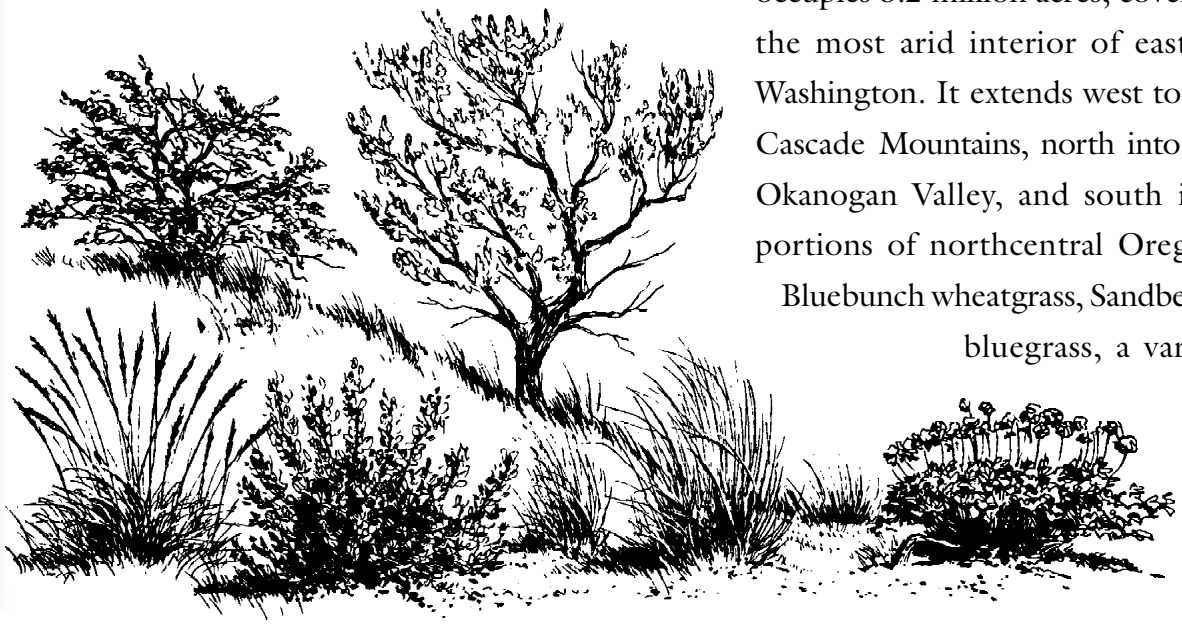
"The shrub-steppe region where we live is a land of great contrasts. To some, it seems a lonely and lifeless expanse, but to those who take the time to observe and recognize its special qualities, it is a unique place, teeming with a variety of insect, bird, mammal, and plant life."

–Lee Rogers

TERRESTRIAL Vegetation

Scientists define the vegetation of large geographic regions according to zones. Seven major vegetation zones exist in eastern Washington, as Figure 1.2 shows. Shrub-dominated plant communities—growing in combination with native perennial grasses—occupy the largest number of acres and make up the major plant communities in our ecoregion.

The Tri-Cities area is located in the largest and driest zone, big sagebrush/bluebunch wheatgrass. This zone occupies 8.2 million acres, covering the most arid interior of eastern Washington. It extends west to the Cascade Mountains, north into the Okanogan Valley, and south into portions of northcentral Oregon. Bluebunch wheatgrass, Sandberg's bluegrass, a variety



of flowering plants (forbs), and a cryptogamic soil crust form the understory of the big sagebrush/bluebunch wheatgrass zone. The understory comprises the vegetation that grows below the tallest shrubs or trees in a plant community. Other native bunchgrass species include needle-and-thread grass, Indian ricegrass, Cusick's bluegrass, and Idaho fescue. Gray rabbitbrush, green rabbitbrush, bitterbrush, spiny hopsage, threetip sagebrush, and black greasewood, and hopsage also occur here. Table 1.1 lists some common shrub-steppe plants.

What is cryptogamic crust?

Along with lichens, some species of algae, fungi, mosses, and cyanobacteria share similar habitats and are collectively referred to as cryptogams. These organisms form a biotic layer, or cryptogamic crust, on soils between shrubs, grasses, and flowering plants in undisturbed arid and semi-arid lands of the world, including the Columbia Basin. With the introduction of agriculture, alien plant species, and livestock grazing in the shrub-steppe, much of the cryptogamic crust in our region has been degraded or destroyed. When large areas of cryptogamic soil are disturbed, erosion by water and wind results. If the disturbance is small, a thin layer of several cyanobacterial species may return in 5 to 7 years. If the original crust was composed of a complex association of species and had a depth of several centimeters, recovery time could be more than 100 years.

—Christine Sandahl

Types of Plant Communities

Within the major vegetation zones of the Columbia Basin Ecoregion, several kinds of plant communities exist that provide habitat for wildlife. This handbook focuses on habitats found in the lower Columbia Basin in and around the Tri-Cities. Soils, climate, topography, and vegetation all determine habitat, but vegetation is particularly important for wildlife. The following subsections describe major plant communities of the lower Columbia Basin and wildlife associated with the community types. More in-depth descriptions of wildlife are provided in Chapter 3.

"The river is the ultimate agent of change and flow, of life itself as change and flow.... I love the rounded pebbles a river creates, smooth ovals that you can pick up and rub like worry beads between your fingers. Collecting river pebbles is an honorable profession."

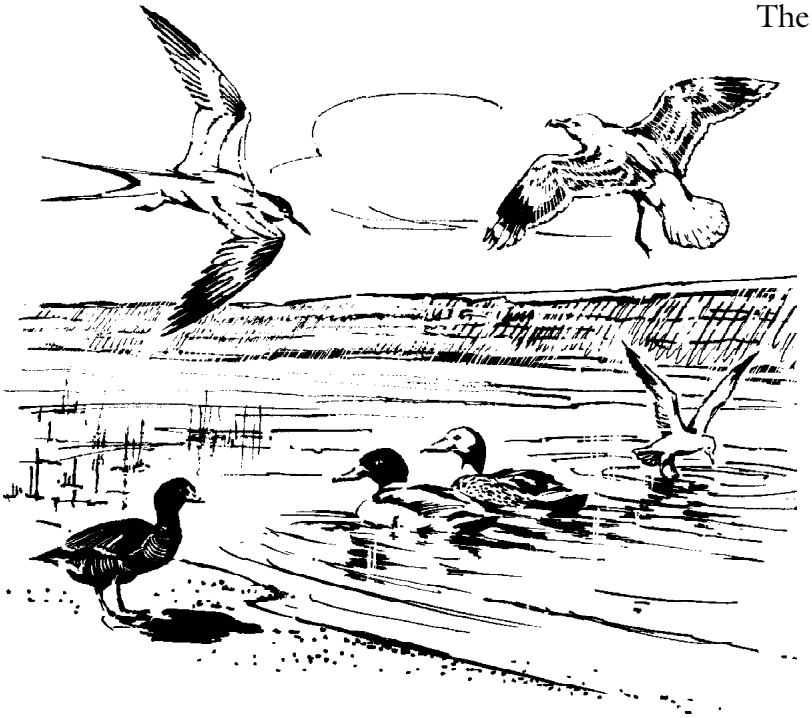
–Ann Zwinger

RIVERS and Streams

Chiawana, the Wanapum Indian name for the Columbia River, is the second largest river in the contiguous United States and fifth largest in North America. The river originates in the mountains of eastern British Columbia, Canada, and drains a total area of approximately 258,000 square miles. It flows 1,240 miles from its Canadian headwaters to the sea at an average rate of about 120,000 cubic feet per second annually.

The Columbia River is the dominant aquatic ecosystem in the lower Columbia Basin. It supports a diverse community of plankton, bottom-dwelling invertebrates, fish, and other communities. The river is dammed upstream and downstream of Richland.

The Hanford Reach of the Columbia is the last free-flowing reach of the river



in the United States and the last significant mainstem Columbia spawning location for fall chinook salmon. As Figure 2.1 shows, the Reach extends from 1 mile below Priest Rapids Dam downstream approximately 51 miles to the McNary Pool north of Richland. The Reach encompasses approximately 105,000 acres, including the river, 21 islands, Wahluke State Wildlife Recreation Area, Saddle Mountain National Wildlife Refuge, and state and privately owned lands.

Because the Hanford Reach was closed to the public from 1943 until 1978, it has remained undammed and undredged. As a result, the Reach is the only portion of the river that now supports breeding populations of fish that evolved in the free-flowing aquatic ecosystem of the Columbia River. The river channel within the Reach is braided around islands, submerged rock ledges, and gravel bars, which cause pooling and channeling and create a complex network of unique habitat features that are now rare or declining in the Columbia River system. The varied fish populations within the Reach are directly attributable to this diversified riverine ecosystem.

What Makes a River?

"The Hanford Reach system comprises the river itself plus the land on both sides of the river; this riparian zone connects the river with the land." —Dave Geist

A river is more than what we see. The Columbia River forms complex habitats that include not only the river itself but water flowing through the river bed and shoreline community. Things living and growing in water (aquatic ecosystems) and things living and growing on land (terrestrial ecosystems) depend on each other to survive.

Streams use food produced in the water (algae, mosses, and large-rooted plants) and food produced on land (leaves, sticks, pine cones, even tree trunks that fall or get blown into a river or stream) to feed the complex food webs that exist within them. The dependence of streams on food produced in the terrestrial ecosystem is one of the least recognized and most important relationships governing stream ecology.

—Dennis Dauble/Lee Rogers

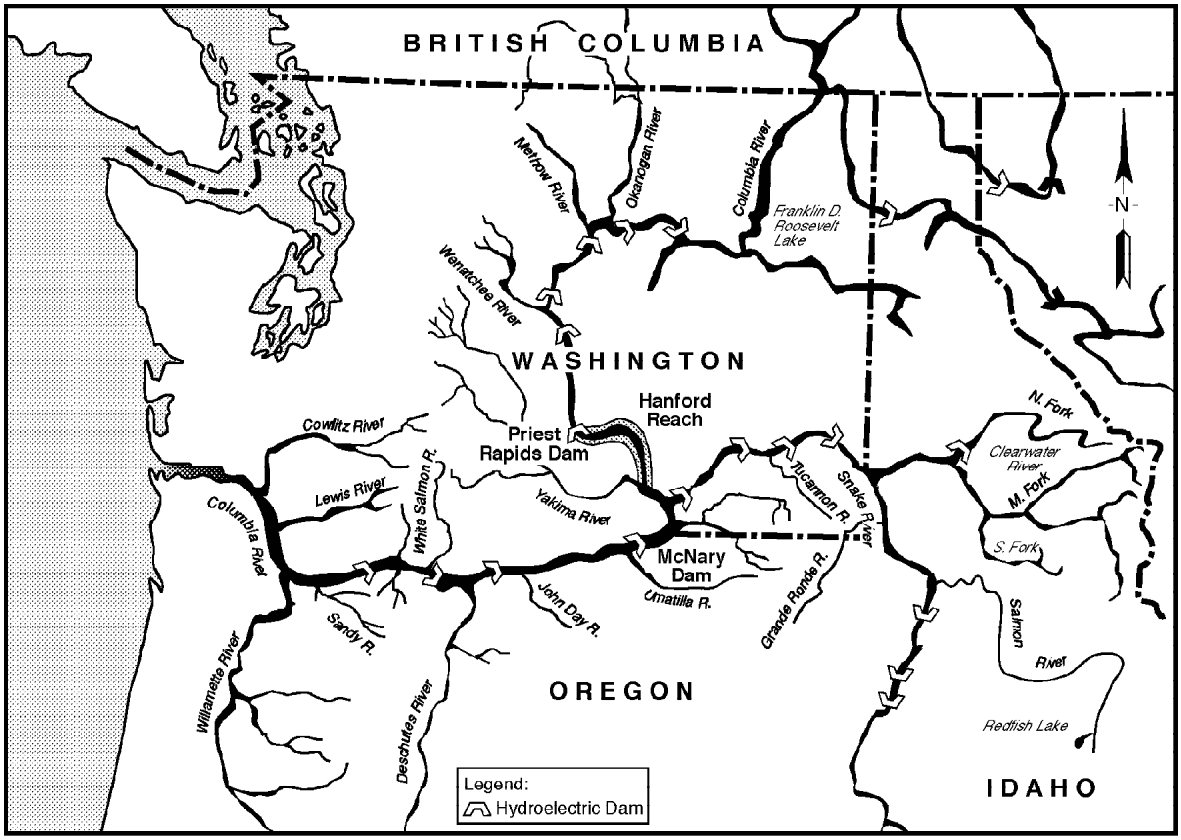
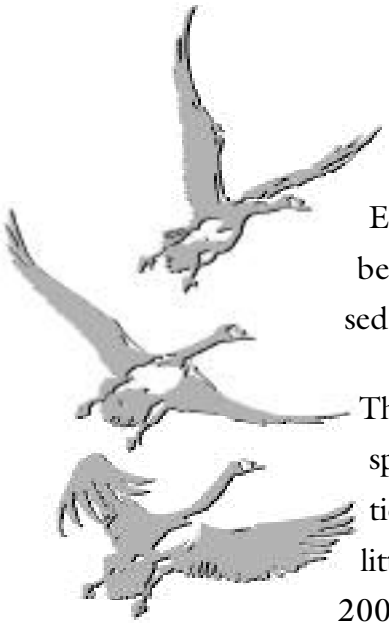


Figure 2.1. Columbia River Basin Showing Location of the Hanford Reach

Riverine/Riparian Habitat Along the Columbia River

The Hanford Reach has been altered less than other reaches of the Mid-Columbia portion of the river and, unlike other reaches, peak water flows associated with winter rains or spring runoff still influence upland, riparian, and riverine vegetation along the shoreline. Riverine habitat includes the sloughs, backwaters, wetted shorelines, islands, and riparian trees that are associated with the river flood plain and covered by water for the majority of the year.

The riparian habitat consists mostly of scattered patches of woody plants that are able to live in areas alternately flooded and dried almost daily. These plants include willows, reed canarygrass, cattail, and horsetail. They all have roots that extend downward into areas influenced by river flows. They also are able to establish themselves in gravel and cobble (round river rocks) found along the shoreline.



Exotic woody species that line the shore include white mulberry, Siberian elm, and Russian olive. Wormwood or mugwort, sedges, and bulbous bluegrass also occur along the shoreline.

The extent of riparian vegetation along the Hanford Reach seems sparse relative to the size of the river. However, with the exception of several new stands of trees, this part of the river has changed little in appearance since Lewis and Clark visited the area almost 200 years ago. Scientists can estimate this from analyzing historic photos taken at the turn of the century and comparing them with current river photos.

Riverine and riparian habitats are important for a variety of wildlife species. They provide cover as well as nesting and foraging opportunities. Willow thickets trap food for waterfowl such as Canada geese and shorebirds, including killdeer and spotted sandpiper. They also provide nesting habitat for a number of bird species.

Along the Columbia River, terrestrial and aquatic insects are abundant in emergent grasses and provide forage for fish, waterfowl, and shorebirds. Beaver and muskrat also rely on shoreline habitat for foraging and denning materials. Beavers that live in the Hanford Reach dig deep trenches near their huts. They use these trenches to stay under water whenever they enter or exit the huts. Raccoon, bald eagle, and osprey feed on Columbia River fish, especially spawned salmon, along the Reach. Mule deer forage on the leaves and twigs of willow and mulberry trees and other plants in summer.

In winter, bald eagles use planted shoreline trees along the Hanford Reach—black locust, Siberian elm, and white poplar—as night roosts and daytime perches. Great blue herons, black-billed magpies, and Bullock's orioles use some shoreline trees as nesting sites. Swainson's hawks, red-tailed hawks, and great horned owls also nest in shoreline trees.

"One of the fundamental laws of ecology is that all living things are interconnected in some way with all other living and nonliving things.... Understanding the relationships between habitat and wildlife is an important first step in understanding the region's ecology."

–Lee Rogers

WILDLIFE and Fish

Some 300 species of wildlife inhabit the lower Columbia Basin, including about 40 species of mammals, 246 species of birds (depending on the time of year), 5 species of amphibians, and 10 species of reptiles. In addition to these species, which use the habitats described in previous sections, more than 100 species of insects exist in the ecoregion as well as 44 species of fish.

Most information on terrestrial wildlife presented here is from rangeland habitats. Published information on wildlife populations in cultivated fields and urban areas in the Columbia Basin is scarce.

Mammals

Species diversity in mammals is lower in the Basin than in wetter regions of

the Pacific Northwest. Here, mammals must adapt to the dry climate or live near a permanent source of surface water to survive. Approximately 40 species of mammals have been identified in our area. Of these species, some 30 are known to be associated with shrub-steppe habitat, the Columbia River, and riparian habitats. The Washington ground squirrel is the only mammal endemic to the Columbia Basin Ecoregion. It is found in the grasslands, sagebrush, wheat fields, and rocky hillsides of central Washington and northeastern Oregon.

Table 3.1 lists some common mammal species inhabiting the lower Columbia Basin. Characteristic mammals include black-tailed jackrabbits, pocket gophers, ground squirrels, pocket mice, deer mice, woodrats, coyotes, mule deer, beaver, and muskrat.

How have rodents adapted to arid lands?

How animals adapt to arid regions such as the shrub-steppe is nicely illustrated by rodents. Most of these small creatures lead secretive lives. Because they are mostly nocturnal, the casual observer is rarely aware of their abundance or impact on the natural system. Many native rodents are well adapted for digging. This is especially true of pocket gophers, badgers, and ground squirrels. Their burrowing activities help cultivate the soil, thereby providing small localized areas for plant germination and growth. Rodents also play a significant role in controlling insect populations, and they serve as a food base for large predators in the shrub-steppe food chain.

—Lee Rogers

Mice

Rodents are the most numerous of all mammals. Between one-third and one-half of all species of land mammals are rodents. The Great Basin pocket mouse is the most abundant small mammal in terrestrial areas of the Columbia River Plain. This rodent belongs to a group of mice with fur-lined cheek pouches, or pockets, long tails with a tassel at the end, and long hind legs. The Great Basin pocket mouse can jump several times its own length. Although the pocket mouse

"The one thing geology has taught us is that nothing remains constant. The Earth is always evolving. Ridges will continue to grow, and rivers will continue to erode. Given enough time, even the continents move."

—Steve Reidel

GEOLOGY and Soils

The Pacific Northwest has some of the most diverse geology in North America. The word geology comes from the Greek words *geo*, which means Earth, and *logos*, meaning discourse and description.

Geology attempts to decipher the past history of the Earth. Geologists investigate the origin, structure, and history of the Earth and its inhabitants as recorded in the rocks and landforms that exist in our environment today.

Geological investigations can reveal great changes the Earth has undergone over millions of years, changes brought about by geologic processes such as volcanism, tectonism, and erosion.

The Columbia Plateau—also known as the Columbia Basin because it forms a broad lowland surrounded by mountains—is one of the largest continental volcanic provinces in the

world. The Basin's knobs and kettles were created by great flows of lava followed by cataclysmic floods that eroded a 12,000-square-mile area of eastern Washington. The current environment of the Basin also owes its origins to the geologic process of plate tectonics, a name that describes the dynamic nature of the Earth's crust. The crust comprises many large plates that are constantly in motion. When two or more plates collide, the edges crumple, and mountain ranges often are the result.

Although it seems as if the hills and valleys that make up the Columbia Basin have been here forever, the geography/geology of our area has formed over the last 17 million years. That's relatively young in geologic history, which reaches back 4 billion years. What we see now is just the most recent step of a continuing process as Mother Nature constantly changes the landscape.

Geologic Time

Time is a central concept of geology. Because most geologic processes occur over millions and billions of years, geologists have built a geologic time scale that they use to understand geologic events of the Earth's history in sequence according to relative age. Some geologists define geologic time as "the time elapsed between the formation of the Earth and the beginning of human history, almost all the planet's 4.6 billion years of existence." It also can describe spans of time over which geological processes occur. See Figure 4.1 for a look at a geologic time scale pertinent to the Columbia Basin. The time scale is divided by eras, periods, epochs, and events.

A History of Floods

The geologic/geographic features of the Columbia Basin resulted from two of the greatest cataclysmic events ever to occur in North America: massive flows of lava followed by cataclysmic Ice Age floods.