

# **Biodiversity in the Hanford Reach National Monument and Surrounding Areas**

By: Allyson Goldstein  
HC 441: Columbia River Ecology  
Clark Honors College, University of Oregon  
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## **Introduction**

The Hanford Reach is the only non-tidal free-flowing section of the Columbia River within the United States, and is a critical refuge for the flora and fauna of the semi-arid interior of the Pacific Northwest. It is a haven for a wide range of species and has a biodiversity unparalleled anywhere else in the Columbia River Basin. Today less than 40 percent of Washington's shrub-steppe ecosystem exists, since it has been replaced by development and agriculture. The Hanford Reach is one of the last remaining areas of this natural and unique environment. Types of organisms present in the Hanford Reach include plants, microbotic crusts, invertebrates, fish, mammals and birds (Poston, 2). Scientists have identified several previously unidentified species of plants and insects at the Hanford Reach.

Now a National Monument jointly run by the Department of Energy (DOE) and United States Fish and Wildlife Services (USFWS), The Hanford Reach stretches along a 51-mile section of the Columbia River in southeastern Washington State. According to the Nature Conservancy, "The Hanford Site and the Hanford Reach National Monument constitute a conservation site of national and regional importance. The landscape, scale of the shrub-steppe ecosystem, the diversity of the habitats, [and] the relatively undisturbed nature of much of the site make it a unique haven for native biodiversity" (Evans et al. iii). The Hanford Reach is a prime example of what has been lost to development and agriculture elsewhere along the Columbia River, and provides scientists with vital information about shrub-steppe ecosystems, salmon populations, and the different effects of native versus non-native species.

Ironically, Hanford's extensive natural wonders stem from its long history as the site of the nation's first plutonium reactor, built there in 1943 as part of the Manhattan project. Because the government created a large nearly road-free barrier around the plant, the Hanford Reach escaped the urban and agricultural development that occurred along most of the rest of the Columbia River.

This paper examines the biodiversity in the Hanford Reach, explores its designation as a National Monument, gives an overview of the dominant flora and fauna in the region, and explains the Hanford Reach's regional and national significance. Though continued controversy exists about the effectiveness and success of the clean up of radioactive waste in and around the Hanford Site, this paper focuses on the types of plants and animals present there rather than their exposure to radioactivity. Finally, this paper looks at the region's future including threats from invasive and introduced species.

## **History**

In 1943, the U.S. Army Corps of Engineers began construction on Hanford's B Reactor, the first full-scale nuclear material production reactor built in the United States. Plutonium produced in Hanford's B Reactor was used in the atomic bomb dropped on Nagasaki in 1945. In its efforts to build an atomic weapon before the Nazis, the United State Governments all but ignored environmental problems caused by the reactors. Between 1943 and 1963, nine plutonium production reactors, five chemical processing plants and various support building were constructed. By 1964, production cutbacks started, and by 1989, the government had closed all of Hanford's major facilities ("Hanford History"). During its production years, the

Hanford Site dumped large quantities of nuclear waste in the Columbia River and disposed of 440 billion gallons of contaminated liquids directly into the ground (Alvarez, 31)

The full-scale clean up of the Hanford Site began in 1996, and has mainly focused on liquid wastes. The clean-up project will last until 2070, but the effects of radioactive waste in the region will endure for millennia (Alvarez, 33). That being said, according to the DOE clean-up efforts have been successful so far, and in calendar year 2004 radioactive material levels in the air, Columbia River, fish and wildlife, and vegetation were acceptable according to EPA standards (Poston, xiv).

Shortly before leaving office in 2000, Bill Clinton designated the Hanford Reach a National Monument under Proclamation 7319. Under a 1906 law, the executive can designate areas of natural or cultural significance national monuments without congressional approval. Though the Republican-controlled congress tried to overrule Clinton's designation, his order stood. The USFWS runs the monument, but the DOE continues to oversee clean-up efforts at the Hanford Site across the river from the National Monument (Richard). In his proclamation declaring the monument, Clinton summarized the site's importance by saying,

The monument is a biological treasure, embracing important riparian, aquatic, and upland shrub-steppe habitats that are rare or in decline in other areas. Within its mosaic of habitats, the monument supports a wealth of increasingly uncommon native plant and animal species, the size and diversity of which is unmatched in the Columbia Basin (Clinton).

Because of its status as a national monument, and the continued threat of radioactive contamination, the Hanford Site is also one of the most carefully observed and studied wilderness areas in the continental United States.

## **Climate**

The Hanford Reach is located along a semi-arid plateau, and demonstrates the shrub-steppe environment. Because so little of Washington's original shrub-steppe environment exists, the Hanford Reach contains a wide variety of plant species that are non-existent or scarce throughout the rest of the Pacific Northwest. In addition, Hanford lies in the rain shadow of the Cascade Mountains, and thus annual precipitation only averages 6.35 centimeters each year (Becker 2.1)

## **Flora**

The various types of vegetation living in the Hanford Reach indicate the wide variety of different ecosystems the area supports. By thoroughly understanding which types of plants are present in the Reach, scientists can assess ecosystem health, and further understand the effects that radiation and invasive species have had on the area. In addition, an understanding of local flora is critical for the DOE to make important decisions about cleanup, land management and land use. Habitat types in the Hanford Reach include unstabilized dunes, riparian, wetlands, high-elevation basalt outcrop and vast sagebrush and bunch grass communities (Sackschewsky and Downs 11). The official list of plants present in the Hanford Reach includes 725 species, which are classified in over 355 genera and 90 families (Sackschewsky and Downs 1.6).

Big sagebrush is the most dominant plant throughout the Hanford Reach area. This plant is particularly important in eastern Washington because it provides a habitat for a variety of birds and small mammal species. Other prolific plants in the region include rabbit brush, antelope bitter bush, and black greasewood. The sages and other large plants also provide a site for a wide variety of understory plants such as Sandberg's bluegrass, wheat grass, and many types of flowering plants to grow (Sackschewsky and Downs 2.7)

In many parts of the Columbia River Basin, cheatgrass, a non-native species, has become more dominant than the native bunch grasses. In the Hanford Reach though, cheatgrass is present, but is not the dominant understory grass.

The sages and grasses present on in the Hanford Reach occur elsewhere in the region. Rarer species also exist in the Hanford Reach though, and are some of the regions' unique and most valuable features. Because the Hanford Site has not been subject to the same pressures for agricultural and urban development over the past 50 years, some plant communities are almost non-existent outside of the site's boundaries. These species include Umtanum desert buckwheat, White Bluffs bladderpod, and the more widespread Columbia yellowcress. In addition, scientists are considering the reintroduction of the northern wormwood along the Columbia River. While White Bluffs bladderpod and Columbia yellowcress populations have held relatively steady over the past eight years, but Umtanum desert buckwheat appears to be in decline (Evans et al.). The Hanford Site also contains a wide variety of Endangered and critical species (see appendix a for a complete list).

### **Biological Soil Crusts**

In addition to the plants themselves, the Hanford reach supports an extensive network of biological soil crusts, also known as cryptobiotic crusts, or microbotic crusts. These communities of organisms are an often overlooked, but vital element of arid and semi-arid ecosystems. These crusts are mainly comprised of lichens, bryophytes (including mosses and a few liverworts), single-celled algae and cyanobacteria. They also contain fungal hyphae, plant roots, litter and soil. These conglomerations of organisms are compact and fragile, and can contain more than 10 species of organisms on as little as two centimeters of soil. The crusts

contribute greatly to ecosystem health because they increase soil stability and increase water infiltration rates into the soil (Evans et al. 40).

Though once widespread throughout the Pacific Northwest, microbiotic crusts are now scarce because of their fragile nature. Human activities such as building roads and grazing livestock have contributed to a drastic decline in microbiotic soils in the region. The soils grow very slowly, and one footprint can destroy hundreds of years of growth. Because the Hanford Reach, was, and remains, relatively free of roads and development (outside of the nine plutonium reactors) the soils have survived much better there than elsewhere in the Columbia River Basin. However, extensive damage from past grazing and fires exists in the region, and so microbiotic crust covers just a small fraction of the land it once did. Thus, all management and clean-up activities in the Hanford Reach must avoid damaging of the microbiotic crusts. Because scientists have not yet found a way to regrow microbiotic crusts, and because of their ecological importance, all activities in the Hanford Reach should take these crusts into account (Evans et al.).

## **Invertebrates**

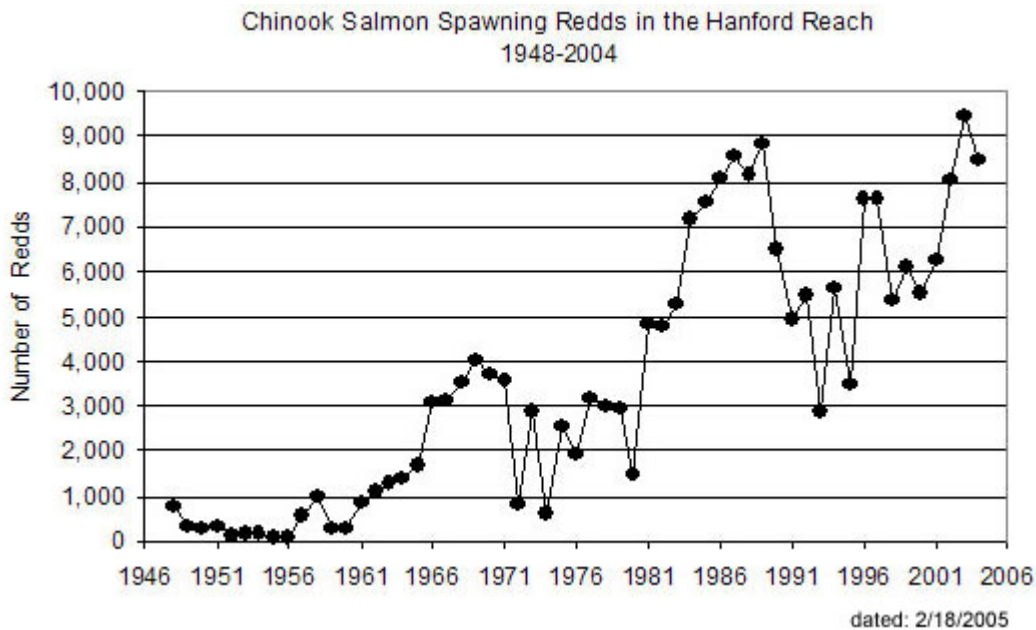
Invertebrates including insects, arthropods, non-arthropods, mollusks, arachnids, and other classifications of species live in the Hanford Reach. They are an important indicator of ecosystem health because they are the first living things to return to an ecosystem after pollution or other disasters. In addition to being key indicator species, invertebrates are vital to the food web, pollination, and decomposition of detritus and soil (Niwa et al. 25). Over 12,000 species of invertebrates live in the Hanford Reach, and most flourish there (Evans et al. 2). Those that are endangered or threatened are listed in appendix a.

## **Fish**

Because the dams along the Columbia River have such a negative impact on salmon species in the region, the Hanford Reach has the strongest natural Columbia River salmon run each year. The Hanford Reach supports spawning populations of fall Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Salmon gairdneri*). It also serves as a migration route for up river runs of Chinook, coho, and sockeye salmon (Becker v). The undammed river is vital for the continued survival of anadromous fish in the Columbia River. The large pools created by dams along the Columbia River hinder salmon from migrating upstream and thus limit their reproduction potential. The dams pose a threat to both the juvenile salmonids and the adult fish returning to spawn.

Anadromous salmonids share the Hanford Reach with nearly forty other native and introduced fish species (Grey and Dauble).

Because of differences in lifestyles, the type of salmonids present at the Hanford Site varies by season. Chinook salmon are present from March to November (though they spawn during three different runs). Coho salmon appear in the region between late August and November, sockeye from July to August, and steelhead are present all year, but are most visible between August and November (Becker 3.1). The following graph shows changes in the number of redds, or nests for salmon eggs in the Hanford Reach over the past 50 years.



(Downs)

While yearly fluctuations occur, in general the number of redds have increased significantly over time. The salmon are a keystone species, and affect all levels of the ecosystem. For instance, salmon carcasses fertilize soil off-stream (Todd). Thus, salmon levels are important not only for Native American fishermen, but also as an indicator of overall ecosystem health. The dams along the Columbia River, and especially Bonneville Dam, have forced salmon that used to spawn in other parts of the river to spawn in the Hanford Reach. Thus, controlling leakage of radioactively contaminated water into the Columbia River is paramount to protecting the last remaining free-flowing salmon run (Evans et al.).

### **Mammals and Birds**

The mammals present at the Hanford Site represent mammals throughout the Pacific Northwest, and are typical of the semi-arid shrub-steppe environment. Many animals protected by the Endangered Species Act inhabit the Hanford Reach (for a complete list see appendix a).

Human intrusion negatively affected many large mammal populations throughout Washington. Ironically, the building of nine plutonium plants limited human intrusion on large mammals in the Hanford Reach, and so though the climate is harsh, the area supports a variety of populations. Mammals present in the Hanford Reach include mice, gophers, hares, coyote, bobcat, badger, mule deer, elk and others (Rickard et al. 182). According to the DOE, these animals are not currently exposed to unacceptable high radiation levels (Poston et al.).

The Hanford Site is a haven for many different types of both migrating and non-migrating birds. Though these birds consume fish that are exposed to radiation, they do not have abnormally high radiation levels (Poston et al.). Most bird species along the river are field foragers like Canada geese and mallard ducks. Other birds include pelicans, warblers, blackbirds, and predators like bald eagles and black-billed magpies. Some of these birds appear on the endangered species list (Becker and McKinstry 281). The birds and mammals are two of the major reasons why Clinton designated the area a National Monument, and their continued survival is dependant on further protection of the Hanford Region (Clinton).

### **Non-Native Species**

The Hanford Reach's National Monument status protects it from major threats to other parts of the Columbia River Basin like agriculture and urban development. Therefore, invasive and introduced species are the greatest threat to the area. These non-native species include mammals, fish and plants and have a strong effect on the Hanford Site's ecosystem. According to The Nature Conservancy's Invasive Species Management plan, "invasive noxious alien plant species compete against and reduce habitat available for rare plant taxa. Weeds alter ecosystem structure and function, disrupt food chain... and can dramatically alter key ecosystem processes

such as hydrology, productivity, nutrient cycling, and fire regime (Nugent 2). Therefore, DOE officials and scientists must continue to work together to minimize these species' effects of the Hanford Reach environment.

Cheatgrass is one of the greatest threats to native flora and fauna. This introduced seasonal grass competes with native plants for water, sunlight, and soil nutrients. It also smothers microbiotic crusts, and affects soil composition, which can also harm cryptobiotic soil (Evans et al. 41). In addition to cleaning the radioactive material at the Hanford Site, the DOE in conjunction with USFWS must develop a plan to control harmful non-native species.

The control of invasive species in the Hanford Reach must occur according to general land management practices and following rough guidelines set up by Clinton's proclamation of the area as a National Monument. The best way to avoid effects of non-native plants is to avoid introducing them in the first place. If non-native species are already growing in an area, an early and rapid response works best to control the noxious weeds. Officials use both chemical and non-chemical methods to attempt to control non-native species; however oftentimes they are unsuccessful (Nugent et al. 35).

While non-native species are a problem throughout the shrub-steppe environment, and really throughout the United States as a whole, they are of particular concern in the Hanford Reach because the area contains such a wealth of native plant and animal species, some of which are very rare. Non-native species steal precious resources from the Hanford Reach's native species, many of which are on the Endangered and Threatened Species list (Nugent et al. 48).

Though they pose less of a threat than invasive plants, introduced animal species also have a strong effect on the Hanford reach. For instance, whereas native insects tend to be helpful to the ecosystem as a whole, introduced insects tend to be just pests (Evans et al. 71). In

addition, non-native insects occur with higher frequency in areas populated by non-native plants. The bullfrog is another non-native species that eats a wide variety of native invertebrates, and represents a threat to the native fauna in the Hanford Region.

Because so little of the natural shrub-steppe ecosystem remains in the western United States, and in particular in Washington, protecting the Hanford Reach from invasive species is of paramount importance.

## **Conclusion**

Even though the Hanford Reach has a tainted past as the site of the United States' first nuclear reactor, it now is a vital resource for scientists and citizens alike to explore the shrub-steppe ecosystem of the Pacific Northwest. As the DOE and other government agencies continue to work on cleaning up the radioactive waste present in the area, it is important that they maintain strict environmental standards for protecting both the National Monument and the surrounding area. The Hanford Reach will never go back to the pristine condition it was in hundreds of years ago, or even the condition it was in before the Manhattan project. However, perhaps the Hanford Site's radioactive legacy is somewhat of a blessing in disguise. Because of the reactors, the site escaped urban development, the building of roads, and over-grazing, and agriculture.

The plants, microbiotic soils, insects and animals that inhabit the reach all live together in an intricately connected web that the government must make it a priority to protect. Only through further study can scientists use information they glean at the Hanford Site to help protect and restore the rest of the Columbia River basin.

## Appendix A

### Hanford Site Federal and State Listed Endangered, Threatened or Candidate Species March 2005

#### Animal Species

Scientific name	Common name	Federal Status	State Status
<b>Mollusks</b>			
<i>Anodonta californiensis</i>	California floater	Species of Concern	Candidate
<i>Fisherola</i> (= <i>Lanx</i> ) <i>nutalli</i>	giant Columbia River limpet		Candidate
<i>Fluminicola</i> (= <i>Lithoglyphus</i> ) <i>columbiana</i>	giant Columbia River spire snail	Species of Concern	Candidate
<b>Insects</b>			
<i>Cicindela columbica</i>	Columbia River tiger beetle <sup>(a)</sup>		Candidate
<b>Fish</b>			
<i>Salvelinus conuentus</i>	bull trout <sup>(b)</sup>	Threatened	Candidate
<i>Rhinichthys flacatus</i>	leopard dace <sup>(b)</sup>		Candidate
<i>Catostomus platyrhynchus</i>	mountain sucker <sup>(b)</sup>		Candidate
<i>Lampetra ayresi</i>	river lamprey <sup>(b)</sup>		Candidate
<i>Oncorhynchus tshawytscha</i>	spring-run Chinook salmon	Endangered	Candidate
<i>Oncorhynchus mykiss</i>	steelhead	Endangered	Candidate
<b>Reptiles</b>			
<i>Sceloporus graciosus</i>	sagebrush lizard	Species of Concern	Candidate
<i>Masticophis taeniatus</i>	striped whipsnake		Candidate
<b>Birds</b>			
<i>Pelecanus erythrorhychos</i>	American white pelican		Endangered
<i>Haliaeetus leucocephalus</i>	bald eagle	Threatened	Threatened
<i>Athene cunicularia</i>	burrowing owl	Species of Concern	Candidate
<i>Gavia immer</i>	common loon		Sensitive
<i>Buteo regalis</i>	ferruginous hawk	Species of concern	Threatened
<i>Otus flammeolus</i>	flamulated owl <sup>(b)</sup>		Candidate
<i>Aquila chrysaetos</i>	golden eagle		Candidate
<i>Melanerpes lewisii</i>	Lewis woodpecker <sup>(b)</sup>		Candidate
<i>Lanius ludovicianus</i>	loggerhead shrike	Species of Concern	Candidate
<i>Falco columbarius</i>	merlin		Candidate
<i>Accipter gentilis</i>	northern goshawk <sup>(b)</sup>	Species of Concern	Candidate
<i>Falco peregrinus</i>	peregrine falcon	Species of Concern	Sensitive

<i>Amphispiza belli</i>	sage sparrow		Candidate
<i>Oreoscoptes montanus</i>	sage thrasher		Candidate
<i>Grus canadensis</i>	sandhill crane		Endangered
<i>Aechmorus occidentalis</i>	western grebe		Candidate
<i>Centrocercus urophasianus phaios</i>	western sage grouse	Candidate	Threatened

### Mammals

<i>Lepus californicus</i>	black-tailed jackrabbit		Candidate
<i>Sorex merriami</i>	Merriam's shrew		Candidate
<i>Spermophilus townsendii</i>	Townsend's ground squirrel		Candidate
<i>Spermophilus washingtoni</i>	Washington ground squirrel <sup>(b)</sup>	Candidate	Candidate
<i>Lepus townsendii</i>	white-tailed jackrabbit		Candidate

- (a) Probable, but not observed on the Hanford Site  
(b) Reported, but seldom observed on the Hanford Site

### Plants

Scientific Name	Common Name	Federal Status	State Status
<i>Allium robinsonii</i>	Robinson's onion		Watch
<i>Allium scilloides</i>	scilla onion		Watch
<i>Ammannia robusta</i>	grand redstem		Threatened
<i>Arenaria franklinii thompsonii</i>	Thompson's sandwort		Review 2
<i>Artemisia lindleyana</i>	Columbia River mugwort		Watch
<i>Astragalus columbianus</i>	Columbia milkvetch	Species of Concern	Sensitive
<i>Astragalus conjunctus</i> var. <i>rickardii</i>	basalt milk-vetch		Watch
<i>Astragalus geyeri</i>	Geyer's milkvetch		Threatened
<i>Astragalus sclerocarpus</i>	stalked pod milkvetch		Watch
<i>Astragalus speirocarpus</i>	medic milkvetch		Watch
<i>Astragalus succumbens</i>	crouching milkvetch		Watch
<i>Balsamorhiza rosea</i>	rosy balsamroot		Watch
<i>Calyptridium roseum</i>	rosy pussypaws		Threatened
<i>Camissonia</i> (= <i>Oenothera</i> ) <i>minor</i>	small-flowered evening-primrose		Sensitive
<i>Camissonia</i> (= <i>Oenothera</i> ) <i>pygmaea</i>	dwarf evening primrose		Sensitive
<i>Carex hystericina</i>	porcupine sedge		Watch
<i>Castilleja exilis</i>	annual paintbrush		Watch
<i>Centunculus minimus</i>	chaffweed		Review 1

<i>Cryptantha leucophaea</i>	gray cryptantha	Species of Concern	Sensitive
<i>Cryptantha scoparia</i>	miner's candle		Sensitive
<i>Cryptantha spiculifera</i> (= <i>C. interrupta</i> )	Snake River cryptantha		Sensitive
<i>Cuscuta denticulata</i>	desert dodder		Threatened
<i>Cyperus bipartitus</i> ( <i>rivularis</i> )	shining flatsedge		Sensitive
<i>Delphinium multiplex</i>	Kittitas larkspur		Watch
<i>Eatonella nivea</i>	white eatonella		Threatened
<i>Eleocharis rostellata</i>	beaked spike-rush		Sensitive
<i>Epipactis gigantea</i>	giant helleborine		Watch
<i>Erigeron piperianus</i>	Piper's daisy		Sensitive
<i>Eriogonum codium</i>	Umtanum desert buckwheat	Candidate	Endangered
<i>Gilia leptomeria</i>	Great Basin gilia		Sensitive
<i>Hypericum majus</i>	Canadian St. John's wort		Sensitive
<i>Lesquerella tuplashensis</i>	White Bluffs bladderpod	Candidate	Threatened
<i>Limosella acaulis</i>	southern mudwort		Watch
<i>Lindernia dubia anagallidea</i>	false pimpernel		Watch
<i>Lipocarpha</i> (= <i>Hemicarpha</i> ) <i>aristulata</i>	awned halfchaff sedge		Threatened
<i>Loeflingia squarrosa</i> var. <i>squarrosa</i>	loeflingia		Threatened
<i>Lomatium tuberosum</i>	Hoover's desert parsley	Species of Concern	Sensitive
<i>Mimulus suksdorfii</i>	Suksdorf's monkey flower		Sensitive
<i>Minuartia pusilla</i> var. <i>pusilla</i>	annual sandwort		Review 1
<i>Myosurus clavicaulis</i>	mousetail		Sensitive
<i>Nama densum</i> var. <i>parviflorum</i>	small-flowered nama		Watch
<i>Nicotiana attenuata</i>	coyote tobacco		Sensitive
<i>Oenothera caespitosa</i>	desert evening-primrose		Sensitive
<i>Opuntia fragilis</i>	brittle prickly pear		Review 1
<i>Pectocarya penicillata</i>	winged combseed		Watch
<i>Pectocarya setosa</i>	bristly combseed		Watch

Pediocactus simpsonii var. robustior	hedge hog cactus		Review 1
Pellaea glabella simplex	smooth cliffbrake		Watch
Penstemon eriantherus whitedii	fuzzytongue penstemon		Sensitive
Rorippa columbiae	persistent sepal yellowcress	Species of concern	Endangered
Rotala ramosior (Downs)	lowland toothcup		Threatened

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