C.6. Electronic Appendix - Food Demands, Bioenergetics and Fish Growth

Mainstem reservoirs as feeding habitats for yearling Chinook salmon

Initial and final weights during the simulation period. Tagging at Lower Granite Dam occurred during April to early June 2008, and tag recoveries at Bonneville Dam occurred primarily during May and June 2008. For simplicity, growth and consumption are simulated from the modal body mass and release period at Lower Granite to the modal recapture period and body mass at Bonneville Dam. The modal release period occurred from 2-9 May, representing 2511 fish (49% of the PIT tag releases). The midpoint of this period (Julian day 127) is designated as the starting date for the simulation, and the corresponding mean body mass during this period is 15.0 g (SD = 3.5 g). The modal recapture period at Bonneville Dam occurred from 16-22 May (midpoint Julian day 140), representing 79 fish (70% of the PIT tag recaptures reported through early July). The corresponding mean body mass on day 140 was 18.2 g (SD = 2.5 g).

Diet composition. During the feeding migration, the diets of yearling Chinook salmon contained dipterans and other insects (Coleoptera and Hymenoptera) at Lower Granite Dam. When passing McNary Dam the diet contained predominantly *Daphnia* and a mix of dipterans and other insects. At Bonneville Dam, the diets contained predominantly amphipods (the supposedly estuarine *Corophium*), followed by dipterans, and lesser quantities of other insects (Muir and Coley 1996).

Thermal Experience. Water temperatures ranged from 11-12^{o}C between Lower Granite and Bonneville dams on early to mid-May (days 127-140).

Table C.6.A. Bioenergetics simulation of population-level growth and consumption for a cohort of yearling Chinook, migrating from Lower Granite Dam to Bonneville Dam during 2008 (diet from Muir & Coley 1996). N = hypothesized initial Chinook abundance of 1,000,000 smolts. Survival S = e^{-Zt} represents the survival rate of smolts passing from Lower Granite Dam to Bonneville Dam, Z = the instantaneous daily mortality rate operating over the t = 13 d migration between dams.

Julian Day	Temperature (^{o}C)	Weight (g)	Surviving Smolts	Dipteran	Other Insects	Daphnia	Amphipods	Total
127	11.3	15.2	1,000,000	305	813	407	---	1,525
128	11.4	15.4	966, 253	298	729	464	---	1,492
129	11.4	15.6	933,644	292	648	519	---	1,459
130	11.4	15.8	902,137	285	570	570	---	1,426
131	11.5	16	871,692	279	515	501	97	1,393
132	11.6	16.2	842,275	272	463	435	190	1,390
133	11.6	16.4	813,850	266	412	372	279	1,329
134	11.6	16.7	786,385	260	364	312	364	1,299
135	11.7	16.9	759,847	254	318	254	445	1,270
136	11.8	17.1	734,204	248	273	199	522	1,242
137	11.8	17.4	709,427	243	231	146	595	1,215
138	11.9	17.6	685,486	238	190	95	665	1,188

139	11.9	17.9	662,353	233	151	47	732	1,163
140	11.9	18.2	640,000	228	114	---	796	1,138
Total Consumption (Day 127-140)				3,700	5,791	4,320	4,686	18,498

Consumption demand by juvenile American Shad

Input data Tables for Diet (C.6.C), Temperature (C.6.B), prey energy density (C.6.D), shad size and growth (C.6.E) used in the model simulations.

Table C.6.B. Temperature inputs used for shad simulations during July-Sep in 1994 and1996. July 1st is the first day of the simulation period.

Month	Day	1994 High (^{o}C)	1996 Low (^{o}C)
1-Jul	1	17	14
1-Aug	31	20	19
1-Sep	62	21	19
1-Oct	93	18	17

Table C.6.C. Dietary inputs used for shad simulations during July-Sept, 1994 & 1996. The simulation starts on July 1st.

Day	Daphnia	Bosmina	Copepods	Other
1	0.8	0.05	0.1	0.05
31	0.8	0.05	0.1	0.05
62	0.15	0.1	0.65	0.1
93	0	0.35	0.65	0

Table C.6.D. Prey energy density (J/g wet weight) inputs for shad simulations

Day	Daphnia	Bosmina	Copepods	Other
1	1930	1930	2290	3064
365	1930	1930	2290	3064

Table C.6.E. Summer growth patterns and simulated feeding rate (%Cmax), total per capita consumption (C), and growth efficiency for the average individual age-0 American shad in John Day Reservoir during 1994 and 1996.

Month & Year	Start Weight (g)	Final Weight (g)	Growth (g)	% C_{max}	C	Growth Efficiency
Jul1-Aug1, 1994	0.2	0.36	0.16	33%	3.2	5.00%
Aug1-Sep1, 1994	0.36	2.9	2.54	60%	18.3	13.90%
Sep1-Oct1, 1994	2.9	6	3.1	44%	31.5	9.80%
Jul1-Sep1, 1996	0.2	1.4	1.2	41%	13.7	8.80%
Sep1-Oct1, 1996	1.4	1.8	0.4	28%	10.2	3.90%

Table C.6.F. Simulated monthly consumption demand for larval-juvenile American shad in John Day Reservoir during peak reservoir rearing periods July-Sept in 1994 (warmer year) and 1996 (cooler year).

			Monthly consumption (Kg/million shad)				
Period	**Average Weight**	**Average Temperature**	**Daphnia**	**Bosmina**	**Copepods**	**Other**	**Total**
July, 1994	0.3	18.5	2,484	155	310	155	3,105
Aug, 1994	1.3	20.5	7,115	1,376	7,380	1,376	17,248
Sep, 1994	4.4	19.5	2,168	7,420	20,490	1,445	31,522
1994 Total	2	19.5	11,766	8,952	28,180	2,977	51,875
July, 1996	0.4	16.5	3,543	221	443	221	4,429
Aug, 1996	0.9	19	3,926	684	3,549	684	8,844
Sep, 1996	1.6	18	745	2,325	6,623	496	10,189
1996 Total	1	17.8	8,214	3,231	10,615	1,402	23,462