Snake River Fall Chinook Salmon Early Life History, Condition, and Growth as Affected by Dams[1]

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Abstract.—Construction of dams in North America has affected changes in the early life history, growth, and condition of anadromous salmonids. Prior to dam construction, the freshwater life cycle of Snake River fall chinook salmon *Oncorhynchus tshawytscha* was complete by early July about 3 months after fry emergence. Dam construction in the 1950's, 1960's, and 1970's blocked passage to the historic production area of Snake River fall chinook salmon, confined spawning to marginal areas, altered the water temperature regimes of these areas, and impounded the downstream migration route of smolts. Young fall chinook salmon in the three main present-day production areas can reside in freshwater until late fall, and some fish hold over in reservoirs until the following spring. Condition and growth are relatively high for parr and smolts of all three present-day production areas. Rearing during periods of decreasing day length and slightly slower growth helps explain why some fall chinook salmon revert to parr, hold over in reservoirs, and resume seaward migration as yearlings. We conclude dams have extended the freshwater life cycle of juvenile Snake River fall chinook salmon by eliminating production in the historic spawning area that was warm during egg incubation and produced early emerging fry, and by impounding the seaward migration route thereby delaying downstream passage of smolts.

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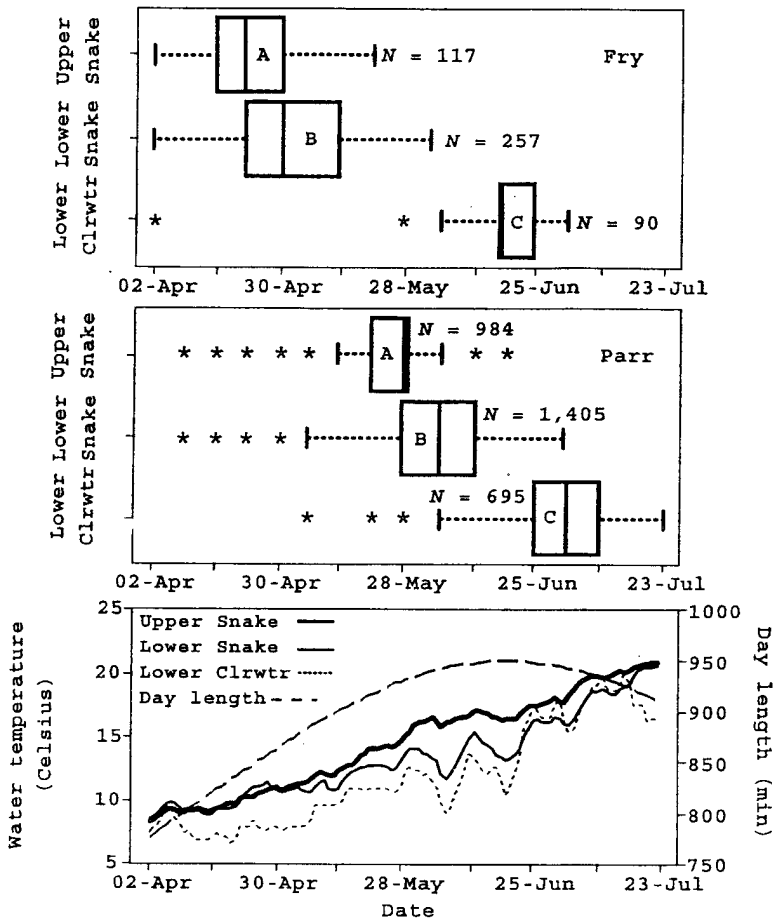

Figure 1.— Sideways box plots showing the timing of fry presence (Top), timing of parr presence (Middle), mean daily water temperature and day length (Bottom) in 1995 for the upper and lower reaches of the Snake River (abbreviated upper Snake and lower Snake) and the lower Clearwater River (abbreviated lower Clrwtr). The vertical sides of each box are the 25th and 75th percentiles, the vertical line within each box is the median, the horizontal dotted lines extend to the upper and lower fences (e.g., 25th percentile minus 1.5 multiplied by the interquartile range), and the asterisks are outliers (i.e., greater than upper fence or less than lower fence). Different letters in a box indicate that the date distribution differed significantly (alpha = 0.05). Water temperature data were collected by the Idaho Power Company, Boise, Idaho, U. S. Fish and Wildlife Service, Ahsahka, Idaho, and the U. S. Geological Survey. Photoperiod data were collected by the U. S. Navy.

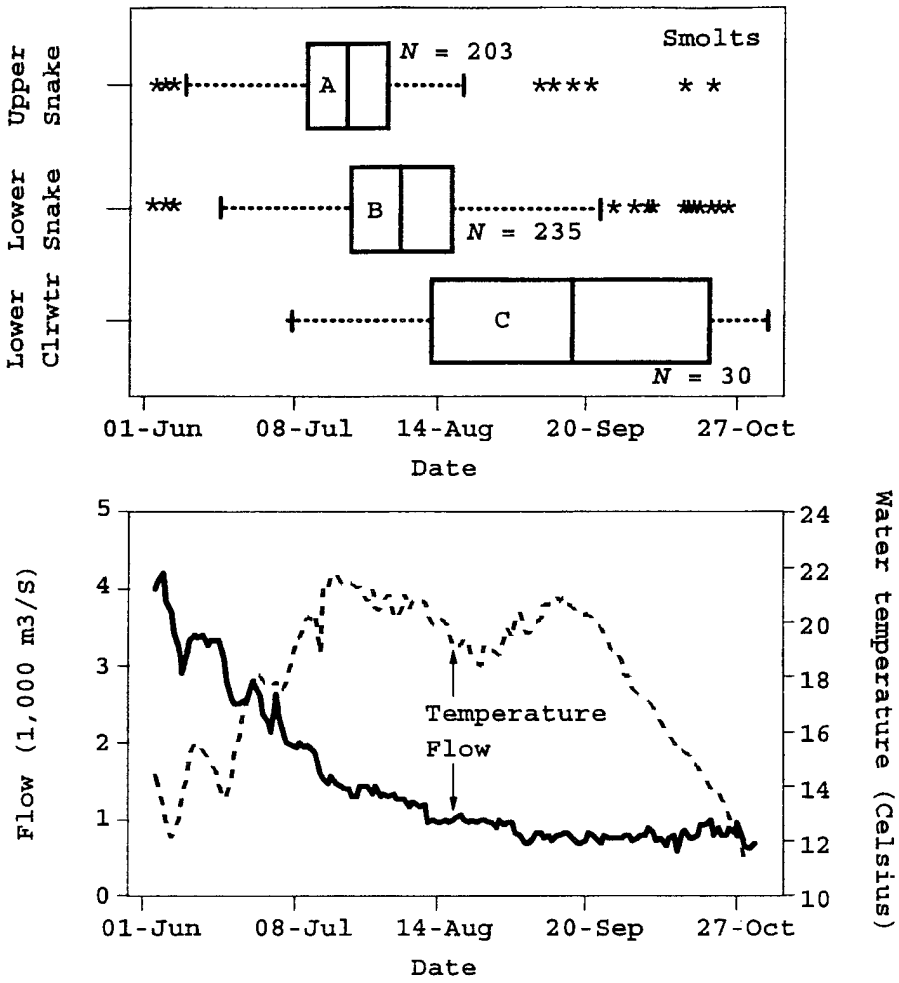

Figure 2.—Sideways box plots showing passage timing at Lower Granite Dam for PIT-tagged smolts from the upper and lower reaches of the Snake River (abbreviated upper Snake and lower Snake) and the lower Clearwater River (abbreviated lower Clrwtr)(Top), and the mean daily water flow and temperature (Bottom) measured in Lower Granite Reservoir by the U. S. Army Corps of Engineers in 1995. The vertical sides of each box are the 25th and 75th percentiles, the vertical line within each box is the median, the horizontal dotted lines extend to the upper and lower fences (e.g., 25th percentile minus 1.5 multiplied by the interquartile range), and the asterisks are outliers (i.e., greater than upper fence or less than lower fence). Different letters in a box indicate that the date distribution differed significantly (alpha = 0.05).

Table 1.– Mean condition factors (*K*) and absolute growth rates for wild subyearling chinook salmon parr that were collected in the upper and lower reaches of the Snake and lower Clearwater River in a beach seine, and for smolts that were recaptured at Lower Granite Dam or Little Goose Dam, 1992–2000.

Year	Parr				Smolt			
	N	*K*±SD	*N*	Growth±SD (mm/d)	*N*	*K*±SD	*N*	Growth±SD (mm/d)
Upper reach Snake River								
1995	605	1.1±0.142	145	1.2±0.253	131	1.4±0.168	132	1.3±0.170
1996	112	1.2±0.105	19	1.1±0.245	12	1.1±0.049	9	1.3±0.133
1997	114	1.2±0.109	20	1.3±0.322	17	1.1±0.096	19	1.2±0.143
1998	980	1.2±0.129	110	1.1±0.295	84	1.1±0.091	105	1.4±0.147
1999	1,489	1.1±0.119	168	1.3+0.315	---	---------	---	---------
2000	932	1.1±0.115	95	1.3±0.202	---	---------	---	---------
Grand means		**1.2±0.050**		**1.2±0.090**		**1.2±0.130**		**1.3±0.071**
Lower reach Snake River								
1992	1,194	1.1±0.130	66	0.9±0.340	---	---------	17	0.9±0.228
1993	2,042	1.2±0.200	203	0.7±0.361	---	---------	114	1.3±0.232
1994	3,713	1.1±0.130	343	1.1±0.345	115	1.3±0.128	115	1.2±0.248
1995	887	1.1±0.156	78	1.0±0.353	143	1.4±0.272	153	1.4±0.168
1996	713	1.2±0.134	49	0.9±0.384	48	1.2±0.144	48	1.3±0.193
1997	922	1.2±0.130	80	0.8±0.310	59	1.2±0.092	61	1.3±0.151
1998	2,141	1.2±0.178	129	0.9±0.309	139	1.2±0.098	139	1.4±0.228
1999	1,641	1.1±0.118	92	1.0+0.309	---	---------	---	---------
2000	1,551	1.1±0.113	44	1.0±0.275	---	---------	---	---------
Grand means		**1.1±0.050**		**0.9±0.113**		**1.3±0.048**		**1.3±0.159**
Lower Clearwater River								
1993	358	1.1±0.132	56	0.9±0.438	---	---------	---	---------
1994	940	1.2±0.133	49	0.7±0.297	---	---------	---	---------
1995	152	1.1±0.171	18	0.9±0.428	14	1.4±0.116	15	1.3±0.303
Grand means		**1.1±0.047**		**0.8±0.094**		**n/a**		**n/a**