# Snake River Fall Chinook

## A Primer: 1900-1975

Mark Schuck – Washington Department of Fish and Wildlife.

**Acknowledgements and note to the reader.**

The majority of the structure of the presentation was developed by Dr. Billy Connor (USFWS) and through extensive history research by Jim Chandler (Idaho Power Company). Additional insights and historical perspective were provided by several persons from numerous agencies involved with fall Chinook management {Stuart Rosenberger, IPC - GIS Division, Jay Hesse (NPT), Pete Hassemer (IDFG), and several other biologist and researchers that indirectly provided data for slides}. It was my privilege to assemble that information into this presentation. While some of the content from slides in the original presentation provided to the ISRP and attendees on August 6, 2013 will be included in this narrative and slide references are provided in the text that follows, I suggest the best approach to reviewing the history is to read this in concert with the slide presentation, available on the LSRCP website at: http://www.fws.gov/lsnakecomplan/

The purposes of this overview are:

- Provide a history of the near demise of Snake Fall Chinook
- Review the actions that resulted in the need for, and authorization of, the LSRCP in 1975
- Put everyone on the same plane so that they better understand fall Chinook history
- Provide context to better evaluate the success or failure of the LSRCP fall Chinook program, because: We can't know where we are going if we don't know where we've been.

**Introduction**

Chinook are a cultural icon of the Pacific Northwest. King, Tyee or Chinook, the terms convey the aura of big hard fighting fish of the most splendid flavor. They are of legendary size and adaptability, adopting spring, summer and fall life history variants that allowed them to inhabit widely variable ecosystems. Also, the Columbia River was legendary for its historical abundance that has sustained tribal cultures for centuries. The fall run species, termed upriver brights in the upper Columbia and Snake River were also large mainstem spawners, adapted to utilize deep, swift water. The Snake was historically a large producer of fall bright Chinook.

But as is so common in the Northwest, the degree of decline of the once vast populations is legendary as well. Subjected to a litany of abuses across the four H's: Harvest, habitat, hydro and hatcheries, the Snake River Chinook began declining by the late 1800's. We discuss the history of events that contributed across the decades and also briefly examine the possible confounding effects of ocean conditions and productivity, only recently better understood.

**Historical distribution**

Real knowledge of the distribution and abundance is not available for the pre-European settlement period but speculation based on oral histories and more recent investigations suggest a distribution as shown in figure 1.

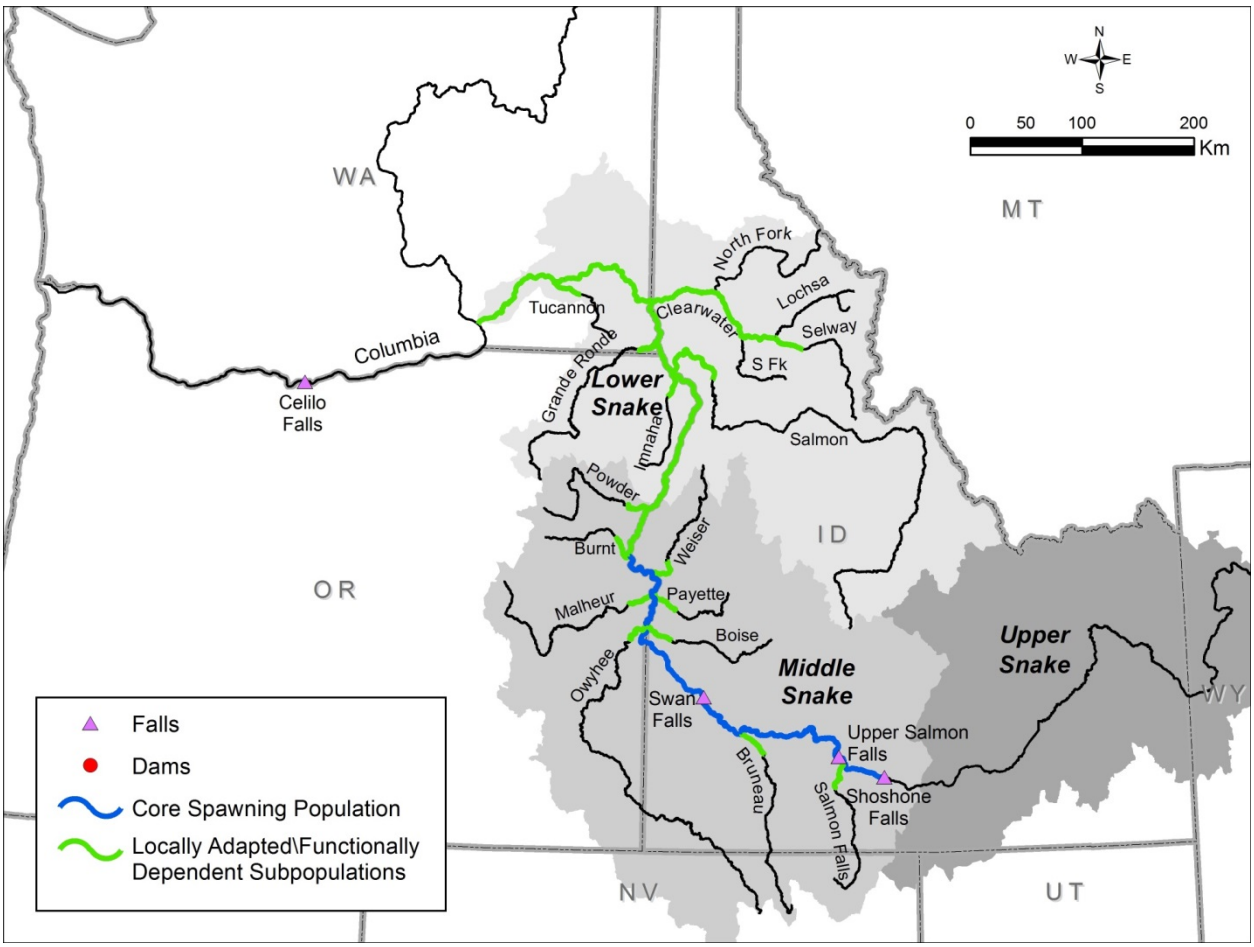


Figure 1. Possible historic distribution of habitat utilized by Snake fall Chinook salmon (slide 6)

The core habitat for the population was believed to extend from the upper reach of Hells Canyon to Shoshone Falls where anadramous fish passage ceased. The reach was characterized by broad expanses of spawning and rearing areas and was fed by abundant tributary streams and large spring water reaches across the Snake River plain (slides 7, 8 and 9). Although not provable, the lower reaches of the Snake and tributaries were believed to support small locally adapted or functionally dependent subpopulations.

As previously mentioned, estimates of abundance are somewhat speculative and those that have been attempted rely on inferences based in early explorations (Fremont 1843; Gilbert and Evermann 1894) or commercial landings from lower Columbia fisheries. Fremont remarked on the 1,000's of salmon jumping at a falls in the upper Snake in the fall and termed it the "fishing

falls (possibly lower Salmon Falls, slide 9). Although not accurate for estimating actual abundance of an individual population, commercial landings of Chinook from lower Columbia fisheries between 1870 and 1900 averaged nearly 27 million pounds. Using 15 and 25 pounds as lower and upper average sizes for Chinook for that era suggests that between 1.1 and 1.8 million Chinook were harvested annually during that period. It is reasonable to assume that Snake River fish contributed to these extensive fisheries and were being significantly affected by such enormous harvests. Regardless, by the turn of the 20th century, the early seeds of commercial harvest in the Snake River had been planted to provide local supplies of abundant fish to the increasing numbers of immigrants to the region.

High harvest rates continued into the early 20th century with average annual landings decreasing only slightly to around 24 million pounds annually. This extraction continued through the middle 1930's with between 1 and 1.6 million Chinook taken each year. This corresponded with an upsurge in abundance during 1915-1919, when an estimate of Snake fall Chinook abundance placed 1.25 million fish at the Columbia River mouth and 460,000 escaping fisheries into the Snake (Chapman 1986). Despite such estimated abundance, this likely did very little other than encourage the local fishers that fish numbers were unlimited and as the population of the Snake River plain expanded, so did demand for the fish to feed a hungry populace.

**Other pressures come to bear.**

While harvest continued unabated, the demands for water and impacts on habitat from other activities accelerated as the 20th century unfolded. Immigrants set up farms and found that the fertile valleys of Oregon and Idaho produced abundantly with the application of water. Small and large diversions of water from the untapped rivers where salmon and steelhead spawned and reared began reducing tributary flows. And as the population grew and more land came under the plow, more water was required. Construction of irrigation dams on tributary rivers were more effective at water removal but often blocked access to these reaches for anadromous fish. By the 1930's, there was friction between irrigators and fishers for how best to use available waters. Advocates for the fish wanted the abundance to continue to support their lucrative fishing businesses, while farmers needed water for crops. A representative from Washington D.C. was sent to investigate and in a letter to the Commissioner of Fisheries, suggested there was not a strong case to deny or remove water from farms to support fisheries (slide 13).

Like in other regions of the west, the search for gold was universal and unbridled by concerns about the extraction methods used. Hydraulic and floating dredge mining devastated large reaches of the landscape (slide 14), often leaving behind unrecognizable gravel piles rather than habitat capable of supporting fish populations. Direct and indirect effects, such as sediment smothering of habitat downstream of dredging operations certainly degraded habitat. Similar effects resulted from expanded timber harvest to provide materials for homes and cities (slide 15). And finally with the desire to be in the new century, hydroelectric dams were destined to grace the region. Swan Falls Dam was completed in early 1901 and was situated in the middle

of core Chinook habitat. Although designed and built with a fish ladder which was rebuilt in 1922, it never worked for Chinook and functionally blocked Chinook from over 250 Km of prime spawning and rearing habitat; 25% of that available to fall Chinook in the Snake basin and about half of the core habitat. A similar event occurred on the Clearwater at Lewiston, ID in 1927 when Lewiston Dam was completed. Again, it was constructed with a fish ladder that did not function for fall Chinook, even after being rebuilt to improve passage in 1939. The dam is credited with extirpating Chinook in the Clearwater by 1939.

Incidental to, but also contributing the impacts on anadromous fish like Snake Chinook, as more dams were built and reservoirs available, the demand for fisheries on new species grew. Immigrants often brought desires for fishes that they had traditionally sought. So by around 1900, channel catfish had been introduced in the Snake basin and by 1930, smallmouth bass were present. The reservoirs were also prime habitat for endemic predators such as Northern pikeminnow, and collectively the predation impacts on salmon and steelhead were certainly greater that historically and not conducive to maintaining strong populations. These factors coupled with continuing harvest began having noticeable effects on population abundance in the Snake River.

**The Early Era of Hatchery Intervention**

In 1901, Oregon appointed a Master Fish Warden to manage interior populations to ensure the continuation of their abundance that supported existing fisheries. Van Dusen was almost immediately concerned with the levels of harvest and early habitat loss and ordered a trial collection of Chinook at Swan Falls Dam to determine if a hatchery effort could be conducted. Fish were netted at Swan Falls and over half a million eggs collected. This success inspired a greater effort with the construction of Ontario Hatchery to enable greater efforts to maintain the fish since the dam blocked so much habitat. The facility was completed by 1902 and capable of incubating 5.5 M eggs in their “hatching house” (slide 24). The entire river was picketed that year (slide23) and enough adults captured to collect nearly 22M eggs. It is unclear why this occurred since the hatchery was not capable of holding them. The approximated 16 M surplus eggs were “planted” in gravel bars close by. Such robbery from the population that could have more effectively planted their own eggs is puzzling.

Such abundance was not to continue. Collection in 1903 was large but by 1904, the number of fish and eggs plummeted (slide 25) and never regained its original abundance. Van Dusen and his hatchery manager had differing opinions about the reasons, with Van Dusen continuing to believe that excessive downriver harvest was to blame, and Manager Brown believing the loss of access to habitat above Swan Falls Dam was the cause. Regardless, the population was greatly reduced and would not regain such abundance for the foreseeable future. And Van Dusen acted on his concerns regarding excessive downriver harvest and vocally opposed the continued use of stationary and floating fish wheels, which he apparently believed were primarily responsible for the over harvest. He was somewhat successful in getting their use banned in Oregon around

Celilo falls about 1908, but they continued to be used throughout the lower Columbia and were not fully banned until around 1934. While it is clear that fish wheels were not solely responsible for dwindling fish numbers, the excessive harvest rates over 60-70 years, sometimes approaching an estimated 80%, greatly reduced spawning escapement into the Snake and other river reaches. And by the time Van Dusen resigned as Master Fish Warden in 1909, his attitude toward hatcheries had cooled substantially and he advocated relying more on natural production to maintain fisheries (slide 29).

**The Dam Construction Era**

As the 20th century progressed immigration and the changes it brought accelerated. More and more tributaries were dammed to facilitate multiple uses of available water, which was more irrigation for diverse crops, from wheat to apples. Although this didn't directly affect fall Chinook, the indirect effect of decreased inflow to the snake and irrigation returns laden with sediments accumulated. The direct effects of dam construction remained from Swan Falls and Lewiston dams, but that was soon to change as Congress, the Corps of Engineers and private electric utilities set about planning a vast network of large hydroelectric projects throughout the Columbia and Snake rivers. About this time Bonneville Dam was completed on the lower Columbia, which allowed direct counts of fish passing into the upper Columbia and its tributaries for the first time. The abundances of species that had only been inferred based on commercial landings were now available for managers to see and contemplate and utilize to evaluate the degree of harvest that was occurring. Interest in Snake River Chinook remained high and although the ability to manage fisheries was low, the data from Bonneville passage counts allows us to retrospectively analyze the impact of commercial and tribal fisheries on their abundance. By the 1940's Snake Fall Chinook were considerably less abundant that what Chapman (1986) derived as their possible abundance during the decade of 1911-1920 (Figure 2). Harvest rates varied widely among years but were around 80% in some years and not below 30% in any of the years shown. Such levels of harvest were hardly sustainable considering the habitat degradation, direct habitat loss and within Snake basin harvest that was yet to be imposed on these estimates.

And the impacts were to become more pronounced as plans for large mainstem dams were completed and the boom period following World War II saw man's desire to harness nature come into sharp focus. By 1955 the first of Idaho Power Company's Hells Canyon Complex (HCC) of three dams, Brownlee, was under construction and was completed by 1958. Although Brownlee (slide 35) did not directly impound more core fall Chinook habitat, it blocked access to the river upstream and since two more dams were planned for construction below the site, it was not fitted with a ladder or permanent trap. Rather to provide passage for fall Chinook, a large electric weir was constructed at its base. Fish were "shocked", collected and transported above the dam and released to spawn naturally. Not surprisingly, such a large electric weir imposed an estimated 10% mortality/injury rate on captured adults. It was used to capture more than 15,000 adults in one year, but around 3,000 was more normal. It was used until 1961 when Oxbow dam was completed.

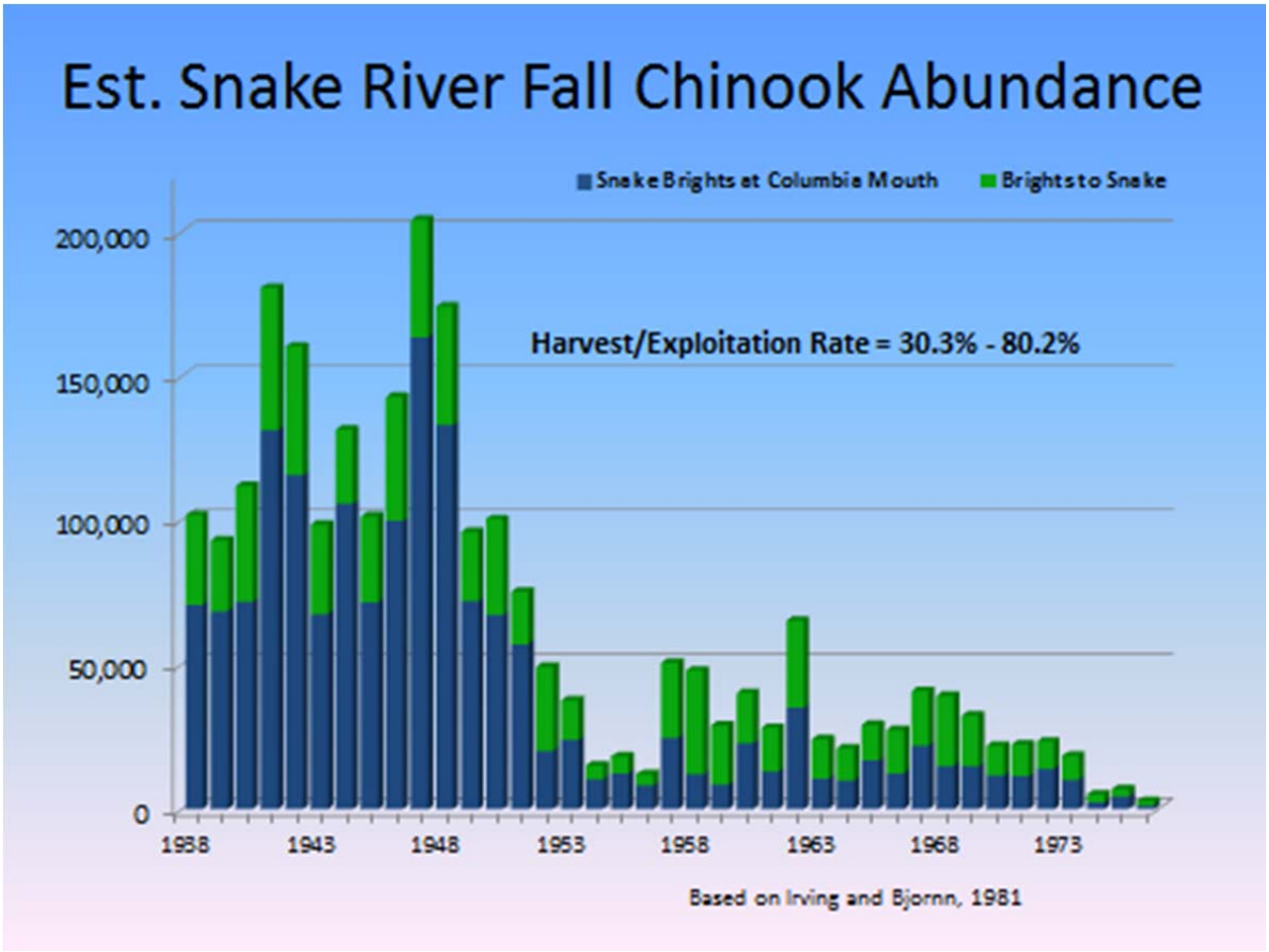


Figure 2. Estimates of Snake River fall Chinook abundance, 1938-1976

The trap at Oxbow was a more traditional trap than the electric weir used at Brownlee, and its ability to capture fish and pass them upstream of the next dam was considered reasonably successful. But adults up was only part of the equation for maintaining the fall Chinook population. The offspring of those adults had to be able to get back through the HCC dams and to facilitate that, IPC constructed a juvenile collection system above Brownlee (slide 38). The device was plagued by poor capture efficiency (est. 0.7 – 14.8%) and in fact estimates of juveniles passing through the turbines of Brownlee far exceeded the number captured and passed by the collection boom.

Moreover, the reservoirs imposed new ecological conditions on the juvenile Chinook and the first yearling life history smolt was documented during evaluation of the collection boom. Snake fall Chinook were considered an ocean type Chinook, emigrating as a sub-yearling smolt, but changes in their environment were clearly eliciting a change in the life history of some. Evaluation of migrant passage and survival brought biologists to conclude that despite reasonable success at passing adults, poor juvenile survival was further depressing the population.

**The Middle Era of Hatchery Intervention**

The conclusion that poor juvenile was contributing to further losses of fall Chinook encouraged managers to once again consider the use of the hatchery tool. An experimental hatchery, Oxbow, was built below Oxbow Dam (slide 41) around 1960. The new facility included an incubation channel. Chinook were trapped and hauled to the hatchery where they were spawned and fertilized eggs were funneled into the substrate of the channel where they were allowed to develop, hatchery, swim up and eventually emigrate as fry from the channel into the Snake River. The hatchery was plagued with problems from the beginning, including high pre-spawning mortality of adults in some years because of warm water temperatures and cold winter water temperatures that retarded of juvenile growth. The hatchery continued its efforts with fall Chinook through the 1960, but adult trapping was moved to the newly completed Hells Canyon Dam in 1967 (slide 43) and 100% of fish trapped were hauled to Oxbow, completely eliminating all natural spawning in the Snake above the HCC in what had been the population's core habitat.

Extreme temperatures, diseases and high dissolved gasses that inflicted gas bubble trauma to fish in the hatchery and in the river continued to plague the Oxbow hatchery effort. Researchers concluded that fish released from the hatchery were considerably smaller with lower condition than they wild counterparts had been 10 years earlier (slides 44 and 45), and believed these were the primary factors to poor survival. Despite ongoing research, smolt quality could not be measurably improved and poor progeny: parent performance (<1.0) eventually led to the abandonment of the program about 1972.

Fall Chinook had now been completely extirpated from their core habitat and were relegated to what habitat remained in the steep reaches of the canyon below the HCC to the tail waters of Ice Harbor Dam (IHD; 1$^{st}$ of the USCOE lower Snake Dams) near the mouth of the Snake River. The once vast spawning reaches of the Idaho plain were cut off and little real knowledge of fall Chinook use in Hells Canyon existed. Further, because of reservoir construction and altered flow regimes in what remained of fall Chinook habitat, temperature profiles and regimes in the canyon and lower Snake were vastly altered from their historical norms. As adaptable as Chinook can be, adjusting their life history to the new temperature norms in such short time frames is an unreasonable expectation. The pressures of dam building had nearly reached their peak with the population being crowded out of habitat from above and below (slides 48 and 49). These pressures sparked efforts to understand where the remaining fall Chinook were spawning and rearing.

**Some additional recovery efforts**

Managers recognized that the number of adults passing IHD exceeded the number ever trapped at the HCC and set about during the 1960's with moderate efforts to understand and describe the habitat being utilized by these fish. At the same time, Idaho undertook an effort in the upper

Selway River (a tributary to the Clearwater) to reintroduce fall Chinook into the Clearwater River, which had once support these great fish.

Between 1960-1968, IDFG obtained eggs from Oxbow Hatchery and funneled them into artificially created incubation channels on the Selway River. Fish were allowed to hatch and swim up out of the gravels and once the majority of swim-up had occurred, fry were either trapped from the lower end of the channel or the channel dike was breached and fry allowed to emigrate into the river. Although well-meaning and successful at producing hatched fry into the river, over the course of the effort only nine adult fall Chinook were documented to have returned to the Clearwater River at Lewiston Dam during that time. Because of the poor success, the effort was abandoned in 1972.

Concurrent with these recovery efforts in the Clearwater, the environmental movement of the 1960's and early 1970's was well established and several organizations were vocal opponents to continuing the rapid expansion of hydroelectric dams and the resulting habitat loss or both aquatic and land based species. Coupled with a desire to preserve the dramatic scenery of Hells Canyon, a concerted effort was brought to bear to designate Hells Canyon a National Park, or at least a National Recreation Area. And efforts to preserve the vestiges of fall Chinook continued as well. Research into how best to operate flows from the HCC to minimize dewatering of redds or flushing of gravels and adults from spawning areas was underway. Simultaneously, an assessment of the impacts of the construction of several more large hydropower dams in the Snake Canyon above the Town of Asotin were being conducted by a multi-organizational team (slide 52). Flow research resulted in recommendations for powerhouse operation to better enable spawning and incubation of fall Chinook: much of which is still implemented today. More importantly, the environmental movement was successful and Congress declared Hells Canyon an National Recreation Area, and any further hydropower development died with that designation. The last best habitat was to be preserved for the fish.

However, while the efforts to protect the canyon raged within Congress, the construction of the final three Lower Snake River dams was well underway toward making Lewiston, Idaho an inland port. By 1975, the four lower Snake dams were complete and the lower river constriction of habitat complete. The area where an estimated 5,000 fall Chinook spawned was now slack water capable of allowing barged from Portland, Oregon steam to Lewiston.

One small bit of good news was the removal of Lewiston Dam on the Clearwater in 1973. The HCC made the old dam obsolete and unrequired. Its removal reopened the Clearwater for access by salmon and steelhead, but whatever unique life histories were once represented by fish using the Clearwater had been completely suppressed for nearly 50 years. The habitats that remained that could be accessed by Snake River fall Chinook were a mere 13% of its original mileage (slides 55 and 56), and none of the original best core habitat was available.

**Pacific Decadal Oscillation – part of the perfect storm on fall Chinook.**

While anthropogenic impacts accumulated over the decades, nature itself took a swing at Columbia basin salmon and steelhead. Scientists trying to better understand the role of ocean conditions and productivity on salmon populations theorize and developed the Pacific Decadal Oscillation (PDO). The PDO describes the interplay between sea surface temperatures and upwelling of nutrient rich deep pacific water that drives primary productivity in the ocean. During periods of strong upwelling (La Niña), ocean productivity and salmon populations tend to survive better and grow bigger. During periods of warm sea surface temperature (El Niño), ocean productivity is suppressed and salmon survival and average size declines because of decreased food availability and increased predator abundance. What the NOAA researchers found utilizing historic ocean data back to 1938 was that good ocean conditions existed for salmon in the period from 1938 to 1947, but that between 1948 and 1975 (slide 57), every year was a negative PDO. This additional stressor of poor ocean productivity was overlain on steadily accumulating impacts of overharvest and habitat degradation for Snake River fall Chinook.

**Summary**

The cumulative effects of habitat degradation and elimination, poorly devised and implemented hatchery programs, altered river ecology that fostered the expansion of native and introduced predators, hydropower development and natural declines in ocean productivity (slides 58 and 59), drove Snake River fall Chinook from possible abundances in excess of 450,000 escaping to the river in 1915, to a mere 2,500 in 1975. There can be little doubt that extreme measures were necessary to preserve the last vestiges of a once great salmon population.