this habitat was mostly open and park-like, with relatively few undergrowth trees. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that gives the habitat a more closed, multilayered canopy. Fire suppression has led to a buildup of fuels that increases the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover and tends to favor shrub and conifer species. Nearly the entire xeric, mature forest component has been lost or converted to earlier successional stages in the Pahsimeroi watershed.

The mesic, mature forest component of the pine/fir forest habitat was assessed in terms of mixed conifer habitat. This habitat has been most affected by timber harvesting and fire suppression. Timber harvesting has focused on taking large shade-intolerant species in mid- and late seral forests, leaving shade-tolerant species. Fire suppression enforces these logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and are composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently 70% more abundant than it was in the historical condition (IBIS 2003). Late seral forests of shade-intolerant species are now essentially absent. Early seral forest abundance is similar to that found historically, but such forest lacks snags and other legacy features.

Species characteristic of the mesic, immature forest component include grand fir, subalpine fir, Douglas-fir, lodgepole pine, Engelmann spruce, and occasionally ponderosa pine and western larch. These habitats are characterized by either moderately warm or cool moist habitats on northerly exposures. These types typically reflect early successional forest vegetation that originated with fires. Fire suppression has left many single-canopy habitats unburned to develop into more multilayered stands. Without fires and insects, stands become more closed-canopy forest with sparse undergrowth.

Native Grassland—Native grassland habitat currently comprises 16% of the landscape in the Pahsimeroi watershed. This percentage is a decrease of 38% from historical conditions. Most of these reductions are attributable to habitat conversion to dryland or irrigated agriculture. The suppression of natural wildfire, which controlled many types of shrubs, has also contributed to these losses.

Aspen—Aspen habitat is a patchily distributed resource in the Pahsimeroi watershed. Aspen habitat is not a significant component of the landscape in the watershed; it currently comprises less than 1% of that landscape. Aspen habitats have decreased an estimated 96% from historical conditions in the Pahsimeroi watershed.

Western Juniper/Mountain Mahogany—The western juniper/mountain mahogany woodland habitat is an insignificant vegetative element in the Pahsimeroi watershed, amounting to just 5% of the current habitat. The western juniper component of the habitat is at the northern periphery of its range in the Salmon subbasin. However, it continues to expand in range due in large part to an altered fire regime: the longer fire-return intervals give junipers a competitive advantage over the shrub/forb vegetation. According to the best available information, the western juniper component has increased 646% from historical conditions. The mountain mahogany component of the habitat has declined across the Pahsimeroi watershed because of the altered fire regime. Although mountain mahogany is not a significant component of the landscape, the habitat is of critical importance to overwintering wildlife species (Hickman 1975, Dittberner and Olson 1983, Miller and Tausch 2001).

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Pahsimeroi watershed at alpine and subalpine elevations. Whitebark pine habitat comprises less than 1% of the landscape in the Pahsimeroi watershed and, according to the best data available, has declined nearly 100% from historical conditions due to blister rust and an altered fire regime.

2.3.9.3 Lemhi

Aquatic Habitat—Channel alterations and extensive irrigation diversions impact the lower Lemhi drainage. These activities have resulted in steeper gradients, scouring, and redeposition of gravel in the lower river, subsequently raising the riverbed and increasing flood hazards, as well as destroying fish habitat. Only 2 of the 30 tributaries to the Lemhi River are regularly connected to the mainstem. State Highway 28 channelized and realigned 4.1 km (2.5 miles) of the Lemhi River, isolating 3.7 km (2.3 miles) of former channel from the river by the roadbed (Loucks 2000). Floodplain development in the Lemhi River basin is occurring in the 50- and 100-year floodplains, similar to the Upper Salmon River Core Area. The main land uses are agriculture and livestock grazing. A major source of pollution is irrigation water return, which increases sedimentation and water temperatures. Cattle grazing along the mainstem river degrades the riparian vegetation and streambank stability.

Kirtley and Bohannon creeks were dredged in the past to mine gold, and dredge piles remain (Loucks 2000).

Depending on the amount and distribution of snow, dewatering of the lower river can delay anadromous smolt and adult migrations. The large number of irrigation diversions may also be a mortality factor because the diversions delay smolts, affecting migration timing. Except for Big Springs Creek, tributaries of the upper Lemhi River above Hayden Creek are no longer available to anadromous production because of low flows and diversions.

Riparian/Herbaceous Wetlands—The most significant impacts to wetland habitats in the Lemhi watershed result from various forms of development and/or conversion within the floodplain. Over 2,500 points of water diversion have been constructed in the Lemhi watershed for dryland irrigation. The diversions have significant ramifications to hydrologic processes in the watershed. Other forms of development and/or land conversion within the 50- and 100-year floodplains impact wetland habitat quantity and quality. Data limitations prevent us from accurately or precisely quantifying the direct and indirect losses of riparian/herbaceous wetland habitat in the Lemhi watershed.

Shrub-Steppe—Shrub-steppe habitats currently comprise 47% of the landscape in the Lemhi watershed. Based on the best estimates, this percentage is an increase of nearly 50% from historical conditions. Shrub-steppe habitat increases in the Lemhi watershed may largely be attributed to the altered fire regime, which allows the shrub component of grassland habitats to expand at the expense of native grasslands. The quality of remaining shrub-steppe habitat is severely reduced from historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forest—Pine/fir forests are the most encompassing habitats in the Lemhi watershed. Data limitations pertaining to historical acreages of forested habitats prevent the precise quantification of habitat losses (Appendix 2-1). However, based on the best available data, the focal habitat components of pine/fir forests comprise 31% of the Lemhi watershed. This percentage is a decrease of 22% from historical conditions. The quality of the pine/fir forests has shifted from a mix of seral stages to a young seral-dominated habitat. Late seral stages were preferentially harvested and once under management, stands are not permitted to reach late stages. Young seral stages have higher stem density, lower diversity and cover of understory species, and fewer large-diameter snags and downed wood.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of ponderosa pine habitat. However, ponderosa pine is not a significant vegetative element in the Lemhi watershed. Douglas-fir is the most representative species of xeric, mature forests in the Lemhi watershed. Historically, this habitat was mostly open and park-like, with relatively few undergrowth trees. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that gives the habitat a more closed, multilayered canopy. Fire suppression has led to a buildup of fuels that increases the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover and tends to favor shrub and conifer species. Nearly all of the xeric, mature forest component has been lost or converted to earlier successional stages in the Lemhi watershed.

The mesic, mature forest component of the pine/fir forest habitat was assessed in terms of mixed conifer habitat. This habitat has been most affected by timber harvesting and fire suppression. Timber harvesting has focused on taking large shade-intolerant species in mid- and late seral forests, leaving shade-tolerant species. Fire suppression enforces these logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and are composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently 70% more abundant than it was in the historical condition (IBIS 2003). Late seral forests of shade-intolerant species are now essentially absent. Early seral forest abundance is similar to that found historically, but such forest lacks snags and other legacy features.

Species characteristic of the mesic, immature forest component include grand fir, subalpine fir, Douglas-fir, lodgepole pine, Engelmann spruce and occasionally ponderosa pine and western larch. These habitats are characterized by either moderately warm or cool moist habitats on northerly exposures. These types typically reflect early successional forest vegetation that originated with fires. Fire suppression has left many single- canopy habitats unburned to develop into more multilayered stands. Without fires and insects, stands become more closed-canopy forest with sparse undergrowth.

Native Grassland—Native grassland habitat currently comprises 13% of the landscape in the Lemhi watershed. This percentage is a decrease of 91% from historical conditions. The most significant reductions of native grassland habitat in the Salmon subbasin have occurred in the Lemhi watershed. Most of these reductions are attributable to habitat conversion to dryland or irrigated agriculture. The suppression of natural wildfire, which controlled many types of shrubs, has also contributed to these losses.

Aspen—Aspen habitat is a patchily distributed resource in the Lemhi watershed. Aspen habitat is not a significant component of the landscape in the watershed; it currently comprises less than 1% of that landscape. Aspen habitats have decreased an estimated 94% from historical conditions in the Lemhi watershed.

Western Juniper/Mountain Mahogany—The western juniper/mountain mahogany woodland habitat is an insignificant vegetative element in the Lemhi watershed, amounting to just 2% of the current habitat. The western juniper component of the habitat is at the northern periphery of its range in the Salmon subbasin. However, it continues to expand in range due in large part to an altered fire regime: the longer fire-return intervals give junipers a competitive advantage over the shrub/forb vegetation. Although mountain mahogany is not a significant component of the landscape, the habitat is of critical importance to overwintering wildlife species (Hickman 1975, Dittberner and Olson 1983, Miller and Tausch 2001). Mountain mahogany plant communities have declined across the Lemhi watershed due largely to the altered fire regime, which favors conifer encroachment (primarily Douglas-fir) at the expense of mountain mahogany.

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Lemhi watershed at alpine and subalpine elevations. Whitebark pine habitat comprises less than 1% of the landscape in the Lemhi watershed and, according to the best data available, has declined by 100% from historical conditions due to blister rust and an altered fire regime.

2.3.9.4 Middle Fork Salmon

Aquatic Habitat—Recreational use is an extremely important consideration for this drainage. The lower 156 km of the Middle Fork Salmon River is accessible only by air, raft, or trail. Therefore, most of the Middle Fork drainage and aquatic habitat lies in a pristine wilderness state, and habitat quality is good to excellent. Consequently, Loucks (2000) showed that the correlation of salmon and steelhead runs of the East Fork Salmon River (1957–2000) with those of Salmon River Wild Trend Areas was 0.92, indicating that there is little within the East Fork Salmon River watershed that affects run size. However, some notable exceptions exist. Important salmon and steelhead streams (Bear Valley, Marsh, Camas, Big, Monumental, and Loon creeks) lie outside the wilderness area and have been degraded to various degrees by past land use activities such as mining, grazing, logging, and road building. Historical dredge mining had a significant influence on fish habitat in Bear Valley Creek, and this mining area has continued to contribute about 35% of the fine sediment to the creek since active mining ceased (SBNFTG 1998a). Legacy mining effects have also contributed low levels of chemical contamination into upper Marble Creek (Wagoner and Burns 1998).

Also, in the Silver Creek drainage (a tributary to Camas Creek), an earthen dam above Rams Creek is a barrier and isolates fish in upper Silver Creek (USFS 1999d). This isolation reduces habitat available for bull trout in this area and reduces genetic exchange with other local populations in the area.

Riparian/Herbaceous Wetlands—The most quantifiable impacts to wetland habitats in the Middle Fork Salmon watersheds result from various forms of development and/or conversion within the floodplain. Seventy-seven points of water diversion have been constructed in the Middle Fork Salmon watersheds for various purposes. These watersheds are located within protected areas of the Salmon subbasin, so anthropogenic influences are less pronounced. Nevertheless, data limitations prevent us from accurately or precisely quantifying the direct and indirect losses of riparian/herbaceous wetland habitat in the Middle Fork Salmon watersheds.

Shrub-Steppe—Shrub-steppe habitat is not a significant component of the landscape in the Middle Fork Salmon watersheds. Currently, shrub-steppe habitat comprises less than 6 and 7% of the Lower and Upper Middle Fork Salmon watersheds, respectively. Based on the best available data, the shrub-steppe habitat has decreased 7 and 13% from historical conditions in the Lower and Upper Middle Fork Salmon watersheds, respectively. Most shrub-steppe habitat losses in the Middle Salmon watersheds have been attributed to conifer encroachment due to an altered fire regime. The quality of the remaining shrub-steppe habitat is severely degraded from historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forest—Pine/fir forests are the most encompassing habitats in the Middle Fork Salmon watersheds. Data limitations pertaining to historical acreages of forested habitats prevent the precise quantification of habitat losses (Appendix 2-1). In the Middle Fork Salmon watersheds, the focal habitat components of the pine/fir forests comprise 75% of the landscape. This percentage is a decrease of 7 and 14% from historical conditions in the Lower and Upper Middle Fork Salmon watersheds, respectively. The remoteness and protected status of portions of the Middle Fork Salmon watersheds have precluded significant impact from anthropogenic disturbances. For the most part, natural successional processes have continued to function, except with varying levels of grazing intensity and occasional fire-suppression actions.

Native Grassland—Native grassland habitat currently comprises 8% of the landscape in the Middle Fork Salmon watersheds. This percentage is a decrease of 23 and 48% from historical conditions in the Lower and Upper Middle Fork Salmon watersheds, respectively. Most of these reductions are attributable to the suppression of natural wildfire, which controlled many types of shrubs.

Aspen—Aspen habitat is a patchily distributed resource in the Middle Fork

Salmon watersheds. Currently, aspen habitat comprises less than 1% of the landscape. It has been estimated that aspen habitats have increased by 100 and 1142% from historical conditions in the Lower and Upper Middle Fork Salmon watersheds, respectively. These watersheds are protected by wilderness designation, so many of the anthropogenic impacts to aspen habitat are not significant.

Aspen successional processes are generally allowed to proceed unhindered.

Western Juniper/Mountain Mahogany—Western juniper and mountain mahogany are not significant habitat components in the Middle Fork Salmon watersheds. Currently, western juniper/mountain mahogany habitats comprises less than 3 and 2% of the Lower and Upper Middle Fork Salmon watersheds, respectively. Nevertheless, western juniper range expansion has resulted in an increase of 153 and 100% from historical conditions in the Lower and Upper Middle Fork Salmon watershed, respectively.

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Middle Fork Salmon watersheds at alpine and subalpine elevations. Whitebark pine habitat is probably most pristine in the Middle Fork Salmon watersheds. Current estimates indicate that whitebark pine habitat comprises 4 and 5% of the landscape in the Lower and Upper Middle Fork Salmon watersheds, respectively. Whitebark pine habitat has declined an average of 35% from historical conditions in the Middle Fork Salmon watersheds due to blister rust and an altered fire regime.

2.3.9.5 Middle Salmon–Chamberlain

Aquatic Habitat—The Chamberlain Creek drainage is one of the largest between the South Fork and the Middle Fork Salmon rivers. Ball (1985) reported it to be a major steelhead spawning stream in the canyon area, followed by Bargamin, Horse, Crooked, Sabe, and Sheep creeks. The habitat in this drainage has been unchanged since the 1950s and managed as wilderness since the 1930s. The area is free of major diversions, roads, or man-caused pollution.

Both historical and current mining affects water quality in the watershed. Water withdrawals for mining and the related hydroelectric power production still occur in Warren Creek. Active mining exists on private land and lands administered by the Payette National Forest. Legacy effects of mining still exist in Fall Creek from altered stream channel conditions (CBBTTAT 1998b). Numerous historical mines exist in the Crooked Creek drainage. The upper watershed contained the most activity in the past, and most of the private patented mining claims are now recreational property. The area around the town of Dixie was dredge mined, impacting both riparian and aquatic habitats.

Riparian/Herbaceous Wetlands—The most quantifiable impact to wetland habitats in the Middle Salmon–Chamberlain watershed results from various forms of development and/or conversion within the floodplain. Twenty-six points of water diversion have been constructed in the Middle Salmon–Chamberlain watershed for various purposes. This watershed is located within protected areas of the Salmon subbasin, so anthropogenic influences are less pronounced. Nevertheless, data limitations prevent us from accurately or precisely quantifying the direct and indirect losses of riparian/herbaceous wetland habitat in the Middle Salmon–Chamberlain watershed.

Shrub-Steppe—Shrub-steppe habitat is not a significant component of the landscape in the Middle Salmon–Chamberlain watershed. Currently, shrub-steppe habitat comprises 3% of the watershed. Based on the best available data, the shrub-steppe habitats have increased 155% from historical conditions. Shrub-steppe habitat increases in the Middle Salmon–Chamberlain watershed may largely be attributed to the altered fire regime, which allows the shrub component of grassland habitats to expand at the expense of native grasslands. The quality of remaining shrub-steppe habitat is severely reduced from that of historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forest—Pine/fir forests are the most encompassing habitats in the Middle Salmon–Chamberlain watershed. Data limitations pertaining to historical acreages of forested habitats prevent the precise quantification of habitat losses (Appendix 2-1). In the Middle Salmon–Chamberlain watershed, the focal habitat components of the pine/fir forests comprise 80% of the landscape. This percentage is a decrease of 18% from historical conditions. The quality of the pine/fir forests has shifted from a mix of seral stages to a young seral-dominated habitat. Late seral stages were preferentially harvested, and once under management, stands are not permitted to reach late stages. Young seral stages have higher stem density, lower diversity and cover of understory species, and fewer large-diameter snags and downed wood. The remoteness and protected status of portions of the Middle Salmon–Chamberlain watershed have precluded significant impact from anthropogenic disturbances. For the most part, natural successional processes have continued to function, except with varying levels of grazing intensity and occasional fire-suppression actions.

Native Grassland—Native grassland habitat currently comprises 8% of the landscape in the Middle Salmon–Chamberlain watershed. This percentage is an increase of 437% from historical conditions. This increase may be a result of recent fires in forested habitats having restored grassland successional processes to portions of the watershed.

Aspen—Aspen habitat is a patchily distributed resource in the Middle Salmon–Chamberlain watershed. Aspen habitat is not a significant component of the landscape in the watershed; it currently comprises less than 1% of that landscape. Aspen habitats have decreased an estimated 41% from historical conditions in the Middle Salmon–Chamberlain watershed.

Western Juniper/Mountain Mahogany—Western juniper and mountain mahogany are not significant habitat components in the Middle Salmon–Chamberlain watershed, amounting to just over 4% of the current vegetation. Nevertheless, western juniper range expansion has resulted in an increase of 100% in the Middle Salmon–Chamberlain watershed. Mountain mahogany becomes an increasingly important winter range habitat component for numerous wildlife species in the upper reaches of the Salmon subbasin (Hickman 1975, Dittberner and Olson 1983, Miller and Tausch 2001). Mountain mahogany plant communities have declined across the Middle Salmon–Chamberlain watershed due largely to the altered fire regime, which favors conifer encroachment (primarily Douglas-fir) at the expense of mountain mahogany.

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Middle Salmon–Chamberlain watershed at alpine and subalpine elevations. Whitebark pine habitat comprises less than 1% of the landscape in the Middle Salmon–Chamberlain watershed, and, according to the best data available, has declined nearly 27% from historical conditions due to blister rust and an altered fire regime.

2.3.9.6 Middle Salmon–Panther

Aquatic Habitat—Much of the Panther Creek drainage suffers from varying degrees of chemical pollution from mining. About 32 km (20 miles) of mainstem Panther Creek are polluted by toxic heavy metal effluent from the Blackbird Mine. Active mining in the Blackbird area began in the 1890s for cobalt and copper. Mine tailings originally flowed directly into Blackbird Creek. The Blackbird Mine is continuing to release contaminants, including copper, arsenic, cobalt, and iron, into Blackbird, Big Deer, South Fork Big Deer, and Panther creeks (USFWS 2002). This site has recently been designated a superfund site by the Environmental Protection Agency. Bear Track Mine on Napias Creek is an inactive, open-pit gold and silver cyanide heap leach mine. In addition, historical mining operations in Napias Creek have degraded channel conditions (USFWS 1999c).

Riparian/Herbaceous Wetlands—The most significant impacts to wetland habitats in the Middle Salmon–Panther watershed result from various forms of development and/or conversion within the floodplain. Nearly 1,900 points of water diversion have been constructed in the Middle Salmon–Panther watershed for dryland irrigation. The diversions have significant ramifications to hydrologic processes in the watershed. Other forms of development and/or land conversion within the 50- and 100-year floodplains impact wetland habitat quantity and quality. Data limitations prevent us from accurately or precisely quantifying the direct and indirect losses of riparian/herbaceous wetland habitat in the Middle Salmon–Panther watershed.

Shrub-Steppe—Shrub-steppe habitats currently comprise 22% of the landscape in the Middle Salmon–Panther watershed. Based on the best estimates, this percentage is an increase of nearly 46% from historical conditions. Shrub-steppe habitat increases in the Middle Salmon–Panther watershed may largely be attributed to the altered fire regime, which allows the shrub component of grassland habitats to expand at the expense of native grasslands. The quality of remaining shrub-steppe habitat is severely reduced from that of historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forest—Pine/fir forests are the most encompassing habitats in the Middle Salmon–Panther watershed. Data limitations pertaining to historical acreages of forested habitats prevent the precise quantification of habitat losses (Appendix 2-1). The focal habitat components of the pine/fir forests comprise 67% of the landscape in the Middle Salmon–Panther watershed. This percentage is a decrease of 10% from historical conditions. The quality of the pine/fir forests has shifted from a mix of seral stages to a young seral-dominated habitat. Late seral stages were preferentially harvested, and once under management, stands are not permitted to reach late stages.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of ponderosa pine habitat. However, ponderosa pine is not a significant vegetative element in the Middle Salmon–Panther watershed. Douglas-fir is the most representative species of xeric, mature forests in this watershed. Historically, this habitat was mostly open and park-like, with relatively few undergrowth trees. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that gives the habitat a more closed, multilayered canopy. Fire suppression has led to a buildup of fuels that increases the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover and tends to favor shrub and conifer species. Nearly all of the xeric, mature forest component has been lost or converted to earlier successional stages in the Middle Salmon–Panther watershed.

The mesic, mature forest component of the pine/fir forest habitat was assessed in terms of mixed conifer habitat. This habitat has been the most affected by timber harvesting and fire suppression. Timber harvesting has focused on taking large shade-intolerant species in mid- and late seral forests, leaving shade-tolerant species. Fire suppression enforces these logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and are composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently 70% more abundant than it was in the historical condition (IBIS 2003). Late seral forests of shade-intolerant species are now essentially absent. Early seral forest abundance is similar to that found historically, but such forest lacks snags and other legacy features.

Species characteristic of the mesic, immature forest component include grand fir, subalpine fir, Douglas-fir, lodgepole pine, Engelmann spruce, and occasionally ponderosa pine and western larch. These habitats are characterized by either moderately warm or cool moist habitats on northerly exposures. These types typically reflect early successional forest vegetation that originated with fires. Fire suppression has left many single-canopy habitats unburned to develop into more multilayered stands. Without fires and insects, stands become more closed-canopy forest with sparse undergrowth.

Young seral stages have higher stem density, lower diversity and cover of understory species, and fewer large-diameter snags and downed wood.

Native Grassland—Native grassland habitat currently comprises 6% of the landscape in the Middle Salmon–Panther watershed. This percentage is a decrease of 76% from historical conditions. Most of these reductions are attributable to habitat conversion to dryland or irrigated agriculture. The suppression of natural wildfire, which controlled many types of shrubs, has also contributed to these losses.

Aspen—Aspen habitat is a patchily distributed resource in the Middle Salmon–Panther watershed. Aspen habitat is not a significant component of the landscape in the watershed; it currently comprises less than 1% of that landscape. Aspen habitats have decreased an estimated 76% from historical conditions in the Middle Salmon–Panther watershed.

Western Juniper/Mountain Mahogany—The western juniper/mountain mahogany woodland habitat is an insignificant vegetative element in the Middle Salmon–Panther watershed, amounting to just 2% of the current habitat. The western juniper component of the habitat is at the northern periphery of its range in the Salmon subbasin. However, it continues to expand in range due in large part to an altered fire regime: the longer fire-return intervals give conifers a competitive advantage over the shrub/forb vegetation. According to the best available information, the western juniper component has increased 66% from historic conditions. The mountain mahogany component of the habitat has declined across the Middle Salmon–Panther watershed because of the altered fire regime. Although mountain mahogany is not a significant component of the landscape, the habitat is of critical importance to overwintering wildlife species (Hickman 1975, Dittberner and Olson 1983, Miller and Tausch 2001).

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Middle Salmon–Panther watershed at alpine and subalpine elevations. Whitebark pine habitat comprises less than 1% of the landscape in the Middle Salmon–Panther watershed and, according to the best data available, has declined nearly 42% from historical conditions due to blister rust and an altered fire regime.

2.3.9.7 South Fork Salmon

Aquatic Habitat—Extremely unstable soils, steep topography, and climatic stresses give rise to significant base surface erosion, slumping, and debris avalanche hazards in the South Fork Salmon watershed (Megahan 1975, Jensen *et al*. 1997). Logging and road construction have increased stream sedimentation. In the mid-1960s, high precipitation events resulted in massive silt loads in the South Fork Salmon River. The U.S. Forest Service suspended logging for a period and initiated a rehabilitation program, closing roads and revegetating hillsides. Large quantities of sediment still occur in 50% of the drainage. Impacts from mining are largely localized in the East Fork South Fork Salmon River and its headwater tributaries (Thurow 1987). Manmade barriers for fish passage are found in Goat, Tailholt, and Reegan creeks (SBNFTG 1998b). Artificial waterfalls exist above Glory Hole at Stibnite Mine and the outlet of Warm Lake.

The Cinnabar Mine, an old remote, abandoned mercury mine on Cinnabar Creek, a tributary to Sugar Creek, continues to degrade water quality. Heavy metals continue to leach from mine sites into the East Fork South Fork Salmon River and into groundwater (USFWS 1998, SBNFTG 1998b). Stibnite Mine, an open-pit mine in the Meadow Creek drainage that uses cyanide leach pads, has been proposed by the State of Idaho as a superfund site (September 13, 2001, 66 FR 47612). From 1978 to 1996, arsenic and antimony concentrations exceeded acute state water quality criteria in the upper East Fork South Fork Salmon River.

Riparian/Herbaceous Wetlands—The most quantifiable impacts to wetland habitats in the South Fork Salmon watershed result from various forms of development and/or conversion within the floodplain. Eighty-eight points of water diversion have been constructed in the South Fork Salmon watershed for various purposes. The downstream reaches of the watershed are outside the protected areas of the Salmon subbasin, so dryland irrigation becomes the principal purpose of the diversions. The upstream reaches are located within protected areas, so anthropogenic influences are less pronounced. Nevertheless, data limitations prevent us from accurately or precisely quantifying the direct and indirect losses of riparian/herbaceous wetland habitat in the South Fork Salmon watershed.

Shrub-Steppe—Shrub-steppe habitat is not a significant component of the landscape in the South Fork Salmon watershed. Currently, shrub-steppe habitat comprises 2% of the watershed. Based on the best available data, the shrub-steppe habitats have increased 668% from historical conditions. Shrub-steppe habitat increases in the South Fork Salmon watershed may largely be attributed to the altered fire regime, which allows the shrub component of grassland habitats to expand at the expense of native grasslands. However, the quality of remaining shrub-steppe habitat is severely reduced from that of historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forest—Pine/fir forests are the most encompassing habitats in the South Fork Salmon watershed. Data limitations pertaining to historical acreages of forested habitats prevent the precise quantification of habitat losses (Appendix 2-1). In the South Fork Salmon watershed, the focal habitat components of the pine/fir forests comprise 79% of the landscape. This percentage is a decrease of 19% from historical conditions. The quality of the pine/fir forests has shifted from a mix of seral stages to a young seral-dominated habitat. Late seral stages were preferentially harvested, and once under management, stands are not permitted to reach late stages.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of ponderosa pine habitat. However, ponderosa pine is not a significant vegetative element in the South Fork Salmon watershed. Douglas-fir is the most representative species of xeric, mature forests in the South Fork Salmon watershed. Historically, this habitat was mostly open and park-like, with relatively few undergrowth trees. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that gives the habitat a more closed, multilayered canopy. Fire suppression has led to a buildup of fuels that increases the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover and tends to favor shrub and conifer species. Nearly the entire xeric, mature forest component has been lost or converted to earlier successional stages in the South Fork Salmon watershed.

The mesic, mature forest component of the pine/fir forest habitat was assessed in terms of mixed conifer habitat. This habitat has been most affected by timber harvesting and fire suppression. Timber harvesting has focused on taking large shade-intolerant species in mid- and late seral forests, leaving shade-tolerant species. Fire suppression enforces these logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and are composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently 70% more abundant than it was in the historical condition (IBIS 2003). Late seral forests of shade-intolerant species are now essentially absent. Early seral forest abundance is similar to that found historically, but such forest lacks snags and other legacy features.

Species characteristic of the mesic, immature forest component include grand fir, subalpine fir, Douglas-fir, lodgepole pine, Engelmann spruce, and occasionally ponderosa pine and western larch. These habitats are characterized by either moderately warm or cool moist habitats on northerly exposures. These types typically reflect early successional forest vegetation that originated with fires. Fire suppression has left many single-canopy habitats unburned to develop into more multilayered stands. Without fires and insects, stands become more closed-canopy forest with sparse undergrowth.

Native Grassland—Native grassland habitat currently comprises 14% of the landscape in the South Fork Salmon watershed. This percentage is an increase of 310% from historical conditions. This increase may be a result of recent catastrophic fires in forested habitats opening up the forest canopy and allowing grassland types to pioneer.

Aspen—Aspen habitat is a patchily distributed resource in the South Fork Salmon watershed. Currently, aspen habitat comprises less than 1% of the landscape. It has been estimated that aspen habitats have increased by 19% from historical conditions in the South Fork Salmon watershed. This watershed is protected by wilderness designation, so many of the anthropogenic impacts to aspen habitat are not significant. Aspen successional processes are generally allowed to proceed unhindered.

Western Juniper/Mountain Mahogany—The western juniper/mountain mahogany woodland habitat is an insignificant vegetative element in the South Fork Salmon watershed, amounting to just 2% of the current habitat. The western juniper component of the habitat is at the northern periphery of its range in the Salmon subbasin. However, it continues to expand in range due in large part to an altered fire regime: the longer fire-return intervals give junipers a competitive advantage over the shrub/forb vegetation. According to the best available information, the western juniper component has increased 100% from historical conditions. The mountain mahogany component is not a significant vegetative element in the South Fork Salmon watershed.

Whitebark Pine—Whitebark pine habitats are broadly distributed across the South Fork Salmon watershed at alpine and subalpine elevations. Whitebark pine habitat comprises 1% of the landscape in the South Fork Salmon watershed. The condition of the habitat in this watershed appears to be good to excellent. According to the best data available, whitebark pine habitat has declined only 3% from historical conditions due to blister rust and an altered fire regime.

2.3.9.8 Lower Salmon

Aquatic Habitat—Deep pools and rocky rapids characterize the lower mainstem Salmon River. Tributary drainages are mostly high-gradient streams in deep canyons having very unstable soils. Increased sedimentation and stream channelization have occurred in areas where logging and road building were conducted on unstable lands. Many of the large tributaries to the lower Salmon River have been altered by riparian degradation due to grazing, road construction, and development. A culvert in East Fork John Day Creek at RK 3.9 (RM 2.4) is restricting fish passage in the drainage (BLM 2000). The legacy of past mining activity has been significant near Florence in the upper Slate Creek drainage and areas along the Salmon River (CBBTTAT 1998b).

Riparian/Herbaceous Wetlands—The most significant impacts to wetland habitats in the Lower Salmon watershed result from various forms of development and/or conversion within the floodplain. Over 270 points of water diversion have been constructed in the Lower Salmon watershed for dryland irrigation. The diversions have significant ramifications to hydrologic processes in the watershed. Other forms of development and/or land conversion within the 50- and 100-year floodplains impact wetland habitat quantity and quality. Data limitations prevent us from accurately or precisely quantifying the direct and indirect losses of riparian/herbaceous wetland habitat in the Lower Salmon watershed. Riparian habitat degradation due to grazing, road construction, and development are a significant issue in many of the larger tributaries of the Lower Salmon watershed.

Shrub-Steppe—Shrub-steppe habitat is not a significant component of the landscape in the Lower Salmon watershed. Currently, shrub-steppe habitat comprises less than 1% of the watershed. Based on the best available data, shrub-steppe habitats have decreased 72% from historical conditions. Most shrub-steppe habitat losses in the Lower Salmon watershed have been attributed to conversion to dryland or irrigated agriculture. The quality of the remaining shrub-steppe habitat is severely degraded from historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forest—Pine/fir forests are the most encompassing habitats in the Lower Salmon watershed. Data limitations pertaining to historical acreages of forested habitats prevent the precise quantification of habitat losses (Appendix 2-1). In the Lower Salmon watershed, the focal habitat components of the pine/fir forests comprise 59% of the landscape. This percentage is a decrease of 14% from historical conditions. The quality of the pine/fir forests has shifted from a mix of seral stages to a young seral-dominated habitat.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of ponderosa pine habitat. Ponderosa pine is a significant vegetative element of the Lower Salmon watershed. Historically, the mature/climax ponderosa pine was the predominant landscape feature. Timber harvest activities in the watershed during the last century selectively harvested the mature stands, while other factors limit reestablishment of normal forest successional processes in the Lower Salmon watershed.

The mesic, mature forest component of the pine/fir forest habitat was assessed in terms of montane mixed conifer habitat. This habitat is characterized by either moderately cool and xeric grand fir or moderately warm and moist grand fir habitats. This habitat has been most affected by timber harvest and fire suppression. Timber harvesting has focused on taking large shade-intolerant species in mid- and late seral forests, leaving shade-tolerant species. Fire suppression enforces these logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and are composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently 70% more abundant than it was in the historical condition. Late seral forests of shade-intolerant species are now essentially absent. Early seral forest abundance is similar to that found historically, but such forest lacks snags and other legacy features.

The mesic, immature forest component was assessed in terms of lodgepole pine habitat. Lodgepole pine is a species characteristic of early seral successional forest structure. Much of this pine/fir forest component is decadent and highly susceptible to insect infestation and/or catastrophic fire due to high fuel loads.

Native Grassland—Native grassland habitats in the lower portions of the Salmon subbasin are associated with the steep gradient canyon lands typical of Salmon River Canyon. Native grassland habitat currently comprises 31% of the landscape in the Lower Salmon watershed. This percentage is a decrease of 79% from historical conditions. Most of these reductions are attributable to habitat conversion to dryland or irrigated agriculture. The suppression of natural wildfire, which controlled many types of shrubs, has also contributed to these losses.

Aspen—Aspen habitat is a patchily distributed resource in the Lower Salmon watershed. Aspen habitat is not a significant component of the landscape in the watershed; it currently comprises less than 1% of that landscape. Aspen habitats have decreased an estimated 32% from historical conditions in the Lower Salmon watershed.

Western Juniper/Mountain Mahogany—The western juniper/mountain mahogany woodland habitat is a small vegetative element in the lower portion of the Lower Salmon watershed, amounting to 6% of the current habitat in the watershed. This habitat in the Lower Salmon watershed is almost entirely composed of western juniper. Mountain mahogany is not found in the lower portion of the Salmon subbasin. According to the best available data, western juniper has increased 100% from historical conditions in the Lower Salmon watershed. The western juniper component of the habitat continues to expand in range due in large part to an altered fire regime: the longer fire-return intervals give junipers a competitive advantage over the shrub/forb/native grassland vegetation.

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Lower Salmon watershed at alpine and subalpine elevations. Whitebark pine habitat comprises less than 1% of the landscape in the Lower Salmon watershed and, according to the best data available, has declined by 100% from historical conditions due to blister rust and an altered fire regime.

2.3.9.9 Little Salmon

Aquatic Habitat—The Little Salmon River has been heavily influenced by the presence of the State Highway 95 that runs along the lower 55 km of the river. The headwaters of the Little Salmon River are currently blocked to anadromous fish due to a series of rock falls. The river above the falls has degraded riparian areas and been impacted by irrigation withdrawals. Rapid River, the largest tributary of the little Salmon River, is protected by its designation within the Wild and Scenic Rivers System. Most of the Rapid River drainage is in relatively pristine condition. A small, low-gradient tributary, Bullhorn Creek, has no fish passage because of improper culvert installation. Highway 95 fill altered accessibility for bull trout into Fiddle Creek (USFWS 2002).

Riparian/Herbaceous Wetlands—Riparian wetlands on the Little Salmon River above the rock falls are degraded and impacted by irrigation withdrawals. The most significant impacts to wetland habitats in the Little Salmon watershed result from various forms of development and/or conversion within the floodplain. Over 1,200 points of water diversion have been constructed in the Little Salmon watershed for dryland irrigation. The diversions have significant ramifications to hydrologic processes in the watershed. Other forms of development and/or land conversion within the 50- and 100-year floodplains impact wetland habitat quantity and quality. Data limitations prevent us from accurately or precisely quantifying the direct and indirect losses of riparian/herbaceous wetland habitat in the Little Salmon watershed.

Shrub-Steppe—Shrub-steppe habitat is not a significant component of the landscape in the Little Salmon watershed. Currently, shrub-steppe habitat comprises approximately only 3% of the watershed. Based on the best available data, shrub-steppe habitats have decreased 74% from historical conditions. Most shrub-steppe habitat losses in the Little Salmon watershed have been attributed to conversion to dryland or irrigated agriculture. The quality of the remaining shrub-steppe habitat is severely degraded from that of historical conditions (Dobler *et al*. 1996, West 1999).

Pine/Fir Forest—Pine/fir forests are the most encompassing habitats in the Little Salmon watershed. Data limitations pertaining to historical acreages of forested habitats prevent the precise quantification of habitat losses (Appendix 2-1). In the Little Salmon watershed, the focal habitat components of the pine/fir forests comprise 75% of the landscape. This percentage is a decrease of 20% from historical conditions. The quality of the pine/fir forests has shifted from a mix of seral stages to a young seral-dominated habitat. Late seral stages were preferentially harvested, and once under management, stands are not permitted to reach late stages.

The xeric, mature forest component of the pine/fir forest habitat was assessed in terms of ponderosa pine habitat. Ponderosa pine is a significant vegetative element of the Little Salmon watershed. Historically, this habitat was mostly open and park-like, with relatively few undergrowth trees, and was the predominant landscape feature. Timber harvest activities in the watershed during the last century selectively harvested the mature stands, while other factors limit reestablishment of normal forest successional processes. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that gives the habitat a more closed, multilayered canopy. Fire suppression has led to a buildup of fuels that increases the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover and tends to favor shrub and conifer species.

The mesic, mature forest component of the pine/fir forest habitat was assessed in terms of Interior mixed conifer habitat. This habitat has been most affected by timber harvesting and fire suppression. Timber harvesting has focused on taking large shade-intolerant species in mid- and late seral forests, leaving shade-tolerant species. Fire suppression enforces these logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and are composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently 70% more abundant than it was in the historical condition (IBIS 2003). Late seral forests of shade-intolerant species are now essentially absent. Early seral forest abundance is similar to that found historically, but such forest lacks snags and other legacy features. In the Little Salmon watershed, the mesic, mature forest component has also been nearly lost due to timber harvest and fire regime alteration.

The mesic, immature forest component was assessed in terms of lodgepole pine habitat. This habitat typically reflects early successional forest vegetation that originated with fires. Most lodgepole pine forests are early to mid-seral stages initiated by fire. Fire suppression has left many single-canopy lodgepole pine habitats unburned to develop into more multilayered stands. Without fires and insects, stands become more closed-canopy forest with sparse undergrowth. Because lodgepole pine cannot reproduce under its own canopy, old, unburned stands are replaced by shade-tolerant conifers. Currently, much of this pine/fir forest component is decadent and highly susceptible to insect infestation and/or catastrophic fire due to high fuel loads.

Native Grassland—Native grassland habitat currently comprises 16% of the landscape in the Little Salmon watershed. This percentage is a decrease of 9% from historical conditions. Most of these reductions are attributable to habitat conversion to dryland or irrigated agriculture. The suppression of natural wildfire, which controlled many types of shrubs, has also contributed to these losses.

Aspen—Aspen habitat is a patchily distributed resource in the Little Salmon watershed. Aspen habitat is not a significant component of the landscape in the watershed; it currently comprises less than 1% of that landscape. Aspen habitats have decreased an estimated 99% from historical conditions in the Little Salmon watershed.

Western Juniper/Mountain Mahogany—The western juniper/mountain mahogany woodland habitat is a very small vegetative element in the Little Salmon watershed, amounting to just 3% of the current habitat in the watershed. Western juniper plant communities are the component of this habitat found in the Little Salmon watershed. Western juniper is at the northern periphery of its range in the Salmon subbasin. However, it continues to expand in range due in large part to an altered fire regime: the longer fire-return intervals give junipers a competitive advantage over the shrub/forb/native grassland vegetation. According to the best available data, western juniper has increased 100% from historical conditions in the Little Salmon watershed.

Whitebark Pine—Whitebark pine habitats are broadly distributed across the Little Salmon watershed at alpine and subalpine elevations. Whitebark pine habitat comprises less than 1% of the landscape in the Little Salmon watershed and, according to the best data available, has declined by 98% from historical conditions due to blister rust and an altered fire regime.

3 Biological Resources Limiting Factors

Abundance, productivity, and diversity of organisms are integrally linked to the characteristics of their ecosystem and we assume that a naturally functioning ecosystem provides the basis for sustainable populations of the organisms that are native to that system. Ecosystems, their habitats, and fish and wildlife populations are expected to fluctuate; and while more dynamic than stable, these variations demonstrate and rely on the resilience of ecosystems and their components. This resilience is generally greater in systems retaining all or the majority of their components.

Human activities may affect ecosystems in ways similar to natural occurrences, but human impacts tend to be chronic, directional and long-term rather than episodic. Therefore, human effects on ecosystem function tend to alter the system beyond the range of natural variation that native organisms are adapted to, resulting in decreased habitat quality or quantity for native species.

The Interior Columbia Basin Ecosystem Management Project (ICBEMP) assessment concluded that development of the Interior Columbia Basin over the last 150 years has greatly altered ecological processes to the detriment of many native species of fish and wildlife (ICBEMP 1997). Information collected for the ICBEMP assessment was considered in the preparation of the terrestrial portion of this assessment. The ICBEMP data presented here were intended for use at the broad-scale, generally at the watershed level (Appendix 2-1). Land- and water-use practices contributing to these changes included unrestricted or little-restricted livestock grazing, road construction, timber harvest and fire management, certain intensive agricultural practices, placer and dredge mining, dam construction, and stream channelization. The ICBEMP assessment also concluded that these anthropogenic disturbances cause risks to ecological integrity by reducing biodiversity and threatening riparian-associated species across broad geographic areas.

We suggest that reduction of habitat quality, quantity and habitat fragmentation are the primary limiting factors impacting focal fish and wildlife species in the Salmon subbasin (Figure 3-1). We discuss watershed specific impacts to aquatic habitats in Section 3.1 in terms of the degree an altered ecosystem component impacts the habitat quality or quantity of focal fish species in the Salmon subbasin based on information and professional judgement. Watershed scale impacts to terrestrial focal habitats and species are presented in terms of how quality or quantity of a habitat is limited by identified causes.

Appendix 3-1 provides background and more specific information on the major causes of limiting factors affecting focal fish and wildlife populations and habitats in the Salmon subbasin.

Figure 3-1. Expression of limiting factors and their causes for each focal habitat type in the Salmon subbasin, Idaho. This table is representative rather than comprehensive. The classification of exogenous material in this assessment generally refers to nonnatural physical barriers to migration or sediment, chemical impacts, and introduction of nonnative plants or animals (aquatic habitat information modified from Gregory and Bisson [1997]).

Focal Habitat	Limiting Factor	Cause of Limiting Factor	Expression of Limiting Factor
Aquatic			
	Habitat quality		
		Alteration of channel structure	
			Loss of floodplain access alters hydrology by preventing energy dissipation of high flows, reduces organic matter input from riparian interaction Change in pool to riffle ratio reduces rearing/overwinter habitat Loss or reduction in large woody debris reduces cover for fish, alters sediment storage and pool formation, reduces production of macroinvertebrates, changes salmon carcass transport rates Changed substrate reduces salmonid egg survival and loss of interstitial space for rearing, reduces macroinvertebrate production Changes in interaction with groundwater/hyporheic zone reduces nutrient exchange, reduces potential for recolonizing disturbed substrates
		Alteration of hydrology	
			Changes timing of discharge-related lifecycle, changes food availability, alters sediment and organic matter transport, may reduce biodiversity, leads to juvenile crowding, reduces primary/secondary productivity, increases predation, changes sediment transport by reducing stream power, may result in stranding, increases water temperature
		Increased sedimentation	
			Reduces salmonid egg survival, affects macroinvertebrate production, reduces rearing area, reduces pool volumes
		Change in water temperature	
			Alters migration patterns, changes emergence timing, may result in behavioral avoidance, increases susceptibility to disease/parasites, changes mortality in macroinvertebrate community
		Altered riparian areas	

Focal Habitat	Limiting Factor	Cause of Limiting Factor	Expression of Limiting Factor
			Reduce cover, reduce large woody debris recruitment thereby changing channel structure, reduce production of macroinvertebrates, reduce access to terrestrial invertebrates for food, reduce growth, decrease shading increases water temperature (see ecosystem effects to Riparian/Herbaceous Wetlands below)
		Exogenous materials	
			Chemical pollution reduces invertebrate production, possible mortality of fish Exotics increase competition, displacement, introgression of population, predation, disease risk, altered nutrient cycles
Aquatic			
	Habitat quantity		
		Exogenous materials	
			Barriers reduce access to suitable habitat either completely or seasonally, affect behavior by preventing migration and colonization, lead to loss of thermal refuge, results in population fragmentation for resident fish species Chemical pollution makes habitat uninhabitable
Riparian/herbaceous wetlands			
	Habitat quality		
		Altered fire regime	
			Reduces food, cover, shading, and sediment filtering
		Grazing/browsing	
			Changes soil condition, results in introduction of nonnative vegetation and loss of native vegetation, reduces species diversity and vegetative density, increases water temperature, results in excessive sedimentation due to bank and upland instability, results in high coliform bacterium counts, alters channels, reduces water table, alters aquatic nutrient cycling
		Altered hydrology	
			Increases water temperature, degrades water quality, alters sediment movement, blocks material and organisms, increases stream bank erosion, reduces habitat complexity, results in stream channelization, results in wetland drainage or filling, leads to inundation, reduces amount of mature riparian vegetation, reduces number of beaver, increases overland flow, reduces filtration capability, increases effects due to pollution
		Timber harvest	

Focal Habitat	Limiting Factor	Cause of Limiting Factor	Expression of Limiting Factor
			Results in bed scour and stream bank erosion; alters sediment movement and aggregation; destabilizes stream banks; reduces instream woody debris; alters snow depth and timing and rate of runoff; leads to wetter soils resulting in later summer runoff; accelerated runoff on roads, trails, and landings; degrades water quality
		Land use/ conversion/development	Seasonal recreation and tourism increases disturbance from road and trail networks
		Exotic invasive species	Reduces biodiversity and foragability, while physically fragmenting habitats.
Riparian/herbaceous wetlands	Habitat quantity	Altered hydrology	Reduces amount of habitat due to channel alteration and lowered water table
		Land use/ conversion/development	Results in conversion of habitat to agriculture or “urban”
Riparian/herbaceous wetlands	Fragmentation/ connectivity	Altered hydrology	Reduces amount of habitat due to channel alteration and lowered water table
		Land use/ conversion/development	Results in loss of linkage and corridor habitats, increases patch and edge habitats, creates linear barriers related to road/trail development
Shrub-steppe	Habitat quality	Altered fire regime	Results in vegetative uniformity and loss of perennial herbaceous understory, increases susceptibility to noxious weed spread, leads to unmanageable fuel loading, results in conversion to annual grassland habitat
		Grazing/browsing	

Focal Habitat	Limiting Factor	Cause of Limiting Factor	Expression of Limiting Factor
			Alters vegetative community, ecosystem structure and function, and species composition; leads to trampling of vegetation and soil; alters fire regime; decreases soil organic matter aggregates, decreases infiltration capacity; increases overland flow; results in localized habitat fragmentation due to “trailing”
		Altered hydrology	Decreases infiltration capacity, increases overland flow, increases potential for nonpoint source pollution
		Land use/ conversion/development	Results in habitat fragmentation from conversion and road networks, increases disturbance from road and trail networks
		Exotic invasive species	Displace native species, alter predator/prey relationships, decrease ecosystem resiliency, reduce biodiversity, reduce soil productivity, reduce aesthetic quality, reduce forage
Shrub-steppe	Habitat quantity	Altered fire regime	Results in habitat loss due to stand-converting fire
		Land use/ conversion/development	Results in conversion of habitat to dryland or irrigated agriculture or to development, leads to exclusion due to increased human/wildlife conflict at the wildland interface
Shrub-steppe	Fragmentation/ connectivity	Altered fire regime	Fragments habitat due to stand-converting fire
		Land use/ conversion/development	Results in loss of linkage and corridor habitats, increases patch and edge habitats, creates linear barriers related to road/trail development
Pine/fir forest	Habitat quality	Altered fire regime	

Focal Habitat	Limiting Factor	Cause of Limiting Factor	Expression of Limiting Factor
			Reduces landscape complexity and habitat diversity, alters nutrient flow and other ecosystem processes, alters successional stages and associated plants and animals, elevates insect and disease risk
		Grazing/browsing	
			Alters fire regime and forest structure, reduces herbaceous understory, alters understory cover and composition, results in introduction of noxious weeds, reduces plant litter, alters nutrient cycling, compacts soils, reduces infiltration, increases soil erosion, results in dietary conflicts between wildlife and domestic ungulates
		Timber harvest	
			Reduces productivity, results in loss of nutrients, compacts soil, increases soil erosion, disrupts microorganism processes, results in fragmentation
		Land use/ conversion/development	
			Increases disturbance from road and trail networks
		Exotic invasive	
			Outcompete native plants species, reduce native plant and animal biodiversity, decrease forage production, increase soil erosion, increase sedimentation
Pine/fir forest			
	Habitat quantity		
		Timber harvest	
			Results in loss of habitat such as old growth, alters habitat structural components due to harvest regimes
Pine/fir forest			
	Fragmentation/ connectivity		
		Altered fire regime	
			Fragments habitat due to stand-altering fire
		Land use/ conversion/development	
			Results in loss of linkage and corridor habitats, increases patch and edge habitats, creates linear barriers related to road/trail development
Native grasslands			
	Habitat quality		
		Altered fire regime	

Focal Habitat	Limiting Factor	Cause of Limiting Factor	Expression of Limiting Factor
			Results in shrub/conifer encroachment, alters nutrient cycling, leads to vegetative uniformity, increases susceptibility to noxious weed invasion, results in conversion to annual grassland habitat
		Grazing/browsing	Alters vegetative community, ecosystem structure and function, and species composition; leads to trampling of vegetation and soil; alters fire regime; decreases soil organic matter aggregates, decreases infiltration capacity; increases overland flow; results in localized habitat fragmentation due to "trailing"
		Timber harvest	Results in localized erosion, soil compaction, and fragmentation; leads to introduction of noxious weeds
		Land use/ conversion/development	Results in habitat fragmentation from conversion and road networks
		Exotic invasive species	Displace native species, alter predator/prey relationships, decrease ecosystem resiliency, reduce biodiversity, reduce soil productivity, reduce aesthetic quality, reduce forage
Native grasslands	Habitat quantity	Altered fire regime	Results in habitat losses due to conversion to shrub/conifer types
		Land use/ conversion/development	Results in conversion of habitat to dryland or irrigated agriculture or to development, leads to loss due to road/trail development and disturbance
Native grasslands	Fragmentation/ connectivity	Land use/ conversion/development	Results in loss of linkage and corridor habitats, increases patch and edge habitats, creates linear barriers related to road/trail development
Aspen	Habitat quality		

Focal Habitat	Limiting Factor	Cause of Limiting Factor	Expression of Limiting Factor
		Altered fire regime	
			Reduces post-fire regeneration, reduces fine fuels to carry fire, results in conifer encroachment/change in successional processes
		Grazing/browsing	
			Reduces aspen habitat due to excessive grazing of regenerative stands
		Altered hydrology	
			Results in localized habitat degradation due to water table reduction
		Timber harvest	
			Reduces size and structure of stands
Aspen			
	Habitat quantity		
		Altered fire regime	
			Reduces aspen habitat due to successional processes
		Grazing/browsing	
			Reduces aspen habitat due to excessive grazing of regenerative stands
		Altered hydrology	
			Reduce aspen habitat due to dysfunctional hydrology
Juniper/mountain mahogany			
	Habitat quality		
		Altered fire regime	
			Results in conifer encroachment/change in successional processes, leads to landscape dominated by overly mature, decadent stands and high fuel loading resulting in "hot" fires with slow regenerative ability
		Grazing/browsing	
			Results in high palatability and nutrition resulting in overbrowsing, increases water runoff and erosion, reduces regeneration
		Exotic invasive species	
			Displace native species, decrease ecosystem resiliency, reduce biodiversity, reduce soil productivity, reduce forage

Focal Habitat	Limiting Factor	Cause of Limiting Factor	Expression of Limiting Factor
Juniper/mountain mahogany			
	Habitat quantity		
		Altered fire regime	
			Results in habitat losses due to conifer encroachment
		Grazing/browsing	
			Inhibits regeneration
Whitebark pine			
	Habitat quality		
		Altered fire regime	
			Results in interspecific site competition/successional processes; leads to landscape dominated by overly mature, decadent stands
		Exotic invasive species	
			Results in direct mortality due to blister rust
Whitebark pine			
	Habitat quantity		
		Altered fire regime	
			Reduces habitat due to lack of regeneration
		Exotic invasive species	
			Results in landscape habitat losses due to blister rust

3.1 Limiting Factors by Watershed

Unlike other subbasins in the Columbia River basin, the Salmon subbasin has large areas where the composition, structure, and function of the aquatic, wetland and riparian ecosystems have been relatively undisturbed by anthropogenic effects.

Aquatic habitats are created and maintained by natural processes within the watersheds that surround them: watershed size, vegetation, slope, geology, and climate combine to form the aquatic habitat (Doppelt *et al*. 1993). In addition to reflecting the nature of their watersheds, flowing waters shape the watersheds over time by cutting channels, terracing floodplains, depositing sediment, and transporting materials from highlands to lowlands (Stanford 1996). Ward (1989) further describes the nature of stream networks, indicating that any point along a stream has four dimensions (longitudinal, lateral, vertical, and temporal) that combine to form that particular location. The longitudinal dimension is related to the location of the point in the profile of the stream (from headwaters to mouth). The lateral dimension encompasses the transition of the stream into the terrestrial environment. The movement of water as subsurface or interstitial flow within the river and its floodplain is the vertical link, and the naturally associated changes in the system over time of all the above components is the temporal dimension.

The distribution and abundance of aquatic animals and invertebrates are determined by their distinct preferences and tolerances for specific habitat conditions. As discussed above, the conditions of a stream at any point along the stream are determined by the conditions upstream of that point; therefore, the distribution and abundance of aquatic species must be examined in the context of the stream and associated watershed.

The functional components of aquatic ecosystems are made up of several ecosystem “features” that are interrelated and interdependent. These features can generally be classified into the following categories: channel structure, hydrology, sediment, and water quality. In addition to the natural variation present in the processes that form ecosystems, human actions have altered the ecosystem components. The degree of alteration can range from minor to severe, with varying lengths of effects.

Difficulties encountered in the analysis of the limiting factors for each habitat by watershed are due, in part, to either information gaps, differences in information-collection methods, and/or interpretation or to data limitations (Appendix 2-1). Therefore, this assessment relies on expert opinion as much as information based on data when assessing terrestrial limiting factors.

Table 3-1. Rankings of the impacts of limiting factor causes for terrestrial resources in each watershed in the Salmon subbasin (rankings by the technical team: 0 = none to insignificant, 1 = low, 2 = moderate, and 3 = high).

Watershed[a]	Altered Fire Regime	Grazing/ Browsing	Altered Hydrologic Regime	Timber Harvest	Land-Use Conversion	Invasive/ Exotics
UPS	3	3	3	2	3	2
PAH	3	3	3	1	3	2
LEM	3	3	3	2[b]	3	3
MFL	2	1	1	0	0	2
MFU	2	1	1	0	0	1
MSC	2	1	1	0	0	2
MSP	3	3	3	2	3	3
SFS	3	2	1	1[b]	0	2
LOS	3	3	2	2	1	3
LSA	3	3	3	2	2	2

[a] See Table 1-1 for watershed acronyms
[b] Historically, timber harvest was high in this watershed.

This section attempts, as specifically as possible, to identify ecosystem features that have been altered and are believed to keep fish and wildlife populations in the basin from reaching their full potential (Table 3-1). We based our evaluations on a variety of sources, including the literature, direct observation, local knowledge, and professional judgment.

Altered ecosystem components were ranked from 1 (least influence on ecosystem or populations) to 3 (greatest influence on ecosystem or population). Highlighting only one altered component of an ecosystem feature does not imply that all other components of that feature are functioning. It is more likely that the higher the ranking of one component, the more likely that multiple components of the ecosystem are not functioning. The information should be viewed as a prioritization of the issues in the areas that need to be addressed and presented by watershed and subdivided by drainage or tributary, where necessary.

Although a more detailed discussion of limiting factors by watershed follows, several limiting factors are common to all anadromous fish species in the Salmon subbasin. These include the effects of low population size, presence of nonnative smallmouth bass in the main Salmon River and reductions in marine derived nitrogen back to spawning areas from severe declines in numbers of returning adults.

Out-of-basin effects impact the distribution and abundance of salmon and steelhead in the basin and dictate the ability of these populations to recover and persist into the future. In some cases the low size of these populations may be a limiting factor in their ability to recover. Small populations are at higher risk to be negatively impacted by extrinsic factors such as variation in environmental conditions and natural catastrophes. Small populations are also more impacted by intrinsic factors like demographic and genetic stochasticity. Demographic stochasticity refers to random variation in population parameters such as sex ratios, age structure, or birth and death rates. As population size decreases, variation in all of these parameters increases.

Genetic stochasticity refers to changes in the genetic composition of a population due to genetic drift (random loss of alleles due to sampling of a finite population size), and inbreeding (mating between related individuals). Theoretically, as a population decreases in size, inbreeding and genetic drift increase, resulting in the loss of genetic variation and subsequently a reduction in individual fitness and population adaptability. This in turn, decreases reproduction and increases mortality resulting in a further decrease in the size of the population, increasing its likelihood of extinction. This interacting positive feedback loop (resulting in a particularly negative outcome) is described in the conservation literature as 'an extinction vortex' (Lacy and Lindenmayer 1995, Gilpin and Soulé 1986).

3.1.1 Upper Salmon

Twelve percent of the total stream length in the Upper Salmon watershed is identified as being impaired by sedimentation. There are about 2,585 points of water diversion[1] (Figure 3-2) and record of 603 stream-alteration permits. There are 216 road culverts in the Upper Salmon watershed, and only 10 are known to allow adult fish passage (Appendix 3-1). Sediments impact approximately 12% of streams in the watershed, with the Salmon River, Yankee Fork, and seven other creeks in the watershed included on the 303(d) list as sediment -impaired streams (Appendix 3-1).

Valley Creek was separated from other tributaries due to the identified presence of a Chinook salmon population in the watershed (Table 3-2). Brook trout are the primary competitive limiting factor in Valley Creek, and channel structure impacts in the lower end from development in Stanley, Idaho, are a secondary concern. Other concerns include increased sediment loads, water temperature, and barriers.

The Yankee Fork Salmon River was also separated due to the identified presence of a Chinook salmon population in the watershed (Table 3-2). The primary limiting factor in the Yankee Fork is caused by potential chemical impacts from mine waste. The secondary limiting factor cause is the massive channel alteration (legacy dredge-mining effect) in the lower section, which has eliminated access to the floodplain and is causing tributary erosion as tributaries attempt to adjust their elevations to the lowered elevation of the mainstem at their confluences. Downcutting and sedimentation are reducing the quality of rearing habitat in this section.

Specific issues identified in the Yankee Fork Salmon River include restoring floodplain connectivity, evaluating tributary passage issues, and evaluating water quality as defined by administrative orders of consent.

The primary limiting factor expressions in the mainstem Salmon River from the Pahsimeroi River upstream to the East Fork Salmon River (excluding the area known as the 12-mile reach) are increased fine sediments and reduction in discharge (primarily at low flows) (Table 3-2). Some barriers to fish movement from the mainstem into tributaries are present. These barriers are a concern because fish use the tributaries as thermal

[1] The points of water diversion (PODs) summed are actually water rights with surface water irrigation PODs associated with them. The total consists of the Snake River Basin Adjudication recommended rights, the claims they are or will be processing, and any other licensed and permitted rights currently recognized. There can be more than one POD associated with a water right and vice versa, so the count is an estimate. Also, because the amount of water that can be diverted at any one time depends on available water and many other factors, no diversion rates or volumes have been given. Models are being developed to estimate diversion rates or volumes, but the findings can only be verified and used in areas where there is a substantial effort at gauging the flow.

refuge when water temperatures in the main river increase.

The 12-mile reach of the Salmon River was assessed separately (Table 3-3). The primary limiting factors in this reach are lack of access to floodplain and side-channel habitat from barriers and alteration of the channel (through diking), altered riparian habitat function, and sediment. Sediment loads and changes in temperature are of secondary concerns in this reach.

Altered discharge from water diversions, increased fine sediments from land use, and riparian alterations are the primary limiting factors in the mainstem Salmon River upstream of the East Fork Salmon River. Riparian habitat alterations also result in decreased streambank stability, increased sedimentation and water temperature (from shade loss), and low recruitment of large woody debris. Migration barriers are a secondary concern in this reach (Table 3-3).

Table 3-2. Ranked impacts of altered ecosystem features impacting habitat quality and quantity for focal fish species in tributaries to the mainstem Salmon River from the Pahsimeroi River upstream to headwaters of the main Salmon River. Valley Creek and the Yankee Fork Salmon River area listed separately. Degree of impact on habitat quality or quantity ranked as: P (component is functioning properly, needs protection), 1 (least influence), 2 (moderate influence), 3 (greatest influence-highest priority).

Ecosystem Feature	Altered Component	Tributaries		
		Pahsimeroi to Headwaters	Valley Creek	Yankee Fork Salmon River
Channel Structure	Floodplain	P	2	3
	Pool/Riffle Ratio	P	2	3
	Large Woody Debris	P	1	3
Hydrology	Discharge	3	P	P
	Low Flow	3	P	P
	Peak	3	P	P
Sediment	Increased Fines	3	2	2
Water Quality	Temperature	2	2	2
Riparian	Shade	2	1	2
	Streambank Stability	2	1	2
Exogenous	Exotics	P	3	P
	Chemicals	P	P	3
	Barriers	3	2	P

Table 3-3. Ranked impacts of altered ecosystem features impacting habitat quality and quantity for focal fish species in tributaries to the mainstem Salmon River from the Pahsimeroi River to the headwaters in the Upper Salmon watershed. Degree of impact on habitat quality or quantity ranked as: P (component is functioning properly, needs protection), 1 (least influence), 2 (moderate influence), 3 (greatest influence-highest priority).

Ecosystem Feature	Altered Component	Mainstem Salmon River		
		Pahsimeroi to East Fork (except 12-Mile Section)	12-Mile Section	East Fork to Headwaters
Channel Structure	Floodplain	P	3	P
	Pool/Riffle Ratio	P	3	P
	Large Wood Debris	P	P	P
Hydrology	Discharge	P	P	3
	Low Flow	P	P	3
	Peak	P	P	3
Sediment	Increased Fines	2	2	3
Water Quality	Temperature	2	1	3
Riparian	Shade	2	3	3
	Streambank Stability	2	3	3
Exogenous	Exotics	P	P	P
	Chemicals	P	P	P
	Barriers	2	3	2

The East Fork Salmon River was divided into four reaches. From the mouth of the East Fork Salmon River to Herd Creek limiting factors are primarily associated with altered riparian habitat and increased water temperatures. Some migration barriers exist but are of secondary concern (Table 3-4). The primary concerns for the East Fork Salmon River from Herd Creek to Germania Creek, were related to altered riparian habitat and increased water temperatures. Migration barriers and channel structure issues were of secondary concern and are related to rearing habitat quality.

Primary limiting factors in the Herd Creek area were altered riparian habitat, increased sedimentation, increased limiting factor expressions temperatures, and migration barriers.

Water diversion (primarily during low flow), altered riparian areas, increased water temperatures, and some fish-passage barrier issues were among the areas of secondary concern in unspecified tributaries to the East Fork Salmon River and headwater areas (Table 3-4).

Focal terrestrial habitat fragmentation associated with land uses, development, and habitat conversion has moderately impacted 32% of the Upper Salmon watershed, while 68% has been classified as having low impacts due to habitat fragmentation (Table 3-5).

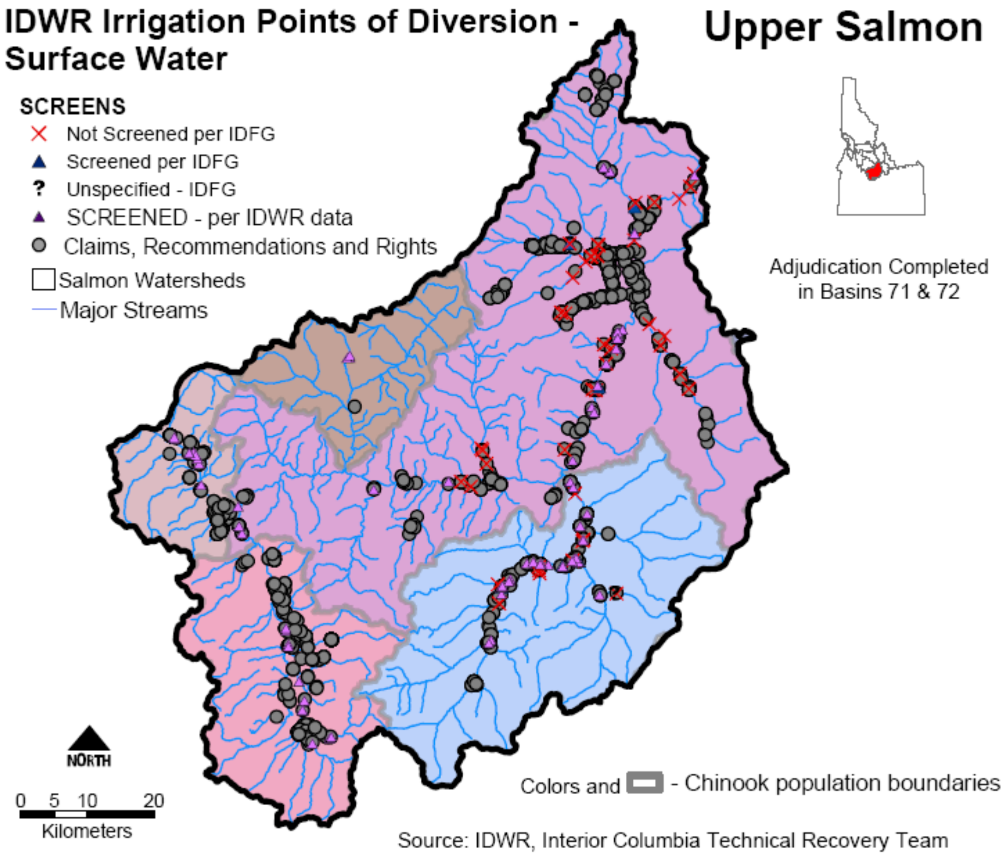

Figure 3-2. Idaho Department of Water Resources points of water diversions in the Upper Salmon watershed, Salmon subbasin, Idaho.

Results from the most recent Natural Resource Inventory (NRI) of non-federal lands in the Upper Salmon watershed indicate that since 1982, a net loss of 3,800 acres (13.6%) of rangeland habitat (presumably shrub-steppe or native grassland) was converted to other uses (NRCS 2004). The majority of these rangeland habitat impacts occur in the downstream portions of the watershed.

With the exception of several relatively small fires, the Upper Salmon watershed has experienced very little fire activity during the last 100 years. Currently, 53% of the watershed is classified as at moderate risk of stand-replacement fire. Thirty-one percent of the watershed is classified as being at high fire risk. Less than 1% of the Upper Salmon watershed is classified as low fire risk (Table 3-5).

Historically, timber harvest had greater impacts to habitat quality and quantity in the Upper Salmon watershed than it currently does. Currently, 54% of the watershed has not been impacted by timber harvest. Seven percent of the watershed has been highly impacted by timber-harvest activities, and 4% has been moderately impacted. Thirty-four percent of the Upper Salmon watershed has been classified as having only low impacts from timber-harvest activities.

Table 3-4. Ranked impacts of altered ecosystem features impacting habitat quality and quantity for focal fish species in the East Fork Salmon River drainage located in the Upper Salmon watershed. Degree of impact on habitat quality or quantity ranked as: P (component is functioning properly, needs protection), 1 (least influence), 2 (moderate influence), 3 (greatest influence-highest priority).

Ecosystem Feature	Altered Component	East Fork Salmon River, Mouth to Herd Creek	East Fork R., Herd Creek to Germania Creek	Herd Creek	Other East Fork Tribs and Headwaters
Channel Structure	Floodplain	P	P	P	P
	Pool/Riffle ratio	P	2	P	P
	Large Woody Debris	P	P	P	P
Hydrology	Discharge	P	P	P	2
	Low Flow	P	P	P	2
	Peak	P	P	P	2
Sediment	Increased Fines	P	P	3	2
Water Quality	Temperature	2	3	3	2
Riparian	Shade	2	3	3	2
	Streambank Stability	2	3	3	2
Exogenous	Exotics	P	P	P	P
	Chemicals	P	P	P	P
	Barriers	2	2	3	2

Table 3-5. Comparison of the relative percentages of area impacted by the causes of limiting factors in the Upper Salmon watershed for terrestrial resources (source: ICBEMP 1997[a]).

Causes of Limiting Factors	Very Low	Low	Medium	High	Very High
Human Population Density	$(x<1)$ 0	$(1<x>10)$ 22	$(10<x>60)$ 66	$(60<x<100)$ 10	$(100<x>300)$ 2
Habitat Fragmentation		68	32	0	0
Altered Fire Regime (13% of the area not at risk)		<1	53	31	
Timber Harvest (54% of the area with no harvest)		34	4	7	54
Grazing/Browsing		2	45	25	

[a] For information about ICBEMP data limitations, see Appendix 2-1.

Cattle-grazing allotments currently comprise 37% of grazing impacts in the Upper Salmon watershed (Figure 3-3, Appendix 3-1). Horses impact an additional 8%, and sheep account for 5% of the watershed grazing. Twenty-one percent of the watershed is of unknown grazing-impact status. Measurements of rangeland condition in the Upper Salmon watershed indicate that approximately 30% of the watershed is moderately to very highly vulnerable to grazing impact (Appendix 3-1). An additional 30% of the watershed has low to very low vulnerability to grazing impact.

Numerous invasive exotic noxious weeds with significant potential impacts to habitat quality and quantity have invaded the Upper Salmon watershed. Leafy spurge, spotted knapweed, and yellow starthistle are species currently posing the greatest threat. Yellow starthistle has become a significant management issue in the most southern portion of the watershed.

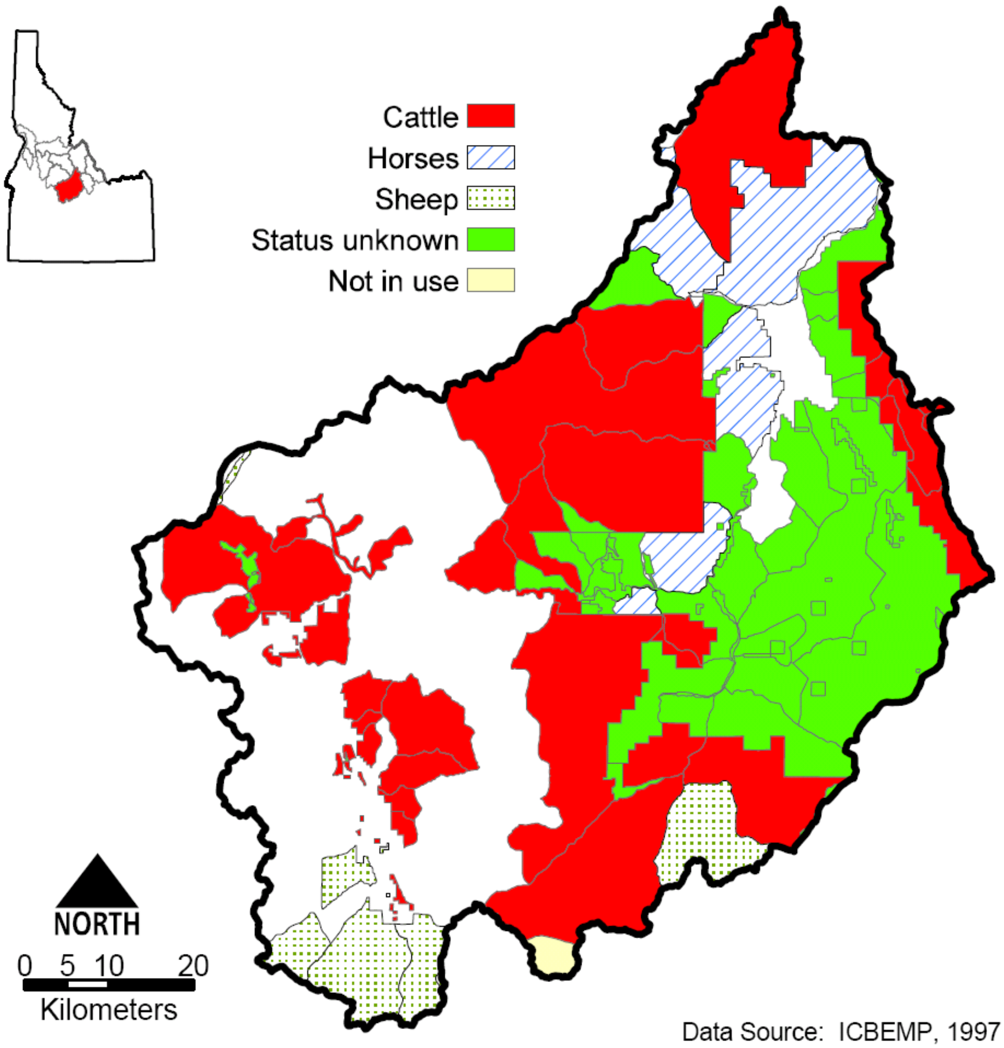

Figure 3-3. Occurrences of grazing and browsing activities by domestic animals in the Upper Salmon watershed, Idaho.

3.1.2 Pahsimeroi

The primary impacts to aquatic habitat quality for the Pahsimeroi watershed are altered riparian areas, increased fines, and altered hydrology (primarily through dewatering) (Table 3-6). Today, approximately 61% of the drainages within the Pahsimeroi watershed have less than satisfactory riparian vegetation conditions based on stream functionality and/or plant community type assessments (BLM and USFS 2001). Most of these altered riparian communities exist in the lower portions of the watershed (Loucks 2002). Nineteen percent of the total stream length in the watershed is classified as impaired due to sedimentation. There are an estimated 850 points of water diversion (Figure 3-4) and record of 25 stream-alteration permits.

None of the tributaries in the Pahsimeroi watershed are connected (fish-passage barriers), which reduces available spawning and rearing habitat for anadromous fish and isolates bull trout populations that are located in tributary habitats. On U.S. Forest Service Lands in the watershed one road culvert in the is a known barrier to fish passage (Appendix 3-1).

Specific issues identified in the Pahsimeroi watershed include increasing flow in the main river through voluntary water acquisition (lease) and reconnecting tributaries to increase main river water flow and provide access to additional spawning and rearing habitat for focal fish species.

Table 3-6. Ranked impacts of altered ecosystem features impacting habitat quality and quantity for focal fish species in the Pahsimeroi watershed. Degree of impact on habitat quality or quantity ranked as: P (component is functioning properly, needs protection), 1 (least influence), 2 (moderate influence), 3 (greatest influence-highest priority).

Ecosystem Feature	Altered Component	Pahsimeroi River, Mouth to Hooper Lane	Patterson Creek to Big Springs Creek	Pahsimeroi Tributaries and Headwaters
Channel Structure	Floodplain	P	P	P
	Pool/Riffle Ratio	P	P	2
	Large Wood Debris	P	P	P
Hydrology	Discharge	3	2	3
	Low Flow	3	2	3
	Peak	3	2	3
Sediment	Increased Fines	3	3	3
Water Quality	Temperature	3	3	3
Riparian	Shade	3	3	3
	Streambank Stability	3	3	3
Exogenous	Exotics	P	P	P
	Chemicals	P	P	P
	Barriers	3	3	3

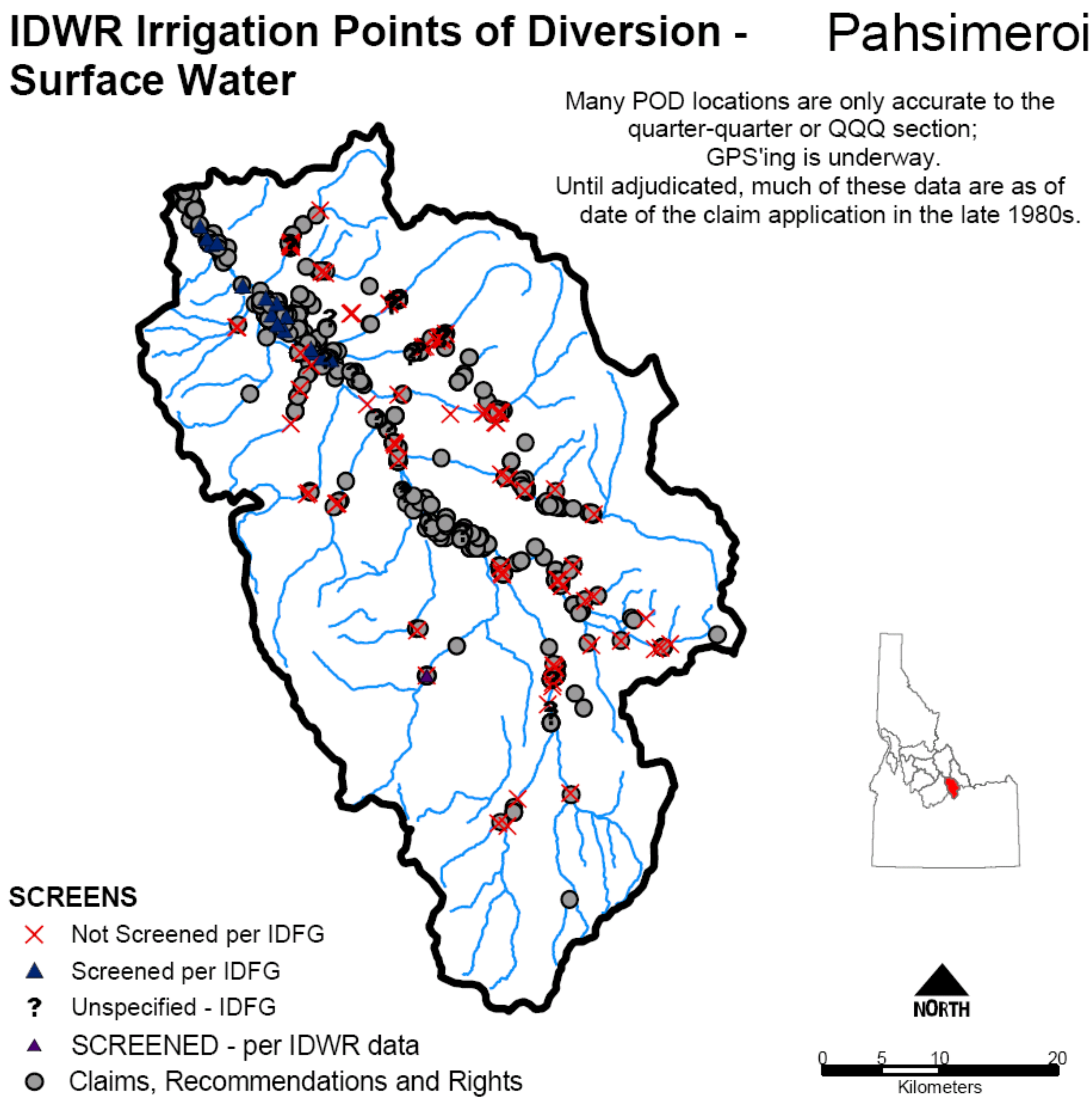

Figure 3-4. Idaho Department of Water Resources points of water diversions in the Pahsimeroi watershed, Salmon subbasin, Idaho.

Habitat fragmentation associated with land uses, development, and habitat conversion is identified as having a moderate impact in 64% of the Pahsimeroi watershed (Table 3-7). The remaining 36% of the watershed is classified as having low impacts from habitat fragmentation (Table 3-7). Results from the most recent NRI of non-federal lands in the Pahsimeroi watershed indicate that since 1982, a net loss of 4,900 acres (10.8%) of rangeland habitat (presumably shrub-steppe or native grassland) was converted to other uses (NRCS 2004). The primary cause of habitat fragmentation in the Pahsimeroi watershed is the conversion of shrub-steppe and grassland habitat types to dryland or irrigated agriculture.

The Pahsimeroi watershed has had no significant fire activity during the last 100 years. Fifty-six percent of the Pahsimeroi watershed is classified as moderate to high risk of stand-replacement fires in all vegetation classes (Table 3-7). The shrub-steppe habitat types (34% of the watershed) are at the greatest risk of stand-replacement fire.

Table 3-7. Comparison of the relative percentages of area impacted by the causes of limiting factors in the Pahsimeroi watershed for terrestrial resources (source: ICBEMP 1997).

Causes of Limiting Factors	Very Low	Low	Medium	High	Very High
Human Population Density	(*x*<1) 0	(1<*x*>10) 6	(10<*x*>60) 87	(60<x<100) 7	(100<*x*>300) 0
Habitat Fragmentation		36	64	0	0
Altered Fire Regime (3% of the area not at risk)		34	45	11	
Timber Harvest (55% of the area with no harvest)		12	22	11	
Grazing/Browsing		21	68	7	

[a] For information about ICBEMP data limitations, see Appendix 2-1.

Historically, timber harvest had greater impacts to watershed habitat quality and quantity than it does now. Fifty-five percent of the Pahsimeroi watershed has never been impacted by timber-harvest activities. Eleven, 22, and 12% of the Pahsimeroi watershed have been classified as having high, moderate, and low impacts, respectively, from timber-harvest activities (Table 3-7).

Grazing impacts in the Pahsimeroi watershed are varied. Cattle are the most significant source of grazing impact to habitat quality and quantity, followed by sheep and horses (Figure 3-5, Appendix 3-1). Thirty-nine percent of the watershed is classified as unknown grazing-impact status. Measurements of rangeland condition indicate the approximately 90% of the watershed is classified as vulnerable to grazing impact (Appendix 3-1).

Numerous invasive exotic weeds with significant potential impacts to habitat quality and quantity have invaded the Pahsimeroi watershed. Leafy spurge, rush skeletonweed and spotted knapweed are the species currently posing the greatest threats.

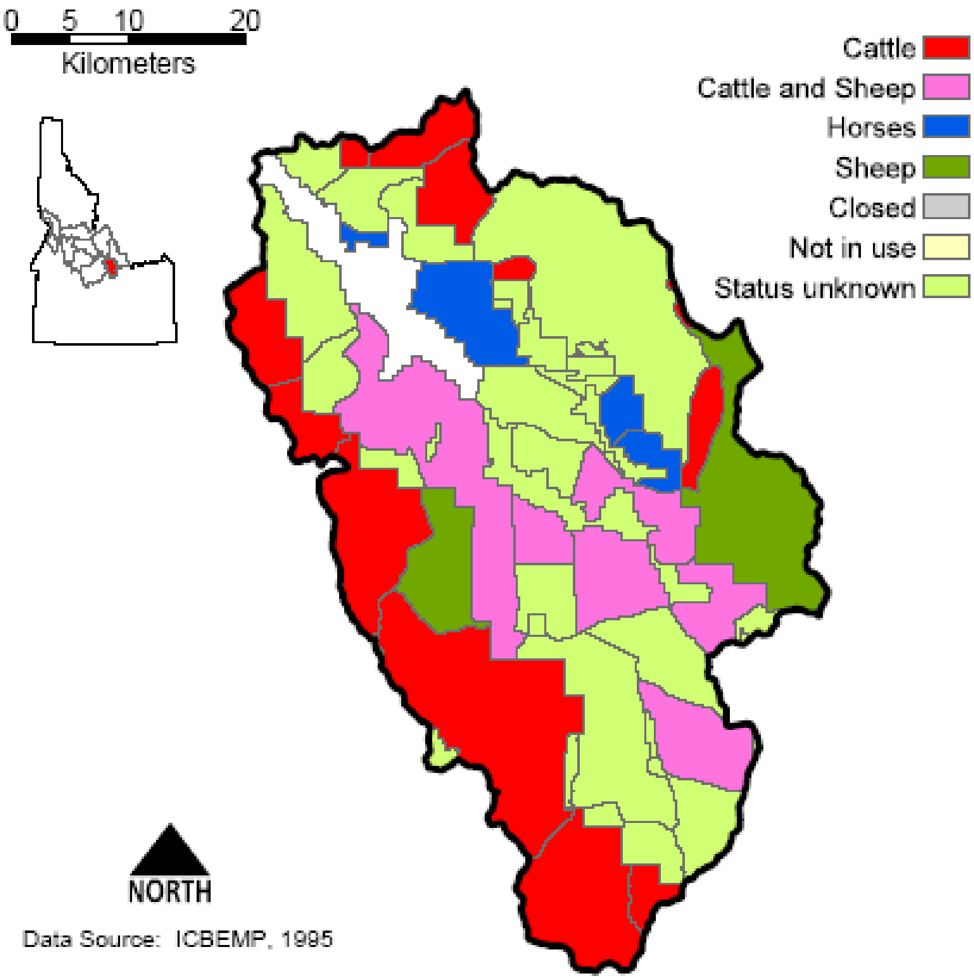

Figure 3-5. Occurrences of grazing and browsing activities by domestic animals in the Pahsimeroi watershed, Idaho.

3.1.3 Lemhi

The primary limiting factor in the Lemhi watershed is disconnected tributaries, a situation that reduces spawning and rearing habitat quantity for anadromous species and isolates resident fish populations (Table 3-8). Big Springs Creek and Hayden Creek are the only tributaries connected to the Lemhi year-round. Low flows are a primary concern in the Lemhi, but channelization has also caused a loss of floodplain access and lack of habitat diversity in the lower reach. When State Highway 28 was constructed in 1952, approximately 5 miles (8 km) of the Lemhi River channel were altered and/or isolated from the river (Gebhards 1958). An additional 10 miles (16 km) of Lemhi River channel were altered in 1957 in response to significant flooding (Gebhards 1958). Channelization was not the primary concern in the Lemhi due to the amount of available spawning/rearing habitat upstream. Altered riparian habitats are common in the drainage. High water temperatures in the Lemhi River downstream of Agency Creek and in Big Springs Creek impact habitat quality.

There are 2,950 points of water diversion in the Lemhi watershed (Figure 3-6) and record of 191 stream-alteration permits. The majority of diversions in the mainstem waters accessible to salmon and steelhead are screened to NOAA's Fisheries (NMFS) criteria. Twelve creeks are included on the 303(d) list as sediment-impaired streams, representing a 10.7% of the total waterways in the watershed.

There are a total of 22 known road culverts on U.S. Forest Service Lands in the Lemhi watershed (Appendix 3-1). Thirteen are known to block adult fish passage, one allows passage, and the fish passage status of the remaining are unknown.

Table 3-8. Ranked impacts of altered ecosystem features impacting habitat quality and quantity for focal fish species in the Lemhi watershed. Degree of impact on habitat quality or quantity ranked as: P (component is functioning properly, needs protection), 1 (least influence), 2 (moderate influence), 3 (greatest influence-highest priority).

Ecosystem Feature	Altered Component	Lemhi River, Mouth to Agency Creek	Lemhi River, Agency Creek to Hayden Creek	Lemhi River, Hayden Creek to Leadore	Big Springs Creek	Hayden Creek	Other Lemhi Tribs and Lemhi Headwaters
Channel Structure	Floodplain	2	2	P	P	P	P
	Pool/Riffle Ratio	2	2	P	2	P	2
	Large Woody Debris	2	P	P	P	P	P
Hydrology	Discharge	P	P	2	P	2	1
	Low Flow	3	2	P	P	2	3
	Peak	P	P	2	P	2	3
Sediment	Increased Fines	P	P	3	3	2	2
Water Quality	Temperature	2	3	2	3	P	P
Riparian	Shade	2	3	3	3	2	2
	Streambank Stability	2	3	3	3	2	2
Exogenous	Exotics	P	P	P	P	P	P
	Chemicals	P	P	P	P	P	P
	Barriers	3	2	2	P	3	3

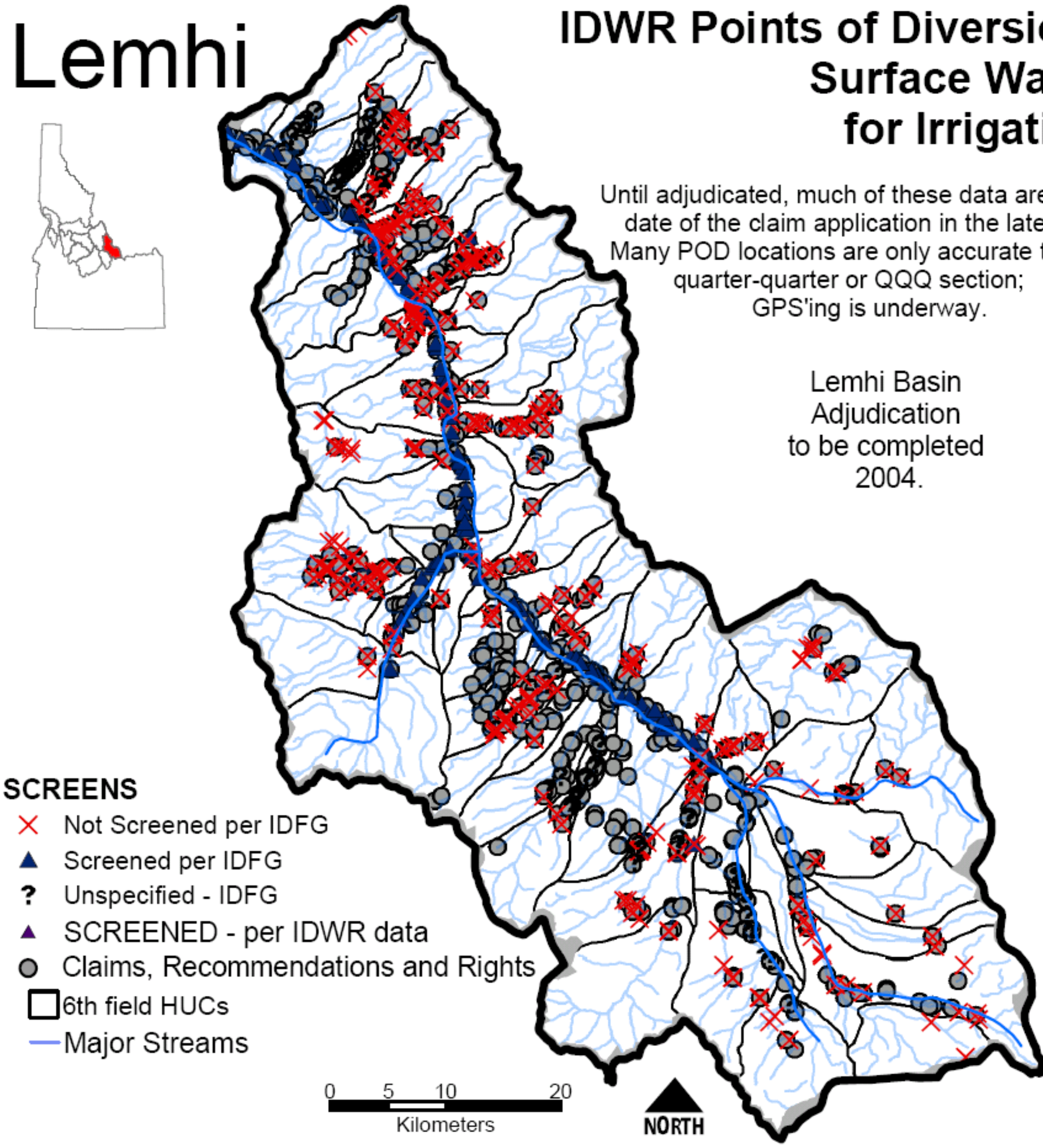

Figure 3-6. Idaho Department of Water Resources points of water diversions in the Lemhi watershed, Salmon subbasin, Idaho.

Specific habitat issues identified in the Lemhi River Agreement (2002-2003) include maintaining the 35-cubic feet per second (cfs) minimum flow (measured at the L5 gauge), acquiring a minimum 8 cfs of flow in Hayden Creek, and reconnecting priority tributaries. Modification of the L6 diversion to facilitate fish passage and improve resting and rearing habitat is also cited as a specific need.

For terrestrial habitats, fragmentation associated with land uses, development, and habitat conversion is identified as having a moderate impact in nearly 60% of the Lemhi watershed. Only 6% of the watershed is classified as being highly impacted from habitat fragmentation (Table 3-9). Results from the most recent NRI of non-federal lands in the Lemhi watershed indicate that since 1982, a net loss of 2,900 acres (3.4%)

of rangeland habitat (presumably shrub-steppe or native grassland) was converted to other uses (NRCS 2004).

Cattle are the most significant source of grazing impacts to upland habitat quality and quantity in the Lemhi watershed (Figure 3-7, Appendix 3-1). Thirty-seven percent of the non-riparian watershed is impacted to some degree by cattle grazing (Appendix 3-1). Forested habitats appear most severely impacted, with nearly 50% of these habitats classified as impacted by cattle grazing (Appendix 3-1). Measurements of rangeland condition estimate 70% of the watershed is classified as moderately to highly vulnerable to grazing impacts (Appendix 3-1).

The Lemhi watershed has had no significant fire activity during the last 100 years. Over 60% of the Lemhi watershed is classified as having moderate to high risk of stand-replacement fires in all vegetation classes (Table 3-9). The shrub-steppe habitat types in the watershed are at the greatest risk of stand-replacement fire.

Historically, timber harvest had greater impacts to Lemhi habitat quality and quantity than it does now. Twenty percent of the Lemhi has been classified as highly impacted by timber-management activities. Sixty percent of the watershed is classified as having low timber-management impacts (Table 3-9).

Numerous invasive exotic weeds with significant potential impacts to habitat quality and quantity have invaded the Lemhi watershed. Leafy spurge, rush skeletonweed, spotted knapweed, and thistle are species currently posing the greatest threat. The Lemhi watershed has relatively fewer known weed infestations than other watersheds.

Table 3-9. Comparison of the relative percentages of area impacted by the causes of limiting factors in the Lemhi watershed for terrestrial resources (source: ICBEMP 1997).

Causes of Limiting Factors	Very Low	Low	Medium	High	Very High
Human Population Density	(*x*<1) 0	(1<*x*>10) 12	(10<*x*>60) 80	(60<x<100) 5	(100<*x*>300) 3
Habitat Fragmentation		37	57	6	0
Altered Fire Regime (5% of the area not at risk)		31	35	27	
Timber Harvest (13% of the area with no harvest)		60	7	20	
Grazing/Browsing		4	72	9	

[a] For information about ICBEMP data limitations, see Appendix 2-1.

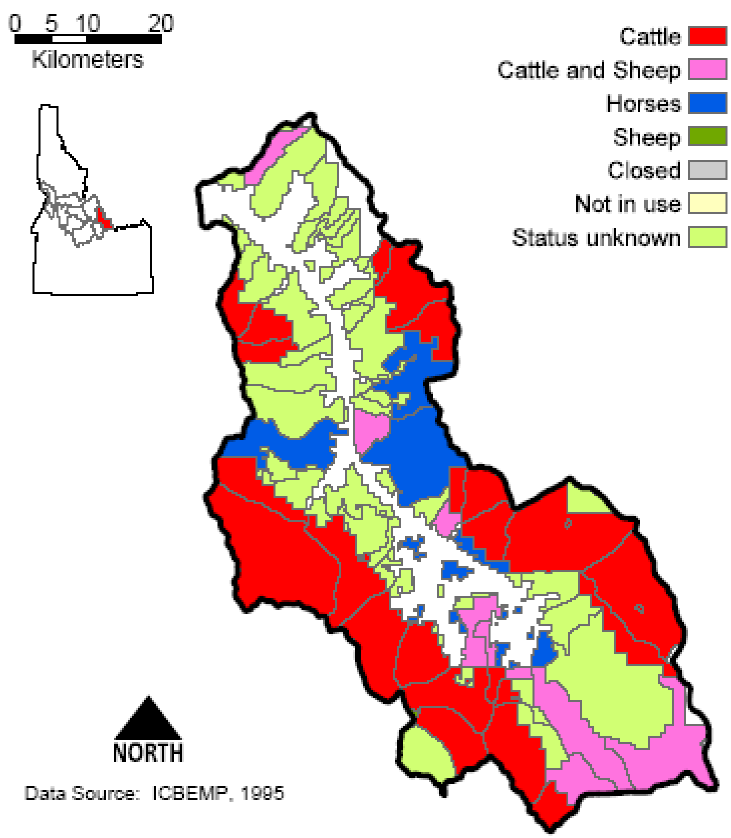

Figure 3-7. Occurrences of grazing and browsing activities by domestic animals in the Lemhi watershed, Idaho.

3.1.4 Middle Fork Salmon

The Upper and Lower Middle Fork Salmon watersheds are located in wilderness areas, and most waterways are pristine (Table 3-12). Habitat quality outside wilderness protection has been impacted by increased sedimentation from land-use activities, and the potential legacy effects of mining activity. Brook trout are known to occur in the Middle Fork waters.

Less than 6% and 1% of the total stream length in the Upper and Lower Middle Fork watersheds, respectively, are identified as being impaired by sedimentation. There are 105 points of water diversion in the Upper and Lower Middle Fork watersheds and record of 66 stream-alteration permits.

Due in large part to their remoteness and protected status, the Middle Fork Salmon watersheds are not significantly impacted by habitat fragmentation associated with land uses, development, and habitat conversion. Ninety-eighty percent of these watersheds are classified as having low impacts due to habitat fragmentation (Table 3-11 and Table 3-12). The upper portion of the Upper Middle Fork watershed that occurs near the Stanley Basin is the most impacted by habitat conversion to dryland agriculture.

The protected status of these watersheds has prevented the widespread impacts of grazing and browsing. Currently, there are active sheep-grazing allotments with identified impacts in the upper portions of the Upper Middle Fork watershed. Horses and cattle have been identified as having some grazing impact in the Lower Middle Fork watershed (Appendix 3-1). Measurements of rangeland condition in these watersheds indicate both watersheds have low to very low vulnerability to grazing impact.

Because the Middle Fork Salmon watersheds are located within the protected areas of the Salmon subbasin, the fire regime more closely resembles natural processes. Recent fire activity has burned large areas within the watersheds during the last decade. Because of this fire activity, only 16% and 27% of the Upper and Lower Middle Fork watersheds, respectively, are classified as being at high risk of stand-replacement fire. When the two watersheds are combined, over half of the area is classified as low fire risk (Table 3-11 and Table 3-12).

Eighty-five percent of these watersheds have had no timber-harvest activity (Table 3-11 and Table 3-12).

The Middle Fork Salmon watersheds have not experienced the spread of noxious and invasive exotic weeds, until recently. The recreation corridors through the watersheds have enabled establishment and subsequent spread of noxious and invasive exotic weeds. Currently, spotted knapweed and rush skeletonweed appear to be the weeds with the greatest potential for negatively impacting habitat quality and quantity in these watersheds.

Table 3-10. Ranked impacts of altered ecosystem features impacting habitat quality and quantity for focal fish species in the Middle Fork Salmon watersheds. Degree of impact on habitat quality or quantity ranked as: P (component is functioning properly, needs protection), 1 (least influence), 2 (moderate influence), 3 (greatest influence-highest priority).

Ecosystem Feature	Altered Component	Upper Middle Fork	Lower Middle Fork
Channel Structure	Floodplain	P	P
	Pool/Riffle Ratio	P	P
	Large Woody Debris	P	P
Hydrology	Discharge	P	P
	Low Flow	P	P
	Peak	P	P
Sediment	Increased Fines	1	P
Water Quality	Temperature	P	P
Riparian	Shade	P	P
	Streambank Stability	P	P
Exogenous	Exotics	1	P
	Chemicals	1	1
	Barriers	P	P

Table 3-11. Comparison of the relative percentages of area impacted by the causes of limiting factors in the Upper Middle Fork Salmon watershed for terrestrial resources (source: ICBEMP 1997).

Causes of Limiting Factors	Very Low	Low	Medium	High	Very High
Human Population Density	(*x*<1) 0	(1<*x*>10) 73	(10<*x*>60) 27	(60<x<100) 0	(100<*x*>300) 0
Habitat Fragmentation		95	5	0	0
Altered Fire Regime (0% of the area not at risk)		58	26	16	
Timber Harvest (82% of the area with no harvest)		12	6	0	
Grazing/Browsing)		12	7	0	

[a] For information about ICBEMP data limitations, see Appendix 2-1.

Table 3-12. Comparison of the relative percentages of area impacted by the causes of limiting factors in the Lower Middle Fork Salmon watershed for terrestrial resources (source: ICBEMP 1997).

Causes of Limiting Factors	Very Low	Low	Medium	High	Very High
Human Population Density	(*x*<1) 0	(1<*x*>10) 96	(10<*x*>60) 4	(60<x<100) 0	(100<*x*>300) 0
Habitat Fragmentation		99	1	0	0
Altered Fire Regime (0% of the area not at risk)		43	29	27	
Timber Harvest (87% of the area with no harvest)		11	1	0	
Grazing/Browsing		4	9	0	

[a] For information about ICBEMP data limitations, see Appendix 2-1.

3.1.5 Middle Salmon–Chamberlain

The only concern for that portion of the Middle Salmon–Chamberlain watershed in the wilderness area is elevated temperature (Table 3-13). The primary limiting factor for aquatic habitat quality factor in the remaining areas is elevated water temperatures. Secondary limiting factors in these areas are related to channel structure alterations, altered rearing habitats, altered hydrology and riparian areas, brook trout presence, and legacy mining effects (chemical).

Just over 5% of the total stream lengths in the Middle Salmon–Chamberlain are identified as being impaired by sedimentation. There are 40 points of water diversion in the Middle Salmon–Chamberlain watershed and record of 56 stream-alteration permits.

The Middle Salmon–Chamberlain watershed has not been significantly impacted by habitat fragmentation associated with land uses, development, and habitat conversion. Seventy-six percent of the watershed has low habitat-fragmentation impacts and the remaining 24% is classified as being moderately impacted by habitat fragmentation (Table 3-14). The majority of habitat-fragmentation impacts are located in the lower portion of the watershed.

Thirty-two percent of the Middle Salmon–Chamberlain watershed is classified as status unknown with regards to grazing impact (Appendix 3-1). The lower portions of this watershed have sheep-grazing allotments, but resulting impacts have not been assessed (Table 3-14). Measurements of rangeland condition indicate that approximately 10% of the watershed is moderately vulnerable to grazing impacts (Appendix 3-1). The remainder of the watershed is either ungrazed or has low to very low vulnerability to grazing impact.

The fire regime in the wilderness areas most closely resembles natural processes. Fire activity within the watershed during the last decade has burned reasonably large areas. Nevertheless, 21% of the Middle Salmon–Chamberlain watershed is classified as being at high risk of stand-replacement fire. An additional 25% is classified as moderate risk (Table 3-14).

Historically, timber harvest had greater impacts to Middle Salmon–Chamberlain watershed habitat quality and quantity than it does now. Most of the timber harvest occurred in the lower portions of the watershed. Sixty-eight percent of the Middle Salmon–Chamberlain watershed has not been impacted by timber-harvest activities. Ten percent of the watershed has been classified as moderately impacted, and another 20% has been classified with low impacts from timber-harvest activities (Table 3-14).

The Middle Salmon–Chamberlain watershed has not experienced the spread of noxious and invasive exotic weeds, until recently. The recreation corridor for the main Salmon River has enabled the spread of noxious weeds. Currently, spotted knapweed and rush skeletonweed appear to be the weeds with the greatest potential for negative impacts to habitat quality and quantity in this watershed.

Table 3-13. Ranked impacts of altered ecosystem features impacting habitat quality and quantity for focal fish species in the Middle Salmon–Chamberlain watershed. Degree of impact on habitat quality or quantity ranked as: P (component is functioning properly, needs protection), 1 (least influence), 2 (moderate influence), 3 (greatest influence-highest priority)..

Ecosystem Feature	Altered Component	Wilderness Section	Area West of Wind River (Including Meadow Creek)
Channel Structure	Floodplain	P	2
	Pool/Riffle ratio	P	2
	Large Woody Debris	P	P
Hydrology	Discharge	P	2
	Low Flow	P	2
	Peak	P	P

Ecosystem Feature	Altered Component	Wilderness Section	Area West of Wind River (Including Meadow Creek)
Water Quality	Temperature	2	3
Riparian	Shade	P	2
	Streambank Stability		
Exogenous	Exotics	P	2
	Chemicals	P	2
	Barriers	P	P

Table 3-14. Comparison of the relative percentages of area impacted by the causes of limiting factors in the Middle Salmon–Chamberlain watershed for terrestrial resources (source: ICBEMP 1997).

Causes of Limiting Factors	Very Low	Low	Medium	High	Very High
Human Population Density	(*x*<1) 0	(1<*x*>10) 79	(10<*x*>60) 21	(60<x<100) 0	(100<*x*>300) 0
Habitat Fragmentation		76	24	0	0
Altered Fire Regime (0% of the area not at risk)		49	25	21	
Timber Harvest (68% of the area with no harvest)		20	10	1	
Grazing/Browsing		8	6	0	

[a] For information about ICBEMP data limitations, see Appendix 2-1.

3.1.6 Middle Salmon–Panther

Less than 2% of the total stream lengths in the Middle Salmon–Panther watershed are identified as sediment impaired (Appendix 3-1). There are 2,250 points of water diversion in the Middle Salmon–Panther watershed (Figure 3-8) and record of 337 stream-alteration permits. There are also a total of 95 known road culverts on U.S. Forest Service lands in the Middle Salmon-Panther watershed (Appendix 3-1). Fifty-one of these culverts are known to block adult fish passage while 10 allow passage

Riparian habitat alteration, increased temperatures, and streambank stability are habitat quality issues in the mainstem Salmon River from the mouth of the Middle Fork Salmon River to the mouth of the Pahsimeroi River (Table 3-15). The North Fork Salmon River has secondary impacts from altered channel structure. Barriers to fish migration are the primary concern for tributaries to the mainstem Salmon River from the Middle Fork to the North Fork Salmon River. Altered hydrology (primarily during low flow) and altered channel structure are the primary limiting factors associated with tributaries to the main Salmon River from the Middle Fork Salmon River upstream to the Pahsimeroi River. These tributaries provide important thermal refuge for fish when water temperatures warm during the summer. The

Panther Creek drainage downstream of and including Blackbird Creek has been impacted by chemical contamination and is under a U.S. Environmental Protection Agency-supervised cleanup. Concerns upstream of Blackbird Creek include altered riparian habitat, increased sediment, and some fish-passage barriers.

Seventy-one percent of the Middle Salmon–Panther watershed has been moderately impacted by habitat fragmentation associated with land uses, development, and habitat conversion (Table 3-16). Only 28% of the watershed is classified as having low habitat-fragmentation impacts (Table 3-16). Results from the most recent NRI of non-federal lands in the Middle Salmon Panther watershed indicate that since 1982, a net loss of 200 acres (0.8%) of rangeland habitat (presumably shrub-steppe or native grassland) was converted to other uses (NRCS 2004).

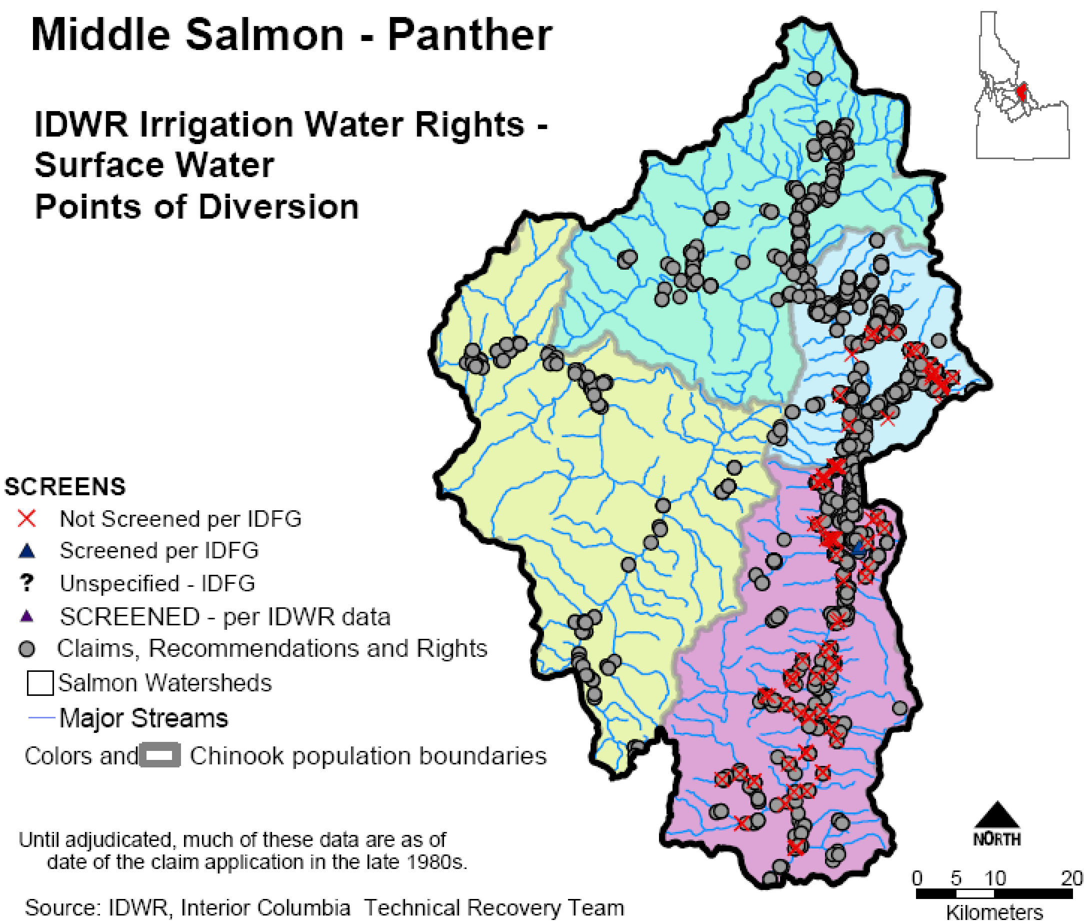

Figure 3-8. Idaho Department of Water Resources points of water diversions in the Middle Salmon–Panther watershed, Salmon subbasin, Idaho.

Cattle and sheep grazing affect 73% of the Middle Salmon–Panther watershed (Appendix 3-1). The upstream portions of the watershed are the most severely impacted. Nine percent of the watershed is classified as status unknown with regards to grazing impact.

Based on measurements of rangeland condition, approximately, 40% of the watershed is highly to very highly vulnerable to grazing impacts.

The Middle Salmon–Panther watershed is almost evenly split into three fire risk classifications. Thirty-eight percent of the watershed is classified as being at low risk, 36% is classified as moderate risk, and 25% is classified as high risk. A significant amount of the watershed has burned in recent years; however, much of the recreation corridor for the main Salmon River is still at high risk of stand-replacement fire (Figure 3-9).

Only 11% of the Middle Salmon–Panther watershed has been unaffected by timber-harvest activities. Over half of the watershed has been impacted to a low degree. Eight percent of the watershed has been highly impacted by timber-harvest activities, while 26% has been moderately impacted by timber-harvest activities.

Although there are many noxious and invasive exotic weed species found in the watershed, leafy spurge, rush skeletonweed and spotted knapweed are of the most serious concern in terms of threats to habitat quality and quantity in the Middle Salmon–Panther watershed.

Table 3-15. Ranked impacts of altered ecosystem features impacting habitat quality and quantity for focal fish species in the Middle Salmon–Panther watershed. Degree of impact on habitat quality or quantity ranked as: P (component is functioning properly, needs protection), 1 (least influence), 2 (moderate influence), 3 (greatest influence-highest priority).

Ecosystem Feature	Altered Component	Mainstem Salmon River, Middle Fork to Pahsimeroi	North Fork Salmon River	Mainstem Salmon River Tribs, Middle Fork to North Fork	Mainstem Salmon River Tribs, North Fork Salmon to Pahsimeroi	Panther Creek, Blackbird Creek to Headwaters	Panther Creek, mouth to Blackbird Creek
Channel Structure	Floodplain	P	P	P	P	P	P
	Pool/Riffle Ratio	P	2	P	3	P	P
	Large Woody Debris	P	P	P	P	P	P
Hydrology	Discharge	P	P	P	3	P	P
	Low Flow	P	P	P	3	P	P
	Peak	P	P	P	3	P	P
Sediment	Increased Fines	P	P	P	P	2	2
Water Quality	Temperature	2	P	P	2	2	2
Riparian	Shade	2	P	P	2	2	2
	Streambank Stability	2	P	P	2	2	2
Exogenous	Exotics	P	P	P	P	P	P
	Chemicals	P	P	P	P	P	3
	Barriers	P	P	2	3	2	P

Table 3-16. Comparison of the relative percentages of area impacted by the causes of limiting factors in the Middle Salmon–Panther watershed for terrestrial resources (source: ICBEMP 1997).

Causes of Limiting Factors	Very Low	Low	Medium	High	Very High
Human Population Density	(*x*<1) 2	(1<*x*>10) 45	(10<*x*>60) 42	(60<x<100) 8	(100<*x*>300) 3
Habitat Fragmentation		28	71	1	0
Altered Fire Regime (1% of the area not at risk)		38	36	25	
Timber Harvest (11% of the area with no harvest)		55	26	8	11
Grazing/Browsing		22	37	7	

[a] For information about ICBEMP data limitations, see Appendix 2-1.

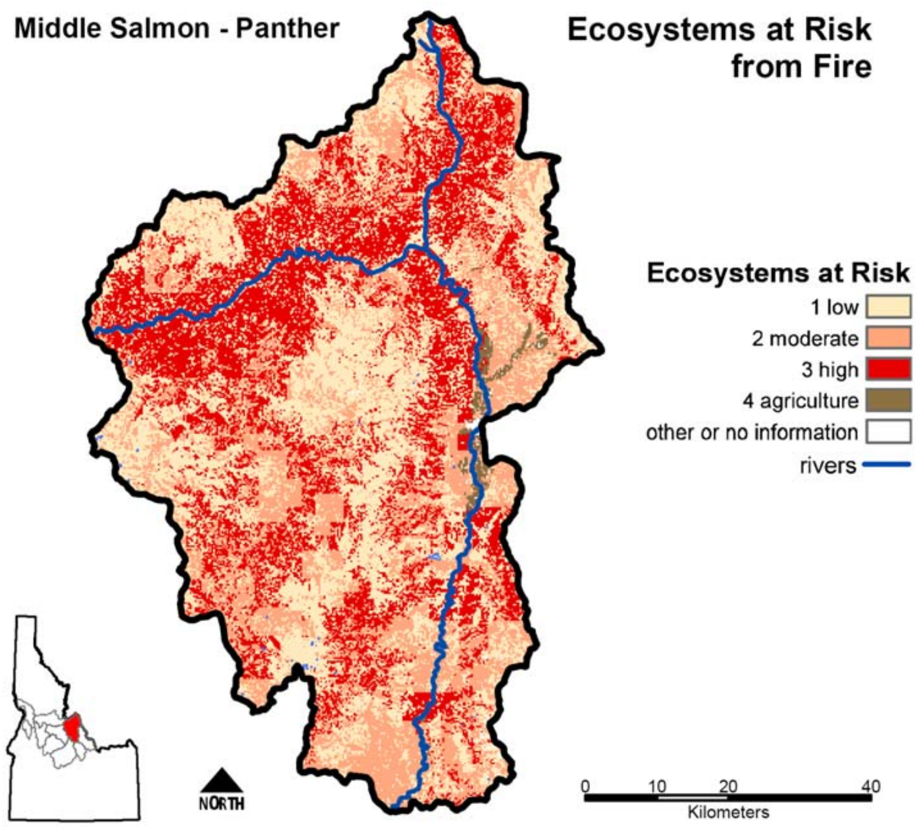

Figure 3-9. Predicted areas within the Salmon subbasin most likely to have severe burns (Source: Northern Regional National Fire Plan Cohesive Strategy Assessment Team, Flathead National Forest). Ecosystems-at-risk integrates ignition probability, fire weather hazard, and fire regime condition class.

3.1.7 South Fork Salmon

Primary concerns in the South Fork Salmon watershed relate to the effects of land use and severe sediment impacts that have occurred in the watershed (Table 3-17). Fine sediments are naturally high in this watershed, but data indicate that current conditions are good for salmon spawning and that fine sediments, in general, are decreasing or at least stable.

Due in large part to its remoteness and relatively roadless management, the South Fork Salmon watershed has not been significantly impacted by altered hydrology. Still, there area total of 150 known road culverts without allowance for fish passage in the watershed (Appendix 3-1). There are also 120 points of water diversion in the South Fork Salmon watershed and record of 80 stream-alteration permits. Twenty-one percent of the total stream length in the South Fork Salmon watershed is identified as being impaired by sedimentation.

In the Secesh River drainage, impacted riparian habitat is a concern, as is the presence of brook trout, which may impact bull trout. Fine sediments, primarily from watershed disturbance and legacy mining effects, reduce focal habitat quality.

The East Fork South Fork Salmon drainage is the most habitat quality limited watershed in the South Fork Salmon watershed. Primary factors in the East Fork South Fork drainage are reduced riparian habitat quality and decreased streambank stability from roads. Secondary factors include removal of large woody debris from the channel and chemical impacts and fish passage barriers resulting from legacy mining in the area.

On Johnson Creek, localized grazing occurs in the most important Chinook salmon spawning areas. Increased fine sediments and presence of brook trout are also concerns.

The primary factors in the main South Fork Salmon drainage are increased fine sediment and reduced riparian habitat quality. Secondary factors are presence of brook trout, two areas of inaccessible habitat due to blockage, and potential impacts to naturally produced Chinook salmon from sport and tribal fisheries (Table 3-17).

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Table 3-17. Ranked impacts of altered ecosystem features impacting habitat quality and quantity for focal fish species in tributaries to the South Fork Salmon watershed. Degree of impact on habitat quality or quantity ranked as: P (component is functioning properly, needs protection), 1 (least influence), 2 (moderate influence), 3 (greatest influence-highest priority).

Ecosystem Feature	Altered Component	Secesh River	East Fork South Fork	Johnson Creek	Main South Fork
Channel Structure	Floodplain	P	P	P	P
	Pool/Riffle Ratio	P	P	P	P
	Large Woody Debris	P	2	3	P
Hydrology	Discharge	P	P	P	P
	Low Flow	P	P	P	P
	Peak	P	P	P	P
Sediment	Increased Fines	2	2	2	3

Ecosystem Feature	Altered Component	Secesh River	East Fork South Fork	Johnson Creek	Main South Fork
Water Quality	Temperature	P	P	P	P
Riparian	Shade	3	3	3	3
	Streambank Stability	P	3	P	P
Exogenous	Exotics	3	P	2	2
	Chemicals	P	2	P	P
	Barriers	P	2	P	1
	Harvest	P	P	P	2

The South Fork Salmon watershed has not been significantly impacted by habitat fragmentation associated with land uses, development, and habitat conversion (Table 3-18).

Cattle-grazing allotments do not exist in the South Fork Salmon watershed. Measurements of rangeland condition in the South Fork Salmon watershed indicate that approximately 10% of the watershed is moderately vulnerable to grazing impact and approximately 30% of the watershed has low to very low vulnerability to grazing impact.

The South Fork Salmon watershed is federally classified as roadless for management purposes, but where roads do occur they occur immediately adjacent to waterways. Under that management scheme, the fire regime more closely resembles natural processes. Fire activity has burned large amounts of the watershed during the last decade.Only 18% of the watershed is classified as being at high risk of stand-replacement fire. Fifty-three percent of the watershed is classified as being at low fire risk.

Historically, timber harvest had greater impacts to habitat quality and quantity in the South Fork Salmon watershed than it does now. Timber-harvest activities occurred throughout the watershed with varied levels of impact. Currently, 37% of the watershed has not been impacted by timber harvest. The remaining 63% of the watershed is evenly split between having low, moderate, or high impacts from timber-harvest activities (Table 3-18).

Numerous noxious weeds pose significant potential impact to habitat quality and quantity in the South Fork Salmon watershed. Rush skeletonweed, spotted knapweed and yellow starthistle currently pose the greatest threats.

Table 3-18. Comparison of the relative percentages of area impacted by the causes of limiting factors in the South Fork Salmon watershed for terrestrial resources (source: ICBEMP 1997).

Causes of Limiting Factors	Very Low	Low	Medium	High	Very High
Human Population Density	$(x<1)$ 5	$(1<x>10)$ 52	$(10<x>60)$ 40	$(60<x<100)$ 3	$(100<x>300)$ 0
Habitat Fragmentation		65	35	0	0
Altered Fire Regime (0% of the area not at risk)		53	29	18	
Timber Harvest (37% of the area with no harvest)		19	20	24	
Grazing/Browsing		23	0	0	

[a] For information about ICBEMP data limitations, see Appendix 2-1.

3.1.8 Lower Salmon and Little Salmon

Lack of properly functioning riparian habitat, decreased recruitment of large woody debris, floodplain and channel encroachment from by roads and land use development (Table 3-19) have resulted in increased water temperatures which are the primary limiting factor concerns in the Little Salmon watershed. Secondary factors are increased fine sediments, loss of access to historic habitat, and presence of brook trout. There are 1,500 points of water diversion in the Little Salmon watershed and record of 184 stream-alteration permits. Twenty-one percent of the total stream length in the watershed is impaired by sedimentation.

The primary concern for the main Salmon River is reduction of riparian habitat from roads, and land use (Table 3-19). Loss of riparian habitat in the Lower Salmon watershed has contributed to reductions in rearing habitat for fall Chinook salmon during high flow. Secondary concerns in the main Salmon River include barriers to tributaries that provide thermal refuge for fish during the periods of elevated water temperatures. Presence of brook trout and degraded riparian habitat are the primary factors for some tributaries to the Lower Salmon River.

Twenty percent of the total stream length in the Lower Salmon watershed is identified as being impaired by sedimentation. There are 450 known points of water diversion in the Lower Salmon watershed and record of 231 stream-alteration permits. The majority of diversions in the mainstem Salmon River that are accessible to salmon and steelhead are screened to NOAA Fisheries criteria as are most pump intakes in the Lower Salmon (Lynn Stratton, IDFG Anadromous Fish Screen Shop, personal communication).

Habitat fragmentation associated with land uses, development, and habitat conversion is identified as having a moderate to very high impact in 94% of the Lower Salmon watershed (Table 3-20). Native grassland conversion to dryland irrigation and agriculture is the most significant source of habitat fragmentation and loss of focal habitat in this watershed. Habitat fragmentation is identified as having a moderate to high impact in 83% of the Little Salmon watershed (Table 3-21). Native grassland conversion to dryland irrigation and agriculture is also the most significant source of habitat fragmentation and loss of focal habitat in this watershed.

Table 3-19. Ranked impacts of altered ecosystem features impacting habitat quality and quantity for focal fish species in the Lower Salmon and the Little Salmon watersheds. Degree of impact on habitat quality or quantity ranked as: P (component is functioning properly, needs protection), 1 (least influence), 2 (moderate influence), 3 (greatest influence-highest priority).

Ecosystem Feature	Altered Component	Lower Main Salmon Tributaries	Lower Main Salmon	Little Salmon River
Channel Structure	Floodplain	P	P	P
	Pool/Riffle Ratio	P	P	P
	Large Woody Debris	P	2	3
Hydrology	Discharge	P	P	P
	Low Flow	P	P	3
	Peak	P	P	P
Sediment	Increased Fines	2	2	2
Water Quality	Temperature	P	P	3
Riparian	Shade	3	3	1
	Streambank Stability	P	2	P
Exogenous	Exotics	3	P	2
	Chemicals	P	2	P
	Barriers	P	2	2

Table 3-20. Comparison of the relative percentages of area impacted by the causes of limiting factors in the Lower Salmon watershed for terrestrial resources (source: ICBEMP 1997).

Causes of Limiting Factors	Very Low	Low	Medium	High	Very High
Human Population Density	(*x*<1) 0	(1<*x*>10) 3	(10<*x*>60) 89	(60<x<100) 4	(100<*x*>300) 3
Habitat Fragmentation		5	47	44	3
Altered Fire Regime (3% of the area not at risk)		19	21	47	
Timber Harvest (13% of the area with no harvest)		23	29	35	
Grazing/Browsing		12	28	2	

[a] For information about ICBEMP data limitations, see Appendix 2-1.

Table 3-21. Comparison of the relative percentages of area impacted by the causes of limiting factors in the Little Salmon watershed for terrestrial resources (source: ICBEMP 1997).

Causes of Limiting Factors	Very Low	Low	Medium	High	Very High
Human Population Density	(*x*<1) 0	(1<*x*>10) 7	(10<*x*>60) 93	(60<x<100) 0	(100<*x*>300) 0
Habitat Fragmentation		17	63	20	0
Altered Fire Regime (3% of the area not at risk)		32	40	24	
Timber Harvest (20% of the area with no harvest)		18	14	47	
Grazing/Browsing		25	62	0	

[a] For information about ICBEMP data limitations, see Appendix 2-1.

Eight percent of the watershed has been classified as impacted by sheep grazing, and two percent by cattle and sheep grazing (Appendix 3-1). Fifty-two percent of the watershed is classified as unknown grazing-impact status. Historical grazing regimes in the Lower Salmon watershed were much more intensive than they currently are. This is reflected in measures of rangeland condition, with approximately 85% of the watershed is either highly or moderately vulnerable to grazing impact.

Nearly 62% of the watershed has been classified as impacted by cattle and sheep grazing (Table 3-21). Sheep appear to have the greatest impact on aspen focal habitats, while cattle mostly impact forested habitats (Appendix 3-1). Measurements of rangeland condition indicate approximately 20% of the watershed is classified as highly vulnerable, 20% is classified as moderately vulnerable, and 20% is classified as low vulnerability to grazing impacts.

Two large fires in 1999 burned approximately 15% of the Lower Salmon watershed. Based upon fire risk assessment data, 40% of the Lower Salmon watershed is still classified as high risk of stand-replacement fire (Figure 3-10). An additional 21% of the watershed is classified as moderate risk (Table 3-20).

The Little Salmon watershed has had no significant fire activity during the last 100 years. Over 60% of the Little Salmon watershed is classified as being at moderate to high risk of stand-replacement type fire in forested habitat types (Table 3-21; Figure 3-11).

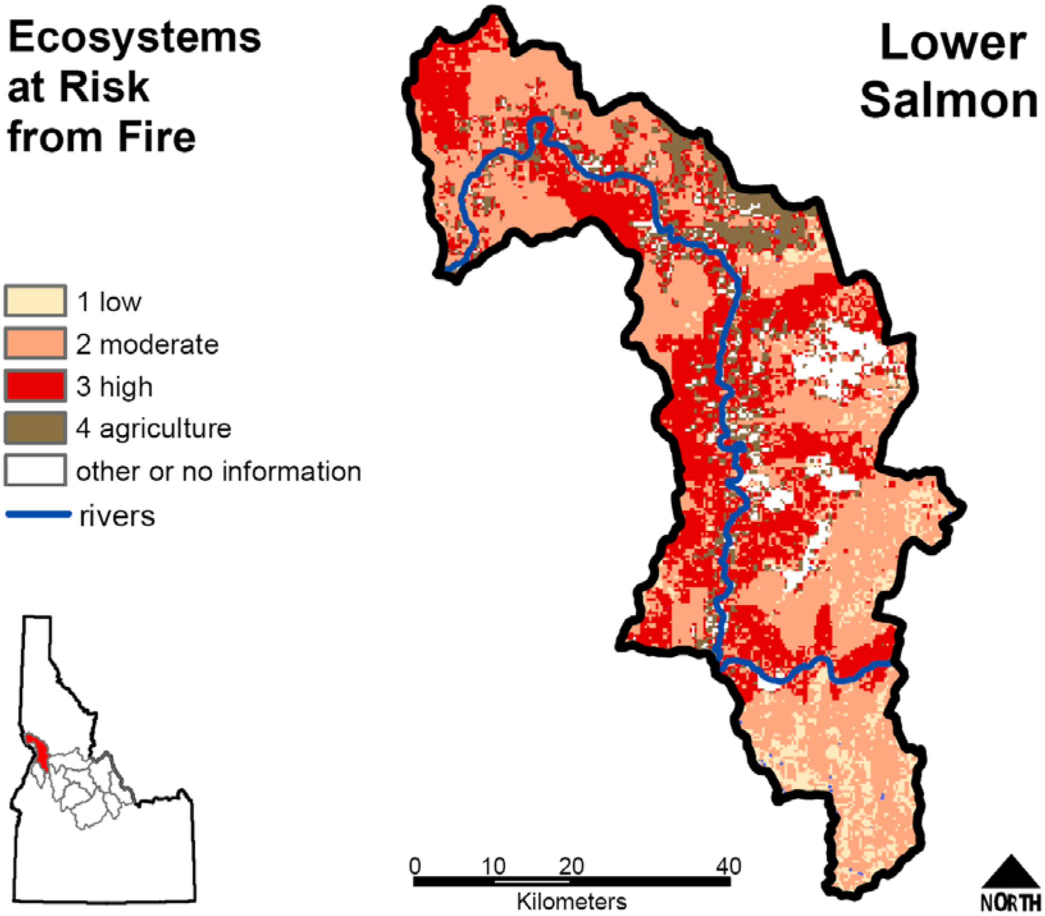

Figure 3-10. **Predicted areas within the Lower Salmon watershed most likely to have severe burns (Source: Northern Regional National Fire Plan Cohesive Strategy Assessment Team, Flathead National Forest). Ecosystems-at-risk integrates ignition probability, fire weather hazard, and fire regime condition class.**

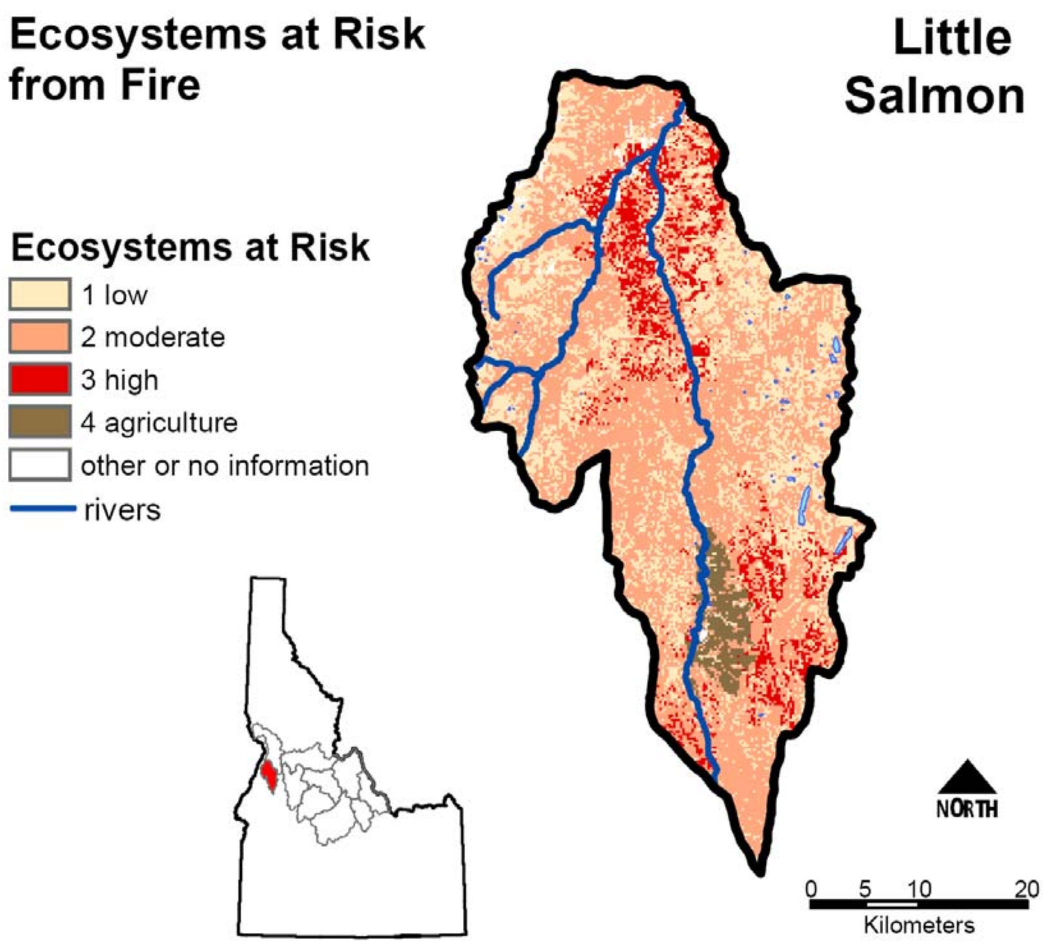

Figure 3-11. Predicted areas within the Little Salmon watershed most likely to have severe burns (Source: Northern Regional National Fire Plan Cohesive Strategy Assessment Team, Flathead National Forest). Ecosystems-at-risk integrates ignition probability, fire weather hazard, and fire regime condition class.

Historic timber harvest impacts to focal habitat quality and quantity were greater than present. Nearly 65% of the Lower Salmon watershed has been impacted by timber-harvest activities. Only 13% has not been impacted by timber-management activities (Table 3-20). Twenty percent of the Little Salmon watershed has not been impacted by timber-harvest activities and 47% has been classified as highly impacted by timber-management activities (Table 3-21).

The most significant weeds with potential negative impacts to focal habitat quality and quantity are rush skeletonweed, leafy spurge, spotted knapweed, and yellow starthistle. The most significant noxious weed threats to habitat quality and quantity in the Little Salmon watershed is spotted knapweed. Yellow starthistle has also been invading via U.S. Highway 95, the primary travel corridor through the watershed.

3.2 Out-of-Subbasin Effects

3.2.1 Aquatic Resources

Salmon and steelhead populations in the Salmon subbasin are directly affected by sources of mortality outside the subbasin. Early in the subbasin planning process, the NPCC convened an out-of-basin effects (OBE) work session to discuss how to address mortality that occurs outside the boundaries of the subbasin. The outcome of this session was a decision to use smolt-to-adult return (SAR) rates as a standardized measure of OBE. Smolt-to-adult return rate is calculated by dividing number of adults produced by a cohort of smolts by number of out-migrating smolts for a given out-migration year. These SAR rates should be calculated for wild/natural fish close to the mouth of the subbasin, or if available, population-specific SAR information should be used.

Smolt-to-adult survival represents the combined effect of survival through the hydropower system, survival in the lower Columbia River, survival through the estuary, survival in the ocean, and the overall harvest rate. Smolt-to-adult return rates for Chinook salmon and steelhead in the Salmon subbasin are estimated at Lower Granite Dam on the Snake River. The SAR rate for sockeye salmon is calculated at the Redfish Lake Creek fish trap located 1.4 km downstream from Redfish Lake. The SAR rate for sockeye salmon incorporates survival from the trap location to Lower Granite Dam for migrating juveniles and adults. The time period for the SAR rate was smolt migration years 1990 to 2000. This time period was assumed to include both good and poor ocean survival and represent the most recent improvements in fish passage through the hydropower system. The NPCC established interim SAR targets of 2% to 6% with an average SAR of 4% for stocks in the upper Basin. The technical basis for the SAR targets identified by the NPCC were derived from analysis in Marmorek *et al*. (1996, see Chapter 6) and Marmorek *et al*. (1998, see Chapter 4). The lowest SARs recorded for all three species occurred during the 1992 migration year for Chinook salmon and steelhead, and the 1993 migration year for sockeye salmon (Figure 3-12). The SAR estimated for 1999 and 2000 for Chinook salmon and steelhead were above the 2% target set by the NPCC, but the estimated SAR for Chinook salmon was below the desired 4% average. Even at their highest level, sockeye salmon SARs have been well below 1%. Overall, most SARs from 1990 to 2000 were below desired levels. Smolt-to-adult survival rates less than 2% indicate a condition where out-of-basin effects are a major limiting factor for the populations.

Spawner-to-spawner ratios can be used as a measure of productivity of a population. Estimates of spawner-to-spawner ratios for index stocks of Chinook salmon in the Salmon subbasin, compared with the aggregate SARs calculated at Lower Granite Dam, suggest that the NPCC's targeted SAR average of 4% would be sufficient to allow Chinook salmon populations to increase (Figure 3-13). Spawner-to-spawner ratios estimated at Rapid River fish trap for wild steelhead (Figure 3-14) also provide evidence that the targeted SAR of 4% would allow this population of steelhead to increase.

Schaller *et al*. (1999) found that declines in life cycle productivity were greater for Snake River stocks than for stocks that migrate past fewer dams. Petrosky *et al*. (2001) found little evidence to indicate that a decline in freshwater survival was primarily responsible for the decline observed over the entire life cycle, but they did find substantial evidence of declines in the smolt-to-adult life stage. Reductions in smolt-to-adult life stage, rather than a decline in egg-smolt survival, was identified by Wilson (2003) as being primarily responsible for the observed declines in Snake River spring/summer Chinook salmon. The information above suggests that improving anadromous fish populations in the Salmon subbasin will rely on improvements in out-of-basin survival, which will be especially important for stocks in areas that currently have high-quality habitat (Middle Fork watersheds). The above studies were performed on the aggregate Chinook salmon stocks in the Snake River basin, and results do not imply that there are no areas in the Salmon subbasin that would benefit from habitat improvement (described in section 3.1). However, what has not been determined is whether improving tributary habitat in the Columbia River basin (and therefore the Salmon subbasin) will be, in and of itself, sufficient to recover natural production of anadromous fish stocks (ISAB 2003).

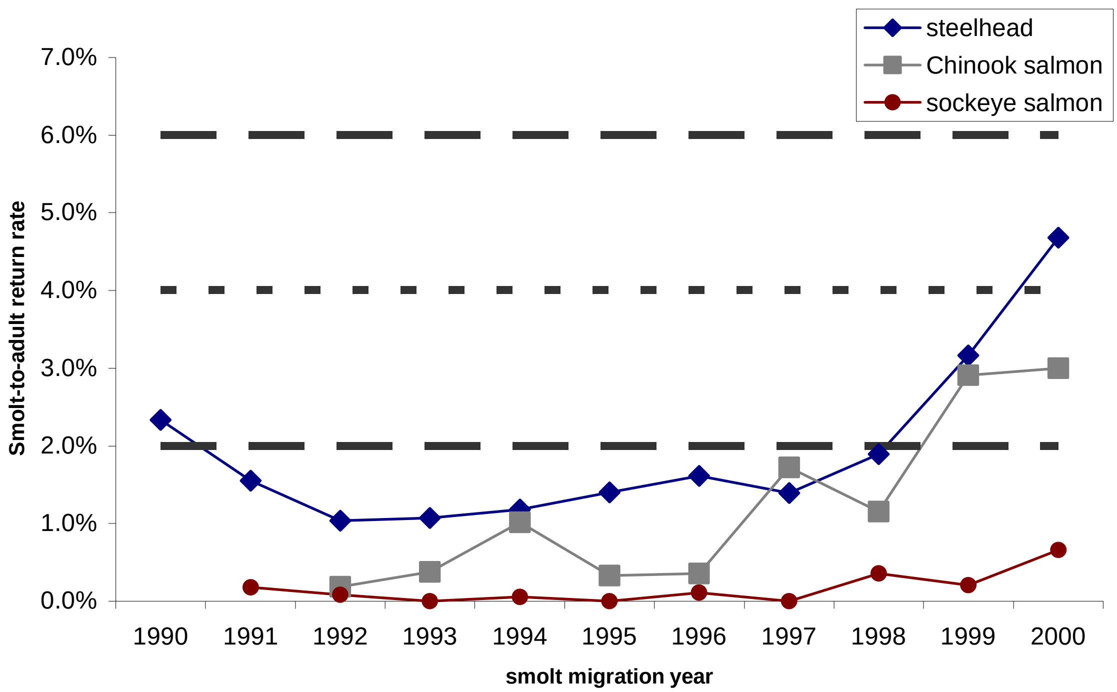

Figure 3-12. Smolt-to-adult return (SAR) rates by smolt migration year for wild/natural Chinook and sockeye salmon and steelhead. Chinook salmon and steelhead SARs were calculated at Lower Granite Dam. Data for Chinook salmon SAR are from Petrosky *et al.* (2001), updated with estimates from Berggren *et al*. (2003). Steelhead SAR data are from Marmorek *et al.* (1998), updated with unpublished IDFG data. Sockeye salmon SAR was calculated at the trap located on Redfish Lake Creek from methods in Hebdon *et al*. (in press). The horizontal lines represent the range and mean SAR targets set by the NPCC in the 2003 mainstem amendments (NPCC 2003).

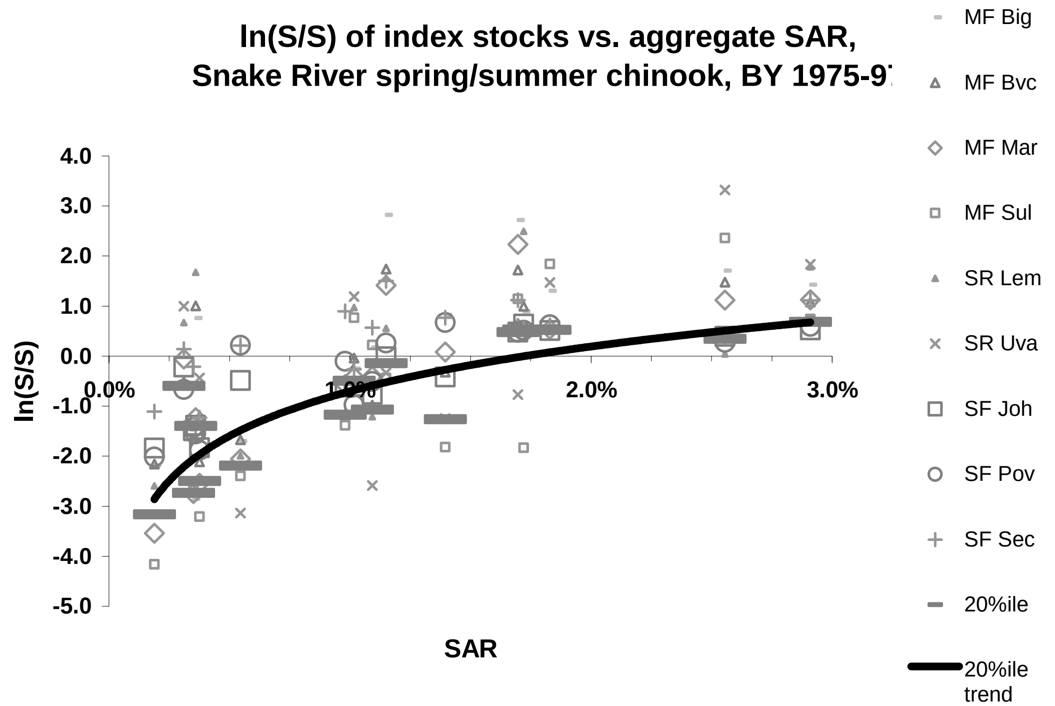

Figure 3-13. Spawner to spawner ratios (S/S) by aggregate smolt-to-adult return rates measured at Lower Granite Dam for index stocks of spring/summer Chinook salmon in the Salmon subbasin for brood years 1975 to 1997. Values for ln(S/S) > 0.0 indicate increasing population trends and for ln(S/S) < 0.0 indicate declining populations. Index stocks were identified by major drainage and index locations: MF = Middle Fork Salmon River, SR = Salmon River, SF = South Fork Salmon River, Big = Big Creek, Bvc = Bear Valley Creek, Mar = Marsh Creek, Sul = Sulfur Creek, Lem = Lemhi River, Uva = Upper Valley Creek, Joh = Johnson Creek, Pov = Poverty Flats, Sec = Secesh River. Methods are from Beamesderfer *et al*. (1997), updated with data from IDFG.

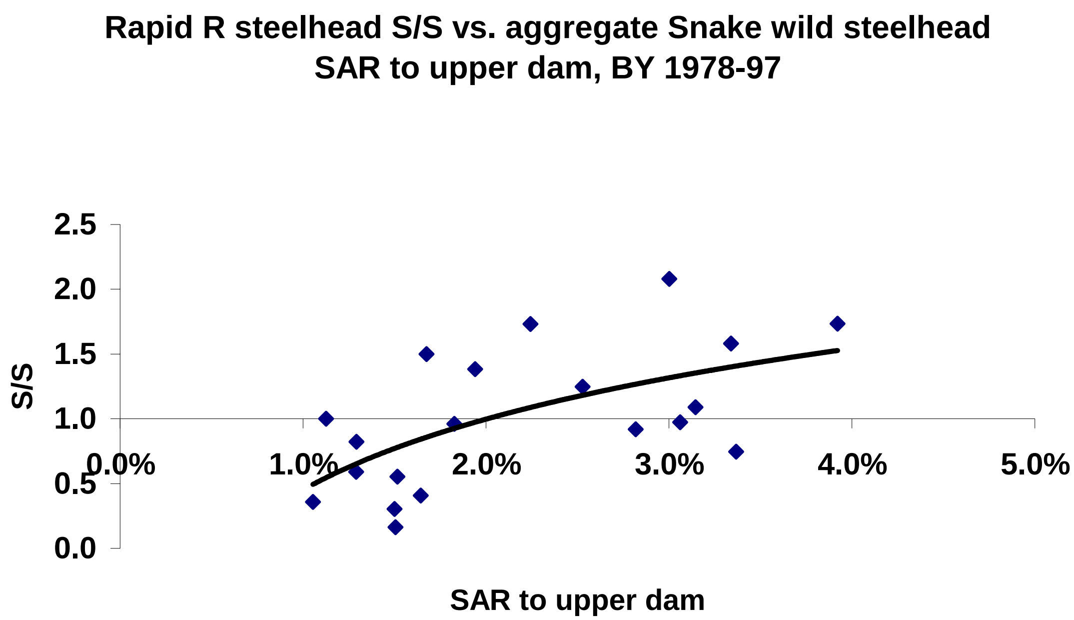

Figure 3-14. Spawner –to-spawner ratios (S/S) by aggregate smolt-to-adult return rates measured at Lower Granite Dam for wild steelhead captured at Rapid River in the Salmon subbasin for brood years 1978 to 1997. Values for S/S > 1.0 indicate increasing population trends and for S/S < 1.0 indicate declining populations (IDFG data).

3.2.2 Terrestrial Resources

For terrestrial assessment purposes, out-of-basin effects in the Salmon subbasin will be discussed in terms of the following categories:

- Nutrient cycling
- Invasive exotic weeds
- Insect and disease outbreaks—natural and unnatural
- Invasive exotic wildlife
- Habitat linkages
- Genetic linkages
- Development
- Habitat loss
- Climate cycles—short term and long term

3.2.2.1 Nutrient Cycling

Salmon declines are traditionally viewed in terms of species extinction and diminishing supply for sport and commercial fishing. Therefore, salmon recovery has focused on production hatcheries, mainstem migration, and harvest constraints. However, wild salmon returning from the ocean to spawn bring vital nutrients with them to the watershed. Through decomposing carcasses, wild adult salmon spawning offers a vital source of food not just for other fish species, but also for a whole host of organisms in the watershed. Therefore, wild spawning salmon heighten nutrient cycling and are vital to ecosystem health (Gresh *et al*. 2000).

Large-scale reductions in returning adult salmon and steelhead may have significant consequences to terrestrial focal habitats and ecosystems in the Salmon subbasin. Anadromous fish return significant amounts of marine nutrients (carbon, nitrogen, and phosphorous) to their freshwater streams and the associated riparian areas (Mathisen 1972, Larkin and Slaney 1997). The importance of this nutrient source has been documented in coastal systems (Kline 1994, Bilby *et al*. 1996). Levin *et al*. (2003) suggested that a decrease in marine-derived nutrients might be increasing the density-dependent mortality in the Salmon subbasin. Preliminary information suggests that productivity of streams in the headwater areas of the Salmon subbasin is co-limited by nitrogen and phosphorous (Andy Kohler, Shoshone-Bannock Tribes Fisheries Department, personal communication). The effects of reducing the input of marine-derived nitrogen on ecosystems in the Salmon subbasin have only recently being investigated.

Many wildlife species feed on anadromous fishes of several life-history stages (Willson and Halupka 1995). There is evidence that the availability of anadromous fish is critically important for the survival or reproduction of some wildlife species. In some regions, anadromous fish in fresh water appear to be keystone food resources for vertebrate predators and scavengers, forging an ecologically significant link between aquatic and terrestrial ecosystems (Willson and Halupka 1995). The spatial distribution of anadromous fish in fresh water, including the occurrence of runs in very small streams, has important consequences for wildlife biology (social interactions, distributions, activity patterns, and survivorship) and conservation biodiversity (Willson and Halupka 1995).

In Idaho, anadromous fish were once found in more than 60% of the state (IDFG 1992a). Wild anadromous fish abundance in Idaho is now approximately 1% of estimated predevelopment abundance (NRC 1996), and greater than 80% of all returning fish are now of hatchery origin (ISG 1999). In contrast to wild stocks, hatchery fish are incubated and raised in hatcheries, and for the most part, they also return to hatcheries, reducing the distribution of nutrients from returning adults. In the Pacific Northwest, this situation means that an estimated 20 to 40% fewer wild fish spawn in watersheds than did historically, and only 5 to 7% of the marine-derived nutrients returned by spawning salmon are being delivered to streams (Gresh *et al*. 2000). This is a nutrient deficit of 5 to 7 million kilograms of marine-derived nutrients per year in areas where anadromous fish were historically abundant. This reduction in nutrients is one indication of ecosystem failure that may contribute not only to the downward spiral of salmonid abundance and diversity, but may also impact the terrestrial focal species and habitats dependent on those nutrient resources (Gresh *et al*. 2000).

3.2.2.2 Invasive Exotic Weeds

The issues of noxious and invasive exotic weeds and the effects they are having on the Salmon subbasin habitats have been discussed in detail in other sections (affected watersheds in sections 2.3.9, 3.1 and 3.2.1.2). Out-of-basin effects with regards to noxious and invasive exotic weeds in the Salmon subbasin, result from the influx of people, livestock, and equipment into the subbasin for various work or recreational activities (Karl *et al*. 1996). The Salmon subbasin is one of the premier recreational destinations in the Pacific Northwest because of its fishing, hunting, and water sports opportunities. The rapid spread of many noxious and invasive exotic weeds in the Salmon subbasin can be attributed to human activities that bring “contaminated” equipment, gear, livestock, and livestock supplies into the subbasin from areas outside (Karl *et al*. 1996, NISC 2003). State, federal, and nongovernmental organizations are collaborating to document and track the spread of noxious weeds (USNAL 2004). The science of invasive species management seeks to develop management tools, technologies, and strategies for effective control of noxious weeds at the appropriate landscape scales (TNC 2003).

3.2.2.3 Insect and Disease Outbreaks

Both insect and disease outbreaks are natural and common events in the Salmon subbasin. Generally, most insect infestations are localized occurrences with little impact or ramifications at larger scales (Amman and Cole 1983). However, given the altered functionality of some aspects of the environment, each additional disruption of ecological function becomes cumulative and leads to further decline of environmental integrity (section 2.3.9).

Deleterious disease outbreaks in the form of whitebark pine blister rust are discussed in detail in section 2.3.7. Regarding insect and disease outbreaks in the Salmon subbasin, out-of-basin effects may be discussed in terms of vectors and pathways (NISC 2003). Pathways are the means by which species are transported from one location to another. Natural pathways include wind, currents, and other forms of dispersal that specific species have developed morphologically and behaviorally (NISC 2003). Man-made pathways are those that are enhanced or created by human activity. These are characteristically of two types (NISC 2003).

The first type is intentional or the result of a deliberate action to translocate an organism. Examples of intentional introductions include the intended movement of living seeds, whole plants, or pets. A specific intentional pathway can only be judged by the positive or negative impact of the organisms being moved (NISC 2003).

The second type is the result of unintentional movement of organisms. Examples of unintentional pathways are ballast water discharge (e.g., red-tide organisms), soil associated with the trade of nursery stock (e.g., fire ants), fruit and vegetable importation (e.g., plant pests), and the international movement of people (e.g., pathogens). In these and countless other unintentional pathways, the movement of species is an indirect byproduct of our activities (NISC 2003).

3.2.2.4 Invasive Exotic Wildlife

Invasive exotic wildlife may have significant impacts on Salmon subbasin aquatic and terrestrial habitats and species. Although neither species is currently documented in the Salmon subbasin, two species of exotic wildlife with potential negative impacts to Salmon subbasin focal habitats and species include the New Zealand mudsnail and the bullfrog.

The New Zealand mudsnail was most likely introduced to Idaho from imported products at a fish hatchery near Hagerman, Idaho, from which it was widely disseminated through trout stocking (Bowler 1991). This western American strain is colonial and apparently did not bring the normally associated trematode parasites with it. Without its natural enemies, the mudsnail has spread uncontrolled through some of the most productive waters in North America (Bowler 1991). The mudsnail has a tremendous propensity to populate its environment rapidly, and upward of 700,000 mudsnails per square meter have been found in some waters. The mudsnail does not appear to be self-limiting from density-dependent effects. Their sheer numbers dominate the base of the food web, and they can consume over 80% of a river’s productivity (Bowler 1991). Though quantitative analysis is not yet published, it appears quite likely that the presence of large numbers of New Zealand mudsnail can have a profoundly negative impact on a trout or salmon fishery with subsequent negative impacts to terrestrial resources.

In 2003, the New Zealand mudsnail is documented at six locales in the Salmon subbasin. These sites include the Tower Creek campground, Pahsimeroi at Burnstedt Lane, the mouth of the Pahsimeroi, the Salmon River below Pahsimeroi, Salmon River at Bruno's landing (below Challis) and the Squaw Creek steelhead release pond.

Introduced predators such as the bullfrog can have devastating effects on faunas that evolved without equivalent predatory types (Schwalbe and Rosen 1988). The bullfrog, as an exotic in the absence of key original enemies (the basses, pikes, snapping turtles, and water snakes of the eastern United States), attains tremendous population densities. Such nonnative predators, in core population areas of native species, can lead to regional extinctions and may account for some unexplained amphibian declines (Schwalbe and Rosen 1988).

3.2.2.5 Habitat Linkages

Maintaining wild habitats that support the long-term survival of native wildlife populations throughout the Columbia River basin and providing for the continued course of the region's large-scale evolutionary and ecological processes require scientific and conservation action at the continental scale (Noss and Soule 1998, Robinson *et al*. 2004).

Habitat fragmentation has been recognized as a major threat to the survival of natural populations and the functioning of ecosystems. The reduction of large, more or less continuous habitats to small and isolated patches may affect the abundance and species composition of those living in the area (Martin *et al*. 2000). Some factors that may contribute to this decline include changes in predation or food availability, microclimatic effects, loss of genetic variation, and lack of recolonization following local extinctions (Noss and Soule 1998, Robinson *et al*. 2004).

Unfortunately, the effects of this widespread habitat fragmentation on populations remain unknown. Some of the species affected may be dominant carnivores and act as "keystone predators." These are species whose removal dramatically alters the composition of ecological communities by resulting in the decline and extinction of some species and marked increase in others (Noss and Soule 1998, Carroll *et al.* 2001, Robinson *et al*. 2004).

Although certain species have much more influence than others on an ecosystem's structure, not all ecosystems include a single species that exerts such a pervasive influence. In fact, most ecosystems are somewhat sensitive to the loss of any one of many species, though some losses have greater impact on the system than others (Noss and Soule 1998, Woodroffe and Ginsberg 1998, Gittleman *et al*. 2001, Mattson and Merrill 2002, Robinson *et al*. 2004).

One of the approaches that conservation biology implements to mitigate the effects of habitat fragmentation is the development of habitat reserves and linkages. All species require a minimum amount of habitat for survival. Wildlife habitat reserves are established to meet these requirements for as many species as possible. Some national parks, wilderness areas, and other protected habitats are suitable for the survival of a wide range of species (Noss and Soule 1998, Haila 1999, Robinson *et al*. 2004). Maintaining connectivity or "linkage" between wildlife populations across the landscape will make for healthier populations and could prevent many of the detrimental consequences of habitat fragmentation. Maintaining opportunities for wildlife movement across the landscape preserves the natural processes that animals have used for centuries (Servheen and Sandstrom 1993, Ruediger *et al*. 1999, Ruediger *et al*. 2000).

The physical representation of a subbasin or watershed is defined primarily by the geomorphology of the landscape and secondarily by humans seeking to understand complex ecosystem structure and function in a context that is comprehensible. The functional components of the landscape do not necessarily "recognize" the anthropogenic or natural boundaries that are used to describe the environment. Habitat fragmentation, either natural or anthropogenic, may become an out-of-basin effect, if a specific functional components becomes limited outside of the subbasin, thereby increasing the importance or significance of that component inside the subbasin.

3.2.2.6 Genetic Linkages

Other effects of habitat fragmentation can be changes in population structure resulting from changes in dispersal patterns. As fragmentation proceeds, dispersal from one habitat fragment to another becomes more difficult. Many studies have addressed the threats to the small populations resulting from the fragmentation of formerly large populations (Noss 1991). The basic idea is that local populations become separated so widely that their demography and genetic dynamics become independent of one another, which may eventually lead to local extinctions and/or loss of genetic variation (Noss and Soule 1998, Robinson *et al*. 2004).

Regional groups of interconnected populations are called metapopulations. These metapopulations are, in turn, connected to one another over broader geographic ranges. As local populations within a metapopulation fluctuate in size, they become vulnerable to extinction during periods when their numbers are low. Extinction of local populations is common in some species, and the regional persistence of such species is dependent on the existence of a metapopulation (Flather *et al*. 1998). As a result, the elimination of a portion of the metapopulation structure of some species can increase the chance of regional extinction of the species (Noss and Soule 1998, Robinson *et al*. 2004).

Out-of-basin losses of metapopulation structure may have important ramifications to aquatic and terrestrial components of the landscape within the Salmon subbasin.

It is relatively easy to comprehend the significance of the loss of prominent species such as Chinook salmon or the grizzly bear. It is much more difficult to comprehend the role less conspicuous species have in metapopulation structure and ecosystem function. Conserving genetic diversity at landscape scales is essential because genetic variation allows species to adapt and survive environmental changes (Noss and Soule 1998, Robinson *et al*. 2004).

Ecosystem diversity is thought of as the broadest means for protecting species diversity and genetic diversity (Noss 1983). To protect an ecosystem, all the species within that ecosystem must be protected (Groves *et al.* 2002). Populations of many species are not completely isolated but are connected by the movement of individuals (immigration and emigration). Consequently, the dynamics and evolution of many local populations are determined by both the populations' life histories and patterns of movement of individuals between populations (Noss and Soule 1998, Robinson *et al*. 2004).

3.2.2.7 Development

Human impacts on wildlife and habitats have been accelerated in the Salmon subbasin as a result of development of federal hydropower projects in the Columbia River basin. Having a reliable and affordable power source, irrigation water supply, and employment opportunities provided impetus for development of agriculture and other industry (NPCC 2003).

This development has led to increased human disturbance of wildlife populations, increased human use of wildlife, and accelerated habitat losses across the Salmon subbasin. Extirpation of anadromous fishes in adjacent subbasins has led to increased harvest pressure on wildlife for subsistence and cultural and recreational uses in the Salmon subbasin. Factors limiting terrestrial resources in the Salmon subbasin are dominated by modification of forested stands through timber management and combined effects of mining, grazing, agriculture, and residential development, including roads (NPCC 2003). Development, including agriculture, has converted 2.9% of lands in the Salmon subbasin to unvegetated habitats (IBIS 2003).

An artifact of continued development outside of the Salmon subbasin is the increased effect the populace of those out-of-basin subbasins have within the Salmon subbasin. For example, the small high-impact area identified in the southern tip of the Upper Middle Fork watershed results from the effects of urban sprawl from an adjacent subbasin (Appendix 3-1, Figure 6).

While difficult to quantify, the indirect effects of hydropower development can be far-reaching. Mitigation for these effects will address a broader array of habitats and species than the construction loss assessments. Protection of existing high-value habitats and restoration of habitats are viewed as primary goals (NPCC 2003).

3.2.2.8 Habitat Loss

Habitat losses due directly to the construction of the four lower Snake River dams have been identified in the *Lower Snake River Compensation Plan* (LSRCP) process (USFWS 2001). Mitigation for those fish and wildlife habitat losses has been primarily focused on aquatic resources, with an emphasis on hatchery production to mitigate for lost harvest opportunity on salmon and steelhead as a result of dam construction (USFWS 2001). Habitat loss assessments and mitigation efforts have occurred in downstream sections of the lower Snake River (USACE 1990, BPA 1997, NPCC 2003). However, the LSRCP has not addressed impacts to aquatic and terrestrial habitats resulting from the change in abundance and distribution of naturally spawning chinook salmon and steelhead in the Salmon subbasin. The NPCC has a funding process whereby terrestrial and aquatic habitats can potentially receive funding for restorative work. However, the terrestrial components of the landscape have received comparatively little funding (NPCC 2004).

Due to the “more” pristine nature of the habitats in the Salmon subbasin, large-scale environmentally altering events outside the subbasin may influence habitat protection/restoration priorities within the subbasin. Out-of-basin habitat losses with potential ramifications within the Salmon subbasin include the loss of shrub-steppe acreages to fire in the Upper Snake Province. Since 1999, more than 350,000 acres of shrub-steppe habitats in the Upper Snake Province have been lost due to fire (NIFC 2004). Continued losses of shrub-steppe habitats outside the Salmon subbasin may place greater ecological significance on shrub-steppe habitats and obligate terrestrial species within the subbasin(Connelly *et al*. 2000).

3.2.2.9 Climate Cycles

Climatic variation is identified as an out-of-basin effect since research is beginning to show that land-use practices can influence regional climate and vegetation in adjacent natural areas in predictable ways (Pielke *et al*. 1994, Stohlgren *et al*. 1998). Northern ecosystems are expected to be particularly sensitive to climatic changes. In addition, climatic changes are predicted to be most pronounced in the North, with implications for biodiversity, annual growth pattern, forage quality, and carrying capacity for terrestrial species (UNEPWCMC 2004). Climate change is likely to have considerable impacts on most or all ecosystems. The distribution patterns of many species and communities are determined, to a large degree, by climatic parameters, but the responses to changes in these parameters are rarely simple (UNEPWCMC 2004).

At the simplest level, changing patterns of climate will change the natural distribution limits for species or communities. In the absence of barriers, it may be possible for species or communities to migrate in response to changing conditions. Vegetation zones may move toward higher latitudes or higher altitudes following shifts in average temperatures. In most cases, natural or man-made barriers will impact the natural movement of species or communities (UNEPWCMC 2004).

Rainfall and drought will also be of critical importance. Extreme flooding will have implications for large areas, especially riverine and valley ecosystems. Rates of change will also be important, and these rates will vary at regional and even local levels. The maximum rates of spread for some sedentary species, including large tree species, may be slower than the predicted rates of change in climatic conditions (UNEPWCMC 2004). In many cases, further complications will arise from the complexity of species interactions and differential sensitivities to changing conditions among species. Certain species may rapidly adapt to new conditions and act in competition with others (UNEPWCMC 2004). Negative impacts may include increased ranges of insect pests and diseases, as well as failure of crops in some regions from drought or flooding (UNEPWCMC 2004).

Mesoscale atmospheric/land-surface modeling, short-term trends in regional temperatures, forest distribution changes, and hydrology data indicate that the effects of land-use practices on regional climate may overshadow larger-scale temperature changes commonly associated with observed increases in carbon dioxide and other greenhouse gases (Pielke *et al.* 1994, Stohlgren *et al*. 1998).

4 Inventory/Synthesis

4.1 Inventory

A component of the assessment process is the examination of previous and current management actions (projects) that seek to address limiting factors in the Salmon subbasin. Appendix 4-1 provides a list of fish and wildlife habitat restoration projects being conducted in each watershed, along with project implementation and funding information. This inventory is a collection of information from technical and planning team participants, from websites of funding and implementation agencies, and through interviews of nonparticipants. Due to the size and complexity of the Salmon subbasin, it is likely that not all activities that have taken place in the last five years have been captured. However, we believe that the information provided is representative of the types of activities taking place.

4.1.1 Existing Protection

The Salmon subbasin contains considerable wilderness, roadless, and other protected areas (discussed in section 1.6.4). The Frank Church–River of No Return Wilderness Area in the Salmon subbasin is the largest contiguous wilderness area in the lower 48 states and, by law, is to be preserved in its natural state for future generations. Additional protection for aquatic habitat is provided through wild and scenic rivers designation. Together these protected habitats function as reference and control habitats relative to management actions to restore fish and wildlife in the Columbia basin.

This assessment identifies areas where restoration will improve focal habitats and populations in the Salmon subbasin. Much of the altered habitat in the Salmon subbasin is still capable of supporting focal species, once it is restored or rehabilitated, because impacts have altered or attenuated ecosystem processes rather than resulted in whole-scale habitat loss or permanent conversion such as might result from urbanization or large-scale dam building (Class 1 or 2 waters from National Research Council 1996, Upstream, p. 208).

4.1.2 Existing Management Plans and Programs

The Salmon subbasin summary presented a comprehensive list of management programs or initiatives with significance to fish, wildlife, water resources, riparian areas, and/or upland areas (NPCC 2001, see also Appendix 4-1). We were unable to find additional private, county, or local plans dealing with fish and wildlife management. The following is a list of other planning and management efforts initiated or completed since the subbasin summary:

1. *Frank Church–River of No Return Wilderness Management Plan* (www.fs.fed.us/r4/sc/recreation/fcronr/rod/plantoc.pdf)

2. Management indicator species list of the Salmon and Challis land and resource management plans (www.fs.fed.us/r4/sc/projects/mis/ea.pdf)

3. Ongoing fuel-reduction plans (http://www.gao.gov/new.items/d011114r.pdf)

4. Salmon Wild and Scenic River management plan (www.fs.fed.us/r4/sc/projects/3camp/3camp_fseis_jan2003.pdf)

5. Salmon interface watershed assessment (www.fs.fed.us/r4/sc/projects/siwa/siwabrochure.pdf)

6. *Frank Church–River of No Return Wilderness Noxious Weed Treatments*

(www.fs.fed.us/r4/sc/projects/#wildernessweeds)

7. Salmon-Challis National Forest Noxious Weed Management Program (www.fs.fed.us/r4/sc/projects/#noxious_weeds)

8. Morgan Creek and Eddy Creek grazing allotment management plans (www.fs.fed.us/r4/sc/projects/rangenepa/morganeddy/scopingsept2003.pdf)

9. Red tree reduction project information (www.fs.fed.us/r4/sawtooth/redtree/redtreeindex.htm)

10. Salmon River Corridor outfitter/guide permit reissuance (www.fs.fed.us/r4/sawtooth/riverea/rivereaindex.htm)

11. Final environmental impact statement for the Upper and Lower East fork cattle and horse allotment management plan (www.fs.fed.us/r4/sawtooth/eastfork/eastforkindex.htm)

12. *Annual Forest Plan Monitoring Report for the Boise, Payette, and Sawtooth National Forests* (www.fs.fed.us/r4/sawtooth/projects/annualmonitoringreport.pdf)

13. Southwest Idaho Ecogroup—Boise, Payette, and Sawtooth National Forests revised land and resource management plans (www.fs.fed.us/r4/sawtooth/arevision/revision.htm)

14. North Sheep environmental impact statement (www.fs.fed.us/r4/sawtooth/northsheep/nsheepindex.htm)

15. Trapper Creek Vegetation Project (www.fs.fed.us/r4/sawtooth/trappercreek/trappercrkindex.htm)

16. Clearwater and Nez Perce Forest Plan revision (www.fs.fed.us/cnpz/)

17. IDFG *Wolf Management Plan* (www.accessidaho.org/species/id_wolf_cons_plan.pdf)

18. State of Idaho *Yellowstone Grizzly Bear Management Plan* (fishandgame.idaho.gov/wildlife/plans/grizzly_plan.pdf)

Ongoing public management programs are consistent with the direction of this assessment with respect to the universal goals of protecting or restoring fish, wildlife, and ecosystem resources. Further, federal planning cycles typically incorporate an adaptive management scheme where pertinent objectives and strategies “evolve” as new information is collected and incorporated into the decision-making process. Because a large portion of the information presented in this assessment is based on information previously used in existing management plans, as well as more site-specific information, this assessment should enhance future fish and wildlife related planning, prioritization, and implementation efforts.

The direction and focus of existing management plans and ongoing management programs appear to address many of the fish and wildlife issues identified in the Salmon subbasin assessment. However, lack of implementation of existing plans due to funding, legal, and political constraints inhibits the protection and restoration of fish and wildlife resources. Furthermore, habitat restoration efforts may take years before effects are fully realized.

4.1.3 Habitat Restoration and Conservation Projects

The inventory for the Salmon subbasin identified 481 projects with objectives targeting a variety of fish and wildlife species and/or habitat management issues. Project descriptions are located in Appendix 4-1. The majority of the work being conducted in the

Salmon subbasin focuses on aquatic and riparian components of the landscape, which also provide benefits to terrestrial animals.

We classified the 481 habitat restoration projects into 12 activity categories based on project descriptions. The categories and criteria used to classify projects are summarized in Table 4-1. If a project included numerous activities, the project was credited in all applicable categories. The values only represent numerical tallies of project categories.

Table 4-1. Project activity categories and criteria for habitat restoration projects identified in the Salmon subbasin.

Project Activity	Criteria for Classification
Wetland restoration	Specifically mentioned purpose of "wetland restoration"
Upland habitat protection	Identified protection of habitat other than riparian or stream
Riparian fencing	Provided riparian habitat with natural (passive) recovery opportunity
Water conservation	Discussed diversion consolidation, conversion to more efficient methods, or retiring of the water right
Stream structure	Mentioned placement of structures (bank barbs, drop structures) to prevent erosion or protect/create habitat
Road/trails	Involved modification, moving, or closing of roads and trails to reduce sediment or protect habitat
Access management	Pertained to recreation access (campgrounds, boat ramps) designed to reduce sediment or protect habitat
Fish passage	Allowed or increased fish movement (culvert replacement, dam modification)
Grazing management	Designed to protect habitat while allowing limited grazing typically in riparian areas
Riparian restoration	Discussed active work on riparian areas including vegetation planting
Diversion	Modified existing water diversion structure including fish screening or consolidation
Channel restoration	Reconnected side channels or eliminated stream crossings
Miscellaneous	Included projects that were unclassifiable

Survey and monitoring information was collected separate from the project inventory and has not been incorporated into the database. If the number of reported projects were used as an index of priority for restoration or protection projects, then the Upper Salmon, South Fork Salmon, and Lemhi watersheds would rank the highest. Funding for projects in the Salmon subbasin was overwhelmingly federal, with 58% of reported projects indicating some type of federal funding. Bonneville Power Administration funding, which was not included in the federal estimates, accounted for part or all of 18% of projects in the subbasin (Figure 4-1).

Our information indicates that 235 km (146 miles) of riparian fencing and 385 km (239 miles) of road or trail modification have been conducted in the Salmon subbasin, primarily to restore aquatic habitat and fish species. An additional 250 km (155 miles) of riparian habitat adjacent to important streams had significant modifications made to the grazing regimes to reduce impacts to riparian vegetation. Riparian fencing projects could be classified primarily as passive (allowing natural processes to restore the habitat). Active riparian restoration (such as planting native vegetation) was reported only occasionally, and as would be recommended, these projects were most often completed after fencing removed the cause of the alteration. Many of the riparian projects were conducted on private land with the cooperation of private landowners. This type of effort is vital, especially in areas upstream of the Middle Fork Salmon River where the large percentage of Chinook salmon and steelhead spawning occurs in streams bordered by private land. Road and trail management involved decommissioning, active modification of surface or drainage patterns, or complete relocation. Road and trail activities in the Salmon subbasin were largely designed to reduce sedimentation and protect wildlife habitat. Watersheds upstream of the Middle Fork Salmon River were most likely to have habitat blocked or fragmented from access by anadromous or resident fish, primarily due to dewatering of streams by water diversion. These areas were also the focus of two water savings efforts that attempt to increase flows and reduce dewatering through the acquisition of water through purchase or lease.

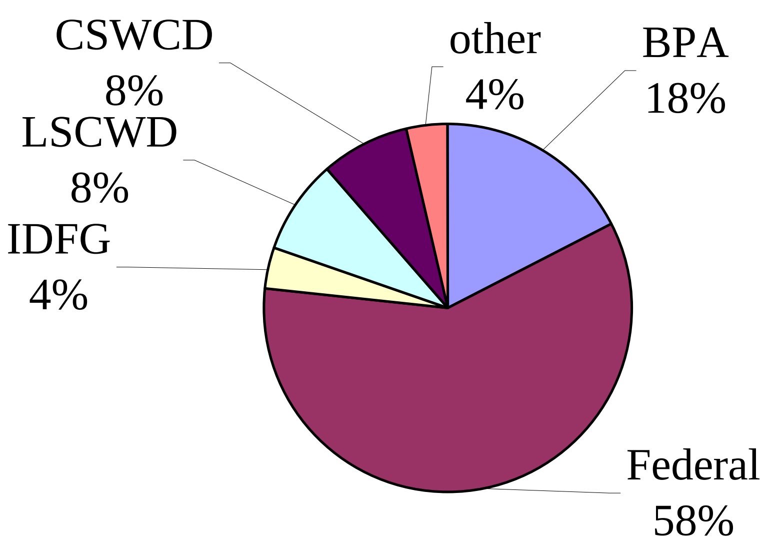

Figure 4-1. Funding breakdown for habitat restoration projects in the Salmon subbasin identified during the assessment process, BPA = Bonneville Power Administration; Federal = U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, NOAA Fisheries, and Bureau of Reclamation; IDFG = Idaho Department of Fish and Game; LSCWD = Lemhi Soil and Water Conservation District; CSWCD = Custer Soil and Water Conservation District; Other = private, Natural Resources Conservation Service, Idaho Department of Transportation, Idaho Department of Environmental Quality, Idaho Soil Conservation Commission, and Resource Advisory Committees.

4.1.3.1 Upper Salmon Watershed

The Upper Salmon watershed contains 5 spring/summer Chinook salmon populations, 2 steelhead populations, 20 bull trout local populations, and the only remaining sockeye salmon population in the Snake River basin. The importance of this watershed for listed fish is high. This watershed, which had the highest reported number of projects (151) aimed at restoring fish and wildlife habitat, was also the only one in the Salmon subbasin that reported activity in all 12 of our habitat restoration categories. The activities reported as occurring most frequently in the Upper Salmon watershed include water diversion modifications, riparian fencing, and access management (Figure 4-2). Based on our information, an estimated 63 km (39 miles) of stream habitat have been protected through riparian fencing, and 32 km (20 miles) of road or trail have been altered to reduce impacts to stream habitats from sedimentation. Through the state water bank, the Idaho Department of Water Resources (IDWR) has leased water to maintain flows (on a willing seller basis) in Fourth of July and Beaver creeks. Due to the large amount of recreation in this watershed, managing impacts of human access was also important. Project funding was most often reported as federal or Bonneville Power Administration sources.

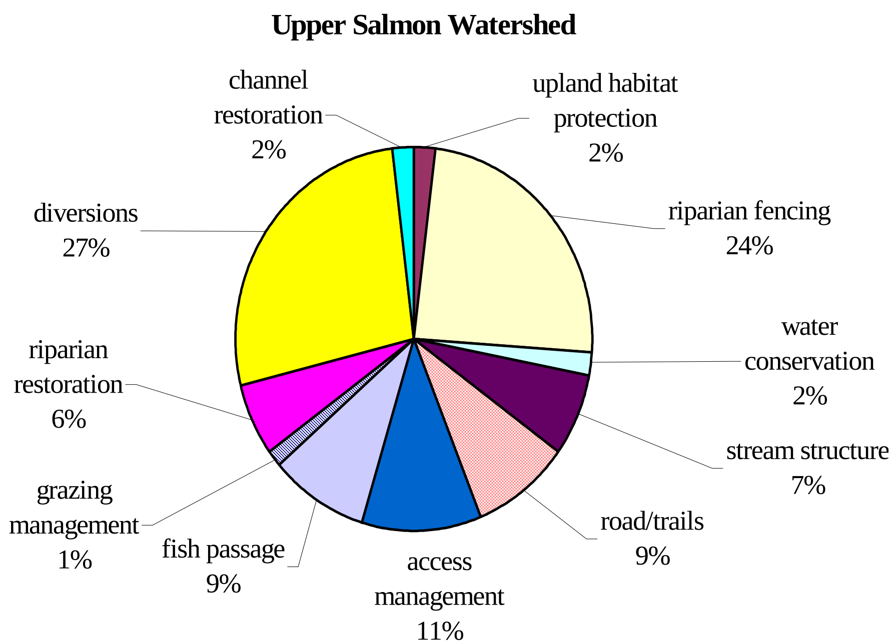

Figure 4-2. Summary of habitat restoration activities in the Upper Salmon watershed identified during the assessment process.

4.1.3.2 Pahsimeroi Watershed

We identified and ranked 20 projects designed to restore fish and wildlife habitat in the Pahsimeroi watershed. Riparian fencing represented over half the project effort in the watershed, with diversion modification the next most common activity reported (Figure 4-3). Despite the relatively low number of projects, an estimated 50 km

(31 miles) of river habitat have been fenced to improve or maintain riparian habitat, and 2.6 km (1.6 miles) of road have been altered to reduce sediment production. All diversions in waters accessible to anadromous fish have been screened. Project funding in the Pahsimeroi watershed was often identified with the Bonneville Power Administration, other federal agencies, or the Custer County Soil and Water Conservation District.

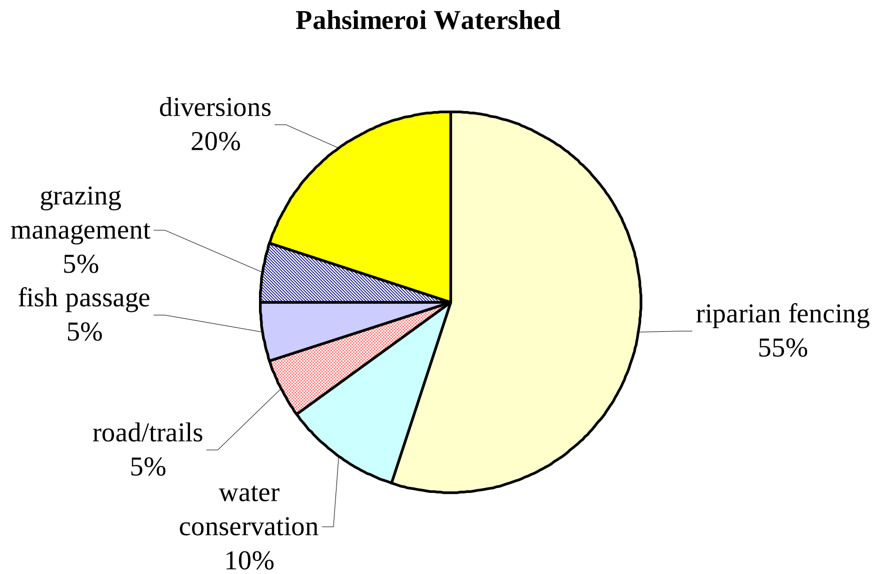

Figure 4-3. Summary of habitat restoration activities in the Pahsimeroi watershed identified during the Salmon subbasin assessment process.

4.1.3.3 Lemhi Watershed

The habitat enhancement activities that have occurred in the Lemhi watershed are, to a large extent, the result of cooperative relationships developed over the last decade between groups involved in the Upper Salmon Basin Model Watershed Project (Loucks 2000). We identified 96 projects directed at improving fish and wildlife habitat in the Lemhi watershed. We focused our efforts on summarizing information about projects started within the last five years, although we have projects from as far back as the 1980s. Based on our data, an estimated 106 km (66 miles) of stream habitat have been fenced to improve or maintain riparian habitat conditions and bank stability, an estimated 238 km (148 miles) of stream have had significant alterations made to adjacent grazing activities to reduce impacts to riparian vegetation, and an estimated 35 km (22 miles) of road or trail have been altered to reduce sediment impacts and protect wildlife. A total of 18 diversions have been eliminated in the Lemhi watershed through consolidation, conversion to pumping, or conversion to sprinkler irrigation. Additionally, all diversions in waters accessible to anadromous fish have been screened. The Lemhi River also contains the only water bank in the State of Idaho that is designated for maintaining instream flow. The IDWR also leases water with Bonneville Power Administration funds to maintain flows in Kenney Creek. Our information indicates that riparian fencing, grazing management, water diversion modifications, and water conservation were the most common habitat restoration activities undertaken in the Lemhi watershed (Figure 4-4). The Lemhi watershed has the only state-legislated water bank designated to maintain natural flows in Idaho. Currently, the IDWR leases water to maintain flows in Kenney Creek. Project funding was most often identified with the Bonneville Power Administration, Lemhi Soil and Water Conservation District, and federal sources.

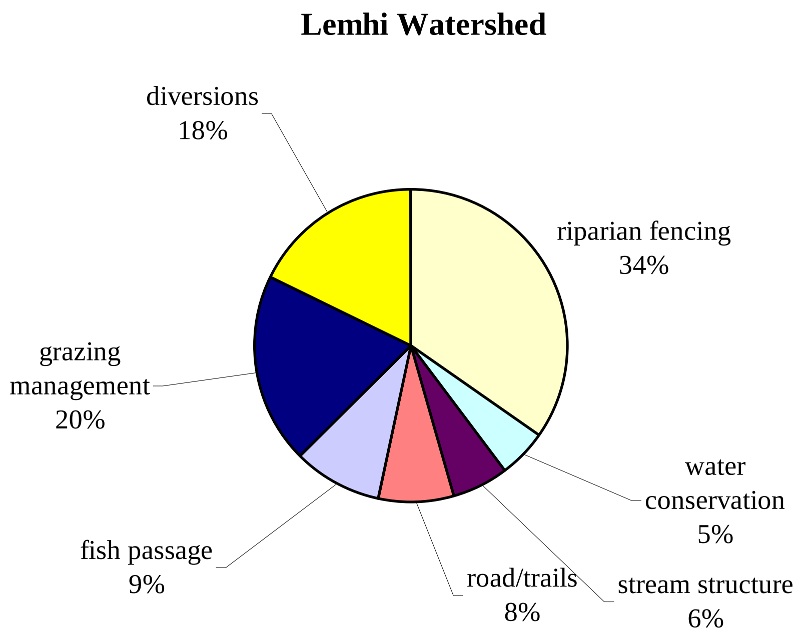

Figure 4-4. Summary of habitat restoration activities in the Lemhi watershed identified during the assessment process.

4.1.3.4 Middle Salmon–Panther Watershed

We identified 56 projects designed to restore fish and wildlife habitat in the Middle Salmon–Panther watershed. Habitat restoration activities reported most frequently in the Middle Salmon–Panther watershed included instream structures and fish passage improvement (Figure 4-5). Riparian fencing, road and trail work, and diversion modification were also reported. An estimated 10 miles of stream habitat have been fenced to improve or maintain riparian habitat conditions, 11 km (7 miles) of stream have had significant alterations made to grazing practices to reduce impacts to riparian vegetation, and 31.4 km (19.5 miles) of road or trail have been altered to reduce sediment impacts and protect wildlife. Project funding was most often identified as federal. The Panther Creek drainage is undergoing a substantial cleanup effort designed to reduce the legacy of mining-related impacts.

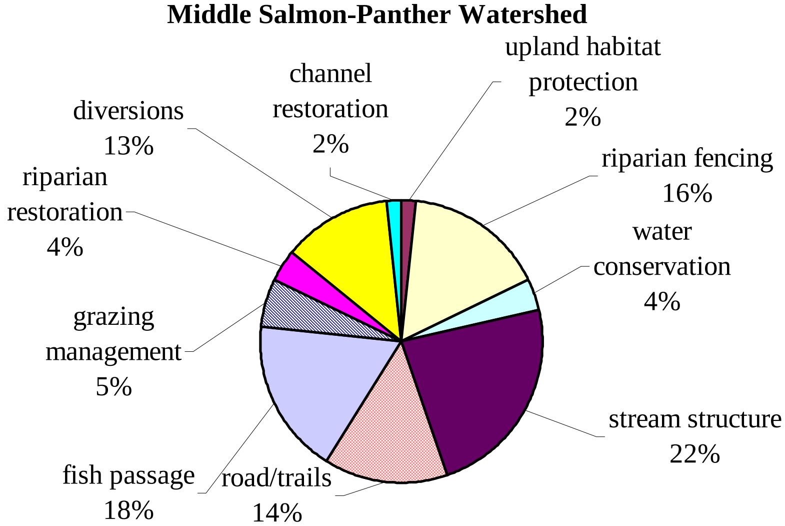

Figure 4-5. Summary of habitat restoration activities in the Middle Salmon–Panther watershed identified during the assessment process.

4.1.3.5 Upper and Lower Middle Fork Salmon Watersheds

The Upper and Lower Middle Fork Salmon watersheds are primarily located within wilderness boundaries; therefore, very few projects (12) were identified. The habitat restoration projects that did take place were primarily for areas outside the wilderness boundaries and consisted primarily of road or trail management, riparian habitat fencing, and stream structure restoration (Figure 4-6). Funding for projects was most often reported as Bonneville Power Administration, federal, or IDFG sources.

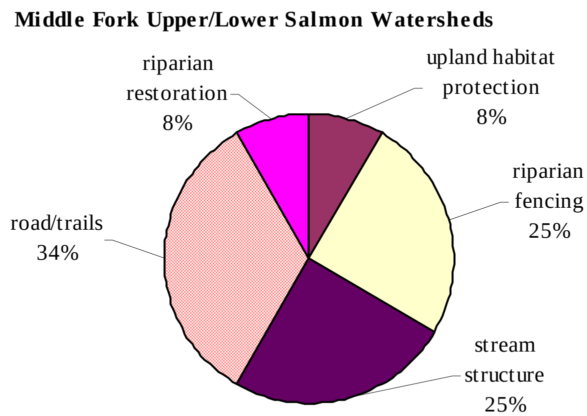

Figure 4-6. Summary of habitat restoration activities in the Upper and Lower Middle Fork Salmon watersheds identified during the assessment process.

4.1.3.6 Middle Salmon–Chamberlain Watershed

This watershed is partly within the wilderness boundary, and the fewest (4) projects were associated with this watershed (Figure 4-7). The projects that were identified were aimed at fish passage, road or trail management, upland habitat protection, and channel restoration. Funding for projects in this area was most often reported as either federal or Bonneville Power Administration sources.

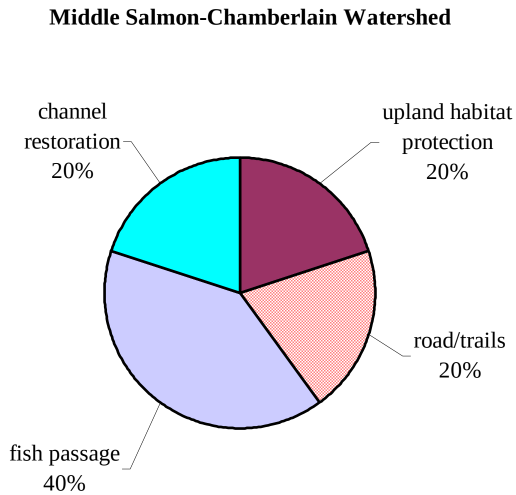

Figure 4-7. Summary of habitat restoration activities in the Middle Salmon–Chamberlain watershed identified during the assessment process.

4.1.3.7 South Fork Salmon Watershed

We identified 114 projects in the South Fork Salmon watershed designed to restore fish and wildlife habitat. The projects that were identified were aimed primarily at road or trail management and access management (Figure 4-8). The South Fork Salmon watershed also had the highest number (9) of reported wetland restoration projects in the subbasin. Funding for projects in this area was most often reported as federal sources.

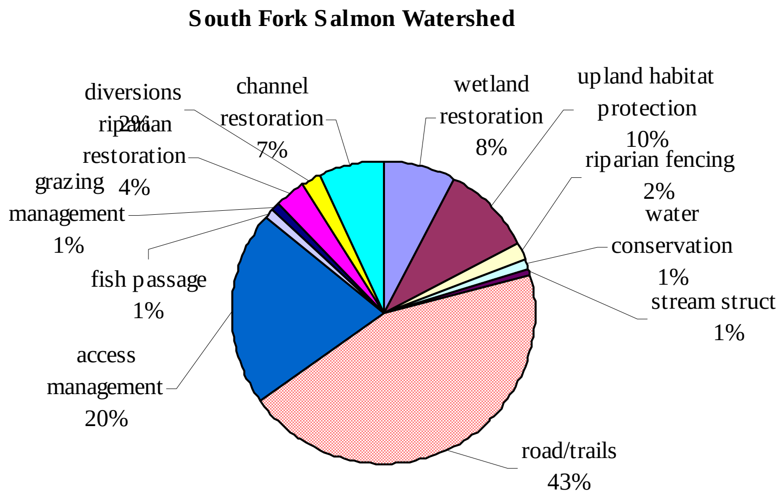

Figure 4-8. Summary of habitat restoration activities in the South Fork Salmon watershed identified during the assessment process.

4.1.3.8 Little Salmon Watershed

We identified 20 projects in the Little Salmon watershed designed to restore fish and wildlife habitat (Figure 4-9). The projects that were identified were primarily riparian restoration, riparian fencing, and road or trail management. Funding for projects in this area was most often reported as federal sources.

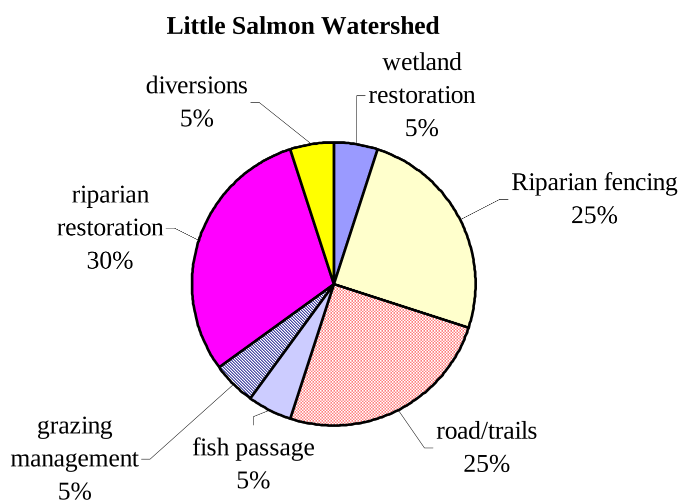

Figure 4-9. Summary of habitat restoration activities in the Little Salmon watershed identified during the assessment process.

4.1.3.9 Lower Salmon River Watershed

We identified 8 projects in the Lower Salmon watershed designed to restore fish and wildlife habitat. The projects that were identified were primarily upland habitat protection, road or trail management, and wetland restoration (Figure 4-10). Funding for projects in this area was most often reported as federal sources. The Lower Salmon watershed also reported several conservation easements that allow current land use to continue but restrict further development.

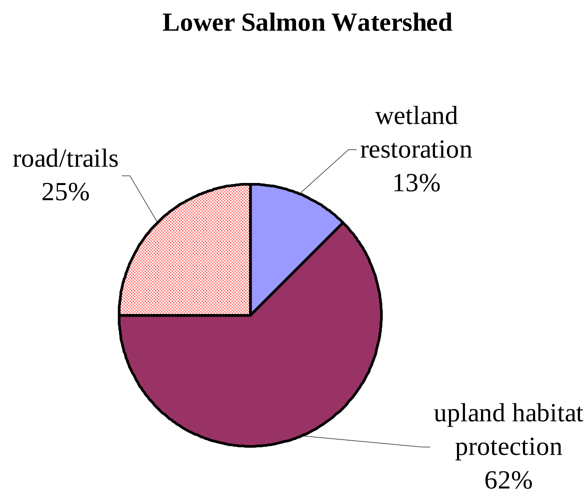

Figure 4-10. Summary of habitat restoration activities in the Lower Salmon watershed identified during the assessment process.

4.1.4 Monitoring and Evaluation Activities

4.1.4.1 Aquatics

Within the Salmon subbasin, state and federal agencies, tribes, and occasionally private parties collect data on focal fish species. Section 2 of this assessment discusses any accessible datasets. However, because new data are constantly being collected, it is impossible to provide an assessment of all available data. Additionally, there is no central location that archives data, nor even a centralized location for project information. Project descriptions and accomplishments collected during this assessment period are presented in Appendix 4-1.

Adult and juvenile salmon and steelhead abundances are estimated at several sites throughout the subbasin (Section 2). Most adult traps are permanent structures associated with hatchery facilities, or they trap only Chinook or sockeye salmon. The adult trap located on Squaw Creek is the only nonpermanent weir operating in the Salmon subbasin.

4.1.5.2 Terrestrial

Terrestrial research, monitoring, and evaluation (RME) activities in the Salmon subbasin are limited in number and scope, with most RME effort expended on threatened, endangered, candidate, or recently delisted species (Appendix 4-2). Focal habitats have received negligible RME effort, resulting in significant data gaps, which inhibit the land management decision-making process. Additional focal habitat information is needed to determine habitat quantity and quality, and population dynamic and abundance information is needed for the focal species dependent on those habitats.

4.1.5 Project Gap Assessment

4.1.6.1 Habitat Restoration

The habitat restoration projects identified in the subbasin inventory address many of the limiting factors identified in the assessment. A topic identified in the assessment, one having great potential to increase habitat quality and quantity for focal fish species, is the reconnection of tributaries that have been dewatered. Progress has been made in the Salmon subbasin in terms of terms of tributary reconnection; however, there is a substantial amount of spawning and rearing habitat for fish focal species in the Lemhi, Pahsimeroi, and Upper Salmon watersheds that is currently inaccessible. The reasons these areas have not been reconnected are primarily social and legal issues. The consensus among technical team members is that aquatic habitats impacted by human actions are steadily improving and continue to do so. It is assumed that the current aquatic habitat (even without reconnections) can now support similar numbers of adult salmon and steelhead to what was observed during the 1950s and 1960s. However, stream reconnections would be of significant benefit to bull trout and other resident fish species, while also improving quantity and quality of habitat available for anadromous fish spawning and rearing.

4.1.6.2 Monitoring and Evaluation

Ideally, aquatic habitat conditions in the Salmon subbasin would be compared using life stage-specific survival information (egg-to-parr, parr-to-smolt, smolt-to-adult) for anadromous fish species collected at a population level. Data at this scale would allow comparisons between years and between populations occupying habitats with varying levels of human alterations. However, in the Salmon subbasin, the only egg-to-smolt survival data available for spring/summer Chinook salmon were collected at the subbasin scale and were not population specific. In addition, because fish are adapted to a range of conditions, this data limitation may not allow us to recognize when a habitat attribute is near the optimum or minimum for a specific population.

Chinook salmon adult abundance and redd count data combined with data on juvenile Chinook salmon emigration have been collected at 10 locations in the Salmon subbasin by the Idaho Supplementation Studies Program (Lutch *et al*. 2003). The data are currently undergoing a thorough quality control revision and standardized analysis and will provide valuable information related to life stage-specific survival information, which will provide additional insight into areas in the subbasin that would benefit from habitat restoration actions (Table 4-2).

Data on adult abundance at the population scale for steelhead are available only for that portion of the population that is spawning upstream of hatchery weirs. Steelhead redd count data were collected in the past in the Salmon subbasin, but this effort was stopped for several reasons. The lack of population-specific adult abundance data or an index of adult abundance (redd counts) for steelhead populations is a major data gap in the Salmon subbasin and severely limits management of these populations.

Resident fish populations in the Salmon subbasin have not received the same level of monitoring afforded to their anadromous counterparts. For bull trout, only the Pahsimeroi watershed had a comprehensive survey effort aimed at identifying distribution and relative population strength. Additional bull trout data are collected incidentally to anadromous fish survey efforts (such as parr monitoring), and the compilation of this data would provide a much better understanding of bull trout population status for each watershed in the Salmon subbasin (a compilation that was beyond the ability of this effort but is being performed for the upcoming Bull Trout Status Review).

Table 4-2. Pending life stage-specific survival data by watershed, stream, the Interior Columbia Technical Recovery Team (ICTRT) population code, and the date collection started.

Watershed	Stream	ICTRT Population Code	Date
Lemhi	Lemhi	SRLEM	1992
Pahsimeroi	Pahsimeroi	SRPAH	1992
South Fork Salmon	South Fork Salmon	SFMAI	1992
Upper Salmon	Upper Salmon	SRUMA	1992
Upper Salmon	West Fork	SRYFS	1998
Upper Salmon	East Fork	SREFS	1993
Upper Middle Fork Salmon	Marsh	MFMAR	1993
South Fork Salmon	Johnson	SFEFS	1998
South Fork Salmon	Lake	SFSEC	1997
South Fork Salmon	Secesh	SFSEC	1997

4.2 Synthesis of Findings

4.2.1 Key Findings

Riparian focal habitats in the Salmon subbasin provide rich and vital resources to subbasin focal fish and wildlife due to their high productivity, diversity, continuity, and critical contributions to both aquatic and upland ecosystems. Riparian areas function as the transition zone between aquatic and terrestrial ecosystems, and aquatic and riparian habitat mutually influence and benefit each other. Thirty-seven species of fish inhabit aquatic habitats, and more than 75% of the Salmon subbasin’s terrestrial vertebrate species use riparian habitats for essential life activities. Properly functioning riparian habitats are critical in creating and maintaining instream conditions necessary for imperiled native fish stocks in the Salmon subbasin. Protecting functioning riparian habitat and restoring altered riparian habitat may yield the greatest gains for fish and wildlife across the landscape, while involving the least amount of total land area and providing the best cost-benefit ratio.

In watersheds upstream from the Middle Fork Salmon River, there are substantial opportunities to improve the quality and quantity of habitat for anadromous fish focal species. These opportunities include reconnecting tributaries, improving riparian habitat, reducing sediment inputs, and removing barriers.

Areas downstream from the Middle Fork Salmon River have been subject to similar impacts but without the loss of access to tributary habitat from dewatering. Aquatic habitat in the South Fork Salmon River is recovering from catastrophic sediment impacts that occurred in the 1960s. Habitat restoration actions appear to have stabilized the sediment impacts in this watershed. Downstream from the Middle Fork Salmon River, opportunities exist to restore riparian habitat and reduce sediment impacts.

Increasing adult salmon and steelhead returns depends on reducing out-of-basin impacts, which appear to have been the largest factor limiting adult returns to the subbasin during the period from 1991 to 1998. As the effects of out-of-basin activities are reduced, as measured by increased smolt-to-adult returns (SARs), quality of freshwater habitat will become more important for populations outside the wilderness areas in the subbasin. While it is important to determine whether improving freshwater habitat within the subbasin can ameliorate out-of-basin impacts, we could not do so with the data available during the preparation of this assessment.

Although the bull trout is the only resident fish focal species included in the assessment, the Salmon subbasin contains populations of westslope cutthroat and resident rainbow trout that are also affected by the habitat alterations impacting anadromous fish. Bull trout (and other resident fish species) are widely distributed in the Salmon subbasin, but populations in many watersheds are fragmented by dewatering and impassable culverts. Removal of identified barriers and continued improvements of riparian habitat will benefit anadromous fish species, bull trout, and other resident fish. Removing barriers to allow access to unoccupied habitat is one of the most positive, certain, and rapid habitat restoration activities for providing long-term benefits to fish (Roni *et al.* 2002).

The Salmon subbasin's terrestrial environment is assessed in terms of seven focal habitats at the watershed scale relative to six primarily anthropogenic activities that limit habitat quantity and quality across the subbasin. For the purposes of this assessment, the definitions of the seven focal habitats are simplifications of extremely complex interactions of natural processes, geomorphology, climate, and land uses across the landscape. During the last 140 years, human influences have had an increasingly significant impact upon structure and function of the environment in the Salmon subbasin. Analyses of focal habitats in the assessment have attempted to determine not only the most significantly altered habitats, but also where they are in the subbasin and what the causes of alterations have been.

The analysis of key ecological functions and environmental correlates for focal habitats and species in the Salmon subbasin showed that there are areas within watersheds that have both increases and decreases in total functional diversity (Figure 2-5). However, the overall trend is a decline in total functional diversity for all focal habitats and species. Focal species closely related to shrub-steppe and native grassland habitats also show significant declines in their total functional diversity. The greater sage-grouse, in particular, has seen a 97% decline in total functional diversity in the shrub-steppe habitat. The vesper sparrow has seen a 94% decline in total functional diversity in the native grassland habitats of the Salmon subbasin. The significance of declining total functional diversity for wildlife species in the Salmon subbasin is that habitats and communities are less resilient and limiting factors are subsequently exaggerated.

We are unable to explain why there are increases in total functional diversity for some of the focal habitats and species in the Salmon subbasin. One possible explanation is that populations within fragmented habitats reach their carrying capacities sooner than they do in connected habitats. This situation may force individuals in populations to migrate to other habitats to find forage, or the populations suffer declines. Certainly, wildlife species move within their preferred habitats, but we have very little information on movements of focal species within their known ranges at the watershed scale. Further, information on population dynamics and abundance of the focal species are also sometimes lacking.

The analysis of key ecological functions and environmental correlates also showed how some species are linked to other species and to their habitats. For instance, some species are critical link species because they are the only species in their habitats to perform certain roles. The American beaver was shown to be a critical link species for the riparian/herbaceous wetlands because it can impound water by creating diversions or dams. Other species, such as the whitebark pine and Clark's nutcracker, have mutualistic relationships. Whitebark pine depends on the nutcrackers for seed dispersal, and the nutcrackers eat the pine seeds. Eighty-seven wildlife species in the Salmon subbasin were shown to have trophic associations with salmonids. Some species such as the black bear, grizzly bear, and marten feed directly on spawning adults or carcasses, while other species benefit indirectly from the presence of the carcasses. Most importantly, species are not performing their ecological roles in isolation. Species are interconnected within communities, and the loss of one species could result in irreversible losses to a community and lowered overall functional resilience.

Below are listed key findings for the terrestrial habitats and species in the Salmon subbasin:

- Altered hydrologic processes have had significant impacts to quantity, quality, structure, and function of aquatic and riparian/herbaceous wetlands focal habitats.

- Numerous water diversion structures in the subbasin have altered hydrologic processes, resulting in significant impacts to terrestrial and aquatic resources.

- An altered fire regime is likely the most significant ecological influence affecting ecosystem structure and function in the subbasin.

- Pine/fir forest expands and encroaches upon aspen and mountain mahogany habitats in the absence of normal fire regimes.

- Invasive exotics have impacted all habitats in subbasin, with negative impacts to biodiversity, forage, habitat quality, soil productivity, and aesthetic quality.

- Pine/fir forest habitats in the Salmon subbasin have greatly altered structure and function due to the effects of an altered fire regime.

- Grazing/browsing activities by sheep and cattle have impacted plant species composition, diversity, and density; disrupted ecosystem functioning; and altered forest dynamics.

- Development, conversion, and other land-use practices have fragmented habitats in all but the most remote watersheds of the subbasin.

- Shrub-steppe habitat quantity and quality have been impacted by the encroachment of western juniper due to an altered fire regime in the subbasin.

- The size and diversity of protected areas in the Salmon subbasin provide important refugia and reference areas for focal habitats and species.

4.2.1.1 Upper Salmon Watershed—Key Findings

1. Approximately 62% of aspen habitat has been lost.
2. Approximately 79% of whitebark pine habitat has been lost.
3. Approximately 82% of native grassland habitat has been lost.
4. Nearly 40% of forested habitats have been impacted by legacy timber-harvest activities.
5. Approximately 50% of the watershed has been impacted by grazing and browsing activities.

4.2.1.2 Pahsimeroi Watershed—Key Findings

1. Approximately 96% of aspen habitat has been lost.
2. Approximately 99.9% of whitebark pine habitat has been lost.
3. Approximately 38% of native grassland habitat has been lost.
4. Approximately 29% of forested habitats have been lost.
5. Nearly 33% of forested habitats have been impacted by legacy timber-harvest activities.
6. The Pahsimeroi watershed is one of the most severely impacted watersheds in terms of habitat fragmentation resulting from landscape conversion, with approximately 64% of the watershed classified as moderately impacted.
7. Approximately 56% of the watershed has been impacted by grazing and browsing activities.

4.2.1.3 Lemhi Watershed—Key Findings

1. Approximately 94% of aspen habitat has been lost.
2. Approximately 99.9% of whitebark habitat has been lost.
3. Approximately 91% of native grassland habitat has been lost.
4. Approximately 22% of forested habitats have been lost.
5. Nearly 66% of forested habitats have been impacted by legacy timber-harvest activities.
6. The Lemhi watershed is one of the most severely impacted watersheds in terms of habitat fragmentation resulting from landscape conversion, with approximately 63% of the watershed classified as moderately impacted.
7. Approximately 56% of the watershed has been impacted by grazing and browsing activities.

4.2.1.4 Middle Salmon–Panther Watershed—Key Findings

1. Approximately 76% of aspen habitat has been lost.
2. Approximately 42% of whitebark habitat has been lost.
3. Approximately 76% of native grassland habitat has been lost.
4. Approximately 10% of forested habitats have been lost.

5. Nearly 56% of forested habitats have been impacted by legacy timber-harvest activities.

6. The Middle Salmon–Panther watershed is one of the most severely impacted watersheds in terms of habitat fragmentation resulting from landscape conversion, with approximately 72% of the watershed classified as moderately to very highly impacted.

7. Approximately 58% of the watershed has been impacted by grazing and browsing activities.

4.2.1.5 Upper and Lower Middle Fork Salmon Watersheds—Key Findings

1. Approximately 35% of whitebark habitat has been lost.

2. Approximately 33% of native grassland habitat has been lost.

3. Approximately 13% of forested habitats have been lost.

4. The Middle Fork watersheds are the least impacted in the subbasin in terms of hydrology, with approximately 99.9% of the watershed classified with low to very low impairment.

4.2.1.6 Middle Salmon–Chamberlain Watershed—Key Findings

1. Approximately 41% of aspen habitat has been lost.

2. Approximately 27% of whitebark pine habitat has been lost.

3. Approximately 18% of forested habitats have been lost.

4. Nearly 28% of forested habitats have been impacted by legacy timber-harvest activities.

4.2.1.7 South Fork Salmon Watershed—Key Findings

1. Approximately 3% of whitebark pine habitat has been lost.

2. Approximately 19% of forested habitats have been lost.

3. Nearly 80% of forested habitats have been impacted by legacy timber-harvest activities.

4. The South Fork watershed is one of the least impacted in the subbasin in terms of hydrology, with approximately 98% of the watershed classified with low to very low impairment.

4.2.1.8 Lower Salmon Watershed—Key Findings

1. Approximately 32% of aspen habitat has been lost.

2. Approximately 78% of whitebark pine habitat has been lost.

3. Approximately 19% of forested habitats have been lost.

4. Approximately 79% of native grassland habitat has been lost.

5. Nearly 76% of forested habitats have been impacted by legacy timber-harvest activities.

6. The Lower Salmon watershed is the most severely impacted watershed in terms of hydrology, with approximately 84% of the watershed classified as highly impacted.

7. The Lower Salmon watershed is the most severely impacted watershed in terms of habitat fragmentation resulting from landscape conversion, with approximately 94% of the watershed classified as moderately to very highly impacted.

4.2.1.9 Little Salmon Watershed—Key Findings

1. Approximately 99.9% of aspen habitat has been lost.

2. Approximately 98% of whitebark pine habitat has been lost.

3. Approximately 20% of forested habitats have been lost.

4. Approximately 9% of native grasslands habitat has been lost.

5. Nearly 73% of forested habitats have been impacted by legacy timber-harvest activities.

6. The Little Salmon watershed is one of the most severely impacted watersheds in terms of hydrology, with approximately 77% of the watershed classified as highly impacted.

7. The Little Salmon watershed is one of the most severely impacted watersheds in terms of habitat fragmentation resulting from landscape conversion, with approximately 83% of the watershed classified as moderately to very highly impacted.

8. Approximately 55% of the watershed has been impacted by grazing and browsing activities.

4.2.2 Reference Conditions

Reference condition is defined as the range of factors (for example, meteorology, surface and groundwater, soils, geology, vegetation, topography, channel geometry factors, and natural and human disturbances) that are representative of a watershed's recent historical values prior to significant alteration of its environment (ESA 2000). The reference condition is a pristine condition with no or very minor human impacts. It could represent conditions found in a relic site or a site that has had little significant disturbance. The reference condition does not necessarily represent conditions that are attainable.

The purpose of reference conditions is to establish a basis for comparing what currently exists to what has existed in recent history. Reference conditions can be obtained through actual data or through extrapolated techniques, such as modeling (ESA 2000). Reference sites represent high-quality assemblages of aquatic and terrestrial ecosystem components. Anthropogenic effects often coincide with landform, thereby limiting availability of pristine reference conditions for assessments. Consequently, reference conditions must be defined within a background of land use. In the context of a habitat-based assessment, a fundamental assumption is that aquatic and terrestrial focal species inhabiting reference sites are themselves reference populations. "True" reference conditions likely do not exist in the Salmon subbasin at watershed scales. Certainly, at finer environmental scales, ecosystem structure and function are theorized to be operating within the assumptions of reference conditions. However, the data to either quantifiably or qualitatively describe them with accuracy or precision are lacking. The authors have opted, in some contexts, to describe Salmon subbasin habitats in terms of optimal quality and quantity to avoid any misconception that might result from the use of the term reference condition.

In the Salmon subbasin, terrestrial and aquatic habitat quality and quantity are optimal in the most protected, least impacted watersheds. These watersheds include the Upper and Lower Middle Fork Salmon and the Middle Salmon–Chamberlain watersheds. These watersheds are subject to the least amount of impact from the anthropogenic influences identified in the assessment. However, fire suppressive policies continue to be implemented even in the roadless areas, and invasive exotic species have begun to have greater impacts. Landscape characteristics resulting from the altered fire regime will continue to prevail until natural fire regimes all allowed to function within these watersheds. These protected areas are not immune from out-of-basin impacts to salmon and steelhead populations, impacts that decrease the nutrients available to these systems. The ecological ramifications of invasive exotic species are well documented. Due in large part to their remoteness and protected characteristics, the Upper and Lower Middle Fork Salmon and the Middle Salmon–Chamberlain watersheds have been spared much of the impact of invasive exotic species, except in the recreational corridors.

4.2.2.1 Aquatic Habitat and Anadromous Fish

Aquatic habitat within the protected areas (Upper and Lower Middle Fork Salmon portions of the Middle Salmon–Chamberlain watersheds) in the Salmon subbasin can be considered “reference areas” for aquatic habitat function.[1] Additionally, there are minimal impacts to anadromous fish populations from hatchery fish in these watersheds. This situation allows comparisons with areas where hatchery releases are ongoing or are known to have occurred. Overall, out-of-basin effects may make it difficult to call the anadromous fish populations within these watersheds reference populations, as defined above, as there have clearly been human impacts to these populations that have resulted in decreased adult abundance. Resident fish populations in these watersheds should be considered reference populations.

Current return status and harvest for adult salmon and steelhead are summarized in Table 4-3, along with hatchery broodstock needs and future harvest goals. The minimum number of adults that would need to return to the subbasin is the future escapement for the natural spawning component for each species. Based on current information and assuming a no-new-action scenario, we assume that adult returns would be within the current range of natural spawning, which is well below the future minimum goals identified as the NOAA Fisheries interim delisting criteria (Table 4-3). For harvest goals, operating with no new action is assumed to result in continued operation within the current range, which is also well below goals identified as future harvest conditions (Table 4-3).

[1] Riparian function is considered to be in reference condition.

Table 4-3. Current status and desired future condition of wild and hatchery adult salmon and steelhead in the Salmon subbasin.

Escapement	Natural Spawning Component	Hatchery Component		Treaty and Nontreaty Harvest Component
		Broodstock Need	Rack Return	
Spring Chinook				
Future	> 36,400[a]	4,110[bj]	Unknown	unknown
Current–mean (range)	3,886[c] (312–9,760)	3,350	2,615 (37–12,642)	4,447[d] (0–22,895)
Summer Chinook				
Future	> 36,400[a]	2,050[b]	Unknown	unknown
Current–mean (range)	3,886[c] (312–9,760)	2,050	2,322 (36–12,624)	2,192[e] (0–8,560)
Fall Chinook				
Future	2,100[f]–2,500[g]	Undefined	Unknown	unknown
Current	49	0	0	0
Sockeye				
Future	>2,000[a]	Undefined	Unknown	Unknown
Current–mean (range)	28[j] (0–257)	Undefined	28[h] (0–257)	0
Steelhead				
Future	> 21,600[a]	1,740[b]	Unknown	unknown
Current–mean (range)	Unknown	1,740	2,568 (338–11,862)	22,601[i] (11,212–61,074)
Coho				
Future	Undefined	Undefined	Unknown	Unknown
Current	0	0	0	0

[a] NMFS interim abundance delisting criteria (spring and summer Chinook salmon combined; A and B run steelhead combined).
[b] Future broodstock needs will likely change as a result of negotiations within the U.S. v. Oregon process.
[c] Existing condition is mean adult returns estimated from run reconstruction using redd count data for spring and summer Chinook salmon in the Salmon subbasin for 1992 to 2003 (except Middle Fork Salmon streams, 1995 to 2002).
[d] Sport and tribal harvest for Little Salmon River and Salmon River, 1992 to 2003 (sport harvest data from IDFG, tribal harvest data from 2003 TAC *Columbia River Fisheries Biological Assessment*).
[e] Sport and tribal harvest for South Fork Salmon spring Chinook, 1992 to 2003 (sport harvest data from IDFG, tribal harvest data from 2003 TAC *Columbia River Fisheries Biological Assessment*).
[f] Estimate based on fall Chinook salmon spawning habitat quantification in the lower Salmon River (Nez Perce Tribe data).
[g] NMFS interim abundance target for fall Chinook salmon in the mainstem Snake River.
[h] All anadromous returning sockeye salmon regardless of release or retention for hatchery spawning.
[i] Includes sport harvest only (1992 to 2002); no data available for tribal harvest. Data are harvest of return years, not calendar years.
[j] Future broodstock need assumes Sawtooth Fish Hatchery operating at full production as designed in Lower Snake River Compensation Plan.

Regarding potential future harvest, treaty and nontreaty harvest on spring/summer Chinook and steelhead in the Salmon subbasin can be divided between artificial production and natural production-supported harvest. The two artificial production programs in the Salmon subbasin (Lower Snake River Compensation Plan [LSRCP] and Idaho Power Company's mitigation program) that have harvest as a program goal were discussed previously (see section 2.2.2). Escapement goals for both programs are negotiated in other forums. The purpose of the LSRCP was to mitigate for a portion of the adult return impacted by development of the lower Snake River dams, while the Idaho Power Company program was to mitigate for construction of the Hells Canyon Complex on the Snake River. Adult return goals for the LSCRP facilities are 27,000 adult spring/summer Chinook salmon and 25,000 adult steelhead upstream of Lower Granite Dam. Idaho Power Company mitigation goals were based on smolt release targets of three million spring Chinook smolts from Rapid River Fish Hatchery and one million summer Chinook smolts from Pahsimeroi. Based on the planning SARs used for the LSRCP Chinook program (0.87%; LSRCP review document), the adult returns from Idaho Power Company mitigation would be 26,100 adults to Rapid River Fish Hatchery and 8,700 adults to Pahsimeroi Fish Hatchery. Steelhead goals for Idaho Power Company mitigation facilities were identified as 200,000 pounds of smolts. Recent release numbers have been 1 to 1.2 million smolts. Applying steelhead planning SARs from LSRCP facilities (range 0.4–0.5%; LSRCP review document) yields adult escapement goals of 4,000 to 5,000 returning adults.

Neither the Sawtooth or Pahsimeroi Chinook salmon programs have met their fishery goals. The desired future conditions would include the attainment of all mitigation goals and the return of harvestable surpluses of naturally produced salmon and steelhead.

Fisheries for naturally produced Chinook salmon and steelhead have not occurred in the Salmon subbasin for over 20 years due to extremely low adult returns and ESA listing. One of the goals identified by the technical team was to reestablish treaty and nontreaty harvest opportunities throughout the subbasin. When populations do rebound to sustainable levels, treaty and nontreaty harvest goals will likely be based on calculations of maximum sustainable yield. Maximum sustainable yield is the largest average catch or yield that can continuously be taken from a stock under existing environmental conditions (Ricker 1975). This concept implies that, for species with fluctuating numbers, harvest must also fluctuate. Healthy Chinook salmon populations are generally capable of supporting around a 60% harvest rate (see Chapman 1986). Using the NOAA Fisheries interim abundance delisting criteria (NOAA 2003), estimating a 50% female run composition with NPCC’s target SAR goal of 4%, and using an estimated mean of 240 (range 90–403) smolts/female at Lower Granite Dam for Snake River spring/summer Chinook salmon (Kiefer *et al*. 2001 and in preparation), we can estimate a range of potential harvestable numbers of adult spring/summer Chinook salmon returning to the Salmon subbasin of 29,000 to 176,000 adults, depending on target SARs being met (Table 4-4). Data are currently unavailable to estimate harvestable steelhead abundance using the above methods.

Table 4-4. Estimated wild/natural spring/summer chinook adults available for harvest calculated with NOAA Fisheries interim abundance delisting criteria as escapement goals for natural production, using an estimated 50% female composition of the run and a range of smolts/female (mean = 240, range = 90 to 403) (Kiefer *et al*. 2001 and in preparation) and NPPC target SAR goals.

Adults	Females	Smolt/ Female	Smolts Produced	Adult @ 4% SAR	60% Harvest Rate	Harvest (with Minimum Adult Escapement) [a]
36,400	18,200	90	1,638,000	65,520	39,312	29,120
		240	4,368,000	174,720	104,832	138,320
		403	7,334,600	293,384	176,030	256,984

[a] Estimated numbers of adults available for harvest are estimated at 60% harvest rate and use NOAA Fisheries interim abundance information as a fixed minimum adult escapement of 36,400.

4.2.2.2 Riparian/Herbaceous Wetlands

Riparian/herbaceous wetland habitats occur throughout the Salmon subbasin; however, these habitats are assumed to be in “proper functioning condition” within the South Fork Salmon, Upper Middle Fork Salmon, Lower Middle Fork Salmon, and Middle Salmon–Chamberlain watersheds due to their protected status and inaccessibility. Roads and their associated impacts are minimal, and water diversions are relatively nonexistent compared with the more developed watersheds. Although not necessarily described as reference condition based on the best available data, these watersheds may contain some of the best naturally occurring riparian and herbaceous wetland habitats in the entire Columbia River basin.

4.2.2.3 Pine/Fir Forest

Pine/fir forest habitats are the predominant landscape feature in the Salmon subbasin. The watersheds with the greatest forested composition are the South Fork Salmon, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon–Chamberlain, and Little Salmon watersheds. The wilderness and roadless areas of these watersheds are classified as having the least amount of departure from historic fire regimes. With the exception of the Little Salmon watershed, most ecosystem processes are assumed to be functioning at nearly optimal condition in these watersheds.

4.2.2.4 Aspen

As mentioned throughout the assessment, the aspen habitat component is patchily distributed throughout the subbasin. Growing concern about the structure and function of aspen habitats throughout the western United States has led to greater interest in understanding the causes limiting aspen habitat quantity and quality. In the Salmon subbasin, aspen habitat declines have been attributed to a combination of altered fire regime, grazing and browsing, and in some cases, localized alteration of the hydrologic regime. Due to its scarcity on the landscape and the difficulties in assessing it, reference condition aspen habitat has not been identified in the Salmon subbasin. It is assumed that aspen habitat quantity and quality are not limited in the protected watersheds; however, data to support that assumption have not been collected.

4.2.3 Near-Term Opportunities

An issue that became apparent as a result of the assessment process is that numerous state, federal, tribal, and nongovernmental entities conduct active management activities across the Salmon subbasin, sometimes with minimal coordination and frequently overlooking the terrestrial components. Collaborative restoration efforts should incorporate aquatic and terrestrial components of ecosystem processes. The coordinated implementation of management plan goals and objectives in such a manner would minimize duplicated effort, enhance logistical efficiency, ensure that biological objectives are being achieved, and ultimately increase cost effectiveness.

4.2.3.1 Shrub-Steppe

Shrub-steppe focal habitats are the primary terrestrial habitat component in the Lemhi, Pahsimeroi, Middle Salmon–Panther, and Upper Salmon watersheds. Although data at the scale of the Columbia River basin suggest that significant amounts of the habitat have been altered, the professional opinion of the technical team for the Salmon subbasin indicates that much of the habitat in these watersheds probably represents the best quality remaining in the West. Fire regime changes that have impacted so much of the western shrub-steppe landscape have not yet played a significant role in the structure and function of these habitats in the Salmon subbasin. However, shrub-steppe habitats in the Salmon subbasin have been impacted by a century of grazing and landscape conversion, so it is likely that true reference condition shrub-steppe habitat is either nonexistent or occurs in only small fragments throughout the subbasin. Great potential exists for shrub-steppe habitat restoration across the subbasin in these least disturbed watersheds.

The watersheds with the greatest potential for improvement in shrub-steppe structure and function are also the watersheds at the greatest risk of impact from invasive exotic weeds. An adaptive management scheme will be especially important in these watersheds as new information and technology becomes available to address fire regime issues and invasive exotics.

Different species of sagebrush provide food, cover, and nesting substrate for sage-steppe obligates, such as the greater sage-grouse and pygmy rabbit. They are also important winter forage for big game species. Continuing or expanding research to determine how an altered fire regime affects the shrub-steppe community is necessary. In addition, research to collect baseline information on the distribution of pygmy rabbits in the shrub-steppe habitat would be beneficial.

4.2.3.2 Native Grassland

Native grassland habitat, a primary habitat component in the Lower Salmon watershed, is patchily distributed in all the remaining watersheds. Based on this assessment, native grassland habitats throughout the Salmon subbasin are characterized by severely altered structure and function. In reality, it is probably the most detrimentally impacted habitat within the Salmon subbasin. Reference condition native grassland habitat is either nonexistent or occurs in only small fragments throughout the subbasin. The technical team has prioritized the fragmented habitat patches for protection and restoration. Most of the native grassland habitat in the more developed watersheds has been converted to irrigated or dryland agriculture. The remaining patches of native grassland habitat are threatened by the altered fire regime, which facilitates the “unnatural” conversion to other habitat types. Significant opportunity for native grassland habitat improvement exists in locations where a historic fire regime can be established to reverse the conversion to seral shrub or forest habitats.

4.2.3.3 Pine/Fir Forest

Significant amounts of pine/fir forest habitat occur in each of the Salmon subbasin watersheds. Generally, the farther away from the protected watersheds, the greater the departure from the historic fire regime. Apart from legacy timber-harvest activities, the fire regime is the driving force behind pine/fir forest habitat structure and function. Pine/fir forest habitats outside the protected areas are considered by many to be severely altered with little resemblance to historic condition. This is particularly true in the Lower Salmon and Little Salmon watersheds. The ponderosa pine forests of the lower Salmon subbasin provide the greatest opportunity to affect significant improvements to forest structure and function.

Focal species for the pine/fir forest habitat in the Salmon subbasin would benefit from studies furthering our understanding of the relationship between snag availability and population dynamics of cavity-nesting species. Also needed is information on the relationships between mature stand characteristics and white-headed woodpecker and flammulated owl distribution and population dynamics.

4.2.3.4 Mountain Mahogany

Like aspen habitats, mountain mahogany habitat is patchily distributed, primarily in the upper elevations of the Salmon subbasin. The significance of this resource for wildlife resources cannot be overstated. As is the case with aspen habitat, mountain mahogany habitat quantity and quality is assumed to be less limited in the protected watersheds where fire regimes more closely resemble natural processes. Again, data to support this assumption are lacking. Significant improvement in mountain mahogany structure and function is achievable if fire processes are allowed to operate normally.

4.2.3.5 Whitebark Pine

Throughout it range, whitebark pine habitat has declined, mostly due to the blister rust fungus. The direct mortality caused by the disease agent is exacerbated by an altered fire regime that inhibits normal ecosystem processes. As with most altered fire regime habitats, the quantity and quality of whitebark pine habitats would be expected to be optimal in the watersheds where fire processes are allowed to function without anthropogenic influence. It is probably safe to assume that a reference condition site for whitebark pine, where blister rust is completely absent, does not exist. The most pertinent action that can be done for whitebark pine habitat structure and function is to restore the natural fire regime and let natural selection processes “cull” the blister rust-susceptible trees from the landscape. In addition, more research to identify whitebark pine varieties that are resistant to blister rust would be beneficial.

4.2.4 Identification of Strategic Actions to Address the Highest Priorities in the Subbasin

4.2.4.1 Noxious and Invasive Exotic Weeds

The necessary first steps would be collecting and compiling comprehensive distribution information for noxious and invasive exotic weeds that can constantly be updated, disseminated, and incorporated into weed management plans. This effort would build on existing weed management strategies, goals, and objectives and expand coordinated efforts throughout the subbasin.

4.2.4.2 Public Education Campaign

From a subbasin assessment perspective, the technical team believed that addressing watershed-scale fire regime issues through the Bonneville Power Administration funding process was unrealistic or inappropriate given how large the problem is. However, the necessary first step would be to tackle the public perception problem with a concerted wildfire education campaign that would target not only the public but also private and public land managers.

4.2.4.3 Subbasinwide Coordination

We believe that habitat restoration activities in the Salmon subbasin could benefit from creation of a group similar to the Upper Salmon Basin Model Watershed Project for terrestrial issues or incorporation of terrestrial goals, objectives, and natural resource professionals. Due to the size of the Salmon subbasin and differences in habitats and issues impacting these habitats, we recommend splitting the Salmon subbasin into two (using the Middle Fork Salmon River as the dividing line) or possibly three subbasins (creating a subbasin from the Upper and Lower Middle Fork Salmon watersheds).

An issue that became apparent as a result of the assessment process is that numerous state, federal, tribal, and nongovernmental entities conduct active management activities across the Salmon subbasin, sometimes with minimal coordination and frequently overlooking the terrestrial components. Collaborative restoration efforts should incorporate aquatic and terrestrial components of ecosystem processes. The coordinated implementation of management plan goals and objectives in such a manner would minimize duplicated effort, enhance logistical efficiency, ensure that biological objectives are being achieved, and ultimately increase cost effectiveness.

4.2.5 Working Hypotheses

The following is the overall alternative or working hypothesis (H_A) for the Salmon subbasin: Anthropogenic influences in the Salmon subbasin and factors outside the subbasin significantly limit ecological function and performance of focal habitats and species.

The following component hypotheses of the assessment are developed around the causes of limiting factors identified in the assessment.

H_A: Human impacts to natural hydrologic regimes reduce, degrade, and/or eliminate riparian and aquatic habitats and limit focal species populations in the Upper Salmon, Pahsimeroi, Lemhi, Middle Salmon–Panther, Little Salmon, and Lower Salmon watersheds.

H_A: Land use and conversion result in habitat fragmentation and reduce the quality and quantity of focal aquatic, riparian, and grassland habitats and their focal species in the Salmon subbasin.

H_A: Fire suppression in forested habitats reduces resilience and health of these ecosystems and their focal habitats and increases risks to watershed integrity in the Upper Salmon, Pahsimeroi, Middle Salmon–Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon–Chamberlain, South Fork Salmon, Lower Salmon, and Little Salmon watersheds.

H_A: Increased fire frequency in shrub-steppe habitats reduces resilience and health of this ecosystem and its focal species in all watersheds in the Salmon subbasin.

H_A: Legacy timber-harvest activities have reduced function and increased fragmentation of focal forest and aquatic habitats in the

Upper Salmon, Lemhi, Pahsimeroi, Little Salmon, and South Fork Salmon watersheds.

H_A: Old growth- and cavity-dependent wildlife species are limited by legacy timber-harvest and fire suppression activities in the Salmon subbasin.

H_A: The spread of noxious weeds and other exotic invasives limits terrestrial focal habitats and species in the Salmon basin.

H_A: Habitats and fish and wildlife populations in the Upper Middle Fork Salmon, Lower Middle Fork Salmon, and Middle Salmon–Chamberlain watersheds provide reference areas and refugia useful for determining the impacts of out-of-subbasin activities and restoration and conservation designed to benefit focal habitats and their focal species within and outside the Salmon subbasin.

H_A: Out-of-basin effects limit the recovery and sustainability of anadromous species in the Salmon subbasin.

H_A: The status and trend of terrestrial focal habitats and species are predictable with measurable scientific assessment and monitoring.

H_A: Focal grassland habitats in the Lower Salmon watershed are limited by noxious and exotic invasive weeds, fire management activities, and livestock grazing.

H_A: Low numbers of naturally spawning salmon and steelhead limit nutrient cycling and productivity of aquatic and terrestrial habitats and species in the Salmon subbasin.

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