

Introduction to the Hanford Reach National Monument

General Description

The Hanford Reach National Monument/Saddle Mountain National Wildlife Refuge (Monument) includes approximately 195,000 acres sprawled in four counties of south-central Washington. The land forms a large C-shaped region, bisected by the Hanford Reach of the Columbia River. All of the land is controlled by the Department of Energy and is part of the 360,000 acre Hanford Site. The Hanford Site was established by the Atomic Energy Commission in 1943 as a national security area for the production of weapons-grade plutonium and siting associated purification facilities. For more than 40 years, the primary mission at Hanford was associated with the production of nuclear materials for national defense. However, large tracts of land used as protective buffer zones for safety and security purposes were left undisturbed. These buffer zones preserved a biological and cultural resource setting unique in the Columbia Basin region. The 195,000-acre Hanford Reach National Monument was established by Presidential Proclamation in June, 2000, to protect the nation's only remaining non-tidal, free-flowing stretch of the Columbia River and the largest remnant of the shrub-steppe ecosystem once blanketing the Columbia River Basin. The U.S. Fish and Wildlife Service (FWS) and the Department of Energy (DOE) are joint stewards of the Monument. The Proclamation directs the DOE and FWS to protect and conserve the area's native plant communities, specifically recognizing the nationally significant scientific values provided by the area's biologically diverse shrub-steppe ecosystem.

The Monument is located within the planning framework of DOE's Hanford Comprehensive Land-Use Plan (CLUP) and Environmental Impact Statement (EIS; September 1999). Pending completion of a Comprehensive Conservation Plan, the FWS adopted the CLUP and EIS by Record of Decision (ROD) in 1999. This ROD and subsequent DOE/FWS Memorandum of Agreement and Permit establish the project area as an overlay unit of the National Wildlife Refuge System under FWS management.

FWS-administered lands of the Monument are divided into four major management units.

The **Fitzner-Eberhardt Arid Lands Ecology (ALE) Reserve** is a 120-square-mile tract of land in the southwestern portion of the Hanford Site. Designated the Rattlesnake Hills Research Natural Area, the ALE constitutes the single largest tract in the federal Research Natural Area system for Oregon and Washington (Franklin *et al.* 1972, Rickard 1972), and is one of the few remaining large tracts of shrub-steppe vegetation in Washington that retains a predominant pre-European settlement character (Pacific Northwest National Laboratories 1993). This area is closed to the public and is maintained for scientific purposes.

The **Saddle Mountain Unit** of the Monument has been managed by the FWS since 1971 under a 30-day revocable use permit with DOE. This unit is a 50-square-mile tract of land located north-northwest of the river and generally south and east of State Highway 24. The Bureau of

Reclamation's South Columbia Basin Irrigation District maintains an irrigation return canal that created and sustains a series of ponds known as the Saddle Mountain Lakes. This area has been closed to public access since the 1940's. Currently, access is available for approved research activities and special uses through the FWS Monument headquarters.

The **Wahluke Unit** of the Monument is a 87-square-mile tract of land located north and east of both the Columbia River and the Saddle Mountain Unit. It is bisected by Highway 24. The Bureau of Reclamation's South Columbia Basin Irrigation District maintains several irrigation canals throughout the area. The WB-10 pond system was created and is sustained from irrigation runoff. The Wahluke Unit is open to the public year-round for day use only.

The **Columbia River Islands Unit**, is included in the Refuge, but is downstream of the Monument. Seven islands total 320 acres. The islands are seasonally open for limited public use.

Physical Resources

Climate

The Monument is located within the driest and hottest portion of the Columbia Basin. An almost 50-year record of climate data is available for the central portion of Hanford (Hoitink and Burk 1994). Average weather conditions described here are based on that location and are taken from Cushing (1995). Still, it is important to remember that differences in the topography of the Hanford Site contribute to ecologically significant changes in some aspects of climate, particularly annual mean temperature and precipitation (Cushing 1995). For example, although the average annual precipitation for the central portion of Hanford is 6.3 inches, on the crest of Rattlesnake Mountain annual precipitation can reach up to 13.8 inches (Downs et al. 1993). Most precipitation occurs during the winter, with more than half the amount occurring from November through February. Snowfall accounts for about 38% of all precipitation from December through February. Average monthly temperatures range from a low of 30° F in January to a high of 76° F in July. Prevailing wind directions are generally from the northwest in all months of the year, but southwesterly winds also regularly occur. Monthly average wind speeds are lowest during the winter months and highest during the summer.

Physiography

The Monument lies in the heart of the Pasco Basin. Columbia River Basalt, a result of lava flows occurring roughly between 17 and 2 million years ago, underlies the Monument. Several basalt ridges traverse the Monument and provide much of its topographic relief. A stretch of the Columbia River (the Hanford Reach) runs through the Monument and forms part of its southern and southwestern boundary. The Columbia River Plain constitutes the majority of the Monument and is both its lowest (about 360 feet along the river) and most arid region.

Prominent natural features of the ALE Reserve Unit of the Monument include the ridge top and mostly north-facing slope of Rattlesnake Mountain, portions of the Rattlesnake Hills, Dry Creek Valley, Cold Creek Valley, and the east end of Yakima Ridge. Two streams, Snively Creek and Dry Creek, and a number of cold springs occur within the ALE Reserve (DOE-RL 1996). Elevations across the ALE Reserve range from about 500 feet in the Cold Creek Valley to 3450 feet on top of Rattlesnake Mountain.

Prominent natural features within the Saddle Mountain Unit of the Monument include a portion of the Wahluke Slope, the western end of the White Bluffs geologic formation, the slopes and crest of the Saddle Mountains, and a portion of the Hanford Reach of the Columbia River. The refuge contains several lakes and wetlands created and sustained by raised water tables associated with irrigation drainage and runoff.

Prominent natural features found within the Wahluke Unit of the Monument include a portion of the Wahluke Slope, the eastern end of the White Bluffs geologic formation, large dune fields above the White Bluffs, the Saddle Mountains, which rise to over 2000 feet within the Monument, and several lakes and wetlands created and sustained by raised water tables associated with irrigation drainage and runoff.

Vegetation

The Monument is located within the Columbia Basin Ecoregion (DOE-RL 1996: Appendix C), an area that historically included over 14.8 million acres (6 million hectares) of steppe and shrub-steppe vegetation across most of central and southeastern Washington State (Franklin and Dymess 1973), as well as portions of north-central Oregon. Native, pre-settlement vegetation consisted primarily of shrubs, perennial bunchgrass, a variety of forbs and a living soil crust composed of lichens, moss, and algae. The state of Washington has designated shrub-steppe communities as a priority habitat because of their significance to a number of wildlife species and the scarcity of this habitat type (Washington Department of Fish and Wildlife 1996). In addition, the U.S. Department of the Interior (DOI) has identified native shrub and grassland steppe in Washington and Oregon as an endangered ecosystem (DOI 1995).

Native Grassland and Shrub-Steppe

A number of different plant association zones occur as climatic climaxes, or the plant association or community expected to occur in typical sites in the absence of disturbance, throughout the Columbia Basin Ecoregion. The largest and driest of these zones (about 8.2 million acres) is the big sagebrush (*Artemisia tridentata*)/bluebunch wheatgrass (*Pseudoroegneria spicata* [= *Agropyron spicatum*]) association. This association occupies the center of the Columbia Basin Ecoregion, which includes the Hanford Site. In general, the big sagebrush/bluebunch wheatgrass association is characterized by four layers of vegetation: an overstory layer composed mostly of big sagebrush up to two meters tall, a tall understory layer of bluebunch wheatgrass, a short understory dominated by Sandberg's bluegrass (*Poa sandbergii* [included within *Poa secunda*]), and a layer of algae,

lichens, and mosses on the soil surface (i.e., the microbiotic crust). The microbiotic crust is a critical component of native grasslands and shrub-steppe communities. This diminutive community of mosses, lichens, liverworts, algae, and bacteria stabilizes the soils and fills the interstitial space between bunchgrass clumps. Perennial forbs are a minor constituent of the tall understory layer, whereas most annual forbs occur in the short understory layer. Other shrubs that may be present include rabbitbrush (*Chrysothamnus* spp.), bitterbrush (*Purshia tridentata*), spiny hopsage (*Grayia spinosa*), and three-tip sagebrush (*Artemisia tripartita*). Additional locally abundant bunchgrasses include needle-and-thread (*Stipa comata*), Indian ricegrass (*Oryzopsis hymenoides*), Cusick's bluegrass (*Poa cusickii* [included within *Poa secunda*]), and Idaho fescue (*Festuca idahoensis*). Other associations, such as big sagebrush/Idaho fescue, bluebunch wheatgrass/Sandberg's bluegrass, and bluebunch wheatgrass/Idaho fescue can occur as topographic climaxes on moister sites within the big sagebrush/bluebunch wheatgrass association. Certain edaphic (soil-related) plant associations also are of ecological importance within the ecoregion. On deep soils dominated by gravel, sand, or strongly weathered volcanic ash, needle-and-thread and/or Indian ricegrass replaces bluebunch wheatgrass as the dominant grass in several associations. The dominant shrub in these associations can be either big or three-tip sagebrush or bitterbrush. On stony soils or extremely shallow soils over bedrock (lithosols), various species of buckwheat (*Eriogonum*) and/or stiff sage (*Artemisia rigida*) dominate the shrub layer and Sandberg's bluegrass dominates the understory. As the hottest, driest, and lowest elevation part of the ecoregion, the Hanford Site also possesses a series of three plant associations found on reasonably deep, loamy (but dry) soils. These are the big sagebrush/Sandberg's bluegrass, spiny hopsage/Sandberg's bluegrass, and winterfat (*Atoides* [=*Eurotia*] *lanata*)/Sandberg's bluegrass associations. Each of these associations is characterized by the lack of large, perennial bunchgrasses (Sandberg's bluegrass is relatively small) and low overall plant diversity.

Riparian Areas

Riparian vegetation of the Monument is limited to portions of the Columbia River shoreline, islands and sloughs, a few natural desert springs, and ponds, lakes, and wetlands created by irrigation run off. In a dry, cold-desert environment, riparian areas are extremely valuable. Because of their direct association with water, plant diversity and structure is increased, consequently, the value of these communities as wildlife habitat is very high. Although these areas are small in acreage, riparian zones are a very important component of the Monument. These sites are important because the lush riparian habitat sharply contrasts with the surrounding dry shrub-steppe and provides trees and larger shrubs not available elsewhere on the Monument. Riparian areas are characterized by diverse shrubs and trees that include a substantial component of, or dominance by willow (*Salix*) species. Other trees include black cottonwood (*Populus trichocarpa*), black locust (*Robinia pseudo-acacia*), and quaking aspen (*P. tremuloides*). Shrubs include several willow species (*Salix* spp.), mock-orange (*Philadelphus lewisii*), golden currant (*Ribes aureum*), Wood's rose (*Rosa woodsii*), blue elderberry (*Sambucus ceruleus*), chokecherry (*Prunus virginiana*), sumac (*Rhus glabra*), red-osier dogwood (*Cornus stolonifera*), and western virginbower (*Clematis ligusticifolia*). Watercress (*Rorripa nasturtium-aquaticum*), stinging nettle (*Urtica dioica*), water speedwell (*Veronica anagallis-aquatica*), rushes (*Juncus* spp.), bulrush (*Scirpus* spp.), and spike rush (*Eleocharis* spp.) are common

herbaceous species. The “artificial” wetland areas have a larger component of non-native species such as Russian olive (*Elaeagnus angustifolia*), and tamarisk (*Tamarix parviflora*), but also support native willows, common cattail (*Typhus* sp.), and black cottonwood.

Disturbed Vegetation/Invasive Species

Prior to alteration of the shrub-steppe of eastern Washington in the 1800's, big sagebrush/bluebunch wheatgrass was the dominant vegetation type over much of the Columbia Basin (Daubenmire 1970). Although the Monument area has documented large, relatively undisturbed shrub-steppe plant communities as described above, many previously disturbed areas have altered vegetative communities. One of the primary significant changes to the vegetative communities is the invasion of non-native plant species. Once introduced, these species can proliferate due to the lack of natural predators or because they can out-compete native plant species in disturbed habitats. Moreover, some species are aggressive enough to be successful in invading even intact native plant communities. Disturbed areas of the Monument units usually are dominated by cheatgrass and other exotic species, with or without big sagebrush. Cheatgrass is a particularly competitive plant that favors disturbed areas and has several characteristics that enhance its ability to establish and persist, including the ability to germinate in the spring or fall, high seed production, greater germinability than native grasses, and tolerance to grazing. Within several areas the native vegetation has likely been permanently replaced by cheatgrass and other non-native plants, particularly in areas where historic disturbances were the most intense (especially on historically farmed and grazed locations). Vegetation within these areas have highly variable shrub cover, high cover of cheatgrass, frequently a significant cover of Sandberg's bluegrass, and usually a low cover of microbiotic crust. It is unlikely that native bunchgrasses will become established without extensive restoration. Additionally, noxious weeds and other aggressive non-native plants tend to invade and become established more readily within previously disturbed habitats. The invasion of non-native plants represents a threat to the integrity of the Monument and the preservation of its unique biodiversity.

Rare Plants

A total of 127 populations of 30 rare plant taxa have been documented to occur on the Hanford Site. A majority of these populations and taxa occur on the Monument. In addition, three taxa (two species and one variety) had not previously been described and are considered “new” to science—*Eriogonum codium* (Umtanum Ridge desert buckwheat), a Federal Candidate Species for Threatened and Endangered listing; *Lesqurella tuplashensis* (White Bluffs bladder-pod); and *Astragalus conjunctus* var. *rickardii*. (Rattlesnake mountain milk-vetch). Many of these populations of plants are endemic to the area; several were not previously known in Washington State, or are otherwise of botanical interest and potentially of conservation and management concern. Little is known about the ecology, requirements, or population dynamics of these species. Fire may be one of the greatest threats to many of these plants; mortality of Umtanum Ridge desert buckwheat was documented following a 1997 fire. There are currently no federally listed plants on the Monument.

Fish and Wildlife

The diversity of habitats across the Monument support a diverse assemblage of wildlife species. The shrub-steppe ecosystem supports an unusually high diversity of native plant and animal species, including significant breeding populations of nearly all steppe and shrub-steppe dependent wildlife. Mature sagebrush/bunch grass and riparian areas are of particular importance for wildlife. The sagebrush is either a food source or provides nesting, resting, thermal, and escape cover for a wide variety of species. Another value for wildlife includes the thick canopy which protects understory vegetation (forbs) that can be a valuable food source for wildlife. Riparian areas provide structure and diversity critical for nesting, resting, thermal and escape cover, as well as abundant water. Numerous wildlife species depend upon the Monument's intact ecosystems—43 species of fish, including threatened and endangered salmon and trout; 40 mammals; 246 birds; 4 amphibians; 11 reptiles; and over 1500 invertebrates have been documented on the Monument.

Fish

The Monument includes the Hanford Reach, the nation's last, non-tidal, free-flowing segment of the Columbia River. Forty-three species of fish have been documented as occurring in the Hanford Reach. Salmonids are of particular interest; large numbers of fall chinook salmon (*Onchorynchus tshawytscha*) spawn in the Hanford Reach. Upper Columbia River spring chinook (*Onchorynchus tshawytscha*), listed as a federally threatened species, also uses the Hanford Reach for migration, as well as both the Middle Columbia River steelhead (*Onchorynchus mykiss*) and Upper Columbia River steelhead (*Onchorynchus mykiss*), both of which are federally threatened species. Beach seine catches from April-June in the Hanford Reach are dominated by sub-yearling fall chinook salmon (USGS, unpublished data). Other numerically important species during this time are reddsides, shiners, carp, largescale suckers, northern pikeminnow, and peamouth. Mountain whitefish are common in the Hanford Reach and support a recreational fishery. Centrarchids and percids are more common in McNary Reservoir, although smallmouth bass are also abundant in the Hanford Reach. Tench, threespine sticklebacks, and mountain whitefish are rarely captured in Hanford beach seining activities (Ward, 2001). The ponds and lakes created by irrigation run-off also have populations of introduced fishes such as carp, bass, and sunfish. Riparian vegetation and backwater sloughs are very important for fisheries habitat. Shoreline vegetation provides shade, moderates temperatures in shallow water, and provides shelter and substrate for invertebrate populations, all of which are critical for sustaining fish populations. Occasionally, vegetation may become dense and limit open water habitat.

Wildlife

Shrub-Steppe Obligates/Species of Management Concern

The Proclamation establishing the Monument directs the FWS to manage the Monument to protect all of the species associated with the shrub-steppe ecosystem. A primary objective of the FWS is to ensure that the area is operated and managed for the protection and preservation of the native

shrub-steppe habitat and its associated wildlife species. Wildlife species that are dependent on sagebrush and are considered shrub-steppe obligates in the Columbia Basin Ecoregion include ferruginous hawk (*Buteo regalis*), burrowing owl (*Athene cunicularia*), loggerhead shrike (*Lanius ludovicianus*), sage sparrow (*Amphispiza belli*), Brewer's sparrow (*Spizella breweri*), sage thrasher (*Oreoscoptes montanus*), greater sage grouse (*Centrocercus urophasianus*), long-billed curlew (*Numenius americanus*), sagebrush vole (*Lagurus curtatus*), Merriam's shrew (*Sorex merriami*), pygmy rabbit (*Brachylagus idahoensis*), Washington ground squirrel (*Spermophilus washingtoni*), black tailed jack-rabbit (*Lepus californicus*), sagebrush lizard (*Sceloporus graciosus*), and striped whipsnake (*Masticophis taeniatus*). Management to maintain and enhance habitat for these species is and will be a priority throughout the Monument. Because little is known about the habitat needs of many of these species, protection and preservation of intact areas is paramount.

Mammals

The most abundant mammal of shrub-steppe habitat in the Monument is the Great Basin pocket mouse (*Perognathus parvus*). The deer mouse (*Peromyscus maniculatus*), western harvest mouse (*Reithrodontomys megalotis*), northern grasshopper mouse (*Onychomys leucogaster*), bushytail woodrat (*Neotoma cinerea*), and northern pocket gopher (*Thomomys talpoides*) are other common small mammals using habitats on the ALE Reserve. Least chipmunks (*Eutamias minimus*) are found in the upper elevations of Rattlesnake Mountain, and sagebrush voles are relatively common above 1,000 feet (305 m) elevation in sagebrush habitat.

Porcupines (*Erethizon dorsatum*) are typically restricted to riparian areas where they feed on the bark of small limbs and tree branches. Black-tailed jackrabbits (*Lepus californicus*) are usually common in mature sagebrush habitat. White-tailed jackrabbits (*L. townsendi*) occur in sagebrush/bunchgrass habitats, generally at higher elevations than black-tailed jackrabbits. The populations of both species are cyclical and are currently at low levels throughout the Columbia Basin.

Large mammals found on the ALE Reserve include the occasional cougar (*Felis concolor*), bobcat (*Felis rufus*), and badger (*Taxidea taxus*). These species are present throughout the Hanford Site in low numbers. A resident elk (*Cervus elaphus*) herd uses the ALE portion of the Monument. Mule deer (*Odocoileus hemionus*) densities on the ALE Reserve and along the Columbia River are the highest among Hanford habitats. Coyotes (*Canis latrans*) are the most abundant large carnivore on the Monument.

The lack of sufficient roost habitat probably limits the density and diversity of bats on the Monument. Bats may be more common in areas adjacent to the Columbia River and in riparian zones around desert springs and lakes created by irrigation return. Studies in the general Hanford vicinity have documented the presence of pallid bat (*Antrozous pallidus*), silver-haired bat (*Lasionycteris noctivangans*), and western small-footed myotis (*Myotis ciliolabrum*). The extent to which these species use the Monument is not known.

Birds

Approximately 238 species of birds have been documented on or near the Monument, 36 of which are common and 40 are accidental visitors. The Monument provides habitat for year-round residents, migratory species that breed on the site, winter residents, and migrants that are passing through to or from breeding grounds.

Mature sagebrush stands are perhaps the most important habitat on the Monument because large blocks of sagebrush in good condition are a dwindling resource in the Columbia Basin Ecoregion. Horned larks (*Eremophila alpestris*) and meadowlarks (*Sturnella neglecta*) are the most abundant breeding birds in the sagebrush/bunchgrass habitats. Brewer's sparrow is more common in the three-tip sagebrush communities at higher elevations. Brewer's sparrows and sage sparrows are sagebrush obligates and require sagebrush stands for nesting. Other species closely tied to sagebrush occurrence include loggerhead shrikes and sage thrashers. Loggerhead shrikes are commonly observed in dense sagebrush stands of the Monument.

The large expanses of bunchgrass habitat on the Monument provide hunting, nesting, and resting areas a number of bird species. Native bunchgrass habitat is used for foraging by a variety of raptors, including Swainson's hawks (*Buteo swainsoni*), golden eagles (*Aquila chrysaetos*), prairie falcons (*Falco mexicanus*), short-eared owls (*Asio flammeus*), and red-tailed hawks (*Buteo jamaicensis*) among others. Meadowlarks, horned larks, and grasshopper sparrows (*Ammodramus savannarum*) are some of the ground-nesting birds that are commonly found in bunchgrass habitat on the ALE Reserve. Burrowing owls (*Athene cunicularia*) and Swainson's hawks also have been documented nesting and feeding in bunchgrass habitat.

Riparian habitat is a scarce but important resource for birds on the Monument. The sharp contrast with the adjacent shrub-steppe habitat, the presence of trees, and the abundant cover make these areas focal points for predator and prey. Although the total area occupied by riparian habitat is small, the avian diversity is higher than the surrounding shrub-steppe. Riparian habitats are used by neotropical migrants such as western wood peewees (*Contopus sordidulus*), Say's phoebes (*Sayornis saya*), western kingbirds (*Tyrannus verticalis*), and resident downy woodpeckers (*Picoides pubescens*), and northern flickers (*Colaptes auratus*). Trees are rare on the Monument landscape and therefore provide an important resource for a number of birds. Raptors will perch, hunt from, or nest in trees in the riparian zone, or they may be attracted by the presence of prey species. Barn owls (*Tyto alba*), long-eared owls (*Asio otus*), great-horned owls (*Bubo virginianus*), red-tailed hawks, sharp-shinned hawks (*Accipiter striatus*), American kestrels (*Falco sparverius*), and Swainson's hawks regularly use riparian zones. Chuckar (*Alectoris chukar*), California quail (*Callipepla californica*), and mourning dove (*Zenaida macroura*) find abundant cover from predators in the riparian zones. Red-winged (*Agelaius phoeniceus*) and yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) breed along watercourses. Songbirds documented using the Monument riparian zones include ruby-crowned (*Regulus calendula*) and golden-crowned kinglets (*R. satrapa*), warbling vireos (*Vireo gilvus*), orange-crowned warblers (*Vermivora celata*), yellow-rumped warblers (*Dendroica coronata*), MacGillivray's warblers (*Oporornis tolmiei*), and Wilson's

warblers (*Wilsonia pusilla*) among others. In the winter, riparian zones are used by dark-eyed juncos (*Junco hyemalis*), white-crowned sparrows (*Zonotrichia leucophrys*), American robins (*Turdus migratorius*), Townsend's solitaires (*Myadestes townsendi*), and other species (LaFramboise and LaFramboise 1998).

Riverine habitat along the Hanford Reach is used extensively by mallards (*Anas platyrhynchos*), Canada geese (*Branta canadensis*), and other waterfowl for wintering, and the island habitats for nesting. Great blue herons (*Ardea herodias*), great egrets (*Ardea alba*), black-crowned night-herons (*Nycticorax nycticorax*), and other water-related birds have also been noted using the river corridor and islands. Double-crested cormorants (*Phalacrocorax auritus*), American white pelicans (*Pelecanus erythrorhynchos*), and several species of gulls and terns also use these areas.

Amphibians and Reptiles

Limited surveys recently documented a number of common amphibians and reptiles on the Monument. Species recorded include Great Basin spadefoot toads (*Scaphiopus intermontanus*), Woodhouse's toads (*Bufo woodhousei*), tiger salamanders (*Ambystoma tigrinum*), Pacific treefrogs (*Hyla regilla*), painted turtles (*Chrysemys picta*), short-horned lizards (*Phrynosoma douglassi*), sagebrush lizards (*Sceloporus graciosus*), side-bloched lizards (*Uta stansburiana*), racers (*Coluber constrictor*), gopher snakes (*Pituophis melanoleucus*), common garter snakes (*Thamnophis sirtalis*), western terrestrial garter snakes (*Thamnophis elegans*) night snakes (*Hypsiglena torquata*), striped whipsnakes, and western rattlesnakes (*Crotalus viridis*). Bullfrogs (*Rana catesbeiana*), an introduced exotic species, were also documented on the Monument.

Invertebrates

The diversity of insect life on the Monument is very high; over 1500 species have been documented. Darkling beetles (family *Tenebrionidae*) are some of the more conspicuous ground-dwelling insects on the Hanford Site, including the Monument. These beetles play an important role in the nutrient cycling in shrub-steppe communities and are prey for a variety of mammals. Darkling beetles are generally more abundant in warmer and drier locations and in areas dominated by native vegetation, and thus may be a good indicator of change in shrub-steppe habitats.

The ALE Reserve is particularly rich in butterflies and moths; 46 butterfly species and 107 moth taxa have been identified. Umtanum Ridge, Rattlesnake Ridge, and the shorelines of the Columbia River appear to support a wide variety of butterflies, including several rare species. An alkaline spring on Umtanum Ridge supports an endemic snail not known from any other location. Most insects are associated with specific microhabitats or host plants, are short-lived, and travel only short distances during their life. Unlike birds and mammals that may colonize an area if suitable habitat develops, the ability of insects to re-invade sites is minimal. Preservation of the variety of habitats available throughout the Monument is therefore particularly important for invertebrate conservation.

Air Quality

The Monument is located within a Class II air quality area as specified by the Clean Air Act. Air quality in the Monument is well within federal and state standards for criteria pollutants, except that short-term particulate concentrations occasionally exceed the 24-hour standard for particulate matter. Dust storms can create serious visibility problems on highways and other roads within the Monument. Winds capable of moving sand-sized particles occur approximately 40 days per year. An average of eight dust storms a year that decrease visibility to below 6.2 miles occur at the Hanford Meteorology Station (U.S. Department of Energy, 1998). Dust storms occur most frequently from March through May and also in September. Wind-blown dust, or “rural fugitive dust,” is generally exempt from U.S. Environmental Protection Agency (EPA) regulations.

Outdoor burning permits are issued by the Washington State Department of Ecology in Franklin and Grant Counties and by the Benton Clean Air Authority in Benton County.

Water Resources

Primary natural surface water features within the Monument include the Hanford Reach of the Columbia River and Snively and Rattlesnake Springs, two major spring systems with short stream segments located on the ALE. The Snively and Rattlesnake Spring systems provide important aquatic and riparian habitats in an otherwise arid landscape. A number of intermittent natural springs and streams originate on the flanks of Rattlesnake and Saddle Mountains.

Several irrigation canals, part of the Bureau of Reclamation’s Columbia Basin Irrigation Project, form artificial lakes (Saddle Mountain Lakes), ponds (WB-10 pond), and associated wetland areas in the Saddle Mountain and Wahluke Units.

The Columbia River within the Hanford Site is unique within the post-dam Columbia River system in the United States. As opposed to the rest of the river system, which is a series of slack-water reservoirs formed by dams, here, the river runs freely through an approximately 51-mile segment extending from Priest Rapids Dam to the upper end of McNary Dam Reservoir. Although overall flow volume and corresponding water levels are controlled by upstream dams, the Reach itself remains essentially free-flowing. As such, it contains significant riparian habitat, islands, riffles, gravel bars, oxbow ponds, and backwater sloughs which are otherwise rare within the Columbia River system (USFWS 1980; National Park Service 1994). These once common habitats now provide remnant habitat for aquatic organisms, including salmon that were widespread before the remainder of the Columbia River system was converted to reservoir or slack-water habitat. There are no perennial streams originating from the Monument that feed the Columbia River.

Soils

Located within the Columbia River Plain, the Monument is underlaid with Columbia River Basalt, a result of lava flows occurring between 17 and 2 million years ago. Massive flood events (the

Missoula Floods) occurred periodically towards the end of the Pleistocene epoch until roughly 12,000 years ago.

Soils on the Monument vary from wind-carried sand and sandy loam to silt, with 15 types in all described (Hajek 1966). The silt loam soils tend to be found on the slopes and higher elevation areas, whereas sandier soils are found at the lower elevations of the Columbia River Plain. Large, active dune fields occur on both sides of the river.

Throughout much of the Monument, a living crust covers some or all of the soil between plants (Nash, 1996a,b). The soil crust—referred to as microbiotic, cryptobiotic, or cryptogamic—is composed of algae, fungi, lichens, and mosses. Microbiotic soil crusts are especially well developed in relatively undisturbed areas of the Monument. Although the ecological role of the microbiotic crust is not completely understood, it is thought to play an important role in ecosystem functioning. Microbiotic crusts can stabilize the soil, thus reducing wind and water erosion (Metting 1991; Johansen 1993; Eldridge and Greene 1994). Some crust organisms contribute nitrogen (Harper and Pendleton 1993) and organic carbon (Johansen et al. 1993) to the soil. Some researchers have found an increase in the infiltration of precipitation into the soil with microbiotic soil crusts (Brotherson and Rushforth, 1983). Intact crusts can also enhance native seedling establishment in arid ecosystems (St. Clair, et al. 1984), and may discourage invasion by non-native species such as cheatgrass.

Erosion is a major concern on the Monument where disturbance has occurred along roadbeds, powerline corridors, and severely burned areas. High-intensity fires that remove the shrub, herbaceous, and microbiotic crust cover from the soil can result in substantial soil loss through wind erosion and spring melt events.

Cultural Resources

The Monument contains extensive, well-preserved archaeological deposits left by more than 10,000 years of human activity. This area retains traditional cultural significance to members of the Yakama, Umatilla, Nez Perce, and Colville Tribes, and the Wanapum People. Their ancestors resided on the land and used its resources, and their past and present culture is tied closely with the landscape. Numerous archaeological sites have been recorded within the Monument, with documentation secured at the Pacific Northwest National Laboratory and FWS Monument headquarters.

Euro-Americans first visited the region with the Lewis and Clark expedition, followed by fur trappers, military units, miners, and settlers. By 1880, cattle ranches and farms were established on lands currently within the Monument. The federal government acquired 1,517 square kilometers (586 square miles) for the Hanford Engineer Works in 1943, evacuating all citizens and razing most structures. Still, historic sites have been documented throughout the Monument, including the White Bluffs log cabin and ferry landing, natural gas exploration wells, mine tailings, remnants of

homesteads and agricultural structures, and historic trash scatters. More recent historic sites on the Monument include structures and facilities associated with Cold War activities.

Native American Considerations

The symbiotic nature of natural and cultural resources is deeply imbedded in the Native American culture. Because natural resources are integral to their traditional life-ways and culture, Native Americans view natural resources as cultural resources. The Treaty of 1855 clearly spells out tribal rights to access and use traditional resources, including foods, medicines, and places. Any proposed plans for protection, enhancement, and public use of natural resources will need to take the Native American view into consideration.

Recreation Resources

Located within one-half day's drive of more than four million people, the Monument provides locally and regionally significant semi-primitive opportunities for fishing, hunting, wildlife observation, photography, environmental education, and motorized and non-motorized boating. Visitors may access over 57,000 acres located on the Wahluke Unit, and over 50 miles of river along the free-flowing Hanford Reach of the Columbia River. The scenery, wildlife, and seasonal opportunities for solitude contribute to the high quality of the experience in this area. Current visitor facilities consist of access roads, parking areas, and primitive boat launches in the Wahluke Unit.

Anglers from throughout the Pacific Northwest visit the Hanford Reach for the smallmouth bass, sturgeon, steelhead, and fall chinook salmon sport fisheries. The largest remaining wild fall chinook salmon spawning area in the Pacific Northwest—an internationally significant resource—is found within the Hanford Reach. The heaviest recreation use period on the Monument occurs in September and October during the fall chinook runs.

The Hanford Reach offers excellent opportunities for waterfowl hunting during the fall and winter months. The Wahluke Unit is locally popular for upland bird and deer hunting.

The Hanford Reach and Wahluke Unit offer some of the best opportunities for wildlife observation in eastern Washington State. Bald eagles, common loons, white pelicans, terns, gulls, great blue and night-crowned herons, mule and white-tailed deer, coyotes, porcupines, and beavers are commonly observed. Outstanding opportunities for birding are available on the Wahluke Unit, especially during spring's influx of migratory songbirds. Recreationists are drawn by the showy wildflower displays throughout the Monument each spring.

The Hanford Reach was found suitable for Recreational River designation under the National Wild and Scenic Rivers Act (Hanford Reach of the Columbia River Conservation Study and EIS, 1994). This river segment is under interim protection status through Public Law (PL) 100-605, as amended by Section 404 of PL104-333. Interim protection is administered by the FWS.

Visual Resources

The landscape setting within the Monument is characterized by broad basins and flat plateaus interspersed with ridges, providing wide, open vistas throughout much of the area. The majority of the area is undeveloped, although the presence of roads and highways, fences, small buildings, power lines, and irrigation canals are visible in much of the area. Outstanding scenic resources include Rattlesnake Mountain, Saddle Mountain range, Columbia River, White Bluffs geologic formation, sand dunes, and the unbroken expanses of shrub-steppe vegetation communities. Shrub-steppe vegetation communities constitute the region's historic landscape, and the Monument provides excellent examples of the landscape witnessed by the post-European explorers Lewis and Clark. Shrub-steppe vegetation communities are characterized by overstories consisting of sagebrush, bitterbrush, black greasewood, spiny hopsage, and rabbit brush, interspersed by perennial bunchgrasses and forbs. Spectacular wildflower displays are evident throughout the area each spring. Portions of the Monument that have incurred surface disturbance are dominated by non-native plant communities such as cheatgrass, knapweed, thistle, and skeletonweed. These monotypic plant communities appear markedly different from the historic landscape and are undesirable from a visual resource perspective.