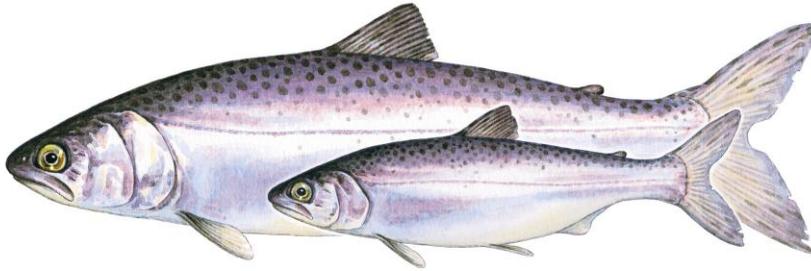
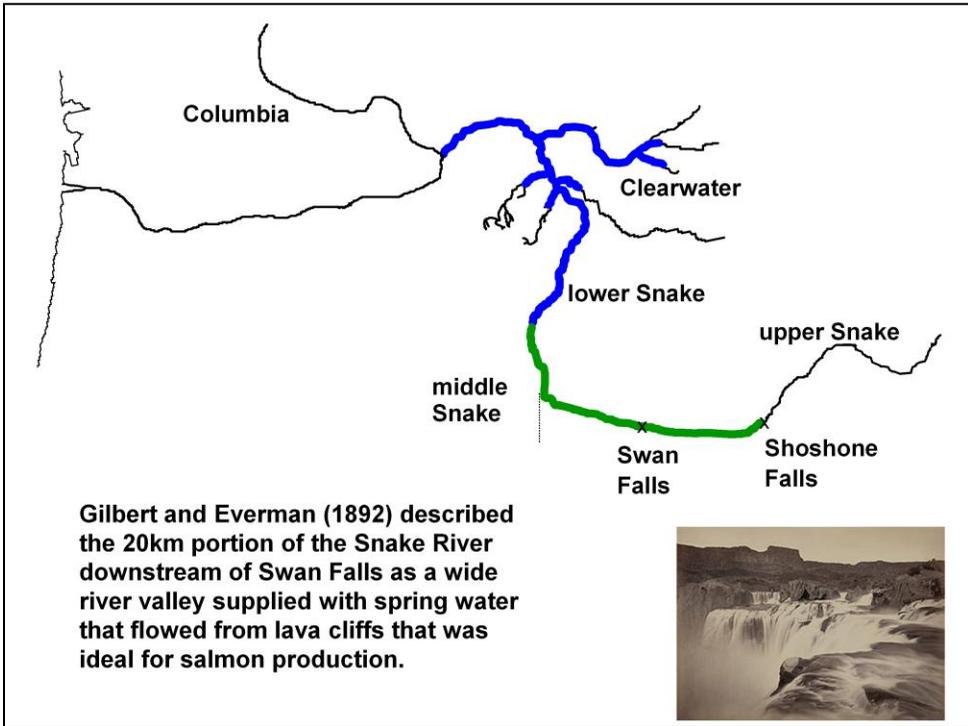


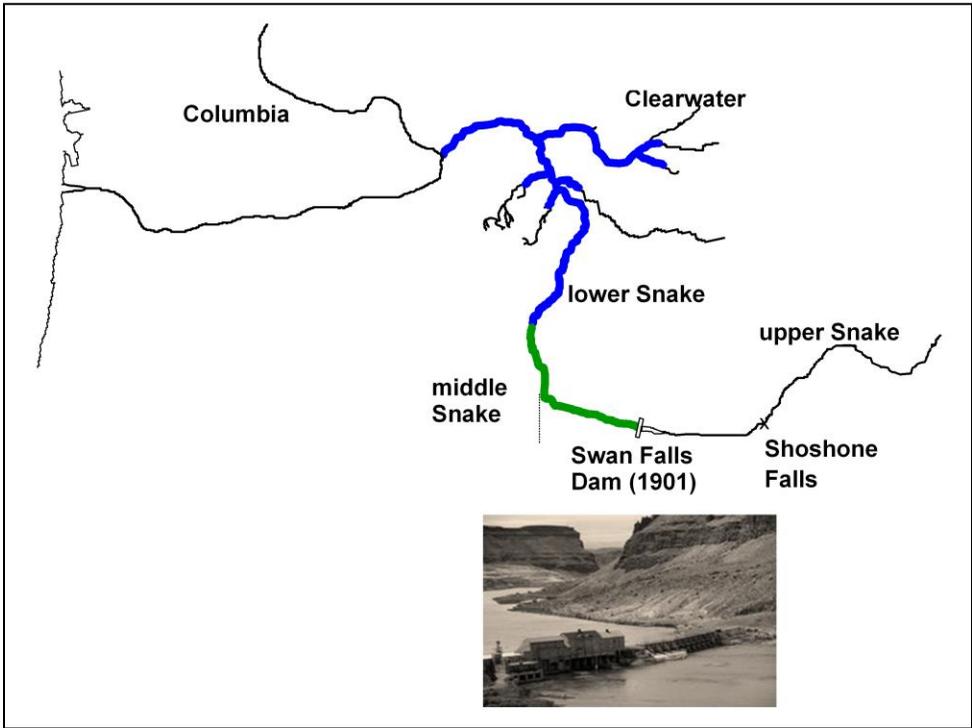
Effects of Dam Construction on Juvenile Life History Diversity and Age and Size at Maturity of Wild and Natural Snake River Basin Fall Chinook Salmon

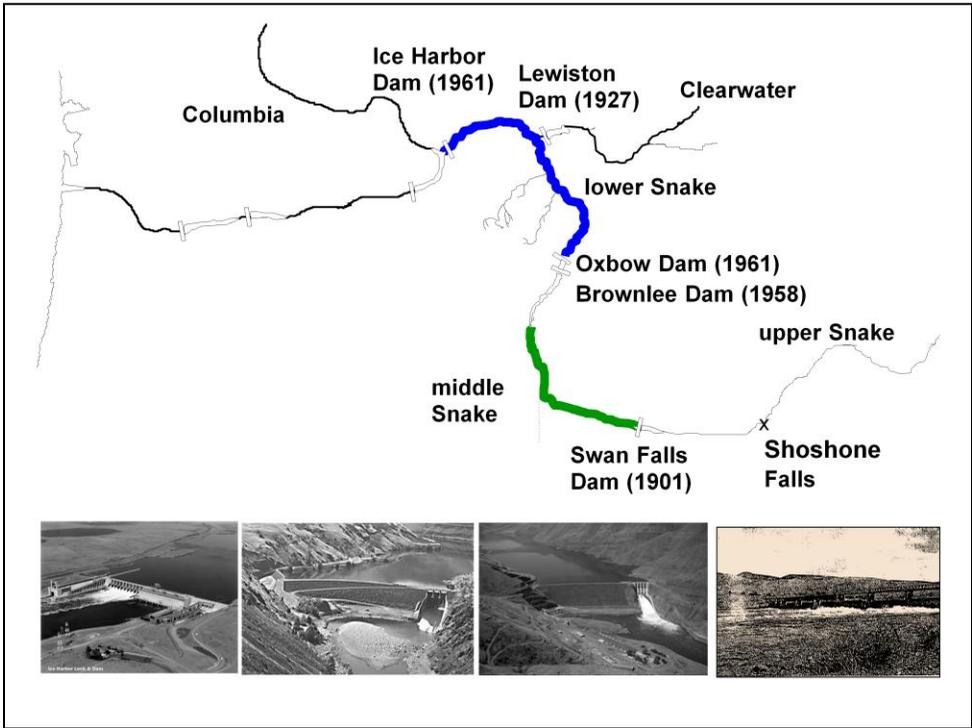


Acknowledgements









Production of Wild Fish Upstream of Oxbow and Brownlee Dams (1957-1963)

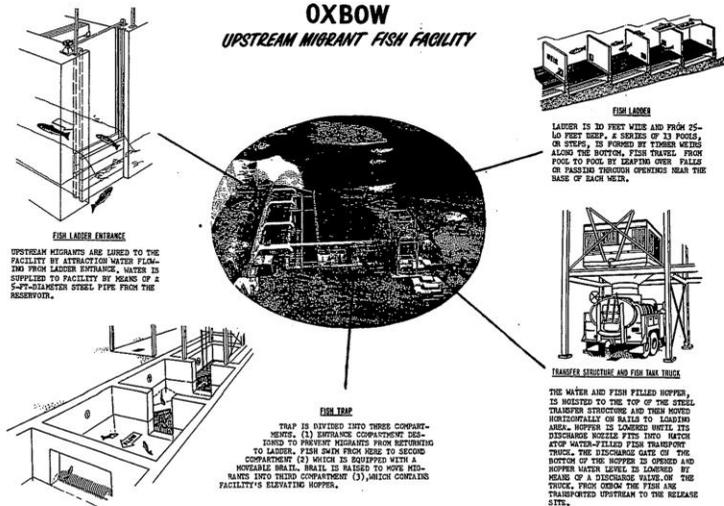


Figure 5. Oxbow * Spillway Trap * Upstream Migrant Fish Facility

(Haas 1965)

Downstream Passage of Wild Juveniles Produced upstream of Oxbow and Brownlee Dams (1957-1963)

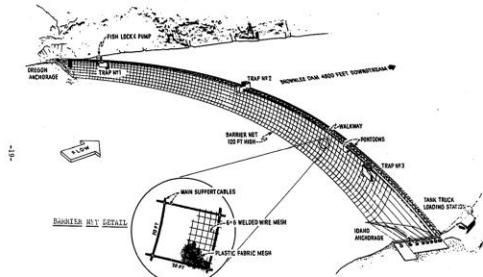


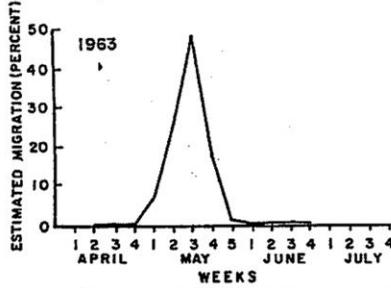
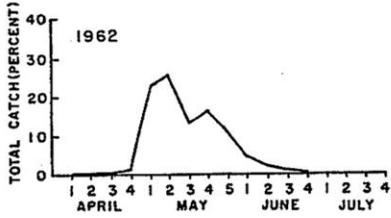
Figure 10. Artist's Conception Of Brownlee Downstream Highest "Barrier Net" Fish Facility.



Figure 13. On Shore Landing Facility At Brownlee Barrier Net With Fish Transport Truck In Loading Position.

(Haas 1965)

**Downstream Passage of Wild Juveniles Produced upstream of
Oxbow and Brownlee Dams (1962-1963)**

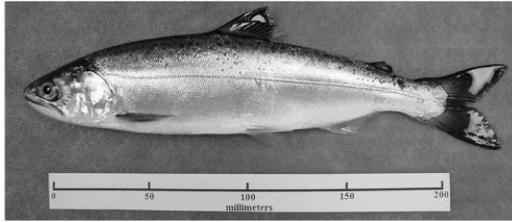
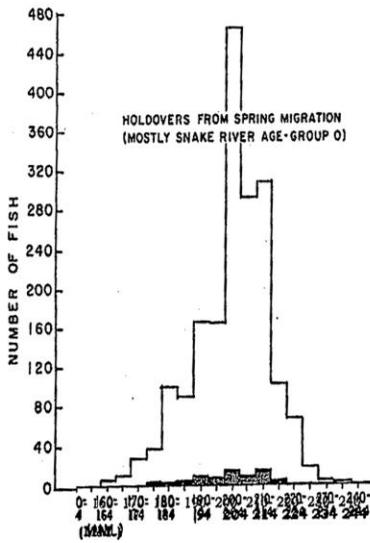


The size of native juvenile fall chinook salmon increased throughout the migration period (table 2). Early migrants in 1962 averaged 52 mm.; by the final week, average length had increased to 71 mm. The migrants averaged larger in 1963—73 mm. at the start and 81 mm. at the end of the migration period.

FIGURE 4.—Timing of migration of native juvenile fall chinook salmon (age-group 0) from the Snake River to Brownlee Reservoir by weekly periods, 1962-63.

(Krcma and Raleigh 1970)

Downstream Passage of Wild Juveniles Produced upstream of Oxbow and Brownlee Dams (1963-1964)



-Held over in Brownlee Reservoir due to disorientation

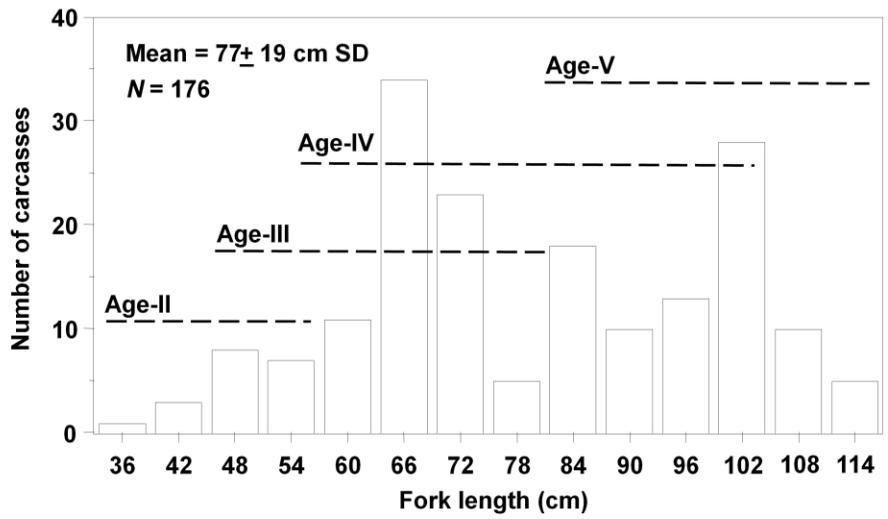
-Mostly fall Chinook easily distinguished by large size (160-240 mm FL)

-Low survival due to high temperatures and low oxygen concentrations

-Survivors Passed Brownlee Dam November-February

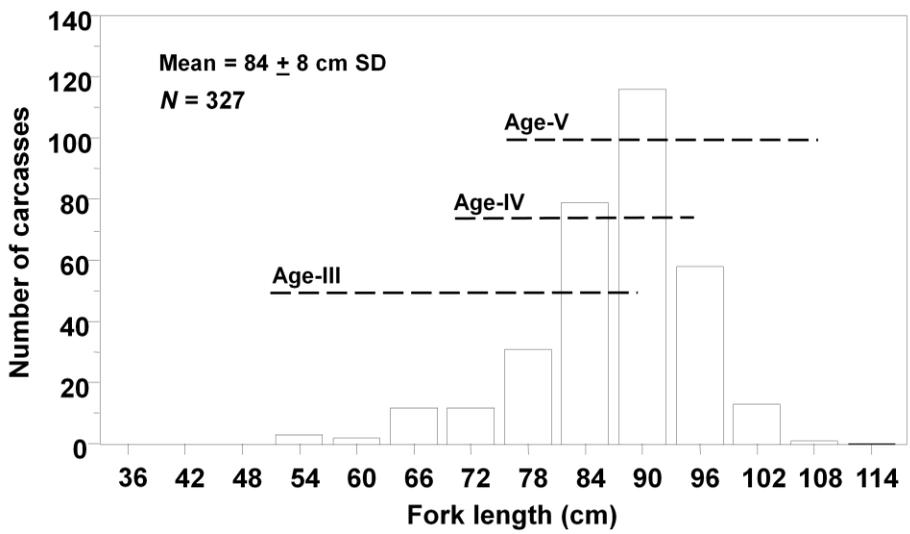
(Durkin et al. 1970)

Male Recoveries on the Spawning Grounds Upstream of Brownlee Reservoir (1961)

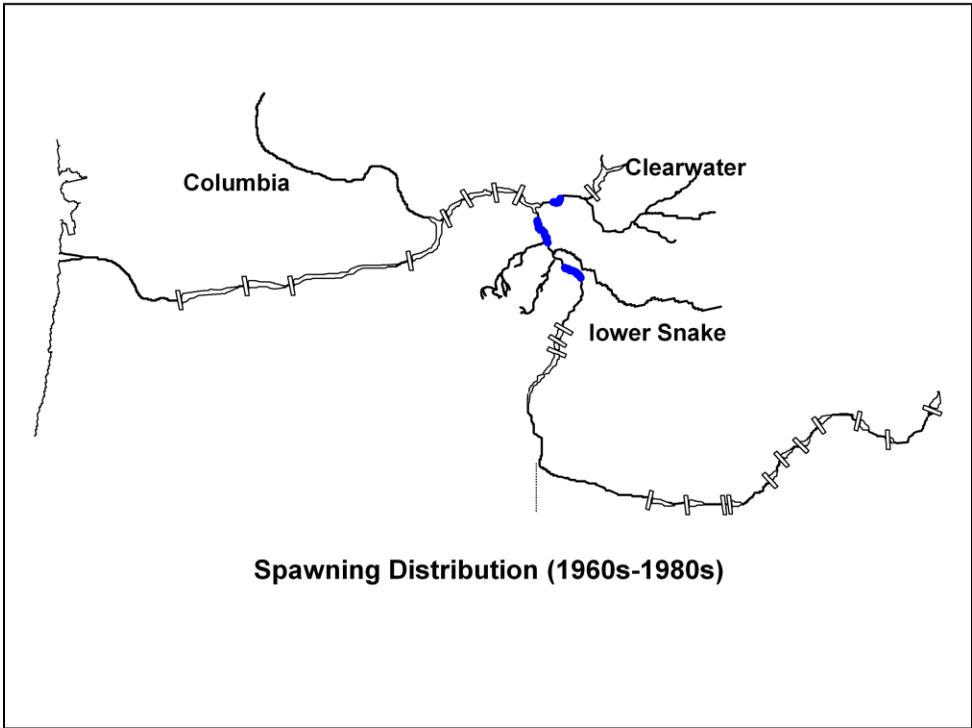


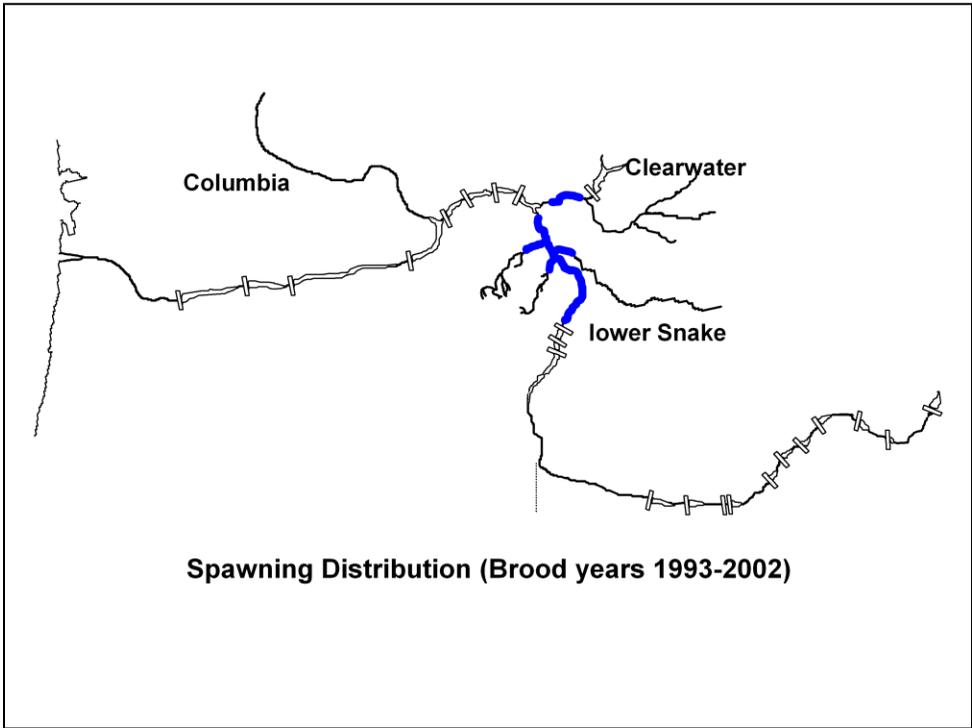
(Richards 1961)

Female Recoveries on the Spawning Grounds Upstream of Brownlee Reservoir (1961)

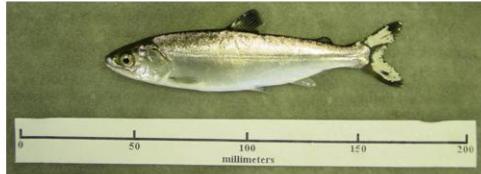


(Richards 1961)

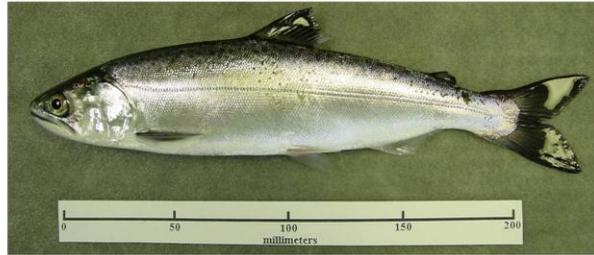




**Age at Ocean Entry of Natural Fall Chinook Salmon
produced upstream of Lower Granite Reservoir**

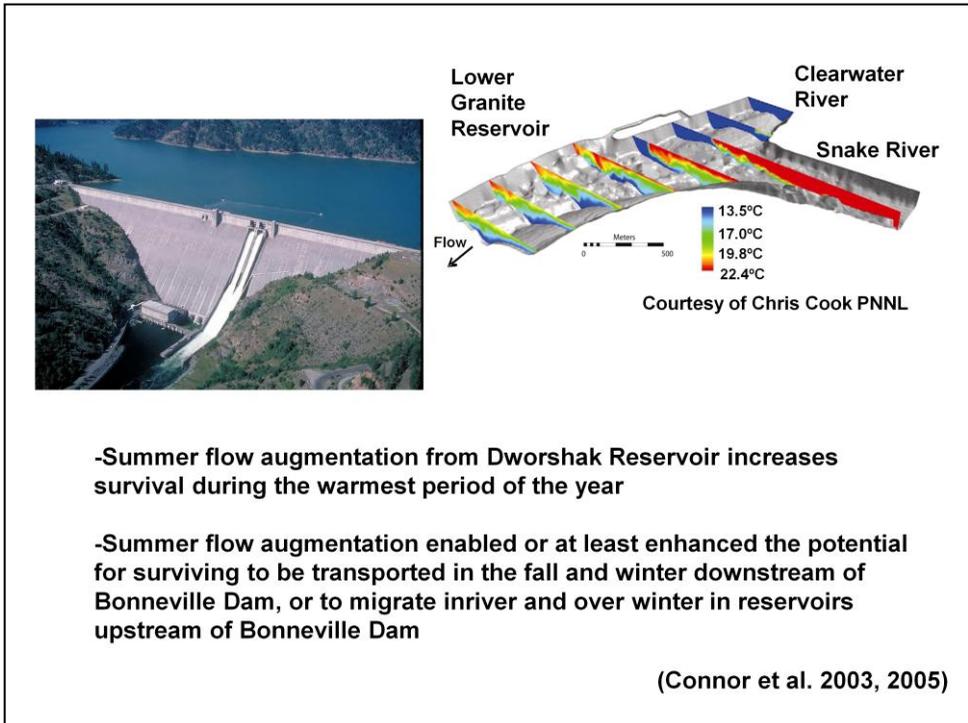


Subyearling



Yearling

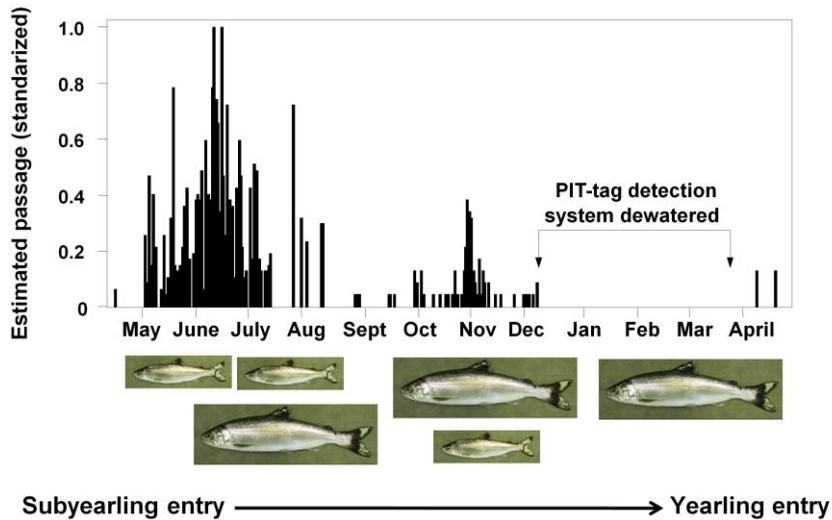
(Arnsberg and Statler 1995; Connor et al. 2002, 2005)



In contrast to Snake River fish that depart from unfavorably warm temperatures into a heterothermic environment that offers cooler temperatures, young salmon from the Clearwater River have the option of moving from cool water into warmer water.

Consequently.....

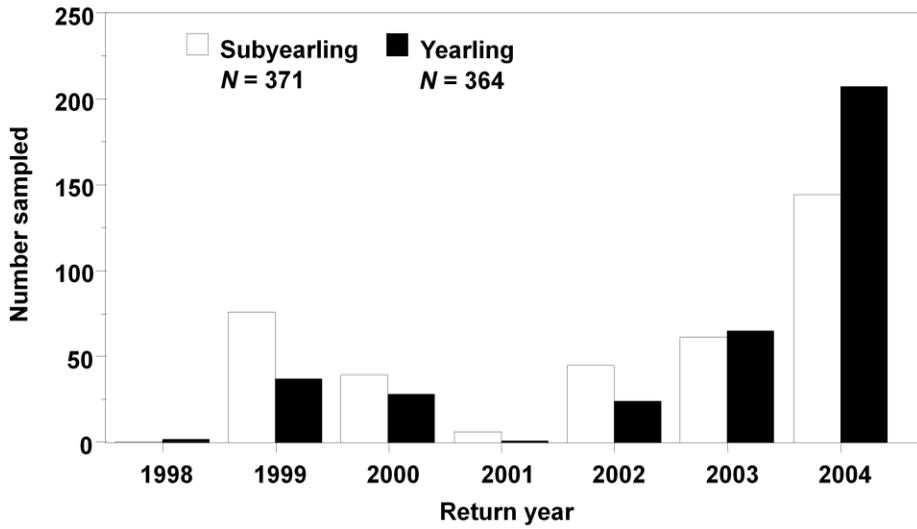
Natural Fall Chinook Salmon Juveniles are Present and Moving Downstream Year Round in Reservoirs Formed by the Federal Columbia River Power System (e.g., Lower Granite Dam shown below)



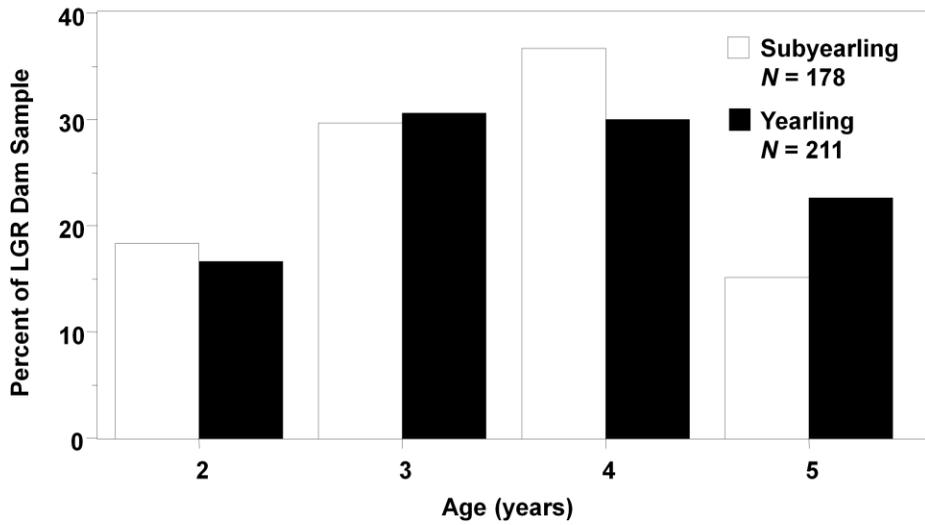
The pattern in the rearing timing distribution among fish from the contemporary spawning areas is generally maintained as fish pass downstream in reservoirs, but the migration timing distribution is more protracted.

Here, Lower Granite Dam PIT-tag detection data adjusted for bypass probability illustrates the protracted period over which young fall Chinook salmon are present in Lower Granite Reservoir.

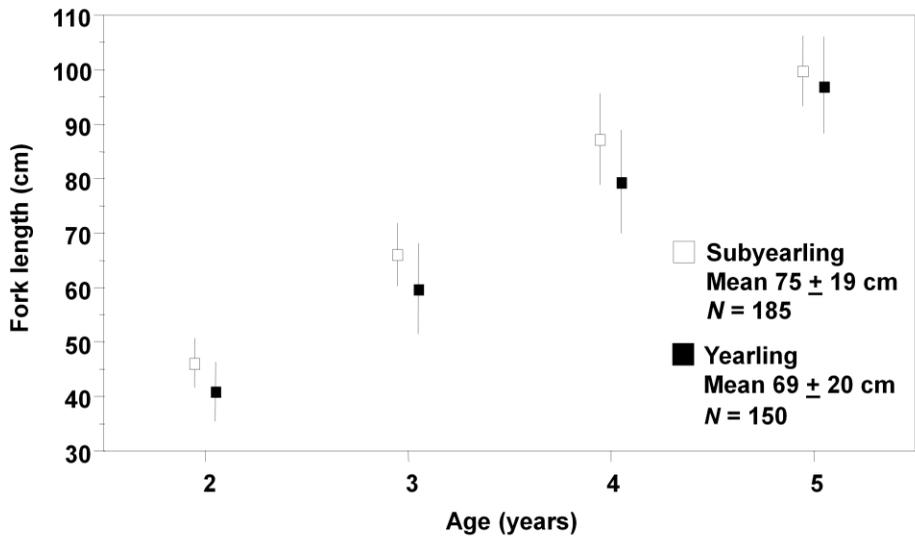
**Age at Ocean Entry of Natural Fall Chinook Salmon Adults
Sampled at Lower Granite Dam
(1998-2004)**



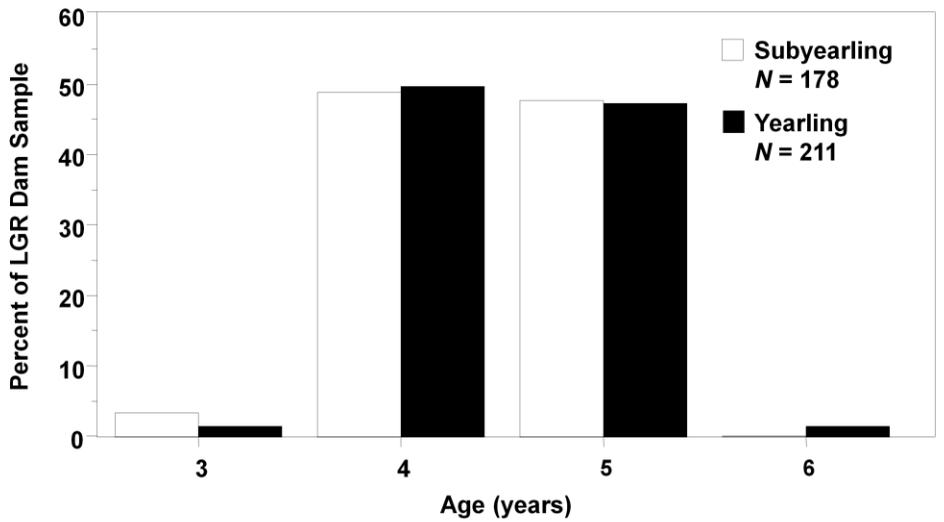
**Age at Maturity of Natural Fall Chinook Salmon Males
Sampled at Lower Granite Dam
(1998-2004)**



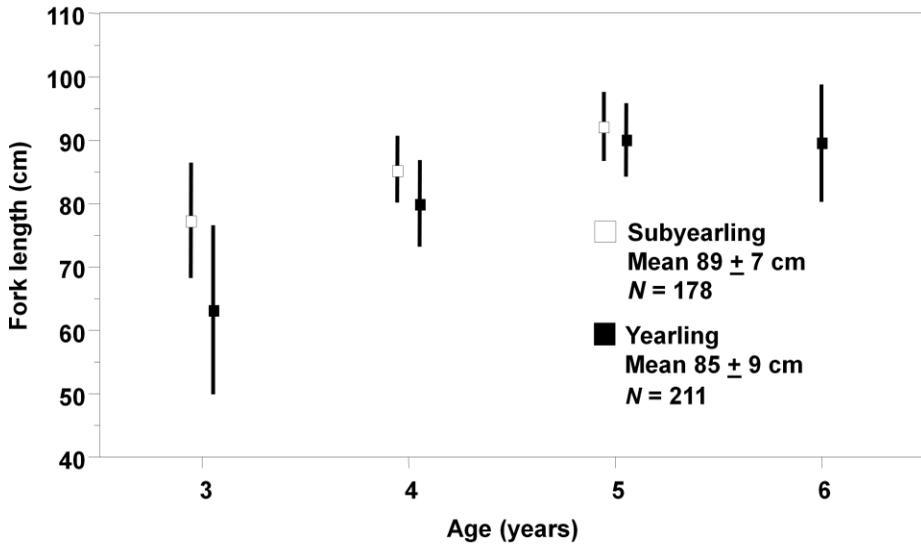
**Size at Maturity of Natural Fall Chinook Salmon Males
Sampled at Lower Granite Dam
(1998-2004)**



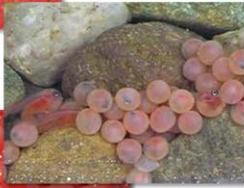
**Age at Maturity of Natural Fall Chinook Salmon Females
Sampled at Lower Granite Dam
(1998-2004)**



**Size at Maturity of Natural Fall Chinook Salmon Females
Sampled at Lower Granite Dam
(1998-2004)**



**Predicted Fecundity at Maturity of Natural Fall Chinook Salmon Females
Sampled at Lower Granite Dam
(1998-2004)**



Subyearling
Mean 5,347 ± 612
N = 178

Yearling
Mean 4,964 ± 711
N = 211

Historical Perspective

Prior to the reduction in the geographic distribution of spawning in the Snake River basin caused by dam construction, the potential for ocean entry by both subyearling and yearling wild fall Chinook salmon juveniles was high

Dam construction eliminated most of the historical spawning habitat by the mid 1970s and created an environment that selected against yearling ocean entry

Restoring access to the Clearwater River combined with the cooling effects of summer flow augmentation re-enabled the potential for yearling ocean entry

Given the habitat conditions observed during the mid-1990s to 2004 that resulted from hydropower dam construction and operation, optimal life-history models suggest that the portion of the population that produces yearling ocean entrants had a higher fitness than the portion that produces subyearling ocean entrants (Williams et al. 2008)

It could be that making management decisions and providing habitat conditions that favor a balance in juvenile life history diversity will increase the fitness of the population as a whole

Historical Perspective

Prior to the reduction in the geographic distribution of spawning in the Snake River basin caused by dam construction, the potential for ocean entry by both subyearling and yearling wild fall Chinook salmon juveniles was high

Dam construction eliminated most of the historical spawning habitat by the mid 1970s and created an environment that selected against yearling ocean entry

Restoring access to the Clearwater River combined with the cooling effects of summer flow augmentation re-enabled the potential for yearling ocean entry

Given the habitat conditions observed during the mid-1990s to 2004 that resulted from hydropower dam construction and operation, optimal life-history models suggest that the portion of the population that produces yearling ocean entrants had a higher fitness than the portion that produces subyearling ocean entrants (Williams et al. 2008)

It could be that making management decisions and providing habitat conditions that favor a balance in juvenile life history diversity will increase the fitness of the population as a whole

Historical Perspective

Prior to the reduction in the geographic distribution of spawning in the Snake River basin caused by dam construction, the potential for ocean entry by both subyearling and yearling wild fall Chinook salmon juveniles was high

Dam construction eliminated most of the historical spawning habitat by the mid 1970s and created an environment that selected against yearling ocean entry

Restoring access to the Clearwater River combined with the cooling effects of summer flow augmentation re-enabled the potential for yearling ocean entry

Given the habitat conditions observed during the mid-1990s to 2004 that resulted from hydropower dam construction and operation, optimal life-history models suggest that the portion of the population that produces yearling ocean entrants had a higher fitness than the portion that produces subyearling ocean entrants (Williams et al. 2008)

It could be that making management decisions and providing habitat conditions that favor a balance in juvenile life history diversity will increase the fitness of the population as a whole

Historical Perspective

Prior to the reduction in the geographic distribution of spawning in the Snake River basin caused by dam construction, the potential for ocean entry by both subyearling and yearling wild fall Chinook salmon juveniles was high

Dam construction eliminated most of the historical spawning habitat by the mid 1970s and created an environment that selected against yearling ocean entry

Restoring access to the Clearwater River combined with the cooling effects of summer flow augmentation re-enabled the potential for yearling ocean entry

Given the habitat conditions observed during the mid-1990s to 2004 that resulted from hydropower dam construction and operation, optimal life-history models suggest that the portion of the population that produces yearling ocean entrants had a higher fitness than the portion that produces subyearling ocean entrants (Williams et al. 2008)

It could be that making management decisions and providing habitat conditions that favor a balance in juvenile life history diversity will increase the fitness of the population as a whole

Historical Perspective

Prior to the reduction in the geographic distribution of spawning in the Snake River basin caused by dam construction, the potential for ocean entry by both subyearling and yearling wild fall Chinook salmon juveniles was high

Dam construction eliminated most of the historical spawning habitat by the mid 1970s and created an environment that selected against yearling ocean entry

Restoring access to the Clearwater River combined with the cooling effects of summer flow augmentation re-enabled the potential for yearling ocean entry

Given the habitat conditions observed during the mid-1990s to 2004 that resulted from hydropower dam construction and operation, optimal life-history models suggest that the portion of the population that produces yearling ocean entrants had a higher fitness than the portion that produces subyearling ocean entrants (Williams et al. 2008)

It could be that making management decisions and providing habitat conditions that favor a balance in juvenile life history diversity will increase the fitness of the population as a whole