

## Southern Appalachians Ecoregion

### *Physical Setting*

The Southern Appalachians ecoregion stretches over 10 states, from northeastern Alabama to central Pennsylvania, and includes the interior highlands of the Ozark Plateau and the Ouachita Mountains in Arkansas, Missouri, and Oklahoma.

The land area of the Southern Appalachians ecoregion covers about 321,900 mi<sup>2</sup> (10.7% of the United States), with about 42,210 mi<sup>2</sup> (13.1%) of land under federal ownership. Many significant public lands, such as the Great Smoky Mountains National Park, the George Washington and Monongahela national forests, and the Shenandoah National Park, reside within this ecoregion. The topography is mostly hills and low mountains, with some wide valleys and irregular plains. Piedmont areas are included within the Southern Appalachians ecoregion.

Rivers in this ecoregion flow mostly over bedrock and other resistant rock types, with steep channels and short meander lengths. Major rivers such as the Susquehanna, James, and Potomac, along with feeders into the Ohio and Mississippi river systems, such as the Greenbrier River in West Virginia, originate in this ecoregion. The total stream length represented in the WSA for the Southern Appalachians ecoregion is 178,449 wadeable stream miles.

This ecoregion's climate is considered temperate wet, and annual precipitation totals average 40 to 80 inches. Mean annual temperature ranges from 55 to 65 °F. Based on satellite images in the 1992 NLCD, the distribution of land cover in this ecoregion is 68% forested and 25% planted/cultivated, with the remaining 7% in other types of land cover.

### *Biological Setting*

The Southern Appalachians ecoregion has some of the greatest aquatic animal diversity of any area in North America, especially for species

**Young Womans Creek, PA, in the Southern Appalachians ecoregion** (Photo courtesy of the Great Lakes Environmental Center).



of amphibians, fishes, mollusks, aquatic insects, and crayfishes. Salamanders, plants, and fungi reach their highest North American diversity in the Southern Appalachians ecoregion; however, some 18% of animal and plant species in the ecoregion are threatened or endangered.

Some areas in the Southern Appalachians ecoregion are among the least-impacted pre-settlement vegetative cover in the United States, such as the spruce-fir forests in the southern part of the ecoregion. The Great Smoky Mountains National Park and other national forests continue to protect exceptional stands of old-growth forest riparian ecosystems.

### *Human Influence*

The effects of habitat fragmentation, urbanization, agriculture, channelization, diversion, and impoundments on river systems have altered a large amount of stream length in the Southern Appalachians ecoregion. Placer mining, which disrupts streambeds and increases a stream's ability to transport fine sediments that influence habitat and water quality downstream, began in the Appalachians in the 1820s. In addition, some 800 mi<sup>2</sup> were surface mined in the Appalachian Highlands between 1930 and 1971, leading to the acidification of streams and reduction of aquatic diversity. Placer mining and surface mining operations have introduced many toxic contaminants to river systems in the Southern Appalachians ecoregion, including arsenic, antimony, copper, chromium, cadmium, nickel, lead, selenium, silver, and zinc. There are 224 active, 5 proposed, and 46 deleted EPA Superfund National Priority List sites in this ecoregion.

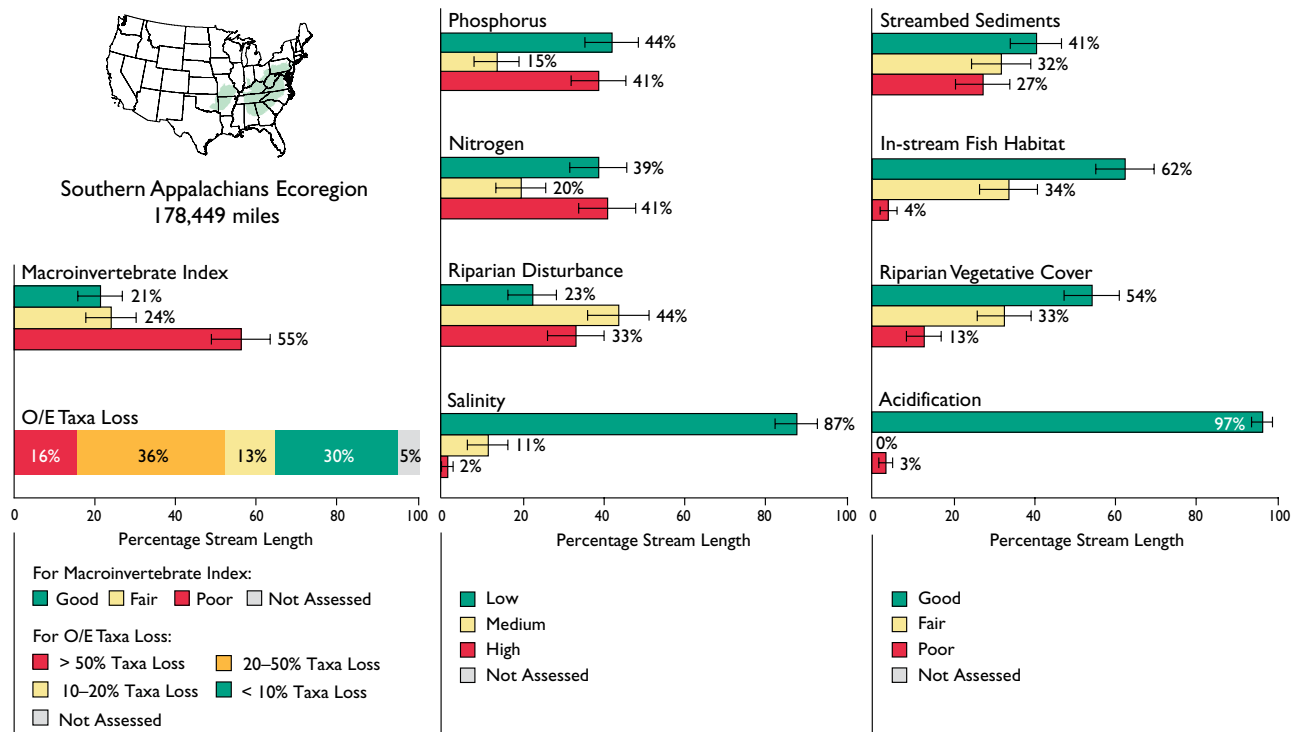
Economic activities in the Southern Appalachians ecoregion include forestry, coal mining, and some local agriculture and tourism industries. Petroleum and natural gas extraction are prevalent along the coal belt, and the ecoregion supports coal, bauxite, zinc, copper, and chromium mining activities. Utility industries include hydro-power in the Tennessee Valley and numerous coal-fired plants throughout the ecoregion. Significant agricultural activities are alfalfa production in Pennsylvania, with apple and cattle production occurring throughout the ecoregion. Wood processing and pulp, paper, and board production are also prevalent.

Approximately 50,208,000 people live in the Southern Appalachians ecoregion, representing approximately 17% of the total population of the United States.

### *Summary of WSA Findings*

A total of 184 random sites were sampled during the summer of 2004 to characterize the condition of wadeable streams in the Southern Appalachians ecoregion. An overview of the WSA survey results for the ecoregion is shown in Figure 27. These results may not be extrapolated to an individual state or stream within the ecoregion because the study design was not intended to characterize stream conditions at these finer scales.

During a series of WSA workshops conducted to evaluate assessment results, professional biologists working in the Southern Appalachians ecoregion said that the least-disturbed reference streams in the ecoregion represent varying degrees of human influence. Although some reference streams are in remote areas, others are intricately linked with road systems in narrow floodplains.



**Figure 27. WSA survey results for the Southern Appalachians ecoregion (U.S. EPA/WSA).** Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

### Biological Condition

- The Macroinvertebrate Index shows that 55% of stream length in the Southern Appalachians ecoregion is in poor condition, 24% is in fair or intermediate condition, and 21% is in good condition compared to least-disturbed reference condition.
- The O/E Taxa Loss results show that 65% of stream length in the Southern Appalachians ecoregion has lost 10% or more of the macroinvertebrate taxa that are expected to occur, and 16% has lost more than 50% of taxa. These results also indicate that 30% of stream length has retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

### Indicators of Stress

Leading indicators of stress in the Southern Appalachians ecoregion include total nitrogen, total phosphorus, riparian disturbance, and streambed sediments.

- Forty-one percent of stream length in the Southern Appalachians ecoregion has high phosphorus concentrations, 15% has medium phosphorus concentrations, and 44% has low phosphorus concentrations based on least-disturbed reference condition.
- Nitrogen concentrations in the ecoregion are high in 41% of stream length, medium in 20% of stream length, and low in 39% of stream length based on least-disturbed reference condition.

- Riparian disturbance, or evidence of human influence in the riparian zone, is at high levels in 33% of stream length, at medium levels in 44% of stream length, and at low levels in 23% of stream length.
- Salinity is found at high levels in only 2% of stream length, at medium levels in 11% of stream length, and at low levels in 87% of stream length.
- Streambed sediments are rated poor in 27% of stream length in the Southern Appalachians ecoregion, fair in 32%, and good in 41%.
- In-stream fish habitat is in poor condition in 4% of stream length, fair in 34% of stream length, and good in 62%.
- Vegetative cover in the riparian zone along Southern Appalachian stream banks is in poor condition in 13% of stream length, fair in 33% of stream length, and good in 54% of stream length.
- Acidification, which is primarily associated with acidic deposition and acid mine drainage in this ecoregion, is rated poor in 3% of stream length.

## Coastal Plains Ecoregion

### *Physical Setting*

The Coastal Plains ecoregion covers the Mississippi Delta and Gulf Coast, north along the Mississippi River to the Ohio River, all of Florida and eastern Texas, and the Atlantic seaboard from Florida to New Jersey. The total land area of this ecoregion is about 395,000 mi<sup>2</sup> (13.2% of the United States), with 25,890 mi<sup>2</sup> (6.6%) of land under federal ownership. River systems lying within or intersecting the Coastal Plains ecoregion are the Mississippi, Suwannee, Savannah,

Roanoke, Potomac, Delaware, Susquehanna, James, Sabine, Brazos, and Guadalupe rivers.

Rivers in the Coastal Plains meander broadly across flat plains created by thousands of years of river deposition and form complex wetland topographies with levees, backswamps, and oxbow lakes. Rivers typically drain densely vegetated catchment areas, while well-developed soils and less intensive rains and subsurface flows keep suspended sediment levels in the rivers relatively low. The Mississippi River carries large loads of sediments from dry lands in the central and western portion of the drainage. The total stream length represented in the WSA for the Coastal Plains ecoregion is 72,130 wadeable stream miles.



**Sandy Creek, LA, in the Coastal Plains ecoregion** (Photo courtesy of the Great Lakes Environmental Center).

The Coastal Plains ecoregion contains about one-third of all remaining U.S. wetlands, more than half of U.S. forested wetlands, and the largest aggregate area of U.S. riparian habitat. The topography of the area is mostly flat plains, barrier islands, numerous wetlands, and about 50 important estuarine systems that lie along the coastal margins. The climate of this ecoregion is considered temperate wet to subtropical in the south, with average annual temperatures ranging from 50 to 80 °F and annual precipitation ranging from 30 to 79 inches. Based on satellite images in the 1992 NLCD, the distribution of land cover in this ecoregion is 39% forested, 30% planted/cultivated, and 16% wetlands, with the remaining 15% of the ecoregion comprised of other types of land cover.

### *Biological Setting*

River habitats in the Coastal Plains ecoregion have tremendous species richness and the highest number of endemic species of aquatic organisms in North America. Abundant fish, crayfish, mollusk, aquatic insect, and other species include such unique species as paddlefish, catostomid suckers, American alligator, and giant aquatic salamanders; however, it is estimated that some 18% of the aquatic species in this ecoregion are threatened or endangered. The Coastal Plains ecoregion includes the Florida Everglades, which contains temperate and tropical plant communities and a rich variety of bird and wildlife species; however, because it is a unique aquatic ecosystem, the Everglades is not represented in the WSA.

### *Human Influence*

Historically, the Coastal Plains ecoregion had extensive bottomlands that flooded for several months; these areas are now widely channelized and confined by levees. Damming, impounding, and channelization in almost all major rivers have altered the rate and timing of water flow, as well as the productivity of riparian habitats. Pollution from acid mine drainage, urban runoff, air pollution, sedimentation, and recreation, as well as the introduction of non-indigenous fishes and aquatic plants, have also affected riparian habitats and native aquatic fauna. There are currently 275 active, 13 proposed, and 77 deleted EPA Superfund National Priority List sites in the Coastal Plains ecoregion.

The ecoregion's economy is varied and includes many activities. Agriculture in this ecoregion includes citrus, peanut, sugar cane, tobacco, cattle, poultry, cotton, corn, rice, vegetable, and stone fruit production. Industries include pulp, paper, board, and board wood processing; aluminum production; salt, sulfur, bauxite, and phosphate mining; and chemical and plastics production. The Coastal Plains contain approximately 40% of U.S. petrochemical refinery capacity, much of which is located offshore in the Gulf of Mexico.

This ecoregion also includes many large coastal cities, which contribute to a population of approximately 56,168,000, the largest population of all the WSA ecoregions, representing approximately 19% of the population of the United States.

## Summary of WSA Findings

A total of 83 random sites were sampled during the summer of 2004 to characterize the condition of wadeable streams in the Coastal Plains ecoregion. An overview of the WSA survey results for this ecoregion is shown in Figure 28. These results may not be extrapolated to an individual state or stream within the ecoregion because the study design was not intended to characterize stream conditions at these finer scales.

During a series of WSA workshops conducted to evaluate assessment results, professional biologists working in the Coastal Plains ecoregion said that the high prevalence of human population centers, agriculture, and industry makes it difficult to find truly undisturbed streams in this ecoregion; therefore, the ecoregion’s least-disturbed reference sites are influenced to some degree by human activities.



**Figure 28. WSA survey results for the Coastal Plains ecoregion (U.S. EPA/WSA).** Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

## Biological Condition

- The Macroinvertebrate Index reveals that 39% of stream length in the Coastal Plains ecoregion is in poor condition, 23% is in fair or intermediate condition, and 36% is in good condition compared to least-disturbed reference condition. No data were available to evaluate 2% of the ecoregion's stream length.
- The O/E Taxa Loss results show that 65% of stream length in the Coastal Plains ecoregion has lost 10% or more of the macroinvertebrate taxa that are expected to occur, and 15% has lost more than 50% of taxa. These results also indicate that 32% of stream length has retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

## Indicators of Stress

Leading indicators of stress in the Coastal Plains ecoregion include total phosphorus, in-stream fish habitat, riparian vegetative cover, and streambed sediments.

- Twenty-nine percent of stream length in the Coastal Plains ecoregion has high phosphorus concentrations, 13% has medium phosphorus concentrations, and 58% has low phosphorus concentrations based on least-disturbed reference condition.
- Ten percent of the ecoregion's stream length has high nitrogen concentrations, 18% has medium nitrogen concentrations, and 72% has low nitrogen concentrations based on least-disturbed reference condition.
- Riparian disturbance, or evidence of human influence in the riparian zone, is at high levels in 20% of stream length, at medium levels in 50% of stream length, and at low levels in 30% of stream length.
- Salinity is found at high or medium levels in 5% of stream length, with the remaining 95% of stream length showing low levels for this indicator.
- Streambed sediments are rated poor in 22% of stream length in the Coastal Plains ecoregion, fair in 11% of stream length, and good in 64% of stream length based on least-disturbed reference condition; no data were available to assess the remaining 3% of stream length.
- In-stream fish habitat is in poor condition in 41% of stream length, fair in 13% of stream length, and good in 46% of stream length, based on least-disturbed reference condition.
- Vegetative cover in the riparian zone along stream banks is in poor condition for 24% of stream length, fair condition for 24% of stream length, and good condition in the remaining 52% of stream length based on least-disturbed reference condition.
- In this ecoregion, the ANC is low enough to result in episodic acidification during rainfall in 6% of stream length. Another 5% of stream length has naturally lower pH.

## Upper Midwest Ecoregion

### *Physical Setting*

The Upper Midwest ecoregion covers most of the northern half and southeastern part of Minnesota, two-thirds of Wisconsin, and almost all of Michigan. The land area of the Upper Midwest ecoregion comprises some 160,374 mi<sup>2</sup> (5.3% of the United States). The river systems in this ecoregion empty into portions of the Great Lakes regional watershed and the upper Mississippi River watershed. Major river systems include the upper Mississippi River in Minnesota and Wisconsin; the Wisconsin, Chippewa, and St. Croix rivers in Wisconsin; and the Menominee and Escanaba rivers in Michigan. Streams in the Upper Midwest ecoregion typically drain relatively small catchments and empty directly into the Great Lakes or upper Mississippi River. These streams generally have steep gradients, but their topography and soils tend to slow runoff and sustain flow throughout the year.

The total stream length represented in the WSA for the Upper Midwest ecoregion is 36,547 wadeable stream miles. Sandy soils dominate these waterbodies, with relatively high water quality in streams supporting cold-water fish communities. Important waterbodies in this ecoregion include the Upper Mississippi River system and Lakes Superior, Michigan, Huron, and Erie.

The glaciated terrain of this ecoregion typically consists of plains with some hill formations. Numerous lakes, rivers, and wetlands predominate in most areas. The climate is characterized by cold winters and relatively short, warm summers, with mean annual temperatures ranging from 34 to 54 °F and annual precipitation in the 20- to 47-inch range. Much of the land in this ecoregion is covered by national and state forests,



**Raisin River, MI, in the Upper Midwest ecoregion** (Photo courtesy of the Great Lakes Environmental Center).

and federal lands account for 15.5% of the area (roughly 25,000 mi<sup>2</sup>). Based on satellite images in the 1992 NLCD, the distribution of land cover in this ecoregion is 40% forested, 34% planted/cultivated, and 17% wetlands, with the remaining 9% of the ecoregion comprised of other types of land cover.

### *Biological Setting*

Vegetative cover for the Upper Midwest ecoregion is mixed boreal woodland, mixed oak-hickory associations, and conifers, as well as bog and moss barrens. The Great Lakes aquatic ecosystems are subject to increasing intrusion by invasive animal and plant species introduced by ocean shipping. These species include the zebra mussel, the round goby, the river ruffe, the spiny water flea, and Eurasian watermilfoil.

### *Human Influence*

The Upper Great Lakes portion of the Upper Midwest ecoregion was entirely forested in



pre-colonial times. Virtually all of the virgin forest was cleared in the 19th and early 20th centuries, and streams and rivers were greatly affected by the logging industry. The upper Mississippi River portion of the Upper Midwest ecoregion was also heavily influenced by logging and agriculture.

Major manufacturing, chemical, steel, and power production (e.g., coal, nuclear, oil) occur in the large metropolitan areas found in the Upper Midwest ecoregion. Other key economic activities are forestry, mining, and tourism. Agriculture includes dairy production, grain crops in the western areas, fruit production around the Great Lakes, and hay and cattle farming throughout the ecoregion. Pulp, paper, and board wood processing are prevalent throughout the northern parts of the ecoregion. The area includes the shipping ports at Duluth, MN, and Superior, WI, as well as cities like Marquette, MI, and Hibbing, MN, which were built up along with the mining industry. The Upper Peninsula of Michigan lies entirely within the Upper Midwest ecoregion, as does Minnesota's Mesabi Range, the largest U.S. iron ore deposit. This area is subject to the environmental effects of mining operations. There are currently 112 active, 1 proposed, and 12 deleted EPA Superfund National Priority List sites in this ecoregion.

The approximate population of this area is 15,854,000, representing approximately 5% of the population of the United States.

### *Summary of WSA Findings*

A total of 56 random sites were sampled in the Upper Midwest ecoregion during the summer of 2004 to characterize the condition of its wadeable streams. An overview of the WSA survey results for the Upper Midwest ecoregion is shown in Figure 29. These results may not be extrapolated

to an individual state or stream within the ecoregion because the study design was not intended to characterize stream conditions at these finer scales.

During a series of WSA workshops conducted to evaluate assessment results, professional biologists working in the Upper Midwest ecoregion said that some of the ecoregion's least-disturbed streams that serve as a benchmark for reference condition are influenced by some form of human activity or land use; however, most of the least-disturbed reference sites are streams in relatively undisturbed areas in the northern portion of the ecoregion.

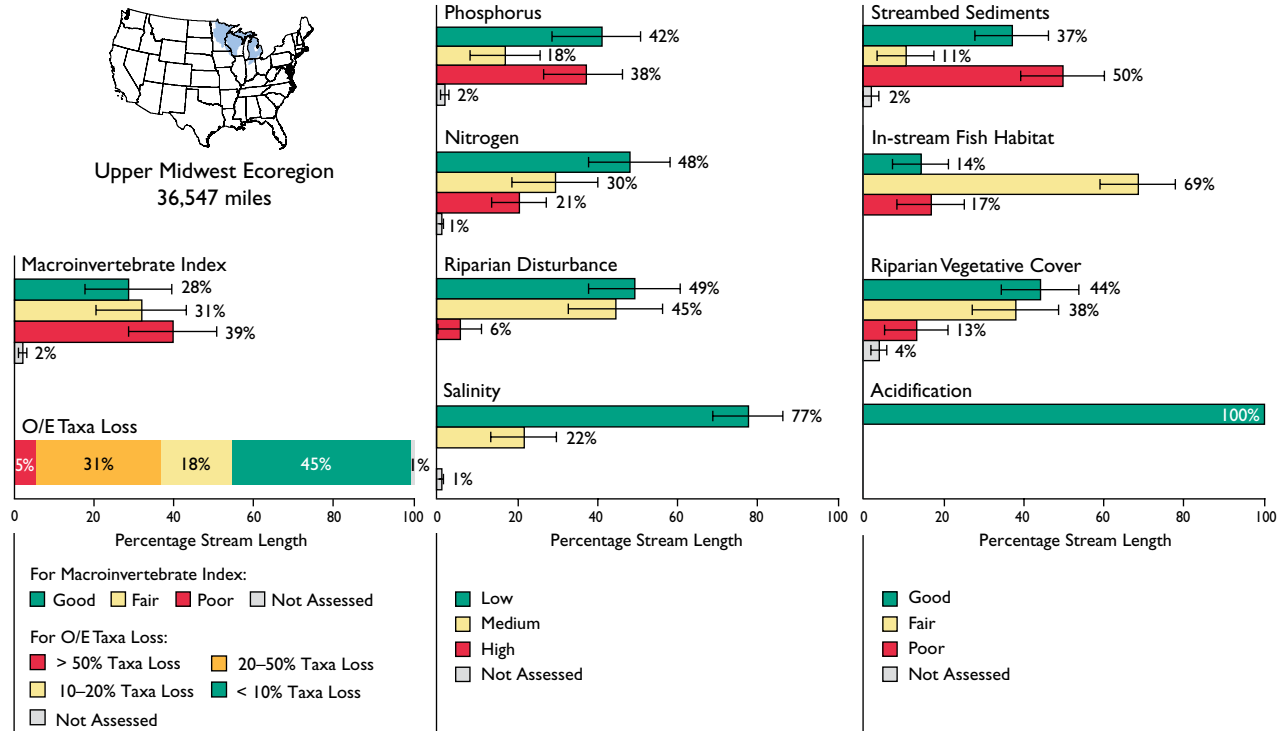
### **Biological Condition**

- The Macroinvertebrate Index reveals that 39% of stream length in the Upper Midwest ecoregion is in poor condition, 31% is in fair condition, and 28% is in good condition based on least-disturbed reference condition.
- The O/E Taxa Loss results show that 54% of stream length in the Upper Midwest ecoregion has lost 10% or more of the macroinvertebrate taxa that are expected to occur, and 5% has lost more than 50% of taxa. These results also indicate that 45% of stream length has retained at least 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

### **Indicators of Stress**

Leading indicators of stress in the Upper Midwest ecoregion include total phosphorus, total nitrogen, streambed sediments, and in-stream fish habitat.

- Thirty-eight percent of stream length in the Upper Midwest ecoregion has high phosphorus concentrations, 18% has medium



**Figure 29. WSA survey results for the Upper Midwest ecoregion (U.S. EPA/WSA).** Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

phosphorus concentrations, and 42% has low phosphorus concentrations based on least-disturbed reference condition.

- Twenty-one percent of the ecoregion’s stream length has high nitrogen concentrations, 30% of stream length has medium nitrogen concentrations, and 48% of stream length has low nitrogen concentrations based on least-disturbed reference condition.
- Riparian disturbance, or evidence of human influence in the riparian zone, is at high levels in 6% of stream length, at medium levels in 45% of stream length, and at low levels in 49% of stream length.
- Salinity is found at medium levels in 22% of stream length and at low levels in 77% of stream length. None of the steam length of the

Upper Midwest ecoregion showed high levels for this indicator.

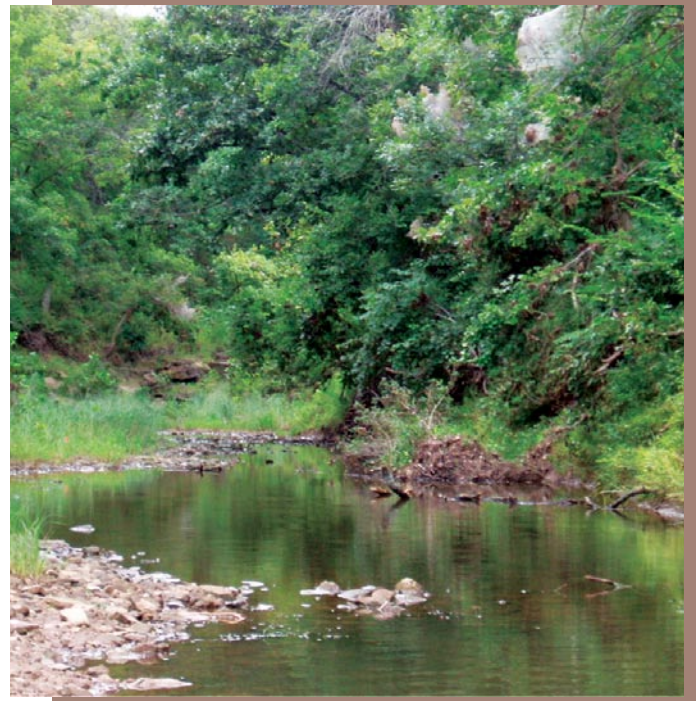
- Streambed sediments are rated poor in 50% of stream length, fair in 11%, and good in 37%; data for this indicator were not available for 2% of stream length.
- In-stream fish habitat is in poor condition in 17% of stream length, fair in 69% of stream length, and good in 14% of stream length based on least-disturbed reference condition.
- Vegetative cover in the riparian zone along stream banks is in poor condition in 13% of stream length, fair condition in 38% of stream length, and in good condition in 44% of stream length.
- The effects of acidification are not noted for the Upper Midwest ecoregion.

## Temperate Plains Ecoregion

### *Physical Setting*

The Temperate Plains ecoregion includes the open farmlands of Iowa; the eastern Dakotas; western Minnesota; portions of Missouri, Kansas, and Nebraska; and the flat farmlands of western Ohio, central Indiana, Illinois, and southeastern Wisconsin. The area of this ecoregion covers some 342,200 mi<sup>2</sup> (11.4% of the United States), with approximately 7,900 mi<sup>2</sup> (2.3%) of land under federal ownership. The ecoregion's terrain consists of smooth plains and numerous small lakes and wetlands. The climate is temperate, with fairly cold winters; hot, humid summers; and mean temperatures ranging from 36 to 55 °F. Annual precipitation in the Temperate Plains ecoregion ranges from 16 to 43 inches.

Many of the rivers in this ecoregion drain into the Upper Mississippi and Ohio regional watersheds, and a few systems empty into the Great Lakes watershed near Toledo, OH; Saginaw, MI; Detroit, MI; and southeastern Wisconsin. Rivers are either supplied by snowmelt or groundwater. Rivers in the tall grass prairie start from prairie potholes and springs and are likely to be ephemeral (flowing for a short time after snowmelt or rainfall). The prairie rivers carry large volumes of fine sediments and tend to be turbid, wide, and shallow. The total stream length represented in the WSA for the Temperate Plains ecoregion is 100,879 wadeable stream miles. Based on satellite images in the 1992 NLCD, the distribution of land cover in this ecoregion is 9% forested and 76% planted/cultivated, with the remaining 15% of the ecoregion comprised of other types of land cover.



**Grey Horse Creek, OK, in the Temperate Plains ecoregion** (Photo courtesy of Monty Porter).

### *Biological Setting*

Vegetation for the Temperate Plains ecoregion consists primarily of oak, hickory, elm, ash, beech, and maple, with increasing amounts of prairie grasses to the west. Rivers have rich fish fauna with many species, including minnows, darters, killifishes, catfishes, suckers, sunfishes, and black bass. Few species are endemic to the ecoregion.

### *Human Influence*

Pre-settlement vegetation of the area was prairie grass and aspen parkland, but is now comprised of about 75% arable cultivated lands. This ecoregion is rich in agricultural production, including field crops such as corn, wheat, alfalfa, soybeans, flaxseed, and rye, along with vegetable crops such as peanuts and tomatoes. Hog and cattle production and processing are also prevalent. Crops and grazing have reduced

natural riparian vegetation cover, increased sediment yield, and introduced pesticides and herbicides into the watershed. Conservation tillage — a reduced-cultivation method — has been implemented in about 50% of crop fields in the Maumee River Basin and in northwestern Ohio tributaries draining to Lake Erie. USGS findings from 1993–1998 in these rivers showed significant decreases in the amounts of suspended sediment. Rivers in the Temperate Plains ecoregion also tend to have high nitrogen concentrations due to nutrients from agriculture and from fertilizer applied to lawns and golf courses in urban areas. In Illinois, where land is intensively developed through urbanization and agriculture, more than 25% of all sizable streams have been channelized, and almost every stream in the state has at least one dam.

Coal mining, petroleum and natural gas production, and zinc and lead mining occur across the Temperate Plains ecoregion. There are very active areas of manufacturing, steel production, and chemical production in the ecoregion's urban centers, with especially high concentrations near Detroit, MI, and the industrial belt from Gary, IN, to Chicago, IL, and Milwaukee, WI. Industrial activities in these large urban centers have contributed sewage, toxic compounds, and silt to river systems. Heavy metals, organochlorines, and PCBs are especially prevalent and persistent river contaminants found in industrial areas; however, many rivers have improved from their worst state in the 1960s. There are currently 133 active, 17 proposed, and 44 deleted EPA Superfund National Priority List sites in the Temperate Plains ecoregion.

The approximate population of this ecoregion is 38,399,000, representing approximately 13% of the U.S. population.

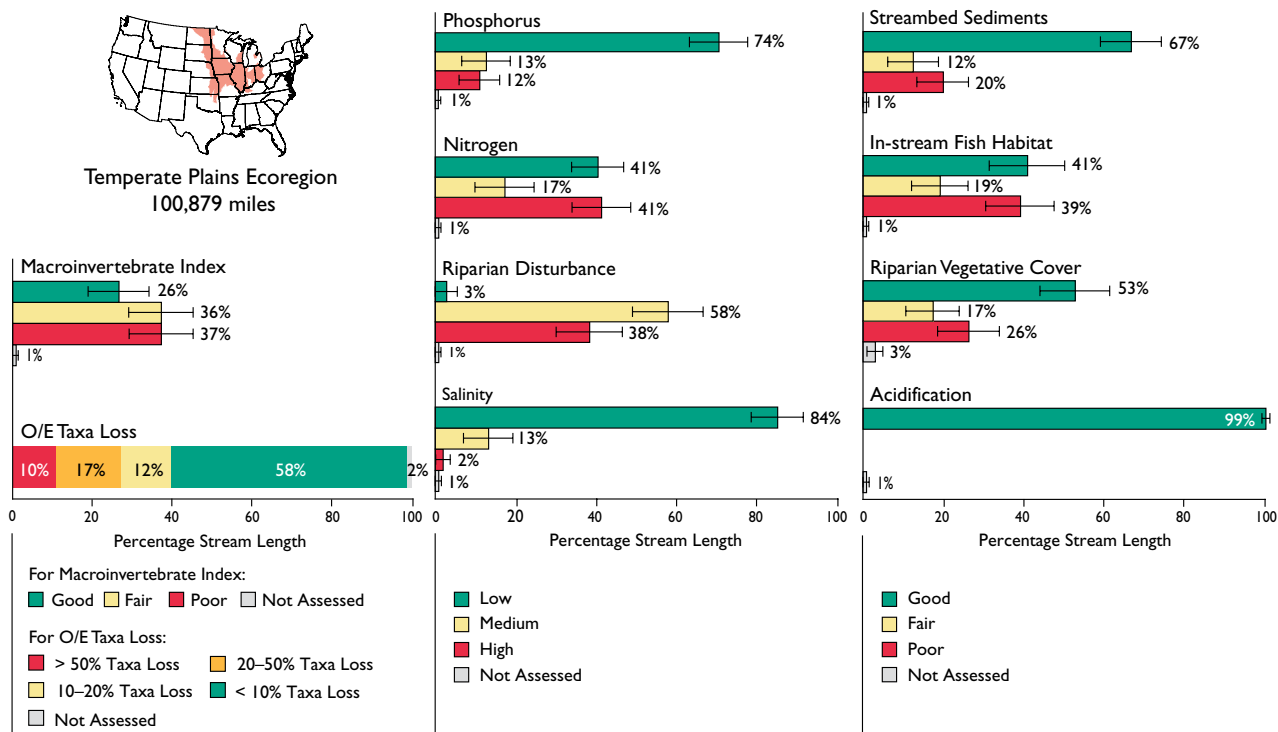
## Summary of WSA Findings

A total of 132 random sites were sampled during the summer of 2004 to characterize the condition of wadeable streams throughout the Temperate Plains ecoregion. An overview of the WSA survey results for the Temperate Plains ecoregion is shown in Figure 30. These results may not be extrapolated to an individual state or stream within the ecoregion because the study design was not intended to characterize stream conditions at these finer scales.

During a series of WSA workshops conducted to evaluate assessment results, professional biologists working in the Temperate Plains ecoregion said that it is hard to find high-quality reference sites in the ecoregion because even the least-disturbed streams are influenced by a long history of land use. Extensive agriculture and development have influenced virtually all waterbodies in this ecoregion.

## Biological Condition

- The Macroinvertebrate Index reveals that 37% of stream length in the Temperate Plains ecoregion is in poor condition, 36% is in fair condition, and 26% is in good condition compared to least-disturbed reference condition.
- The O/E Taxa Loss results show that 39% of stream length in the Temperate Plains ecoregion has lost 10% or more of the macroinvertebrate taxa that are expected to occur, and 10% has lost more than 50% of taxa. These results also indicate that 58% of stream length has retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.



**Figure 30. WSA survey results for the Temperate Plains ecoregion (U.S. EPA/WSA).** Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

### Indicators of Stress

Leading indicators of stress in the Temperate Plains ecoregion include total nitrogen, riparian disturbance, in-stream fish habitat, and riparian vegetative cover.

- Approximately 12% of stream length in the Temperate Plains ecoregion has high phosphorus concentrations, 13% has medium phosphorus concentrations, and 74% has low phosphorus concentrations based on least-disturbed reference condition.
- Approximately 41% of the ecoregion’s stream length has high nitrogen concentrations, 17% has medium nitrogen concentrations, and 41% has low nitrogen concentrations based on least-disturbed reference condition.
- Riparian disturbance for this ecoregion is at high levels in approximately 38% of stream length, at medium levels in 58% of stream length, and at low levels in 3% of stream length.
- Salinity is found at high levels in 2% of stream length, at medium levels in 13% of stream length, and at low levels in 84% of stream length.
- Excess streambed sediments affect streams in the Temperate Plains ecoregion to a lesser extent than other physical stressors. Streambed sediments are rated poor in 20% of stream length in this ecoregion, fair in 12%, and good in 67% based on least-disturbed reference condition.

- In-stream fish habitat is in poor condition in 39% of stream length, fair in 19% of stream length, and good in 41% of stream length based on least-disturbed reference condition.
- Vegetative cover in the riparian zone along stream banks is in poor condition for 26% of stream length, fair condition for 17% of stream length, and good condition for 53% of stream length.
- The effects of acidification are not noted for the Temperate Plains ecoregion.

## Southern Plains Ecoregion

### *Physical Setting*

The Southern Plains ecoregion covers approximately 405,000 mi<sup>2</sup> (13.5% of the United States) and includes central and northern Texas; most of western Kansas and Oklahoma; and portions of Nebraska, Colorado, and New Mexico. The terrain is a mix of smooth and irregular plains interspersed with tablelands and low hills. The Arkansas, Platte, White, Red, and Rio Grande rivers flow through this ecoregion, and most of the great Ogallala aquifer lies underneath this ecoregion. The total stream length represented in the WSA for the Southern Plains ecoregion is 19,263 wadeable stream miles.

Most of the land use is arable and arable with grazing, with desert or semi-arid grazing land in the south. Based on satellite images in the 1992 NLCD, the distribution of land cover in this ecoregion is 45% grassland, 32% planted/cultivated, and 14% shrubland, with the remaining 9% of the ecoregion comprised of other types of land cover. Federal land ownership in this ecoregion totals about 11,980 mi<sup>2</sup> or approximately 3% of the total, the lowest share

of all WSA aggregate ecoregions. The climate is dry temperate, with the mean annual temperature ranging from 45 to 79 °F. Annual precipitation for the ecoregion is between 10 and 30 inches.

### *Biological Setting*

Vegetative cover in the northern portion of this ecoregion is mainly short prairie grasses such as buffalo grass, while in the southern portion, grasslands with mesquite, juniper, and oak woody vegetation are common. Coastal vegetation in the southern Plains ecoregion is typically more salt-tolerant in nature.



**Commission Creek, OK, in the Southern Plains ecoregion** (Photo courtesy of Monty Porter).

## Human Influence

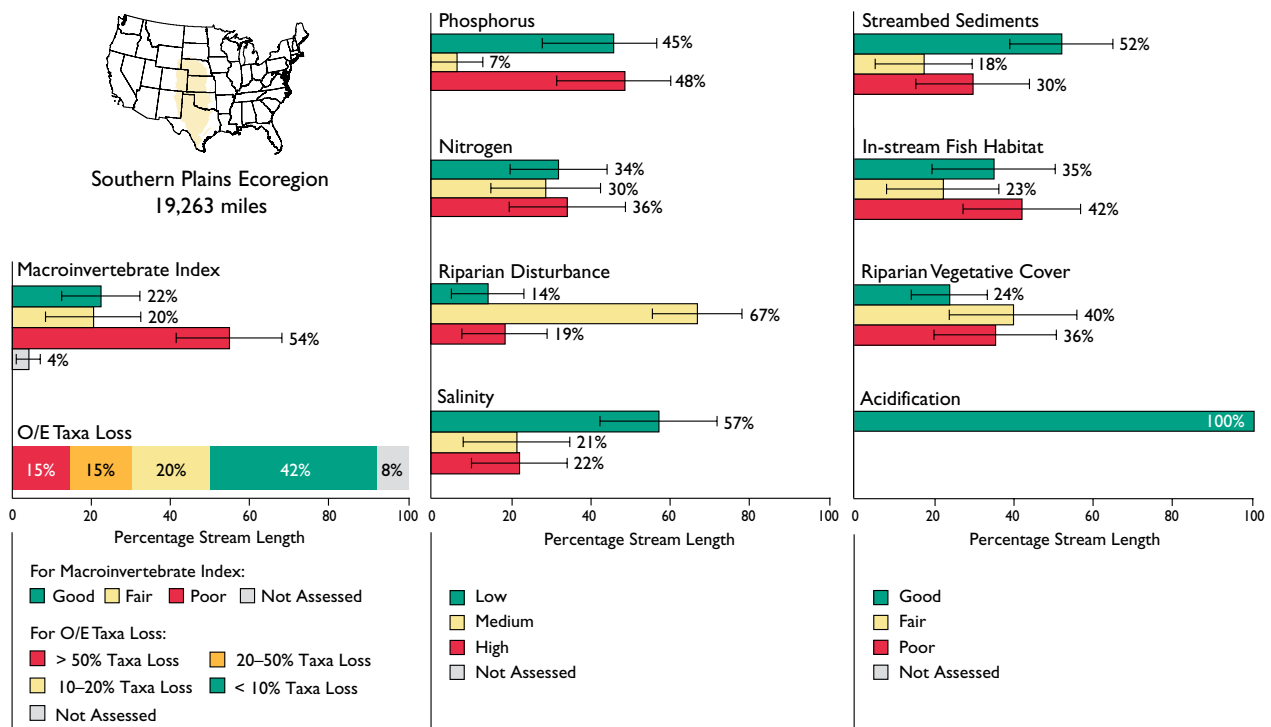
The Great Prairie grasslands, which once covered much of the Southern Plains ecoregion, are the most altered and endangered large ecosystem in the United States. About 90% of the original tall grass prairie was replaced by other vegetation or land uses. Agriculture is an important economic activity in this ecoregion and includes sorghum, wheat, corn, sunflower, bean, and cotton production. Livestock production and processing is prevalent, especially goats, sheep, and cattle. The ecoregion contains a sizable portion of U.S. petroleum and natural gas production in Oklahoma, Kansas, and Texas. Electricity in this ecoregion is generated almost exclusively with gas-fired power plants. Some uranium and zinc mining is found in Oklahoma and the Texas panhandle. There are currently

39 active, 5 proposed, and 14 deleted EPA Superfund National Priority List sites in this ecoregion.

The approximate population in this ecoregion is 18,222,000, representing roughly 6% of the population of the United States.

## Summary of WSA Findings

A total of 49 random sites were sampled during the summer of 2004 to characterize the condition of wadeable streams throughout the Southern Plains ecoregion. An overview of the WSA survey results for the ecoregion is shown in Figure 31. These results may not be extrapolated to an individual state or stream within the ecoregion because the study design was not intended to characterize stream conditions at these finer scales.



**Figure 31. WSA survey results for the Southern Plains ecoregion (U.S. EPA/WSA).** Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

During a series of WSA workshops conducted to evaluate assessment results, professional biologists working in the Southern Plains ecoregion said that no undisturbed streams remain in the ecoregion. The least-disturbed streams are those that retain natural configuration and have riparian buffer zones.

### Biological Condition

- The Macroinvertebrate Index reveals that 54% of stream length in the Southern Plains ecoregion is in poor condition, 20% is in fair condition, and 22% is in good condition compared to least-disturbed reference condition. There are no data for the remaining 4% of stream length.
- The O/E Taxa Loss results show that 50% of stream length in the Southern Plains ecoregion has lost 10% or more of the macroinvertebrate taxa expected to occur, and 15% has lost more than 50% of taxa. These results also indicate that 42% of the ecoregion's stream length has retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

### Indicators of Stress

The most widespread indicators of stress in the Southern Plains ecoregion include total phosphorus, total nitrogen, in-stream fish habitat, and riparian vegetative cover.

- Forty-eight percent of stream length in the Southern Plains ecoregion has high phosphorus concentrations, 7% has medium

phosphorus concentrations, and 45% has low phosphorus concentrations based on least-disturbed reference condition.

- Approximately 36% of the ecoregion's stream length has high nitrogen concentrations, 30% has medium nitrogen concentrations, and 34% has low nitrogen concentrations based on least-disturbed reference condition.
- Riparian disturbance in this ecoregion is at high levels in 19% of stream length. The majority of stream length (67%) has medium levels of riparian disturbance, and only 14% has low levels for this indicator.
- Salinity is found at high levels in 22% of stream length, at medium levels in 21% of stream length, and at low levels in 57% of stream length.
- Streambed sediments are rated poor in 30% of stream length, fair in 18%, and good in 52% based on least-disturbed reference condition.
- In-stream fish habitat is in poor condition in 42% of stream length, fair in 23% of stream length, and good in 35% of stream length based on least-disturbed reference condition.
- Vegetative cover in the riparian zone along stream banks is in poor condition for 36% of stream length, in fair condition for 40% of stream length, and good condition for 24% of stream length.
- The effects of acidification are not noted for the Southern Plains ecoregion.



## Northern Plains Ecoregion

### *Physical Setting*

The Northern Plains ecoregion covers approximately 205,084 mi<sup>2</sup> (6.8% of the United States), including the western Dakotas, Montana east of the Rocky Mountains, northeast Wyoming, and a small section of northern Nebraska. Federal lands account for 52,660 mi<sup>2</sup> or a relatively large (25.7%) share of the total area. The Great Prairie grasslands were also an important feature of this ecoregion, but about 90% of these grasslands have been replaced by other vegetation or land use. The ecoregion's terrain is irregular plains interspersed with tablelands and low hills. This ecoregion is the heart of the Missouri River system and is almost exclusively within the Missouri River's regional watershed. The total stream length represented in the WSA for the Northern Plains ecoregion is 13,445 Wadeable Stream Miles.

Land use is arable with grazing or semi-arid grazing. Based on satellite images in the 1992 NLCD, the distribution of land cover in this ecoregion is 56% grassland and 30% planted/cultivated, with the remaining 14% of the ecoregion comprised of other types of land cover. Significant wetlands are also found in the Nebraska Sandhills area. The climate is dry and continental, characterized by short, hot summers and long, cold winters. Temperatures average 36 to 46 °F, and annual precipitation totals range from 10 to 25 inches. High winds are an important climatic factor in this ecoregion. It is also subject to periodic, intense droughts and frosts.

### *Biological Setting*

The predominant vegetative cover for the Northern Plains ecoregion was formerly native short prairie grasses, such as wheat grass and porcupine grass, but now cropland is much more prevalent.



**Wolf Creek, McCook County, SD, in the Northern Plains ecoregion**  
(Photo courtesy of Dynamac Corp).

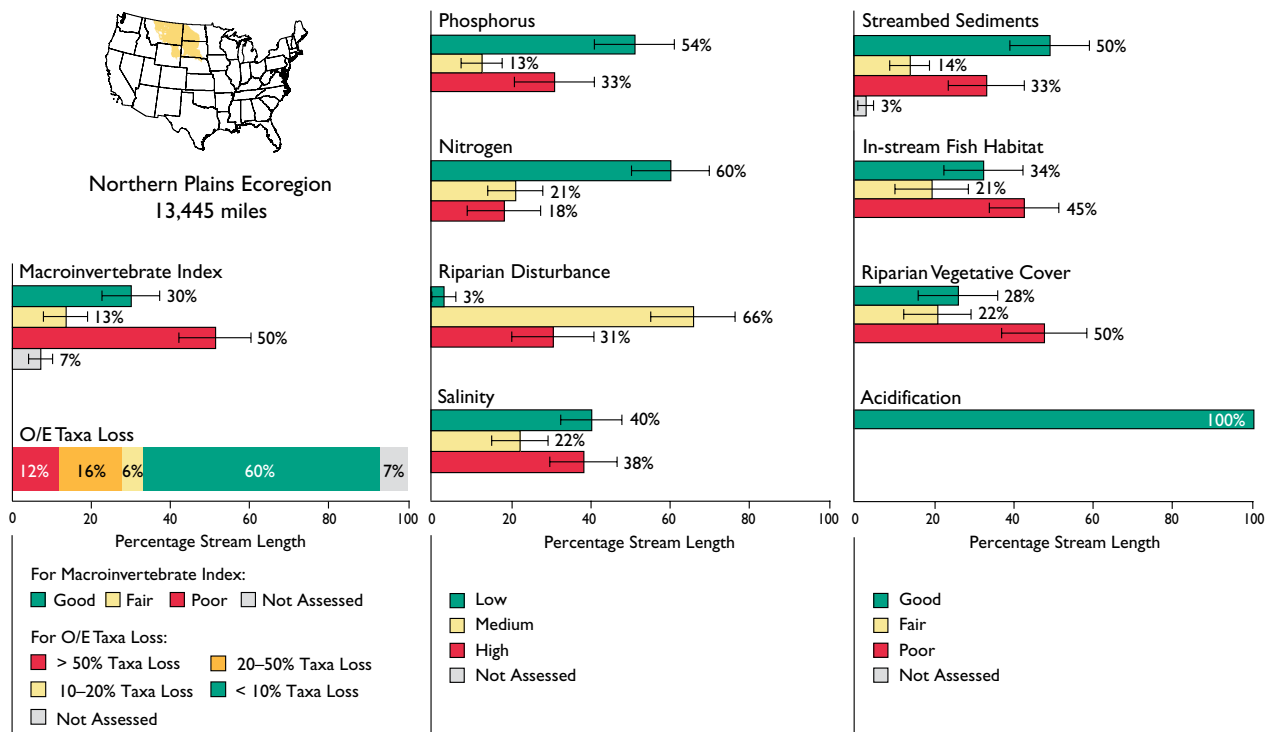
## Human Influence

Human economic activity is primarily agriculture, including cattle and sheep grazing, as well as the growing of wheat, barley, and sugar beets. Coal mining occurs in the North Dakota, Montana, and Wyoming portions of the ecoregion. Petroleum and gas production has grown considerably in the Cut Bank region in north-central Montana. There are several large Indian reservations in this ecoregion, including the Pine Ridge, Standing Rock, and Cheyenne reservations in South Dakota and the Blackfeet, Crow, and Fort Peck reservations in Montana. There are currently four active and one proposed EPA Superfund National Priority List sites in this ecoregion.

The approximate population of this ecoregion is relatively small at 1,066,000, or 0.4% of the population of the United States.

## Summary of WSA Findings

A total of 98 random sites were sampled during the summers of 2000–2004 to characterize the condition of wadeable streams throughout the Northern Plains ecoregion. An overview of the WSA survey results for the ecoregion is shown in Figure 32. These results may not be extrapolated to an individual state or stream within the ecoregion because the study design was not intended to characterize stream conditions at these finer scales.



**Figure 32. WSA survey results for the Northern Plains ecoregion (U.S. EPA/WSA).** Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

During a series of WSA workshops conducted to evaluate assessment results, professional biologists working in the Northern Plains ecoregion said that although the ecoregion has relatively few undisturbed streams, the majority are in areas of low-level agriculture and pastureland.

### Biological Condition

- The Macroinvertebrate Index reveals that 50% of stream length in the Northern Plains ecoregion is in poor condition, 13% is in fair condition, and 30% is in good condition compared to least-disturbed reference condition. There are no data for the remaining 7% of stream length.
- The O/E Taxa Loss results show that 34% of stream length has lost 10% or more of the macroinvertebrate taxa expected to occur, and 12% has lost more than 50% of taxa. These results also indicate that 60% of the ecoregion's stream length has retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

### Indicators of Stress

The most widespread indicators of stress in the Northern Plains ecoregion include riparian vegetative cover, in-stream fish habitat, riparian disturbance, and salinity.

- Thirty-three percent of stream length in the Northern Plains ecoregion has high phosphorus concentrations, 13% has medium phosphorus concentrations, and 54% has low phosphorus concentrations based on least-disturbed reference condition.

- Eighteen percent of the ecoregion's stream length has high nitrogen concentrations, 21% has medium nitrogen concentrations, and 60% has low nitrogen concentrations based on least-disturbed reference condition.
- Riparian disturbance in the Northern Plains ecoregion is at high levels in 31% of stream length, at medium levels in 66% of stream length, and at low levels in 3% of stream length.
- Salinity is a significant stressor in the Northern Plains. Salinity is high in 38% of stream length, medium in 22% of stream length, and low in 40% of stream length.
- Streambed sediments are rated poor in 33% of stream length in the Northern Plains ecoregion, fair in 14%, and good in 50% based on least-disturbed reference condition; data for this indicator were unavailable for 3% of stream length.
- In-stream fish habitat is in poor condition in 45% of stream length, fair in 21% of stream length, and good in 34% of stream length based on least-disturbed reference condition.
- Vegetative cover in the riparian zone along stream banks is in poor condition for 50% of stream length, in fair condition for 22% of stream length, and in good condition for 28% of stream length.
- The effects of acidification are not noted for the Northern Plains ecoregion.

## Western Mountains Ecoregion

### *Physical Setting*

The Western Mountains ecoregion includes the Cascade, Sierra Nevada, and Pacific Coast ranges in the coastal states; the Gila Mountains in the southwestern states; and the Bitterroot and Rocky mountains in the northern and central mountain states. This ecoregion covers approximately 397,832 mi<sup>2</sup>, with about 297,900 mi<sup>2</sup> or 74.8% classified as federal land — the highest proportion of federal property among all the 9 aggregate ecoregions. The terrain of this area is characterized by extensive mountains and plateaus separated by wide valleys and lowlands. Coastal mountains are transected by numerous fjords and glacial valleys, are bordered by coastal plains, and include important estuaries along the ocean margin. Soils are mainly nutrient-poor forest soils. Based on satellite images in the 1992 NLCD, the distribution of land cover in this ecoregion is 59% forested, 19% shrubland, and 13% grassland, with the remaining 9% of the ecoregion comprised of other types of land cover.

The headwaters and upper reaches of the Columbia, Sacramento, Missouri, and Colorado river systems all occur in this ecoregion. Smaller rivers share many characteristics, starting as steep mountain streams with staircase-like channels and steps and plunge pools, with riffles and pools appearing as slope decreases. Upper river reaches experience debris flows and landslides when shallow soils become saturated by rainfall or snowmelt. The total stream length represented in the WSA for the Western Mountains ecoregion is 126,436 wadeable stream miles.



**Unnamed tributary to Lake Creek, Chelan County, WA, in the Western Mountains ecoregion** (Photo courtesy of the Washington Department of Ecology).

The climate is sub-arid to arid and mild in southern lower valleys, and humid and cold at higher elevations. The wettest climates of North America occur in the marine coastal rain forests of this ecoregion. Mean annual temperatures range from 32 to 55 °F, and annual precipitation ranges from 16 to 240 inches.

## *Biological Setting*

Rivers in this ecoregion drain dense forested catchments and contain large amounts of woody debris that provide habitat diversity and stability. Rivers reaching the Pacific Ocean historically had large runs of salmon and trout, including pink, chum, sockeye, coho, and chinook salmon, as well as cutthroat and steelhead trout. Many of these anadromous fish populations have been reduced since the time of European settlement due to the effects of overfishing, introduced species, flow regulations, and dams. Spawning habitats in stream pools have been drastically reduced due to increased sediments from logging, mining, and other land use changes.

## *Human Influence*

Deforestation and urbanization continue to alter stream habitats in the mountainous west. The Western Mountains riparian ecosystems first encountered pressure from grazing and mining from the mid-1800s to about 1910 and then from the logging roads and fire management practices that occur to the present day.

Placer mining, which disrupts stream sediment habitats, was once widespread in the Western Mountains ecoregion. Particularly damaging in mountainous areas was the introduction of mercury, which was used extensively in placer mining for gold. Toxic contaminants from mining also include arsenic, antimony, copper, chromium, cadmium, nickel, lead, selenium, silver, and zinc. In addition to mining, other activities such as logging, grazing, channelization, dams, and diversions in the Sierra Nevada area also significantly impacted rivers and streams. Introduced fish provided further stress, with several native fish species threatened or endangered.

The principal economic activities in this ecoregion are high-tech manufacturing, wood processing, international shipping, U.S. naval operations, commercial fishing, tourism, grazing, and timber harvesting. Hydroelectric power generation is prevalent in the Pacific Northwest area and California. Bauxite mining also occurs in the Pacific Northwest portions of the ecoregion. There are currently 74 active, 7 proposed, and 22 deleted EPA Superfund National Priority List sites in the Western Mountains ecoregion.

The approximate population in the Western Mountains ecoregion is 9,742,192, representing approximately 3% of the population of the United States.

## *Summary of WSA Findings*

A total of 529 random sites were sampled during the summers of 2000–2004 to characterize the condition of wadeable streams throughout the Western Mountains ecoregion. This ecoregion had the greatest number of sample sites because all the western states enhanced the scale of the national survey by including additional random sites. Although there are enough sites to develop state-scale estimates of condition, this report did not produce those estimates. The individual states are analyzing the survey results in the context of their own water quality standards and assessment methodologies. An overview of the WSA survey results for the Western Mountains ecoregion is shown in Figure 33. These results may not be extrapolated to an individual state or stream within the ecoregion.

During a series of WSA workshops conducted to evaluate assessment results, professional biologists working in the Western Mountains ecoregion said that many least-disturbed streams

in the ecoregion are of relatively high quality; however, some of these streams have mining and logging impacts, leading to reference conditions of varying degrees of quality.

### Biological Condition

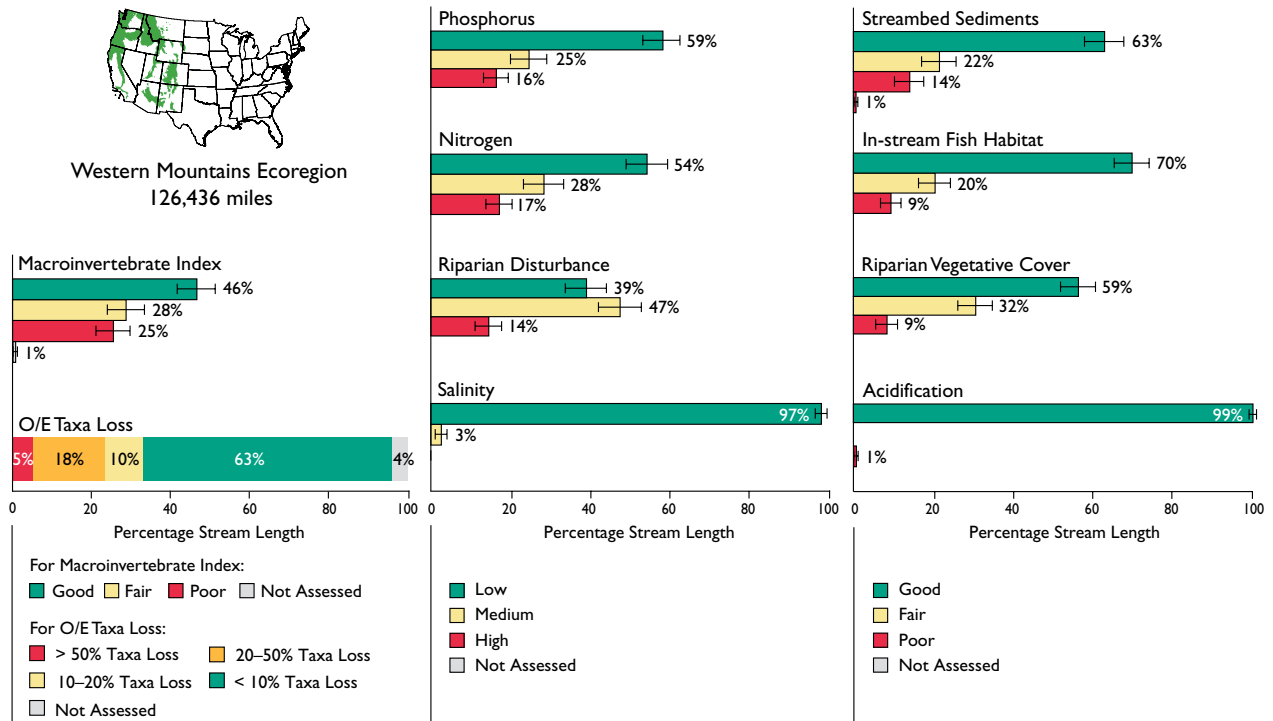
- The Macroinvertebrate Index reveals that 25% of stream length in the Western Mountains ecoregion is in poor condition, 28% is in fair condition, and 46% is in good condition compared to least-disturbed reference condition. There are no data for about 1% of stream length.
- The O/E Taxa Loss results show that 33% of stream length has lost 10% or more of the macroinvertebrate taxa expected to occur, and 5% has lost more than 50% of taxa. These

results indicate that 63% of stream length has retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

### Indicators of Stress

The most widespread indicators of stress in the Western Mountains ecoregion include total nitrogen, total phosphorus, riparian disturbance, and streambed sediments.

- Sixteen percent of stream length in the Western Mountains ecoregion has high phosphorus concentrations, 25% has medium phosphorus concentrations, and 59% has low phosphorus concentrations based on least-disturbed reference condition.



**Figure 33. WSA survey results for the Western Mountains ecoregion (U.S. EPA/WSA).** Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

- Seventeen percent of the ecoregion's stream length has high nitrogen concentrations, 28% has medium nitrogen concentrations, and 54% has low nitrogen concentrations based on least-disturbed reference condition.
- Riparian disturbance, or evidence of human influence in the riparian zone, is at high levels in 14% of stream length, at medium levels in 47% of stream length, and at low levels in 39% of stream length.
- Levels of salinity are medium in 3% of stream length and low in 97% of stream length. None of the stream length for the Western Mountains ecoregion had high levels of salinity.
- Streambed sediments are rated poor in 14% of stream length in this ecoregion, fair in 22%, and good in the remaining 63%.
- In-stream fish habitat is in poor condition in 9% of stream length, fair in 20% of stream length, and good in 70% of stream length.
- Vegetative cover in the riparian zone along stream banks is in poor condition for 9% of stream length, in fair condition for 32% of stream length, and in good condition for 59% of stream length.
- Acidification is rated poor in nearly 1% of stream length and good in 99% of stream length.



**Fishing and tourism are important economic activities in the Western Mountains ecoregion** (Photo courtesy of Ron Nichols, U.S. Department of Agriculture National Resources Conservation Service).

## Xeric Ecoregion

### *Physical Setting*

The Xeric ecoregion covers the largest area of all WSA aggregate ecoregions and includes the most total land under federal ownership. This ecoregion covers portions of eleven western states and all of Nevada for a total of about 636,583 mi<sup>2</sup> (21.2% of the United States). Some 453,000 mi<sup>2</sup> or 71.2% of the land is classified as federal lands, including large tracts of public land, such as the Grand Canyon National Park, Big Bend National Park, and the Hanford Nuclear Reservation. Tribal lands include the Navajo, Hopi, and Yakima reservations. Based on satellite images in the 1992 NLCD, the distribution of land cover in this ecoregion is 61% shrubland and 15% grassland, with the remaining 24% of the ecoregion comprised of other types of land cover.

The Xeric ecoregion is comprised of a mix of physiographic features, including plains with hills and low mountains, high-relief tablelands, piedmont, high mountains, and intermountain basins and valleys. The ecoregion includes the flat to rolling topography of the Columbia/Snake River Plateau; the Great Basin; Death Valley; and the canyons, cliffs, buttes, and mesas of the Colorado Plateau. All of the non-mountainous area of California falls in the Xeric ecoregion and is distinguished by a mild Mediterranean climate, agriculturally productive valleys, and large metropolitan areas.

This ecoregion's relatively limited surface water supply contributes to the Upper and Lower Colorado, Great Basin, California, Rio Grande, and Pacific Northwest regional watersheds. Large rivers flow all year, are supplied by snowmelt,



**West Clear Creek, Yavapai County, AZ, in the Xeric ecoregion**  
(Photo courtesy of the Arizona Game and Fish Department/USGS).



and peak in early summer. Small rivers in this ecoregion are mostly ephemeral. Most rivers are turbid because they drain erodible sedimentary rock in a dry climate, where sudden rains flush sediments down small rivers. Rivers are often subject to rapid change due to flash floods and debris flows. In southern areas, dry conditions and water withdrawals produce internal drainages that end in saline lakes or desert basins without reaching the ocean (e.g., Utah's Great Salt Lake). The total stream length represented in the WSA for the Xeric ecoregion is 25,989 wadeable stream miles.

The Xeric ecoregion's climate varies widely from warm and dry to temperate, with mean annual temperatures ranging from 32 to 75 °F and annual precipitation in the 2- to 40-inch range. The dry weather in the Sonoran, Mojave, and Chihuahuan deserts is created by the rain shadows cast by the mountains to the west and is punctuated by heavy, isolated episodic rainfalls.

### *Biological Setting*

Rivers create a riparian habitat oasis for plants and animals in the dry Xeric ecoregion areas. Many fish are endemic, are restricted to the Colorado River basin, and have evolved to cope with warm, turbid waters. Examples include the humpback chub, bonytail chub, Colorado pikeminnow, roundtail chub, razorback sucker, Colorado squawfish, Pyramid Lake cui-ui, and Lahontan cutthroat trout. Most of these fish are threatened or endangered as a result of flow regulations from dams, water withdrawals, and introduced non-native species. Threatened species of fish in desert areas include the Sonora chub and beautiful shiner.

### *Human Influence*

Impacts to the Xeric ecoregion riparian habitats have been heavy in the past 250 years because of water impoundment and diversion; groundwater and surface water extraction; grazing and agriculture; and mining, road development, and heavy recreational demand. Both the least-altered and most-altered pre-settlement natural vegetation types are found in this ecoregion. Riparian habitats in this ecoregion have also been widely impacted by invasive species and contamination from agriculture and urban runoff. Big rivers in the southwestern canyon regions were altered due to large dam construction and large-scale water-removal projects for cities and agriculture, with attendant small streams that experience cycles of draining and filling in response to grazing, groundwater withdrawal, and urbanization. In many desert areas, dissolved solids such as boron, molybdenum, and organophosphates leach from desert soils into irrigation waters. Almost every tributary in California's Central Valley has been altered by canals, drains, and other waterways.

Principal economic activities include recreation and tourism; mining; agriculture; grazing; manufacturing and service industries; agriculture and food processing; aerospace and defense industries; and automotive-related industries. Petroleum production is prevalent in California. Agriculture includes production of a wide range of crops, from wheat, dry peas, lentils, and potatoes to grapes and cotton. Large agricultural irrigation projects include the Salt and Gila valleys and the Imperial and Central valleys in California. There are currently 139 active, 6 proposed, and 24 deleted EPA Superfund National Priority List sites in this ecoregion.

The total population in the Xeric ecoregion is the third largest of all WSA ecoregions at approximately 46,800,000 people, or 16% of the population of the United States.

### Summary of WSA Findings

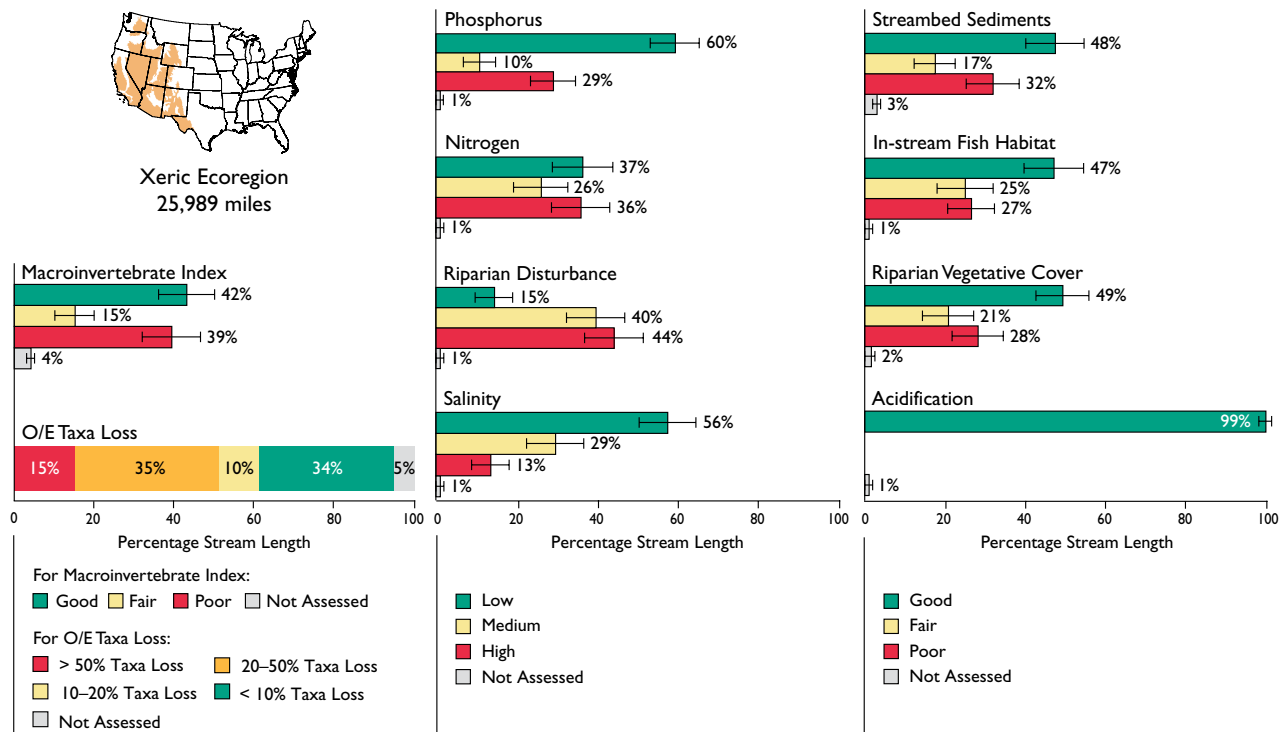
A total of 176 random sites were sampled during the summers of 2000–2004 to characterize the condition of wadeable streams throughout the Xeric ecoregion. An overview of the WSA survey results for the Xeric ecoregion is shown in Figure 34. These results may not be extrapolated to an individual state or stream within the ecoregion.

During a series of WSA workshops conducted to evaluate assessment results, professional biologists working in the Xeric ecoregion said that many of the perennial, least-disturbed streams in

this ecoregion have been influenced by past and current human activities.

### Biological Condition

- The Macroinvertebrate Index reveals that 39% of stream length in the Xeric ecoregion is in poor condition compared to least-disturbed reference condition, 15% is in fair condition, and 42% is in good condition. There are no data for about 4% of stream length.
- The O/E Taxa Loss results show that 60% of stream length in the Xeric ecoregion has lost 10% or more of the macroinvertebrate taxa expected to occur and 15% has lost more than 50% of taxa. These results also indicate that 34% of stream length has retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.



**Figure 34. WSA survey results for the Xeric ecoregion (U.S. EPA/WSA).** Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

## Indicators of Stress

The leading indicators of stress in the Xeric ecoregion include riparian disturbance, total nitrogen, streambed sediments, and in-stream fish habitat.

- Twenty-nine percent of stream length in the Xeric ecoregion has high phosphorus concentrations, 10% has medium phosphorus concentrations, and 60% has low phosphorus concentrations based on least-disturbed reference condition.
- Nitrogen is the leading chemical stressor in the Xeric region. Approximately 36% of stream length has high nitrogen concentrations, 26% has medium nitrogen concentrations, and 37% has low nitrogen concentrations based on least-disturbed reference condition.
- Riparian disturbance, or evidence of human influence in the riparian zone, is the leading physical stressor for the Xeric ecoregion. Riparian disturbance in this ecoregion is at high levels in 44% of stream length, at medium levels in 40% of stream length, and at low levels in 15% of stream length.
- Salinity is rated high in 13% of stream length and medium in 29%, with 56% of stream length showing low levels of this indicator. Data for this indicator were unavailable for approximately 1% of stream length.
- Streambed sediments are rated poor in 32% of stream length in the Xeric ecoregion, fair in 17%, and good in 48%; data on this indicator were unavailable for 3% of stream length.
- In-stream habitat is in poor condition in 27% of stream length, fair in 25%, and good in 47% based on least-disturbed reference condition; data were unavailable for 1% of stream length.
- Vegetative cover in the riparian zone along stream banks is in poor condition in 28% of stream length, in fair condition in 21% of stream length, and in good condition in 49% of stream length.
- The effects of acidification are not noted for the Xeric ecoregion.

**The Xeric ecoregion is comprised of a mix of physiographic features, including plains with hills and low mountains, high-relief tablelands, piedmont, high mountains, and intermountain basins and valleys** (Photo courtesy of Tim McCabe, U.S. Department of Agricultural Natural Resources Conservation Service).

