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Southeast Alaska Coastal Monitoring Survey Cruise Report, 2018

by

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ABSTRACT

Surface trawl and oceanographic data were collected within the northern region of Southeast Alaska (SEAK) as part of the 2018 Southeast Alaska Coastal Monitoring (SECM) survey. SECM surveys have been conducted annually since 1997 to monitor the status of juvenile salmon and ocean conditions in SEAK. Eight stations were sampled in the strait habitat at monthly intervals along two transects (Icy Strait and Upper Chatham Strait) during 2018. Four stations were added in Stephens Passage (inshore habitat) in 2018 to provide additional insight into the early marine ecology of Chinook salmon. Fish, zooplankton, water, and temperature and salinity data were collected at each station using a surface rope trawl, bongo nets, and a conductivity-temperature-depth (CTD) sensor. Surface temperatures increased and salinities decreased over the summer growing season in both inshore and strait habitats; however, salinities were consistently lower in Stephens Passage due to the freshwater discharge of the Taku River. Average temperature in the strait habitat (May–August, upper 20m) was 9.22°C, just below the long-term average of 9.33°C. A total of 1,026 salmon and 29,612 non-salmon fish species (primarily Pacific herring) were captured during 76 rope trawl hauls. Average catch rates and sizes of juvenile salmon were below average in strait habitats during 2018. Peak catch rates of juvenile Chinook and coho salmon occurred in Stephens Passage during June. Juvenile sockeye salmon also had their peak catch rates in Stephens Passage but their peak catch rates occurred in August. The low average size of sockeye salmon within Stephens Passage during August likely reflects the presence of the late out-migrating sub-yearling migratory phenotype. Peak catch rates for juvenile pink and chum salmon both occurred in strait habitats during July. Five coded-wire-tags (CWTs) were recovered from juvenile Chinook salmon in the inshore habitat (Stephens Passage) and three of the tags were from the Douglas Island Pink and Chum, Inc. (DIPAC) hatchery. Two CWTs were recovered from Coho salmon and both were from the DIPAC hatchery. DIPAC chum salmon were the most abundant stock group in the strait habitat during June. The proportion of unmarked (wild) chum salmon (40%) and Northern Southeast Regional Aquaculture Association (37%) were highest in July. We plan to continue sampling the new stations that were added in Stephens Passage during 2018. We believe these stations hold significant promise for improving our understanding of the survival and early marine ecology of local Chinook salmon stocks. Both the size and abundance of juvenile salmon were below average in 2018. Pink salmon forecast models clearly indicate that low juvenile pink salmon abundance will contribute to poor harvests the following year. Models for the other species of salmon have either not been developed or do not provide a clear direction for how to interpret juvenile status. Developing meaningful models for other salmon species will be a priority for the SECM survey over the next several years.

INTRODUCTION

The Southeast Alaska Coastal Monitoring (SECM) survey was designed to improve our understanding of the early marine ecology and production dynamics of Southeast Alaska (SEAK) salmon (*Oncorhynchus* spp.). SECM surveys were initiated in 1997 (Murphy et al. 1999); although the survey design has varied over time, these surveys have been conducted every year since its inception (Fergusson et al. 2018). One of the key applications of the SECM surveys to fisheries management has been the development of a reliable harvest forecast model for SEAK pink salmon fisheries based on juvenile abundance (Wertheimer et al. 2006; Orsi et al. 2016; Murphy et al. 2019). Salmon and salmon fisheries are an integral part of the ecological and socio-economic framework of SEAK. Changes in salmon survival and production have a widespread impact on the ecosystems and communities within SEAK.

Factors controlling the survival and production of Pacific salmon have been intensively studied throughout their range (Beamish et al. 2010). Temperature has been identified as an important factor in freshwater and marine survival of salmon (Pyper et al. 2005; Beauchamp et al. 2007; Taylor 2008; Bryant 2009; Orsi et al. 2016;). Trophic linkages, growth, and condition of salmon are also important to the survival of salmon (Mortensen et al. 2000; Cooney et al. 2001; Brodeur et al. 2007; Farley et al. 2009; Weitkamp et al. 2011; Fergusson et al. 2013; Miller et al. 2013; Moss et al. 2016). Interactions between environmental factors, fishing effects, and ecosystem level processes such as competition and carrying capacity are dynamic and require long-term monitoring projects on stock-specific status of salmon and ocean conditions to identify and understand these linkages (Murphy et al. 2017).

This report summarizes the results of the 2018 SECM survey. The 2018 SECM survey was a cooperative research survey aboard the Alaska Department of Fish and Game (ADF&G) research vessel *Medeia* by NOAA Fisheries and ADF&G. Biologists from NOAA, ADF&G, and the regional aquaculture associations provided direct assistance to the sampling effort during the June, July, and August surveys. We plan to continue working towards increased coordination between agencies and will continue to look for ways to improve the relevance of the SECM survey to the fishing industry and resource management concerns in SEAK.

METHODS

Sampling was conducted in strait (Icy Strait and Upper Chatham Strait transects) and inshore (Stephens Passage) habitats within the northern region of SEAK monthly from May to August 2018 (Figure 1; Table 1). Oceanographic data were collected in May aboard the 12 m NOAA vessel R/V *Sashin*, and both oceanographic and surface trawl data were collected in June-August aboard the ADFG vessel R/V *Medeia* (Table 2).

Oceanographic data collected at each station consisted of a conductivity-temperature-depth profiler (CTD) cast, a surface water sample for chlorophyll (µg/L) concentrations, and a bongo net sample for zooplankton. A Sea-Bird[1] SBE 49 'Fastcat' profiler was deployed with the bongo net to 200 m or within 20 m of the bottom to determine sea surface (< 3-m) temperature (SST, °C) and salinity (PSU) as well as the average 20-m integrated water column temperature and salinity. The 20-m water column depth bracketed typical depths sampled by the surface trawl and the seasonal pycnocline. Surface water samples were collect with a bucket at each station.

[1]Reference to trade names does not imply endorsement by the Auke Bay Laboratories, National Marine Fisheries Service, NOAA Fisheries.

The bongo net had a 60-cm diameter tandem frame with 333- and 505-µm meshes. General Oceanics Model 2031 flow meters were placed inside each bongo net to calculate the volume of water filtered. Zooplankton samples were preserved in a 5% formalin-seawater solution buffered with a 2.5% borax-seawater solution. An additional bongo sample was collected each month to collect live zooplankton for lipid analysis.

Fish sampling was accomplished with a Nordic 264 rope trawl modified to fish at the surface. The trawl was 184 m long with typical fishing dimensions of 18 m wide by 24 m deep (Sturdevant et al. 2012). A detailed description of the trawl is included in Orsi, et al. (2016). Each trawl was towed for 20 or 60 minutes and two trawl sets were made at each station (replicate tows). Trawl sets in the strait habitat (Icy Strait and Upper Chatham Strait transects) were 20 minutes in duration. Trawl sets in Stephens Passage were increased from 20 minutes in June to 60 minutes in July and August to increase sample sizes of juvenile Chinook and coho salmon. The start of each trawl set was offset by approximately 1 nm from the station coordinates and the vessel trawled through or near the station coordinates during each trawl set. Trawl catches were sorted to species and catch weights were recorded in an electronic catch logging system known as Catch Logging for Acoustic and Midwater Trawl System (CLAMS). A subsample of up to 30 fish of each species per trawl haul were electronically measured for length and weight. All juvenile salmon measured for length and weight were frozen whole in 2018 for the analysis of otolith thermal marks, genetic stock origin, diet, and energetics following sample collection protocols identified in the cruise instructions. Up to 10 stomachs were collected and frozen individually from immature and adult life-history stages of salmon at each trawl set. All specimens were given a specimen barcode tag and all tags were scanned into CLAMS with a barcode scanner.

All Chinook and coho salmon were examined for a missing adipose fin and screened for the presence of a coded-wire-tag (CWT) with a handheld CWT tag detector. Juveniles with missing adipose fins or CWTs were bagged individually and an additional CWT label was added to the juvenile specimen. CWTs were removed and read in the lab. Sagittal otoliths were removed from juvenile chum, coho, and sockeye salmon in the lab and sent to the Douglas Island Pink and Chum, Inc. (DIPAC) otolith laboratory for thermal mark processing.

RESULTS AND DISCUSSION

A total of 12 to 13 stations were sampled each month from May–August during 16 days of sampling in 2018 (Table 2). CTD casts and chlorophyll samples were collected at each station. Surface rope trawl hauls occurred each month from June to August. Two trawl events were completed at each station, resulting in a total of 76 surface rope trawl events. Bongo net sampling occurred each month from May to August. Bongo tows were completed at two stations in the inshore habitat (Stephens Passage) and four stations in the strait habitat (Icy Strait transect), resulting in a total of 22 bongo net tows (Table 2).

Average sea surface (3-m) temperatures (SST) ranged from 8.6 to 15.4 ºC and the integrated (top 20-m) temperatures ranged from 7.7 to 10.8 °C from May to August (Table 3). Surface temperatures increased and salinities decreased over the summer growing season in the strait habitat. July temperatures were highest in the inshore habitat. Both 3-m and 20-m salinities were lower in the inshore habitat (Stephens Passage) due to its proximity to the Taku River. Average temperature in the strait habitat (May–August, upper 20m) was 9.2°C, very close to the long-term average of 9.3°C (Table 4).

A total of 1,026 salmon, 29,612 non-salmon fish, and one squid were captured during 76 rope trawl hauls in 2018 (Table 5; Appendix 1–3). Juvenile Chinook and coho salmon catches were highest in inshore habitat (Stephens Passage) during June. Catches of juvenile sockeye salmon were also highest in the inshore habitat, but this was due to a single large catch in August. Nearly all juvenile pink and chum salmon were caught in strait habitats and their largest catches occurred in July. Species-specific coefficients (Wertheimer et al. 2010; Table 6) were used to convert R/V *Medeia* catch rates in 2018 to the NOAA Ship *John N. Cobb* units (the coefficient for coho salmon (1.26) was used to standardize Chinook salmon catches). Standardized catch rates for all juvenile salmon were below average in 2018 (Table 7). The peak standardized catch rate of juvenile pink salmon (1.23) was used in the harvest forecast model for SEAK pink salmon (Piston et al. 2019).

Average lengths and weights of juvenile salmon in 2018 are summarized in Table 8. Juvenile chum, coho, pink, and sockeye salmon all had lengths that were below their long term average (Table 9). The overall average difference in the length of juvenile salmon between June and July indicate that apparent growth rates are in the range of 1 mm/day for all species except sockeye salmon. The average length of juvenile sockeye salmon in Stephens Passage during August (109 mm) was 63% less than their average size in the strait habitat (174 mm). Subyearling (freshwater age-0) salmon enter marine habitats later than other freshwater ages. The small size of juvenile sockeye in the inshore habitat is consistent with this migratory phenotype. Juvenile sockeye salmon have apparent growth rates that are nearly half of the other species of salmon. However, due to the presence of multiple age classes in sockeye salmon, it may not be possible to infer patterns of growth rate without information on age structure (Murphy, et al. 1999).

All Chinook (n = 131 juveniles, n = 9 immature) and coho (n = 172 juveniles, n = 3 maturing) salmon were scanned for the presence of a CWT on-board the survey. A total of eight CWTs were recovered from juvenile Chinook in 2018 and all were recovered in Stephens Passage (Table 10). Mark rate expansions need to be applied to the tag recovery rates before habitat utilization patterns can be resolved. However, there are a number of key observations that can be made with the tag recovery rates. Half of the tags recovered were from the DIPAC hatchery, which is consistent with historic tag recovery rates in the inshore habitat. Only two CWTs were recovered from coho salmon and both were from the DIPAC hatchery (Table 11). The total number of CWTs recovered from coho salmon since 1997 (n = 322) is nearly four times greater than Chinook salmon (n = 85). Coho salmon have relatively similar number of tags recovered from wild (n = 131) and hatchery (n = 191) stocks, whereas Chinook salmon tags have been predominately recovered from hatchery stocks (n = 75).

Otolith thermal mark recoveries also provide key information on origin of hatchery salmon stocks (Table 12). Mark rate expansions for hatchery chum salmon are not necessary as 100% of the hatchery chum salmon are thermally marked. DIPAC chum salmon accounted for all of the thermal marks recovered in June and nearly all chum salmon were estimated to be hatchery origin (96%). The low number of otoliths (n = 53) that were examined in June could be contributing factor to the atypically low proportion of unmarked (wild) chum salmon in June. Minimum sample size requirements to account for sampling error may be necessary to ensure stock proportions are comparable over time. The proportion of unmarked chum salmon (40%) and Northern Southeast Regional Aquaculture Association (37%) were highest in July. Migratory distances and migration timing of chum salmon are important contributing factors in the mark proportions present in Icy Strait (the strait habitat). The overall proportion of DIPAC marks during June (56%) is much higher than NSRAA marks (10%). DIPAC hatchery chum only have to travel approximately 85 km to reach the strait habitat, whereas NSRAA chum salmon are approximately 120 km from the strait habitat, which most likely contributes to a slightly later migration timing through Icy Strait and the strait habitat (Murphy et al. 2019).

SUMMARY

The 2018 SECM survey was conducted as a cooperative research effort by NOAA Fisheries and ADF&G aboard the ADF&G research vessel *Medeia*. We plan to continue sampling the new stations that were added in Stephens Passage during 2018. We believe these stations hold significant promise for improving our understanding of the survival and early marine ecology of local Chinook salmon stocks. Both the size and abundance of juvenile salmon were below average in 2018. Pink salmon forecast models clearly indicate that low juvenile pink salmon abundance will contribute to poor harvests the following year. Models for the other species of salmon have either not been developed or do not provide a clear direction for how to interpret juvenile status. Developing meaningful models for other salmon species will be a priority for the SECM survey over the next several years.

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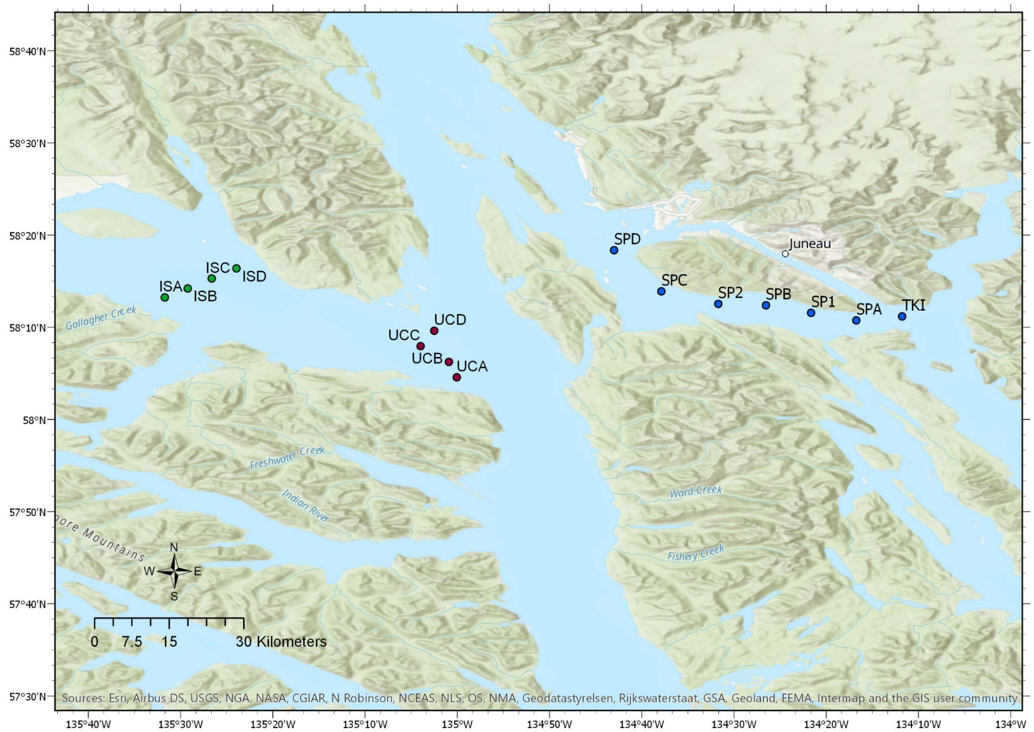

Figure 1. Station locations sampled during the Southeast Alaska Coastal Monitoring Survey, 2018.

Table 1. Names, habitats, coordinates, and depths of stations sampled during the Southeast Alaska Coastal Monitoring Survey, 2018.

Station[1]	Habitat	Latitude (N)	Longitude (W)	Bottom Depth (m)
TKI	Inshore	58° 11.19’	134° 11.71’	175
SPA		58° 10.76’	134° 16.70’	100
SPB		58° 12.37’	134° 26.52’	80
SPC		58° 13.91’	134° 37.85’	55
SPD		58° 18.38’	134° 42.97’	65
SP1		58° 11.58’	134° 21.60’	76
SP2		58° 12.54’	134° 31.68’	68
UCA	Strait	58°04.57’	135°00.08’	400
UCB		58°06.22’	135°00.91’	100
UCC		58°07.95’	135°01.69’	100
UCD		58°09.64’	135°02.52’	200
ISA		58°13.25’	135°31.76’	128
ISB		58°14.22’	135°29.26’	200
ISC		58°15.28’	135°26.65’	200
ISD		58°16.38’	135°23.98’	234

1 SP* = Stephens Passage, TKI = Taku Inlet, UC*=Upper Chatham, IS*=Icy Strait

Table 2. Number and types of sampling gear deployed during the Southeast Alaska Coastal Monitoring Survey, 2018.

				Data Collection Type			
Dates (days)	Vessel	Habitat	Stations	Rope trawl[1]	CTD[2]	Bongo[3]	Chlorophyll[4]
06/01 (1)	R/V Sashin	Strait	8	0	8	4	8
06/19-06/23 (5)	R/V Medeia	Inshore	5	10	6	2	6
		Strait	8	16	8	4	8
07/26-07/30 (5)	R/V Medeia	Inshore	5	10	5	2	5
		Strait	8	16	8	4	8
08/20-08/24 (5)	R/V Medeia	Inshore	4	8	4	2	4
		Strait	8	16	8	4	8
		Total	46	76	47	22	47

[1] 20-min hauls (Strait habitat) 60-min hauls (Inshore habitat) with Nordic 264 surface trawl

[2] To 200m or within 20m of the bottom

[3] 60-cm frame, 505- & 333-µm mesh, oblique tows down to & up from 200m or within 20m of bottom.

[4] chlorophyll are from surface seawater samples.

Table 3. Average upper 3-m and 20-m temperature and salinity in the Inshore and Strait habitats during the Southeast Alaska Coastal Monitoring Survey, 2018.

			Temperature		Salinity	
Habitat	Transect	Month	(3-m)	(20-m)	(3-m)	(20-m)
Inshore	Stephens Passage	June	11.04	8.06	21.04	27.83
		July	15.35	10.58	17.59	27.09
		August	12.56	10.79	17.32	26.22
Strait	Icy Strait	May	8.62	7.71	30.45	31.19
		June	11.00	8.73	28.09	30.30
		July	11.22	9.88	29.73	30.52
		August	12.79	10.33	24.41	28.78
	Upper Chatham	May	8.93	8.12	28.12	29.82
		June	10.78	8.53	27.90	30.07
		July	12.45	10.58	28.05	30.11
		August	12.83	9.90	22.89	29.00

Table 4. Average upper 20-m temperatures in the Strait habitat (Icy Strait and Upper Chatham stations) during the Southeast Alaska Coastal Monitoring Survey, 1997–2018.

Year	May	June	July	August	Average
1997	7.23	9.91	10.63	9.97	9.44
1998	7.40	10.04	11.03	9.93	9.60
1999	6.39	9.10	10.19	10.21	8.97
2000	6.47	9.60	10.20	9.98	9.06
2001	6.78	9.80	10.50	10.52	9.40
2002	6.39	8.98	9.22	9.60	8.55
2003	7.42	9.77	10.86	11.21	9.82
2004	7.38	9.47	10.96	10.68	9.62
2005	8.32	10.98	11.31	10.42	10.26
2006	6.77	9.26	10.29	9.28	8.90
2007	7.05	9.51	10.30	10.40	9.31
2008	6.22	8.11	9.44	9.45	8.31
2009	7.92	9.53	10.69	10.38	9.63
2010	8.49	9.92	9.77	10.43	9.65
2011	6.51	9.74	9.76	9.64	8.91
2012	6.63	8.82	10.07	9.38	8.73
2013	6.55	9.16	10.88	10.10	9.17
2014	7.66	9.44	10.18	10.01	9.32
2015	7.63	10.72	10.59	10.62	9.89
2016	8.68	10.64	11.58	10.74	10.41
2017	7.69	8.64	9.35	10.04	8.93
2018	7.91	8.63	10.23	10.11	9.22
97-18	7.25	9.53	10.36	10.14	9.32

Table 5. Surface trawl effort and catch of jellyfish (kg) and fish (n) at selected life-history stages by month and habitat during the Southeast Alaska Coastal Monitoring Survey, 2018.

		Strait			Inshore		
Species	*Scientific name*	June	July	August	June	July	August
Effort (hrs)		5.3	5.3	5.3	3.3	10.0	8.0
Jellyfish (kg)	*Aequorea sp.*	0	261	148	0	123	541
	Aurelia sp.	0	3	7	0	5	8
	Chrsaora melanaster	1	9	7	0	52	24
	Cyanea capillata	34	175	416	59	196	108
	Staurophora mertensi	3	10	0	0	6	0
Jellyfish subtotals		**38**	**458**	**578**	**59**	**382**	**681**
Salmon (n)							
Chum (juvenile)	*Oncorhynchus keta*	54	223	45	0	4	2
Sockeye (juvenile)	*O. nerka*	65	10	14	0	2	124
Coho (juvenile)	*O. kisutch*	49	24	16	56	24	3
Pink (juvenile)	*O. gorbuscha*	0	118	41	0	0	7
Chinook (juvenile)	*O. tshawytscha*	0	0	1	40	32	58
Chinook (imm.)	*O. tshawytscha*	0	2	1	5	1	0
Coho (adult)	*O. kisutch*	0	1	2	0	0	0
Pink (adult)	*O. gorbuscha*	0	0	0	0	1	0
Sockeye (adult)	*O. nerka*	1	0	0	0	0	0
Salmon subtotals		**169**	**378**	**120**	**101**	**64**	**194**
Non-salmon (n)							
Pacific herring	*Clupea pallasii*	8,961	22	0	2,145	17,834	8
Crested sculpin	*Blepsias bilobus*	3	15	11	1	122	90
Pacific spiny lumpsucker	*Eumicrotremus orbis*	0	4	0	3	38	143
Walleye pollock	*Gadus chalcogramma*	118	0	1	0	0	0
Prowfish	*Zaprora Silenus*	0	10	10	0	15	17
Starry flounder	*Platichthys stellatus*	0	0	0	11	2	3
Capelin	*Mallotus villosus*	0	7	0	0	0	0
Pacific sandfish	*Trichodon trichodon*	0	0	0	0	0	6
Wolf eel	*Anarrhichthys ocellatus*	1	1	0	0	1	2
Walleye pollock (age-0)	*Gadus chalcogramma*	3	0	0	0	0	0
Soft sculpin	*Gilbertidia sigalutes*	0	0	0	3	0	0
Sablefish	*Anoplopoma fimbria*	0	0	0	0	1	0
Gonatid sp.	*Gonatus sp.*	1	0	0	0	0	0
Non-salmon subtotals		**9,087**	**59**	**22**	**2,163**	**18,013**	**269**

Table 6. Vessel calibration coefficients used to standardize juvenile salmon catches between vessels used during the Southeast Alaska Coastal Monitoring Survey (from Wertheimer et al. 2010).

Species	*Chellissa:Medeia*	*Medeia:Cobb*
Pink	1.27	1.13
Chum	1.19	1.21
Sockeye	0.99	1.19
Coho	1.05	1.26
Total Salmon		1.19

Table 7. Average of calibrated log(CPUE+1) by month and year for juvenile salmon species in the Strait habitat (Icy Strait and Upper Chatham stations) during the Southeast Alaska Coastal Monitoring Survey, 1997–2018.

		June					July				
Year	Vessel	Chinook	Chum	Coho	Pink	Sockeye	Chinook	Chum	Coho	Pink	Sockeye
1997	Cobb	0.26	3.14	2.23	1.92	2.10	0.00	3.86	1.04	2.48	1.31
1998	Cobb	0.09	4.67	1.95	5.62	2.15	0.21	3.30	2.50	4.03	2.35
1999	Cobb	0.14	3.09	2.12	1.18	1.61	0.14	2.12	2.27	1.60	0.93
2000	Cobb	0.06	2.62	1.54	1.55	1.80	0.49	4.71	2.15	3.73	1.90
2001	Cobb	0.48	2.57	2.09	1.33	1.54	0.36	2.82	2.13	2.87	1.40
2002	Cobb	0.26	0.98	0.57	0.36	0.41	0.11	3.13	2.30	2.78	1.46
2003	Cobb	0.09	1.91	0.18	0.77	1.43	0.00	3.10	1.37	3.08	1.32
2004	Cobb	0.29	4.96	1.66	3.90	2.22	0.13	1.28	0.87	1.46	0.65
2005	Cobb	0.28	3.21	2.28	2.04	1.57	0.17	1.13	1.34	1.21	0.53
2006	Cobb	0.00	2.36	2.49	2.58	2.23	0.16	2.10	2.01	2.32	0.71
2007	Cobb						0.17	1.58	1.29	1.17	1.14
2008	Steller	0.53	1.39	2.49	0.27	1.56	0.39	2.40	2.18	2.49	1.31
2009	Chellissa	0.09	0.00	0.10	0.00	0.00	0.05	2.83	2.24	2.09	1.16
2010	NW Exp	0.23	2.64	2.30	3.59	2.34	0.08	2.82	2.14	3.67	2.36
2011	NW Exp	0.00	1.00	1.02	0.51	0.95	0.00	1.06	1.08	1.35	0.36
2012	NW Exp	0.16	1.26	1.23	1.55	0.85	0.11	3.01	2.35	3.15	2.30
2013	NW Exp	0.33	0.92	1.48	0.46	0.91	0.15	2.98	1.84	1.91	2.35
2014	NW Exp	0.00	2.54	1.80	2.40	2.69	0.08	2.40	2.20	3.40	2.64
2015	NW Exp	0.43	2.70	2.41	2.19	1.98	0.13	0.83	2.09	0.82	0.28
2016	NW Exp	0.25	3.19	2.70	3.89	2.82	0.02	2.69	2.05	3.05	1.95
2017	NW Exp	0.17	0.60	2.12	0.00	0.49	0.04	0.51	1.21	0.31	0.46
2018	Medeia	0.04	1.29	1.12	0.33	0.99	0.02	1.71	0.65	1.23	0.53
1997–2017		0.21	2.29	1.74	1.81	1.58	0.14	2.41	1.84	2.33	1.37

Table 8. Number of fish measured (*n*), average fork length (mm), and average weight (g) of juvenile salmon by habitat and month during the Southeast Alaska Coastal Monitoring Survey, 2018.

Size	Habitat	Month	Chinook	Chum	Coho	Pink	Sockeye
Sample Size (*n*)	Inshore	June	40	--	56	--	--
		July	32	4	24	--	2
		August	58	2	3	7	124
	Strait	June	--	54	49	--	65
		July	--	178	24	118	10
		August	1	45	16	41	14
Average Length (mm) (sample size >10)	Inshore	June	127	--	137	--	--
		July	151	--	201	--	--
		August	178	--	--	--	109
	Strait	June	--	100	159	--	116
		July	--	129	186	115	122
		August	--	175	230	152	174
Average Weight (g) (sample size > 10)	Inshore	June	23	--	26	--	--
		July	39	--	90	--	--
		August	65	--	--	--	12
	Strait	June	--	9	48	--	15
		July	--	22	73	13	19
		August	--	57	144	34	56

Table 9. Average fork length (mm) of juvenile salmon sampled in the Strait habitat (Icy Strait and Upper Chatham stations) during the June and July Southeast Alaska Coastal Monitoring Survey, 1997–2018.

	Chum		Coho		Pink		Sockeye	
Year	June	July	June	July	June	July	June	July
1997	96.5	135.7	147.0	210.7	95.7	135.8	108.6	139.9
1998	100.7	132.6	168.3	211.9	93.7	129.5	104.9	140.1
1999	103.2	127.8	157.0	211.9	97.2	117.5	126.4	136.7
2000	106.2	132.1	170.6	201.3	95.3	125.5	114.6	144.7
2001	95.8	122.6	163.9	189.4	93.1	121.6	118.9	125.0
2002	95.6	123.5	153.4	210.2	86.1	114.0	121.7	148.1
2003	114.7	124.2	173.9	201.0	98.1	121.7	117.4	125.4
2004	105.3	139.9	167.8	201.8	98.9	130.1	109.8	137.4
2005	112.8	126.2	185.9	209.2	107.9	129.4	118.3	112.2
2006	108.4	137.1	165.2	196.2	101.7	117.9	136.4	128.9
2007	92.0	125.7	157.3	177.9	95.6	127.4	128.6	128.3
2008	--	106.7	132.0	179.2	--	109.5	--	103.2
2009	--	134.1	--	208.5	--	127.4	--	137.3
2010	103.9	125.7	180.7	210.7	95.8	125.8	116.0	119.9
2011	99.0	129.3	176.2	201.7	86.3	117.8	132.3	146.3
2012	93.9	135.6	173.8	208.0	91.2	123.4	120.5	138.7
2013	95.5	130.8	169.2	198.3	101.5	132.6	131.5	144.2
2014	104.5	128.0	179.9	208.5	101.6	126.5	125.5	147.6
2015	123.5	159.1	188.3	222.5	117.3	163.2	130.0	147.2
2016	123.0	156.3	191.7	242.2	115.6	155.1	134.1	133.2
2017	95.5	139.8	165.0	187.8	--	127.5	104.6	152.0
2018	100.1	128.8	159.2	185.5	--	114.9	116.1	122.3

Table 10. Coded-wire tag (CWT) recoveries of juvenile and immature Chinook salmon by recovery year in the Inshore (Stephens Passage) and Strait (Icy Strait and Upper Chatham stations) habitats during the Southeast Alaska Coastal Monitoring Survey (June-August), 1997–2018.

	Inshore Habitat1				Strait Habitat									
	Juvenile Release Locations2				Juvenile Release Locations2					Immature Release Locations2				
Year	Taku R.	DIPAC	LPW	NSRAA	Taku R.	AKI	DIPAC	LPW	NSRAA	Chilkat R.	Fish C.	DIPAC	LPW	NSRAA
1997	--	8	--	--	--	--	--	--	--	--	1	--	--	--
1998	1	5	1	1	--	--	--	--	1	--	--	--	--	--
1999	--	2	--	--	--	--	--	--	--	--	--	1	--	--
2000	--	1	--	--	--	--	--	--	1	--	--	--	--	--
2001					--	--	--	--	5	--	--	2	--	1
2002					--	--	--	--	--	--	--	2	--	--
2003					--	--	--	--	--	--	--	--	--	--
2004					--	--	--	--	2	1	--	3	1	1
2005					--	1	--	2	1	--	--	2	--	--
2006					--	--	--	--	--	--	--	1	--	--
2007					--	--	--	--	1	--	--	3	--	--
2008					--		1		--	--	--	1	1	--
2009					--	--	--	--	--	--	--	--	--	--
2010					--	--	--	--	1	--	--	--	--	--
2011					--	--	--	--	--	1	--	3	1	--
2012					--	--	--	--	--	--	--	--	--	1
2013					--	--	--	--	--	1	--	5	--	2
2014					1	--	--	2	--	1	--	--	--	--
2015					--	1	1	--	--	--	--	--	--	--
2016					--	--	--	--	--	--	--	--	--	--
2017					--	--	--	--	--	--	--	1	--	--
2018	3	4	1	--	--	--	--	--	--	--	--	--	--	--
Total	4	20	2	1	1	2	2	4	12	4	1	24	3	5

1 Inshore habitats were not sampled 2001-2017.

2 Alaska Keta Inc. (AKI), Douglas Island Pink and Chum (DIPAC), Little Port Walter (LPW), Northern Southeast Regional Aquaculture Association (NSRAA), Southern Southeast Regional Aquaculture Association (SSRAA).

Table 11. Coded-wire tag (CWT) recoveries for juvenile Coho salmon by recovery year in the Strait habitat (Icy Strait and Upper Chatham stations) (June-August) during the Southeast Alaska Coastal Monitoring Survey, 1997–2018.

	Inshore Habitat1		Strait Habitat								
	Hatchery Stocks		Wild Stocks					Hatchery Stocks2			
Year	DIPAC	NSRAA	Auke C.	Berners R.	Chilkat R.	Taku R.	Other3	AKI	DIPAC	NSRAA	SSRAA
1997	--	--	2	--	--	--	--	--	4	1	--
1998	--	--	--	2	--	1		--	2	5	1
1999	3	2	1	3	1	--	--	--	3	2	--
2000	--	--	--	1	--	--	--	--	5	1	--
2001			1	6	2	2	1	--	12	1	--
2002			--	4	1	--	--	--	3	5	--
2003			1	--	--	--	--	--	--	--	--
2004			--	--	--	1	--	2	3	1	--
2005			1	3	1	1	--	--	1	2	3
2006			--	4	1	1	--	3	1	3	--
2007			--	1	--	1	--	--	4	2	3
2008			--	--	2	--	--	--	8	1	--
2009			--	2	2	1	--	--	3	4	--
2010			--	1	4	3	--	--	1	3	1
2011			--	2	3	1	--	--	2	1	--
2012			2	3	6	2	--	--	5	7	--
2013			1	4	1	--	--	1	6	3	--
2014			2	6	--	--	2	--	20	2	--
2015			5	9	5	1	1	2	18	9	--
2016			6	3	2	1	--	2	5	6	--
2017			1	2	--	1	--	--	1	--	--
2018	1	--	--	--	--	--	--	--	1	--	--
Total	4	2	23	56	31	17	4	10	108	59	8

1 Inshore habitats were not sampled 2001-2017.

2 Alaska Keta Inc. (AKI), Douglas Island Pink and Chum (DIPAC), Northern Southeast Regional Aquaculture Association (NSRAA), Southern Southeast Regional Aquaculture Association (SSRAA).

3 Other wild stocks include Burro Creek, Cowee Creek, and Stikine River.

Table 12. The number of chum salmon otoliths (*n*) examined for thermal marks and the estimated hatchery stock proportions in the Strait habitat (Icy Strait and Upper Chatham stations) during the June and July Southeast Alaska Coastal Monitoring Survey, 1997–2018.

	June						July					
		Stock Group Proportion				Not		Stock Group Proportion				Not
Year	Otoliths	DIPAC	HF	SSRAA	NSEAK	Marked	Otoliths	DIPAC	HF	SSRAA	NSEAK	Marked
1997	258	0.47	0.03	0.00	0.00	0.49	214	0.11	0.26	0.00	0.00	0.63
1998	359	0.35	0.14	0.00	0.00	0.51	354	0.20	0.18	0.00	0.00	0.62
1999	276	0.25	0.47	0.00	0.00	0.28	83	0.06	0.41	0.00	0.00	0.53
2000	356	0.66	0.07	0.00	0.01	0.26	613	0.15	0.19	0.00	0.00	0.65
2001	341	0.53	0.00	0.00	0.00	0.47	565	0.04	0.22	0.00	0.00	0.74
2002	89	0.04	0.02	0.00	0.00	0.93	590	0.03	0.57	0.00	0.00	0.41
2003	156	0.86	0.01	0.00	0.00	0.13	457	0.05	0.14	0.02	0.00	0.79
2004	1108	0.81	0.01	0.01	0.00	0.18	221	0.07	0.14	0.25	0.00	0.54
2005	698	0.37	0.35	0.00	0.00	0.28	134	0.04	0.31	0.00	0.00	0.64
2006	415	0.54	0.30	0.00	0.00	0.15	413	0.21	0.53	0.00	0.00	0.26
2007	167	0.65	0.07	0.01	0.01	0.26	272	0.20	0.20	0.01	0.00	0.59
2008	8	--	--	--	--	--	671	0.30	0.09	0.00	0.00	0.61
2009	0	--	--	--	--	--	408	0.33	0.10	0.01	0.00	0.57
2010	393	0.64	0.11	0.00	0.01	0.25	494	0.31	0.25	0.00	0.01	0.43
2011	470	0.57	0.05	0.00	0.00	0.38	324	0.39	0.10	0.02	0.01	0.49
2012	360	0.72	0.01	0.00	0.01	0.26	758	0.26	0.28	0.10	0.05	0.31
2013	304	0.48	0.09	0.00	0.00	0.42	497	0.46	0.06	0.01	0.06	0.42
2014	557	0.78	0.03	0.00	0.01	0.18	492	0.16	0.25	0.01	0.07	0.51
2015	223	0.49	0.10	0.01	0.04	0.35	253	0.16	0.14	0.02	0.15	0.53
2016	219	0.49	0.10	0.00	0.14	0.27	271	0.08	0.04	0.13	0.35	0.41
2017	56	0.55	0.02	0.00	0.00	0.43	98	0.17	0.21	0.11	0.12	0.38
2018	53	0.96	0.00	0.00	0.00	0.04	81	0.20	0.37	0.00	0.04	0.40
97-18	312	0.56	0.10	0.00	0.01	0.33	376	0.18	0.23	0.03	0.04	0.52

1 Douglas Island Pink and Chum Hatchery otolith marks

2 Hidden Falls Hatchery otolith marks

3 Southern Southeast Aquaculture Association Hatchery otolith marks

4 Other Northern Southeast Alaska hatchery otolith marks

Appendix 1. Surface trawl catch of juvenile salmon and trawl duration (minutes) in Strait and Inshore habitats during the June Southeast Alaska Coastal Monitoring Survey, 2018.

Habitat	Station	Replicate	Duration	Chinook	Chum	Coho	Pink	Sockeye
Strait	ISC	1	20	0	0	13	0	4
	ISD	1	20	0	0	0	0	0
	ISB	1	20	0	0	0	0	0
	ISA	1	20	0	0	2	0	0
	ISB	2	20	0	1	7	0	1
	ISA	2	20	0	0	7	0	0
	ISD	2	20	0	1	0	0	1
	ISC	2	20	0	0	1	0	1
	UCD	1	20	0	0	0	0	0
	UCC	1	20	0	0	0	0	0
	UCB	1	20	0	1	3	0	3
	UCA	1	20	0	0	4	0	2
	UCA	2	20	0	7	4	0	0
	UCB	2	20	0	2	8	0	0
	UCC	2	20	0	3	0	0	1
	UCD	2	20	0	39	0	0	52
Inshore	TKI	1	20	2	0	0	0	0
	SPA	1	20	7	0	10	0	0
	SP1	1	20	4	0	11	0	0
	SP2	1	20	0	0	11	0	0
	SPC	1	20	3	0	5	0	0
	TKI	2	20	1	0	0	0	0
	SPA	2	20	9	0	1	0	0
	SP1	2	20	4	0	1	0	0
	SP2	2	20	1	0	6	0	0
	SPC	2	20	9	0	11	0	0

Appendix 2. Surface trawl catch of juvenile salmon and trawl duration (minutes) in Strait and Inshore habitats during the July Southeast Alaska Coastal Monitoring Survey, 2018.

Habitat	Station	Replicate	Duration	Chinook	Chum	Coho	Pink	Sockeye
Strait	ISC	1	20	0	16	2	28	2
	ISD	1	20	0	2	0	2	1
	ISB	1	20	0	15	5	1	0
	ISA	1	20	0	8	3	2	0
	ISB	2	20	0	95	1	50	2
	ISA	2	20	0	7	0	10	0
	ISD	2	20	0	1	1	0	0
	ISC	2	20	0	25	3	10	1
	UCD	1	20	0	19	1	2	2
	UCC	1	20	0	14	2	6	0
	UCB	1	20	0	1	0	1	0
	UCA	1	20	0	2	0	1	0
	UCA	2	20	0	2	1	1	0
	UCB	2	20	0	3	0	0	0
	UCC	2	20	0	5	2	2	1
	UCD	2	20	0	8	3	2	1
Inshore	SPA	1	60	5	0	1	0	0
	SP1	1	60	0	0	4	0	0
	SP2	1	60	2	0	0	0	0
	SPC	1	60	2	0	0	0	0
	SPD	1	60	10	1	11	0	0
	SPA	2	60	1	1	0	0	0
	SP1	2	60	2	1	1	0	0
	SP2	2	60	4	1	1	0	0
	SPC	2	60	1	0	4	0	0
	SPD	2	60	5	0	2	0	2

Appendix 3. Surface trawl catch of juvenile salmon and trawl duration (minutes) in Strait and Inshore habitats during the August Southeast Alaska Coastal Monitoring Survey, 2018.

Habitat	Station	Replicate	Duration	Chinook	Chum	Coho	Pink	Sockeye
Strait	ISD	1	20	1	3	1	0	0
	ISC	1	20	0	2	1	2	0
	ISB	1	20	0	1	1	0	0
	ISA	1	20	0	6	0	5	0
	ISB	2	20	0	2	0	0	0
	ISA	2	20	1	9	2	1	2
	ISD	2	20	0	1	1	18	0
	ISC	2	20	0	0	0	2	1
	UCD	1	20	2	14	0	6	2
	UCC	1	20	0	4	1	0	1
	UCB	1	20	0	1	0	2	0
	UCA	1	20	0	5	7	2	1
	UCA	2	20	0	1	0	0	1
	UCB	2	20	0	1	1	0	0
	UCC	2	20	0	0	0	3	0
	UCD	2	20	0	0	0	0	0
Inshore	SPA	1	60	8	0	0	0	8
	SPB	1	60	10	0	1	0	6
	SPC	1	60	6	1	0	6	53
	SPD	1	60	11	0	1	0	19
	SPA	2	60	5	0	0	0	0
	SPB	2	60	0	0	0	0	1
	SPC	2	60	5	0	0	0	0
	SPD	2	60	13	1	1	1	37