

Project #: R0327

Title: Early marine ecology of juvenile chum salmon (*Oncorhynchus keta*) in Kuskokwim Bay, Alaska

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Project Summary: This project examines the early marine ecology of chum salmon in Kuskokwim Bay, Alaska. Our goal is to assess the effect of physical and biological environmental factors on feeding, condition, and growth of juvenile chum salmon in Kuskokwim Bay. Using a bioenergetically-based food web model coupled with directed sampling for prey and diet composition, growth, size structure, and energy content will help us to understand patterns observed in feeding, growth and condition of chum salmon juveniles. Specifically, our objectives include (1) determining the spatial and seasonal distribution of chum salmon juveniles throughout Kuskokwim Bay, (2) assessing the spatial and seasonal patterns of environmental variables, and (3) describing the relationship between juvenile distribution patterns and these variables. In addition, we will (4) describe food habits, (5) analyze length, weight, condition, (6) diurnal feeding patterns, and (7) growth of chum salmon. Finally, (8) we will model the bioenergetics and growth of chum salmon juveniles in Kuskokwim Bay. An improved knowledge of environmental conditions, food resource availability, duration of residence, and growth of juvenile chum salmon during their early marine residence is needed to evaluate hypotheses of population regulation in western Alaska chum salmon. This work will serve to fill significant data gaps concerning the early life history of chum salmon in the Kuskokwim watershed.

Progress Summary: To date, all juvenile salmonids collected in 2003 have been measured and weighed, their gut contents removed and preserved, and the remaining fish freeze-dried for subsequent analysis of energetic content. Calorimetry has been completed for all 2003 chum salmon juveniles. Average energy density for cruise 1 chum salmon juveniles was 4751.49 cal/g (n=57, SD=115.37), while cruise 2 chum salmon juveniles had an average energy density of 4709.44 cal/g (n=3, SD=30.08). Analysis of the diet of chum salmon juveniles is currently in progress.

For the 2004 field season, a 14 m long flat bottom fishing vessel, the F/V Namorada, was chartered to allow us to access the shallow northwestern region of Kuskokwim Bay. Sampling started on May 15 and ended June 15, 2004. A total of 7 cruises were conducted, approximately 1 cruise per week, covering a station grid of 19 stations. Each station was sampled according to the 2003 sampling protocol with only minor changes. Firstly, we added a D&A Instruments turbidity meter to the CTD to better estimate the visual range of chum juveniles in the water column. Also, instead of using the Tucker Trawl, in 2004 we employed a 0.75 m diameter ring net with a 333 μ m net bag and cod end.

During the 2004 field season, a total of 29,027 fish were caught (Table 1). The majority of these fish were represented by five species, namely pond smelt (*Hypomesus olidus*), rainbow smelt (*Osmerus mordax*), chum salmon (*Oncorhynchus keta*), ninespine stickleback (*Pungitius pungitius*) and sand lance (*Ammodytes hexapterus*) (Table 1).

Table 1. Percent occurrence of fish species and total catch for each cruise in 2004

Species	Cruise							Total
	1	2	3	4	5	6	7	
<i>Oncorhynchus keta</i>	0.34	0.55	0.67	0.95	1.49	9.78	47.78	5.38
<i>Oncorhynchus nerka</i>	0.03	0.00	0.07	0.10	0.14	0.10	1.01	0.14
<i>Oncorhynchus gorbusha</i>	0.53	0.14	0.55	0.14	0.08	0.12	0.00	0.27
<i>Oncorhynchus kisutch</i>	0.71	0.00	0.76	0.71	1.21	0.69	0.18	0.74
<i>Oncorhynchus tshawytscha</i>	0.00	0.00	0.00	0.00	0.00	0.59	1.66	0.21
<i>Gasterosteus aculeatus</i>	0.78	0.34	0.42	0.26	0.20	0.05	0.12	0.30
<i>Pungitius pungitius</i>	2.30	1.44	0.74	0.86	0.22	22.06	1.66	5.19
<i>Hypomesus olidus</i>	13.82	30.80	61.27	36.38	59.21	47.59	27.38	45.80
<i>Osmerus mordax</i>	60.17	66.74	35.45	58.75	37.46	14.61	19.34	38.38
<i>Ammodytes hexapterus</i>	20.47	0.00	0.05	1.81	0.00	3.01	0.00	3.15
<i>Others</i>	0.84	0.00	0.01	0.05	0.00	1.40	0.89	0.43
Total Catch	3,219	1,458	7,607	4,208	5,038	5,806	1,691	29,027

The percentage of juvenile chum salmon in the total catch increased from 0.34% during cruise 1 to 47.8% during cruise 7. Chum salmon juveniles varied in length from 34.0 mm to 75.0 mm fork length (FL). There was a significant difference in mean FL of chum salmon juveniles among cruises (ANOVA; $F=89.046$, $p < 0.001$), with fish length increasing from a mean FL of 38.25 mm (SD = 2.49) during cruise 1 to 51.32 mm (SD = 4.51) during cruise 7. Chum salmon outmigration appeared to initially follow the river plume into the bay and, then, fish followed the eastern shore of the bay.

On June 7, a 24-hour sampling was conducted. Every 5 hours a 30-minute tow for chum salmon juveniles was carried out, beginning at 13:00 local time on June 7 and ending with haul 5 at 10:00 on June 8, 2004. Chum salmon abundance in the tows varied substantially with highest catches occurring at 18:00 during an ebb tide and lowest catches at 23:00 during slack tide.



Plankton sample from Kuskokwim Bay with rainbow smelt



Surface trawling for juvenile salmonids with modified 3.0 m by 3.0 m Kvichak trawl