

JC-98-15 Cruise Report
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Prepared by
Joseph A. Orsi, Donald G. Mortensen,
James M. Murphy, and William R. Heard
Auke Bay Laboratory, 11305 Glacier Highway
Juneau, Alaska 99801-8626
TEL (907) 789-6034 FAX (907) 789-6094 E-mail joe.orsi@noaa.gov

Scientists from the Auke Bay Laboratory of the National Marine Fisheries Service, Alaska Fisheries Science Center, conducted a 7-d cruise aboard the NOAA ship *John N. Cobb* in the northern region of southeastern Alaska from 24 to 30 August 1998. This cruise was the fourth in a series of five monthly cruises directed at sampling juvenile salmon (*Oncorhynchus* spp.) in the inside inner channels, straits, and coastal waters of the region. The cruises are part of an annual research and monitoring effort for collecting abundance, size, and trophic data on juvenile salmon. This information will provide insight into processes affecting their marine survival and size and age at return. A major focus of the program is to use otolith marked juvenile salmon to assess stock-specific growth and survival and potential interactions between hatchery and wild stocks in the region.

Primary objectives of the cruises are to: 1) sample juvenile salmon and ecologically related species with a rope trawl, 2) determine the spatial and temporal occurrence of juvenile salmon in relation to oceanographic conditions, 3) examine potential predators and prey of juvenile salmon, and 4) ascertain stock-specific information from coded-wire tagged and otolith marked salmon.

Sampling was scheduled at twenty four stations throughout the inside and coastal waters of the northern region (north of latitude 57° N) of southeastern Alaska (Table 1). At each station, the sampling protocol involved: one 20-min trawl haul, one conductivity-temperature-depth (CTD) cast, one double oblique bongo tow, one 20-m vertical plankton tow, and in coastal waters only, one deep vertical plankton tow. An exception to this protocol was the sampling at Auke Bay Monitor (ABM) station where three additional vertical hauls were planned and trawling was not scheduled on account of the shallow depth. Certain stations were selected for repetitive sampling as time and weather allowed.

Trawl gear:

Fish were sampled using a Nordic¹ 264 rope trawl fished directly astern the NOAA ship *John N. Cobb* at the surface. The mouth opening of the trawl was 20 m deep and 35 m wide and it was

¹Reference to trade names does not imply endorsement by the National Marine Fisheries Service.

spread apart by a pair of 3.0 m Lite trawl doors. The trawl was fished fully open with 75 fathoms of main warp out for a duration of 20 min at a speed of 1.5 m/sec (3 knots). To fish the headrope of the trawl at the surface, a cluster of three meshed A-4 Polyform buoys were tethered to each wing tip of the headrope and one A-3 Polyform float was clipped onto the center of the headrope. Mesh sizes ranged from 162.6 cm in the throat of the trawl near the jib lines to 8.9 cm in the cod end. A 6.1 m long, 0.8 cm knotless liner was sewn into the codend. To minimize the loss of fish behind the headrope, a small mesh panel of 10.2 cm mesh was incorporated along the jib lines on the top panel of the trawl between the head rope and the first 162.6 cm mesh.

Oceanographic sampling:

The physical and biological environment was monitored and sampled at each station immediately prior to or after each trawl haul. One CTD cast was made with a Sea-Bird SBE 19 Seacat profiler to 200 m or within 10 m of the bottom. One double oblique bongo tow was done to 200 m or within 20 m of the bottom using a 60-cm frame with 505 and 333 micron mesh nets.

Vertical plankton tows were made with a 50-cm frame and 243 micron mesh net to 20 m at each station, and in coastal transects and in Auke Bay, a 57-cm frame and a 202 micron mesh net was deployed to 200 m or within 20 m of the bottom. General Oceanics or Roshiga flow meters were placed inside the bongo and deep conical nets. A Bendix time and depth recorder was used with the oblique tows to determine the maximum sampling depths. To assess zooplankton availability at the sampling stations, plankton collections from 20-m vertical plankton tows were settled over a 24 hr period in 1 L Imhof cones at the Laboratory.

Results:

Inclement weather limited sampling opportunities along coastal stations; consequently, stations along the Cape Edward transect and repetitive sampling at stations along the Icy Point transect were not accomplished according to the cruise plan. Rough sea conditions at the completion of the Icy Point transect also precluded taking oceanographic samples at the last station. Sampling at the remaining stations was done according to the cruise plan, including additional rope trawl hauls, 20-m vertical plankton tows, and 50-m CTD casts at two of the inside stations. The total sampling effort on the cruise included: 25 rope trawl hauls, 22 bongo tows, 25 CTD casts, and 31 vertical plankton tows.

A total of 593 fish and squid representing 19 species were sampled with the rope trawl (Table 2).

Of the fish captured, all were measured for length and most were retained for later laboratory analysis. All five species of Pacific salmon and steelhead trout (*O. mykiss*) were captured totaling 371 fish. Over 96% of the salmon caught were juveniles; about 4% of the salmon were immature (3) and adult (12). In the 25 trawl hauls, frequency of occurrence was highest for juvenile coho (*O. kisutch*), pink (*O. gorbuscha*), chum (*O. keta*), and sockeye (*O. nerka*) salmon; they occurred in 60%, 52%, 40%, and 36% of the hauls, respectively. In contrast to the other species of juvenile salmon sampled, the occurrence of chinook salmon (*O. tshawytscha*) was only 12%. Of the remaining fish species sampled, crested sculpins (*Blepsias bilobus*) had the next highest occurrence of 40%.

Temperature and salinity readings at 2-m depths differed between localities. In general, colder temperatures and lower salinities occurred at the inside stations, whereas warmer, more saline conditions occurred at the coastal stations (Table 3). Temperatures ranged from 8.9-11.9°C at inside stations and 9.4-12.4°C at coastal stations, while salinities ranged from 18.6-30.0 ‰ at inside stations and 29.7-31.8 ‰ at coastal stations.

Settled volumes of zooplankton also differed between localities but were highest at the coastal stations (Table 3). Settled volumes in coastal stations ranged from 4.0-15.0 ml and averaged 7.1 ml, whereas settled volumes in strait and inshore stations ranged from 0.5-8.0 ml and averaged 3.5 ml.

The occurrence of juvenile salmon differed by localities and offshore distance sampled. Catch per haul of juvenile salmon was highest in coastal stations (32.0) as opposed to inshore (7.0) and strait (5.4) stations (Table 3). At the stations sampled along the Icy Point offshore transect in the coastal habitat, catches of juvenile salmon diminished from 44 to 0 as the distance offshore increased from 7 to 65 km.

Species occurrence differed by the localities sampled. Catch rates of pink and chum salmon were highest in coastal stations, chinook and coho catch rates were highest in inshore and strait stations, and sockeye catches were highest in coastal and inshore stations. For the most abundant non-salmonid species, sablefish (*Anoplopoma fimbria*) and squid occurred exclusively in coastal stations, whereas, crested sculpin and Pacific herring (*Clupea harengus*) typically occurred in inside stations (Table 4).

Six adipose fin clipped juvenile salmon were examined for internally planted coded-wire tags (CWTs) (Table 5). Five of the fish contained CWTs: four chinook and one coho salmon. The additional adipose fin clipped fish was a chum salmon and did not contain a CWT. All CWT chinook and coho salmon were recovered in inside waters and originated from southeastern Alaska. Migrations of the four CWT chinook salmon ranged from 5-105 km (0.1-1.1 km/d), whereas the migration of the CWT coho was 85 km (1.3 km/d).

Stomachs were examined from 16 potential predators of juvenile salmon which included: 11 adult coho salmon, 3 immature chinook salmon, 1 adult black rockfish (*Sebastes melanops*), and 1 blue shark (*Prionace glauca*). The salmon stomachs contained fish, the shark stomach contained squid, and the black rockfish stomach was empty. Fish in the salmon stomachs included: 14 juvenile sablefish (15-22 cm), 12 Pacific herring (4-8 cm), 1 juvenile pink salmon (15 cm), 1 ling cod (*Ophiodon elongatus*, 20 cm), capelin (*Mallotus villosus*), and euphausiids. The juvenile salmon was found in one of the adult coho salmon.

Discussion:

This was the fourth in a series of five scheduled cruises in southeastern Alaska from May to October 1998. Information from this August cruise can be combined with the three previous 1998 cruises (Cruise reports JC-98-05, -08, and -11) and compared to the 1997 results (Cruise reports JC-97-06, -09, -11, -14, -17; Orsi *et al.* 1997; Murphy *et al.* In Prep). Seasonal abundance and distribution of juvenile salmon in the marine waters of the northern region were relatively consistent between 1997 and 1998. In both years, juvenile salmon were absent at all stations in May, and a month later in June, all five species were present. At strait stations, the highest catch rates of juveniles in both years occurred in June and July, and catch rates declined over 5 fold from July to August. At coastal stations, the highest catch rates in both years occurred in July and August. These data indicate that the primary migration of juvenile salmon within marine waters of the northern region of southeastern Alaska occurs from nearshore localities to strait stations between May and June, and progresses seaward from strait to coastal stations from July to August.

The relative abundances of some species of juvenile salmon differed between 1997 and 1998. This was especially true for pink and chum salmon from 1997 to 1998, where the overall June-July catch rates increased from 17 to 165 for pink salmon, and decreased from 86 to 60 for chum salmon. Consequently, the ratio of pink to chum salmon was over a magnitude lower in the June-July period in 1997 than in 1998. If the assumption is made that the majority of the marine mortality of pink salmon has already occurred by June and July, and trawl CPUE in June and July is an index of abundance, then the adult pink salmon return in the northern region in 1999 may be an order of magnitude higher than the return to the region in 1998. The other species of salmon, which occurred in much lower abundances, did not differ as markedly between years; although coho were about twice as abundant in 1998. These indices of abundance will be monitored in subsequent months of sampling and ultimately correlated with adult returns to determine if trawl CPUE can serve as an index of abundance.

Predation on juvenile salmon by an adult coho salmon was observed for the first time on this cruise. In the previous July cruise, predation on juvenile salmon was observed in one immature sablefish and one spiny dogfish (*Squalus acanthias*). No other instances of predation on juvenile salmon were observed in the May and June cruises in 1998 or in any of the five cruises in 1997. Observing predation on juvenile salmon at sea is rare, so even the low level of predation observed in these two cruises may be biologically significant if extrapolated over a more extensive temporal and spatial period.

Origin and occurrence of the CWT salmon recovered in August were similar between 1997 and 1998. In both years, all CWT salmon originated from the northern region of southeastern Alaska and were recovered in inside waters. The CWTs were predominately from chinook in both 1997 (1 of 1) and 1998 (4 of 5). The additional CWT recovered in 1998 was from a coho salmon.

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Table 1.--Localities and coordinates of stations sampled of the stations scheduled to be sampled in the northern region of southeastern Alaska off the NOAA ship *John N. Cobb*, 24-30 August 1998.

Locality	Station	Latitude	Longitude	Offshore distance	Inter-transect distance	Depth
Inshore stations						
Auke Bay	ABM	58° 22.00' N	134° 40.00' W	1.5 km	-----	60 m
Taku Inlet	TKI	58° 11.19' N	134° 11.71' W	2.2 km	-----	175 m
False Point Retreat	FPR	58° 22.00' N	135° 00.00' W	1.8 km	-----	680 m
Lower Favorite Channel	LFC	58° 20.98' N	134° 43.73' W	1.5 km	-----	75 m
Strait stations						
Upper Chatham Strait	UCA	58° 04.57' N	135° 00.08' W	3.2 km	3.2 km	400 m
	UCB	58° 06.22' N	135° 00.91' W	6.4 km	3.2 km	100 m
	UCC	58° 07.95' N	135° 01.69' W	6.4 km	3.2 km	100 m
	UCD	58° 09.64' N	135° 02.52' W	3.2 km	3.2 km	200 m
Icy Strait	ISA	58° 13.25' N	135° 31.76' W	3.2 km	3.2 km	128 m
	ISB	58° 14.22' N	135° 29.26' W	6.4 km	3.2 km	200 m
	ISC	58° 15.28' N	135° 26.65' W	6.4 km	3.2 km	200 m
	ISD	58° 16.38' N	135° 23.98' W	3.2 km	3.2 km	234 m
Coastal stations						
Cross Sound	CSA	58° 09.53' N	136° 26.96' W	3.2 km	3.2 km	300 m
	CSB	58° 10.91' N	136° 28.68' W	6.4 km	3.2 km	60 m
	CSC	58° 12.39' N	136° 30.46' W	6.4 km	3.2 km	200 m
	CSD	58° 13.84' N	136° 32.23' W	3.2 km	3.2 km	200 m
Icy Point	IPA	58° 20.12' N	137° 07.16' W	6.9 km	6.9 km	160 m
	IPB	58° 12.71' N	137° 16.96' W	23.4 km	16.8 km	130 m
	IPC	58° 05.28' N	137° 26.75' W	40.2 km	16.8 km	150 m
	IPD	57° 53.50' N	137° 42.60' W	65.0 km	24.8 km	1,300 m
Cape Edward	EDA	57° 39.00' N	136° 23.20' W	8.0 km	8.0 km	90 m
	EDB	57° 36.00' N	136° 34.40' W	20.0 km	12.0 km	185 m

EDC	57° 32.50' N	136° 46.60' W	33.0 km	13.0 km	1,270 m
EDD	57° 28.75' N	136° 56.60' W	47.0 km	13.0 km	1,800 m

Table 2.-- Life history stage, number captured, size, and frequency of occurrence of fish and squid captured in 25 hauls with a rope trawl in the northern region of southeastern Alaska off the NOAA ship *John N. Cobb*, 24-30 August 1998.

Common name	Species	Life ² history stage	Number		Fork length (mm)			Percent frequency of occurrence
			captured	measured	min	max	x	
Pink salmon	<i>Oncorhynchus gorbuscha</i>	J	144	144	135	221	161.6	52
Chum salmon	<i>O. keta</i>	J	118	118	127	234	164.1	40
Coho salmon	<i>O. kisutch</i>	J	57	209	311	252.7	60	
Chinook salmon	<i>O. tshawytscha</i>	J	20	20	144	301	190.2	20
Sockeye salmon	<i>O. nerka</i>	J	17	17	100	203	153.1	36
Chinook salmon	<i>O. tshawytscha</i>	I	3	3	480	660	546.0	12
Coho salmon	<i>O. kisutch</i>	A	11	507	762	644.1	28	
Steelhead trout	<i>O. mykiss</i>	A	1	1	685	685	685.0	4
Salmonid total			371	371				
Sablefish	<i>Anoplopoma fimbria</i>	J	83	83	167	225	195.9	16
Pacific herring	<i>Clupea harengus</i>	J, I, A	79	79	49	211	81.9	16
Squid ³	Gonatidae	J	23	23	24	41	32.6	4
Crested sculpin	<i>Blepsias bilobus</i>	J, I	14	14	113	163	133.1	40
Pacific spiny lump sucker	<i>Eumicrotremus orbis</i>	J, I	6	6	35	69	58.0	20
Wolf-eel	<i>Anarrhichthys ocellatus</i>	I	5	5	408	506	461.6	20
Capelin	<i>Mallotus villosus</i>	J	5	5	43	59	51.4	4
Prowfish	<i>Zaprora silenus</i>	J	2	2	123	129	126.0	4
Rockfish	<i>Sebastes</i> sp.	J	1	1	34	34	34.0	4
Smooth lump sucker	<i>Aptocyclus ventricosus</i>	A	1	1	203	203	203.0	4
Pacific saury	<i>Cololabis saira</i>	A	1	1	264	264	264.0	4
Black rockfish	<i>Sebastes melanops</i>	A	1	1	500	500	500.0	4
Blue shark	<i>Prionace glauca</i>	A	1	1	1540	1540	1540.0	4
Non-salmonid total			222	222				
Totals			593	593				

²L = larvae

J = juvenile or post larvae in first year at sea (i.e., age -.0)

I = immature age -.1 or older in pre-spawn condition

A = adult approaching age of maturity.

³Mantle lengths

Table 3.--Temperatures, salinities, plankton volumes, and salmonid catches at stations sampled in the northern region of southeastern Alaska off the NOAA ship *John N. Cobb*, 24-30 August 1998. No trawling occurred at station ABM (Haul# 2085).

Date	Haul#	Station	2-m temperature (°C)	2-m salinity (o/oo)	20-m plankton volume (ml)		Salmonids								
					Zoop	Total	Juvenile					Immature		Adult	
							Pink	Chum	Coho	Chinook	Sockeye	Chinook	Coho	Steelhead	
24 August	2070	TKI	10.6	20.6	8.0	12.0	-	-	-	4	1	-	-	-	
24 August	2071	FPR	11.8	25.2	3.0	3.0	3	2	2	1	2	-	-	-	
25 August	2072	ISA	8.9	30.0	2.5	2.5	-	-	2	-	-	-	-	-	
25 August	2073	ISB	10.5	29.4	6.5	6.5	4	-	-	-	-	-	-	-	
25 August	2074	ISC	11.4	28.1	4.0	4.0	4	-	5	-	1	-	-	-	
25 August	2075	ISD	11.9	27.7	1.5	1.5	-	-	7	-	-	-	-	-	
26 August	2076	UCA	10.0	29.8	1.5	1.5	-	-	1	-	-	-	-	-	
26 August	2077	UCB	10.2	29.8	0.5	0.5	-	-	1	-	-	1	-	-	
26 August	2078	UCC	11.2	28.0	1.5	1.5	-	-	14	-	-	-	-	-	
26 August	2079	UCD	11.2	27.6	3.0	3.0	1	-	4	-	-	-	1	-	
27 August	2080	ISA	9.2	30.0	4.0	4.0	1	-	6	-	-	-	-	-	
27 August	2081	ISB	9.5	29.8	4.5	4.5	-	-	-	-	-	1	-	-	
27 August	2082	ISC	10.4	29.5	4.5	4.5	6	-	1	-	-	-	1	-	
27 August	2083	ISD	11.4	27.9	2.5	2.5	1	2	3	1	-	-	-	-	
27 August	2084	LFC	10.5	18.6	na	66.0	-	-	2	13	-	1	1	1	
27 August	2085	ABM	10.9	19.9	na	60.0	na	na	na	na	na	na	na	na	
28 August	2086	FPR	11.1	24.9	5.0	17.0	-	1	-	-	1	-	-	-	
28 August	2087	LFC	10.1	19.2	na	120.0	-	-	-	1	2	-	-	-	
29 August	2088	CSD	10.1	30.8	5.5	5.5	26	15	5	-	1	-	3	-	
29 August	2089	CSC	9.4	30.8	4.0	4.0	10	6	-	-	-	-	2	-	
29 August	2090	CSB	12.2	30.8	15.0	15.0	25	11	1	-	1	-	1	-	
29 August	2091	CSA	12.3	30.9	5.0	5.0	36	57	3	-	2	-	-	-	
30 August	2092	IPA	11.2	29.7	7.0	7.0	26	12	-	-	6	-	-	-	
30 August	2093	IPB	12.4	31.0	7.0	7.0	1	7	-	-	-	-	-	-	
30 August	2094	IPC	11.8	31.8	6.5	6.5	-	5	-	-	-	-	-	-	
30 August	2095	IPD	11.9	31.2	na	na	-	-	-	-	-	-	2	-	
Total catch					144		118	57	20	17		3	11	1	

Table 4.--Catches of non-salmonid fish and squid by rope trawl haul at stations sampled in the northern region of southeastern Alaska off the NOAA ship *John N. Cobb*, 24-30 August 1998. No trawling occurred at station ABM (Haul# 2085).

Date	Haul#	Station	Pacific													
			Sablefish	Pacific herring	Squid	Crested sculpin	spiny lumpsucker	Wolf-eel	Capelin	Prowfish	<i>Sebastes</i> sp.	Smooth Lumpsucker	Pacific saury	Black rockfish	Blue shark	
24 August	2070	TKI	-	-	-	2	2	-	-	-	-	-	-	-	-	-
24 August	2071	FPR	-	-	-	1	-	-	-	-	-	-	-	-	-	-
25 August	2072	ISA	-	-	-	1	1	-	-	-	-	-	-	-	-	-
25 August	2073	ISB	-	-	-	-	-	1	-	-	-	-	-	-	-	-
25 August	2074	ISC	-	-	-	-	-	1	-	-	-	1	-	-	-	-
25 August	2075	ISD	-	-	-	2	-	-	-	-	-	-	-	-	-	-
26 August	2076	UCA	-	-	-	1	-	-	-	-	-	-	-	-	-	-
26 August	2077	UCB	-	-	-	1	-	-	-	-	-	-	-	-	-	-
26 August	2078	UCC	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26 August	2079	UCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 August	2080	ISA	-	-	-	1	1	1	-	-	-	-	-	-	-	-
27 August	2081	ISB	-	-	-	1	-	-	-	-	-	-	-	-	-	-
27 August	2082	ISC	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 August	2083	ISD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 August	2084	LFC	-	73	-	3	1	-	-	-	-	-	-	-	-	-
27 August	2085	ABM	-	-	-	1	-	-	-	-	-	-	-	-	-	-
28 August	2086	FPR	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28 August	2087	LFC	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29 August	2088	CSD	2	1	-	-	1	-	5	-	1	-	-	-	-	-
29 August	2089	CSC	51	3	-	-	-	1	-	-	-	-	-	-	1	-
29 August	2090	CSB	15	-	-	-	-	-	-	-	-	-	1	-	-	-
29 August	2091	CSA	15	1	-	-	-	-	-	-	-	-	-	-	-	-
30 August	2092	IPA	-	-	-	-	-	1	-	-	-	-	-	-	-	-
30 August	2093	IPB	-	-	-	-	-	-	-	2	-	-	-	-	-	-
30 August	2094	IPC	-	-	23	-	-	-	-	-	-	-	-	-	-	-
30 August	2095	IPD	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Total catch			83	79	23	14	6	5	5	2	1	1	1	1	1	1

Table 5.--Release and recovery information for coded-wire tagged juvenile salmon captured in the northern region of rope trawl haul off the NOAA ship *John N. Cobb*, 24-30 August 1998. Fish recovered that were adipose fin clipped but did not contain coded-wire tags are also reported.

Species	Release information						Recovery information						Days since release	Marine Distance traveled (km)
	Coded-wire tag	Brood code	Agency ⁴	Locality	Date	Size (mm) (g)	Locality	(station code)Date	Size (mm) (g)					
Chinook	04:46/44	1996	ADFG	Taku River (Wild), AK	~05/19/98 ⁵	75 4.3	L. Favorite Chan (LFC)	08/27/98	159 49.4			~99	105	
Chinook	50:04/39	1996	DIPAC	Fish Creek, AK	05/28/98	- 27.2	L. Favorite Chan. (LFC)	08/27/98	205 107.8			91	5	
Chinook	50:04/40	1996	DIPAC	Fish Creek, AK	05/28/98	- 27.2	L. Favorite Chan. (LFC)	08/27/98	213 111.9			91	5	
Chinook	50:04/41	1996	DIPAC	Fish Creek, AK	05/28/98	- 27.2	L. Favorite Chan. (LFC)	08/27/98	207 113.5			91	5	
Coho	50:04/35	1996	DIPAC	Gastineau Channel, AK	06/02/98	- 18.4	Chatham Strait (UCC)	08/26/98	243 166.7			166.7	85	
	65													
Chum	No Tag	-	-	-	-	- -	Icy Strait (ISD)	08/27/98	157 35.4			-	-	

⁴ ADFG = Alaska Department of Fish and Game
DIPAC = Douglas Island Pink and Chum

⁵ Fish tagged sometime between 15-24 May 1998