JC-98-18 Cruise Report
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Scientists from the Auke Bay Laboratory of the National Marine Fisheries Service, Alaska Fisheries Science Center, conducted a 5-d cruise aboard the NOAA ship *John N. Cobb* in the northern region of southeastern Alaska from 05 to 09 October 1998. This cruise was the fifth in a series of 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 collect otolith marked juvenile salmon to assess stock-specific growth, migration characteristics, and survival, as well as 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 sixteen 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 tows were planned and trawling was not scheduled because of the shallow depth.

Trawl gear:

Fish were sampled using a Nordic[1] 264 rope trawl fished at the surface directly astern the NOAA ship *John N. Cobb*. The mouth opening of the trawl was 20 m deep and 35 m wide and 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

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

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.

Oceanographic sampling:

The physical and biological environment was monitored and sampled at each station immediately prior to 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 made 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 abundance 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:

Fifteen of the sixteen stations were sampled according to the cruise plan; the furthest offshore station along the Icy Point transect (IPD) was not sampled due to rough seas (Table 1). The total sampling effort on the cruise included:14 rope trawl hauls, 15 bongo tows, 15 CTD casts, and 21 vertical plankton tows.

A total of 253 fish representing 14 species were sampled with the rope trawl (Table 2). Of the fish captured, all but one were measured for length and most were retained for later laboratory analysis. All five species of Pacific salmon were captured totaling 133 fish; all were juveniles except one adult coho. In the 14 trawl hauls, frequency of occurrence was highest for juvenile coho (*O. kisutch*), pink (*O. gorbuscha*), sockeye (*O. nerka*), chum (*O. keta*), chinook (*O. tshawytscha*) salmon; they occurred in 64%, 57%, 50%, 43%, and 43% of the hauls, respectively. The next highest frequency of occurrence (29%) was observed for sablefish (*Anoplopoma fimbria*) and Pacific herring (*Clupea harengus*).

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 8.6-9.1°C at inside stations and 7.6-11.3°C at coastal stations, while salinities ranged from 23.4-27.9 o/oo at inside stations and 30.7-31.3 o/oo at coastal stations.

Settled volumes of zooplankton differed somewhat between localities; it was highest at inshore stations, intermediate at coastal stations, and lowest at strait stations (Table 3). Settled volumes at inshore stations ranged from 2.0-20.0 ml and averaged 8.0 ml, at coastal stations setteled

volumes ranged from 1.0-8.0 ml and averaged 4.3 ml, and settled volumes at strait stations ranged 1.0-5.0 ml and averaged 3.8 ml.

The occurrence of juvenile salmon differed by localities and offshore distance sampled. Average catch per haul of juvenile salmon was highest in strait stations (16.5), lowest in coastal stations (4.6), and intermediate in inshore (11.3) stations (Table 3). At the three stations sampled along the Icy Point offshore transect, catches of juvenile salmon only occurred at the 7 km offshore station; none were captured at 23 and 40 km offshore.

Species occurrence differed by the localities sampled. Although, all five species of juvenile salmon were found at inshore, strait, and coastal strait stations, catch rates of all species except chinook were highest at strait stations: chinook were most abundant at inshore stations. For the more abundant non-salmonid species, sablefish and capelin *(Mallotus villosus*) occurred exclusively at coastal stations, Pacific herring occurred at strait and coastal stations, and Pacific sandfish (*Trichodon trichodon*) were found at one inshore station (Table 4).

Three adipose fin clipped juvenile salmon were examined for internally planted coded-wire tags (CWTs) (Table 5). Two of the fish contained CWTs: one chinook and one coho salmon. The additional adipose fin clipped fish that did not contain a CWT was a chum salmon. All CWT chinook and coho salmon were recovered in inside waters and originated from southeastern Alaska. Migration of the one CWT chinook salmon was 5 km (<0.1 km/d), whereas the migration of the CWT coho was 50 km (0.4 km/d).

Stomachs were examined from three potential predators of juvenile salmon: one adult starry flounder (*Platichthys stellatus*), one adult coho salmon, and one adult salmon shark (*Lamna ditropis*). The starry flounder stomach was empty, the coho stomach contained one juvenile pink salmon (20 cm) and one juvenile sablefish (~20 cm), and the salmon shark contained one adult coho salmon (~60 cm).

Discussion:

This was the fifth in a series of scheduled cruises in southeastern Alaska from May to October 1998. Information from this October cruise can be combined with the four previous 1998 cruises (Cruise reports JC-98-05, -08, -11, and -15) and compared to the 1997 results (Cruise reports JC-97-06, -09, -11, -14, -17; Orsi *et al*. 1997; Orsi *et al*. 1998; 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. From July to October, all five species were still captured, but abundance generally declined. Juveniles occurred most frequently in strait stations; in both years the highest catch rates occurred in June and July, and 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. Combined catch rates of these species in June and July from 1997 to 1998 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.

Of the three potential juvenile salmon predators captured on this cruise, predation was observed only in the one adult coho sampled. Predation on juvenile salmon by adult coho salmon was also observed in the August cruise in 1998. Two other species were observed to predate on juvenile salmon during the July cruise in 1998: spiny dogfish (*Squalus acanthias*) and immature sablefish. 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.

CWT recoveries of both juvenile chinook and coho salmon of Alaska origin in October suggests a protracted migration for some stocks in the region. In contrast to this 1998 cruise, no CWTs were recovered in October of 1997 (Murphy et al. 1997). In both the 1997 and 1998 cruises, CWT coho salmon recoveries occurred exclusively in June and July, whereas CWT chinook salmon recoveries occurred in June, July, and August (Orsi et al. 1997; 1998). Moreover, most juvenile chinook salmon recoveries occurred at inshore stations and CWT age -.1 fish were present in May at strait stations in 1997. This suggests that as juveniles, not all coho stocks migrate rapidly to the ocean and portions of some stocks of chinook salmon may reside extensively in inshore waters.

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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*, 05-09 October 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						
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

Table 2.-- Common name, species, life history stage, number captured, size, and frequency of occurrence of fish captured in 14 hauls with a rope trawl in the northern region of southeastern Alaska off the NOAA ship *John N. Cobb*, 05-09 October 1998.

Common name	Species	Life[2] history stage	Number captured	Number measured	Fork length (mm) min	Fork length (mm) max	Fork length (mm) $\bar{x}$	Percent frequency of occurrence
Sockeye salmon	*Oncorhynchus nerka*	J	46	46	152	211	178.2	50
Pink salmon	*O. gorbuscha*	J	26	26	179	293	220.7	57
Chinook salmon	*O. tshawytscha*	J	26	26	161	296	225.8	43
Coho salmon	*O. kisutch*	J	21	21	273	321	297.5	64
Chum salmon	*O. keta*	J	13	13	164	281	203.5	43
Coho salmon	*O. kisutch*	A	1	1	771	771	771.0	7
Salmonid total			133	133				
Sablefish	*Anoplopoma fimbria*	J	54	54	219	276	244.8	29
Pacific sandfish	*Trichodon trichodon*	J	20	20	115	140	125.1	7
Capelin	*Mallotus villosus*	J	17	17	46	95	60.0	21
Pacific herring	*Clupea harengus*	J, I, A	14	14	81	215	128.1	29
Soft sculpin	*Gilbertidia sigalutes*	J	9	8	23	34	28.3	7
Crested sculpin	*Blepsias bilobus*	I, A	2	2	143	201	172.0	14
Walleye pollock	*Theragra chalocogramma*	I, A	2	2	117	337	227.0	14
Starry flounder	*Platichthys stellatus*	A	1	1	547	547	547.0	7
Salmon shark	*Lamna ditropis*	A	1	1	1830	1830	1830.0	7
Non-salmonid total			120	119				
Totals			253	252				

[2] L = 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.

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*, 05-09 October 1998. No trawling occurred at station ABM (Haul# 2109).

			2-m	2-m	20-m plankton volume (ml)		Salmonids						
							Juvenile					Adult	
Date	Haul#	Station	temperature (°C)	salinity (o/oo)	Zoop	Total	Sockeye	Pink	Chinook	Coho	Chum	Coho	Total
05 October	2096	TKI	8.6	23.4	3.0	3.0	-	-	7	-	-	-	7
05 October	2097	FPR	8.9	27.9	20.0	20.0	7	2	1	1	2	-	13
06 October	2098	ISA	8.8	26.6	4.0	4.0	1	-	2	7	-	-	10
06 October	2099	ISB	8.8	26.0	5.0	5.0	1	4	-	1	-	-	6
06 October	2100	ISC	8.9	25.1	5.0	5.0	21	5	-	2	5	-	33
06 October	2101	ISD	9.1	23.7	1.0	11.0	9	4	1	1	2	-	17
07 October	2102	CSA	10.3	31.0	7.0	7.0	-	-	-	1	-	-	1
07 October	2103	CSB	7.6	31.2	1.0	1.0	-	3	-	5	1	1	10
07 October	2104	CSC	7.7	31.2	2.0	2.0	-	1	1	-	1	-	3
07 October	2105	CSD	7.6	31.1	3.0	3.0	1	2	-	2	2	-	7
08 October	2106	IPA	11.3	30.7	5.0	5.0	6	5	-	1	-	-	12
08 October	2107	IPB	11.1	31.0	4.0	4.0	-	-	-	-	-	-	-
08 October	2108	IPC	11.2	31.3	8.0	8.0	-	-	-	-	-	-	-
09 October	2109	ABM	9.1	25.0	7.0	7.0	na	na	na	na	na	na	na
09 October	2110	LFC	8.6	24.9	2.0	2.0	-	-	14	-	-	-	14
~~Total catch~~					~~46~~		~~26~~	~~26~~	~~21~~	~~13~~		~~1~~	~~133~~

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*, 05-09 October 1998. No trawling occurred at station ABM (Haul# 2109).

Date	Haul#	Station	Sablefish	Pacific sandfish	Capelin	Pacific herring	Soft sculpin	Crested sculpin	Walleye pollock	Starry flounder	Salmon shark	Total
05 October	2096	TKI	-	20	-	5			-	-	-	1-
	26											
05 October	2097	FPR	-	-	-	-			-	1	-	--
	1											
06 October	2098	ISA	-	-	-	-			9	1	-	--
	10											
06 October	2099	ISB	-	-	-	-			-	-	-	--
	-											
06 October	2100	ISC	-	-	-	-			-	-	-	--
	-											
06 October	2101	ISD	-	-	-	-			-	-	-	-1
	1											
07 October	2102	CSA	2	-	5	-			-	-	-	--
	7											
07 October	2103	CSB	32	-	-	1			-	-	-	--
	33											
07 October	2104	CSC	-	-	11	3			-	-	1	--
	15											
07 October	2105	CSD	1	-	1	5			-	-	-	--
	7											
08 October	2106	IPA	19	-	-	-			-	-	-	--
	19											
08 October	2107	IPB	-	-	-	-			-	-	-	--
	-											
08 October	2108	IPC	-	-	-	-			-	-	-	--
	-											
09 October	2109	ABM	na	na	na	na	na	na	na	na	na	na
09 October	2110	LFC	-	-	-	-			-	-	1	--
	1											

Total catch	54	20	17	14	9	2	2	1	1	120

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*, 05-09 October 1998. Fish recovered that were adipose fin clipped but did not contain coded-wire tags are also reported.

		Release information						Recovery information					Days	Marine Distance
Species	Coded-wire tag code	Brood year	Agency[3]	Locality	Date	Size (mm)	(g)	Locality	(station code)	Date	(mm)	Size (g)	since release	traveled (km)
Chinook	50:04/40	1996	DIPAC	Fish Creek, AK	05/28/98	-	27.2	L. Favorite Chan.	(LFC)	10/09/98	186	65.2	134	5
Coho	50:04/35 50	1996	DIPAC	Gastineau Channel, AK	06/02/98	-	18.4	Chatham Strait	(UCC)	10/06/98	286	260.4		126
Chum	No Tag	-	-	-	-	-	-	Icy Strait	(ISD)	10/06/98	191	72.9	-	-

[3] DIPAC = Douglas Island Pink and Chum