Arid Land Restoration and the Owens Valley, California

Introduction

Owens Valley is part of the arid Great Basin region. It is located in the center of California near the eastern border with Nevada in the county of Inyo. The valley runs north to south, is over 75 miles long, about 6-10 miles wide, and has an average elevation of about 4000 feet.[1] The Sierra Nevada Mountain Range forms the western border and the White and Inyo Mountains form the eastern border of the valley. Mountain passes at elevations around 11,000 feet and peaks in excess of 14,000 feet provide formidable barriers into and out of the valley. The Owens Valley is in the rainshadow of the Sierra Nevada and averages only 4-6 inches of annual rainfall.[2] The valley receives its water from snowmelt-fed creeks running down the eastern slopes of the Sierra Nevada, which flow into the perennial Owens River. The river historically flowed into the landlocked Owens Lake. (See Appendix 1 for a map of the Owens Valley).

In 1913, an aqueduct was completed that diverted water from the Owens River down to Los Angeles. In 1970, Los Angeles opened a parallel aqueduct that pumped ground water from the Owens Valley down to the city. The diversion of surface and ground water has drastically altered the landscape of the Owens Valley.

In this paper I seek to address the cultural and natural history of the Owens Valley before the Los Angeles aqueducts, and the cultural and ecological impacts that the aqueducts have on the Owens Valley. I also examine current restoration and mitigation projects conducted by the City of Los Angeles and Inyo County, and discuss how arid land ecological restoration could alleviate present and future problems for Owens Valley residents.

History of the Owens Valley

Owens Valley Paiute

The Owens Valley Paiute were the native inhabitants of the valley before it was settled by white pioneers in the latter half of the 18th century. Estimates of the Owens Valley Paiute population before whites permanently settled the valley hover around 1,000 individuals.[3] The Paiute ranged all over the valley and the surrounding foothills in order to utilize seasonal resources. Their primary food source was pinenuts, gathered in the hills above the valley, but they also relied on a variety of other seeds and plants, as well as hunting and fishing.[4] Game included deer, bighorn sheep, antelope, rabbit, and waterfowl, and they fished in the Owens River, fresh-water sloughs, and streams coming off the Sierra Nevada.[5] Water coming off the Sierra Nevada flowed down through meadows, turning them into marshy bogs, and then flowed into the Owens River, whose banks were thick with trees and other riparian vegetation.[6] The Paiute built dams and ditches to divert water from streams to selectively irrigate meadow plots and increase the natural yield of several wild seed species.[7] In his landmark ethnography on the Owens Valley Paiute, Julian Steward argues that the Paiute practiced "irrigation without agriculture." However, Lawton et. al (1993) argue that the Paiute had a complex agricultural system that was well developed in the northern part of the valley, and not practiced at the southern end of the valley near Owens Lake. The definition of agriculture, and whether or not the Owens Valley Paiute practiced it, is still being debated, but what is clear is that the Owens Valley contained a variety of resources that sustained the Paiute.

The lush green meadows of the valley, enhanced by the Paiute, impressed white explorers and accounts of the valley remarked on its potential for settlement and agriculture. On an expedition to the Owens Valley in 1859, Captain J.W. Davidson remarked, "…where the eye

wanders over a sea of green…the grass (over two feet in height, broad leaved, and juicy) extended for miles."[8] Davidson speculated that the valley was well-suited for livestock grazing and agriculture; his impressions may have encouraged later settlement of the region.[9] However, earlier expeditions into the Owens Valley emphasized the inhospitable nature of the land. In 1834, Zenas Leonard wrote, "The country on this side [of the Sierra Nevada] is much inferior to that on the opposite side – the soil being thin and rather sandy, producing but little grass."[10] In 1845, Edward M. Kern noted a large tule marsh and salt "incrusted to the thickness of a quarter of an inch on the surface of the earth."[11] In 1855, A.W. Von Schmidt said of the valley, "On a general average the country forming Owens Valley is worthless to the White Man. Both in soil and climate."[12] Examining the negative accounts of the valley, it may seem a small miracle that the Owens Valley was settled at all. But when gold and silver were discovered in the eastern Sierra Nevada in 1860, the Owens Valley was settled by ranchers to meet the demands for meat of the mining towns to the north.[13]

White Settlers

Mining established a motive for agricultural colonization of the Owens Valley, and the areas with the most fertile land where it was easiest to divert water were settled first. These areas created the towns of Bishop, Big Pine, Independence, and Lone Pine, which still exist today. Small farmers raised corn, wheat or oats, potatoes, some orchard and garden produce, hay, horses, milk cows, range cattle, hogs, and poultry. After conflicts between white settlers that eventually led to displacement by military action, the majority of Owens Valley Paiute took up jobs on the small farms and ranches and settled on the edges of the four main towns. The number of farms in the Owens Valley tripled during the 1870s, and ranchers started raising several large cattle herds and large flocks of sheep.[14]

By the 1880s, the mines petered out, the local market for the valley's surplus farm products collapsed, and farmers were unable to sell surplus products to distant markets because of the valley's isolation from other California markets. Owens Valley farmers turned to raising livestock and alfalfa to feed the livestock, and thousands of acres were cleared for cultivation and irrigated. In the early 1890s, the level of Owens Lake began to fall due to uncontrolled irrigation by Owens Valley farmers. By the turn of the century, the northern end of the valley was producing alfalfa, livestock, dairy, sheep, fruit, poultry, honey, wheat, oats and corn. There were very few farms at the southern end of the valley because of the lack of irrigation projects. Some claim that if the southern part of the Owens Valley had been more effectively settled by the turn of the century, Los Angeles may have been compelled to look elsewhere for water.[15]

The City of Los Angeles

William Mulholland, superintendent of the Los Angeles Department of Water and Power (LADWP), began designing the Los Angeles Aqueduct in 1904, which would channel the flow of the Lower Owens River by gravity to Los Angeles. Fred Eaton, former mayor of Los Angeles, began acquiring property and water rights for Los Angeles in 1905 under the guise that he was working for the Reclamation Service (precursor of the modern day U.S. Bureau of Reclamation), a federal government agency planning to build a reservoir to improve valley agriculture. Unfortunately for Owens Valley residents, the reservoir was never built. Los Angeles had acquired most of the land that the Reclamation Service needed in order to build the reservoir, and in June of 1906, President Roosevelt decided the reclamation of Owens Valley water in favor of Los Angeles, in the interest of what he called, "the greatest good for the greatest number." By late 1909, Los Angeles had acquired over 82,000 acres of land and water rights in the Owens Valley, which included most of the southern half, and a large portion of the northern half.[16]

The aqueduct opened in November of 1913. As early as 1918, Los Angeles began pumping groundwater. When a prolonged drought hit the southwest in 1923, and with Los Angeles' population reaching the 1 million mark, Los Angeles turned to the groundwater of the Owens Valley and began purchasing more land and water rights. The city's extensive land purchases, combined with the reversion of northern valley lands to desert due to groundwater depletion, caused despair and insecurity among valley residents, and people began to abandon farmland and leave the valley. By 1924, Owens Lake was a dry alkaline sink, and the 50-mile stretch of the Owens River below the aqueduct intake was dry. In 1970, Los Angeles opened a parallel aqueduct that pumped groundwater from the valley down to Los Angeles, increasing water export by 60 percent.[17]

Legal Action: Owens Valley Residents Fight Back

In 1972, Inyo County filed a lawsuit against the City of Los Angeles, claiming that increased groundwater pumping was harming the environment of Owens Valley and that it should be analyzed in an Environmental Impact Report (EIR) in accordance with the California Environmental Quality Act. After several years of litigation, Inyo County and Los Angeles came up with a preliminary agreement on a joint long term groundwater management plan, which resulted in the 1991 Inyo/LA Long Term Water Agreement. The goal of the plan was to manage water resources within Inyo County so that environmental damage to the valley was minimized while still providing a reliable supply of water to Los Angeles. The Agreement included plans to manage well fields – areas where groundwater was being pumped from – based on a vegetation classification scheme, a provision for the creation of a management plan for the Lower Owens River, and a Saltcedar (*Tamarix ramosissima*) control program. The 1991 EIR that followed

adopted the Lower Owens River Project (LORP) as a compensatory mitigation measure for past damages caused by the second aqueduct, as well as a revegetation program for the valley.[18]

Owens Valley Today

Diversion of surface water and depletion of ground water by the Los Angeles Aqueducts have had lasting effects on the people and ecology of the Owens Valley.

People of the Owens Valley

The U.S. Census of 2000 put the total population of Inyo County at 17,945 people, with a labor force of 8,840 people.[19] Inyo County includes the incorporated town of Bishop (population 3,575) and the unincorporated areas of Big Pine, Independence, Lone Pine, Cartago, Olancha, Pearsonville, Shoshone, and Tecopa.[20] In 2004, the largest private industry employment was in "accommodation and food services" at 27%, the next largest was the "retail trade" at 23%, and then "health care and social assistance" at 8%.[21] "Agriculture, forestry, fishing, and hunting," once the primary industries in the Owens Valley, now employ only 1% of the workforce, and the mining industry employs only 0.3% of the workforce.[22] Motels, restaurants, coffee shops, retail shops, and outdoor outfitters jostle for space along the Main Street of Bishop. During the summer, restaurants display signs that say "Welcome Fishermen!", and during the winter, "Welcome Skiers and Snowboarders!" It is clear that the town depends on tourism and the constant stream of people traversing Highway 395. Where there once was a diverse agricultural community producing fruit, vegetables, wheat, and poultry, now top agricultural commodities consist of cattle, turf, hay, and pasture.[23]

Ecological Changes in the Owens Valley

After the Owens Lake dried up in 1924, it became the single largest source of particulate matter air pollution in the United States.[24] Wind blows across the dry lake bed, eroding and lifting fine sediments and salts into the air, making the lake a major source of PM10 aerosols (particulate air pollution less than 10 micrometers in diameter).[25] Because aerosol particles from Owens Valley dust storms are much smaller than particles from typical dust storms, and because they contain hazardous compounds such as arsenic, they pose a much greater risk to human health.[26] Dust particles are transported throughout the Owens Valley and, ironically, down to Los Angeles. The dust may seriously impact the sensitive Bristlecone Pine (*Pinus longaeva*) and Limber Pine (*P. flexilis*) of the White and Inyo Mountains and wilderness areas in the southern Sierra Nevada.[27]

Surface water diversion and groundwater pumping have induced measurable changes in vegetation composition and cover, including increased shrub cover replacing grass cover.[28] Preliminary evaluations of vegetation change found that from 1906 to 1968, major vegetation cover declined by 38%, and from 1968 to 1981, major vegetation cover declined by 67%.[29] It has been estimated that approximately 25,000 acres of groundwater-dependent vegetation in the valley have been negatively affected by groundwater pumping.[30]

The water table served as a buffer for vegetation to adjust to the annual fluctuations in precipitation, but diversion and pumping have led to fluctuations in the water supply that negatively affects native plants such as willow (*Salix* sp.), Saltgrass (*Distichlis spicata*), Greasewood (*Sarcobatus vermiculatus*), and favors weed species such as Russian Thistle (*Salsola* sp.) and Bassia (*Bassia hysopifolia*).[31] Saltcedar (*Tamarix ramosissima*) has colonized riparian habitats below the aqueduct intake because intermittent surface water flow creates

disturbance that harms native vegetation and favors Saltcedar.[32] Nevada Saltbush Scrub (*Atriplex torreyi*), Saltgrass Meadow, and Alkali Marsh communities around the Little Black Rock Spring have declined because of groundwater pumping.[33]

Vegetation composition and cover have also been affected by land use changes that have been brought about by diversion and pumping. Agricultural field sites that were abandoned now have a sparse cover of weedy species and the topsoil has often been blown away.[34] Intensive grazing by livestock can further stress vegetation already struggling to cope with groundwater depletion. Ecosystem changes in vegetation have undoubtedly affected native wildlife, especially grazing ungulates such as Mule Deer (*Odocoileus hemionus*) and Pronghorn (*Antilocapra americana*).

And of course, the diversion of all surface water from the Owens River into the first aqueduct seriously degraded the riparian and wetland habitat on the lower reaches of the Owens River below the aqueduct intake. Riparian and wetland habitat and Owens Lake had been extremely important to wildlife. Of Owens Lake, pioneer Beveridge R. Spear wrote, "The lake was alive with waterfowl…Ducks were by the square mile, millions of them."[35] In his book, *Cadillac Desert*, Marc Reisner describes the original Owens Lake as a huge, turquoise, saline lake that supported immense populations of salt-loving flies and brine shrimp which attracted millions of migratory waterfowl. Today the lake supports migratory shorebirds as well as a winter population of shorebirds and waterfowl due to recent efforts to control dust blowing off the dry lake bed.

Can the damage be repaired?

The lawsuits filed by Inyo County in 1972 began the process of forcing the City of Los Angeles to take responsibility for the damages it has caused to the Owens Valley. Several projects are now underway.

The Owens Lake Dust Mitigation Program began in 1998 after the Great Basin Unified Air Pollution Control District required the City of Los Angeles to control dust coming off the Owens Lake bed. Control projects now exist along the northern, eastern, and southern shores of the dry lake. The City is using shallow flooding, managed native vegetation cover, or gravel cover on different portions of the lake for dust control management.[36] Shallow flooding provides the most benefit to waterfowl and shorebirds, but currently only 10 square miles of the lake's surface are shallow flooded.[37]

Several projects resulted from the 1991 Long Term Water Agreement, 1991 EIR, and 1997 MOU. These projects include well-field vegetation management and monitoring, the Lower Owens River Project, a Saltcedar control program, a revegetation program for the valley, enhanced Yellow-billed Cuckoo habitat, an inventory of spring and seep vegetation for monitoring purposes, and additional mitigation to specified sites.[38]

The Lower Owens River Project is the largest river riparian restoration project in the western United States.[39] The goal of the LORP is, "the establishment of a healthy, functioning Lower Owens River riverine-riparian ecosystem, and the establishment of healthy, functioning ecosystems in the other physical features of the LORP, for the benefit of biodiversity and Threatened and Endangered Species, while providing for the continuation of sustainable uses including recreation, livestock grazing, agriculture and other activities."[40] The LORP has four main components (presented here from north to south):

(1) Black Rock Waterfowl Habitat Area – wetlands will be flooded when runoff is average or above average to increase wetland productivity and diversity for waterfowl.

(2) Off River Lakes and Ponds – off river lakes and ponds near the Black Rock Waterfowl Habitat Area will be maintained for fisheries, waterfowl, shorebirds, and other animals through water flow and land management.

(3) The Lower Owens Riverine-Riparian Ecosystem – water from the aqueduct will be pumped into the Owens River to create and sustain riparian and aquatic habitat for wildlife and native fish species.

(4) The Owens River Delta Habitat Area – water from a pump station will be used to enhance and maintain 325 acres of wetland within the Delta.

Different components of the LORP are currently under construction, and water from the aqueduct is being released into the Lower Owens River.

The Role of Ecological Restoration

The efforts of the City of Los Angeles and Inyo County to repair ecological damage done to the Owens Valley are admirable. The system can never truly be restored as long as Los Angeles continues to divert and pump water out of the valley, but ecological restoration is playing a large role in healing the ecological and cultural wounds caused by the two aqueducts. As the largest riparian restoration project in the western United States, the Lower Owens River Project is restoring miles of riparian and wetland habitat to the benefit of wildlife and people of Owens Valley. Many of the other projects being undertaken in the valley – Saltcedar control, revegetation, shallow flooding of Owens Lake – can also be called ecological restoration because they are attempting to restore the ecological integrity and historical fidelity of the systems. For

other projects, such as the well-field vegetation management and monitoring, the term "mitigation" is more fitting because historical accuracy of the plant communities is not taken into account.

While the sheer number of projects being undertaken by the City and Inyo County would suggest that enough is being done to protect the Owens Valley, more could be done using ecological restoration. The aqueducts had an immense impact on the Owens Valley, but before the aqueducts, the white settlers – the farmers and ranchers – were there, carving their legacy into the valley. Farmers and ranchers still work the land of the Owens Valley today, and the ecological health of the valley suffers from land use changes caused by the white settlers who took the valley from the Paiute.

Arid lands all over the world have been and are being damaged and made less productive by poor management. Poor management of the Owens Valley limits the ability of residents to make a living, reduces their quality of life, destroys communities, leads to conflicts over land and water, reduces health and life expectancy, and negatively impacts natural systems and biodiversity. Ecological restoration and improved management of the valley are extremely important in reversing the processes of degradation and desertification.[41]

Overgrazing is the most common and serious problem affecting arid lands today, and the Owens Valley is no exception. The decline of arid or semiarid rangeland is triggered by drought and reinforced by a positive feedback cycle of damage to vegetation and soil structure, reduced capacity of the soil to capture and retain water, which leads to slowed recovery of vegetation. This cycle is exacerbated when ranchers switch to sheep after the range is no longer suitable for cattle. Eventually the land is not fit even for sheep grazing. Agriculture destroys native plants, their associated belowground communities, and soil structure. Poor water management by

farmers can increase salinity and alkalinity. Today, the use of off-road vehicles (ORV) for recreation is popular in the Owens Valley. ORV use causes direct damage to plants and living organisms, and disrupts soil structure and function. Exotic plants, such as Saltcedar, affect water, nutrient, and resource distribution. Natural recovery of overgrazed rangelands, abandoned agricultural lands, and ORV recreational areas is slow. Recovery of arid lands is limited by extreme temperatures, intense sun, high winds, limited moisture, and low fertility of soils even if disturbance to a site is stopped.[42]

While the City of Los Angeles has caused serious (and possibly irreparable) damage to the Owens Valley, residents of the valley must also consider the impact they are having on the ecological health of the valley. Today livestock grazing, agriculture, off-road vehicle use, and exotic plants all threaten the health of the Owens Valley. Irrigation practices by early settlers damaged the soil. Early farmers of the valley irrigated land by flowing water downslope through ditches without control checks or levees, which eventually caused over-irrigation, saturation, and flooding of older fields.[43] Poor drainage trapped concentrations of minerals on the surface of the field, and when the water evaporated it left a hard alkali crust that ruined the soil.[44] Instead of improving irrigation systems, early farmers found it cheaper and easier to pasture livestock on over-irrigated land, and take up new land for farming.[45] The damage done to soils by early farmers has not been remedied. Residents need to take action to prevent further degradation of the Owens Valley. Riparian areas need to be protected from overgrazing, trampling, and erosion by livestock. Cattle and sheep could be prevented from damaging riparian areas and springs with fencing, while allowing large native mammals such as Mule Deer (*Odocoileus hemionus*) and Mountain Sheep (*Ovis Canadensis*) to access vegetation associated with those sites.[46] Exotic species, such as Saltcedar, must be removed from riparian habitat.

The livelihoods of ranchers and farmers cannot be taken away, and ORV recreation will continue, but it is possible for residents of the Owens Valley to reduce the impact that they have on the local ecosystems. In addition to fencing riparian areas and springs, ranchers could distribute grazing impacts with multiple watering sites for livestock, develop water catchments for livestock and other wildlife, reroute fences to direct animal trails to minimize erosion, use fencing to reduce overgrazing by allowing areas to recover, and revegetate grazed areas.[47] Farmers could move away from inefficient irrigation methods, explore high yield per water input of high-value crops, explore market opportunities for value-added crops, diversify crop production, develop crop rotations to optimize land and water use, leave fields fallow to recharge soil moisture, control erosion, and stimulate revegetation.[48] To reduce the impacts of ORVs on local ecosystems, fences and signs could be erected in recreation areas, and efforts could be made to control erosion and revegetate protected areas.[49]

Conclusion

The Owens Valley has suffered from poor management by early white settlers, the City of Los Angeles, and Inyo County. What was once a fertile, productive, and diverse ecosystem now is at risk of further degradation and desertification. The Owens Lake is the single largest source of particulate matter air pollution in the United States. Changes to the valley's hydrology have damaged plant and wildlife communities. Legal action against Los Angeles has forced the City to take responsibility for the damages it has caused the Owens Valley. While the City of Los Angeles and Inyo County have exerted significant effort – in the form of time, resources, and money – to mitigate the damage done to the Owens Valley by the two aqueducts, it is not enough. The Lower Owens River Project is undeniably an important project, but it might be too

little, too late, especially with the completion of the project still a long way off.[50] The LORP and other mitigation projects will bring ecological and economic benefits to residents, especially in the southern part of the county, by increasing hunting, fishing, bird-watching, canoeing, and kayaking opportunities.[51] But current efforts are not sufficient. If Owens Valley is to avoid desertification and is to remain habitable, further degradation – by Los Angeles and by Owens Valley residents – of the valley must be prevented. Ecological restoration must play a larger role in protecting the Owens Valley, and the City of Los Angeles and Inyo County must work together to achieve this goal.

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