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Contents

Front Cover: Katie Frazier, a Pauite, prepares cui-ui fish at Pyramid Lake, ca. 1930. Photographer unknown. *(Nevada Historical Society)*

Salmon's Presence in Nevada's Past

ALISSA PRAGGASTIS AND JACK E. WILLIAMS

Salmon used to run the South Fork of the Owyhee River every spring. The ranchers in the Independence Valley and the people in Tuscarora would take them with pitch forks and spears. It was quite a sport for a while. I remember the run of 1887. Those fish even went up that little stream that runs down through Tuscarora. It dried up completely in the latter part of July, but when it was high in the spring, the salmon could go up. Old Jess Snyder went out with a pitch fork one day and right down under the bridge, he saw one spawning. He just put the pitch fork under it and heaved it on the bank. The fish weighed about 30 pounds.

—Syd Tremewan: Forest Supervisor of the Humboldt National Forest from 1908-1913[1]

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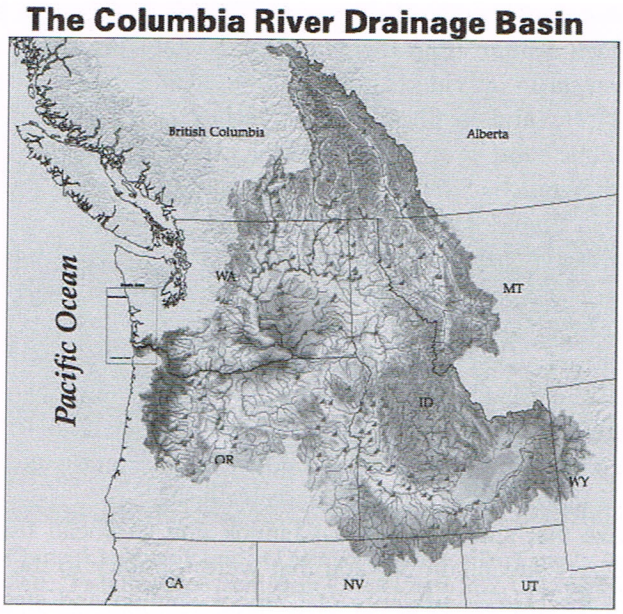


Shaded Relief of the Columbia River Basin. A total of 219 dams are located within the basin, severely altering the stream flow and ecology of the river. Source: www.ecy.wa.gov/programs/sea/swces/products/maps.htm

Introduction

The vast Columbia River, with its basin comprising an area roughly the size of France, is the largest North American river flowing into the Pacific Ocean. The basin extends west from the Continental Divide of the Rocky Mountains, and as far north as southern British Columbia and as far south as northeastern Nevada and northwestern Utah. Historically, but to a much lesser extent today, the Columbia River basin produced an estimated 10-16 million adult salmon and steelhead annually.[2]

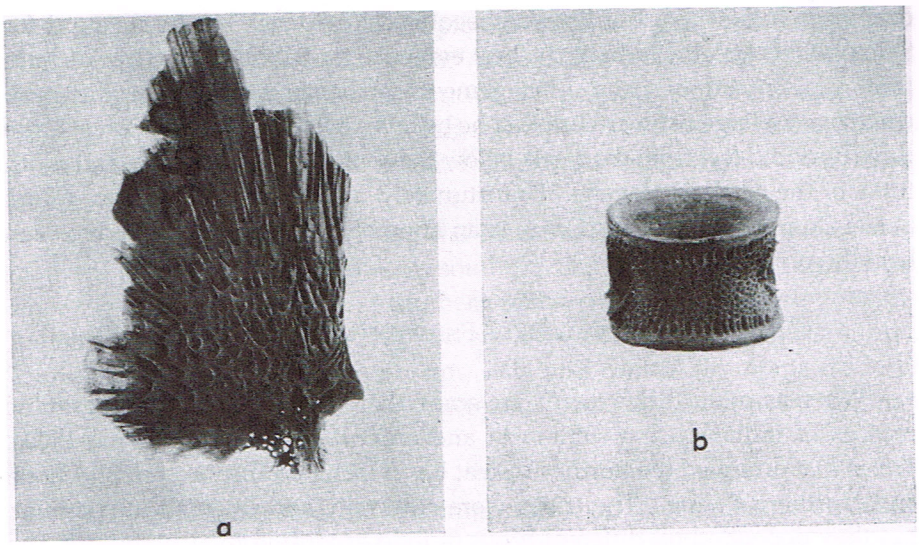
The natural ecology of the Columbia River has been severely altered since the Euro-Americans arrived in the 1850s and began mining, logging, ranching, farming, and developing hydroelectric power. Perhaps the most noticeable change has been the construction of dams and their reservoirs since the late nineteenth century. By 1975, a total of 211 hydroelectric dams, 83 of them classified as multipurpose, had been constructed in the Columbia River Basin (including tributary streams).[3] In addition, thousands of unlisted smaller dams have been installed for municipal, industrial, irrigation, livestock, and rural uses.[4]

While some dams contain fish-passage facilities, others are barriers and completely block salmon from their historic habitat. Prior to the 1850s, the Columbia River Basin provided approximately 14,666 stream miles of salmon (*Oncorhynchus spp.*) and steelhead (*Oncorhynchus mykiss*) habitat. Because of impassable dams, salmon are now blocked from 31percent of their historic habitat, including much of the drainage of the Snake River, the largest tributary of the Columbia River.[5] Historically, the mainstem Snake River above Hells Canyon provided important spawning grounds for fall Chinook salmon (*Oncorhynchus tshawytscha*), while the tributaries between Hells Canyon and Shoshone Falls provided spawning habitat for spring/summer Chinook and steelhead. Of the anadromous fish historically produced in the Columbia River Basin, 50 percent of fall Chinook, 88 percent of spring/summer Chinook, and 28 percent of steelhead were produced upstream of the Hells Canyon Dam Complex.[6] Unfortunately, three Hells Canyon dams completed around 1967 made this area inaccessible to salmon and steelhead.

Few realize that spring/summer Chinook and steelhead used to spawn in the high desert streams in Nevada that were tributary to the Snake River. We document the historic presence of Chinook salmon and steelhead in the Nevada portions of the Owyhee, Bruneau, Jarbidge, and Salmon Falls Creek drainages by reviewing archaeological and ethnographic records from Indian tribes within the Great Basin, newspaper clippings from the late nineteenth and early twentieth centuries, and oral histories of early settlers. Our contention is that these anadromous fishes were at one time economically, ecologically, and culturally significant to northeastern Nevada and its inhabitants. We hope to raise awareness of these largely forgotten desert fishes that migrated from the Pacific Ocean to headwaters of the Snake River system and to understand the reasons for their local extinction, which might in turn help inform future restoration efforts.

PREHISTORY: EARLY RECORDS FOR USE OF ANADROMOUS FISHES BY INDIANS

Archaeological findings in southern Idaho, eastern Oregon, and northeastern Nevada demonstrate that prehistoric Indians used salmon. Archaeological evidence is rare, however, in part because salmon fossils are fragile and perishable.[7] Nonetheless, evidence dating from the archaic archaeological period, 7,800-220 Y.B.P. (years before present), provides a record of salmon and steelhead ascending into Nevada or into adjacent portions of Idaho and Oregon downstream of Nevada. Although uncommon, some fossils have been discovered at sites used by prehistoric Indians who occupied the Snake River Plain since about 14,500 Y.B.P.[8] Many of the sites discovered have been along the banks of the Snake River between Hells Canyon and Shoshone Falls and include Clover Creek, Three Island Crossing, Givens Hot Springs, Nahas Cave, the Bliss site, Cave no. 1, Pence-Duerig Cave, and Deer Creek Cave.[9]



Remains from Chinook salmon found at Deer Creek Cave, Elko County, Nevada. Source: W.I. Follett. "Fish Remains from Deer Creek Cave, Elko County, Nevada," Nevada State Museum Anthropological Papers, No. 11 (Carson City, 1963), 32.

The Western Shoshone and Northern Paiute ancestors were hunters and gatherers and established a settlement pattern described as "a dual central base pattern in which there were established major winter camps and closely spaced spring-summer and fall camps of shorter duration all within relatively restricted geographic areas."[10] Nahas Cave was a spring camp located on Pole Creek in southwestern Idaho and, according to radiocarbon dates, was used over the last 6,000 years. Remains of three individual steelhead dating from 4,990 to 2,920 Y.B.P. suggest that these early peoples used Nahas Cave during March or April when steelhead migrated up the Snake River and its tributaries.[11]

Deer Creek Cave is another important site located at the confluence of Deer Creek and the Jarbidge River, four miles north of Jarbidge, Nevada, and four miles south of the Idaho border.[12] Archeological evidence from Deer Creek Cave suggests that it was occupied between 10,000 Y.B.P. and during the Proto-Historic period (300-220 Y.B.P.). The cave was used for hunting, and, while the artifacts found primarily consist of mountain sheep, marmot, and porcupine, remains of two Chinook salmon were also found, one of which was about twenty-eight inches in length and an estimated eight pounds in weight.[13,14] Evidence from Nahas Cave and Deer Creek Cave supports the hypothesis that salmon and steelhead spawned in the Owyhee, Bruneau, and Jarbidge

drainages in Nevada, but little archaeological evidence has been found for Salmon Falls Creek. Perhaps the best evidence for Salmon Falls Creek comes from the Bureau of Land Managements archeologist Tim Murphy, who discovered a large fish vertebra that he believes belonged to a salmon at a site three hundred feet from the creek, below the confluence of the north and south forks of the creek in Nevada. Unfortunately, archaeological evidence found at sites along Salmon Falls Creek is an anomaly since many sites have been heavily raided.[15]

EARLY 1800S: ANADROMOUS FISHERIES AND INDIAN CULTURES

Whereas prehistoric records are scant, there are numerous ethnographic records of Indians using salmon in and around Nevada during the 1800s. Tribes that occupied the northern Great Basin included the Western Shoshone and Northern Paiute. The tribes were culturally and linguistically similar, but they depended on different types of food according to availability.[16] The food they ate differentiated bands within a tribe. For example, bands of the Western Shoshone who lived along the Snake River were called Koa'aga'i, or "the salmon eaters," suggesting that salmon were an important food.[17] These salmon eaters also referred to themselves using a hand motion that appeared to signify a snake (resulting in the Shoshone Indians being called Snakes) but which actually referred to salmon.[18]

Salmon were such an important resource that Indians often traveled hundreds of miles to gather with other bands during the late spring and early summer when the steelhead and spring/summer Chinook salmon spawned. While Indians of northeastern Nevada more commonly went north to the Snake River to fish, Julian Steward notes that Indians from the Snake River and near the Humboldt River traveled to fish along the South Fork of the Owyhee River, implying that the South Fork of the Owyhee supported an important fishery.[19]

The Shoshone and Paiute used many different fishing techniques, including a large array of gear such as fish hooks, bi-pointed and barbed spears, harpoons with detachable composite points, dip nets, lifting nets, seine nets equipped with floats, weirs, and basket traps, as well as fixed platforms to provide access to the best fishing sites. Their fish-processing equipment included drying racks, split roasting sticks, fish skin bags, deep bowl mortars, cache pits and framed storage sheds.[20] Archaeological evidence of this gear was discovered at Shellbach Cave along the Snake River.[21] At another site near Shoshone Falls, the archaeologist Daniel Meatte found two conical baskets that both the Northern Shoshone and Northern Paiute apparently used as fish traps in the Snake River tributaries and in shallower, less turbulent portions of the Snake River mainstem. These baskets were thought to have been constructed in the spring because of the visible flower buds on the willow stems that coincide with the spring Chinook spawning run.[22]

The Shoshone and Paiute employed different gear combinations at important fishing locations. They used natural falls, cascades, and rapids, and other sites with constructed weirs during the peak days of the anadromous fish runs and worked together in large groups for as long as sixteen hours a day to garner enough food to survive. Simpler sites were located along smaller streams.[23]

In Duck Valley, located along the Nevada/Idaho border, Indians used many of the same techniques as in southern Idaho, which is not surprising since the bands in Nevada and southern Idaho often intermingled. Like the Indians of southern Idaho, the Indians of Nevada caught salmon with spears, arrows with small fork-like horn tips, nets and conical fish traps made of willows.[24] The Shoshones also constructed fishhooks as described by Hoffman in 1878:

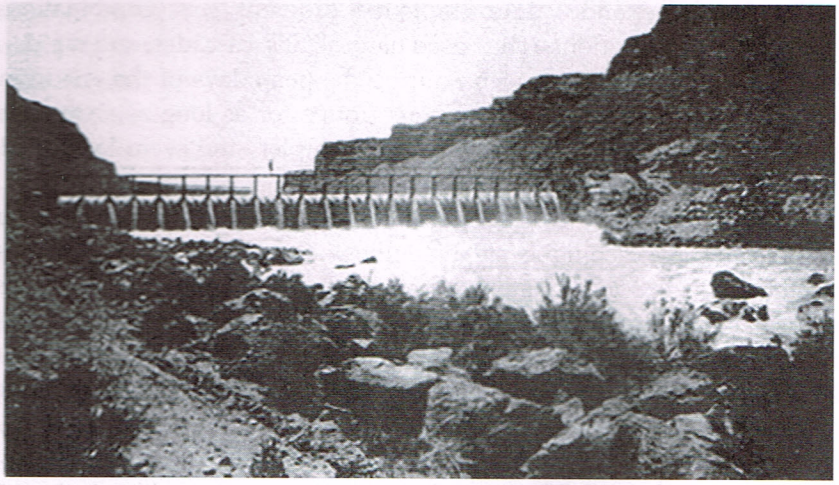
> The Shoshones sometimes manufacture their own fishhooks by taking a splinter of bone and attaching another and smaller piece at one end, at an angle of about 40 degrees, by means of silver threads.[25]

The Duck Valley Shoshone cooked salmon in dugouts and covered them with rocks heated by a fire.[26] They also sun-dried fish on rocks or smoked them to improve taste and protect them against insects.[27]

After Euro-Americans came to Nevada, they negotiated with the Shoshone in 1877 for a reservation at Duck Valley, chosen because of its prolific salmon fishery.[28] According to interviews of tribal fishermen born in the nineteenth century and tribal catch records, the fisheries on the Owyhee and Bruneau rivers combined to produce an estimated six thousand fish, averaging about fifteen pounds each, and yielded an average annual catch of ninety thousand pounds prior to construction of dams impassable to fish.[29] The tribal member John Harney's memories of the salmon runs also denote the Duck Valley's large fishery. In an interview with the author Mike Hanley, Harney said, "When the salmon come, they die in the water.... It smelled so bad you can't ride a horse to the river."[30]

Mid to Late 1800s: Early Euro-Americans and their Fisheries

For a long time the Rocky Mountains and the harsh climate of the Great Basin discouraged occupation by Euro-Americans. The first contact the Shoshone and Paiute had with Euro-Americans was in the 1820s when fur trappers explored the land for beavers.[31] However, not until the second half of the nineteenth century did Euro-Americans fully settle in northeastern Nevada. The 1860s saw a period of gold speculation and discovery, followed by longer-term settlement activities of ranching, logging, and farming.



Dam on the Lower Bruneau River built at the turn of the twentieth century. Source: Adelaide Hawes, Valley of Tall Grass (Caldwell: Caxton Printers, Ltd., 1975), 144.

While these activities would ultimately lead to the extirpation of salmon, the Euro-American settlers provided numerous records that help define the salmon's geographic distribution, economic and cultural significance, and the approximate time the salmon runs began to decline.

Geographic Distribution of Salmon

Some of the most valuable sources of information about the geographic distribution of anadromous fish runs in Nevada were documented in oral histories of nineteenth century Euro-American settlers and newspaper accounts from population centers in northeastern Nevada. Robert McQuivey, a retired fisheries biologist from the Nevada Department of Wildlife, reviewed newspapers published in Tuscarora and Elko from 1869 to 1900 and found hundreds of references to salmon in the headwaters of the South Fork of the Owyhee and mainstem Owyhee rivers; however, most references mention neither the Bruneau or Jarbidge rivers nor Salmon Falls Creek.[32] This, McQuivey says, is probably because Rowland, Jarbidge, and Contact, the small historic towns surrounding the Bruneau and Jarbidge rivers, and Salmon Falls Creek did not have local newspapers as did Tuscarora and Elko.

Fishery reports, other oral histories from settlers in northeastern Nevada, and newspapers from Ruby City and Silver City in Idaho, help to minimize this

distribution gap.[33] One of the most informative references was the 1894 report by Charles Gilbert and B.W. Evermann for the United States Fish Commission that documented salmon distribution in the Columbia River Basin. According to Gilbert and Evermann, J.L. Fuller had seen salmon spawning in the Bruneau River's headwaters, and others well acquainted with the river verified him.[34] Hugh Martin, also well acquainted with the Bruneau, remembered that "salmon and steelhead were plentiful in the Bruneau River and its tributaries prior to construction of the Swan Falls Dam on the Snake River in 1901."[35]

Gilbert and Evermann's report was again helpful in referencing Salmon Falls Creek. Fuller had also seen salmon in the lower two or three miles of the Salmon Falls Creek but did not know how far the salmon ascended the river.[36] We infer that salmon ascended into Nevada because of available upstream habitat. This is supported by Walt Gilmer, resident of the Gilmer Ranch in Contact, Nevada, who remembered as a child catching salmon with a pitchfork in Salmon Falls Creek.[37]

Based on newspaper reports, oral histories, and the scientific reports by Gilbert and Evermann and by Ira La Rivers, we can assume that the salmon and steelhead spawned in the headwaters of the Owyhee, Bruneau, Jarbidge and Salmon Falls Creek drainages.

Salmon's Economic and Cultural Impact

Salmon were a significant part of northeastern Nevada's economy in the late nineteenth century, particularly for the Indians. Before the reservation was established in Duck Valley, the Indians tried to adapt to some of the settlers' ways of life such as farming and ranching, but they still relied heavily on salmon, as described in 1870 in the Elko *Independent*:

> INDEPENDENCE VALLEY, TUSCARORA AND BULL RUN DISTRICTS.... Wild game of nearly every species roam at large, and salmon from the Columbia literally dam up the streams, affording subsistence for thousands of Indians...[38,39]

Indians also played a large role in the Elko and Tuscarora fish markets. Using their knowledge of good fisheries and their fishing expertise, Indians brought countless salmon into nearby towns to sell: *The Tuscarora Times-Review* reported, "Salmon are quite plentiful, being hawked about town by Indians."[40] According to the *Times-Review*, the Indians frequently came into town during spring with salmon from the Owyhee and its tributaries,[41] and their arrival often caught the attention of local newspapermen: As the Elko *Independent* reported in 1873, "An Indian brought in a wagon load of salmon trout from the Owyhee on Tuesday, and retailed them out at ten cents per pound."[42] Another report in Winnemucca's *Silver State* in 1878 marveled at the size and weight of fish the Indians brought:

> A LARGE FISH – The TIMES-REVIEW notes the arrival of an Indian in Tuscarora with a salmon trout, three feet eight inches in length, and weighing eighteen and a half pounds.... Such whales are only found in the tributaries of the Owyhee.[43]

While the fish market clearly furnished the Indians with food and capital, it also was an economic resource for settlers in Elko County. Numerous newspaper reports describe fish brought into Elko and Tuscarora to be sold at restaurants. One account noted, "Charlie Wood getting his spear in readiness this forenoon. [We] infer that he will serve his customers with salmon for breakfast."[44] The ability to feast on fresh salmon was an attractive feature of Elko County. In fact, the *Silver State* reported, the idea of rusticating in northern Nevada while indulging in fresh salmon even appealed to the governor of Nevada:

> ON THE OWYHEE – Governor Bradley, who has left the cares of the State and the Capital for a little recreation in the mountains, is contemplating the beauties of nature and feasting on fine salmon on the headwaters of the Owyhee near Cornucopia.[45]

Clearly, the bucolic way of life in Elko County was alluring, and the unique ability to see, catch, and eat salmon from the ocean enhanced Elko's charm. Fresh salmon had marketable value and served as a local tourist attraction.

Similar to their economic importance, the salmon were also valued culturally. The Nevada salmon, today only a distant memory were once part of seasonal recreation for locals. Each spring, ranchers, farmers, miners, and Indians eagerly awaited the first salmon runs. For example, in 1890 the *Tuscarora Times-Review* reported, "Our local sportsmen are getting out and sharpening up their fish-gigs preparatory to a general onslaught on the salmon when they make their appearance in the Owyhee in Independence Valley."[46] Upon the salmon's arrival, fishing parties departed to test their luck. These fishing excursions made lasting memories. For instance, Ed Strickland, resident of Diamond A, Nevada, in 1925 remembered steelhead fishing on the Jarbidge as a boy:

> When I was growing up there on the Diamond A, I would sometimes go with my uncle, Albert Tayler, fishing down on the Jarbidge River. We'd take our saddle horses, along with four packhorses and spend two weeks fishing for steelhead. There were a lot of big steelhead in the Jarbidge at the time.[47]

By the early 1900s, however, the ability to catch steelhead in the Jarbidge was rapidly disappearing.[48]

The unique ability to catch salmon from the Pacific Ocean became a source of pride for settlers in northeastern Nevada. For example, in 1882, the *Tuscarora Times-Review* reported:

> Referring to the distribution of fish throughout the State by the Fish Commissioner, the SILVER STATE says: The Tuscarora people ought not to complain because the streams in other parts of the State are given the preference over the Owyhee and its tributaries. That stream is the only one in the State of Nevada that has an outlet to the Sea, and Tuscarorans are the only people in the State who can go before breakfast and catch a twenty-pound salmon right from the ocean.[49]

This statement is not entirely true since the Bruneau, Jarbidge, and Salmon Falls Creek also had outlets to the ocean. Still, it demonstrates the Tuscarorans' satisfaction that they were among the only settlers in Nevada to have salmon. Their feasting on a twenty-pound salmon for breakfast, however, stirred envy in other parts of Nevada. For example, one newspaper account relayed the suggestion to plant the salmon of Owyhee in the Truckee River. That report continued, "Though they would have no ocean into which to descend, they could run down into Pyramid Lake and would probably never find out the difference."[50] Another report proposed connecting the Owyhee River and the North Fork of the Humboldt River. In 1869, the Elko *Independent* reported:

> HUMBOLDT AND OWYHEE – Prospectors who have recently explored the country bordering on the South Fork of the Owyhee, inform us that the waters of the North Fork Humboldt could be diverted from their present course into the Owyhee at a mere trifling expense. Such being the case, it renders it not only possible but probable that some of the waters of the Humboldt river may yet find their way by open outlet to the Pacific ocean, and that epicures living on the banks of the Humboldt may be enabled in the future to feast on salmon caught in its waters, as the waters of the Owyhee are well stocked at certain seasons of the year with these fish which penetrate to its very source in the spawning season. Let us open communication between the streams and supply our tables with Humboldt salmon.[51]

While the propositions are far-fetched, they are important examples because they demonstrate the cultural value the settlers bestowed on salmon.

The Decline of Salmon

Salmon runs that, according to the Elko *Independent* in 1870, "dammed up the streams" in Nevada, started to dwindle around 1900.[52] By 1899, settlers were noticing the difference in run size and reported in the *Tuscarora Times-Review* that the dams and traps downstream of the South Fork of the Owyhee River prevented many fish from ascending into Nevada.[53] Again, in 1900, the *Times-Review* reported:

> ...These fish used to ascend the creeks around here in swarms, but the cannery traps and dams between here and the ocean have almost completely stopped the runs, and a salmon is now almost a curiosity.[54]

While Nevada settlers noticed the declines in 1900, the United States Fish Commission had already expressed concern about the decline of salmon at the Columbia River's headwaters. The commission ordered a study that documented the abundance, distribution, and spawning habits of salmon in the Columbia River Basin and addressed the reasons for the decline of salmon runs. The 1894 report stated:

> There is no reason to doubt—indeed, that fact is beyond question—that the number of salmon now reaching the head waters of streams in the Columbia River basin is insignificant in comparison with the number which some years ago annually visited and spawned in these waters.[55]

The Fish Commission report blamed the commercial fisheries at the mouth of the Columbia, but the decline of salmon was probably a consequence of the many economic activities undertaken in the basin by that time, including fur trapping, mining, ranching, and agricultural development.[56]

The sheer resilience that salmon have shown over millions of years of environmental change makes one question why these species that have adapted to survive in climates ranging from rain forests to deserts are now on the verge of extinction. For millennia, anadromy was the salmon's greatest strength. Exploiting the rich ocean food resources, the migratory salmon were larger at maturity, allowing them to fight harder through falls and strong currents and carry more eggs to distant spawning grounds, thereby increasing their geographic distribution throughout the Northwest.[57] Returning adult salmon also brought large quantities of nutrients and minerals from the ocean into low-productivity headwater streams, which created more robust ecosystems that benefited a wide range of species and enabled their offspring to thrive.[58] Unfortunately, as Jim Lichatowich noted, this migratory lifestyle also made salmon more susceptible to land-use changes caused by humans:

> Their ubiquitous distribution brings them into contact with a wide range of human economic activities: mining and timber cutting in the headwaters; grazing, irrigation and other agricultural operations farther downstream; industrial and residential development in the lower river reaches and the estuary; and large scale commercial fishing in the ocean.[59]

These economic activities are the reasons for the salmon's decline, which started with the coming of the Euro-Americans during the early nineteenth century and continues today.[60] The Euro-Americans brought their cattle,

Hydraulic hoses at Gold Creek Mine. Source: Stanley W. Paher, *Nevada Ghost Towns and Mining Camps* (Berkeley: Howell North Books, 1970), 211.

plows, seeds, and axes, but, more importantly, they brought their belief that resources were there for the taking and that their supply was inexhaustible.

Beginning as early as 1820, there was a strong demand for beaver to be made into the "high hats" that symbolized high social status. During this era, British fur trappers of Hudson's Bay Company had a monopoly on the fur trade in the Columbia River Basin, and fear of losing this control drove the company to intentionally exterminate beaver from much of the Pacific Northwest.[61] Between 1826 and 1834, trappers in the Pacific Northwest killed an average of three thousand beavers per year, and by 1900, the beaver was nearly extinct throughout much of the country, including areas in northeastern Nevada.[62]

Discovery of gold in California in 1849 spurred a large influx of miners and prospectors who fixated on finding precious metals throughout the western United States and triggered a strong market for the miners' support systems, such as logging, ranching, and agriculture. In Nevada, gold discoveries in the Reese River District in 1862 catalyzed the mining boom in northeastern Nevada.[63] Most mining in the nineteenth century was placer mining, which used water to separate the denser gold or silver from alluvial deposits and, unfortunately for the salmon, damaged their spawning and rearing habitat by depositing substantial quantities of fine sediment and mercury into streams. Once the surface minerals were extracted, placer miners often used hydraulic hoses to wash mountainsides into the river, which caused stream siltation and the loss of riparian habitat.[64]

TABLE 1.
Characteristics of Mainstem Dams on the Columbia and Snake Rivers

Dams	*Year Started*	*Year Completed*	*Distance From Ocean (km)*
Columbia River			
Bonneville	1933	1938	233
The Dalles	1953	1957	307
John Day	1958	1968	348
McNary	1947	1954	470
Priest Rapids	1956	1959	639
Wanapum	1959	1963	668
Rock Island	1930	1933	729
Rocky Reach	1956	1961	763
Wells	1963	1967	832
Chief Joseph*	1950	1955	877
Grand Coulee*	1934	1941	961
Snake River			
Ice Harbor	1957	1961	538
Lower Monumental	1962	1969	589
Little Goose	1963	1970	636
Lower Granite	1965	1973	716
Hells Canyon*	1961	1967	919
Oxbow	1958	1961	961
Brownlee	1955	1958	980
Swan Falls	1906	1910	1,255
C.J. Strike	1950	1952	1,313
Bliss	1948	1949	1,423
Lower Salmon	1910	1910	1,444

*Blocks anadromous fish.
Source: National Research Council, *Upstream: Salmon and Society in the Pacific Northwest* (Washington, D.C.: National Academy Press, 1996), 61.

Farming and ranching brought additional problems for the salmon. Livestock grazing in riparian zones trampled much of the streamside vegetation, which led to erosion and increased stream temperatures.[65] Meanwhile, the irrigation canals built for agriculture took water and juvenile salmon from the streams and diverted them into fields. Adding to the impact was the loss of the beaver ponds, which reduced the upstream rearing habitat for juvenile salmon and steelhead.[66]

Downstream, salmon faced other obstacles, particularly hydroelectric dams. Dams flood important spawning habitats and create problems for migrating fish, including juvenile fish swimming downstream. First, the juveniles must find their way through slack-water reservoirs created by the dams. With slower stream flows, juvenile salmon migrating downstream often become disoriented, causing them to spend more time traveling to the ocean. This has energetic consequences and increases their exposure to non-native fish predators that reside in the reservoirs.[67] Second, juveniles must pass through the dam. To increase survival, dam operators transport juveniles around dams by truck or barge, spill fish over the tops of dams, and have developed turbines that lower mortality rates for fish that pass through the them.[68] While these actions help the fish directly survive dams, salmon that do pass through or around dams are still at risk and suffer delayed mortality downstream. Many fish that successfully pass through dams are stunned and sluggish, making them easy targets for birds and piscivorous fishes.[69] In addition, the accumulated stress from the reservoirs and dams leads to decreased swimming performance, disease resistance, foraging ability, growth, reproductive success, and, ultimately, survival.[70] Juvenile salmon that are barged or trucked around dams suffer increased stress and reduced homing abilities when they return as adults.[71]

Currently, a series of large dams, which began in the 1930s with the Grand Coulee and Bonneville dams, hinders mainstem passage on the Columbia and Snake Rivers.[72] By 1973, twenty-two dams had been constructed on the mainstem of the Columbia and Snake rivers. Acknowledging the impact of dams on fish, the United States Congress in 1976 authorized the Lower Snake River Compensation Plan (LSRCP), which called for hatcheries to mitigate the loss to the Lower Snake River dams of 48 percent of the Chinook salmon and steelhead. Unfortunately, this program has not met target returns, and the presence of large numbers of artificially produced fish has caused unexpected disease and domestication problems. A 1998 status review of the LSRCP program found low smolt-to-adult survival rates and projected that natural populations would go extinct between 2025 and 2050 if mainstem passage conditions and spawning and rearing habitat were not substantially improved.[73]

A Possible Salmon Future

Most salmon and steelhead populations south of the Canadian border are currently at risk of extinction. To date, salmon have disappeared from

40 percent of their historic breeding ranges in Washington, Oregon, Idaho, and California.[74] Of the remaining populations, many are listed as endangered or threatened, demonstrating the ongoing nature of the many threats they face.[75] Many fishery scientists believe that the Snake River salmon's best hope for survival is through the breaching of the lower four Snake River dams (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams). This would ease fish passage, restore a more natural flow regime to aid both upstream and downstream migration, remove reservoir habitat that delays outmigration and favors non-native predatory fishes, and create shoreline habitat for juvenile rearing and feeding.[76] In 1998, the Idaho Department of Fish and Game called breaching the dams and restoring natural river conditions "the best biological choice for recovering salmon and steelhead in Idaho."[77] Conservationists also are hopeful that the ongoing relicensing of the Hells Canyon dams will result in Idaho Power providing fish passage around the dams and restoring habitat above the dams.[78] Breaching the lower Snake River dams and mandating fish passage and habitat improvement above Hells Canyon would increase the possibility of salmon and steelhead returning to Nevada streams.

Historically, salmon were an important part of Nevada's economy, ecology, and culture, and economy. They were a source of subsistence for the Indians and a source of excitement as well as food for Nevada's early settlers. Contemplating the eighteen-hundred-mile journey that salmon made annually to spawn in Nevada, it is easy to marvel at the persistence and resilience of these high-desert fish. Unfortunately, our actions over the last two centuries have seldom considered the requirements of these fish. Thinking only of our immediate economic gains, we have failed to acknowledge the natural limits of the ecosystems.

The question now before us is whether we can conduct our economic pursuits in ways that are compatible with the requirements of salmon and steelhead. Clearly, it is possible to manage farms and ranches in ways that improve water quality and protect riparian habitats.[79] Providing fish passage around some existing dams is needed but the cumulative extent of mortality to migrating adults and juvenile fish suggests that some dams may need to be substantially modified or removed in order to restore salmon to Nevada.

Removing the lower four Snake River dams, which has been described as an essential recovery action for remaining Idaho salmon, also might improve local economies.[80] While there are no studies on the economic impact of restored salmon and steelhead fisheries in Nevada, we can infer the economic benefits based on the results of a similar study done in Idaho.[81] The study found that a restored salmon and steelhead fishery in Idaho could bring $544 million annually to the state: $196 million in direct expenditures (out-of-pocket spending by anglers) and $348 million in indirect expenditures (the total economic impact of angler spending in a community). Furthermore, this study also found that the economic contribution of the restored salmon and steelhead fishery reaches areas outside of the riverside communities. This is an important finding since many of the Nevada river communities near the tributaries occupy a very small percentage of the state's land.

Conclusion

It has been approximately a hundred years since the last native salmon swam Nevada streams, yet they have not completely disappeared from the Snake River. According to University of Washington professor David Montgomery, salmon are "like weeds colonizing a vacant lot."[82] They are extremely resilient fishes; still, we have tested their limits. Restoring salmon to Nevada requires at least four actions:

- Significantly modify or breach the lower four Snake River dams.
- Provide upstream and downstream fish passage at the Hells Canyon Dam Complex.
- Improve fish passage and water quality along the Snake River in southern Idaho.
- Restore spawning habitat in Nevada tributaries to the Snake River.

Passage to only one of three river systems—the Owyhee, Bruneau, or Salmon Falls Creek—need to be restored to potentially bring salmon back to Nevada. From our present perspective in the twenty-first century, it is hard to imagine that salmon ever spawned in Nevada streams, but the anomalous situation is that Nevada is without salmon. Perhaps one day these fish again can inspire Nevada residents and reconnect them to the broader Columbia River Basin.

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[44]*Tuscarora Times-Review* (19 May 1883).

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[48]The ability of steelhead to ascend the Jarbidge was already being restricted in the early 1900s. Swan Falls Dam was constructed on the Snake River downstream of the confluence of the Snake and Jarbidge rivers in 1901 and blocked upstream passage; however, some steelhead were able to pass Swan Falls Dam in the spring until C.J. Strike Reservoir was built in 1950. Also, a dam was built on the lower Bruneau River in 1887. This dam would have blocked anadromous fish passage into the Jarbidge River; however, the dam was washed out and rebuilt several times, in 1892, 1910, 1936 (partially) and 1948. Perhaps some steelhead were able to make it past this dam during construction or else migrated up the stream early enough to pass through the dam.

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