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Annual Survey of Juvenile Salmon, Ecologically-Related Species, and Environmental Factors in the Marine Waters of Southeastern Alaska, May–August 2008

by

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Annual Survey of Juvenile Salmon, Ecologically-Related Species, and Environmental Factors in the Marine Waters of Southeastern Alaska, May–August 2008

Abstract

Juvenile Pacific salmon (*Oncorhynchus* spp.), ecologically-related species, and associated biophysical data were collected from the marine waters of the northern region of southeastern Alaska in 2008. This annual survey marks 12 consecutive years of systematically monitoring how juvenile salmon interact in marine ecosystems, and was implemented to identify the relationships among biophysical parameters that influence habitat use, marine growth, predation, stock interactions, and year-class strength of juvenile salmon. This report summarizes findings from the 2008 survey year, and contrasts these findings to selected biophysical parameters of the prior 11 sampling years. Up to 13 stations were sampled in epipelagic waters over four time periods (20 sampling days) from May to August. Typically, at each station, fish, zooplankton, surface water samples, and physical profile data were collected during daylight using a surface rope trawl, conical and bongo nets, water sampler, and a conductivity-temperature-depth profiler. Surface (3-m) temperatures and salinities ranged from 6.8 to 11.6 ºC and 18.2 to 32.0 PSU from May to August. A total of 5,186 fish, representing 16 taxa, were captured in 56 rope trawl hauls from June to August. Juvenile salmon comprised about 97% of the total fish catch. Juvenile salmon occurred frequently in the trawl hauls, with pink (*O. gorbuscha*), chum (*O. keta*), sockeye (*O. nerka*), and coho salmon (*O. kisutch*) present in 66-86% of the trawls, whereas juvenile Chinook salmon (*O. tshawytscha*) occurred less commonly, in about 39% of the hauls. Exceptionally few juvenile salmon were captured in June. Peak monthly catch rates of juvenile salmon differed by species: pink, chum, and coho were highest in July, whereas sockeye and Chinook were highest in August. Coded-wire tags were recovered from 11 juvenile coho salmon and three Chinook salmon (one juvenile and two immature). All fish were from hatchery and wild stocks originating in southeastern Alaska. Alaska enhanced stocks were also identified by thermal otolith marks from 39% of the chum and 4% of the sockeye salmon examined. Onboard stomach analysis of 20 potential predators, representing four species, did not provide evidence of predation on juvenile salmon. Biophysical measures from 2008 differed from prior years, in many respects. Integrated (20-m) temperatures and salinities were anomalously low and zooplankton densities were anomalously high in 2008. In addition, for most juvenile salmon species, unusual CPUE patterns, small fish size, and low condition residuals suggested that migration timing shifted to later than average. Long-term monitoring of key stocks of juvenile salmon, on seasonal and interannual time scales, will enable researchers to understand how growth, abundance, and ecological interactions affect year-class strength of salmon and to better understand their roles in North Pacific marine ecosystems.

Introduction

The Southeast Coastal Monitoring Project (SECM), a coastal monitoring study focused in the northern region of southeastern Alaska, was initiated in 1997 to annually study the early marine ecology of Pacific salmon (*Oncorhynchus* spp.) and associated epipelagic ichthyofauna and to better understand effects of environmental change on salmon production. Salmon are a keystone species that constitute an important ecological link between marine and terrestrial habitats, and therefore play a significant, yet poorly understood, role in marine ecosystems. Fluctuations in the survival of this important living marine resource have broad ecological and socio-economic implications for coastal localities throughout the Pacific Rim.

Evidence for relationships between production of Pacific salmon and shifts in climate conditions has renewed interest in processes governing salmon year-class strength (Beamish 1995; Downton and Miller 1998; Beauchamp et al. 2007; Taylor 2007). In particular, climate variation has been associated with ocean production of salmon during El Niño and La Niña events, such as the recent warming trends that benefited many wild and hatchery stocks of Alaskan salmon (Wertheimer et al. 2001). Biophysical attributes of climate and habitat, such as temperature, salinity, and mixed layer depth (MLD), influence primary and secondary production (Bathen 1972; Kara et al. 2000; Alexander et al. 2001) and therefore influence the trophic links leading to variable growth and survival of salmon (Mann and Lazier 1991; Francis and Hare 1994; Brodeur et al. 2007). However, research is lacking in several areas, such as the links between salmon production and climate variability, between intra- and interspecific competition and carrying capacity, and between stock composition and biological interactions. Past research has not provided adequate time-series data to explain such links (Pearcy 1997). Because the number of salmonids produced in the region have increased over the last few decades, understanding the consequences of these population changes on the growth, distribution, migratory rates, and survival of all salmon stock groups is important.

One SECM goal is to identify mechanisms linking salmon production to climate change using a time series of synoptic data that combines stock-group life history characteristics of salmon with the ocean conditions they experience. In the past, stock information relied on labor-intensive methods of marking individual fish, such as coded-wire tagging (CWT; Jefferts et al. 1963), which could not practically be applied to all of the fish released by enhancement facilities. However, mass-marking with thermally induced otolith marks (Hagen and Munk 1994), a technological advance frequently implemented by enhancement facilities throughout Alaska, enables researchers to collect stock-specific data, including growth, survival, and migratory rates, in southeastern Alaska (Courtney et al. 2000). For example, two private non-profit enhancement facilities in the northern region of southeastern Alaska produced more than 150 million otolith-marked juvenile chum salmon (*O. keta*) in recent years. Consequently, a high proportion of these otolith-marked fish have been included in commercial harvests of adult chum salmon in the common property fishery of the region since the mid-1990s, and have contributed substantially to the average annual catch of 12 million fish and the ex-vessel commercial value of 27 million $U.S. (Alaska Department of Fish and Game [ADFG] 2008). In addition, sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), and Chinook salmon (*O. tshawytscha*) are otolith-marked by some enhancement facilities. Therefore, examining the early marine ecology of these marked stocks provides an opportunity to study stock-specific abundance, distribution, and species interactions of juvenile salmon that will later recruit to the fishery.

The extent of interactions between hatchery and wild salmon stocks in marine ecosystems is also important to examine. Increased hatchery production of juvenile chum salmon has coincided with declines of some wild chum salmon stocks, suggesting the potential for hatchery and wild stock competition or other interactions in the marine environment (Seeb et al. 2004; Reese et al. 2009). A study using a bioenergetics approach and SECM data from Icy Strait concluded that hatchery and wild stocks of juvenile salmon consumed only a small percentage of the available zooplankton during their summer residence (Orsi et al. 2004a). Since feeding indices remained high for juvenile pink (*O. gorbuscha*), chum, and coho salmon throughout the diel cycle and summer season (Sturdevant et al. 2002, 2004, 2008), this suggests that growth of the fish was not food-limited. The bioenergetics study also suggested that vertically-migrating planktivores may have a greater impact on the zooplankton standing stock than hatchery stock groups of chum salmon, including abundant forage species such as walleye pollock (*Theragra chalcogramma*) and Pacific herring (*Clupea pallasi*) (Sigler and Csepp 2007). Companion studies in Icy Strait suggested that the amount of food consumed may be more important to survival of juvenile salmon con-specifics than the type of food consumed (Sturdevant et al. 2004; Weitkamp and Sturdevant 2008) and that predation events may affect salmon year class strength (Sturdevant et al. 2009). These findings stress the importance of consistently examining the entire epipelagic community of ichthyofauna in the context of trophic interactions.

In previous years, when NOAA vessel support was available, the SECM research scope also included sampling in the southern region of southeastern Alaska. This regional study component was added to the SECM project to support an increased emphasis on forecasting of adult pink salmon returns and to understand regional differences in prey, competitor, and predation dynamics. This study component supplements the core sampling of eight stations in the strait habitat of the northern region, and geographically broadens the monitoring to include the strait habitat in the southern region which encompasses a migration corridor at the opposite end of southeastern Alaska. A primary focus of this component is to explore the concordance of adult pink salmon harvests in both the southern and northern regions of southeastern Alaska in conjunction with biophysical parameters such as juvenile abundance, temperature, and zooplankton abundance in each region.

This document summarizes catches of juvenile salmon, ecologically-related species, and associated biophysical data collected by SECM scientists in 2008, and contrasts key parameters from 2008 with the entire 12-yr time series. This study has been partially funded by the Northern Fund of the Pacific Salmon Commission, and the Alaska Sustainable Salmon Fund of the ADFG .

Methods

Up to 13 stations were sampled in southeastern Alaska during four time periods from May to August 2008 (Table 1). The sampling occurred in the northern portion of the region, which extends 250 km from inshore waters, within the Alexander Archipelago, along Chatham Strait and Icy Strait into the Gulf of Alaska (Figure 1). At each station, the physical environment, zooplankton, and fish were typically sampled during daylight hours. Sampling was accomplished initially, as conditions permitted, by the National Oceanic and Atmospheric Administration (NOAA) ship *John N. Cobb*, a 29 m long research vessel with a main engine of 325 hp and a cruising speed of 10 knots. After an unexpected, catastrophic breakdown of the *John N. Cobb* in early June, in order to complete sampling, emergency vessel charters were implemented: 1) the fishing vessel *Steller*, a 21 m long 425 hp charter vessel in June and July, and 2) the Alaska Department of Fish and Game (ADFG) research vessel *Medeia*, a 33 m long 1,250 hp research vessel in August. As a result, the original sampling plan for 2008, which included sampling in both the northern and southern regions, was reduced to focus only on sampling in the northern region.

Sampling in the northern region of southeastern Alaska was conducted in the vicinity of Icy Strait (Figure 1). The selection of these stations was determined by 1) the presence of historical time series of biophysical data in the region, 2) the intent to sample primary seaward migration corridors used by juvenile salmon, and 3) the operational constraints of the vessel. The inshore station (Auke Bay Monitor, ABM) and the four Icy Strait stations (ISA, ISB, ISC, and ISD) were selected initially because historical data exist for them (Bruce et al. 1977; Jaenicke and Celewycz 1994; Landingham et al.1998; Murphy and Orsi 1999; Murphy et al. 1999; Orsi et al. 1997, 1998, 1999, 2000a,b, 2001a,b, 2002, 2003, 2004b, 2005, 2006, 2007a, 2008). The Chatham Strait stations (UCA, UCB, UCC, and UCD) were selected to intercept juvenile salmon (both wild and hatchery otolith-marked) entering Icy Strait from both the south (i.e., Hidden Falls Hatchery (HF), operated by Northern Southeast Alaska Regional Aquaculture Association (NSRAA)), and from the north (i.e., Douglas Island Pink and Chum Hatchery (DIPAC) facilities) (Figure 1). The Icy Point stations were selected to monitor conditions in the coastal habitat of the Gulf of Alaska, proximal to the outflow of Icy Strait into the Alaska Coastal Current.

Vessel and sampling gear constraints limited operations to within 1.5 and 65 km off shore. Additionally, trawl sampling was restricted to bottom depths greater than 75 m; this precluded trawling at the Auke Bay Monitor station (Table 1). Sea conditions less than 2.5 m and winds less than 12.5 m/sec were necessary to operate gear safely; these requirements often prevented sampling in coastal waters.

Oceanographic sampling

Oceanographic data were collected at each station immediately before or after each trawl haul. These data generally consisted of one conductivity-temperature-depth profiler (CTD) cast, one Secchi reading for water clarity, one surface water sample for chlorophyll and nutrients, one ambient light reading, one or more vertical plankton tows with conical nets, and at certain stations, one or more double oblique plankton tows with a bongo net system. The CTD data were collected with a Sea-Bird[1] SBE 19 Seacat profiler to 200 m or within 10 m of the bottom. We used CTD data profiles to determine mixed layer depth (MLD, m), defined as the depth where the temperature was at least 0.2°C colder than the water at 5 m. This established the water column depth above which surface mixing is active or recent, while waters below are more stable (Kara et al. 2000). We also used the CTD profile data to compute average temperature and salinity over the 20-m integrated water column; this measure thus bracketed the typical MLD and surface thermoclines and haloclines. The CTD was also used in the manner of a Secchi disk during deployment, by recording the depth (m) that its white top was no longer visible from the surface. Surface water samples were taken once monthly at each station for later nutrient and chlorophyll analysis contracted to the Marine Chemistry Laboratory at the University of

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

Washington School of Oceanography. To quantify ambient light levels, light intensities (W/m^2) were recorded at each station with a Li-Cor Model 189 radiometer or LI-250A light meter.

Zooplankton was sampled at all stations with several net types each month. At least one shallow vertical haul (20 m) was made at each station with a 50-cm, 243-µm mesh NORPAC net. One deep vertical haul ($\leq$ 200 m or within 10 m of bottom) was made at the Auke Bay Monitor station with a 57-cm, 202-µm mesh WP-2 net. One double oblique bongo haul was made at stations along the Icy Strait and Icy Point transects and at ABM ($\leq$ 200 m or within 20 m of bottom) using a 60-cm diameter tandem frame with 505-µm and 333-µm mesh nets. A VEMCO ML-08-TDR[1] time-depth recorder was used with the oblique bongo hauls to record the maximum sampling depth of each haul. General Oceanics model 2031 or Rigosha[1] flow meters were placed inside the bongo and deep conical nets for calculation of filtered water volumes.

Zooplankton samples were immediately preserved in a 5% formalin-seawater solution. In the laboratory, zooplankton settled volumes (SV, ml) and total settled volumes (TSV, ml) of each 20-m vertical zooplankton haul were measured after settling the samples for a 24-hr period in Imhof cones. Mean SVs were determined for pooled stations by habitat and month. Displacement volumes (DV, ml) of zooplankton were measured for bongo net samples (333-µm and 505-µm mesh); data are reported for those collected in Icy Strait. Samples were brought to a constant volume (500 ml) by adding water, and then were drained through a 243-µm mesh sieve. The volume of decanted liquid was measured, and then subtracted from the sample starting volume to yield zooplankton DV. Standing stock (DV/m^3) of bongo samples was calculated using DV divided by the volume of water filtered based on flow meter revolutions per haul. Detailed zooplankton species composition from the 333-µm samples was determined microscopically from subsamples obtained using a Folsom splitter. Density ($number/m^3$) was then estimated by dividing the count in the subsample by the split fraction and then dividing this expanded count by the volume filtered, to yield estimates for each species. Percent total composition was summarized across species by major taxa, including small calanoid copepods ($\leq$ 2.5 mm total length, TL), large calanoid copepods (> 2.5 mm TL), euphausiids (principally larval and juvenile stages), oikopleurans (Larvacea), decapod larvae, amphipods, chaetognaths, and combined minor taxa.

Fish sampling

Fish sampling was accomplished with a Nordic 264 rope trawl modified to fish the surface water directly astern of a trawl vessel. The trawl was 184 m long and had a mouth opening of approximately 30 m by 24 m (width by depth). A pair of 3-m foam-filled Lite trawl doors, each weighing 544 kg (91 kg submerged), was used to spread the trawl open. Recent gear trials with this trawl indicated the actual fishing dimensions of the trawl to be 31 m deep (head rope to foot rope) by 21 m wide (wingtip to wingtip) (Wertheimer et al. 2009). Trawl mesh sizes 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 over the 129.6-m meshed length of the rope trawl. A 6.1-m long, 0.8-cm knotless liner mesh was sewn into the cod end. The trawl also contained a small mesh panel of 10.2-cm mesh sewn along the jib lines on the top panel between the head rope and the 162.6-cm mesh to reduce loss of small fish. To keep the trawl head rope fishing at the surface, two clusters of three A-4 Polyform buoys (inflated to 0.75 m diameter and encased in knotted mesh bags) were clipped on the opposing corner wingtips of the head rope and one A-3 Polyform float (inflated to 0.5 m diameter) was clipped into a mesh kite pocket in the center of the head rope. The trawl was fished with about 150 m of 1.6-cm wire main warp attached to each door, a 9.1 m length of 1.6-

cm wire trailing off the top and bottom of each trawl door (back strap), and each back strap connected with a "G" hook and flat link to a 70.1-m wire swiveled bridle. The head rope bridles were 1.0-cm wire and the footrope bridles were 1.3-cm wire.

For each haul, the trawl was fished across a station for 20 min at about 1.5 m/sec (3 knots), covering approximately 1.9 km (1.0 nautical mile). Station coordinates were targeted as the midpoint of the trawl haul; however, current, swell, and wind conditions dictated the direction in which the trawl was set. Hauls were usually fished downwind and with the prevailing current and seas. Replicate hauls were made in the strait habitats to ensure that sufficient samples of marked juvenile salmon were obtained for interannual comparisons. During these replicate hauls only minimal oceanographic sampling occurred, including one 20-m vertical plankton tow and a 50-m ("shallow") CTD haul.

After each trawl haul, the fish were separated from the jellyfish, anaesthetized with tricaine methanesulfonate (MS-222), identified, enumerated, measured, labeled, bagged, and frozen. Jellyfish were identified to genus, counted, and volumetrically measured to the nearest 0.1 liter (L). After the catch was sorted, all fish and squid were typically measured to the nearest mm fork length (FL) or mantle length with a Limnoterra FMB IV electronic measuring board (Chaput et al. 1992). In instances of very large fish catches, all fish were counted but only a subsample was measured for length. Up to 100 juvenile salmon of each species were bagged individually; the remainder was bagged in bulk (≤ 200) or discarded after enumeration. All fish were frozen immediately after measurement. During times of extended processing, fish were chilled with ice packs to minimize tissue decomposition and gastric activity. All Chinook and coho salmon were examined for missing adipose fins that could indicate the presence of implanted CWTs; those with adipose fins intact were again screened with a magnetic detector in the laboratory. The snouts of these tagged fish were dissected in the laboratory to recover the CWTs, which were then decoded and verified to determine fish origin.

Potential predators of juvenile salmon from each haul were identified, measured (FL, mm), weighed (0.1 kg), and stomach contents were examined onboard the vessel. Stomachs were excised, weighed (0.1 g), and visually classified by percent fullness (nearest 10%). Stomach content weight was determined by subtracting the empty stomach weight from the full stomach weight. General prey composition was determined by estimating contribution of major taxa to the nearest 10% of total volume. The wet-weight contribution of each prey taxon to the diets was then calculated by multiplying its volumetric fraction by the total content weight. Whenever possible, fish prey were measured and identified to species. Overall diets were summarized by percent weight of major prey taxa and the frequency of feeding fish.

After each cruise, frozen individual juvenile salmon were weighed in the laboratory to the nearest 0.1 gram (g). Mean lengths, weights, Fulton condition factor ($g/mm^3 \cdot 10^5$; Cone 1989), and residuals from a length-weight linear regression (condition residuals, CR) were computed for each species by habitat and sampling month. To identify stock of origin of juvenile chum and sockeye salmon, the sagittal otoliths were extracted from the crania and preserved in 95% ethyl alcohol. Laboratory processing of otoliths for thermal marks was contracted to DIPAC. Otoliths were prepared for microscopic examination of potential thermal marks by mounting them on slides and grinding them down to the primordia (Secor et al. 1992). Ambiguous otolith thermal marks were verified by personnel at the ADFG otolith laboratory. Stock composition and growth trajectories of thermally marked fish were then determined for each month and habitat.

In order to compare the biophysical conditions observed in 2008 to the prior 11-yr time series, a set of key parameters was examined. These parameters included: integrated (20-m) temperature and salinity, MLD, zooplankton density, CPUE, size-at–time (length on July 24), and condition residuals for the principal juvenile salmon species (pink, chum, sockeye, and coho). Graphical plots were used to compare mean values from the core sampling area in the vicinity of Icy Strait and portray new analyses of SECM anomalies (deviations from the means).

Results and Discussion

In 2008, monitoring of northern strait stations was completed but, unfortunately, the southern region was not sampled due to vessel limitations. During the four monthly surveys (22-d total), data were collected from 56 rope trawl hauls, 66 CTD casts, 24 bongo net samples, 74 Norpac net samples, 8 WP-2 net samples, 40 surface water samples, 65 Secchi depth readings, and 66 ambient light measures (Table 2, Appendix 1). The sampling periods occurred near the ends of each month from May to August. Oceanographic sampling was completed at ABM and all strait stations from May to August, and sampling scheduled at Icy Point was only conducted in May. Rope trawling and associated fish collections were completed in Icy and Chatham Straits in June, July, and August.

Oceanography

Overall, surface (3-m) water temperatures ranged from 6.8 to 11.6 ºC from May to August (Table 3; Appendix 1). Mean surface (3-m) temperatures followed a similar pattern of seasonal increase among habitats from May to June, and then showed relatively stable readings from June to August (Figure 2a). Monthly mean temperatures differed by ~1 ºC among habitats. By comparison, the monthly 20-m integrated temperatures were colder than the 3-m values, but showed a more moderate pattern of seasonal increase.

Overall, surface (3-m) salinities ranged from 18.2 to 32.0 PSU from May to August (Table 3; Appendix 1). Surface salinities followed a similar seasonal pattern among habitats, decreasing from May to August in strait and inshore habitats (Figure 2b); salinities were considerably lower in inshore than in strait habitat, except for the month of July. By comparison, the monthly 20-m integrated salinities were higher than the 3-m values, but showed a more moderate pattern of seasonal decline.

Secchi depths ranged from 2 to 8 m and averaged 5 m (Appendix 1). Secchi depth measurements indicated water clarity was highest in the coastal habitat and lowest in the inshore habitat. Water clarity generally increased from May to June and then decreased in July or August (Figure 3a).

Mixed layer depth ranged from 6 to 42 m (Appendix 1). Mean MLD was highest in the coastal habitat in May (42 m), and was approximately 6 m in all months in the inshore and strait habitats (Figure 3b). Thus, our 3-m temperature and salinity, and most Secchi depths typically represented the most active segment of the water column, while trawling depth encompassed the more stable waters below the MLD.

Nutrient, chlorophyll, and phaeopigment patterns from water samples varied among habitats and months (Tables 2 and 4). Nutrient concentrations (range and mean) were 0.0–2.2 and 0.8 µM for PO_4, 2.6–26.8 and 8.7 µM for $Si(OH)_4$, 0.0–11.8 and 1.4 µM for NO_3, 0.0–0.3 and 0.1 µM for NO_2, and 0.5–3.5 and 1.5 µM for NH_4. Chlorophyll concentration ranged from 0.2 to 4.6 µg/L, with a mean of 1.9 µg/L, and phaeopigment concentration ranged from 0.1 to 1.8 µg/L, with a mean of 0.6 µg/L (Table 4). Overall, chlorophyll concentration was highest in May (Figure 4a).

Ambient light measurements ranged from 21 to 881 W/m^2, with a mean of 227 W/m^2. May and June were the months of greatest light intensity (Appendix 1).

Zooplankton SVs ranged from 1 to 63 ml and averaged 14 ml (Table 5). Seasonal patterns of zooplankton settled volumes (ZSV) were evident in both habitats: from May to August, ZSV declined from 25 to 5 ml in the strait habitat, but was relatively stable each month (~12 ml) in the inshore habitat (Figure 4b). Qualitative, visual examination of samples indicated a wide diversity of mesozooplankton taxa and phytoplankton present.

Standing stock varied from < 0.1 to 0.9 ml/m^3 across stations, months, and mesh sizes (i.e., 333- and 505-µm bongo nets) (Table 6). Seasonal declines were evident in the strait habitat from May to July and in the inshore habitat from May to June (Table 6, Figure 5). Seasonal patterns were similar for the two mesh sizes, but standing stock of organisms from the smaller, 333-µm mesh (Figure 5a) were greater than those from the larger 505-µm mesh (Figure 5b). Standing stock was greatest in the strait habitat.

Abundance of seasonal, daytime prey fields present for planktivorous juvenile salmon and ecologically-related ichthyofauna was represented by zooplankton in 333-µm bongo samples from Icy Strait. Mean zooplankton density declined over the season, and ranged from a high of nearly 3,000 $organisms/m^3$ in May to a low of approximately 1,200 $organisms/m^3$ in August (Table 6, Figure 6a). Zooplankton taxa were dominated by small and large calanoid copepods throughout the season; other taxa that were seasonally present and comprised densities less than 10% of the total included euphausiids, hyperiid amphipods, gastropods (pteropods), oikopleurans (Larvacea), barnacle larvae, and combined minor taxa (Figure 6b). The minor taxa mainly included chaetognaths, cladocera, bryozoan larvae, and decapod larvae. Many of these taxa are prominent in diets of juvenile salmon and other planktivores (Landingham et al. 1998; Purcell and Sturdevant 2001; Sturdevant et al. 2002; Orsi et al. 2004a; Weitkamp and Sturdevant 2008).

Large and small calanoid taxa were remarkably consistent among the four sampling months (data not shown). From May to August, small calanoids were predominantly *Pseudocalanus* spp. (>85%) while large calanoids were predominantly *Metridia* spp. (~75%). The majority of the remaining small calanoid species were consistently *Acartia* spp. (~10%), and for large calanoid species were *Neocalanus plumchrus/flemingeri* (seasonally decreasing) and *Calanus marshallae* (seasonally increasing). The abundance and timing of large and small calanoids and other zooplankters with different life history strategies may depend on environmental conditions which vary seasonally and interannually (Coyle and Paul 1990; Paul et al. 1990; Park et al. 2004).

Catch composition

The trawls sampled a total of five genera of jellyfish: *Aurelia* sp., *Aequorea* sp., *Cyanea* sp., *Chrysaora* sp., and *Staurophora* sp. (Table 7). The monthly mean volume of jellyfish per haul ranged from 0.0 to 37.9 L, from 8 hauls in June, 28 hauls in July, and 20 hauls in August. Overall, biomass of jellyfish increased monthly from June to August for most genera, except *Aequorea* sp., which was highest in July (Figure 7). Most of the jellyfish occurred in late summer, with *Aurelia* sp. and *Aequorea* sp. comprising 65% and 25% of the total seasonal jellyfish biomass.

A total of 5,186 fish, representing 16 taxa, were captured in 56 trawl hauls from June to August (Table 8). Juvenile salmon were rarely caught in June, but occurred frequently and comprised about 97% of the total fish catch in July and August (Figure 8). Juvenile pink, chum, sockeye, and coho salmon were present in 66-86% of the monthly trawl hauls, whereas juvenile

Chinook salmon occurred less frequently, in about 39% of the monthly trawl hauls (Table 9). Peak monthly catches of juvenile salmon differed by species: pink, chum, and coho catches were greatest in July, whereas sockeye and Chinook catches were greatest in August (Figure 9). Overall, seasonal catch patterns shifted to late summer in this cold year.

Size and condition of juvenile salmon differed among the species and sampling periods (Tables 10–14, Figures 10–13). Most species increased in both length and weight in successive time periods, indicating growth despite the influx of additional stocks with varied times of saltwater entry. Mean FLs of juvenile salmon in July and August were: 109.5 and 138.1 mm for pink; 106.7 and 131.6 mm for chum; 103.2 and 156.1 mm for sockeye; 179.2 and 206.2 mm for coho; and 169.3 and 214.6 for Chinook salmon (Figure 10). Mean weights of juvenile salmon in July and August were: 12.4 and 28.1 g for pink; 12.1, and 28.9 g for chum; 11.8 and 42.4 g for sockeye; 69.0 and 107.1 g for coho; and 65.6 and 144.0 g for Chinook salmon (Figure 11). Juvenile coho and Chinook salmon were consistently 50-75 mm longer and 50-100 g heavier than sockeye, chum, and pink salmon in a given time period. Mean Fulton's condition factor values for juvenile salmon in July and August were: 0.9 and 0.9 for pink; 0.9 and 1.0 for chum; 1.0 and 1.1 for sockeye; 1.1 and 1.2 for coho; and 1.2 and 1.4 for Chinook salmon (Figure 12). In July and August, negative CR indicated poor condition for pink and coho salmon, while positive CR indicated good condition for the other three species (Figure 13). These species differences suggest that marine conditions differentially affected juvenile salmon in this colder than average year.

Fourteen of the 15 juvenile and immature salmon lacking adipose fins contained CWTs (Table 15). Coded-wire tags were recovered from 11 juvenile coho salmon and 3 Chinook salmon (1 juvenile and 2 immature). All fish were from hatchery and wild stocks originating in southeastern Alaska. Migration rates of juvenile coho salmon averaged 1.9 km/day, while for Chinook salmon, migration rates averaged 2.5 km/day for the juvenile fish and 0.3 km/day for the immature fish.

In addition to the CWT information on stock origins, stock-specific information was obtained from recoveries of otolith-marked hatchery chum and sockeye salmon that originated in the northern and southern regions of southeastern Alaska (Tables 16-17; Figures 14-16). These species, which comprise a major enhancement component in southeastern Alaska, are not normally tagged with CWTs.

For juvenile chum salmon, stock-specific information was derived from the otoliths of a subsample of 915 fish, representing 74% of those caught (Tables 8, 9, and 16; Figure 14). These fish were the same individuals sampled for weight and condition (Table 11). Of all chum salmon otoliths examined, 362 (39%) were marked from hatcheries in southeastern Alaska: 216 (23%) were from DIPAC, 110 (12%) were from NSRAA, and 36 (4%) were from SSRAA. The remaining 543 (59%) of chum salmon examined were unmarked and probably included both wild stocks and unmarked hatchery stocks. No chum salmon were caught in June; however, hatchery stocks comprised 41% of the chum salmon catch in both July and August. Consistent with later juvenile salmon catches in 2008, the stock composition of hatchery chum originating in the northern region also shifted to later (DIPAC-July, NSRAA-August). Catches of the hatchery chum stocks originating from the southern region were delayed until August, corroborating both the usual observation that these more distant stocks require a time lag to migrate several hundred kilometers northward and the 2008-specific observation of seasonally late occurrence (Table 16).

For juvenile sockeye salmon, stock-specific information was derived from the otoliths of a subsample of 456 fish, representing 98% of those caught (Tables 8, 9, and 17; Figure 15). These fish were the same individuals sampled for weight and condition (Table 12). Of all the sockeye salmon otoliths examined, 19 (4%) were marked and originated from four stock groups: 15 from Speel Arm, Alaska (3%), 1 from Sweetheart Lake, Alaska (<1%), 1 from Tahltan Lake/Stikine River, British Columbia (<1%), 1 from Tatsamenie Lake, Alaska (<1%), and 1 from Tuya/Stikine River, British Columbia (<1%). The remaining 437 (96%) sockeye salmon examined were unmarked and presumably from wild stocks.

Monthly samples of thermally marked juvenile chum and sockeye salmon were used to examine stock-specific growth trajectories for weights (Figure 16). Both of these salmon species were released in 2008 at the following approximate dates and size ranges: chum salmon in April–May (1–4 g) and sockeye salmon in April–June (5–10 g). Stock-specific sizes of these species increased monthly for all stock groups (Figure 15).

Stomachs of 20 potential predators of juvenile salmon were analyzed onboard, but no incidents of predation on juvenile salmon were observed for the 4 species represented (Table 18, Figure 17). Immature and adult Pacific salmon (chum, Chinook and coho) represented 90% of the potential predators captured; non-salmonids included two walleye pollock (*Theragra chalcogramma*). Immature Chinook salmon were the most common potential predator, and were the only species caught in all three months (Table 18). Empty stomachs were observed only for Chinook salmon (three of the 13). Diets of all predators except the chum salmon were dominated by fish prey (Figure 16), including larval walleye pollock, capelin (*Mallotus villosus*), lanternfish (Myctophidae), lumpsuckers (Cyclopteridae), and unidentified larvae and fish remains. Non-fish prey included cephalopods, euphausiids, and amphipods for the Chinook salmon, coho salmon, and walleye pollock, and gelatinous taxa (Larvacea) for the chum salmon. Limited predation on juvenile salmon has been documented from past SECM shipboard analyses, but coho salmon, spiny dogfish, and juvenile sablefish (*Anoplopoma fimbria*) are among the few commonly-caught species with regular, low incidents of predation (Orsi et al. 1999, 2007b; Sturdevant et al. 2009).

Our research over the past twelve years suggests that in southeastern Alaska, juvenile salmon exhibit seasonal patterns of habitat use and display species- and stock-dependent migration patterns, as well as annual trends in associated biophysical factors. Biophysical measures from 2008 differed from prior year averages, in many respects. The 2008 values from the vicinity of Icy Strait were compared to the 12-yr time series to identify anomalies (Figures 18-24). Among physical factors, integrated (20-m) temperatures and salinities were anomalously low in 2008. Integrated (20-m) temperatures were low in all four months, while integrated (20-m) salinity and MLD varied in May and June, then were anomalously low in late summer (Figures 18 and 19). In contrast, zooplankton densities were anomalously high in every month (Figure 20), principally due to abundant copepods. Among the biological variables for the four primary juvenile salmon species, the unusual CPUE patterns, the small size-at-time, and the low condition residuals for 2008 suggest that migration timing shifted to later than average. The CPUEs for all species were anomalously low in June 2008 (Figures 21 and 22); no pink, chum or sockeye salmon were caught. The CPUE for juvenile pink and chum salmon is typically low in June of each year; however, the long-term average is strongly influenced by two years when catches were unusually high for these species (1998 and 2004; Figure 21), and thus deviations for most years with low catches appear as strong negative values (Figure 22). In July and August of 2008, however, pink and chum CPUEs remained unusually low, while coho and sockeye

CPUEs were unusually high. Size-at-time (FL on July 24) indicated that all species of juvenile salmon were anomalously small in 2008 (Figure 23). In addition, condition residuals of the primary juvenile salmon species were average or slightly below average in July, but were anonymously high for chum and sockeye in August (Figure 24). Thus, the cold 2008 sampling season was reflected in shifts of timing, growth, and abundance patterns from the norms described by the 12-yr time series. Long-term monitoring of key stocks of juvenile salmon, on seasonal and interannual time scales, will enable researchers to understand how growth, abundance, and ecological interactions affect year-class strength of salmon and to better understand their role in North Pacific marine ecosystems.

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Literature Cited

ADFG. 2008. Preliminary Alaska salmon catches – blue sheet. Alaska Department of Fish and Game. <http://csfish.adfg.state.ak.us/BlueSheets/BLUEWebReport.php Accessed: 9-12-2008.

Alexander, M. A., M. S. Timlin, and J. D. Scott. 2001. Winter-to-winter recurrence of sea surface temperature, salinity and mixed layer depth anomalies. Prog. Oceanog. 49:41-61.

Bathen, K. H. 1972. On the seasonal changes in the depth of the mixed layer in the North Pacific Ocean. J. Geophy. Res. 77:7138-7150.

Beamish, R. J. (editor). 1995. Climate change and northern fish populations. Can. Spec. Publ. Fish. Aquat. Sci. 121, 739 p.

Beauchamp, D. A., A. D. Cross, J. L. Armstrong, K. W. Meyers, J. H. Moss, J. L. Boldt, and L. J. Haldorson. 2007. Bioenergetics responses by Pacific salmon to climate and ecosystem variation. North Pac. Anad. Fish Comm. Bull. 4:257-269.

Brodeur, R. D., E. A. Daly, R. A. Schabetsberger, and K. L. Mier. 2007. Interannual and interdecadal variability in juvenile coho salmon (*Oncorhynchus kisutch*) diets in relation to environmental changes in the northern California Current. Fish. Oceanog.16:395-408.

Bruce, H. E., D. R. McLain, and B. L. Wing. 1977. Annual physical and chemical oceanographic cycles of Auke Bay, southeastern Alaska. NOAA Tech. Rep. NMFS SSRF-712, 11 p.

Chaput, G. J., C. H. LeBlanc, and C. Bourque. 1992. Evaluation of an electronic fish measuring board. ICES J. Mar. Sci. 49:335-339.

Cone, R. S. 1989. The need to reconsider the use of condition indices in fishery science. Trans. Amer. Fish. Soc. 118:510-514.

Courtney, D. L., D. G. Mortensen, J. A. Orsi, and K. M. Munk. 2000. Origin of juvenile Pacific salmon recovered from coastal southeastern Alaska identified by otolith thermal marks and coded wire tags. Fish. Res. 46:267-278.

Coyle, K. O., and A. J. Paul. 1990. Abundance and biomass of meroplankton during the spring bloom in an Alaska Bay. Ophelia 32(3):199-210.

Downton, M. W., and K. A. Miller. 1998. Relationships between Alaskan salmon catch and North Pacific climate on interannual and interdecadal time scales. Can. J. Fish. Aquat. Sci. 55:2255-2265.

Francis, R. C., and S. R. Hare. 1994. Decadal-scale regime shifts in the large marine ecosystems of the north-east Pacific: A case for historical science. Fish. Oceanog. 3: 279-291.

Hagen, P., and K. Munk. 1994. Stock separation by thermally induced otolith microstructure marks. Pp. 149-156 *In*: Proceedings of the 16th Northeast Pacific Pink and Chum Salmon Workshop. Alaska Sea Grant College Program AK-SG-94-02, University of Alaska, Fairbanks.

Jaenicke, H. W., and A. C. Celewycz. 1994. Marine distribution and size of juvenile Pacific salmon in Southeast Alaska and northern British Columbia. Fish. Bull. 92:79-90.

Jefferts, K. B., P. K. Bergman, and H. F. Fiscus. 1963. A coded wire identification system for macro-organisms. Nature (Lond.) 198:460-462.

Kara, A. B., P. A. Rochford, and H. E. Hurlburt. 2000. An optimal definition for the ocean mixed layer depth. J. Geophys. Res. 105:16,803–16,821.

Landingham, J. H., M. V. Sturdevant, and R. D. Brodeur. 1998. Feeding habits of juvenile Pacific salmon in marine waters of southeastern Alaska and northern British Columbia. Fish. Bull. 96:285-302.

Mann, K. H., and J. R. N. Lazier. 1991. Dynamics of marine ecosystems, biological and physical interactions in the oceans. Blackwell Scientific Publications, Boston, MA.

Murphy, J. M., and J. A. Orsi. 1999. Physical oceanographic observations collected aboard the NOAA Ship *John N. Cobb* in the northern region of southeastern Alaska, 1997 and 1998. NOAA Proc. Rep. 99-02, 239 p.

Murphy, J. M., A. L. J. Brase, and J. A. Orsi. 1999. An ocean survey of juvenile salmon in the northern region of southeastern Alaska, May–October. NOAA Tech. Memo. NMFS-AFSC-105. Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 40 p.

Orsi, J. A., J. M. Murphy, and A. L. J. Brase. 1997. Survey of juvenile salmon in the marine waters of southeastern Alaska, May–August 1997. (NPAFC Doc. 277) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 27 p.

Orsi, J. A., J. M. Murphy, and D. G. Mortensen. 1998. Survey of juvenile salmon in the marine waters of southeastern Alaska, May–August 1998. (NPAFC Doc. 346) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 27 p.

Orsi, J. A., D. G. Mortensen, and J. M. Murphy. 1999. Early marine ecology of pink and chum salmon in southeastern Alaska. Pp. 64-72 *In*: Proceedings of the 19th Northeast Pacific Pink and Chum Workshop, Juneau, Alaska.

Orsi, J. A., M. V. Sturdevant, J. M. Murphy, D. G. Mortensen, and B. L. Wing. 2000a. Seasonal habitat use and early marine ecology of juvenile Pacific salmon in southeastern Alaska. NPAFC Bull. 2:111-122.

Orsi, J. A., M. V. Sturdevant, J. M. Murphy, D. G. Mortensen, B. L. Wing, and B. K. Krauss. 2000b. Survey of juvenile salmon in the marine waters of southeastern Alaska, May–October 1999. (NPAFC Doc.497) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 51 p.

Orsi, J. A., M. V. Sturdevant, A. C. Wertheimer, B. L. Wing, J. M. Murphy, D. G. Mortensen, E. A. Fergusson, and B. K. Krauss. 2001a. Survey of juvenile salmon in the marine waters of southeastern Alaska, May–September 2000. (NPAFC Doc. 536) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 49 p.

Orsi, J. A., M. V. Sturdevant, J. M. Murphy, D. G. Mortensen, B. L. Wing, A. C. Wertheimer, and W. R. Heard. 2001b. Southeast Alaska coastal monitoring for habitat use and early marine ecology of juvenile Pacific salmon. NPAFC Tech. Rep. 2:38-39.

Orsi, J. A., E. A. Fergusson, W. R. Heard, D. G. Mortensen, M. V. Sturdevant, A. C. Wertheimer, and B. L. Wing. 2002. Survey of juvenile salmon in the marine waters of southeastern Alaska, May–September 2001. (NPAFC Doc. 630) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 51 p.

Orsi, J. A., E. A. Fergusson, M. V. Sturdevant, B. L. Wing, W. R. Heard, A. C. Wertheimer, and D. G. Mortensen. 2003. Survey of juvenile salmon in the marine waters of southeastern Alaska, May–August 2002. (NPAFC Doc. 702) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 60 p.

Orsi, J. A., A. C. Wertheimer, M. V. Sturdevant, E. A. Fergusson, D. G. Mortensen, and B. L. Wing. 2004a. Juvenile chum salmon consumption of zooplankton in marine waters of southeastern Alaska: a bioenergetics approach to implications of hatchery stock interactions. Rev. Fish Biol. Fish. 14:335-359.

Orsi, J. A., E. A. Fergusson, M. V. Sturdevant, B. L. Wing, W. R. Heard, A. C. Wertheimer, and D. G. Mortensen. 2004b. Survey of juvenile salmon in the marine waters of southeastern Alaska, May–August 2003. (NPAFC Doc. 798) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 59 p.

Orsi, J. A., E. A. Fergusson, M. V. Sturdevant, B. L. Wing, A. C. Wertheimer, and W. R. Heard. 2005. Survey of juvenile salmon and associated epipelagic ichthyofauna in the marine waters of southeastern Alaska, May–August 2004. (NPAFC Doc. 871) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 61 p.

Orsi, J. A., E. A. Fergusson, M. V. Sturdevant, B. L. Wing, A. C. Wertheimer, and W. R. Heard. 2006. Survey of juvenile salmon and ecologically-related species in the marine waters of southeastern Alaska, May–August 2005. (NPAFC Doc. 955) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 108 p.

Orsi, J. A., E. A. Fergusson, M. V. Sturdevant, B. L. Wing, A. C. Wertheimer, and W. R. Heard. 2007a. Annual survey of juvenile salmon and ecologically related species and environmental factors in the marine waters of southeastern Alaska, May–August 2006. NPAFC Doc. 1057, 72 p. (Available at http://www.npafc.org).

Orsi, J. A., J. A. Harding, S. S. Pool, R. D. Brodeur, L. J. Haldorson, J. M. Murphy, J. H. Moss, E. V. Farley, Jr., R. M. Sweeting, J. F. T. Morris, M. Trudel, R. J. Beamish, R.L. Emmett, and E. A. Fergusson. 2007b. Epipelagic fish assemblages associated with juvenile Pacific salmon in neritic waters of the California Current and the Alaska Current. Am. Fish. Soc. Symp. 57:105–155.

Orsi, J. A., E. A. Fergusson, M. V. Sturdevant, B. L. Wing, A. C. Wertheimer, and W. R. Heard. 2008. Annual survey of juvenile salmon and ecologically related species and environmental factors in the marine waters of southeastern Alaska, May–August 2007. NPAFC Doc. 1110, 82 pp. (Available at http://www.npafc.org).

Park, W., M. Sturdevant, J. Orsi, A. Wertheimer, E. Fergusson, W. Heard, and T. Shirley. 2004. Interannual abundance patterns of copepods during an ENSO event in Icy Strait, southeastern Alaska. ICES J. Mar. Sci. 61(4):464-477.

Paul, A. J., K. O. Coyle, and D. A. Ziemann. 1990. Variations in egg production rates by *Pseudocalanus* spp. in a subarctic Alaskan bay during the onset of feeding by larval fish. J. Crustacean Biol. 10(4):648-658.

Pearcy, W. G. 1997. What have we learned in the last decade? What are research priorities? Pp. 271–277 *In*: R. L. Emmett and M. H. Schiewe (eds.), Estuarine and ocean survival of northeastern Pacific salmon: Proceedings of the workshop. NOAA Tech. Memo. NMFS-NWFSC-29.

Purcell, J. E., and M. V. Sturdevant. 2001. Prey selection and dietary overlap among zooplanktivorous jellyfish and juvenile fishes in Prince William Sound, Alaska. Mar. Ecol. Prog. Ser. 210:67-83.

Reese, C., N. Hillgruber, M. Sturdevant, A. Wertheimer, W. Smoker, and R. Focht. 2009. Spatial and temporal distribution and the potential for estuarine interactions between wild and hatchery chum salmon (*Oncorhynchus keta*) in Taku Inlet, Alaska. Fish. Bull. 107:433-450.

Seeb, L. C., P. A, Crane, C. M. Kondzela, R. L. Wilmot, S. Urawa, N. V. Varnavskaya, and J. E. Seeb. 2004. Migration of Pacific Rim Chum Salmon on the High Seas: Insights from Genetic Data. Env. Biol. Fish 69(1-4):21-36.

Secor, D. H., J. M. Dean, and E. H. Laban. 1992. Otolith removal and preparation for microstructure examination. Can. Spec. Publ. Fish. Aquat. Sci. 117:19-57.

Sigler, M. F., and D. J. Csepp. 2007. Seasonal abundance of two important forage species in the North Pacific Ocean, Pacific herring and walleye pollock. Fish. Res. 83:319-331.

Sturdevant, M. V., E. A. Fergusson, J. A. Orsi, and A.C. Wertheimer. 2002. Diel feeding of juvenile pink, chum, and coho salmon in Icy Strait, Southeastern Alaska, May-September 2001. (NPAFC Doc. 631) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 42 p.

Sturdevant, M. V., E. A. Fergusson, J. A. Orsi, and A. C. Wertheimer. 2004. Diel feeding and gastric evacuation of juvenile pink and chum salmon in Icy Strait, southeastern Alaska, May-September 2001. NPAFC Tech. Rep. No. 5: 107-109. Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA,

Sturdevant, M.V., Fergusson, E.A. Orsi, and Wertheimer, A.C. 2008. Seasonal patterns in diel feeding, gastric evacuation, and energy density of juvenile chum salmon in Icy Strait, Southeast Alaska, 2001. Proceedings of the 23rd Northeast Pacific Pink and Chum Workshop, February 19-21, Bellingham, WA.

Sturdevant, M. V., M. F. Sigler, and J. A. Orsi. 2009. Sablefish predation on juvenile salmon in the coastal marine waters of Southeast Alaska in 1999. Trans. Am. Fish. Soc. 138:675-691.

Taylor, S. G. 2007. Climate warming causes phenological shift in pink salmon, *Oncorhynchus gorbuscha*, behavior at Auke Creek, Alaska. Global Change Biology 14:229-235.

Weitkamp, L. A., and M. V. Sturdevant. 2008. Food habits and marine survival of juvenile Chinook and coho salmon from marine waters of Southeast Alaska. Fish. Oceanogr. 17(5):380–395.

Wertheimer, A. C., W. W. Smoker, T. L. Joyce, and W. R. Heard. 2001. Comment: A review of the hatchery programs for pink salmon in Prince William Sound and Kodiak Island, Alaska. Trans. Amer. Fish. Soc. 130:712-720.

Wertheimer, A. C., J. A. Orsi, E. A. Fergusson, and M. V. Sturdevant. 2009. Calibration of juvenile salmon catches using paired comparisons between two research vessels fishing Nordic 264 surface trawls in southeastern Alaska, July 2008. NPAFC Doc. 1180. 16 pp. (Available at http://www.npafc.org).

Table 1.—Localities and coordinates of stations sampled in the marine waters of southeastern Alaska, May–August 2008. Transect and station positions are shown in Figure 1.

Station	Latitude north	Longitude west	Distance: Offshore (km)	Distance: Between adjacent station (km)	Bottom depth (m)
Auke Bay Monitor					
ABM	58°22.00'	134°40.00'	1.5	—	60
Upper Chatham Strait transect					
UCA	58°04.57'	135°00.08'	3.2	3.2	400
UCB	58°06.22'	135°00.91'	6.4	3.2	100
UCC	58°07.95'	135°04.00'	6.4	3.2	100
UCD	58°09.64'	135°02.52'	3.2	3.2	200
Icy Strait transect					
ISA	58°13.25'	135°31.76'	3.2	3.2	128
ISB	58°14.22'	135°29.26'	6.4	3.2	200
ISC	58°15.28'	135°26.65'	6.4	3.2	200
ISD	58°16.38'	135°23.98'	3.2	3.2	234
Icy Point transect					
IPA	58°20.12'	137°07.16'	6.9	16.8	160
IPB	58°12.71'	137°16.96'	23.4	16.8	130
IPC	58°05.28'	137°26.75'	40.2	16.8	150
IPD	57°53.50'	137°42.60'	65.0	24.8	1,300

Table 2.—Numbers and types of data collected using the NOAA ship *John N. Cobb* and two charter vessels in different habitats sampled monthly in the marine waters of the northern region of southeastern Alaska, May–August 2008.

			Data collection type[1]					
Dates (days)	Vessel	Habitat	Rope trawl	CTD cast	Oblique bongo	20-m vertical	WP-2 vertical	Chlorophyll & nutrients
22-25 May	R/V *John N. Cobb*	Inshore	0	1	1	3	1	1
(4 days)		Strait	0	8	4	8	0	8
		Coastal	0	4	4	4	4	4
16-21 June	F/V *Steller*	Inshore	0	1	1	3	1	1
(6 days)		Strait	8	10	4	10	0	8
		Coastal	0	0	0	0	0	0
25-31 July	F/V *Steller*	Inshore	0	1	1	3	1	1
(7 days)		Strait	28	23	4	23	0	8
		Coastal	0	0	0	0	0	0
20-24 August	R/V *Medeia*	Inshore	0	1	1	3	1	1
(5 days)		Strait	20	17	4	17	0	8
		Coastal	0	0	0	0	0	0

[1]Rope trawl = 20-min hauls with Nordic 264 surface trawl 18 m deep by 24 m wide; CTD casts = to 200 m or within 10 m of the bottom; oblique bongo = 60-cm diameter frame, 505- and 333-µm meshes, towed double obliquely down to and up from a depth of 200 m or within 20 m of the bottom; 20-m vertical = 50-cm diameter frame, 243-µm conical net (Norpac) towed vertically from 20 m; WP-2 vertical = 57-cm diameter frame, 202-µm conical net towed vertically from 200 m or within 10 m of the bottom; chlorophyll and nutrients are from surface seawater samples.

Table 3.—Surface (3-m, mean) temperature (°C) and salinity (PSU) data collected monthly at stations in the marine waters of the northern region of southeastern Alaska, May–August 2008. Station code acronyms are listed in Table 1.

Month	*n*	Temp (°C)	Salinity (PSU)	*n*	Temp (°C)	Salinity (PSU)	*n*	Temp (°C)	Salinity (PSU)	*n*	Temp (°C)	Salinity (PSU)
Auke Bay Monitor												
	ABM											
May	1	8.7	26.0									
June	1	11.3	22.3									
July	1	9.7	22.9									
August	1	11.1	18.3									
Upper Chatham Strait transect												
	UCA			UCB			UCC			UCD		
May	1	8.2	30.1	1	8.4	29.9	1	8.0	29.8	1	7.2	29.6
June	2	11.3	27.6	2	10.2	28.5	1	10.4	28.1	1	10.1	28.3
July	2	10.8	18.2	2	10.6	19.3	3	10.6	21.5	2	10.6	20.8
August	2	10.8	24.5	2	11.3	21.9	2	10.9	23.4	2	11.6	20.5
Icy Strait transect												
	ISA			ISB			ISC			ISD		
May	1	7.3	30.6	1	7.8	30.3	1	8.9	30.4	1	7.2	30.5
June	1	10.5	28.9	1	10.7	28.8	1	10.6	28.7	1	10.5	29.0
July	3	9.8	26.7	3	10.7	22.2	4	10.4	22.6	4	10.8	22.2
August	2	9.8	26.7	3	10.8	23.4	3	11.3	21.2	2	11.3	21.3

Table 3.—cont.

Month	*n*	Temp (°C)	Salinity (PSU)	*n*	Temp (°C)	Salinity (PSU)	*n*	Temp (°C)	Salinity (PSU)	*n*	Temp (°C)	Salinity (PSU)
						Icy Point transect						
	IPA			IPB			IPC			IPD		
May	1	7.2	31.8	1	7.2	31.8	1	7.2	31.8	1	6.8	32.0
June	—	—	—	—	—	—	—	—	—	—	—	—
July	—	—	—	—	—	—	—	—	—	—	—	—
August	—	—	—	—	—	—	—	—	—	—	—	—

Table 4.—Nutrient (µM) and chlorophyll (µg/L) concentrations from 200-ml surface water samples collected monthly at stations in the marine waters of the northern region of southeastern Alaska, May–August 2008. Station code acronyms are listed in Table 1.

		Nutrients [µM]						
Station	Date	[PO_4]	[$Si(OH)_4$]	[NO_3]	[NO_2]	[NH_4]	Chlorophyll (µg/L)	Phaeopigment (µg/L)
ABM	22 May	0.75	5.84	0.39	0.07	0.89	2.16	1.45
	16 June	0.49	12.35	0.21	0.03	3.51	1.85	0.55
	25 July	0.28	3.21	0.11	0.15	1.07	3.50	1.08
	20 August	0.49	7.96	0.18	0.09	2.61	0.92	0.30
UCA	25 May	1.28	5.69	0.35	0.06	0.97	4.06	0.59
	19 June	0.67	5.37	0.18	0.05	1.02	0.56	0.14
	29 July	0.00	3.57	0.00	0.01	2.66	1.22	0.29
	21 August	0.18	10.79	0.40	0.09	2.48	1.72	0.48
UCB	25 May	0.89	3.28	0.27	0.04	1.09	4.12	0.76
	19 June	0.43	4.93	0.24	0.02	1.05	0.51	0.16
	29 July	0.11	4.77	0.04	0.01	1.63	1.84	0.53
	21 August	0.63	11.27	0.53	0.08	2.18	1.71	0.48
UCC	25 May	1.31	3.97	0.30	0.04	1.00	4.64	0.81
	19 June	0.48	7.86	0.20	0.04	0.74	1.07	0.33
	29 July	0.00	5.03	0.02	0.00	1.88	1.37	0.40
	21 August	0.42	11.10	0.27	0.06	0.93	2.60	0.58
UCD	25 May	1.19	7.68	3.22	0.12	2.23	0.97	0.17
	19 June	0.62	5.62	0.30	0.03	0.67	1.37	0.46
	29 July	0.00	5.03	0.00	0.00	1.44	1.49	0.35
	21 August	0.51	11.61	0.53	0.07	0.79	2.31	0.77
ISA	24 May	0.49	4.30	0.39	0.06	0.51	3.97	1.77
	20 June	0.31	3.39	0.05	0.02	2.54	0.58	0.16
	26 July	0.82	7.16	1.60	0.11	1.64	2.39	0.68
	22 August	2.15	22.71	9.13	0.24	2.12	2.15	0.91
ISB	24 May	1.22	4.04	0.28	0.04	0.76	2.34	0.91
	20 June	0.60	10.63	0.78	0.02	1.01	0.24	0.10
	26 July	0.78	6.48	1.00	0.10	1.90	1.58	0.47
	22 August	0.96	15.06	2.66	0.14	1.12	1.98	0.72
ISC	24 May	0.69	5.42	0.42	0.03	0.62	2.07	0.62
	20 June	0.62	7.50	0.32	0.03	0.97	0.36	0.11
	26 July	0.70	4.51	0.32	0.05	1.07	2.01	0.59
	22 August	0.58	9.04	0.26	0.05	1.01	2.15	0.50

Table 4.—cont.

Station	Date	Nutrients [µM] $[PO_4]$	$[Si(OH)_4]$	$[NO_3]$	$[NO_2]$	$[NH_4]$	Chlorophyll (µg/L)	Phaeopigment (µg/L)
ISD	24 May	0.74	3.44	0.29	0.03	0.57	4.13	1.24
	20 June	0.78	7.50	0.30	0.02	1.07	0.29	0.11
	27 July	1.29	2.62	0.14	0.04	1.76	2.24	0.66
	22 August	0.24	8.87	0.02	0.04	1.45	3.59	0.65
IPA	23 May	2.17	26.84	9.36	0.29	1.72	1.74	0.64
IPB	23 May	1.53	15.26	3.26	0.24	1.73	1.22	0.44
IPC	23 May	2.03	24.94	5.50	0.29	1.61	2.07	0.52
IPD	23 May	2.13	21.83	11.81	0.34	2.26	0.55	0.25

Table 5.— Mean zooplankton settled volumes (ZSV, ml) and total plankton settled volumes (TSV, ml) from vertical 20-m NORPAC hauls collected monthly at stations in the marine waters of the northern region of southeastern Alaska, May–August 2008. Station code acronyms are listed in Table 1. Volume differences between SV and TSV are caused by presence of slub in the sample. Standing stock (ml/m^3) can be computed by dividing by the water volume filtered, a constant factor of 3.9 m^3 for these samples.

Month	*n*	ZSV	TSV	*n*	ZSV	TSV	*n*	ZSV	TSV	*n*	ZSV	TSV
Auke Bay Monitor												
	ABM											
May	3	12.5	68.3									
June	3	9.2	9.2									
July	3	12.3	12.3									
August	3	14.2	14.2									
Upper Chatham Strait transect												
	UCA			UCB			UCC			UCD		
May	1	15.0	15.0	1	18.0	18.0	1	30.0	30.0	1	10.0	10.0
June	2	15.0	15.0	2	19.0	19.0	1	20.0	20.0	1	10.0	10.0
July	2	11.3	11.3	2	12.5	12.5	3	9.3	9.3	2	12.5	12.5
August	2	1.3	1.3	2	2.3	2.3	2	1.8	1.8	2	3.0	3.0
Icy Strait transect												
	ISA			ISB			ISC			ISD		
May	1	17.5	75.0	1	37.5	60.0	1	62.5	90.0	1	16.0	45.0
June	1	10.0	10.0	1	17.0	17.0	1	35.0	35.0	1	30.0	30.0
July	3	14.3	14.3	3	11.3	11.3	4	12.4	12.4	4	17.3	17.3
August	2	5.3	5.3	3	5.0	5.0	2	5.0	5.0	2	6.8	6.8
Icy Point transect												
	IPA			IPB			IPC			IPD		
May	1	17.0	18	1	20.0	20	1	12.0	14	1	40.0	40
June	—	—	—	—	—	—	—	—	—	—	—	—
July	—	—	—	—	—	—	—	—	—	—	—	—
August	—	—	—	—	—	—	—	—	—	—	—	—

Table 6.—Zooplankton displacement volumes (DV, ml), standing stock (DV/m^3), and total density (number/m^3, 333-µm only) from double oblique bongo (333- and 505-µm mesh) hauls collected monthly at the Icy Strait stations in the marine waters of the northern region of southeastern Alaska, May–August 2008. Standing stock (ml/m^3) is computed using flow meter readings to determine water volume filtered. Station code acronyms are listed in Table 1.

Month	Depth (m)	DV	DV/m^3	Total density	Depth (m)	DV	DV/m^3	Total density	Depth (m)	DV	DV/m^3	Total density	Depth (m)	DV	DV/m^3	Total density
333-µm mesh																
	ISA				ISB				ISC				ISD			
May	95	120	1.0	5,627.7	175	200	0.9	2,785.9	200	210	0.8	1,398.9	200	225	0.9	1,822.0
June	63	100	0.8	2,992.7	182	175	0.9	2,610.2	243	245	0.8	2,142.3	228	320	1.0	2,223.9
July	62	50	0.3	2,654.2	141	125	0.5	1,425.1	267	150	0.5	2,484.6	182	235	0.6	1,795.0
August	89	55	0.4	1,575.3	162	70	0.3	861.6	213	165	0.5	1,457.2	206	180	0.8	792.0
505-µm mesh																
	ISA				ISB				ISC				ISD			
May	95	85	0.7	—	175	145	0.6	—	200	165	0.7	—	200	150	0.6	—
June	63	50	0.4	—	182	120	0.6	—	243	170	0.5	—	228	255	0.7	—
July	62	20	0.1	—	141	70	0.3	—	267	80	0.3	—	182	200	0.5	—
August	89	35	0.3	—	162	55	0.2	—	213	130	0.4	—	206	65	0.3	—

Table 7.—Mean volume (L) of jellyfish captured in 56 rope trawl hauls in the marine waters of the northern region of southeastern Alaska, June-August 2008.

	Volume (L)		
Genus	June	July	August
Aurelia sp.	0.0	18.1	37.9
Aequorea sp.	0.0	13.4	10.0
Cyanea sp.	0.8	1.8	3.6
Chrysaora sp.	0.1	0.3	0.3
Staurophora sp.	0.0	0.1	0.2
Total	0.9	33.7	52.0

Table 8.—Numbers of fish captured in 56 rope trawl hauls in the marine waters of the northern region of southeastern Alaska, June–August 2008.

		Number caught			
Common name	Scientific name	June	July	August	Total
	Salmonids				
Pink salmon[1]	*Oncorhynchus gorbuscha*	0	1,896	997	2,893
Chum salmon[1]	*O. keta*	0	868	381	1,249
Sockeye salmon[1]	*O. nerka*	0	180	283	463
Coho salmon[1]	*O. kisutch*	1	249	130	380
Chinook salmon[1]	*O. tshawytscha*	1	23	20	44
Chinook salmon[2]	*O. tshawytscha*	2	9	2	13
Coho salmon[3]	*O. kisutch*	0	0	4	4
Chum salmon[3]	*O. keta*	0	1	0	1
Salmonid subtotals		4	3,226	1,817	5,047
	Non-salmonids				
Crested sculpin	*Blepsias bilobus*	0	49	25	74
Spiny lumpsucker	*Eumicrotremus orbis*	1	14	5	20
Smooth lumpsucker	*Aptocyclus ventricosus*	4	2	5	11
Prowfish	*Zaprora silenus*	0	8	2	10
Pacific herring	*Clupea pallasi*	1	4	3	8
Big mouth sculpin	*Hemitripterus bolini*	6	0	0	6
Walleye pollock	*Theragra chalcogramma*	1	0	2	3
Walleye Pollock larvae	*T. chalcogramma*	1	1	1	3
Wolf-eel	*Anarrhichthys ocellatus*	0	2	0	2
Hexagrammidae	*Hexagrammos* sp.	0	0	1	1
Salmon shark	*Lamna ditropis*	0	1	0	1
Non-salmonid subtotals		14	81	44	139
Grand total fish and squid		18	3,307	1,861	5,186

[1]Juvenile
[2]Immature
[3]Adult

Table 9.—Monthly and total frequency of occurrence of fish captured in the marine waters of the northern region of southeastern Alaska by rope trawl, June–August 2008. The percent frequency of occurrence in 56 total hauls is shown in parentheses.

		Frequency of occurrence				
Common name	Scientific name	June	July	August	Total	(%)
Salmonids						
Pink salmon[1]	*Oncorhynchus gorbuscha*	0	21	20	41	(73)
Chum salmon[1]	*O. keta*	0	24	18	42	(75)
Sockeye salmon[1]	*O. nerka*	0	18	19	37	(66)
Coho salmon[1]	*O. kisutch*	1	27	20	48	(86)
Chinook salmon[1]	*O. tshawytscha*	1	10	11	22	(39)
Chinook salmon[2]	*O. tshawytscha*	2	5	2	9	(16)
Coho salmon[3]	*O. kisutch*	0	0	4	4	(7)
Chum salmon[3]	*O. keta*	0	1	0	1	(2)
Non-salmonids						
Crested sculpin	*Blepsias bilobus*	0	24	14	38	(68)
Spiny lumpsucker	*Eumicrotremus orbis*	1	8	5	14	(25)
Smooth lumpsucker	*Aptocyclus ventricosus*	4	2	4	10	(18)
Prowfish	*Zaprora silenus*	0	8	2	10	(18)
Pacific herring	*Clupea pallasi*	1	3	2	6	(11)
Big mouth sculpin	*Hemitripterus bolini*	4	0	0	4	(7)
Walleye pollock	*Theragra chalcogramma*	1	0	2	3	(5)
Walleye pollock larvae	*T. chalcogramma*	1	1	1	3	(5)
Wolf-eel	*Anarrhichthys ocellatus*	0	2	0	2	(4)
Hexagrammidae	*Hexagrammos* sp.	0	0	1	1	(2)
Salmon shark	*Lamna ditropis*	0	1	0	1	(2)

[1]Juvenile
[2]Immature
[3]Adult

Table 10.—Length (mm, fork), weight (g), Fulton's condition [$(g/mm^3)\cdot(10^5)$], and condition residuals from length-weight regression analysis of juvenile pink salmon captured in the marine habitat of the northern region of southeastern Alaska by rope trawl, June–August 2008.

		June				July				August			
Locality	Factor	*n*	range	mean	se	*n*	Range	mean	se	*n*	range	mean	se
Upper Chatham Strait	Length	—	—	—	—	147	81-147	105.4	0.9	197	103-193	140.9	1.2
	Weight	—	—	—	—	123	4.5-28.0	10.5	0.4	141	10.5-67.6	28.2	1.0
	Condition	—	—	—	—	123	0.7-1.0	0.9	0.0	141	0.8-1.1	0.9	0.0
	Residual	—	—	—	—	123	-0.25-0.11	-0.05	0.01	141	-0.17-0.19	0.00	0.01
Icy Strait	Length	—	—	—	—	1,135	79-155	110.0	0.3	799	97-206	137.4	0.6
	Weight	—	—	—	—	453	3.9-30.4	12.9	0.2	332	9.2-84.5	28.0	0.6
	Condition	—	—	—	—	453	0.7-1.1	0.9	0.0	332	0.6-1.3	0.9	0.0
	Residual	—	—	—	—	453	-0.21-0.20	-0.01	0.00	332	-0.39-0.30	0.01	0.00
Total	Length	—	—	—	—	1,282	79-155	109.5	0.3	996	97-206	138.1	0.5
	Weight	—	—	—	—	576	3.9-30.4	12.4	0.2	473	9.2-84.5	28.1	0.5
	Condition	—	—	—	—	576	0.7-1.1	0.9	0.0	473	0.6-1.3	0.9	0.0
	Residual	—	—	—	—	576	-0.25-0.20	-0.02	0.00	473	-0.39-0.30	0.00	0.00

Table 11.—Length (mm, fork), weight (g), Fulton's condition [(g/mm^3)·(10^5)], and condition residuals from length-weight regression analysis of juvenile chum salmon captured in the marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2008.

		June				July				August			
Locality	Factor	*n*	range	mean	se	*n*	Range	mean	se	*n*	range	mean	se
Upper	Length	—	—	—	—	171	77-133	101.9	0.8	44	88-179	142.3	2.8
Chatham	Weight	—	—	—	—	170	4.1-21.6	9.8	0.2	44	6.4-53.8	29.9	1.8
Strait	Condition	—	—	—	—	170	0.7-1.2	0.9	0.0	44	0.8-1.1	1.0	0.0
	Residual	—	—	—	—	170	-0.26-0.21	-0.05	0.01	44	-0.14-0.15	0.02	0.01
Icy	Length	—	—	—	—	698	81-162	107.9	0.4	337	82-203	130.2	1.2
Strait	Weight	—	—	—	—	484	4.8-44.1	12.9	0.2	238	6.5-89.3	28.7	1.0
	Condition	—	—	—	—	484	0.6-1.9	1.0	0.0	238	0.8-2.1	1.0	0.0
	Residual	—	—	—	—	484	-0.44-0.70	0.02	0.00	238	-0.18-0.78	0.05	0.01
Total	Length	—	—	—	—	869	77-162	106.7	0.4	381	82-203	131.6	1.2
	Weight	—	—	—	—	654	4.1-44.1	12.1	0.2	282	6.4-89.3	28.9	0.9
	Condition	—	—	—	—	654	0.6-1.9	0.9	0.0	282	0.8-2.1	1.0	0.0
	Residual	—	—	—	—	654	-0.44-0.70	0.00	0.00	282	-0.18-0.78	0.04	0.01

Table 12.—Length (mm, fork), weight (g), Fulton's condition [$(g/mm^3)\cdot(10^5)$], and condition residuals from length-weight regression analysis of juvenile sockeye salmon captured in the marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2008.

		June				July				August			
Locality	Factor	*n*	range	mean	se	*n*	Range	mean	se	*n*	range	mean	se
Upper	Length	—	—	—	—	37	63-167	102.7	3.0	121	111-179	158.1	1.1
Chatham	Weight	—	—	—	—	37	2.2-44.9	11.5	1.3	119	12.5-61.7	42.6	0.9
Strait	Condition	—	—	—	—	37	0.8-1.1	0.9	0.0	119	0.9-1.2	1.1	0.0
	Residual	—	—	—	—	37	-0.18-0.12	-0.02	0.01	119	-0.08-0.19	0.06	0.00
Icy	Length	—	—	—	—	142	78-179	103.4	1.3	163	93-205	154.6	1.6
Strait	Weight	—	—	—	—	141	4.3-66.4	11.9	0.6	162	6.9-100.4	42.2	1.2
	Condition	—	—	—	—	141	0.8-1.4	1.0	0.0	162	0.9-1.4	1.1	0.0
	Residual	—	—	—	—	141	-0.20-0.35	0.02	0.01	162	-0.11-0.34	0.08	0.00
Total	Length	—	—	—	—	179	63-179	103.2	1.2	284	93-205	156.1	1.0
	Weight	—	—	—	—	178	2.2-66.4	11.8	0.6	281	6.9-100.4	42.4	0.8
	Condition	—	—	—	—	178	0.8-1.4	1.0	0.0	281	0.9-1.4	1.1	0.0
	Residual	—	—	—	—	178	-0.20-0.35	0.10	0.01	281	-0.11-0.34	0.07	0.00

Table 13.—Length (mm, fork), weight (g), Fulton's condition [(g/mm^3)·(10^5)], and condition residuals from length-weight regression analysis of juvenile coho salmon captured in the marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2008.

		June				July				August			
Locality	Factor	*n*	range	mean	se	*n*	Range	mean	se	*n*	range	mean	se
Upper	Length	1	132	132.0	—	98	125-227	173.7	2.2	31	148-255	201.1	4.4
Chatham	Weight	—	—	—	—	98	21.4-133.2	61.5	2.4	30	33.3-182.0	95.1	6.8
Strait	Condition	—	—	—	—	98	0.9-1.3	1.1	0.0	30	1.0-1.2	1.1	0.0
	Residual	—	—	—	—	98	-0.21-0.16	-0.02	0.01	30	-0.16-0.02	-0.07	0.01
Icy	Length	—	—	—	—	151	135-259	182.7	1.8	99	137-270	207.8	2.5
Strait	Weight	—	—	—	—	109	25.1-225.2	75.8	3.1	98	25.0-220.6	110.8	4.3
	Condition	—	—	—	—	109	1.0-1.3	1.1	0.0	98	1.0-1.4	1.2	0.0
	Residual	—	—	—	—	109	-0.14-0.20	-0.01	0.01	98	-0.15-0.16	-0.01	0.01
Total	Length	1	132	132.0	—	249	125-259	179.2	1.4	130	137-270	206.2	2.2
	Weight	—	—	—	—	207	21.4-225.2	69.0	2.0	128	25.0-220.6	107.1	3.7
	Condition	—	—	—	—	207	0.9-1.3	1.1	0.0	128	1.0-1.4	1.2	0.0
	Residual	—	—	—	—	207	-0.21-0.20	-0.02	0.00	128	-0.16-0.16	-0.02	0.00

Table 14.—Length (mm, fork), weight (g), Fulton's condition [$(g/mm^3)\cdot(10^5)$], and condition residuals from length-weight regression analysis of juvenile Chinook salmon captured in the marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2008.

		June				July				August			
Locality	Factor	*n*	range	mean	se	*n*	Range	mean	se	*n*	range	mean	se
Upper	Length	1	157	157.0	—	20	123-247	171.2	6.0	5	207-261	229.2	11.0
Chatham	Weight	—	—	—	—	20	18.2-183.7	67.8	8.6	5	115.7-241.8	168.6	26.2
Strait	Condition	—	—	—	—	20	1.0-1.4	1.2	0.0	5	1.3-1.4	1.4	0.0
	Residual	—	—	—	—	20	-0.09-0.20	0.04	0.02	5	0.00-0.07	0.04	0.01
Icy	Length	—	—	—	—	3	152-166	157.0	4.5	15	170-262	209.7	7.8
Strait	Weight	—	—	—	—	3	43.7-60.0	50.6	4.9	15	56.2-252.7	135.8	17.2
	Condition	—	—	—	—	3	1.2-1.4	1.3	0.0	15	1.1-1.6	1.4	0.0
	Residual	—	—	—	—	3	0.06-0.18	0.11	0.03	15	-0.04-0.17	0.07	0.02
Total	Length	1	157	157.0	—	23	123-247	169.3	5.3	20	170-262	214.6	6.6
	Weight	—	—	—	—	23	18.2-183.7	65.6	7.5	20	56.2-252.7	144.0	14.5
	Condition	—	—	—	—	23	1.0-1.4	1.2	0.0	20	1.1-1.6	1.4	0.0
	Residual	—	—	—	—	23	-0.09-0.20	0.05	0.01	20	-0.04-0.17	0.06	0.02

Table 15.—Release and recovery information, decoded from coded-wire tags recovered from coho and Chinook salmon lacking an adipose fin. Fish were captured in the marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2008. Station code acronyms and coordinates are shown in Table 1.

		Release information						Recovery information							
Species	Coded-wire tag code	Brood year	Agency[1]	Locality	Date	FL (mm)	Wt. (g)	Locality	Station code	2008 date	FL (mm)	Wt. (g)	Age	Days[2] since release	Distance traveled (km)
						July									
Coho	04:13/15	2006	NSRAA	Kasnyku Bay, AK	5/22/2008		18.2	Icy Strait	ISB	7/27	192	77.5	1.0	66	135
Coho	04:13/73	2006	ADFG	Chilkat R., AK (Wild)	5/24/2008			Icy Strait	ISA	7/26	176	64.8	1.0	63	150
Coho	04:15/58	2006	DIPAC	Gastineau Channel, AK	6/20/2008		19.4	Icy Strait	ISB	7/27	164	47.7	1.0	37	90
Coho	04:15/58	2006	DIPAC	Gastineau Channel, AK	6/20/2008		19.4	Icy Strait	ISA	7/27	177	60.4	1.0	37	93
Coho	04:15/61	2006	DIPAC	Gastineau Channel, AK	6/20/2008		13.5	Icy Strait	ISD	7/27	135	25.1	1.0	37	87
Coho	04:15/61	2006	DIPAC	Gastineau Channel, AK	6/20/2008		13.5	Icy Strait	ISD	7/28	148	32.5	1.0	38	87
Chinook	04:02/64	2005	NMFS	Little Port Walter, AK	5/15/2007	122	21.8	U. Chatham	UCD	7/29	402	950.0	1.1	441	195
Chinook	04:14/53	2005	DIPAC	Gastineau Channel, AK	6/11/2007		19.1	U. Chatham	UCD	7/29	370	800.0	1.1	414	67
						August									
Coho	04:13/73	2006	ADFG	Chilkat R., AK (Wild)	5/24/2008			Icy Strait	ISB	8/23	219	125.0	1.0	91	145
Coho	04:15/58	2006	DIPAC	Gastineau Channel, AK	6/20/2008		19.4	Icy Strait	ISC	8/23	203	91.3	1.0	64	89
Coho	04:15/58	2006	DIPAC	Gastineau Channel, AK	6/20/2008		19.4	Icy Strait	ISD	8/23	201	99.0	1.0	64	87
Coho	04:15/58	2006	DIPAC	Gastineau Channel, AK	6/20/2008		19.4	U. Chatham	UCA	8/21	207	92.6	1.0	62	76
Coho	04:15/61	2006	DIPAC	Gastineau Channel, AK	6/20/2008		13.5	Icy Strait	ISD	8/22	193	76.2	1.0	63	87
Coho	No tag							Icy Strait	ISB	8/22	205	98.9	1.0	91	145
Chinook	04:15/62	2006	DIPAC	Pullen Creek, AK	6/19/2008		15.0	Icy Strait	ISD	8/23	175	75.3	1.0	65	160

[1] ADFG = Alaska Department of Fish and Game; DIPAC = Douglas Island Pink and Chum; NMFS = National Marine Fisheries Service; NSRAA = Northern Southeast Regional Aquaculture Association.

[2] Days since release may potentially include freshwater residence periods.

Table 16.—Stock-specific information on juvenile chum salmon released from regional enhancement facilities and captured in the marine waters of the northern region of southeastern Alaska by rope trawl, June-August 2008. Length (mm, fork), weight (g), Fulton's condition [(g/mm^3) · (10^5)], and condition residuals from length-weight regression analysis are reported for each stock group by sample size (*n*), range, mean, and standard error (se) about the mean. See Table 15 for agency acronyms. L/L = late large release size.

		June				July				August			
Locality	Factor	n	range	mean	se	n	range	mean	se	n	range	mean	se
Northern region stocks													
DIPAC													
Upper	Length	—	—	—	—	29	91-119	104.5	1.4	1	145	145.0	—
Chatham	Weight	—	—	—	—	29	6.2-15.7	10.3	0.4	1	30.1	30.1	—
Strait	Condition	—	—	—	—	29	0.8-1.0	0.9	0.0	1	1.0	1.0	—
	Residual	—	—	—	—	29	-0.18-0.07	-0.06	0.01	1	0.03	0.03	—
Icy	Length	—	—	—	—	169	83-137	107.9	0.8	17	111-165	144.1	3.7
Strait	Weight	—	—	—	—	169	5.4-27.1	12.5	0.3	17	12.2-50.0	31.1	2.4
	Condition	—	—	—	—	169	0.8-1.2	1.0	0.0	17	0.9-1.1	1.0	0.0
	Residual	—	—	—	—	169	-0.16-0.25	0.02	0.01	17	-0.10-0.17	0.04	0.02
Total	Length	—	—	—	—	198	83-137	107.4	0.7	18	111-165	144.2	3.5
	Weight	—	—	—	—	198	5.4-27.1	12.2	0.3	18	12.2-50.0	31.0	2.3
	Condition	—	—	—	—	198	0.8-1.2	1.0	0.0	18	0.9-1.1	1.0	0.0
	Residual	—	—	—	—	198	-0.18-0.25	0.01	0.01	18	-0.10-0.17	0.04	0.02
NSRAA													
Kasnyku Bay													
Upper	Length	—	—	—	—	7	108-123	112.3	2.0	7	111-164	141.7	7.0
Chatham	Weight	—	—	—	—	7	10.6-15.3	12.3	0.6	7	12.9-43.1	29.5	4.0
Strait	Condition	—	—	—	—	7	0.8-0.9	0.9	0.0	7	0.9-1.1	1.0	0.0
	Residual	—	—	—	—	7	-0.16--0.02	-0.09	0.02	7	-0.07-0.11	0.04	0.02

Table 16.—cont.

Locality	Factor	June				July				August			
		n	range	mean	se	n	range	mean	se	n	range	mean	se
Icy Strait	Length	—	—	—	—	21	99-129	113.0	1.7	20	103-167	129.4	3.7
	Weight	—	—	—	—	21	8.9-20.8	13.4	0.7	20	11.7-50.4	22.8	2.4
	Condition	—	—	—	—	21	0.6-1.1	0.9	0.0	20	0.8-1.2	1.0	0.0
	Residual	—	—	—	—	21	-0.44-0.12	-0.04	0.02	20	-0.18-0.22	0.04	0.02
Total	Length	—	—	—	—	28	99-129	112.8	1.3	27	103-167	132.6	3.4
	Weight	—	—	—	—	28	8.9-20.8	13.1	0.5	27	11.7-50.4	24.6	2.1
	Condition	—	—	—	—	28	0.6-1.1	0.9	0.0	27	0.8-1.2	1.0	0.0
	Residual	—	—	—	—	28	-0.44-0.12	-0.05	0.02	27	-0.18-0.22	0.04	0.02
Kasnyku Bay L/L													
Upper Chatham Strait	Length	—	—	—	—	1	121	121.0	—	1	151	151.0	—
	Weight	—	—	—	—	1	16.2	16.2	—	1	35.3	35.3	—
	Condition	—	—	—	—	1	0.9	0.9	—	1	1.0	1.0	—
	Residual	—	—	—	—	1	-0.03	-0.03	—	1	0.06	0.06	—
Icy Strait	Length	—	—	—	—	5	105-120	114.0	3.0	3	111-114	113.0	1.0
	Weight	—	—	—	—	5	11.8-16.7	14.6	1.1	3	13.1-14.7	13.7	0.5
	Condition	—	—	—	—	5	0.9-1.0	1.0	0.0	3	0.9-1.0	1.0	0.0
	Residual	—	—	—	—	5	0.00-0.08	0.03	0.01	3	-0.05-0.05	0.01	0.03
Total	Length	—	—	—	—	6	105-121	115.2	2.7	4	111-151	122.5	9.5
	Weight	—	—	—	—	6	11.8-16.7	14.9	0.9	4	13.1-35.3	19.1	5.4
	Condition	—	—	—	—	6	0.9-1.0	1.0	0.0	4	0.9-1.0	1.0	0.0
	Residual	—	—	—	—	6	-0.03-0.08	0.02	0.02	4	-0.05-0.06	0.02	0.02

Table 16.—cont.

Locality	Factor	June				July				August			
		n	range	mean	se	n	range	mean	se	n	range	mean	se
						Takatz Bay							
Upper	Length	—	—	—	—	6	105-127	116.3	2.9	5	125-145	134.0	3.4
Chatham	Weight	—	—	—	—	6	10.6-16.9	14.0	0.9	5	19.4-29.0	23.5	1.7
Strait	Condition	—	—	—	—	6	0.8-0.9	0.9	0.0	5	1.0-1.0	1.0	0.0
	Residual	—	—	—	—	6	-0.14--0.03	-0.07	0.02	5	-0.01-0.05	0.01	0.01
Icy	Length	—	—	—	—	23	101-140	116.6	2.2	20	107-146	127.4	2.0
Strait	Weight	—	—	—	—	23	8.7-24.1	15.4	0.9	20	14.9-31.3	20.4	0.9
	Condition	—	—	—	—	23	0.8-1.1	0.9	0.0	20	0.9-1.2	1.0	0.0
	Residual	—	—	—	—	23	-0.22-0.13	0.00	0.02	20	-0.08-0.26	0.02	0.02
Total	Length	—	—	—	—	29	101-140	116.6	1.9	25	107-146	128.7	1.8
	Weight	—	—	—	—	29	8.7-24.1	15.1	0.8	25	14.9-31.3	21.0	0.8
	Condition	—	—	—	—	29	0.8-1.1	0.9	0.0	25	0.9-1.2	1.0	0.0
	Residual	—	—	—	—	29	-0.22-0.13	-0.01	0.02	25	-0.08-0.26	0.02	0.01
						Deep Inlet L/L							
Icy	Length	—	—	—	—	—	—	—	—	1	165	165.0	—
Strait	Weight	—	—	—	—	—	—	—	—	1	42.4	42.4	—
(Total)	Condition	—	—	—	—	—	—	—	—	1	0.9	0.9	—
	Residual	—	—	—	—	—	—	—	—	1	-0.02	-0.02	—

Table 16.—cont.

Locality	Factor	June n	June range	June mean	June se	July n	July range	July mean	July se	August n	August range	August mean	August se
Southern region stocks													
SSRAA Anita Bay													
Icy	Length	—	—	—	—	—	—	—	—	16	123-184	149.7	4.1
Strait	Weight	—	—	—	—	—	—	—	—	16	23.7-59.1	36.2	2.5
(Total)	Condition	—	—	—	—	—	—	—	—	16	0.9-2.1	1.1	0.1
	Residual	—	—	—	—	—	—	—	—	16	-0.05-0.78	0.10	0.05
Kendrick Bay													
Icy	Length	—	—	—	—	—	—	—	—	2	183-190	186.5	3.5
Strait	Weight	—	—	—	—	—	—	—	—	2	56.8-74.6	65.7	8.9
(Total)	Condition	—	—	—	—	—	—	—	—	2	0.9-1.1	1.0	0.1
	Residual	—	—	—	—	—	—	—	—	2	-0.05-0.11	0.03	0.08
Neets Bay (fall)													
Upper	Length	—	—	—	—	—	—	—	—	2	167-169	168.0	1.0
Chatham	Weight	—	—	—	—	—	—	—	—	2	45.7-47.9	46.8	1.1
Strait	Condition	—	—	—	—	—	—	—	—	2	1.0-1.0	1.0	0.0
	Residual	—	—	—	—	—	—	—	—	2	0.01-0.02	0.02	0.00
Icy	Length	—	—	—	—	—	—	—	—	6	144-187	164.0	6.0
Strait	Weight	—	—	—	—	—	—	—	—	6	34.7-68.9	46.3	5.1
	Condition	—	—	—	—	—	—	—	—	6	1.0-1.2	1.0	0.0
	Residual	—	—	—	—	—	—	—	—	6	-0.01-0.19	0.07	0.03

Table 16.—cont.

Locality	Factor	June				July				August			
		n	range	mean	se	n	range	mean	se	n	range	mean	se
Total	Length	—	—	—	—	—	—	—	—	8	144-187	165.0	4.5
	Weight	—	—	—	—	—	—	—	—	8	34.7-68.9	46.4	3.7
	Condition	—	—	—	—	—	—	—	—	8	1.0-1.2	1.0	0.0
	Residual	—	—	—	—	—	—	—	—	8	-0.01-0.19	0.05	0.02
Neets Bay (summer)													
Upper Chatham Strait	Length	—	—	—	—	—	—	—	—	2	163-169	166.0	3.0
	Weight	—	—	—	—	—	—	—	—	2	43.8-48.5	46.1	2.4
	Condition	—	—	—	—	—	—	—	—	2	1.0-1.0	1.0	0.0
	Residual	—	—	—	—	—	—	—	—	2	0.04-0.05	0.04	0.00
Icy Strait	Length	—	—	—	—	—	—	—	—	8	125-184	164.9	7.4
	Weight	—	—	—	—	—	—	—	—	8	16.7-66.6	49.3	5.3
	Condition	—	—	—	—	—	—	—	—	8	0.9-1.6	1.1	0.1
	Residual	—	—	—	—	—	—	—	—	8	-0.11-0.52	0.09	0.07
Total	Length	—	—	—	—	—	—	—	—	10	125-184	165.1	5.8
	Weight	—	—	—	—	—	—	—	—	10	16.7-66.6	48.7	4.2
	Condition	—	—	—	—	—	—	—	—	10	0.9-1.6	1.1	0.1
	Residual	—	—	—	—	—	—	—	—	10	-0.11-0.52	0.08	0.07
Northern and southern region unmarked stocks													
Upper Chatham Strait	Length	—	—	—	—	123	78-133	100.1	0.9	25	88-171	138.2	3.7
	Weight	—	—	—	—	123	4.1-21.6	9.3	0.3	25	6.4-51.0	27.5	2.4
	Condition	—	—	—	—	123	0.7-1.2	0.9	0.0	25	0.8-1.1	1.0	0.0
	Residual	—	—	—	—	123	-0.26-0.21	-0.04	0.01	25	-0.14-0.15	0.01	0.01

Table 16.—cont.

		June				July				August			
Locality	Factor	n	range	mean	se	n	range	mean	se	n	range	mean	se
Icy	Length	—	—	—	—	259	81-162	108.6	0.8	136	89-203	135.8	2.0
Strait	Weight	—	—	—	—	259	4.8-44.1	12.8	0.3	136	6.5-89.3	27.8	1.4
	Condition	—	—	—	—	259	0.8-1.7	1.0	0.0	136	0.8-1.3	1.0	0.0
	Residual	—	—	—	—	259	-0.19-0.61	0.01	0.01	136	-0.19-0.36	0.05	0.01
Total	Length	—	—	—	—	382	78-162	105.9	0.6	161	88-203	136.2	1.8
	Weight	—	—	—	—	382	4.1-44.1	11.7	0.2	161	6.4-89.3	27.7	1.3
	Condition	—	—	—	—	382	0.7-1.7	0.9	0.0	161	0.8-1.3	1.0	0.0
	Residual	—	—	—	—	382	-0.26-0.61	-0.01	0.00	161	-0.19-0.36	0.04	0.01

Table 17.—Stock-specific information on juvenile sockeye salmon released from regional enhancement facilities and captured in the marine waters of the northern region of southeastern Alaska by rope trawl, June-August 2008. Length (mm, fork), weight (g), Fulton's condition [$(g/mm^3) \cdot (10^5)$], and condition residuals from length-weight regression analysis are reported for each stock group by sample size (*n*), range, mean, and standard error (se) about the mean. See Table 15 for agency acronyms.

		June				July				August			
Locality	Factor	*n*	range	mean	se	*n*	range	mean	se	*n*	range	mean	se
Northern region stocks													
DIPAC													
Speel Arm													
Upper Chatham Strait	Length	—	—	—	—	3	100-133	116.7	9.5	—	—	—	—
	Weight	—	—	—	—	3	10.3-25.3	16.5	4.5	—	—	—	—
	Condition	—	—	—	—	3	0.9-1.1	1.0	0.1	—	—	—	—
	Residual	—	—	—	—	3	-0.12-0.08	0.01	0.06	—	—	—	—
Icy Strait	Length	—	—	—	—	8	102-137	116.0	4.7	4	164-175	170.0	2.5
	Weight	—	—	—	—	8	10.3-29.1	17.1	2.4	4	48.8-60.8	54.7	3.1
	Condition	—	—	—	—	8	1.0-1.2	1.0	0.0	4	1.1-1.1	1.1	0.0
	Residual	—	—	—	—	8	0.00-0.18	0.07	0.02	4	0.04-0.12	0.09	0.02
Total	Length	—	—	—	—	11	100-137	116.2	4.0	4	164-175	170.0	2.5
	Weight	—	—	—	—	11	10.3-29.1	16.9	2.0	4	48.8-60.8	54.7	3.1
	Condition	—	—	—	—	11	0.9-1.2	1.0	0.0	4	1.1-1.1	1.1	0.0
	Residual	—	—	—	—	11	-0.12-0.18	0.05	0.02	4	0.04-0.12	0.09	0.02

Table 17.—cont.

Locality	Factor	June				July				August			
		n	range	mean	se	*n*	range	mean	se	*n*	range	mean	se
						Tahltan Lake							
Icy	Length	—	—	—	—	—	—	—	—	1	187	187.0	—
Strait	Weight	—	—	—	—	—	—	—	—	1	68.5	68.5	—
(Total)	Condition	—	—	—	—	—	—	—	—	1	1.0	1.0	—
	Residual	—	—	—	—	—	—	—	—	1	0.03	0.03	—
						Sweetheart Lake							
Upper	Length	—	—	—	—	—	—	—	—	1	179	179.0	—
Chatham	Weight	—	—	—	—	—	—	—	—	1	56.7	56.7	—
Strait	Condition	—	—	—	—	—	—	—	—	1	1.0	1.0	—
(Total)	Residual	—	—	—	—	—	—	—	—	1	-0.03	-0.03	—
						Tatsamenie Lake							
Icy	Length	—	—	—	—	—	—	—	—	1	168	168.0	—
Strait	Weight	—	—	—	—	—	—	—	—	1	59.5	59.5	—
(Total)	Condition	—	—	—	—	—	—	—	—	1	1.3	1.3	—
	Residual	—	—	—	—	—	—	—	—	1	0.22	0.22	—
						Tuya Lake							
Upper	Length	—	—	—	—	—	—	—	—	1	175	175.0	—
Chatham	Weight	—	—	—	—	—	—	—	—	1	52.6	52.6	—
Strait	Condition	—	—	—	—	—	—	—	—	1	1.0	1.0	—
(Total)	Residual	—	—	—	—	—	—	—	—	1	-0.03	-0.03	—

Table 17.—cont.

Locality	Factor	June				July				August			
		n	range	mean	se	*n*	range	mean	se	*n*	range	mean	se
Northern and Southern region unmarked stocks													
Upper	Length	—	—	—	—	34	63-167	101.5	3.1	117	111-179	157.6	1.1
Chatham	Weight	—	—	—	—	34	2.2-44.9	11.0	1.3	117	12.5-61.7	42.4	0.9
Strait	Condition	—	—	—	—	34	0.8-1.1	0.9	0.0	117	0.9-1.2	1.1	0.0
	Residual	—	—	—	—	34	-0.18-0.12	-0.02	0.01	117	-0.08-0.18	0.05	0.00
Icy	Length	—	—	—	—	132	78-179	102.5	1.4	154	93-205	154.1	1.6
Strait	Weight	—	—	—	—	132	4.3-68.2	11.9	0.8	154	6.9-100.4	41.7	1.2
	Condition	—	—	—	—	132	0.8-2.9	1.0	0.0	154	0.9-1.4	1.1	0.0
	Residual	—	—	—	—	132	-0.20-1.08	0.03	0.01	154	-0.11-0.34	0.07	0.00
Total	Length	—	—	—	—	166	63-179	102.3	1.3	271	93-205	155.6	1.0
	Weight	—	—	—	—	166	2.2-68.2	11.7	0.7	271	6.9-100.4	42.0	0.8
	Condition	—	—	—	—	166	0.8-2.9	1.0	0.0	271	0.9-1.4	1.1	0.0
	Residual	—	—	—	—	166	-0.20-1.08	0.02	0.01	271	-0.11-0.34	0.06	0.00

Table 18.—Number examined, length (mm, fork), wet weight (g), stomach content as percent body weight (%BW), and visual index of stomach fullness (0-100% volume) of potential predators of juvenile salmon captured in marine straits of the northern region of southeastern Alaska by rope trawl, June–August 2008. See Tables 8 and 9 for scientific names and Figure 16 for additional feeding data.

		June				July				August			
Species	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Salmonids													
Chum Salmon[2]	Length	—	—	—	—	1	635-635	635.0	—	—	—	—	—
	Weight	—	—	—	—	1	3150-3150	3150.0	—	—	—	—	—
	%BW	—	—	—	—	1	0.02-0.02	0.02	—	—	—	—	—
	Fullness	—	—	—	—	1	10-10	10	—	—	—	—	—
Chinook Salmon[1]	Length	2	297-419	358.0	86.3	9	340-422	369.4	29.7	2	435-588	511.5	108.2
	Weight	2	350-950	650.0	424.3	9	550-1000	722.2	171.6	2	1150-2900	2025.0	1237.4
	%BW	2	0.09-0.63	0.4	0.4	9	0-1.4	0.4	0.4	2	0.21-0.61	0.4	0.3
	Fullness	2	50-75	63	18	9	0-110	44	42	2	25-75	50	35
Coho salmon[2]	Length	—	—	—	—	—	—	—	—	4	308-680	552.3	166.1
	Weight	—	—	—	—	—	—	—	—	4	2700-4200	3150.0	708.3
	%BW	—	—	—	—	—	—	—	—	4	0.02-0.62	0.2	0.3
	Fullness	—	—	—	—	—	—	—	—	4	1-75	44	37
Non-salmonids													
Walleye pollock	Length	1	648-648	648.0		—	—	—	—	1	372-372	372.0	
	Weight	1	1350-1350	1350.0		—	—	—	—	1	500-500	500.0	
	%BW	1	0.5-0.5	0.5		—	—	—	—	1	1.1-1.1	1.1	
	Fullness	1	100-100	100		—	—	—	—	1	75-75	75	

[1]Immature
[2]Adult

Appendix 1.— Temperature (°C), salinity (PSU), light level (W/m^3), Secchi depth (m), mixed layer depth (MLD, m; see text for definition), and zooplankton and total plankton settled volumes (ml) by haul number at each station sampled in the marine waters of the northern region of southeastern Alaska, May–August 2008. Station code acronyms are listed in Table 1. Triplicate zooplankton samples were taken at the Auke Bay Monitor station each month.

Date	Haul #	Station	Temperature (°C)	Salinity (PSU)	Light level (wt/m^3)	Secchi (m)	MLD (m)	Zoop. SV (ml)	Total SV (ml)
22 May	12001	ABM	8.7	26.0	185	3	6	11.5	60.0
								9.0	60.0
								17.0	85.0
23 May	12002	IPD	6.8	32.0	41	6	42	40.0	40.0
23 May	12003	IPC	7.2	31.8	104	6	18	12.0	14.0
23 May	12004	IPB	7.2	31.8	375	5	19	20.0	20.0
23 May	12005	IPA	7.2	31.8	722	5	8	17.0	18.0
24 May	12006	ISA	7.3	30.6	370	3	9	17.5	75.0
24 May	12007	ISB	7.8	30.3	471	3	8	37.5	60.0
24 May	12008	ISC	8.9	30.4	716	3	10	62.5	90.0
24 May	12009	ISD	7.2	30.5	707	4	10	16.0	45.0
25 May	12010	UCA	8.2	30.1	383	3	8	15.0	15.0
25 May	12011	UCB	8.4	29.9	465	3	8	18.0	18.0
25 May	12012	UCC	8.0	29.8	548	3	8	30.0	30.0
25 May	12013	UCD	7.2	29.6	562	6	7	10.0	10.0
16 June	12014	ABM	11.3	22.3	726	4	6	10.0	10.0
								10.0	10.0
								7.5	7.5
19 June	12015	UCD	10.1	28.3	313	4	6	10.0	10.0
19 June	12016	UCC	10.4	28.1	302	3	6	20.0	20.0
19 June	12017	UCB	8.9	29.2	220	5	8	15.0	15.0
19 June	12018	UCA	11.1	27.4	237	4	6	10.0	10.0
20 June	12019	ISA	10.5	28.9	620	4	7	10.0	10.0
20 June	12020	ISB	10.7	28.8	303	6	6	17.0	17.0

Appendix 1.—cont.

Date	Haul #	Station	Temperature (°C)	Salinity (PSU)	Light level (wt/m^3)	Secchi (m)	MLD (m)	Zoop. SV (ml)	Total SV (ml)
20 June	12021	ISC	10.6	28.7	322	5	7	35.0	35.0
20 June	12022	ISD	10.5	29.0	686	6	6	30.0	30.0
21 June	12023	UCA	11.4	27.8	138	5	6	20.0	20.0
21 June	12024	UCB	11.5	27.7	87	5	6	23.0	23.0
25 July	12025	ABM	9.7	22.9	122	2	7	11.0	11.0
								12.0	12.0
								14.0	14.0
26 July	12026	ISA	9.3	27.6	202	5	8	15.0	15.0
26 July	12027	ISB	10.7	22.4	278	4	7	14.0	14.0
26 July	12028	ISC	10.7	22.9	90	3	8	8.5	8.5
27 July	12029	ISD	10.8	21.9	33	5	8	11.0	11.0
27 July	12030	ISD	10.7	22.4	90	4	8	20.0	20.0
27 July	12031	ISC	10.8	21.4	127	5	9	14.0	14.0
27 July	12032	ISB	10.5	22.8	59		7	10.0	10.0
27 July	12033	ISA	9.9	25.9	32	5	9	20.0	20.0
28 July	12034	ISA	10.3	24.7	84	4	8	8.0	8.0
28 July	12036	ISB	10.8	21.2	190	5	6	10.0	10.0
28 July	12038	ISC	10.5	21.9	137	5	7	17.0	17.0
28 July	12039	ISD	10.6	22.6	24	5	6	18.0	18.0
29 July	12040	UCA	10.5	18.8	41	4	9	15.0	15.0
29 July	12041	UCB	10.5	18.2	67	3	6	15.0	15.0
29 July	12042	UCC	10.5	22.7	290	4	10	8.0	8.0
29 July	12043	UCD	10.3	21.1	881	4	10	15.0	15.0
29 July	12045	UCC	10.5	20.2	109	3	9	10.0	10.0
30 July	12046	UCA	11.2	17.6	45	5	7	7.5	7.5
30 July	12048	UCB	10.7	20.3	202	4	8	10.0	10.0
30 July	12050	UCC	10.7	21.6	220	5	7	10.0	10.0
30 July	12051	UCD	10.9	20.4	67	4	7	10.0	10.0

Appendix 1.—cont.

Date	Haul #	Station	Temperature (°C)	Salinity (PSU)	Light level (wt/m^3)	Secchi (m)	MLD (m)	Zoop. SV (ml)	Total SV (ml)
31 July	12052	ISD	10.9	22.5	37	7	6	20.0	20.0
31 July	12053	ISC	9.6	23.4	48	6	6	10.0	10.0
20 August	12054	ABM	11.1	18.3	742	3	6	20.0	20.0
								15.0	15.0
								7.5	7.5
20 August	12055	UCD	11.6	20.5	48	4	8	3.0	3.0
21 August	12056	UCC	10.9	24.0	21	4	6	2.0	2.0
21 August	12057	UCB	11.4	21.1	25	5	6	2.5	2.5
24 August	12058	UCA	10.8	26.5	58	5	8	1.0	1.0
21 August	12059	UCA	10.9	22.5	95	4	7	1.5	1.5
21 August	12060	UCB	11.1	22.6	154	5	6	2.0	2.0
21 August	12061	UCC	10.9	22.8	58	5	10	1.5	1.5
21 August	12062	UCD	11.6	20.5	36	3	6	3.0	3.0
22 August	12063	ISA	9.9	26.7	50	4	6	8.0	8.0
22 August	12064	ISB	10.8	23.3	74	5	6	7.5	7.5
22 August	12065	ISC	11.5	20.8	71	6	7	5.0	5.0
22 August	12066	ISD	11.7	20.5	29	6	6	7.5	7.5
22 August	12068	ISB	10.3	25.3	36	5	7	5.0	5.0
23 August	12069	ISA	9.8	26.7	80	4	6	2.5	2.5
23 August	12070	ISB	11.3	21.9	189	8	7	2.5	2.5
23 August	12071	ISC	11.2	22.4	62	7	6	5.0	5.0
23 August	12074	ISD	11.0	23.6	69	6	8	6.0	6.0

Appendix 2.—Catch and life history stage of salmonids captured in the marine waters of the northern region of southeastern Alaska, June–August 2008. Station code acronyms are listed in Table 1.

			Juvenile salmon					Immature and adult salmon		
Date	Haul #	Station	Pink	Chum	Sockeye	Coho	Chinook	Chum	Coho	Chinook
19 June	12015	UCD	0	0	0	0	1	0	0	0
19 June	12016	UCC	0	0	0	1	0	0	0	0
20 June	12022	ISD	0	0	0	0	0	0	0	1
21 June	12024	UCB	0	0	0	0	0	0	0	1
26 July	12026	ISA	0	0	0	10	0	0	0	0
26 July	12027	ISB	1	0	0	20	0	0	0	0
26 July	12028	ISC	286	138	30	9	1	0	0	0
27 July	12029	ISD	52	46	9	4	1	0	0	0
27 July	12030	ISD	765	103	25	7	0	0	0	0
27 July	12031	ISC	32	24	1	24	0	0	0	0
27 July	12032	ISB	4	5	1	30	0	0	0	0
27 July	12033	ISA	0	1	0	4	0	1	0	0
28 July	12034	ISA	1	4	0	1	0	0	0	0
28 July	12035	ISA	0	0	0	2	0	0	0	0
28 July	12036	ISB	58	65	6	14	0	0	0	0
28 July	12037	ISB	154	44	4	10	0	0	0	0
28 July	12038	ISC	67	47	8	5	0	0	0	0
28 July	12039	ISD	179	102	34	10	1	0	0	0
29 July	12040	UCA	75	55	12	10	4	0	0	0
29 July	12041	UCB	4	4	3	9	0	0	0	0
29 July	12042	UCC	23	30	8	8	5	0	0	0
29 July	12043	UCD	8	32	3	6	1	0	0	4
29 July	12044	UCD	13	9	5	14	4	0	0	0
29 July	12045	UCC	0	2	0	2	0	0	0	2
30 July	12046	UCA	3	12	1	7	2	0	0	1
30 July	12047	UCA	20	9	0	3	0	0	0	0
30 July	12048	UCB	0	1	5	8	3	0	0	0

Appendix 2.—cont.

Date	Haul #	Station	Juvenile salmon					Immature and adult salmon		
			Pink	Chum	Sockeye	Coho	Chinook	Chum	Coho	Chinook
30 July	12049	UCB	2	15	0	3	0	0	0	1
30 July	12050	UCC	0	2	0	19	1	0	0	0
30 July	12051	UCD	0	0	0	9	0	0	0	1
31 July	12052	ISD	16	13	8	0	0	0	0	0
31 July	12053	ISC	133	105	17	1	0	0	0	0
20 August	12055	UCD	22	4	18	10	1	0	0	0
21 August	12056	UCC	2	3	31	3	0	0	0	0
21 August	12057	UCB	94	18	15	4	1	0	0	0
21 August	12059	UCA	13	5	3	2	1	0	0	1
21 August	12060	UCB	1	0	1	1	0	0	0	0
21 August	12061	UCC	30	6	47	6	1	0	1	0
21 August	12062	UCD	1	1	4	2	0	0	1	0
22 August	12063	ISA	3	1	3	2	0	0	0	0
22 August	12064	ISB	42	16	19	16	2	0	0	0
22 August	12065	ISC	267	42	26	11	1	0	1	0
22 August	12066	ISD	115	49	20	7	3	0	0	0
22 August	12067	ISA	3	1	1	10	0	0	0	0
22 August	12068	ISB	33	5	29	18	0	0	0	0
23 August	12069	ISA	4	2	1	6	0	0	0	0
23 August	12070	ISB	109	44	33	10	0	0	0	0
23 August	12071	ISC	6	0	10	4	4	0	0	0
23 August	12072	ISD	34	21	4	3	4	0	0	1
23 August	12073	ISC	176	149	16	7	1	0	0	0
23 August	12074	ISD	8	7	0	5	0	0	0	0
24 August	12058	UCA	34	7	2	3	1	0	1	0

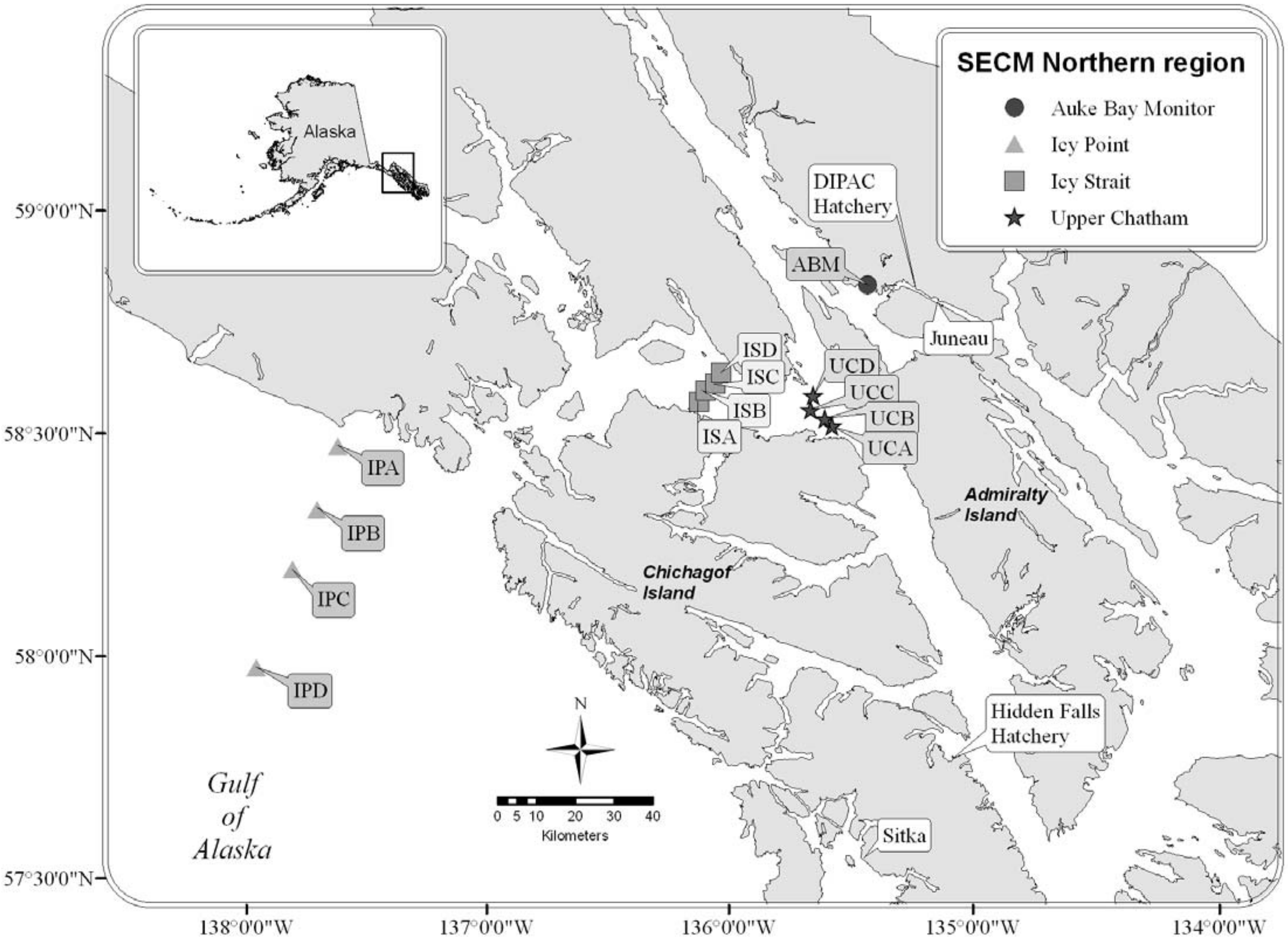


Figure 1.—Stations sampled in the marine waters of the northern region of southeastern Alaska, May–August 2008. Transect and station coordinates and station code acronyms are shown in Table 1.

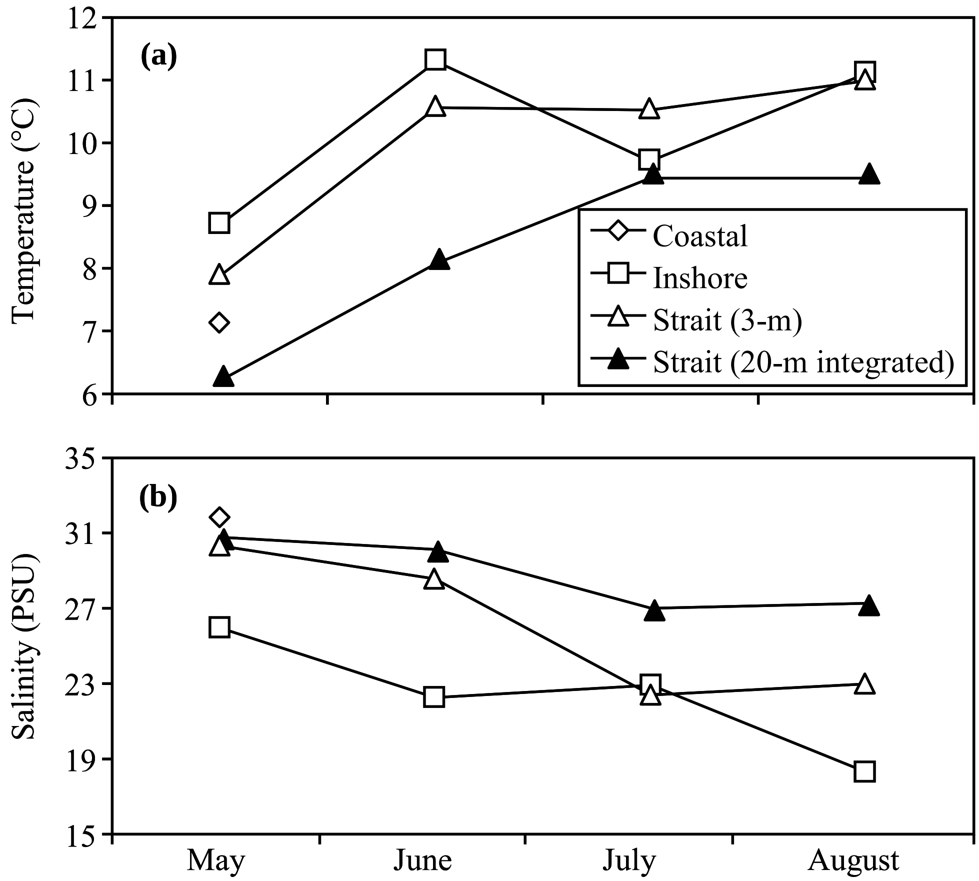


Figure 2.—Surface (mean, 3-m and 20-m integrated) temperature (a) and salinity (b) in the marine waters of the northern region of southeastern Alaska, May–August 2008. The 3-m measures represent the most active segment of the water column, while the 20-m integrated measures represent more stable waters also sampled by the trawl (see also Figure 3). See Table 2 for monthly sample sizes and Appendix 1 for data values.

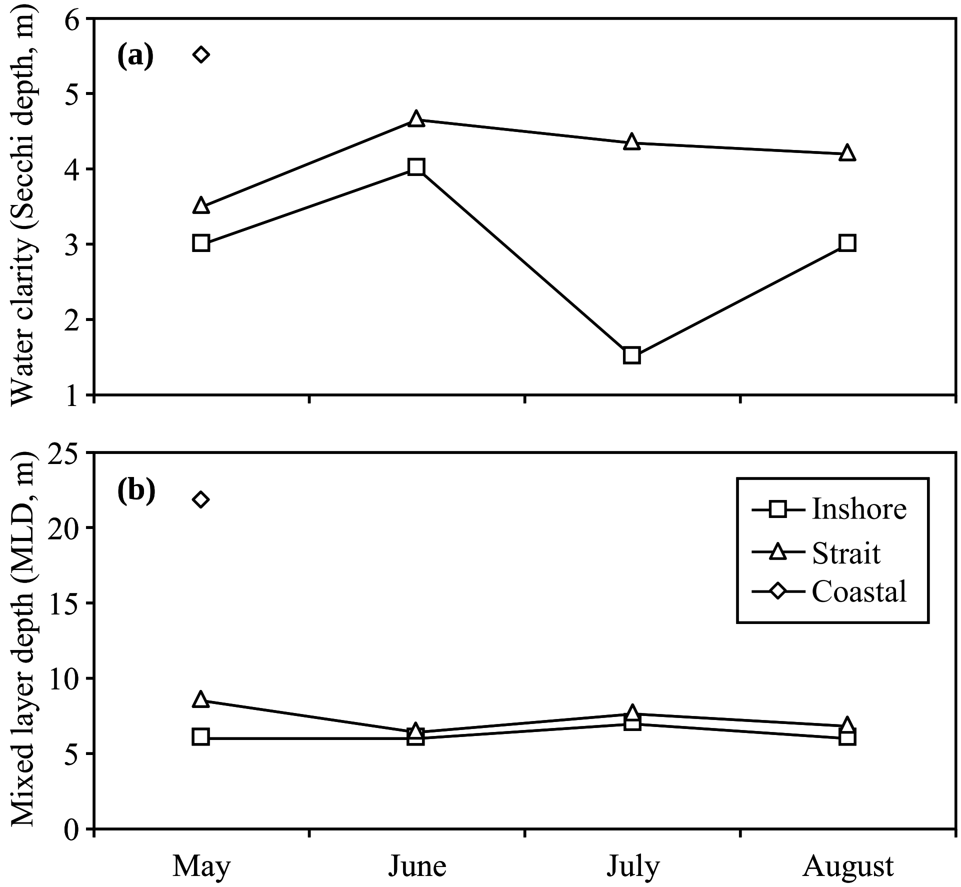


Figure 3.—Water clarity (a) as mean depth (m) of Secchi disappearance and mixed layer depth (MLD, m) (b) calculated from CTD profiles from surface water samples in the marine waters of the northern region of southeastern Alaska, May–August 2008. See Table 2 for monthly sample sizes and Appendix 1 for data values.

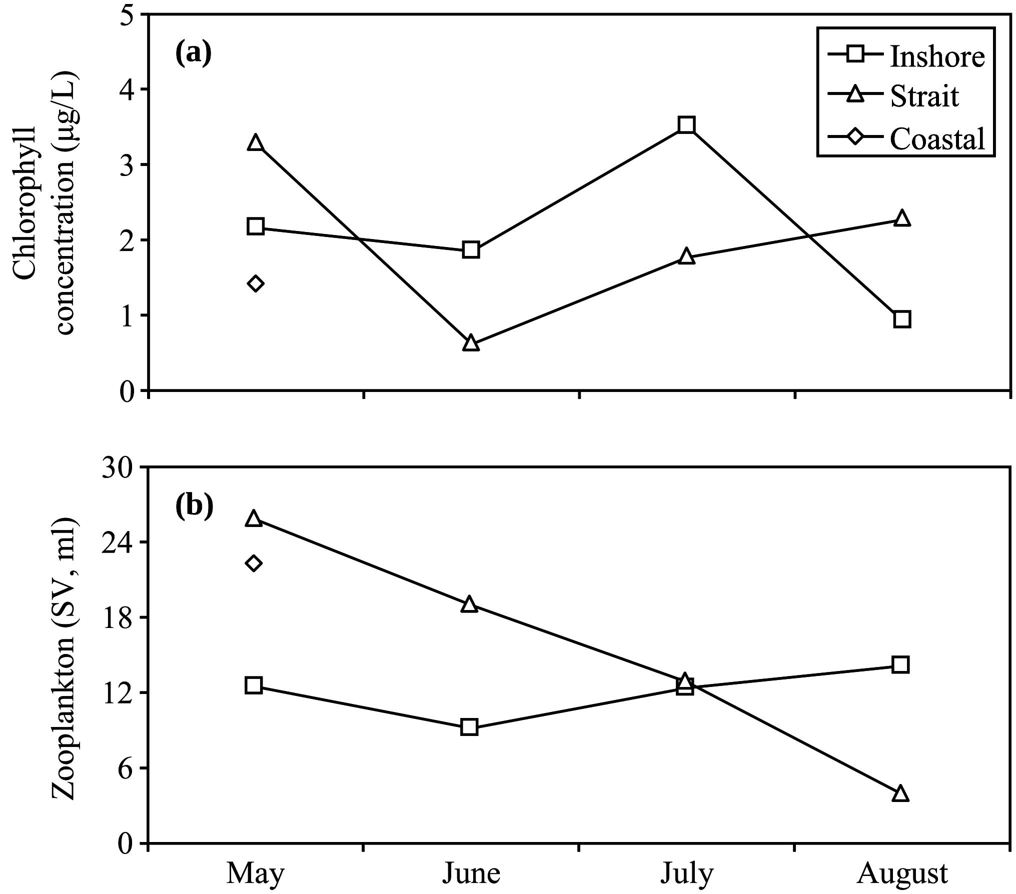


Figure 4.—Mean chlorophyll concentration (µg/L) (a) from surface water samples, and zooplankton settled volumes (ZSV, ml) (b) from 20-m vertical NORPAC hauls in the marine waters of the northern region of southeastern Alaska, May–August 2008. Chlorophyll samples were only sampled once per month per station, while ZSV was measured during all hauls at each station. See Table 2 for monthly sample sizes and Appendix 1 for data values. Zooplankton standing stock (ml/m^3) can be computed by dividing by water volume filtered, a constant factor of 3.9 m^3 for these samples.

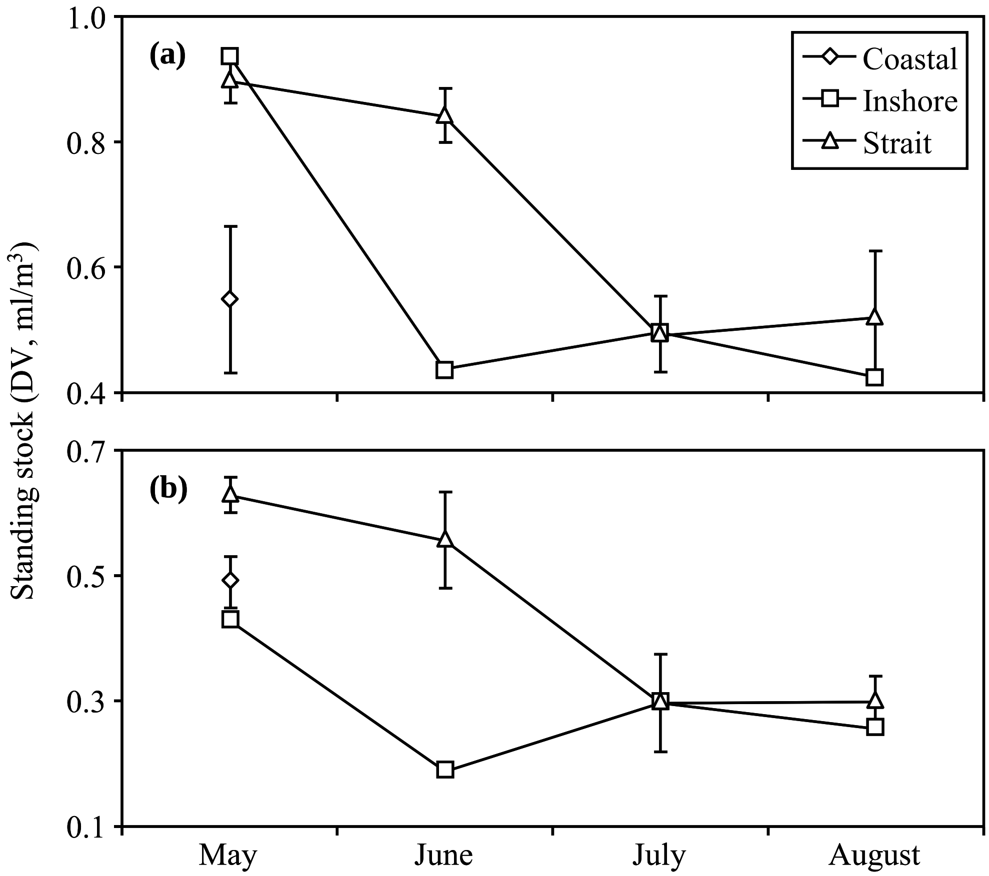


Figure 5.—Monthly zooplankton standing stock (mean ml/m^3, ± 1 standard error) from (a) 333-μm and (b) 505-μm mesh double oblique bongo net samples hauled from ≤ 200 m depths during daylight at stations in Icy Strait (n = 4) in the marine waters of the northern region of southeastern Alaska, May–August 2008.

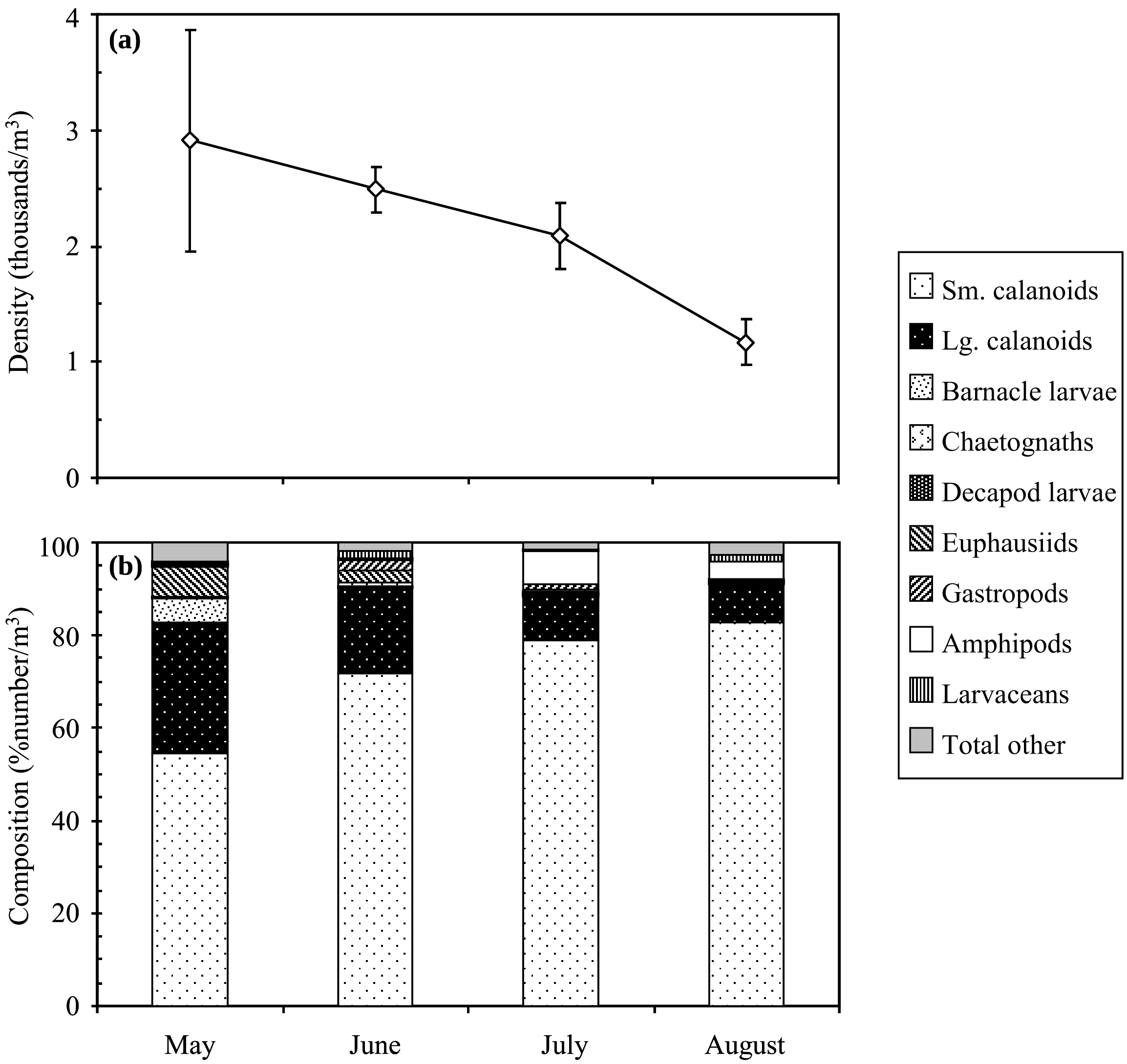


Figure 6.—Monthly "deep" (≤200 m depth) zooplankton collected in marine waters of the northern region of southeastern Alaska, May–August 2008. Data include (a) mean total density of organisms (thousands/m^3) ± 1 standard error, and (b) taxonomic composition (mean percent/m^3). Samples were collected in Icy Strait (n = 4 stations) using a 333-µm mesh bongo net towed in double oblique fashion during daylight, each month.

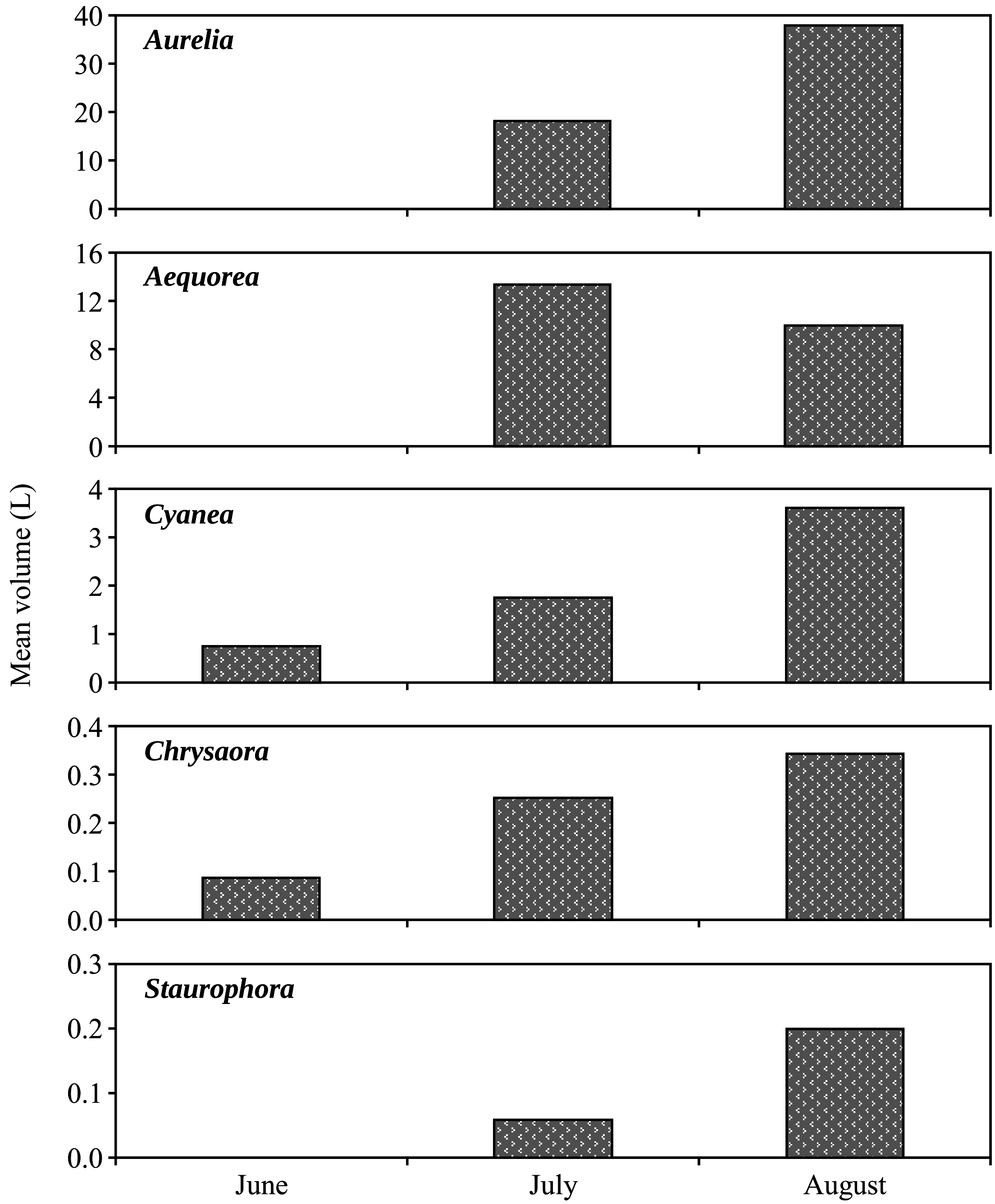


Figure 7.—Mean volume (L) of jellyfish captured in the marine waters of northern region of southeastern Alaska in 56 rope trawl hauls, June–August 2008. See Table 2 for monthly sample sizes.

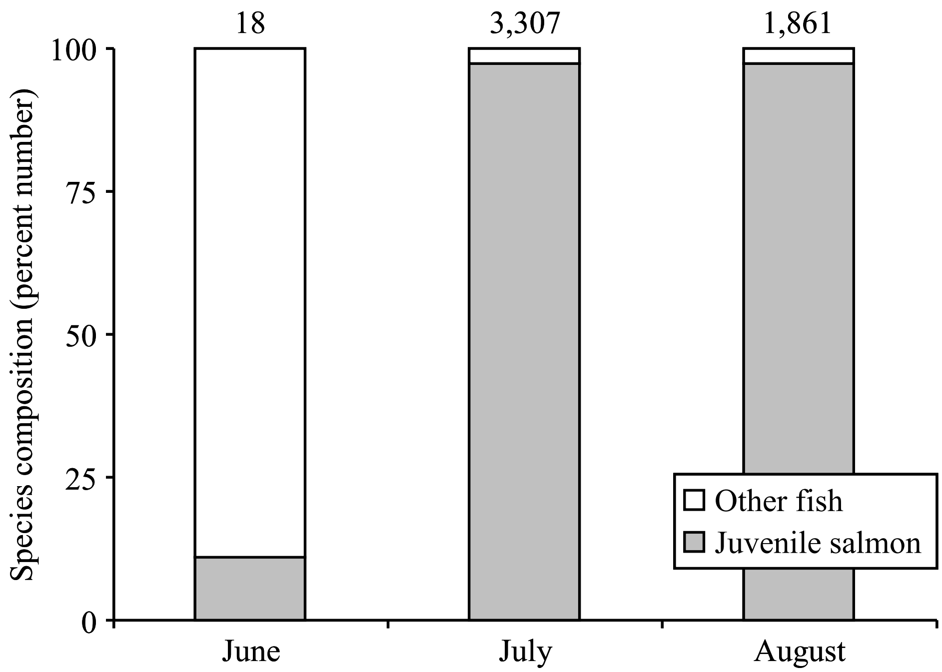


Figure 8.—Fish composition from 56 rope trawl hauls in the marine waters of northern region of southeastern Alaska, June–August 2008. Number of fish is indicated above each bar. See Table 2 for monthly sample sizes.

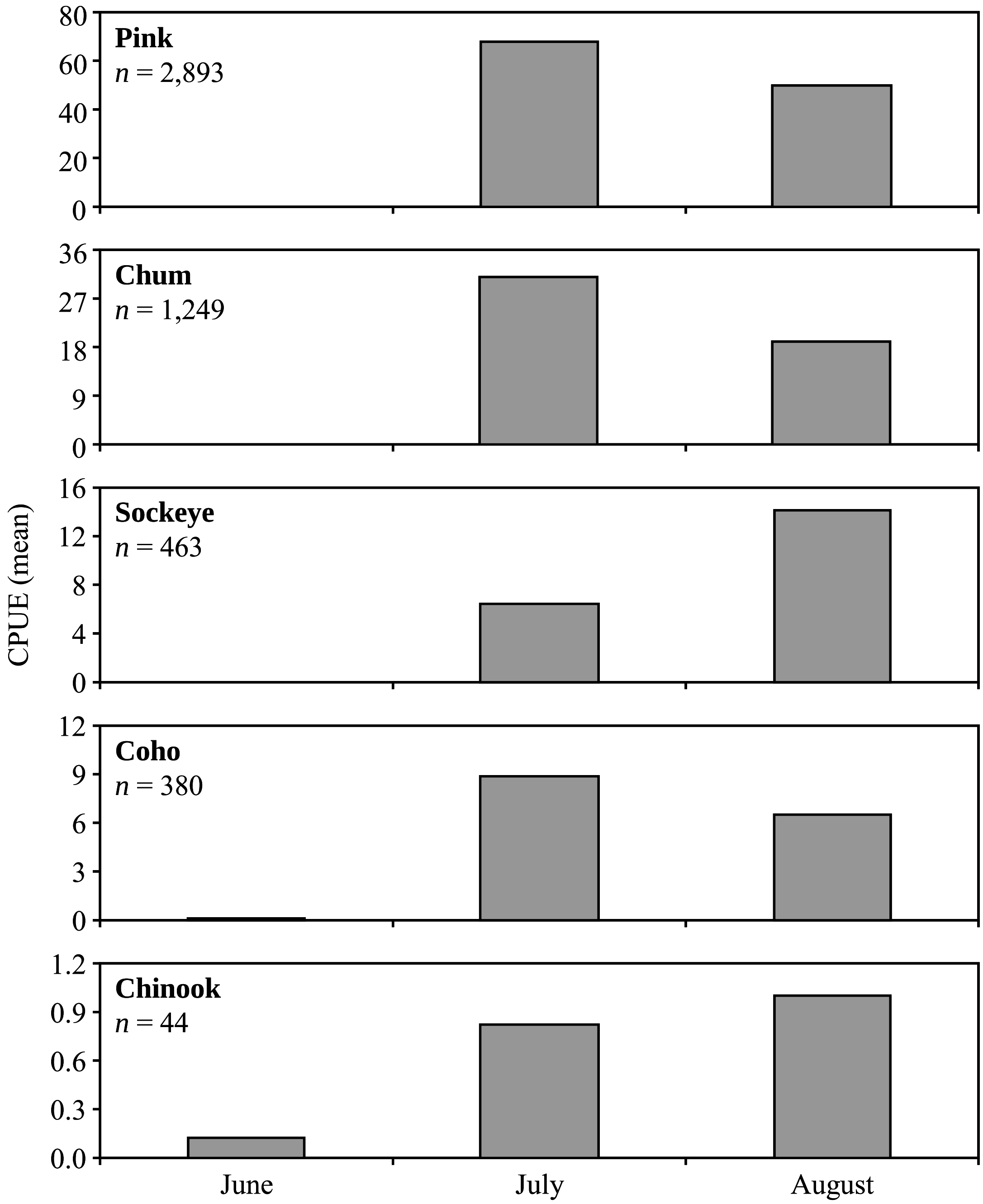


Figure 9.—Catch-per-unit-effort (CPUE, mean catch per trawl haul) of juvenile salmon captured in 56 rope trawl hauls in the marine waters of the northern region of southeastern Alaska, June–August 2008. Total catch is indicated for each species. See Table 2 for monthly sample sizes.

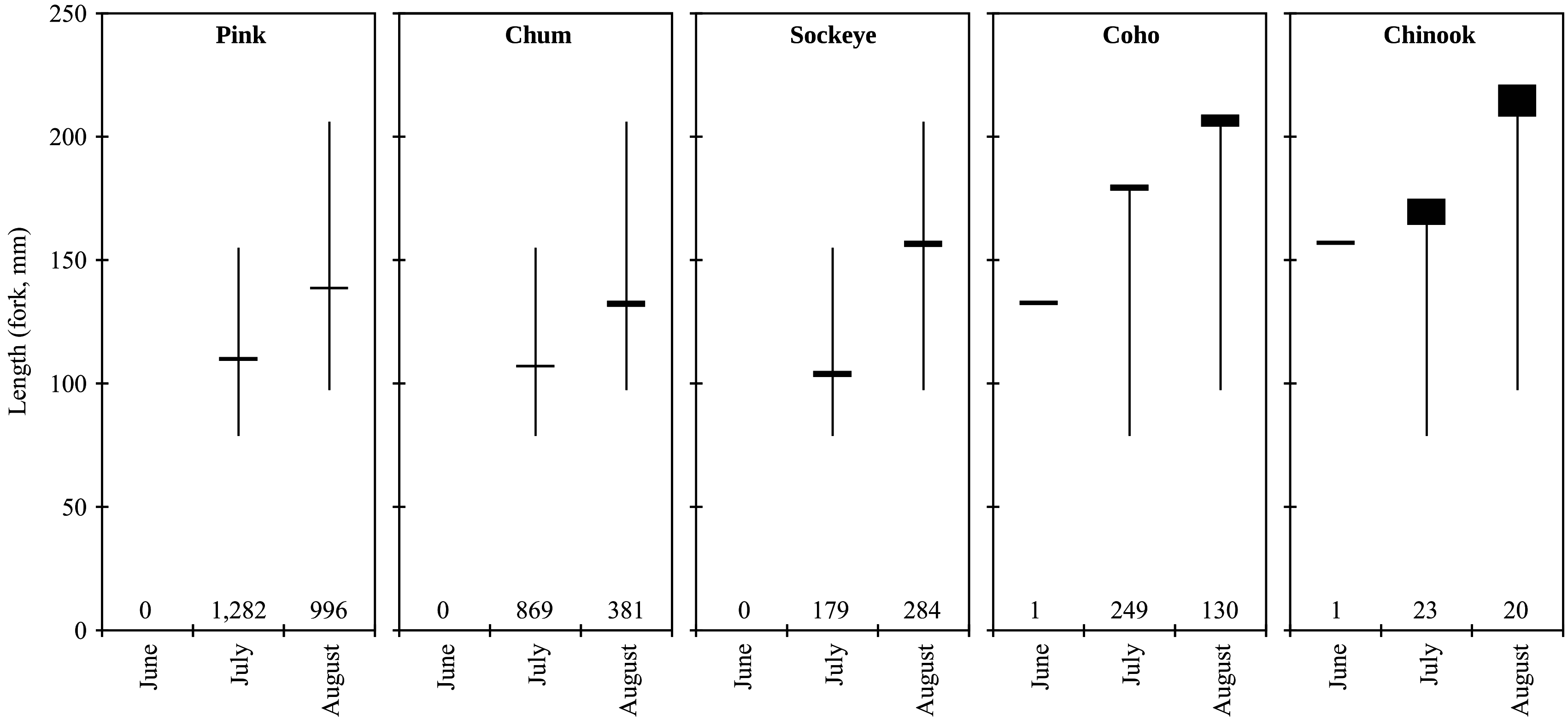


Figure 10.—Length (mm, fork) of juvenile salmon captured in 56 rope trawl hauls in the marine waters of the northern region of southeastern Alaska, June–August 2008. Length of vertical bars is the size range for each sample, and the boxes within the size range are one standard error on either side of the mean. Sample sizes are reported for each month.

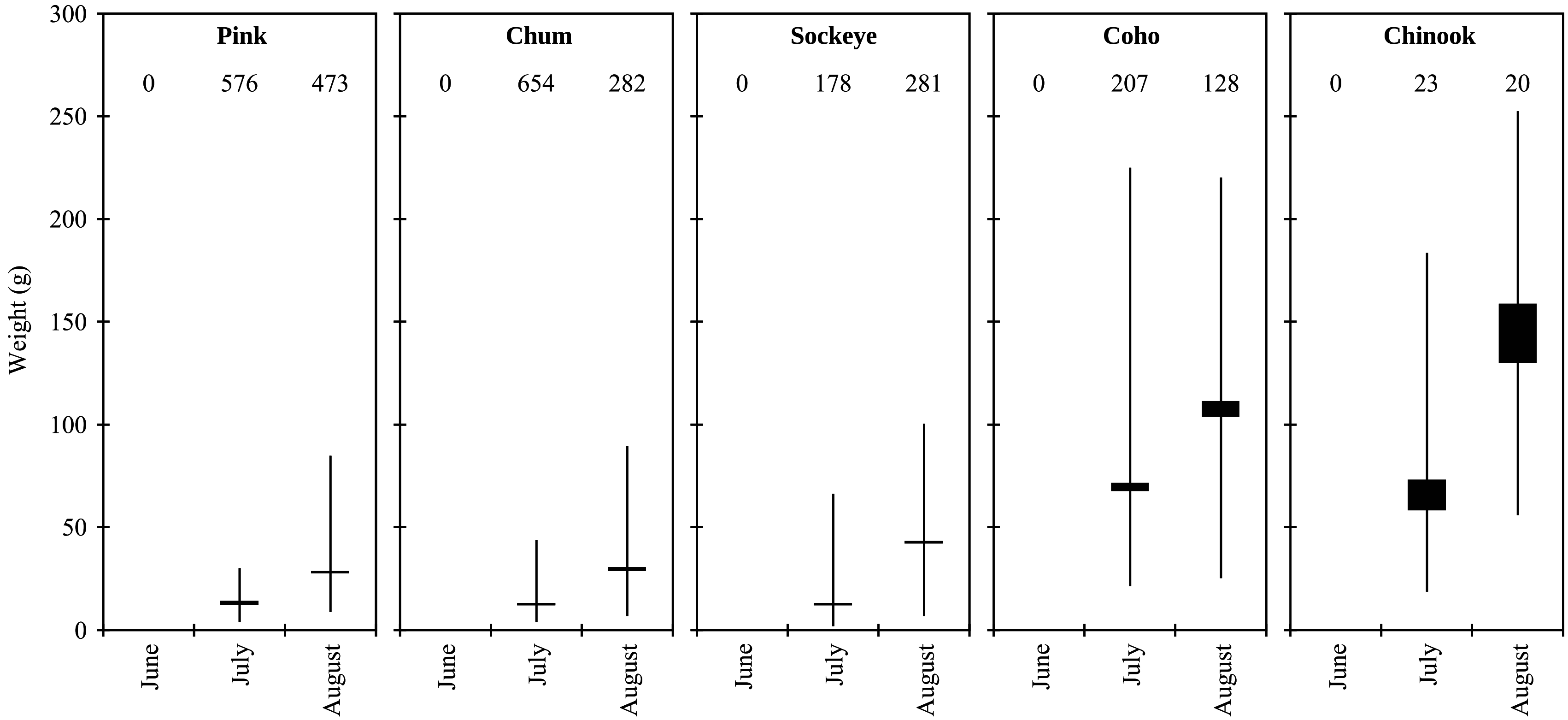


Figure 11.—Weight (g) of juvenile salmon captured in 56 rope trawl hauls in the marine waters of the northern region of southeastern Alaska, June–August 2008. Length of vertical bars is the size range for each sample, and the bars within the size range are one standard error on either side of the mean. Sample sizes are reported for each month.

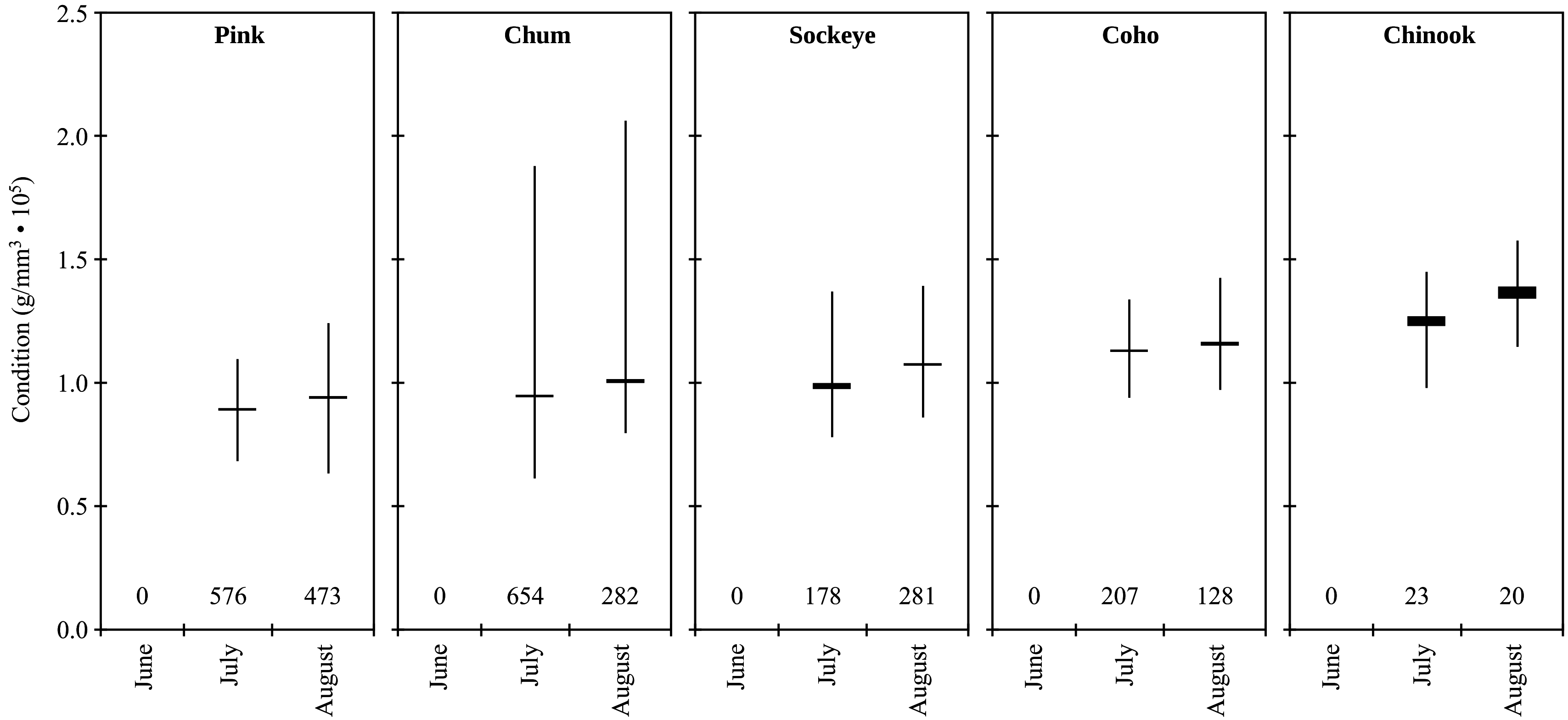


Figure 12.—Fulton's condition ($g/mm^3 \cdot 10^5$) of juvenile salmon captured in 56 rope trawl hauls in the marine waters of the northern region of southeastern Alaska, June–August 2008. Length of vertical bars is the size range for each sample, and the boxes within the size range are one standard error on either side of the mean. Sample sizes are reported for each month.

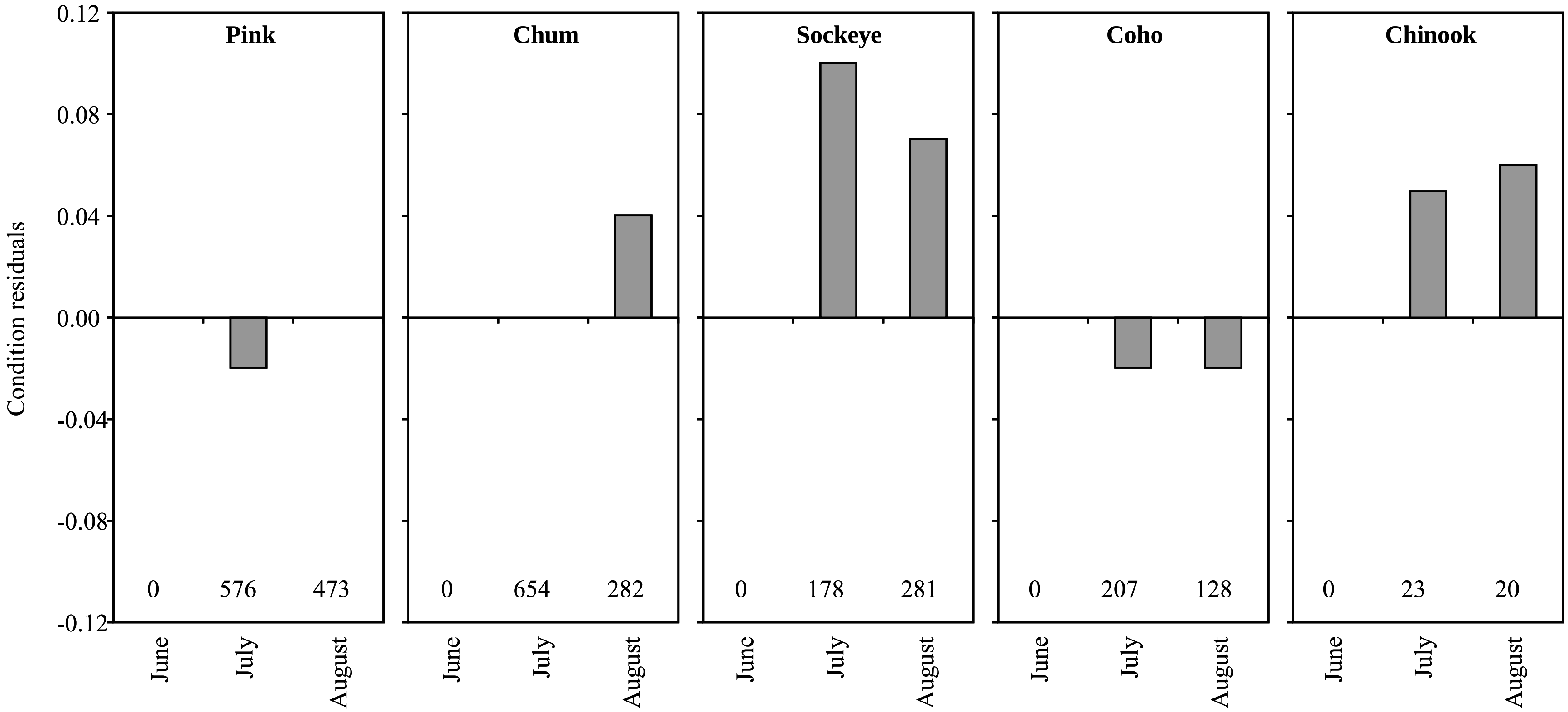


Figure 13.—Condition residuals from length-weight regression analysis of juvenile salmon captured in 56 rope trawl hauls in the marine waters of the northern region of southeastern Alaska, June–August 2008. The 2008 condition residuals are calculated as the average deviation from the long term (1997-2007) length/weight regression equation.

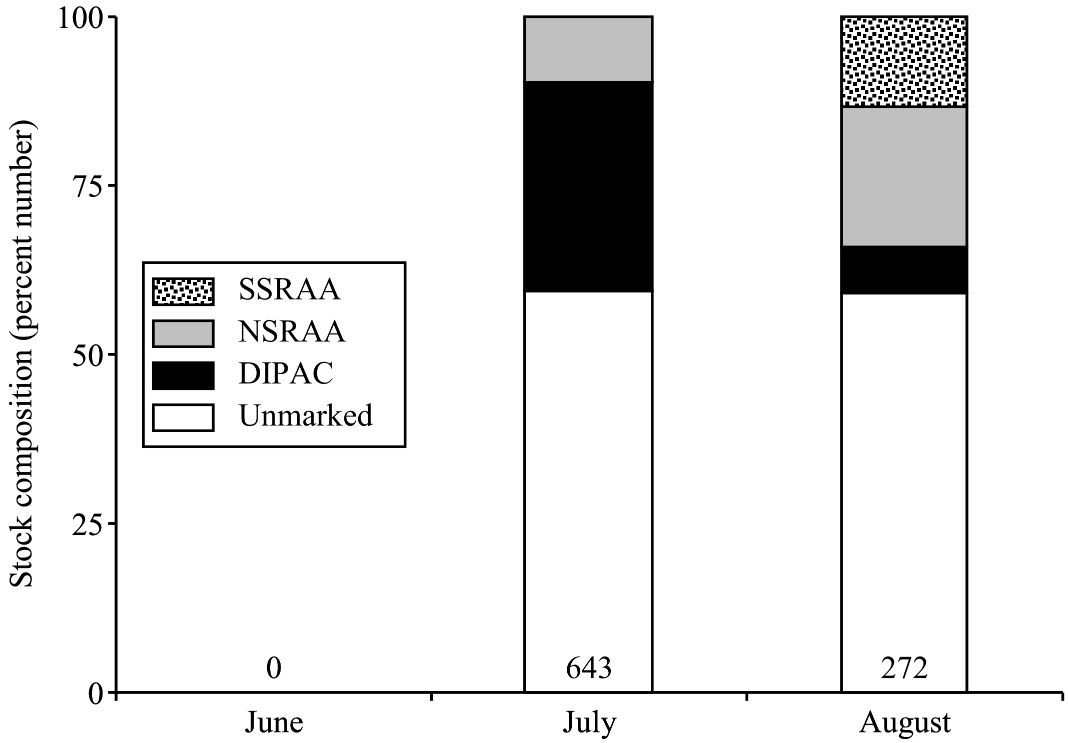


Figure 14.—Monthly stock composition (based on otolith thermal marks) of juvenile chum salmon captured in 56 rope trawl hauls in the marine waters of the northern region of southeastern Alaska, June–August 2008. Number of salmon sampled per month is indicated within each bar.

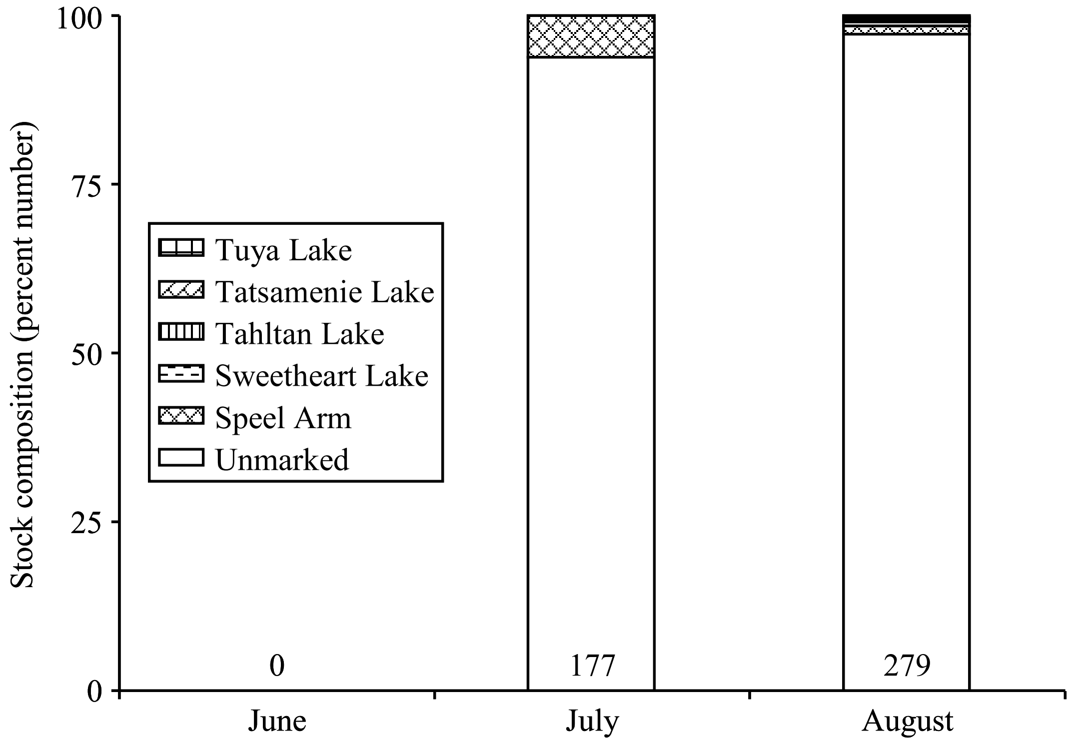


Figure 15.—Monthly stock composition (based on otolith thermal marks) of juvenile sockeye salmon captured in 56 rope trawl hauls in the marine waters of the northern region of southeastern Alaska, June–August 2008. Number of salmon sampled per month is indicated within each bar.

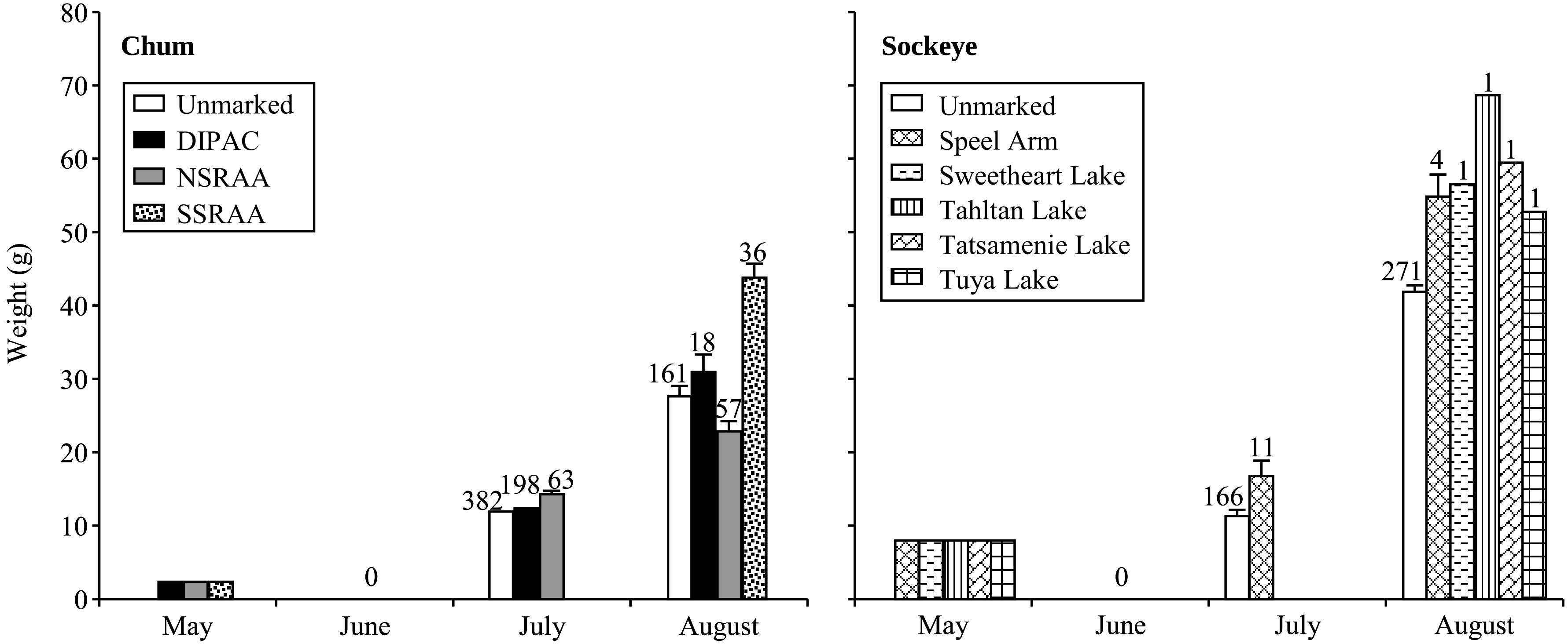


Figure 16.—Stock-specific growth trajectories of juvenile chum and sockeye salmon captured in 56 rope trawl hauls in the marine waters of the northern region of southeastern Alaska, June–August 2008. Weights of May fish are mean values at time of hatchery release. The sample sizes and the standard error of the mean are indicated above each bar.

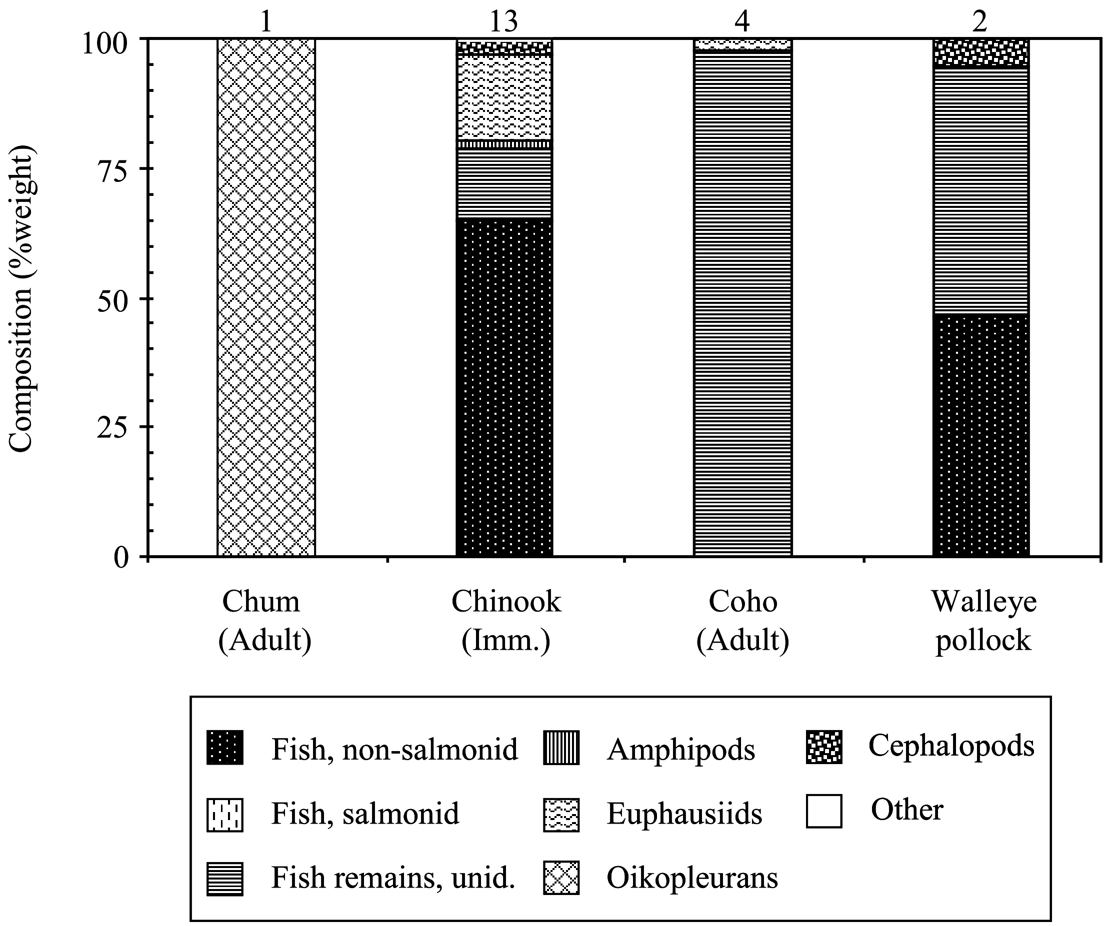


Figure 17.—Prey composition of 20 potential predators of juvenile salmon captured in 56 rope trawl hauls in the marine waters of the northern region of southeastern Alaska, June–August 2008. The numbers of fish examined for each species are shown above the bars. See Table 20 for additional feeding attributes.

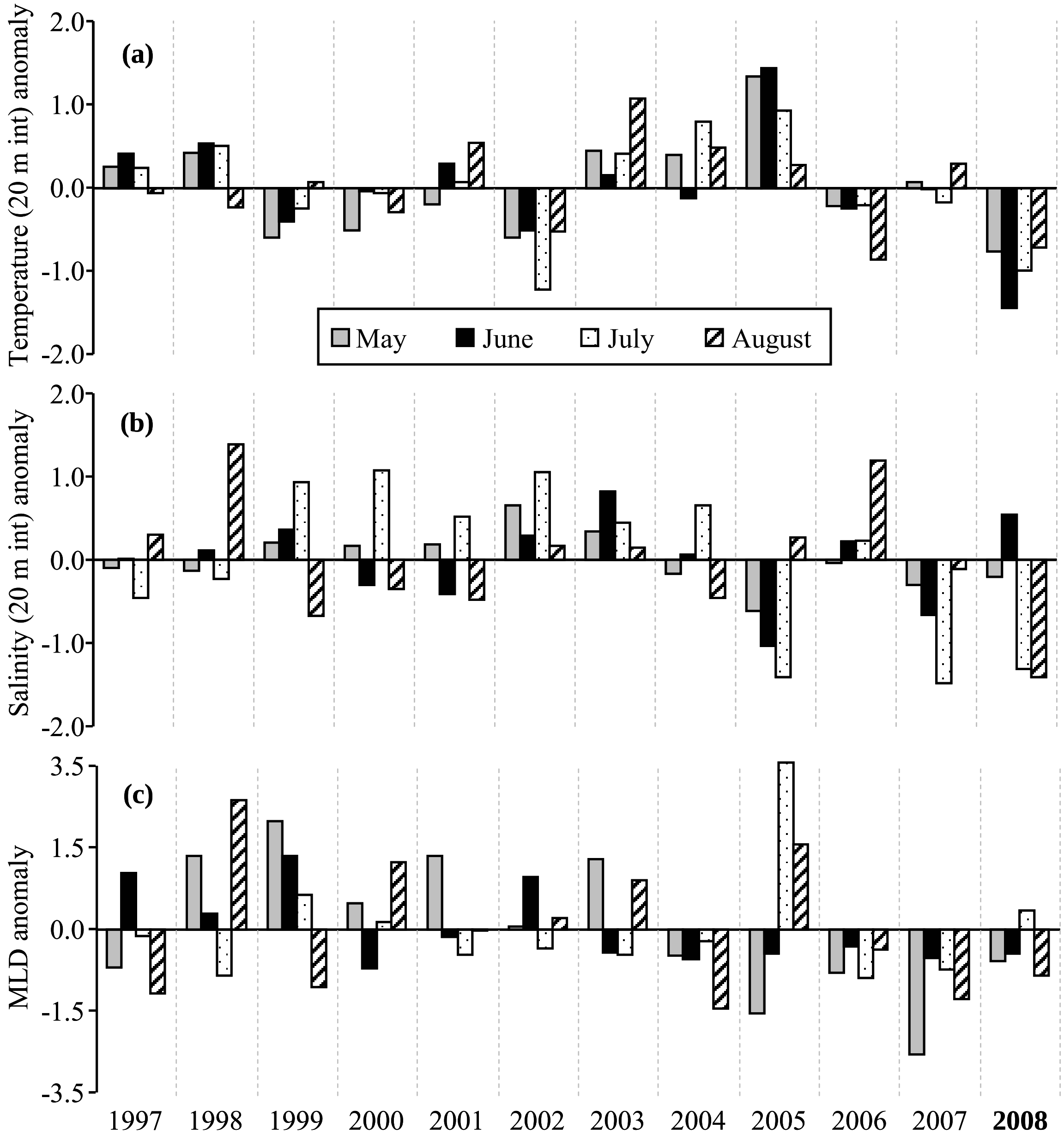


Figure 18.—Monthly anomalies for key environmental parameters across the 12-yr time series from Icy Strait in the northern region of southeastern Alaska, 1997-2008, as (a) temperature (20-m integrated, ºC), (b) salinity (20-m integrated, PSU), and (c) mixed layer depth (MLD, m). Data (shaded bars) are deviations from monthly mean values (0-lines) by year. See also Figures 2 and 3.

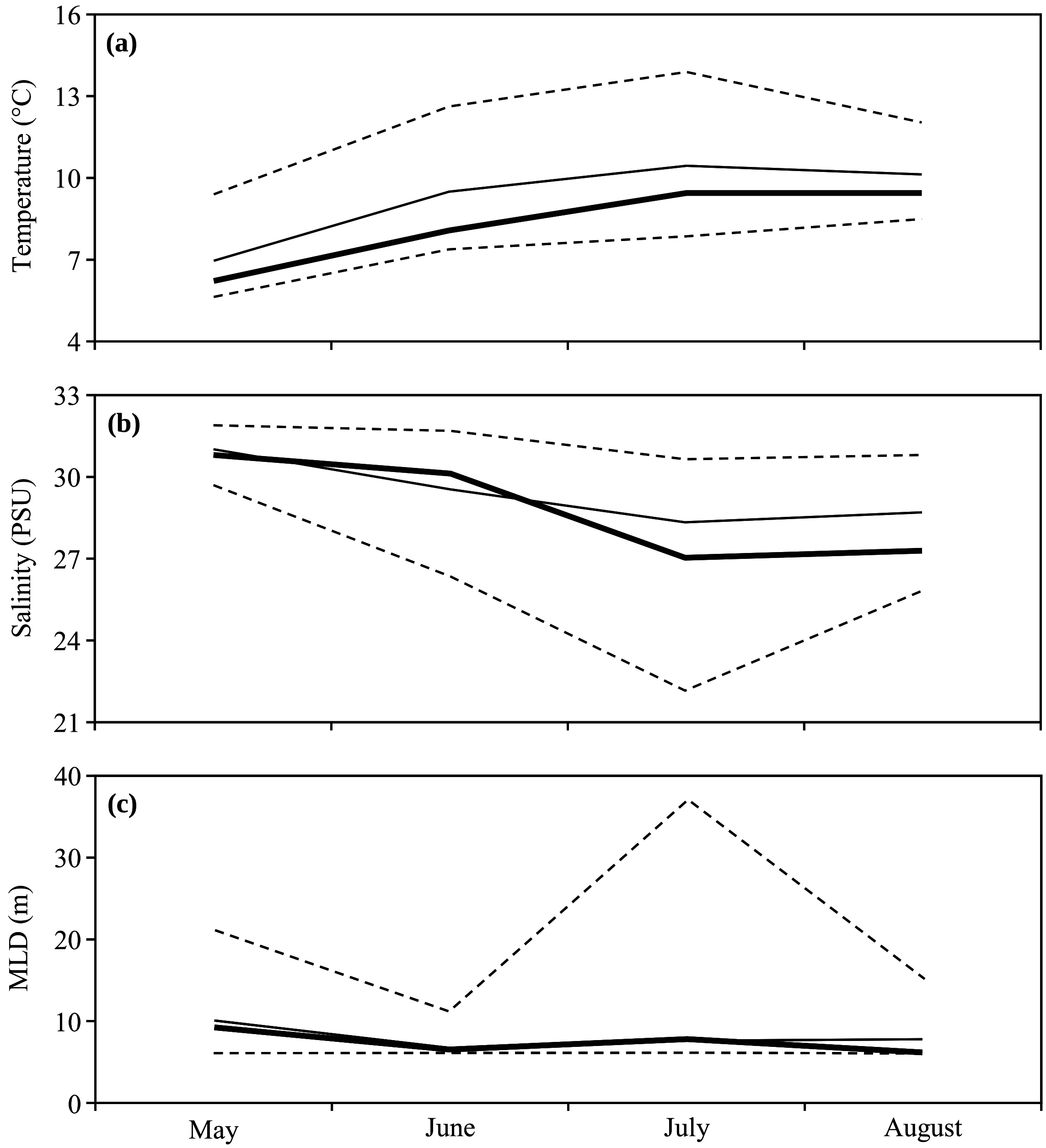
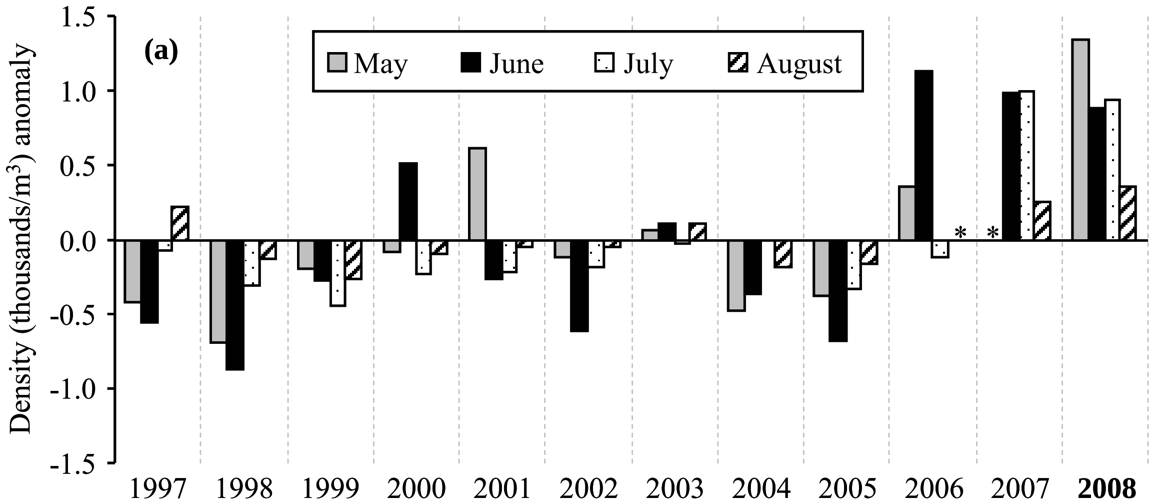


Figure 19.—Temperature (20-m integrated; ºC), salinity (20-m integrated, PSU), and mixed layer depth (MLD, m) across a 12-yr time series from Icy Strait in the northern region of southeastern Alaska, 1997-2008. Data compare the 2008 means for (a) temperature, (b) salinity, and (c) mixed layer depth (thick solid lines) to grand mean values (thin solid lines) within observed ranges (minimum and maximum, dashed lines), by month. See also Figures 2 and 3.



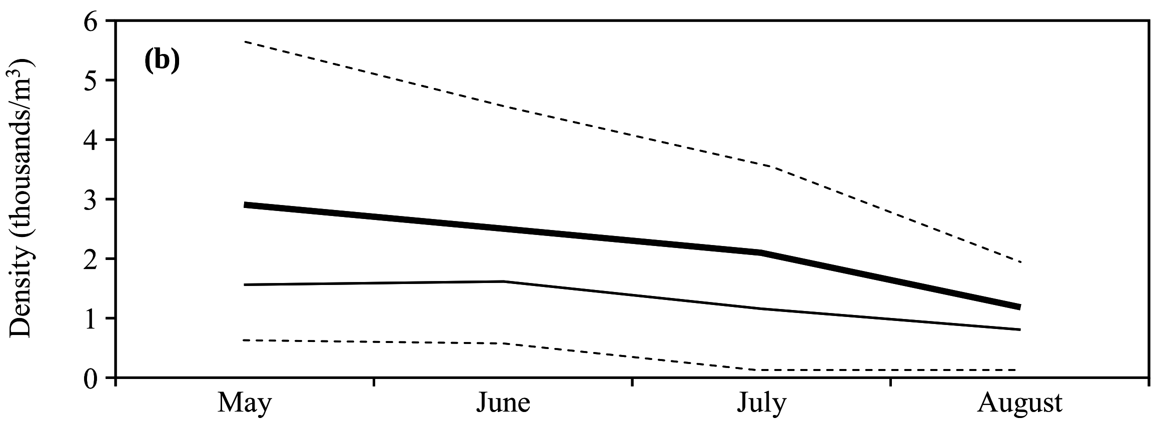


Figure 20.—Zooplankton total density (thousands/m^3) across the 12-yr time series from Icy Strait in the northern region of southeastern Alaska, 1997-2008. Data (shaded bars) are (a) deviations from monthly mean density (0-line) by year, and (b) comparison of 2008 mean densities (thick solid line) to grand mean densities (thin solid line) within observed density range (minimum and maximum, dashed lines), by month. Samples represent “deep” (≤200 m depth; *n* = 4 stations) 333-µm mesh bongo net towed in double oblique fashion during daylight. No samples were collected in August 2006 or May 2007. See also Figure 6.

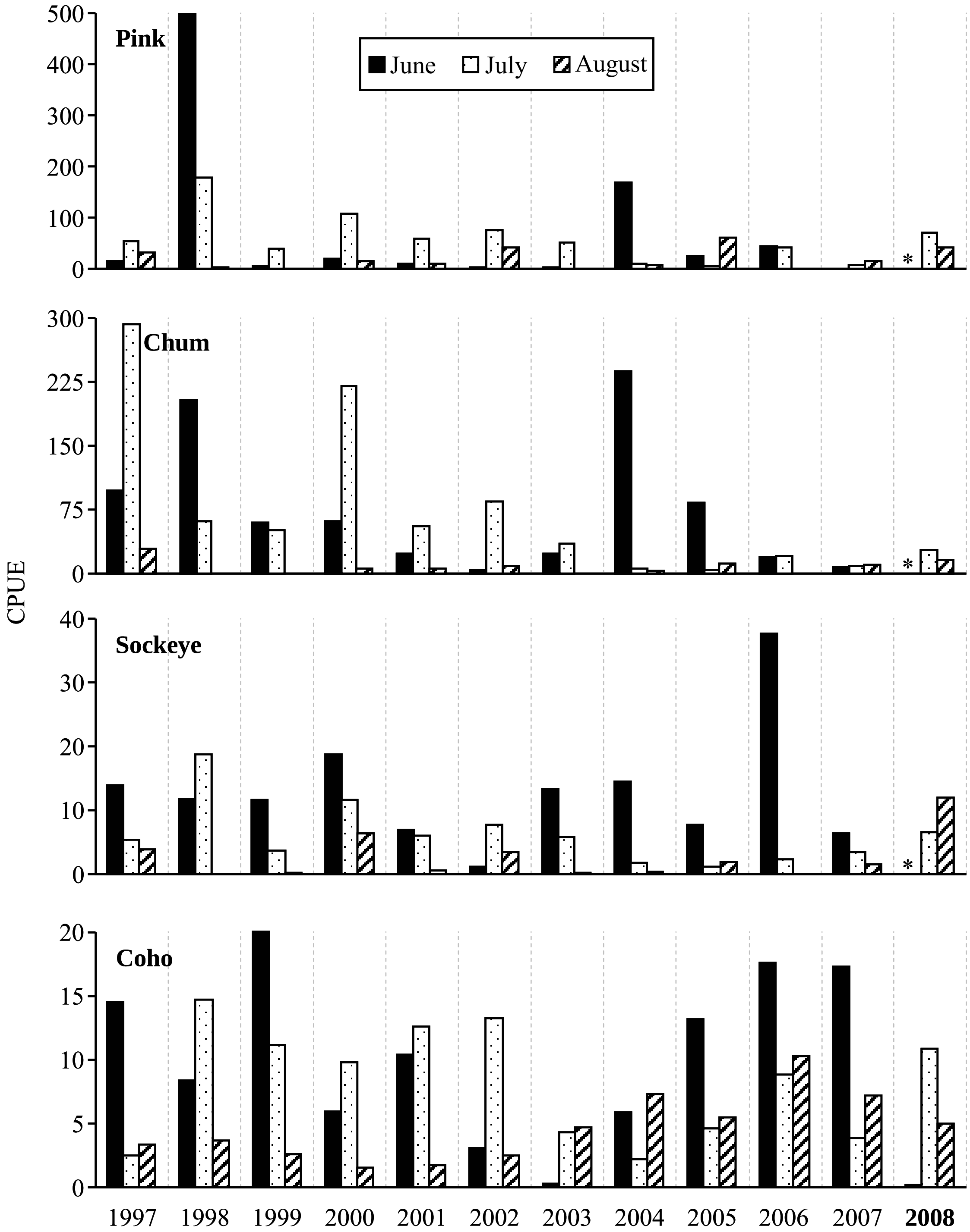


Figure 21.—Catch-per-unit-effort (CPUE, mean catch per trawl haul) for juvenile pink, chum, sockeye, and coho salmon across a 12-yr time series from Icy Strait in the northern region of southeastern Alaska, 1997-2008. Asterisks indicate a zero catch. Note differences in scale of y-axes by species. See also Figure 9.

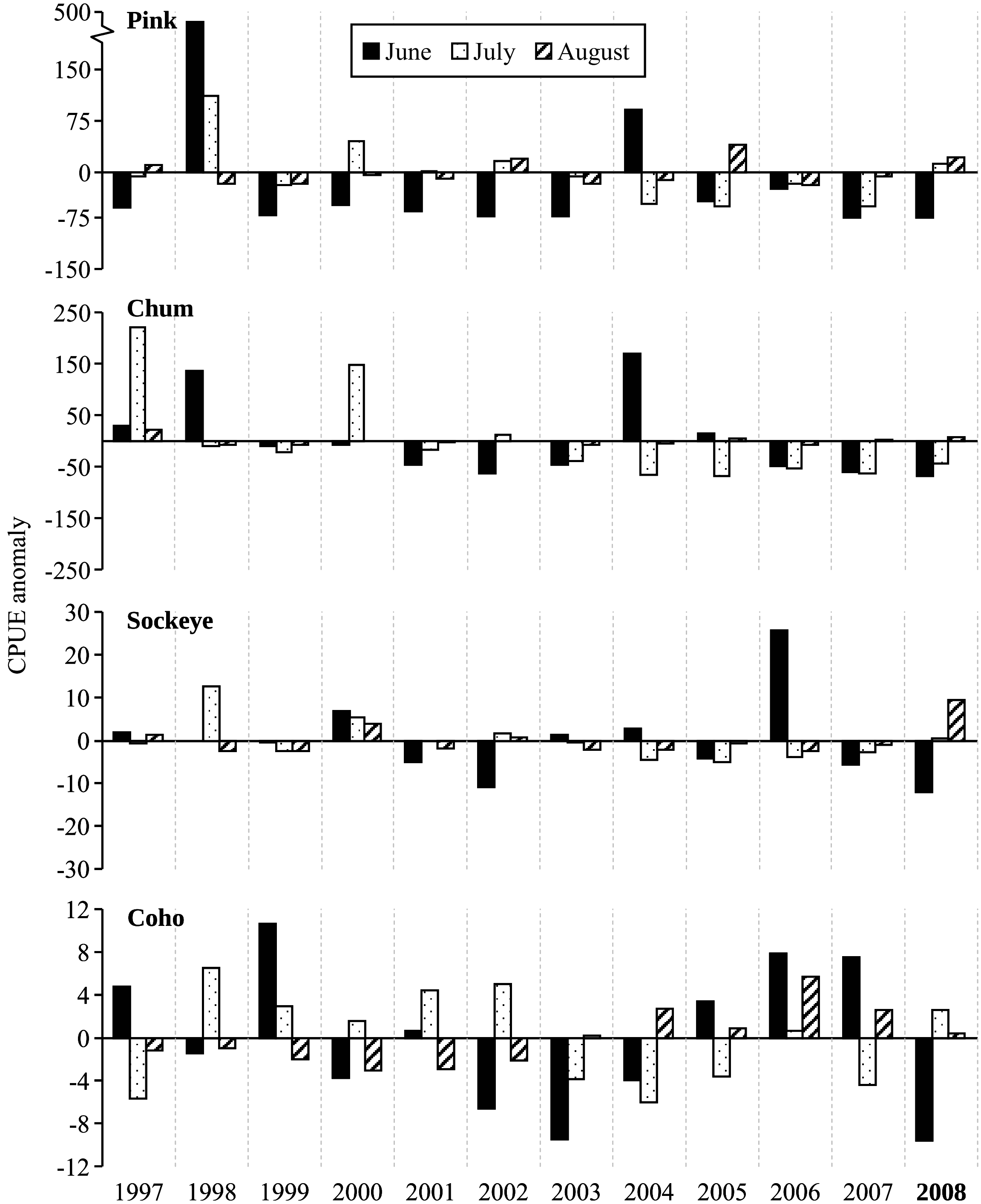


Figure 22.—Catch-per-unit-effort (CPUE, mean catch per trawl haul) anomalies for juvenile pink, chum, sockeye, and coho salmon across a 12-yr time series from Icy Strait in the northern region of southeastern Alaska, 1997-2008. Data (shaded bars) are deviations from the 12-yr monthly mean CPUE (0-lines). The June 2008 catch consisted of only one juvenile coho salmon. Note differences in scale of y-axes by species. See also Figure 9.

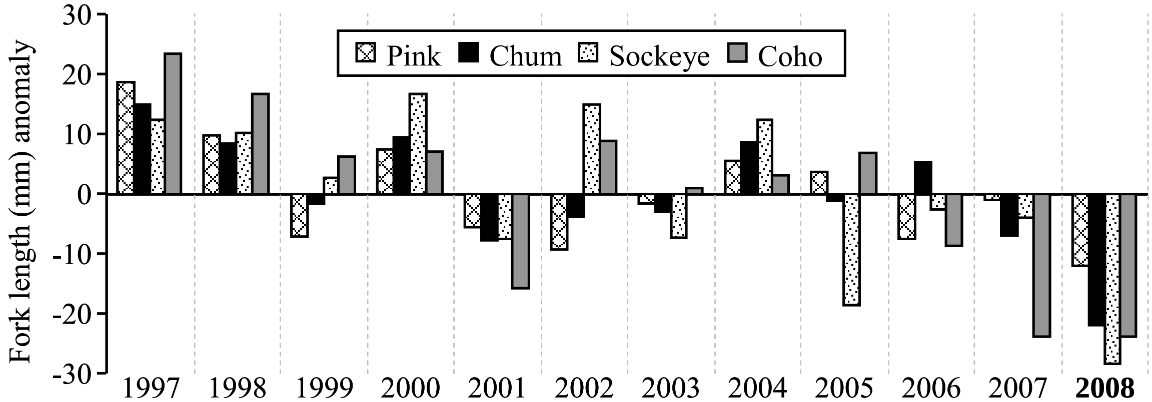


Figure 23.—Annual size at time (fork length, mm, on July 24) anomalies for juvenile pink, chum, sockeye, and coho salmon across a 12-yr time series from Icy Strait in the northern region of southeastern Alaska, 1997-2008. Data (shaded bars) are deviations from the 12-yr monthly mean size at time (0-line). See also Figure 10.

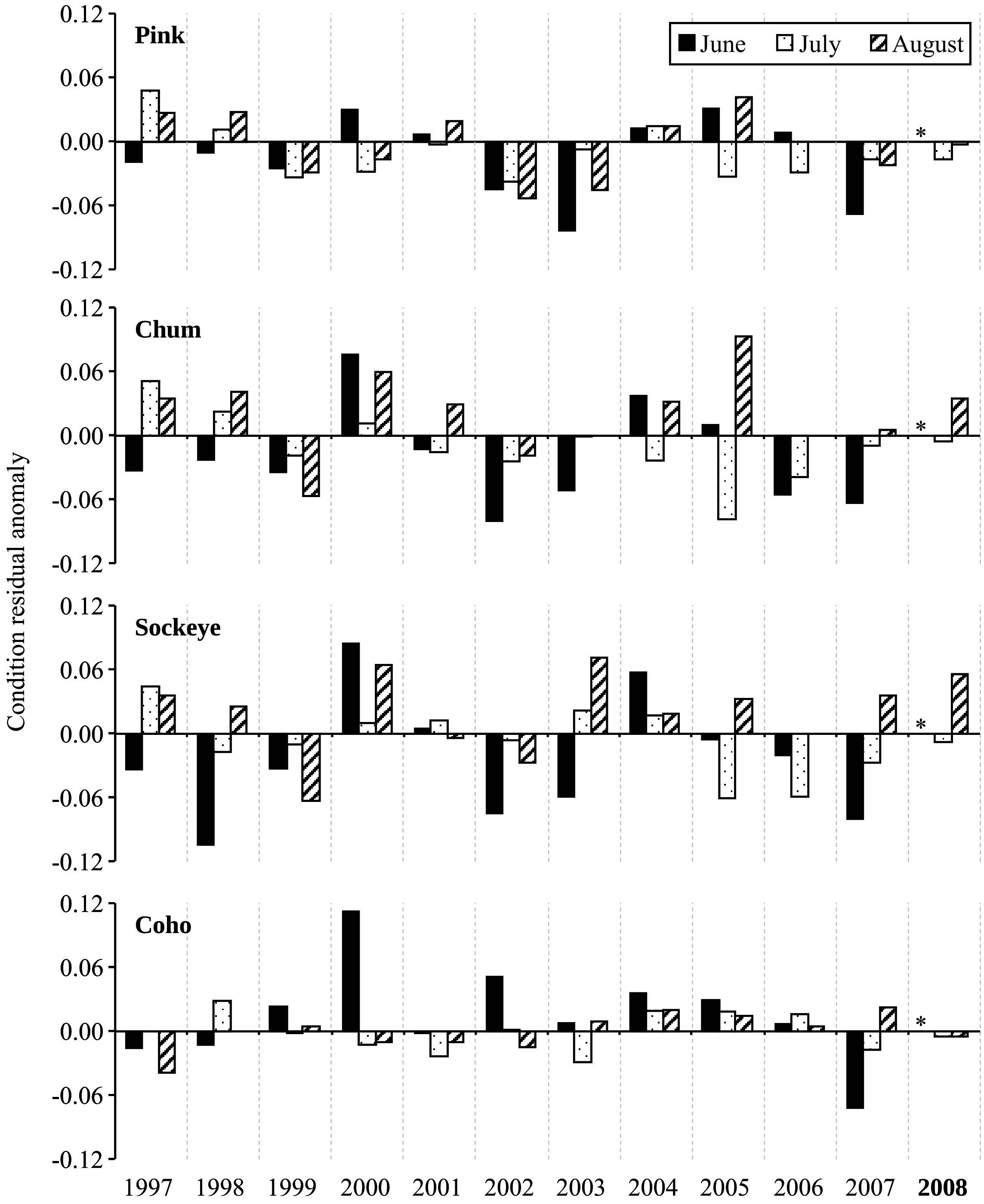


Figure 24—Condition residuals (CR) from length-weight linear regressions for juvenile pink, chum, sockeye, and coho salmon across a 12-yr time series from Icy Strait in the northern region of southeastern Alaska, 1997-2008, by year. Data (shaded bars) are deviations from 12-yr monthly mean CR (0-lines). Asterisks indicate insufficient samples available for processing. See also Tables 10-13 and Figure 13.