Desert Wetland Ecosystems: Springs, Seeps and Irrigation

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While walking through endless xeric shrublands in the Great Basin or far-western Great Plains many people may think they are stark, barren and devoid of water. John Wesley Powell, an early director of the U.S. Geological Survey, pointed out in an important 1878 government study that the defining characteristic of the Great Plains and the West was its lack of water and stated that much of the area would be uninhabitable without extensive systems of irrigation. The region is in the rain shadow of the North American Cordillera. To the north the area is typical cold desert –only 200-300 mm of annual precipitation with long, cold winters and short, hot summers; to the south long, protracted drought periods may be punctuated by rain events from the Pacific Ocean. Yet there are many natural and man-made water features throughout these regions that translate into important wetland ecosystems.

Before the early 1900s the only water sites in the region besides the large river systems (including the Colorado, Snake, Yellowstone and Rio Grande drainages) were meltwater streams originating high in the mountains and dotted with beaver ponds, and at lower elevations springs and ephemeral seeps where geologic faults brought water-bearing strata to the surface. The springs and seeps were pools or wet meadows, and the rivers and larger creeks were riparian corridors bracketed by cottonwood gallery forests with willows on the sandbars (Figure 1). Today it is hard to imagine a world with no Russian olive (*Elaeagnus angustifolia*) or salt cedar (*Tamarix* spp.). Water availability and mesic habitat were limited for native people and fauna. Away from those corridors was an endless tapestry of sagebrush (*Artemisia* spp.), creosote bush (*Larrea* spp.), rabbitbrush (*Chrysothamnus* spp.), and junipers (*Juniperus* spp.). The region has been reworked many times creating a patchwork mosaic of old and new wetland areas embedded in this dry environmental matrix.

SPRINGS AND SEEPS

While climate across much of the west produces xeric environments, underlying aquifers and water bearing strata hold copious amounts of water potentially available to

FIGURE 1. Riparian corridor along the Green River in Dinosaur National Monument, Utah.

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augment surface wetland ecosystems. Extensive geologic faulting brings these water bearing layers to the surface resulting in fracture springs and seeps (ciénegas). Many of these wetland sites are ephemeral, as groundwater is often the consequence of short-term snowmelt and long-term wet-dry cycles. In many locations in the West, seeps may be absent most years and only reappear after a lengthy period of time[2]. Some of these areas may be dry for so long that shrub-steppe habitat develops with the counter-intuitive result of sagebrush or cacti (Cactaceae) seemingly growing in water when the seep reappears (Figure 2).

For native people and early settlers, as well as wildlife, these springs and seeps were critical sites providing water for daily life as well as irrigation. For thousands of years, western tribes developed their own methods of living with the natural world and its limited water supply. Water, bodies of water and places of water, occur as characters and settings in many Native American mythologies and such sacred narratives remain for Native Americans fundamental to an understanding of the world. Water is, of course, portrayed as vital for physical survival and the source of much life-giving sustenance. Many of the animal and plants associated with these aquatic systems have gained prominence for Native American nations. Nearly all ancient sites of habitation are located adjacent to a spring or stream, and many sites are thought to have been abandoned due to shifts in climate or weather that resulted in these water sources being reduced or going dry (Figure 3).

Due to the rock strata through which the water passes, and occasionally geothermal activity, many western springs show high levels of carbonate or sodium but also of such elements as sulfur or metals leading to local names such as Thermopolis or Mineral Wells. William (Buffalo Bill) Cody, an early proponent of tourism in Yellowstone National Park went so far as to change the name of the Wyoming canyon which serves as the eastern entrance to the park from the "Stinking Water" to Shoshone River. A visit to Coulter's Hell, a sulfurous geothermal spring along the river on the west side of Cody, Wyoming helps recall the reason for the original name. Because of their water chemistries and isolated locations these springs often exhibit endemism – species unique to those springs or regions. Perhaps the most studied spring in the southwest, Montezuma Well in Arizona produces a nearly constant daily 5.7 million liters of water with high levels of carbonate and arsenic. It is home to five endemic species – a diatom, snail, water scorpion, amphipod and predaceous leech – the most endemic species of any spring in the desert southwest (Figure 4). In some locations hot springs can be important desert refugia for rare aquatic species, such as pupfish (Cyprinodontidae).

FIGURE 2. Ephemeral seep in Bighorn Canyon National Recreation Area (Wyoming) has only flowed a few times in the past 50 years. Sagebrush standing in water attests to the fact the site is usually dry.

IRRIGATION

Since European settlement, additional water areas have been developed across the Great Basin. While human-constructed for water supply and irrigation, they also have the additional benefit of attracting wildlife and becoming birding hotspots. The large rivers now have dams and lakes/reservoirs, such as Lakes Mead and Powell, and Buffalo Bill and Elephant Butte Reservoirs, for water supply, flood control, and recreation. Together with smaller reservoirs and check dams along the rivers these large reservoirs provide the water for the extensive irrigation projects first started by Mormon pioneers and later expanded by the U.S. Bureau of Reclamation. In a satellite view of the Great Basin it is easy to detect the green swaths of agricultural land along each river (Figure 5).

The irrigation projects have additional reservoirs constructed to regulate the flows of water or to capture return drain water. Leaching of alkali from the soil often produces a ring of white crust around these areas. Many sites are characterized by hard-stem bulrush (*Schoenoplectus* spp.), branchiopods such as tadpole shrimp (Notostraca) and shore and brine flies (Ephydridae) and attract alkaline-loving birds including white pelicans (*Pelecanus erythrorhynchos*), western and eared grebes (*Aechmophorus occidentalis*, *Podiceps nigricollis*), California gulls (*Larus californicus*), ruddy ducks (*Oxyura jamaicensis*), and yellow-headed blackbirds (*Xanthocephalus xanthocephalus*). Some people may find the alkali deposits unattractive, but their biogeochemistry is an important factor for many waterbird species. Likewise, the green patches of irrigated pasture and hayland that mimic herbaceous vegetation in

2. These wetlands may not meet the proposed definition of "waters of the United States" (https://www.epa.gov/newsreleases/epa-and-army-propose-new-waters-united-states-definition) and may lose any protection they now enjoy under current federal wetland regulations.

FIGURE 3A. Spring at El Morro National Monument (New Mexico) shows evidence of Native American, Spanish and pioneer use for centuries.

FIGURE 3B. Adjacent to the spring are hundreds of petroglyphs and inscriptions. "On the 25th of the month of June, of this year of 1709, passed through here on the way to Zuni. Ramón García Jurado"

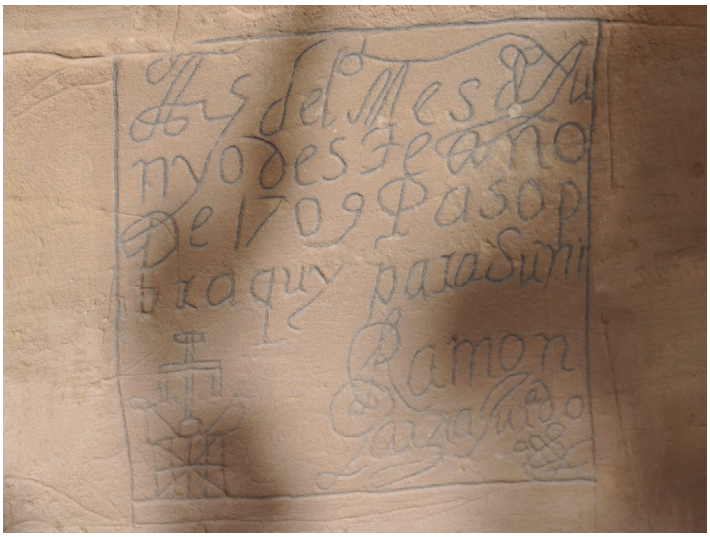

FIGURE 4. Montezuma Well (Montezuma Castle National Monument, Arizona), a natural limestone sinkhole. The site is still considered sacred by local tribes.

FIGURE 5. Irrigated land contrasts sharply with xeric native habitat along the Snake River in Idaho.

seeps are attractive to many wildlife species. Two animals that have responded favorably to this new agrohabitat are Pronghorn (*Antilocapra americana*) and Sandhill cranes (*Grus canadensis*) that use alfalfa and fallow fields to forage on vegetation or invertebrates.

Some irrigation water is purposed specifically for wetland habitat creation. An area that I visit on a regular basis is the Yellowtail Wildlife Habitat Management Area near Lovell, Wyoming. Much of the area is managed for upland habitat and species, but there are also several important created water areas which use irrigation water from the Shoshone Project (Figure 6). Thousands of waterbirds and shorebirds utilize the area, especially during migration, and muskrats (*Ondatra zibethicus*) and mink (*Neovison vison*) are abundant. Four species of concern are frequently seen or heard in these wetland areas: Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), black-crowned night-heron (*Nycticorax nycticorax*) and American bittern (*Botaurus lentiginosus*). Broods of rail chicks have been observed during summer. I have also watched thousands of blackbirds and starlings (*Sturnus vulgaris*) come in to roost in the wetlands at dusk in early winter.

Important municipal sites also utilize irrigation water. Parks and golf courses often have ponds –"water hazards" in golf parlance – incorporated into the layout of the area. In many locations geese have prospered so well as to cause a nuisance in these sites. Most cities and towns in the basin have sewage treatment ponds somewhere removed from

FIGURE 6. Created wetland at Yellowtail Wildlife Habitat Management Area (Wyoming) utilizes water from the federal Shoshone Irrigation Project, the first large-scale irrigation effort in the western United States.

the town proper, Sewage is a nutrient soup that promotes phytoplankton growth which in turn supports high populations of zooplankton, e.g., water fleas (*Daphnia)* and other macroinvertebrates. Since the effluent is relatively warm and often aerated, the ponds can remain ice-free longer in winter than many nearby waters. Like alkaline lakes similar species respond to these habitats. At some treatment ponds northern shovelers (*Anas clypeata*) can be found in large numbers, and American avocets (*Recurvirostra americana*), black-necked stilts (*Himantopus mexicanus*) and Wilson's phalaropes (*Phalaropus tricolor*) may often be seen. Many other waterbird species can also be observed. It may not be "pristine" wildlife habitat, but do not discount the importance of these wetland areas.

I do not mean to imply that created wetlands could ever provide all the functions and values of natural ecosystems. Many people decry the global changes brought about by human manipulation and alteration, but we need to take the good with the bad. While the Great Basin has been modified by people for the past 100+ years, these changes have also benefitted many wildlife species to the enjoyment of birders and outdoor enthusiasts. ■