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**Comparison of Pelagic Fishing Gear in Coastal Waters of Southeastern Alaska**

by

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## Abstract

During August 1998 scientists from the Auke Bay Laboratory conducted a study in the coastal waters of southeastern Alaska to compare a rope trawl modified for fishing at the surface with a floating gillnet of variable mesh size for sampling juvenile sablefish (*Anoplopoma fimbria*) and juvenile salmon (*Oncorhynchus* spp.). Species composition, catches, and average fish size differed between the rope trawl and gillnet catches. A total of 257 fish and squid representing 11 species was captured with rope trawl gear, whereas gillnet sampling resulted in the capture of 89 fish representing six species. Nearly twice as many species were present in rope trawl catches than gillnet catches and this difference is believed to reflect higher selectivity in gillnet sampling gear. Although juvenile salmon catch was higher using the rope trawl, juvenile sablefish catch was higher using the gillnet. Average fork lengths of juvenile salmon were higher in gillnet catches. Average fork length of juvenile sablefish was higher in rope trawl catches, but the difference in length between gear types was not significant.

## Introduction

Scientists from the Auke Bay Laboratory of the National Marine Fisheries Service, Alaska Fisheries Science Center, conducted a 6-day cruise aboard the NOAA ship *John N. Cobb* in the coastal waters of southeastern Alaska from 17 to 22 August 1998. The primary objective of the cruise was to compare rope trawl and gillnet sampling methods for juvenile sablefish and juvenile salmon in coastal southeastern Alaska.

## Methods

A Nordic 264 rope trawl with 3-m foam-filled Lite<sup>1</sup> trawl doors was used to collect fish at each station. The trawl was fished by the NOAA Ship *John N. Cobb*, a 28.3 m research vessel equipped with a 325 hp engine. Main warp was set at 137 m, and 55-m wire bridles were used to attach the trawl to the trawl doors. The Nordic 264 rope trawl is 184 m long and has a mouth opening of 24 m x 30 m (depth x width). Mesh sizes of the rope trawl from the jib lines aft to the cod end were: 162.6 cm, 81.3 cm, 40.6 cm, 20.3 cm, 12.7 cm, and 10.1 cm. A 0.8-cm mesh knotless liner was placed in the cod end. The trawl was modified to fish at the surface by (1) modifying trawl door configuration, (2) adding a cluster of three meshed A-4 Polyform buoys to each wingtip of the headrope, and (3) adding a single A-3 Polyform<sup>1</sup> float to the center of the headrope. The trawl was fished for 20 min with a through-water speed of approximately 1.5 m/sec (3 knots). Trawling speed was monitored with an electromagnetic current meter (Marsh McBirney, Inc., Model 200021) mounted to the side of the ship.

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

The trawl was fished in a west to east direction with the ocean swell and perpendicular to the shore. Station coordinates were the midpoint of the trawl haul. All trawling was conducted during daylight hours.

A floating gillnet with variable mesh sizes was also used to collect fish at each station. The gillnet used during the survey was 200 m in length and 3 m in depth. Mesh sizes increased by .25 inches every 50 m from 0.75 inch to 1.5 inch. Two A-3 Polyform floats were attached to each end of the gillnet and a flagpole with a flasher and radar reflector were attached to the retrieval end. The ship's spare trawl net reel was used to deploy and retrieve the gillnet. The gillnet was deployed at the station coordinates in a north-to-south direction (parallel to the ocean swell and shore) and retrieved in the opposite direction. The gillnet was deployed prior to trawling and retrieved after the trawl samples were processed. Gillnet soak-time depended on the time required to complete trawling and ranged from 73 to 135 min. All gillnet sampling was conducted during daylight hours.

All fish and squid were identified and measured for length onboard the ship. Juvenile salmon, juvenile sablefish, saury (*Cololabis saira*), sardine (*Sardinops sagax*), and herring (*Clupea pallasii*) were frozen and bagged individually for later laboratory analysis. Scale samples were taken, and stomach contents collected from adult pink (*O. gorbuscha*) and sockeye (*O. nerka*) salmon were examined. A total of 21 juvenile sablefish were retained alive for further laboratory analysis of daily growth rates.

Stocks of juvenile salmon were identified by coded-wire tags (CWTs) and thermal marks. Juvenile salmon were tested for the presence of CWTs using a portable CWT detector onboard the vessel. Adult salmon were examined visually for missing adipose fins. Otoliths from juvenile chum salmon were examined for the presence of hatchery-induced thermal marks. Otoliths from other species of juvenile and adult salmon were not examined for thermal marks due to the low expected probability of thermal marks in these species.

## Results

Rope trawl and gillnet samples were collected at seven stations over the continental shelf (bottom depth < 200 m) and three stations in oceanic waters (bottom depth > 200 m) (Table 1). A total of 257 fish and squid representing at least 11 species were captured by rope trawl. A total of 89 fish from six species was captured by gillnet (Table 2; Table 3). Species composition varied between rope trawl and gillnet samples. Trawl catches included 222 juvenile salmon representing five species. Gillnet catches included 35 juvenile salmon representing four species. Catches of adult salmon were higher in gillnet samples. The rope trawl captured two adult pink salmon and the gillnet captured 23 adult salmon (22 pink and one sockeye salmon). Gillnet catches of juvenile sablefish were higher than trawl catches. Twenty six juvenile sablefish were captured by gillnet; only 11 were captured by rope trawl. Saury were absent in trawl catches, but were captured by gillnet. Salmon shark, Pacific sardines, herring, and larval flatfish were captured in the trawl, but none were captured by gillnet.

Average fork lengths of fish varied between trawl and gillnet samples. All juvenile salmon species had higher mean fork lengths in gillnet catches, however, only lengths of juvenile pink and coho salmon were significantly higher ( $p < 0.05$ ). Average fork length of juvenile sablefish was higher in trawl catches than in gillnet catches, but the difference in fish length between gear types was not significant ( $p > 0.05$ ).

Stock information from juvenile salmon was minimal. One coded-wire tag was recovered from a Burnett Inlet hatchery coho salmon (Table 4); and no hatchery thermal marks were present in juvenile chum salmon. Migration rate for the coded-wire tagged coho salmon was approximately 5.0 km/day. Growth for the coho salmon was 2.06 gm/day and 1.45 mm/day.

Stomach contents of 21 adult pink salmon and one adult sockeye salmon were examined on board. All stomachs were empty except for three pink salmon. Two were feeding predominately on euphausiids (20% and 50% full), and one was feeding on crab megalopa (10% full).

## Discussion

Species composition and numbers of fish differed between rope trawl and gillnet catches. Overall, trawl catches were greater and more diverse than gillnet catches. Catch rates of juvenile salmon, particularly pink salmon, were substantially higher in trawl samples and may reflect the herding capability of the trawl. Juvenile salmon were captured by gillnet primarily in the upper meter of the water column. Therefore, it is unlikely that the deeper sampling depth of the trawl contributed significantly to the higher numbers of juvenile salmon in the trawl. Lower species diversity in gillnet catches may be largely due to greater size-selectivity of gillnets. Gillnets are not strictly size-selective, as they also capture fish through entanglement. This is apparent in our gillnet catches of adult salmon. Adult salmon were entangled in the gillnet by their teeth and mouth, features that become pronounced in the later stages of maturation. All of the adult salmon captured in the gillnet were in an advanced state of maturation, suggesting that the small mesh of the gillnet may lead to increased selectivity for maturing salmon by entangling them. Even with the possible selectivity for catching maturing salmon, the gillnet captured significantly more adult salmon than the rope trawl. Saury, which are fast swimming and highly visual feeders, were also notably absent in trawl catches. The absence of saury and the reduced catch of adult salmon suggests the trawl may have a low selectivity for faster-swimming fish.

Although directional effects on catch rates were not considered in this survey, they can be an important aspect of sampling efficiency in passive fishing gear, such as a gillnet. The direction that a gillnet is set may have a significant effect on catch rates, particularly for species that are actively migrating. Along-shore migration of juvenile salmon may result in lower catch rates when gillnets are deployed parallel to the coast and higher catch rates when deployed perpendicular to the shoreline. Similarly, onshore migration of juvenile sablefish and adult salmon may result in increased catch rates when gillnets are deployed parallel to the coast. Directional effects may be contributing to the significant differences between the two gear types and should be considered in the future.

The capture of Pacific sardines in the trawl at this northerly location was exceptional and is likely linked to the strong 1997-98 El Niño event. The eight sardines collected during this survey represent a range extension for this species. The only other time Pacific sardines have been captured in Alaska was in 1931, after the strong 1930-31 El Niño event.

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Table 1. Stations sampled by rope trawl and gillnet by the NOAA ship *John N. Cobb*, 18-20 August 1998.

Haul	Station	Date	Latitude	Longitude	Distance Offshore (km)	Depth (m)
1	1a	8/18/98	57° 20' N	136° 00' W	5.5	90
2	1b	8/18/98	57° 20' N	136° 10' W	10.5	144
3	2a	8/19/98	57° 25' N	137° 02' W	3.5	65
4	2b	8/19/98	57° 25' N	137° 08' W	7.8	96
5	2c	8/19/98	57° 25' N	137° 16' W	10.5	143
6	2d	8/19/98	57° 25' N	137° 23' W	15.0	1830
7	3c	8/20/98	57° 30' N	137° 16' W	13.5	120
8	3d	8/20/98	57° 30' N	137° 24' W	17.0	165
9	3e	8/20/98	57° 31' N	136° 34' W	15.0	620
10	3f	8/20/98	57° 32' N	136° 42' W	25.0	1070

Table 2. Number, life history stage, and size of fish<sup>1</sup> captured by rope trawl and gillnet in coastal southeastern Alaska by the NOAA ship *John N. Cobb*, 18-20 August 1998.

Gear	Common name	Species	Life History		Fork length (mm)			
			Stage	Catch	min	max	avg.	sd
Rope	Pink salmon	<i>Oncorhynchus gorbuscha</i>	J	145	111	203	149.61*	15.86
Trawl	Chum salmon	<i>O. keta</i>	J	51	123	205	161.31	19.18
	Sockeye salmon	<i>O. nerka</i>	J	15	117	162	144.2	10.13
	Coho salmon	<i>O. kisutch</i>	J	10	239	268	252.10*	7.74
	Chinook salmon	<i>O. tshawytscha</i>	J	1	226	226	226	--
	Pink salmon	<i>O. gorbuscha</i>	A	2	506	535	520.5	20.51
	Sablefish	<i>Anoplopoma fimbria</i>	J	11	175	194	182.82	6
	Pacific sardine	<i>Sardinops sagax</i>	A	8	234	273	252.38	11.82
	salmon shark	<i>Lamna ditropis</i>	A	2	1160	1870	1515	502.05
	Pacific herring	<i>Clupea pallasii</i>	A	1	196	196	196	--
	Pleuronectidae	<i>Pleuronectidae</i>	L	1	40	40	40	
Gillnet	Pink salmon	<i>O. gorbuscha</i>	J	20 <sup>2</sup>	133	175	159.80*	11.31
	Chum salmon	<i>O. keta</i>	J	8	143	209	173.63	22.7
	Sockeye salmon	<i>O. nerka</i>	J	3	153	154	153.67	0.58
	Coho salmon	<i>O. kisutch</i>	J	3	250	321	277.33*	38.21
	Pink salmon	<i>O. gorbuscha</i>	A	19 <sup>3</sup>	474	570	522.68	27.58
	Sockeye salmon	<i>O. nerka</i>	A	1	490	490	490	--
	Sablefish	<i>A. fimbria</i>	J	26	135	213	175.81	22.8
	Pacific saury	<i>Cololabis saira</i>	A	5	314	316	314.8	1.1

\* Mean length differs significantly between gear types.

<sup>1</sup> Rope trawl catches of 10 squid are not included (mantle lengths: 30-35 mm).

<sup>2</sup> One juvenile pink salmon captured at station 1a was not measured

<sup>3</sup> Three adult pink salmon dropped out of the gillnet before reaching the ship.

Table 3. Rope trawl and gillnet catches (life-history stages: juvenile, adult, and larval) captured by rope trawl and gillnet in coastal southeastern Alaska by the NOAA ship *John N. Cobb*, 18-20 August 1998.

Gear	Date	Haul	Station	Sampling	Juvenile						Adult						Larval	
				Effort	Pink	Chum	Sockeye	Coho	Chinook	Sablefish	Pink	Sockeye	Pacific	Pacific	Salmon	Pacific	Squid	Flatfish
				(min)	Salmon	Salmon	Salmon	Salmon	Salmon		Salmon	Salmon	Sardine	Saury	Shark	Herring		
Rope	8/18/11	1	1a	20	111	20	8	1	--	--	--	--	--	--	--	1	--	--
Trawl	8/18/11	2	1b	20	9	14	4	--	--	--	--	--	--	--	--	--	--	--
	8/19/11	3	2a	20	--	1	--	1	--	--	--	--	--	1	--	--	--	--
	8/19/11	4	2b	20	2	2	1	--	1	--	--	--	--	1	--	--	--	--
	8/19/11	5	2c	20	2	--	--	--	--	--	--	--	--	--	--	--	--	--
	8/19/11	6	2d	20	--	2	--	1	--	10	--	--	--	--	--	--	--	--
	8/20/11	7	3c	20	21	10	1	6	--	--	1	--	--	--	--	--	10	1
	8/20/11	8	3d	20	--	1	--	1	--	--	--	--	--	--	--	--	--	--
	8/20/11	9	3e	20	--	--	1	--	--	1	1	--	8	--	--	--	--	--
	8/20/11	10	3f	20	--	1	--	--	--	--	--	--	--	--	--	--	--	--
					145	51	15	10	1	11	2	0	8	0	2	1	10	1
Gillnet	8/18/11	1	1a	135	1	--	--	1	--	1	8	1	--	--	--	--	--	--
	8/18/11	2	1b	117	5	3	1	1	--	1	--	--	--	4	--	--	--	--
	8/19/11	3	2a	81	--	1	--	--	--	--	4	--	--	--	--	--	--	--
	8/19/11	4	2b	80	1	1	--	--	--	--	--	--	--	--	--	--	--	--
	8/19/11	5	2c	90	3	1	--	--	--	1	1	--	--	--	--	--	--	--
	8/19/11	6	2d	85	1	--	--	--	--	20	2	--	--	--	--	--	--	--
	8/20/11	7	3c	84	10	--	2	1	--	--	5	--	--	--	--	--	--	--
	8/20/11	8	3d	73	--	--	--	--	--	2	--	--	--	--	--	--	--	--
	8/20/11	9	3e	82	--	2	--	--	--	1	2	--	--	--	--	--	--	--
	8/20/11	10	3f	120	--	--	--	--	--	--	--	--	--	1	--	--	--	--
					21	8	3	3	0	26	22	1	0	5	0	0	0	0

Table 4. Release and recovery information of coded-wire tagged juvenile salmon captured by rope trawl in coastal southeastern Alaska by the NOAA ship *John N. Cobb*, 18-20 August, 1998.

Species	Release Information							Recovery Information					
	Coded-wire tag code	Brood year	Agency	Locality	Date	Size (mm)	Size (g)	Locality (station)	Date	Size (mm)	Size (g)	Days Since Release	Distance Traveled (km)
Coho	04:48/10	1996	SSRAA*	Burnett Inlet	06/01/98	136	25.07	Salisbury Sound (3c)	08/20/98	255	191.5	81	400

\* Southern Southeast Regional Aquaculture Association