3. Fish and Wildlife Communities[1]

3.1 Presettlement and Historic Fish and Wildlife Communities

3.1.1 Historical Accounts of Populations and Habitats[2]

To understand the ecology of today's wildlife populations, it is important to consider past population dynamics, trends, and processes. Boas and Teit (1930) reported that the Native Americans in the Kootenai area hunted deer, elk, caribou, moose, mountain goat, mountain sheep, bear, and beaver. Tribal people prized marmot, ground squirrel, otter, muskrat, coyote, wolf and fox for their pelts and hunted birds for sustenance and plumage. They took grouse, ducks and geese for meat and eagles, hawks and woodpeckers for their plumage. This ethnographic study indicates that elk were abundant during presettlement times.

But even during presettlement times, humans caused changes in the structure, composition, and type of forested areas. Those changes in turn affected wildlife populations and habitat. Prehistoric humans influenced game and fish populations by hunting, and their use of fires probably increased open grazing and big game habitat (Barrett 1980; Barrett and Arno 1982).

Information from David Thompson's journals (1808-1812) suggests that historically, conifer vegetation (wildlife habitat) existed at lower stem densities and larger sizes than seen today. This condition would favor species like mule deer over white-tailed deer. Blocks of unfragmented forested habitat were much larger than today, which would have favored wide ranging species like wolverine, lynx, grizzly bear, cougar, and wolf.

David Thompson, of the Northwest Fur Company and the Hudson Bay Company recorded observations of mountain lion. He also hunted deer and geese. Native Americans traded pelts of beaver, bear, marten, elk, and deer. Vanek (1986) provides references to wildlife found on the Kootenai National Forest during the fur trade period. The list includes cougar, porcupine, weasel, mink, muskrat, bobcat, marten, marmot, beaver, coyote, gophers, mice, snowshoe rabbits, packrats, and bees. She also lists white-tailed and mule deer along with

---

[1] *Unless specified otherwise, the wildlife analyses in this chapter are for the Kootenai and Flathead Subbasins. We have chosen to work at this broader scale for most of our wildlife analysis because of data and time constraints. We emphasize that this is a coarse-scale assessment appropriate for planning at a subbasin scale but not for work at finer scales. Though we used the best subbasin-scale data sets available to us at the time, our technical team has limited confidence in those data. For the aquatic analysis, we worked at a subbasin scale and finer.*

[2] *Adapted from USFS KNF (2002).*

black and grizzly bears as being present. Vanek points out that by the late 1880s mountain lions were trapped to near extinction.

With the arrival of the Northern Pacific Railroad in northwestern Montana (1883) came commercial meat and hide hunters, which took a toll on the large mammal populations (especially deer and elk). Reynolds (1905) makes reference to the scarcity of game found within the Kootenai National Forest area: " … at present large game of all kinds is pitiably scarce on the country where it once abounded. It is due, as usual, to the most unsportsmanlike slaughter carried on at anytime of year by practically everyone who carries a rifle into the hills." He further documents only one small band of caribou left; elk are very rare; moose are likely killed out; grizzly bear are very rare; and beaver, mountain lion, badger, and lynx are practically trapped out. Around the early 1800s elk numbers were approaching ten million throughout their range, and then market hunters essentially extirpated them from this part of the country. Today there are around 1 million elk in the United States (one tenth of the historic level).

Domestic sheep, cattle, and horses brought grazing pressure that modified plant succession (and thus wildlife habitat) in parts of the subbasin. Bear hunters were hired to reduce sheep losses, and they eradicated most of the black bears (Vanek 1975). Vanek also shows that mountain goats were all but eliminated by the early 1940s. In 1939, Abbot and Duvenack completed a study that showed that at the time, the Kootenai National Forest had a shortage of predatory animals.

An early Forest Service report (USFS 1925) indicates that on one part of the Forest " ... big game are confined to a few deer." According to the report there was ample range for game animals. Vanek (1975) documents that following the period of market hunters, elk were rare until after 1950, when transplanted elk (1951-52) began to disperse across the forest. Additional elk transplants (1952, 1960, and 1964) helped the elk population recover. Moose began to increase their numbers in the 1950s as well. The deer population, primarily mule deer, was also growing during this period (Couey 1972).

The historical record clearly indicates that large numbers of fur and game species were taken from the Forest between 1800 and the 1930s. Fur trappers, many of whom were aboriginals, worked most of the riparian areas of the West in the 19th century, heavily impacting populations of beaver and other furbearers. Although regulatory efforts to protect game species were initiated in the 1920s, predators were not protected by game laws and were extensively hunted. Populations of bear, mountain lion and wolf were dramatically reduced in the region (Baker et al. 1993).

Extirpation of some species (woodland caribou and Columbian sharptail grouse) has probably occurred on the Kootenai National Forest, but most species

that were recorded historically are still present in some numbers. Reintroduction programs have occurred for elk, bighorn sheep, mountain goats, fisher, Columbian sharptail grouse, and fish. The existing grizzly bear population has also been augmented.

3.1.2 Circa 1850 Records of Species From IBIS

Appendix 47 lists terrestrial species thought to have occurred in the Kootenai Subbasin prior to 1850. The source of this list is the IBIS-USA database. We noted significant differences that are difficult to explain between the same list for the Flathead subbasin. This raised questions about the accuracy of the list. Perhaps the best and most reliable historical species list would be the present day list of known species (Appendix 19), plus those species known to have been extirpated (table 3.1), minus the species known to have been introduced (tables 3.2 and 3.3).

Table 3.1. Species extirpated within the Kootenai and Flathead Subbasins

Scientific Name	Common Name
Lepus townsendii [1]	White-tailed Jackrabbit
Phrynosoma douglassii [1]	Pygmy Short-horned Lizard
Columba fasciata [2]	Band-tailed Pigeon
Ectopistes migratorius [2]	Passenger Pigeon

[1] *source IBIS Canada (http://habitat.cbt.org/)* [3]
[2] *source USFS KIPNF (2003)*

LINKS

For the Idaho Conservation Data Center, which has species lists and information on species at risk in Idaho, go to http://fishandgame.idaho.gov/tech/CDC/

Click Here

3.1.3 Species Extirpations and Re-introductions

While it would be impossible to quantify the population changes that target species have undergone since presettlement times (pre-1850), we do have knowledge of the species that have been extirpated from the subbasin and those that have been introduced into the subbasin since settlement. Table 3.1 lists species known to have been extirpated according to two sources: the IBIS database[3] and the Kootenai and Idaho Panhandle National Forests. Table 3.2 lists those that were locally extirpated and subsequently reintroduced. Table 3.3 lists introduced terrestrial species. Table 3.4 lists introduced and hybridized fish species.

For the Montana Natural Heritage Program website, which has species lists and information on species at risk in Montana, go to: http://nhp.nris.state.mt.us/

Click Here

[3] *After careful examination of the differences between US and Canada IBIS lists and after consultation with IBIS staff, we decided that the differences between the databases were not significant for the kinds of analyses we were conducting. Further, IBIS personnel in both the U.S. and Canada felt that the Canada database was probably the best list of species to use of those available at the moment for any detail work beyond what was already provided using the IBIS-USA website. The IBIS system for the Canadian portion of the Basin was developed through a cooperative effort with the IBIS group in the USA.*

*Table 3.2. Species extirpated and subsequently reintroduced within the Kootenai and Flathead subbasins**

Scientific Name	Common Name
Cygnus buccinator	Trumpeter Swan
Athene cunicularia	Burrowing Owl
Falco peregrinus	Peregrine Falcon
Rana pipiens	Northern Leopard Frog
Tympanuchus phasianellus	Sharp-tailed grouse
Rangifer tarandus	Mountain Caribou

**source IBIS Canada (http://habitat.cbt.org/)*

*Table 3.3. Terrestrial species introduced into the Kootenai and Flathead subbasins**

Scientific Name	Common Name
Mus musculus	House Mouse
Sturnus vulgaris	European Starling
Columba livia	Rock Dove
Cygnus olor	Mute Swan
Alectoris chukar	Chukar
Phasianus colchicus	Ring-necked Pheasant
Passer domesticus	House Sparrow
Perdix perdix	Gray Partridge
Meleagris gallopavo	Wild Turkey
Callipepla californica	California Quail
Sciurus niger	Eastern Fox Squirrel
Bison bison	Bison
Rana catesbeiana	Bullfrog

**source IBIS Canada (http://habitat.cbt.org/)*

3.2 Present Fish And Wildlife Communities in the Subbasin

3.2.1 Number of Species by Habitat Type and Number of Species at Risk by Habitat Type

To compare total fish and wildlife community diversity across habitat types, we generated a list of the total number of terrestrial species using the Canadian IBIS database[3]. We then looked at the number of terrestrial species at risk in each of those habitat types and developed indices for each to indicate the proportion of species in each biome/habitat type that are at risk (table 3.5). This assessment targets several biomes (montane mixed conifer, ponderosa pine, riparian, wetland, and grasslands), and species-by-biome information for each is summarized in table 3.6 and figure 3.1.

Table 3.4. Non-native and hybridized fish species in the Kootenai subbasin. Source: MFWP 2003.

Name
Introduced Species
Bass
Black Bullhead
Brown Bullhead
Bluegill
Brook Trout
Brown Trout
Chinook Salmon
Coho Salmon
Golden Trout
Kokanee
Lake Trout
Largemouth Bass
Northern Pike
Pumpkinseed
Rainbow Trout
Sauger/Walleye
Smallmouth Bass
Sunfish
Yellow Perch
Hybrids
Brook X Bull Trout Hybrid
Rainbow X Cutthroat Trout
Redband X Rainbow Hybrid
Redband X Westslope Cutthroat
Yellowstone X Westslope Cutth.

LINKS

For a pre-1850 species list for the Kootenai Subbasin go to Appendix 47.

Click Here

Appendix 48 summarizes the changes that have occurred in wildlife habitats between presettlement times and the present.

Click Here

For a review of the literature on presettlement Kootenai hunting with information on relative abundance for a wide range of species, see: Smith, A.H. 1984. Kootenai Indian subsistence and Settlement Patterns. USACOE.

For target biomes, a general trend is evident. For lists derived from either the Federal species status or from IBIS Canada lists, the target biomes with the greatest number of listed species (species at risk) in decreasing order are: grasslands, herbaceous wetlands, riparian wetlands, ponderosa pine (xeric forest), and mixed conifer (mesic forest). Herbaceous wetlands replace grasslands as that biome with the greatest number of "Listed Species" using the IBIS-Status measure (for definitions, see the footnote for table 3.5).

3.2.2 Number of Non-native Species by Wildlife Habitat Type

The number of species that have been introduced into the Canadian portion of the Mountain Columbia Province are listed in Table 3.7. Equivalent data are not available for the U.S. portion of the subbasin, although the Forest Service reports (USFS KIPNF 2003) that recent (since 1840) additions to the Kootenai and Idaho Panhandle National Forests include the European starling, English house

Table 3.5. The total species and the species at risk present within a given habitat type in the Kootenai and Flathead subbasins. IBIS Status refers to a local designation of species status present in the IBIS database. State ALL is state/ provincial threatened as well as endangered species. State R and E is only endangered species. Federal is Canadian and USA designations combined. Indices are explained in table footnotes.*

IBIS Designation	Total Species	IBIS Status	State ALL	State R & E	Federal	IBIS Index	State ALL Index	State R and E Index	Fed Index
Montane Wetlands	136	9	17	1	3	0.07	0.13	0.01	0.02
Subalpine Parkland	162	8	24	4	5	0.05	0.15	0.02	0.03
Alpine	117	9	16	6	4	0.08	0.14	0.05	0.03
Upland Aspen	143	13	23	6	6	0.09	0.16	0.04	0.04
Urban	204	13	25	6	9	0.06	0.12	0.03	0.04
Montane mixed conifer	169	10	30	6	8	0.06	0.18	0.04	0.05
Interior mixed conifer	208	13	39	8	11	0.06	0.19	0.04	0.05
Lodgepole Pine	155	9	27	7	9	0.06	0.17	0.05	0.06
Open Water	129	22	38	11	8	0.17	0.29	0.09	0.06
Pine	193	16	39	11	12	0.08	0.2	0.06	0.06
Agricultural	253	29	47	14	16	0.11	0.19	0.06	0.06
Riparian Wetlands	247	26	49	14	18	0.11	0.2	0.06	0.07
Herbaceous Wetlands	192	28	49	13	14	0.15	0.26	0.07	0.07
Grasslands	152	19	40	14	16	0.13	0.26	0.09	0.11
Shrub	146	15	41	16	16	0.1	0.28	0.11	0.11

**__Total Species:__ derived from IBIS-Canada*
IBIS status: *derived from a column in IBIS-Canada that indicates whether a species is in decline, decreasing, extirpated, stable, or increasing. This column is from IBIS-USA and has been edited to be more accurate for Canada. After careful analysis and consultation with IBIS staff, it was determined the differences between the IBIS-Canada and IBIS-USA lists are not signficant for the kind of analysis we are conducting here.*
State ALL: *from IBIS-USA for the subbasin planning and derived from the Montana and Idaho Natural Heritage programs lists as well as BC's red and blue list designation. Includes Blue and "Species of concern."*
State R and E: *from IBIS-USA for the subbasin planning and derived from the Montana and Idaho Natural Heritage programs lists. Includes only "Red" and Endangered" species.*
Federal: From IBIS-USA subbasin planning and derived from Federal lists from Canada and the US.
IBIS Index: *the IBIS status species/total species in IBIS-Canada.*
State All Index: *the State ALL species/total species in IBIS-Canada.*
Fed Index: *the Federal species/total species in IBIS-Canada.*

Table 3.6. Indices of species at risk impact for target biomes in the Kootenai and Flathead subbasins.

IBIS Designation	Total Species	IBIS	State ALL	State R and E	Federal	IBIS Index	State ALL Index	State R and E Index	Fed Index
Mesic Forest	169	10	30	6	8	0.06	0.18	0.04	0.05
Xeric Forest	193	16	39	11	12	0.08	0.2	0.06	0.06
Riparian Wetlands	247	26	49	14	18	0.11	0.2	0.06	0.07
Herbaceous Wetlands	192	28	49	13	14	0.15	0.26	0.07	0.07
Grasslands	152	19	40	14	16	0.13	0.26	0.09	0.11

**Total Species: derived from IBIS-Canada. See footnotes for table 3.5 for how indecies were calculated.*

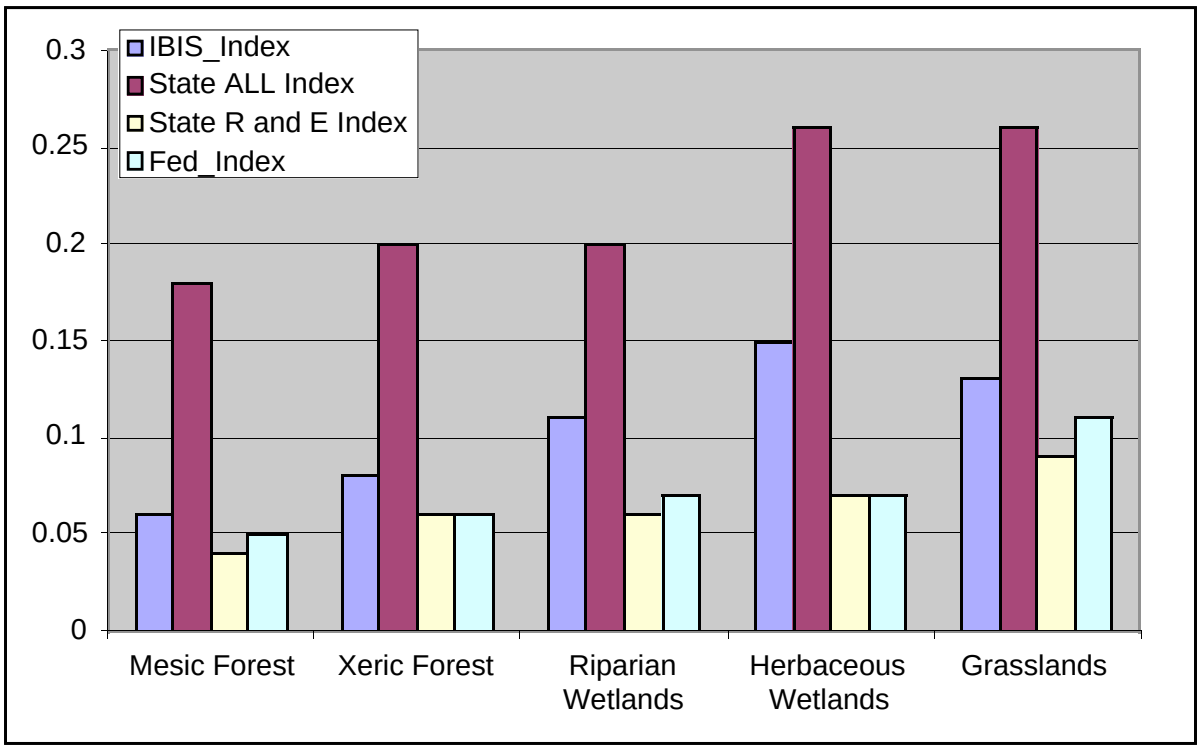

Figure 3.1. The percent of species at risk per total species in targeted biomes in the Kootenai and Flathead subbasins.

Table 3.7. Number of introduced terrestrial species in Canada portion of the Mountain Columbia Province (source IBIS-Canada).

Biome	Grand Total
Agriculture, Pastures, and Mixed Environs	10
Eastside (Interior) Grasslands	7
Eastside (Interior) Mixed Conifer Forest	2
Eastside (Interior) Riparian-Wetlands	6
Herbaceous Wetlands	3
Lodgepole Pine Forest and Woodlands	1
Montane Coniferous Wetlands	1
Montane Mixed Conifer Forest	1
Open Water - Lakes, Rivers, and Streams	1
Ponderosa Pine Forest and Woodlands	5
Shrub-steppe	6
Upland Aspen Forest	2
Urban and Mixed Environs	9
Grand Total	54

sparrow, rock dove, Merriam's turkey and ring-necked pheasant, and westward movement by the barred owl, blue jay, house mouse, and raccoon.

The types with the highest number of exotics in decreasing order are: agricultural and pasture areas, urban areas, grasslands, riparian wetlands, and shrub-steppe. Figure 3.2 shows the number of exotics by target biome.

3.3 Ecological Relationships

3.3.1 Number of Key Ecological Functions by Biome

The IBIS database identifies key ecological functions (KEFs) provided by each species listed in the database. Appendix 49 lists the number of KEFs found within each target biome. This analysis provides the background that enables us to identify declines in ecological functions in each of the target biomes.

3.3.2 General KEF Impact Indices

The KEFs are nested categories within the IBIS database, and as a consequence, species can be represented more than once in an analysis. To remove this redundancy, we chose General KEF categories (table 3.8), which are intermediate

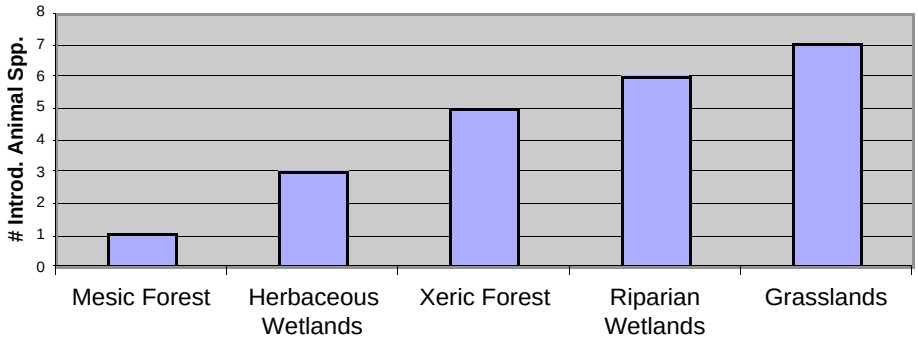

Figure 3.2. Non-native species by target biome (Source IBIS-Canada).

in the hierarchy (neither too general nor too specific) and for which definitions are well understood.

LINKS

Appendix 49 lists the number of key ecological functions (KEFs) by targeted biome.

Click Here

3.3.3 KEF Declines in Target Biomes

To identify possible declines in key ecological functions in the target biomes, we attempted to measure the impact on key ecological functions that have occurred as a result of human impacts on specific species. We used species-at-risk designations to represent impacts to species. We are assuming these designations, while not necessarily indicating a local impact, will nevertheless provide some measure of impact to species composition at the biome/habitat level.

By cross-correlating the species composition changes to the key ecological function that each species plays, we have generalized the key ecological functions impacted for each biome. This index of impact is very coarse and does not take into account local population levels for a given species and does not address functional overlaps between different species occupying the same habitats. In other words, there may be a significant decline in a species providing a key ecological function, but the overall function of a habitat type could be maintained by other species performing a similar role in that biome or habitat type. With this caveat, determining the implications of species at risk effects on habitat function can serve to compare habitats in a general way and help identify restoration priorities.

The index of impact used here is the average of impacted KEF divided by the total KEFs for each General KEF category and normalized, such that the biome with the least amount of impact is given a value of 10. All other biome values are proportionally ranked against this maximum. This makes the trend difference between the three methods of measuring impact more apparent.

Table 3.8. General Key Ecological Functions (KEFs). These categories are traditional ecological categories that occur within a food web.

IBIS Designation	Definition
1.1.1) primary consumer (herbivore)	Herbivore of any sort
1.1.2) secondary consumer	Consumer of herbivores
1.1.3) tertiary consumer (secondary predator or secondary carnivore)	Consumer of secondary consumers
1.2) prey relationships	Acts as prey for another organism
2) aids in physical transfer of substances for nutrient cycling (C,N,P, etc.)	Self explanatory
3) organismal relationships	Strong interrelationships with other species. For example, pirating food from other species, using burrows built by other species, or acting as a seed dispersal agent
4) carrier, transmitter, or reservoir of vertebrate diseases	Disease vectors
5) soil relationships	Creates, develops or alters soil
6) wood structure relationships (either living or dead wood)	Processes or requires wood or wood cavities
7) water relationships	Affects water quality
8) vegetation structure and composition relationships	This species may alter vegetation structure or function. For example they may generate snags.

The three measures of species impacts are: (1) IBIS Status, (2) State and Federal endangered (including red listed) species only, and (3) all state and federal designations showing any degree of impact including blue listed species and species of concern (see the footnote for table 3.5).

Table 3.9 ranks the General KEF indices for wildlife habitat types in descending order for the three different methods of assessing impact to species. Table 3.10 and figure 3.3 show the General KEF indices for target biomes. According to the "IBIS Status" index, the Mesic Forest biome had the least impact of General KEF function followed by Xeric Forest, Riparian Wetlands, Grasslands, and Herbaceous Wetlands. The "Endangered Species" index and the "Any Impact" index ranked Mesic Forest as the least impacted followed by Riparian Wetlands, Xeric Forest, Herbaceous Wetlands, and Grasslands, with Grasslands being the most impacted.

Table 3.9. Descending list of impacts for each biome type in the Kootenai and Flathead subbasins using three different methods of assessing level of impact.

Biome order	IBIS Status Index	Biome order	Endang-ered Index	Biome order	Any Impact Index
Subalpine Parkland	10	Montane Wetlands	10	Montane Wetlands	10
Lodgepole Pine	8.98	Subalpine Parkland	8.35	Subalpine Parkland	4.11
Montane Mixed Conifer	7.91	Lodgepole Pine	7.61	Alpine	2.96
Interior mixed conifer	7.87	Alpine	7.43	Lodgepole Pine	2.82
Montane Wetlands	7.56	Urban	6.83	Montane mixed conifer	2.62
Urban	7.46	Upland Aspen	6.31	Upland Aspen	2.39
Alpine	6.12	conifer	5.96	conifer	2.13
Ponderosa Pine	5.6	Montane mixed conifer	5.9	Urban	1.91
Upland Aspen	5.13	Rip. Wetlands	5.11	Rip. Wetlands	1.5
Rip. Wetlands	4	Ponderosa Pine	5.08	Ponderosa Pine	1.38
Shrub	3.97	Agricultural	4.76	Agricultural	1.3
Agricultural	3.74	Herb Wetlands	4.15	Herb Wetlands	1.04
Grasslands	3.11	Shrub	3.32	Shrub	0.87
Herb Wetlands	2.83	Grasslands	3.3	Grasslands	0.86

IBIS Status Index is based on IBIS categories of species status (Decreasing, Declining, Extirpated, Stable, Increasing). Endangered Index is based on Endangered species and Red listing from Idaho, Montana, British Columbia, and both Federal governments. Any Impact Index is based on Endangered species and Red listing from Idaho, Montana, British Columbia, and both Federal governments PLUS blue listed species, threatened species and species of concern.

Table 3.10. General KEF impact indices using three methods of impact assessment for targeted biomes in the Kootenai and Flathead subbasins.

Biome	IBIS Status Index	Endangered Status Index	Any Impact Index
Herb Wetlands	2.83	4.15	1.04
Grasslands	3.11	3.3	0.86
Mesic Forest	7.91	5.9	2.62
Xeric Forest	5.6	5.08	1.38
Riparian Wetlands	4	5.11	1.5

IBIS Status Index is based on IBIS categories of species status (Decreasing, Declining, Extirpated, Stable, Increasing). Endangered Index is based on Endangered Species and Red listings from Idaho, Montana, British Columbia, and both Federal governments. Any Impact Index is based on Endangered species and Red listing from Idaho, Montana, British Columbia, and both Federal governments PLUS blue listed species, threatened species and species of concern.

LINKS

Appendix 50 provides an explanation of the methodology for the specific KEF analysis used here.

Click Here

The IBIS-USA website has done further analysis that are generally descriptive in nature. These can be viewed at the following URLs: http://www.nwhi.org/ibis/subbasin/ecos2.asp

Click Here

http://www.nwhi.org/ibis/subbasin/uscan2.asp

Click Here

http://www.nwhi.org/ibis/subbasin/subs2.asp

Click Here

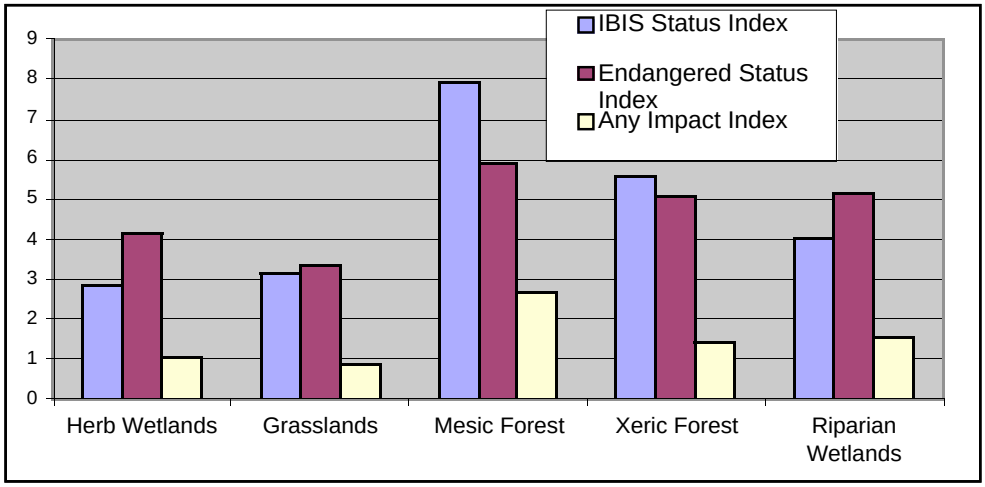

Figure 3.3. General KEF impact indices using three methods of impact assessment for targeted biomes in the Kootenai and Flathead Subbasins.

3.3.4 Functional Specialists

The IBIS-USA group performed an analysis of specific KEF functions (methodology is presented in Appendix 50). Functional specialists[4] that IBIS-USA has identified for the Mountain Columbia Ecological Province are listed in table 3.11. The Critical Functional Link Species[5] pertinent to the subbasin planning process are listed in table 3.12.

[4] *Functional specialists are species that have only one or a very few number of key ecological functions. An example is the turkey vulture, which is a carrion-feeder functional specialist. Note that functional specialists may not necessarily be (and often are not) also critical functional link species (functional keystone species), and vice versa. Thus, the manager may want to understand degree of functional specialization of a species) as well as the number of species that perform a given category of key ecological function (functional redundancy); these are complementary measures of the functionally of species and systems.*

[5] *Critical functional link species are species that are the only ones that perform a specific ecological function in a community. Their removal would signal loss of that function in that community. Thus, critical functional link species are critical to maintaining the full functionality of a system. The function associated with a critical functional link species is termed a "critical function." Reduction or extirpation of populations of functional keystone species and critical functional links may have a ripple effect in their ecosystem, causing unexpected or undue changes in biodiversity, biotic processes, and the functional web of a community. Critical functional link species may be usefully identified as focal species for subbasin planning. A limitation of the concept is that little research has been done on the quantitative effects, on other species or ecosystems, of reduction or loss of critical functional link species."*

Table 3.11. The functional specialists for the Mountain Columbia Province (Source: IBIS-USA)

Common Name	Scientific Name	Count of KEFs
Turkey Vulture	*Cathartes aura*	3
Gyrfalcon	*Falco rusticolus*	5
Peregrine Falcon	*Falco peregrinus*	5
Snowy Owl	*Nyctea scandiaca*	5
Common Nighthawk	*Chordeiles minor*	5
Black Swift	*Cypseloides niger*	5
Wolverine	*Gulo gulo*	5
Ringneck Snake	*Diadophis punctatus*	6
Harlequin Duck	*Histrionicus histrionicus*	6
Red-shouldered Hawk	*Buteo lineatus*	6
Merlin	*Falco columbarius*	6
Northern Pygmy-owl	*Glaucidium gnoma*	6
Boreal Owl	*Aegolius funereus*	6
Northern Bog Lemming	*Synaptomys borealis*	6
Lynx	*Lynx canadensis*	6

Table 3.12. Critical functional link species in the province (Source: IBIS-USA)

Common Name	Scientific Name
American Beaver	*Castor canadensis*
American Crow	*Corvus brachyrhynchos*
American Pika	*Ochotona princeps*
Big Brown Bat	*Eptesicus fuscus*
Black Bear	*Ursus americanus*
Black Tern	*Chlidonias niger*
Black-chinned Hummingbird	*Archilochus alexandri*
Brown-headed Cowbird	*Molothrus ater*
Bushy-tailed Woodrat	*Neotoma cinerea*
Canada Goose	*Branta canadensis*
Deer Mouse	*Peromyscus maniculatus*
Fisher	*Martes pennanti*
Golden-mantled Ground Squirrel	*Spermophilus lateralis*
Great Basin Spadefoot	*Scaphiopus intermontanus*
Great Blue Heron	*Ardea herodias*
Great Horned Owl	*Bubo virginianus*
Grizzly Bear	*Ursus arctos*
House Finch	*Carpodacus mexicanus*
Long-toed Salamander	*Ambystoma macrodactylum*
Mink	*Mustela vison*
Montane Vole	*Microtus montanus*
Moose	*Alces alces*
Mule Deer	*Odocoileus hemionus*
Northern Pocket Gopher	*Thomomys talpoides*
Nuttall's (Mountain) Cottontail	*Sylvilagus nuttallii*
Raccoon	*Procyon lotor*
Red Squirrel	*Tamiasciurus hudsonicus*
Rocky Mountain Elk	*Cervus elaphus nelsoni*
Rufous Hummingbird	*Selasphorus rufus*
Snowshoe Hare	*Lepus americanus*
Tundra Swan	*Cygnus columbianus*
Williamson's Sapsucker	*Sphyrapicus thyroideus*

3.3.5 Key Ecological Correlates (KECs)

LINKS

The results of our Key Ecological Correlate (KEC) analysis are presented in Appendix 51.

Click Here

Key Ecological Correlates[6] (KEC) are more specific habitat features within the biomes—for example, specific substrates, habitat elements, and attributes of species' environments. They are called "habitat elements" within the tables of the IBIS-Canada Access database[7]. In this discussion we use the term KEC because that is the term most commonly used in subbasin planning. The results of our analysis are presented in Appendix 51. Table 1 of this appendix lists all of the KECs in the IBIS-Canada database. Table 2 of Appendix 51 shows the total number of species associated with each of the main categories of KECs for each IBIS biome.

Table 3.13 shows the percentage of the species within each of the main KEC categories[8] that are in decline or decreasing (distressed species) for those main KEC categories with distressed species. For the biomes, this table reveals a pattern of disturbance similar to that seen in the analysis of key ecological function and biome types, which is to be expected since the same species list is used for each analysis and the relationship of those species to biome type remains the same. It shows that for the KECs, "Non-vegetative, Abiotic" and "Freshwater Riparian and Aquatic Bodies" have the greatest percentage of distressed species at 12 percent and 13 percent respectively (figure 3.4). Tables 5 through 10 of Appendix 51 provide the same information for each of the KECs listed under the main KEC categories. They report the number of species and the percentage of

[6] *Key environmental correlates (KECs) are specific substrates, habitat elements, and attributes of species' environments that are not represented by overall (macro)habitats and vegetation structural conditions. Specific examples of KECs include snags, down wood, type of stream substrate, and many others. KECs are denoted for each species using a standard classification system, which include the KECs for vegetation habitat elements, non-vegetation terrestrial elements, aquatic bodies and substrates, anthropogenic structures, and other categories.*

[7] *As we explained in a footnote at the beginning of this chapter, we made a careful examination of the differences between US and Canada IBIS lists and consulted with IBIS staff to determine which IBIS database—U.S. or Canada—we should use, given our specific needs. We decided that the differences between the databases were not significant for the kinds of analyses we were conducting. Further, IBIS personnel in the U.S. and Canada felt that the Canada database was probably the best list of species to use of those available at the time for any detail work beyond what was already provided using the IBIS-USA website. Hence we have chosen to use the Canada database.*

[8] *The advantage of examining the main categories of KECs for this analysis is that there are sufficient data within these broad categories to illustrate frequency without fear of exceeding the limitations of the data. Of course the disadvantage of using these broader categories is that the analysis lacks specificity.*

distressed species associated with a group of biome-related KECs listed according to their presence in that particular biome.

Having presented the results of this analysis, we want to alert readers to some of our concerns about its use. First, one limitation of the KEC data is that they are represented as simple categorical relations with species (e.g., a list of KECs pertinent to each species) rather than as quantified correlations (e.g., specific amounts, levels, or rates of each KEC and corresponding population densities or trends of each species). Similarly, the relative contribution of a given species to

Table 3.13. The percentage of species within each of the main KEC categories in decline or decreasing for the main KEC categories with distressed species.

Key Ecological Correlate	Agriculture, Pastures, and Mixed Environs	Alpine Grasslands and Shrublands	Eastside (Interior) Grasslands	Eastside (Interior) Mixed Conifer Forest	Eastside (Interior) Riparian-Wetlands	Herbaceous Wetlands	Lodgepole Pine Forest and Woodlands	Montane Coniferous Wetlands	Montane Mixed Conifer Forest	Open Water - Lakes, Rivers, and Streams	Ponderosa Pine Forest and Woodlands	Shrub-steppe	Subalpine Parkland	Upland Aspen Forest	Urban and Mixed Environs	Average
1) Forest, Shrubland, & Grassland KECs	9%	11%	11%	7%	10%	**16%**	7%	8%	7%	**28%**	7%	8%	6%	8%	6%	**10%**
2) Ecological KECs	10%	9%	**18%**	6%	12%	15%	6%	6%	6%	**20%**	9%	14%	3%	11%	6%	**10%**
3) Non-vegetative, Abiotic KECs	11%	13%	14%	12%	**15%**	11%	9%	11%	10%	9%	**15%**	**15%**	9%	**15%**	13%	**12%**
4) Freshwater Riparian & Aquatic Bodies KECs	13%	16%	13%	8%	13%	**19%**	10%	12%	11%	**21%**	8%	10%	9%	7%	8%	**13%**
7) Fire as a KEC	9%		**14%**	4%	8%		2%				6%	**13%**		7%	5%	**5%**
8) Anthropogenic-related KECs	11%	10%	**14%**	8%	12%	**17%**	6%	8%	8%	20%	9%	12%	5%	11%	6%	**11%**
Totals	**64%**	**58%**	**85%**	**45%**	**70%**	**78%**	**40%**	**46%**	**42%**	**98%**	**53%**	**71%**	**32%**	**59%**	**44%**	**60%**

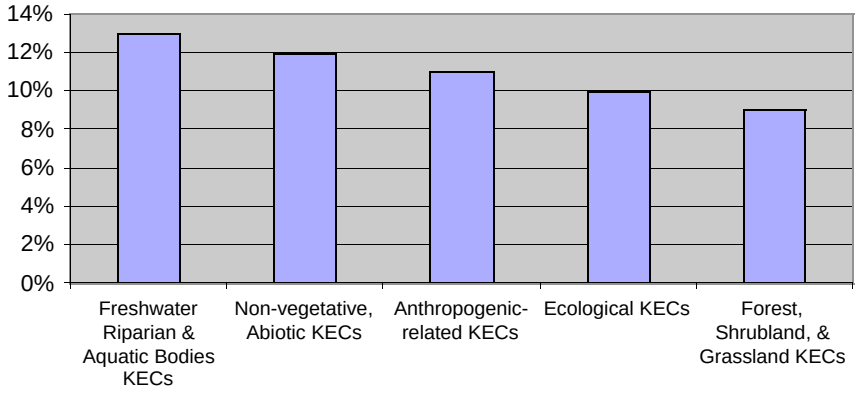

Figure 3.4. Percentage of the species in each main KEC category that are distressed (for those main KEC categories with distressed species).

the proper functioning of a KEC as a habitat is not evident. Second, there appears to be a fair amount of error within the KEC table in the database (for example, redundant categories are present and some categories appear to be missing). We also discovered other potential errors (that would require too much space to go into here) that concern us when it comes to using KEC data (for a description of some of these problems see Appendix 51).

At best, the KEC analysis we present here might be used to formulate hypotheses that could be used to drive further inquiry or investigation (beyond what is possible within this assessment) regarding where within a biome impacts are most serious. One might utilize Tables 5 through 10 of Appendix 51 to identify KECs that have a large number of species associated with them and also where disproportionate numbers of species appear to be distressed. This might be particularly valuable at a project-specific planning level, once priority restoration areas have been identified. For example, based on IBIS data, 3 out of 21 or 14 percent of species associated with downed wood are considered to be decreasing or in decline in the herbaceous wetland biome category. Water depth is an important consideration for 50 species, and 17 out of the 50 species (34 percent) are in decline. Both water depth and downed wood are specific and local in scale and could conceivably be compared informally to formulate hypotheses regarding what sort of restoration projects or measures are needed and where they might be conducted.

3.3.6 The Aquatic-Terrestrial Relationship

Because aquatic habitats are the product of a complex set of processes such as the routing of precipitation, erosion rates, sediment transport, woody debris recruitment, and channel migration, their quality is directly tied to the terrestrial environment within their catchment basin. Aquatic habitats are influenced by any number of small or subtle changes occurring anywhere within a watershed, though they are most vulnerable to degradation from activities that occur on lands adjacent to them (riparian and wetland areas). The health of these systems is of critical importance to the maintenance and formation of stream channels that sustain native fish populations. But uplands, too, have profound effects on aquatic habitats and native fish populations. Human-induced changes to uplands can, for example, alter runoff patterns, rates of sedimentation, stream morphology, and water chemistry. An example of the latter is the effect that a clearcut can have on aquatic productivity. A clearcut can represent a significant loss of phosphorous (P-export) from forested landscapes both from biomass removal and erosion of humus and mineral soil caused by road construction, log skidding, and related activities. Initially, soil-water retention capacities decrease, and runoff and turbidity (P-export) increases. But after new trees and shrubs become established, they absorb high levels of phosphorous, reducing the amount entering streams and lakes (Stockner and Ashley 2003).

Just as the quality of terrestrial habitats can affect fish and other aquatic organisms, the functioning and quality of aquatic habitats influences or impacts a number of terrestrial wildlife species. Figure 3.5 shows the number of Mountain Columbia Province terrestrial focal species with aquatic key environmental correlates.

3.3.7 Wildlife Relationships to Salmonids

While anadromous fish are not present in the subbasin, resident salmonids are important to terrestrial vertebrates, playing a key ecological role that human activities have certainly influenced.

A now famous example of how landlocked salmonids can affect terrestrial wildlife communities occurred in the Flathead Subbasin about twenty years ago. Prior to their decline in the mid-to-late 1980s, tens of thousands of non-native kokanee salmon migrated upstream from Flathead Lake to McDonald Creek in Glacier National Park to spawn. There they drew a diverse array of terrestrial species. In 1981, in excess of 100,000 kokanee spawned there, and more than 1,000 bald eagles congregated to feed on the spent fish. California gulls, herring gulls, mallards, common mergansers, crows, ravens, jays, and magpies gathered and scavenged the carcasses. Common goldeneye, Barrow's goldeneye, and dippers

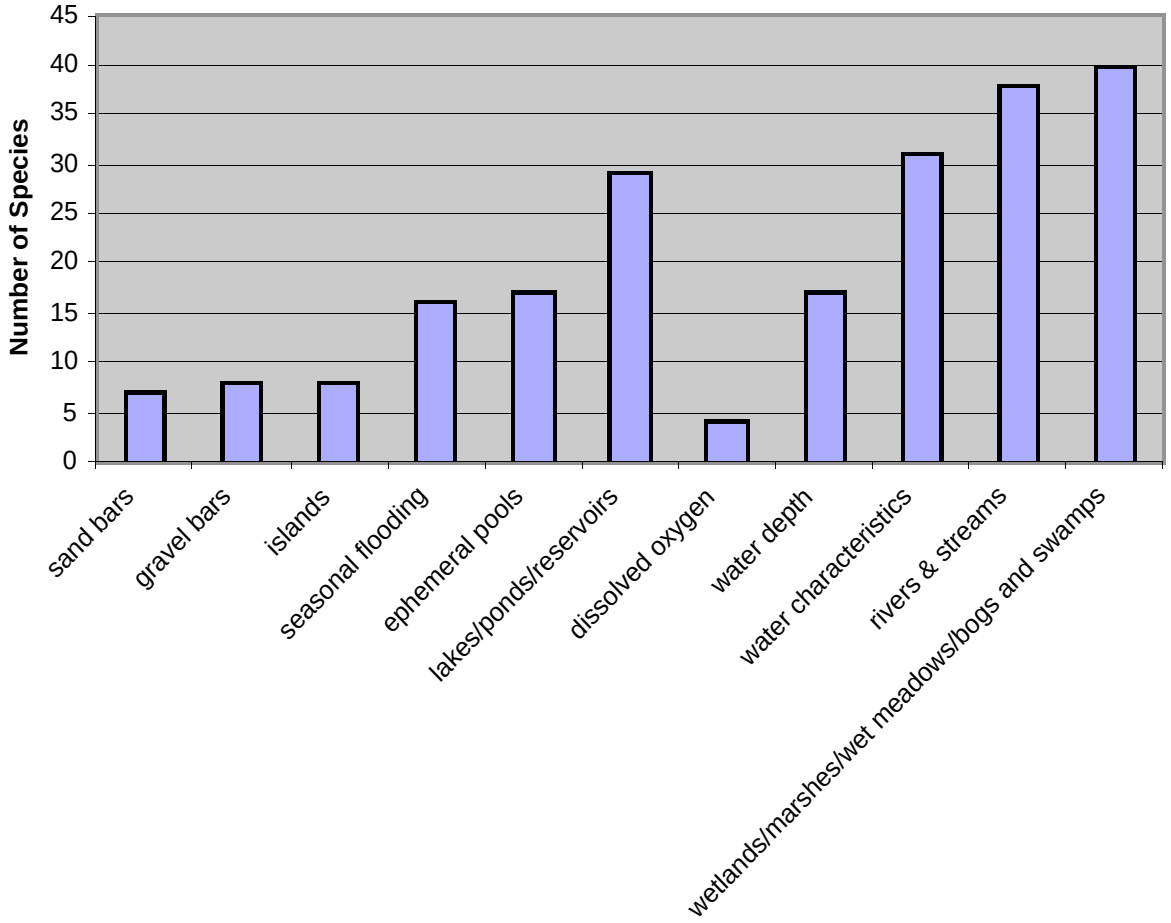

Figure 3.5. The number of Mountain Columbia Province terrestrial focal species with aquatic key environmental correlates.

fed on the millions of eggs buried in the gravel. Mink, otter, and coyotes patrolled the banks. Even white-tailed deer, which are herbivores, were seen pulling dead fish from the creek and eating them. Grizzly bears, too, worked the stream, chasing and stranding fish in shallow riffles or diving to the bottom of 15-foot-deep pools after carcasses. Some bears lingered beside McDonald Creek long past the time they would have normally entered hibernation to gorge on the thousands of carcasses of decaying fish. And the estimated 9 million fry hatching from the eggs fed everything from bull trout to stoneflies (Rockwell 2002). On a smaller scale, a similar scenario has been playing itself out over the past couple decades in the upper Kootenai system with non-native kokanee populations in the Koocanusa Reservoir and in recent years in the lower Kootenai with the

recent recovery of kokanee populations in the north arm of Kootenay Lake (B. Jamieson, pers. comm. 2004). Prior to their collapse, kokanee populations in the south arm of Kootenay Lake probably played a similar role in the lower Kootenai system as did adfluvial bull trout and westslope cutthroat trout. In all these cases, salmonids are conveying nutrients (lake-derived nitrogen and phosphorous) to tributaries upstream from one ecosystem (large lakes) to another (tributary streams) and from one biome to another.

Table 3.14 shows the number of species by biome in the Kootenai and Flathead Subbasins that possess an ecological relationship to salmonids. Table 3.15 lists the specific terrestrial species in the Kootenai tied ecologically to salmonids.

Table 3.14. The number of species in each biome dependent upon or affecting salmonids. Source: IBIS-USA

Biome	Salmonid dependent species
Agriculture, Pastures, and Mixed Environs	51
Alpine Grasslands and Shrublands	31
Eastside (Interior) Grasslands	33
Eastside (Interior) Mixed Conifer Forest	44
Eastside (Interior) Riparian-Wetlands	60
Herbaceous Wetlands	61
Lodgepole Pine Forest and Woodlands	36
Montane Coniferous Wetlands	33
Montane Mixed Conifer Forest	37
Open Water - Lakes, Rivers, and Streams	49
Ponderosa Pine Forest and Woodlands	40
Shrub-steppe	28
Subalpine Parkland	38
Upland Aspen Forest	32
Urban and Mixed Environs	49

KEFs Affected by the Loss of Salmonids

The key ecological functions performed by species dependent upon salmonids are listed in table 3.16.

Table 3.15. Terrestrial species in the Kootenai Subbasin with an ecological relationship to salmonids. Source: IBIS-USA

Common Name	Scientific Name
Amphibians	
Idaho Giant Salamander	*Dicamptodon aterrimus*
Birds	
Common Loon	*Gavia immer*
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Red-necked Grebe	*Podiceps grisegena*
Western Grebe	*Aechmophorus occidentalis*
Clark's Grebe	*Aechmophorus clarkii*
American White Pelican	*Pelecanus erythrorhynchos*
Double-crested Cormorant	*Phalacrocorax auritus*
Great Blue Heron	*Ardea herodias*
Great Egret	*Ardea alba*
Snowy Egret	*Egretta thula*
Green Heron	*Butorides virescens*
Black-crowned Night-heron	*Nycticorax nycticorax*
Turkey Vulture	*Cathartes aura*
Trumpeter Swan	*Cygnus buccinator*
Mallard	*Anas platyrhynchos*
Green-winged Teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Greater Scaup	*Aythya marila*
Harlequin Duck	*Histrionicus histrionicus*
Surf Scoter	*Melanitta perspicillata*
Common Goldeneye	*Bucephala clangula*
Barrow's Goldeneye	*Bucephala islandica*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Red-tailed Hawk	*Buteo jamaicensis*
Golden Eagle	*Aquila chrysaetos*
Gyrfalcon	*Falco rusticolus*
Peregrine Falcon	*Falco peregrinus*
Killdeer	*Charadrius vociferus*
Greater Yellowlegs	*Tringa melanoleuca*
Spotted Sandpiper	*Actitis macularia*
Franklin's Gull	*Larus pipixcan*
Bonaparte's Gull	*Larus philadelphia*
Ring-billed Gull	*Larus delawarensis*
California Gull	*Larus californicus*
Herring Gull	*Larus argentatus*
Glaucous Gull	*Larus hyperboreus*
Caspian Tern	*Sterna caspia*
Common Tern	*Sterna hirundo*
Forster's Tern	*Sterna forsteri*
Snowy Owl	*Nyctea scandiaca*
Belted Kingfisher	*Ceryle alcyon*
Willow Flycatcher	*Empidonax traillii*
Gray Jay	*Perisoreus canadensis*
Steller's Jay	*Cyanocitta stelleri*
Black-billed Magpie	*Pica pica*
American Crow	*Corvus brachyrhynchos*
Northwestern Crow	*Corvus caurinus*
Common Raven	*Corvus corax*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Bank Swallow	*Riparia riparia*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Winter Wren	*Troglodytes troglodytes*
American Dipper	*Cinclus mexicanus*
American Robin	*Turdus migratorius*
Varied Thrush	*Ixoreus naevius*
Varied Thrush	*Ixoreus naevius*
Spotted Towhee	*Pipilo maculatus*
Song Sparrow	*Melospiza melodia*
Mammals	
Masked Shrew	*Sorex cinereus*
Vagrant Shrew	*Sorex vagrans*
Montane Shrew	*Sorex monticolus*
Water Shrew	*Sorex palustris*
Northern Flying Squirrel	*Glaucomys sabrinus*
Deer Mouse	*Peromyscus maniculatus*
Coyote	*Canis latrans*
Gray Wolf	*Canis lupus*
Red Fox	*Vulpes vulpes*
Black Bear	*Ursus americanus*
Grizzly Bear	*Ursus arctos*
Raccoon	*Procyon lotor*
American Marten	*Martes americana*
Fisher	*Martes pennanti*
Long-tailed Weasel	*Mustela frenata*
Mink	*Mustela vison*
Wolverine	*Gulo gulo*
Striped Skunk	*Mephitis mephitis*
Northern River Otter	*Lutra canadensis*
Mountain Lion	*Puma concolor*
Bobcat	*Lynx rufus*
White-tailed Deer (eastside)	*Odocoileus virginianus*
Reptiles	
Snapping Turtle	*Chelydra serpentina*
Western Terrestrial Garter Snake	*Thamnophis elegans*
Common Garter Snake	*Thamnophis sirtalis*

Table 3.16. Key Ecological Functions (KEFs) performed by salmonid-dependent species. The link to salmonids may not be direct in some habitats. This means that a habitat might have a species that would use salmonids if that species lived in an area with salmonids.

Biome	1.1.1) primary consumer (herbivore)	1.1.2) secondary consumer (primary predator or primary carnivore)	1.1.3) tertiary consumer (secondary predator or secondary carnivore)	1.2) prey relationships	2) aids in physical transfer of substances for nutrient cycling (C,N,P, etc.)	3) organismal relationships	4) carrier, transmitter, or reservoir of vertebrate diseases	5) soil relationships	6) wood structure relationships (either living or dead wood)	8) vegetation structure and composition relationships	Grand Total	Percent of total	Index based on max value
Herbaceous Wetlands	15	61	4	35	8	55	19	1	2	2	202	**0.1**	**10**
Eastside (Interior) Riparian-Wetlands	20	58	3	33	2	52	12	2	2	2	186	**0.09**	**9**
Agriculture, Pastures, and Mixed Environs	19	50	5	31	5	45	15	1	1	1	173	**0.09**	**9**
Urban and Mixed Environs	18	47	4	32	5	44	13	1	1	1	166	**0.08**	**8**
Open Water - Lakes, Rivers, and Streams	6	51	3	29	8	43	18	1		1	160	**0.08**	**8**
Eastside (Interior) Mixed Conifer Forest	15	42	3	24		40	6	1	2	1	134	**0.07**	**7**
Ponderosa Pine Forest and Woodlands	15	38	3	23		38	6	1	1	1	126	**0.06**	**6**
Subalpine Parkland	17	37	3	21		34	6	1	2	1	122	**0.06**	**6**
Montane Mixed Conifer Forest	14	35	3	19		33	4	1	2	1	112	**0.06**	**6**
Lodgepole Pine Forest and Woodlands	13	34	3	17		33	4	1	2	1	108	**0.05**	**5**
Eastside (Interior) Grasslands	13	32	5	19		28	6	1	1	1	106	**0.05**	**5**
Montane Coniferous Wetlands	14	31	2	18		28	2	1	2	1	99	**0.05**	**5**
Alpine Grasslands and Shrublands	13	30	3	15		27	6	1	2	1	98	**0.05**	**5**
Upland Aspen Forest	11	30	3	18		29	3	1	2	1	98	**0.05**	**5**
Shrub-steppe	9	27	2	16		25	5	1	1	1	87	**0.04**	**4**
Grand Total	212	603	49	350	28	554	125	16	23	17	1977	**1**	

THIS PAGE INTENTIONALLY BLANK