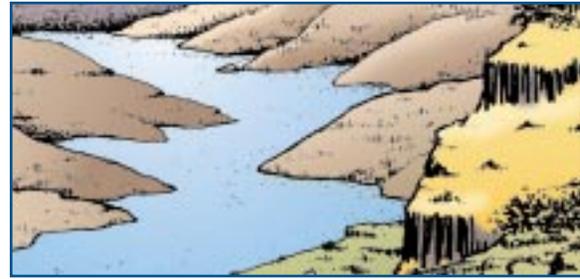


## AQUATIC SPECIES AND HABITATS



The status of aquatic ecosystems in the Basin is influenced by both natural and human processes. The geologic and geomorphic processes described earlier formed and continue to affect the Basin. In concert with the underlying physical environment, these processes establish the template and constrain the successional pathways for aquatic habitats and their associated communities. Similarly, natural fluctuations in the marine environment from variation in atmospheric and ocean circulation patterns influence the productivity of anadromous fish stocks and may temporarily mask changes in freshwater habitats.

Aquatic analyses took place at the subbasin, watershed, and subwatershed level (figure 10). There are 164 subbasins in the project area, averaging just under 900,000 acres. The 2,562 watersheds average about 56,000 acres, while the 7,467 subwatersheds average about 19,000 acres.

Results of survey information and tests of relations among habitat features, landscape features, and disturbance variables reinforce the evidence that streams within the assessment area have been significantly affected by human activities. Resources affected include both riparian vegetation and instream habitat.

### Water Quality

The U.S. Environmental Protection Agency estimates overall water quality impairment within the Basin. This estimate appears to be modest in comparison to total length of streams within the assessment area (table 5). Because these estimates are based on existing and accessible data from local state and Federal monitoring programs, they likely do not reflect the actual extent and distribution of impairment. Most streams in the region are now fully or over-appropriated; irrigation is the primary off-stream use of water in the Basin.

### Riparian Areas

Riparian vegetation is a critical component of aquatic ecosystem integrity. A Basin-wide analysis of riparian vegetation found significant changes, including a widespread decline in shrublands in the riparian zones. Shrublands predominantly shifted to forests and herblands through

***The integrity of riparian vegetation and its extent along rivers has been changed and fragmented throughout the Basin in response to forest conversion and streamside disturbance.***

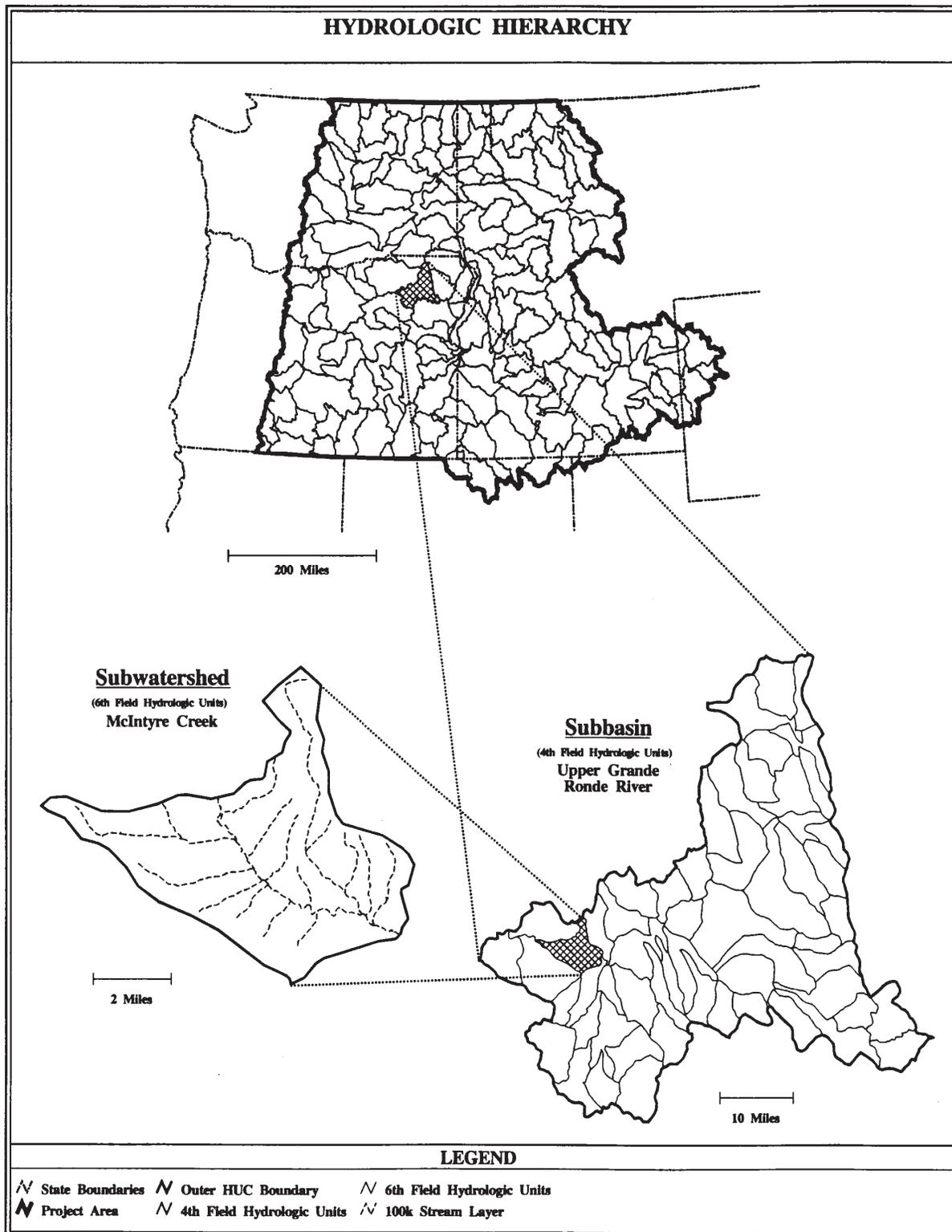


Figure 10—An example of hydrologic hierarchy from subwatersheds to subbasins.

Table 5—Water quality impaired waters reported by the states and the Environmental Protection Agency as miles of streams and rivers in the portions of states within the Interior Columbia Basin Ecosystem Management Project assessment area.

	Total stream miles	Any impairment	Temperature impairment	Nutrient impairment	Sediment/siltation/turbidity impairment	Flow impairment
Oregon (1994/96)	75,186	8,123	7,358	280	948	1,263
Forest Service		2,528	2,464	0	320	134
BLM		646	570	49	65	78
Washington (305b)	49,150	3,962	2,815	33	No Data	2,551
Forest Service		578	204	0	No Data	446
BLM		26	14	0	No Data	16
Idaho (303d)	98,984	10,024	2,632	3,459	8,812	2,714
Forest Service		3,000	455	306	2,568	478
BLM		1,350	513	391	1,187	506
Montana (303d)	31,317	3,912	1,051	1,138	3,034	1,791
Forest Service		1,360	271	99	1,053	556
BLM		70	20	10	56	45
Wyoming (303d)	4,785	71	0	0	46	0
Forest Service		39	0	0	35	0
BLM		2	0	0	2	0
Nevada (303d)	6,835	175	161	14	0	0
Forest Service		11	1	9	0	0
BLM		48	48	0	0	0
<b>TOTALS</b>						
<b>All States</b>	<b>266,257</b>	<b>26,266</b>	<b>14,017</b>	<b>4,922</b>	<b>12,840</b>	<b>831</b>
<b>Forest Service</b> <sup>1</sup>		<b>7,515</b>	<b>3,395</b>	<b>414</b>	<b>3,976</b>	<b>1,431</b>
<b>BLM</b>		<b>2,142</b>	<b>1,164</b>	<b>450</b>	<b>1,311</b>	<b>646</b>

<sup>1</sup>The Utah Department of Environmental Quality reports no impaired streams or rivers within the project area in Utah.

succession or disturbance. Forests, woodlands, and herblands increased in area or stayed approximately the same. Cottonwood, aspen, and willow, typically riparian-associated species known to have significantly declined, are included in the forest class but are likely masked by the dominance of other species in this class. There was a significant

decrease of these cover types in the Snake Headwaters and Columbia Plateau. Significant increases in woodlands—attributed to shrubland conversion to juniper stands—occurred in the Northern Great Basin, Blue Mountains, and Columbia Plateau. The integrity of riparian vegetation and its extent along rivers has been changed and

fragmented throughout the Basin in response to forest conversion and streamside disturbance.

The sufficiency of interim riparian habitat conservation areas (RHCA) to maintain ecological functions and prevent undesirable cumulative effects is a subject of both social and scientific debate. Interim RHCA in the range of anadromous fishes and bull trout are prescribed at 300-foot-minimum widths for fish-bearing streams to maintain stream function and prevent sediment inputs from nonchannelized sources. A review of the literature indicates that this width is likely sufficient to provide for most riparian functions with a margin for error depending on the intensity and extent of activities within a RHCA. The likelihood of disturbance resulting in discernible instream effects increases as adjacent slopes become steeper. Thus, greater protective measures to protect or rehabilitate riparian function and structure on steeper slopes may be required to prevent or reduce in-stream effects.

Taken in aggregate, management of stream and riparian systems on forestlands is more restrictive and ecologically more effective than management of riparian areas where agriculture and urban or industrial land uses are dominant. No state within the Basin has enacted an agricultural practices act explicitly protecting riparian vegetation. If the goal is to ensure survival of salmon and many native fishes in the long term, improved protection of riparian areas in agricultural lands is essential.

## Dams and Diversions

Construction of dams and reservoirs and their complex effects on migration is an important threat to the persistence of salmon and steelhead trout within the Basin. Construction of large dams began about 1900, and has since greatly reduced the range of migrating fish. Today there are at least 1,239 large dams in the assessment area, each with storage capacity in excess of 62,000 cubic meters. The total, includ-

ing small dams, could be several times larger. Most of the thousands of small dams in the Basin do not have fish passage facilities, yet the full extent to which these dams impede migration or affect spawning and rearing habitats of fishes has not been documented. Even with fish passage facilities, detrimental effects from dams occur as a result of direct mortality of juveniles in turbines and bypass systems and indirect mortality owing to physiological stress, increased susceptibility to predators, and the inability to find routes around dams and through slack water.

Although much of the highest-quality habitat for these anadromous fish probably remains in the Central Idaho Mountains, no strong populations persist there largely due to passage mortality in migration corridors. These corridors provide a critical link maintaining the complex life histories of other species as well. For example, non-anadromous species that retain migratory life-history patterns such as bull, redband, Yellowstone cutthroat, and westslope cutthroat trout may move repeatedly between small rivers and headwater streams.

## Roads

The effects associated with roads reach beyond their direct contribution to disruption of hydrologic function and increased sediment delivery to streams. Roads provide access, and the activities that accompany access magnify the negative effects on aquatic systems beyond those solely from roads themselves. Strong populations of fish are present in some roaded subwatersheds. This relationship between population status and roads requires more investigation to be fully understood.

***Increasing road density is correlated with declining aquatic habitat conditions and aquatic integrity and is associated with declines in the status of four non-anadromous salmonid species.***



While roads pose many risks to ecosystem functioning, they provide benefits to humans through access for recreation and other land uses.

Increasing road density is correlated with declining aquatic habitat conditions and aquatic integrity and is associated with declines in the status of four non-anadromous salmonid species. The discussion of the relation of roads to fishes often involves three themes: (1) the belief that road-building practices have improved in the last decade to the point we should not worry about the effects of roads on aquatic systems; (2) the legacy of past road building is so vast and road maintenance budgets so low that the problems will be with us for a long time; and (3) the belief that the correlation of road density to fish habitat and fish population is not strong.

An intensive review of the literature concludes that increases in sedimentation are unavoidable even using the most cautious roading methods. Roads combined with wildfires accentuate the risk

from sedimentation. The amount of sedimentation or hydrologic alteration from roads that streams can tolerate before there is a negative response is not well known. It is not fully known whether building roads to reduce fire risk causes greater risk to aquatic systems than realizing the potential risk of fire.

In addition, the ability of the Forest Service and BLM to conduct road maintenance has been sharply reduced because of declining budgets. This is resulting in progressive degradation of road drainage structures and a potential increase in erosion. Most problems are with older roads located in sensitive terrain and roads that have been essentially abandoned but are not adequately configured for long-term drainage.

## Pools

Along with the loss of riparian vegetation, human activities have combined to create major decreases in pool habitat. Pools provide many key functions, including rearing habitat for juvenile fish, resting places, overwintering areas, and refuges from floods, drought, and extreme temperatures.

Pool frequency (large pools and all pools) is inversely correlated with road density and management intensity. The magnitude of decreases in deep pools is substantial and extensive across the Basin. Most unmanaged streams either have retained pools or have improved pool habitat during the last 55 to 60 years.

A factor likely to be important in controlling pool frequency in the Basin is the abundance of instream wood. Wood effectively stabilizes channels, influences sediment routing, provides a major component of the instream organic matter, provides cover for fish and habitat for invertebrates, and increases overall channel complexity. Protecting sources of instream wood for streams is important: there is not much wood to begin with, it plays a critical role for pool formation and habitat conditions, and wood frequency is sensitive to management practices.

Another important aspect of habitat quality that apparently is influenced by management is the amount of fine sediment (sediment less than 6 mm) on channel beds. Road density significantly affects surface fines and corroborates the link between forest management practices and channel sediment characteristics.

*The composition, distribution, and status of fishes within the Basin is very different than it was historically.*

## Status and Distribution of Fishes

A total of 142 fish taxa were reported within the Basin. Fishes were considered at three levels listed in order of increasing detail: (1) fish species assemblages, from which richness and diversity indices were calculated; (2) 38 taxa considered sensitive, threatened, endangered, or of special concern; and (3) key salmonids [bull, westslope cutthroat, Yellowstone cutthroat, and redband trout; steelhead trout; and ocean-type (age-0 migrant) and stream-type (age-1 migrant) chinook salmon]. This analysis was based on both a



The bull trout is one of seven key salmonids in the Basin.



The Metolius River in central Oregon has clear, cold water flowing from springs that help create excellent habitat for Bull trout.

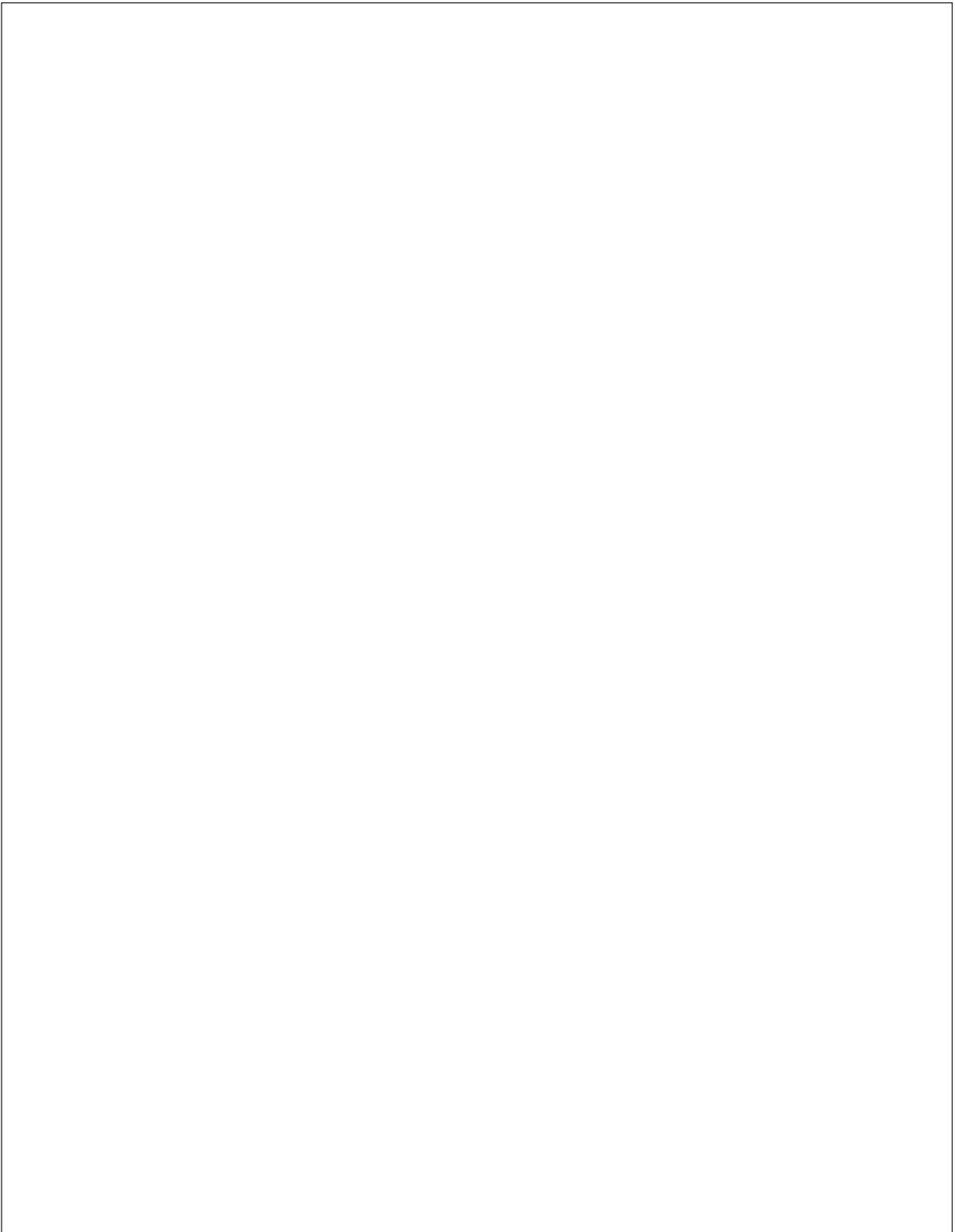
summary of known distributions and the prediction of distributions and status for select species throughout the entire assessment area and was supported by information collected through more than 140 biologists working throughout the region.

Aquatic habitat fragmentation (impassable obstructions—including dams, temperature increases, and water diversion) and simplification (channelization, removal of woody debris, channel bed sedimentation, removal of riparian vegetation, and water flow regulation) have resulted in a loss of diversity within and among native fish populations.

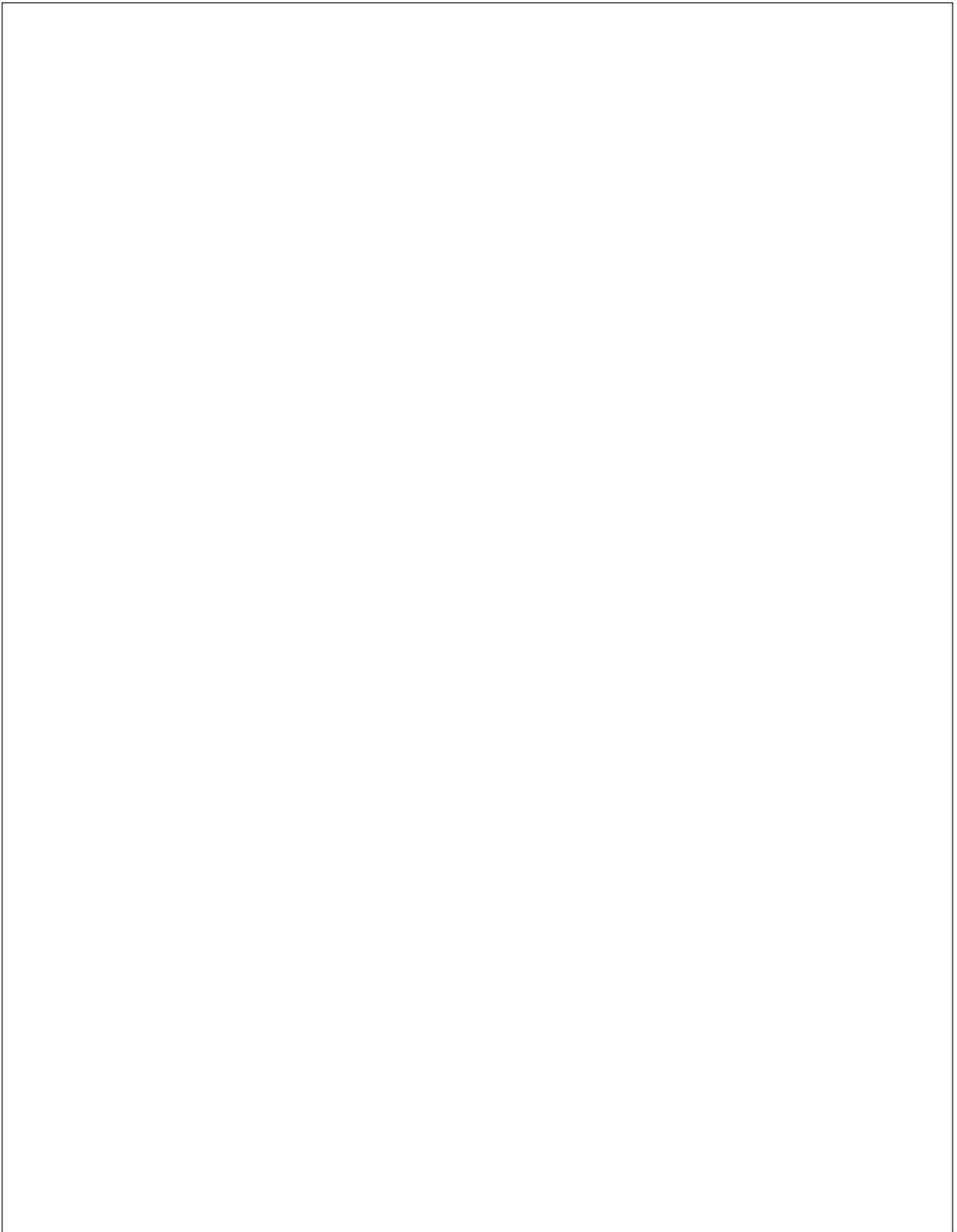
The composition, distribution, and status of fishes within the Basin is very different than it was historically. Some forms are extinct and many others, especially anadromous fish, are extirpated from large portions of their historical range.

Although several of the key salmonids remain distributed through much of their historical ranges (notably the cutthroat trouts and interior redband trout), declines in abundance, the loss of important life histories, local extinctions, and fragmentation and isolation of high-quality habitats are apparent (**maps 15 and 16**). Wild chinook salmon and steelhead trout are approaching extirpation in a major part of the remaining distribution.

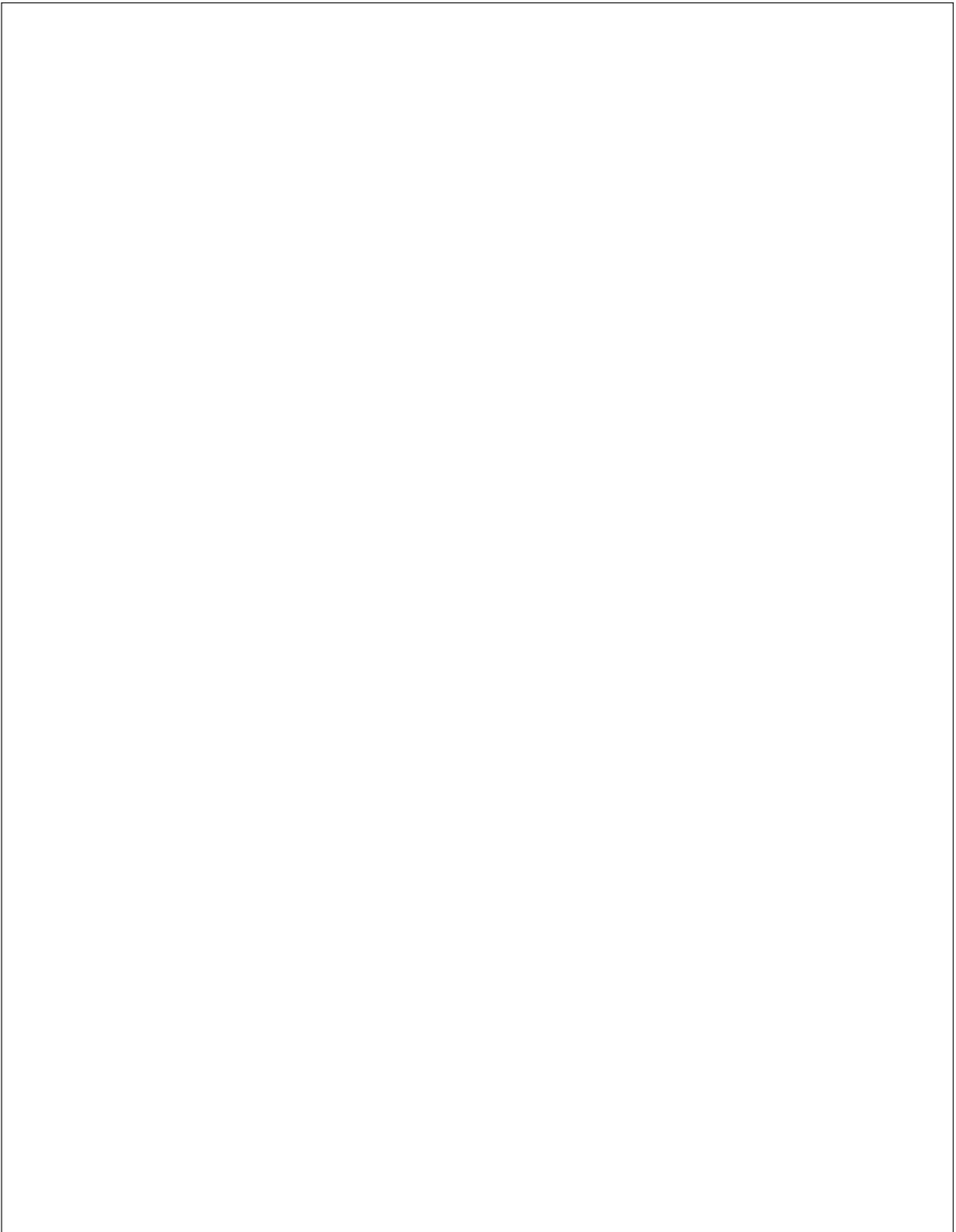
With the exception of the Central Idaho Mountains, Snake Headwaters, and perhaps the Northern Cascades, most of the important areas for the key salmonids exist as patches of scattered watersheds. Many of these important watersheds are associated with high-elevation, steep, and more erosive landscapes. These may be more extreme or variable environments contributing to higher variability in the associated populations



Map 15—Historic key salmonid presence.



Map 16—Current key salmonid presence.



Map 17—Aquatic strongholds and low road densities.

and higher sensitivity to watershed disturbances. Even with no further habitat loss the fragmentation and isolation may place remaining populations at risk. Risks could be aggravated with further development. The distribution of steelhead trout, for example, has decreased from historical range and known or predicted strongholds are few and far between.

Although less is known about the rare and sensitive fish taxa than the seven key salmonids, analyses of existing distribution and reviews of available literature provide insights about common threats and appropriate management needs. Many of these taxa occur in isolated areas of the Columbia River basin, in isolated subbasins of the Great Basin, or are restricted to the upper Klamath Basin. They typically occur in subbasins with only 1 or 2 native fish species present and in very restricted areas, often occupying 1 or 2 small habitat patches within subwatersheds (averaging 8,000 hectares in size). Consequently, broad- or mid-scale assessments that focus on high native species diversity may not adequately describe their distributions.

Some 15 previous efforts to identify special emphasis watersheds for conservation of aquatic resources and ecosystem function in the Basin were examined to address whether habitat criteria or population presence and status are better indicators for such special fish emphasis watersheds. Fish population strength was evaluated to identify the best remaining habitats within the Basin by focusing on subwatersheds with designated strong populations of seven key salmonids. This approach has the distinct advantage of recognizing the biological building blocks necessary to maintain and rehabilitate fish populations in the Basin. More than 27 percent of FS- and BLM-administered lands in the Basin contain strongholds (40 percent of Forest Service and 4 percent of BLM). These subwatersheds contain large areas of unroaded land (**map 17**).

## Implications for Ecosystem Management

Although much of the native ecosystem has been altered, core areas remain for rebuilding and maintaining functional native aquatic systems. Even though they are reduced in numbers and distributions, native trouts remain some of the most widely distributed taxa within the Basin. This suggests that although serious problems exist, particularly in the larger rivers and in the low-elevation agricultural and rangelands, the situation is somewhat better in the forested lands. Conditions remain best in areas that have experienced the least human-caused disturbance. Most of the areas exhibiting high-aquatic integrity fall within forested areas, with the exception of areas inherently high in native-species richness near the southern edge of the Basin.

*Although much of the native ecosystem has been altered, core areas remain for rebuilding and maintaining functional native aquatic systems.*

The largest areas of contiguous watersheds supporting strong populations of key salmonids are associated with the major river subbasins found in the Central Idaho Mountains, the Snake Headwaters and the Northern Cascades. Important but more restricted areas are also found in the Blue Mountains, Upper Clark Fork and the Northern Glaciated Mountains. Each of the key salmonids supported some known or predicted strong populations (**table 6**).

The core for maintaining and restoring much of the biological diversity associated with fishes still exists. Conservation and restoration of important habitats for key salmonids could provide habitat for associated species and will sustain

Table 6—Historical and occupied range and habitat status for key salmonids within the Basin Assessment area.<sup>1</sup>

Species	Historical range occupied	Occupied range classed as strong	Strongholds in wilderness	Strongholds on FS/BLM	Depressed on FS/BLM	Sensitive to FS/BLM uses
..... percent .....						
Bulltrout	45	13	55	95	82	Yes
Westslope cutthroat	85	25	44	94	65	Yes
Yellowstone cutthroat	66	35	19	70	46	Yes
Redband	69	22	8	56	58	Yes
Steelhead	46	1	9	70	61	Yes
Stream-type chinook	28	<1	50	88	77	Yes
Ocean-type chinook	30	15	0	20	25	minor influence

important processes that influence structure and function within these systems.

Restoring or maintaining the integrity of migration corridors will be challenging. Restoration and management of watersheds only on Federal lands will not be sufficient; river corridors surrounded largely by private lands are a particularly important part of fish habitat networks. Connections and habitat provided by larger river systems are critical to maintenance of anadromous populations. Rehabilitation of depressed populations cannot rely on habitat improvement alone but requires a concerted effort to address causes of mortality in all life stages. These include freshwater spawning and rearing, juvenile migration, ocean survival, and adult migration.

The introduction of non-native species and hatchery-propagated native species has influenced aquatic community composition. Contain-

ing non-natives will provide benefits that go beyond system integrity.

Protection and maintenance of system integrity and functioning will require innovative approaches. Simple solutions such as setting aside small, scattered watersheds probably will not be adequate for the persistence of even current distributions and diversity. If maintenance or restoration of the integrity of aquatic ecosystems is an important goal, dramatic and decisive action is required to stop further alterations and restore areas that are degraded.

***If maintenance or restoration of the integrity of aquatic ecosystems is an important goal, dramatic and decisive action is required to stop further alterations and restore areas that are degraded.***

While watershed protection is an effective management approach, evidence suggests that system integrity can be maintained in some intensively managed areas. It is unclear, however, whether intensively managed areas with high integrity are anomalies, regions where the effects on streams lag behind the changes on land, or are areas where intensive management and fish can co-exist.

Additional research will help to design management strategies to accomplish fish and habitat goals. The collective knowledge of status, distribution, and habitats for fishes is incomplete. Existing knowledge reflects the historical focus of fish management and research agencies on production and yield, recreational fishing opportunity, and high-profile species rather than on biotic integrity or species conservation. Sampling methodologies are poorly developed, inventories are incomplete, and reference standards are virtually non-existent. The development of consistent, reliable, large-scale species inventories will be critical for long-term management and evaluation of aquatic ecosystems.

Field experiments can be developed to provide information on the spatial dimensions (that is, width, length, depth, space and continuity) of ri-

parian buffer zones necessary to achieve single and multiple ecological and/or social objectives as well as how well they continue to function through time.

Three types of studies can contribute to the evaluation of hydrologic and geomorphic disturbance effects. First, field surveys are needed to assess the effect of historical events such as fires and large floods. Second, intensive, opportunistic surveys could be undertaken during and following these rare events. Third, the resilience of riparian and aquatic ecosystems to changes in the magnitude and frequency of extreme events could be tested using human-caused events (such as regulating levels of dams, reservoirs, and irrigation withdrawal).



