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Survey of Juvenile Salmon in the Marine Waters of Southeastern Alaska, May–August 2003

by

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Abstract

Juvenile Pacific salmon (*Oncorhynchus* spp.) and associated biophysical data were collected along a primary marine migration corridor in the northern region of southeastern Alaska. Thirteen stations were sampled over six time periods (32 sampling days) from May to August 2003. This survey marks the seventh consecutive year of systematic monitoring, and was implemented to identify the relationships among biophysical parameters that influence the habitat use, marine growth, predation, stock interactions, year-class strength, and ocean carrying capacity of juvenile salmon. Habitats sampled included stations in inshore (Auke Bay), strait (four stations each in Chatham Strait and Icy Strait), and coastal (four stations off Icy Point) localities. At each station, fish, zooplankton, surface water samples, and physical profile data were collected using a surface rope trawl (fish), conical and bongo nets (zooplankton), and a conductivity-temperature-depth profiler (physical data), usually during daylight. Surface (2-m) temperatures and salinities ranged from 7.6 to 15.8EC and 15.5 to 32.0 PSU from May to August. A total of 10,724 fish and squid, representing 23 taxa, were captured in 64 rope trawl hauls from June to August. Juvenile salmon comprised 29% of the total catch and occurred frequently in the trawl hauls, with chum (*O. keta*) occurring in 66% of the trawls, pink (*O. gorbuscha*) in 56%, coho (*O. kisutch*) in 55%, sockeye (*O. nerka*) in 50%, and chinook salmon (*O. tshawytscha*) in 2%. Of the 3,254 salmonids caught, 98% were juveniles. Walleye pollock (*Theragra chalcogramma*) and Pacific herring (*Clupea pallasi*) were the only non-salmonid species that comprised more than 1% of the total catch. Temporal and spatial differences were observed in the catch rates, size, condition, and stock of origin of juvenile salmon species. Catch rates of juvenile salmon were highest for chinook and sockeye salmon in June, highest for chum and pink salmon in July, and highest for coho salmon in August. By habitat type, juvenile salmon catch rates for pink, chum and sockeye were highest in the coastal habitat, whereas catch rates of coho and chinook were highest in the strait habitat. Size of juvenile salmon increased steadily throughout the season; mean fork lengths in June and early August were, respectively: 105 and 133 mm for pink, 116 and 138 mm for chum, 120 and 145 mm for sockeye, 173 and 215 mm for coho, and 169 mm (June only) for chinook salmon. Coded-wire tags were recovered from two juvenile coho and one immature chinook salmon; all were from hatchery and wild stocks of southeastern Alaska origin. Alaska hatchery stocks were also identified by thermal otolith marks from 32% of the chum, 45% of the sockeye, 11% of the coho, and 100% of the chinook salmon. Onboard stomach analysis of 248 potential predators, representing 10 species, indicated one predation instance on juvenile salmon by a spiny dogfish (*Squalus acanthias*) in the coastal habitat in July. This research suggests that in southeastern Alaska, juvenile salmon exhibit seasonal patterns of habitat use synchronous with environmental change, and display species- and stock-dependent migration patterns. Long-term monitoring of key stocks of juvenile salmon, on both intra- and interannual bases, will enable researchers to understand how growth, abundance, and ecological interactions affect year-class strength and ocean carrying capacity for salmon.

Introduction

Studies of the early marine ecology of Pacific salmon (*Oncorhynchus* spp.) in Alaska require adequate time series of biophysical data to relate climate fluctuations to the distribution, abundance, and production of salmon. Because salmon are keystone species and constitute important ecological links between marine and terrestrial habitats, fluctuations in the survival of this important living marine resource have broad ecological and socio-economic implications for coastal localities throughout the Pacific Rim. Increasing 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). In particular, climate variation has been associated with ocean production of salmon during El NiŽo and La NiŽa events, such as the recent warming trends that benefited many wild and hatchery stocks of Alaskan salmon (Wertheimer et al. 2001). However, research is lacking in 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 numbers of salmonids produced in the region have increased over the last few decades (Wertheimer et al. 2001), mixing between stocks with different life history characteristics has also increased. The consequences of such changes on the growth, survival, distribution, and migratory rates of salmonids remain unknown.

To adequately identify mechanisms linking salmon production to climate change, a time series of synoptic data that combines stock-specific life history characteristics of salmon and their ocean conditions is needed. Until recently, stock-specific 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) is a technological advance implemented in many parts of Alaska. The high incidence of these marking programs in southeastern Alaska (Courtney et al. 2000) offers an opportunity to examine growth, survival, and migratory rates of specific salmon stocks during the current record production of hatchery chum salmon (*O. keta*) and wild pink salmon (*O. gorbuscha*) in the region. For example, in recent years, two private non-profit enhancement facilities in the northern region of southeastern Alaska have annually produced more than a total of 150 million otolith-marked juvenile chum salmon. Consequently, since the mid-1990s, commercial harvests of adult chum salmon in the common property fishery in the region have averaged about 12.5 million fish annually (ADFG 2003), supplemented by a high proportion of otolith-marked fish from regional enhancement facilities. In addition, sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), and chinook salmon (*O. tshawytscha*) are otolith-marked by some enhancement facilities. 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.

A coastal monitoring study in the northern region of southeastern Alaska, known as the Southeast Coastal Monitoring Project (SECM), was initiated in 1997 and has been repeated annually to understand the relationships between annual time series of biophysical data and stock-specific information. This document summarizes juvenile salmon catches and associated biophysical data collected by SECM scientists in 2003.

Methods

Up to 13 stations were sampled in each of six time periods, 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, from May to August 2003 (Table 1). Stations were located along the primary seaward migration corridor used by juvenile salmon that originate in the northern region of southeastern Alaska. This corridor extends 250 km from inshore waters, within the Alexander Archipelago, along Chatham Strait, Icy Strait, and off Icy Point into the Gulf of Alaska (Figure 1). At each station, the physical environment, zooplankton, and fish were typically sampled during daylight hours (0655–1920); however, sampling during nocturnal hours (2135–0240) was conducted at several stations in Icy Strait (Appendix 1).

The selection of the 13 core sampling stations was determined by 1) the presence of historical time series of biophysical data in the region, 2) the objective of sampling habitats that transition the primary seaward migration corridor used by juvenile salmon, and 3) the operational constraints of the vessel. The inshore station (Auke Bay Monitor) and the four Icy Strait stations 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 and 2000b, 2001a, 2001b, 2002, 2003). The Chatham Strait stations were selected to intercept juvenile otolith-marked salmon 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. Vessel and sampling gear constraints limited operations to offshore distances between 1.5 km and 65 km, and to bottom depths greater than 75 m; this precluded trawling at the Auke Bay Monitor station (Table 1). Sea conditions of waves less than 2.5 m and winds less than 12.5 m/sec were usually necessary to operate the sampling gear safely, which particularly influenced sampling opportunities in coastal waters.

Oceanographic sampling

Oceanographic data were collected at each station immediately before or after each trawl haul, and consisted of one conductivity-temperature-depth profiler (CTD) cast, one or more vertical plankton hauls with conical nets, and one double oblique plankton haul 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. Surface (2 m) temperature and salinity data were collected at 1-minute intervals with an onboard thermosalinograph (Sea-Bird SBE 21). Surface water samples were taken at each station for later nutrient and chlorophyll analysis contracted to the Marine Chemistry Laboratory at the University of 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.

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

Zooplankton was sampled at all stations with several net types during each month. At least one shallow vertical haul (20 m) was made at each station with a 50-cm, 243-Φm mesh NORPAC net. Up to one deep vertical haul (to 200 m or within 10 m of bottom) was made at most stations with a 57-cm, 202-Φm mesh WP-2 net (Table 2). One double oblique bongo haul was made at all stations, except the Upper Chatham Strait stations, to a depth of 200 m or within 20 m of the bottom using a 60-cm diameter frame with 505-Φm and 333-Φm mesh nets. In addition, one shallow (20 m) bongo was made at the Icy Strait stations except in May. A Bendix bathykymograph was used with the oblique bongo hauls to record the maximum sampling depth of each haul. General Oceanics model 2031 or Rigosha flow meters were placed inside the bongo and deep conical nets for calculation of filtered water volumes.

Zooplankton samples were 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 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) were measured for zooplankton bongo net samples (333-µm mesh) collected in Icy Strait. Samples were brought to a constant volume (500 ml) by adding water, and then were sieved through 243-µm mesh to separate the zooplankton from the liquid. The volume of decanted liquid was measured and subtracted from the sample starting volume to yield zooplankton DV. Standing stock of shallow (20 m) and deep (≤200 m) bongo samples was calculated using DV (ml) divided by the volume of water filtered (m^3) based on flowmeter revolutions per haul. Detailed zooplankton species composition of these hauls was determined microscopically from subsamples obtained using a Folsom splitter. Density was then estimated by multiplying the count in the subsample by the split fraction and dividing the expanded count by the volume filtered. Percent total composition was calculated for major taxa, including small calanoid copepods (=2.5 mm TL), large calanoid copepods (>2.5 mm TL), euphausiids principally larval and juvenile stages), oikopleurans (Larvacea), decapod larvae, 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 the *John N. Cobb*. The trawl was 184 m long and had a mouth opening of 24 m by 30 m (depth by width). A pair of 3-m foam-filled Lite trawl doors, each weighing 544 kg (91 kg submerged), was used to spread the trawl open. Earlier gear trials with this vessel and trawl indicated the actual fishing dimensions of the trawl to be 18 m deep (head rope to foot rope) by 24 m wide (wingtip to wingtip), with a spread between the trawl doors ranging from 52 m to 60 m (Orsi et al., unpubl. cruise report 1996). 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 headrope at the surface, a cluster of three A-4 Polyform buoys, each encased in a knotted mesh bag, was tethered to each wingtip of the headrope, and one A-3 Polyform float was clipped onto the center of the headrope. The trawl was fished with 137 m of 1.6-cm wire main warp attached to each door and three 55-m (two 1.0-cm and one 1.3-cm) wire bridles.

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. Trawling effort in the strait habitat was augmented to ensure that sufficient samples of marked juvenile salmon were obtained for interannual comparisons. In particular, replicate trawls were conducted in Icy Strait when weather and time allowed, with minimal accompanying oceanographic sampling.

After each trawl haul, the fish were anesthetized with tricaine methanesulfonate (MS-222), identified, enumerated, measured, labeled, bagged, and frozen. After the catch was sorted, fish and squid were measured to the nearest mm fork length (FL) or mantle length with a Limnoterra FMB IV electronic measuring board (Chaput et al. 1992). Usually all fish and squid were measured, but very large catches were subsampled due to processing time constraints. Up to 50 juvenile salmon of each species were bagged individually; the remainder was bagged in bulk. 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 would indicate the possible presence of implanted CWTs; those with adipose fins intact were again screened with a detector in the laboratory. The snouts of these fish were dissected in the laboratory to recover CWTs, which were then decoded and verified to determine fish origin.

Frozen individual juvenile salmon were weighed in the laboratory to the nearest 0.1 gram (g). Mean lengths, weights, and Fulton condition factors ($g/mm^3 \cdot 10^5$; Cone 1989) were computed for each species by habitat and sampling interval. To identify stock of origin of juvenile chum, sockeye, coho, and chinook 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 Alaska Department of Fish and Game otolith laboratory. Stock composition and growth trajectories of thermally marked fish were then determined for each month and habitat.

Potential predators of juvenile salmon from each haul were identified, measured, and weighed onboard the vessel. Their stomachs were excised, weighed, and classified by percent fullness (nearest 10%). Stomach contents were removed, empty stomachs weighed, and total content weight determined by subtraction. General prey composition was determined by estimating contribution of 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 percent volume by the total content weight. Fish prey was identified to species, if possible, and lengths were estimated. The incidence of predation on juvenile salmon was computed for each potential predator species. Overall diets were summarized by percent weight of major prey taxa and the frequency of feeding fish.

Results and Discussion

During the 4-month (32-d) survey in 2003, data were collected from 64 rope trawl hauls, 10 two-boat trawl hauls, 96 CTD casts, 174 bongo net samples (40 from 20-m depths and 134 from depths to 200 m), 147 conical net hauls (110 from 20-m depths and 37 from depths to 200 m), and 52 surface water samples (Table 2). The sampling periods occurred near the ends of each month from May to August, and in two additional periods in early June and early August. In May, only oceanographic sampling was completed at all stations; no trawling occurred due to the absence of juvenile salmon documented in previous years. After May, the strait habitat was consistently sampled during each time period; inshore and coastal habitats were generally only sampled at the end of each month from June to August (Table 2).

Oceanography

Surface (2-m) temperature and salinity data followed similar seasonal patterns but differed between habitats. Overall, surface temperatures and salinities during the survey ranged from 7.6 to 15.8EC and from 15.5 to 32.0 PSU from May to August (Table 3). In general, inshore habitat was the least saline, while coastal habitat was warmest and most saline. In strait and inshore habitats, temperatures increased dramatically from May to early August and declined in late August (Figure 2a). In the coastal habitat, temperatures increased from May to July, and were the highest ever recorded for this project, by at least 1EC, for May and July. Salinities in the inshore habitat declined sharply from May to July, while the salinities in the strait habitat declined from May to early August (Figure 2b). Salinities were consistently high and stable in the coastal habitat from May to July and were lowest in inshore habitat in July.

A total of 52 surface water samples were taken at 13 stations over the course of the season (Tables 2 and 4). Nutrient concentration ranges and means were 0.2–1.6 and 0.7 ΦM for PO_4, 1.4–26.7 and 8.5 ΦM for $Si(OH)_4$, 0.0–16.7 and 2.8 ΦM for NO_3, 0.0–0.4 and 0.1 ΦM for NO_2, and 0.0–5.4 and 0.9 ΦM for NH_4. Chlorophyll ranged from 0.9 to 7.5 mg/m^3 with a mean of 1.4 mg/m^3, and phaeopigment concentrations ranged from 0.2 to 0.6 mg/m^3 with a mean of 0.3 mg/m^3 (Table 4).

Ambient light intensities for 90 daylight samples over the season (0655–1920 h) ranged from 2.8 to 988 W/m^2, with a mean of 304.1 W/m^2, while ambient light during for 13 nocturnal samples (2135–0240 h) ranged from 0 to 47 W/m^2, with a mean of 4.6 W/m^2. Ninety water clarity measurements were made by observing the disappearance of the white CTD following deployment. Depth of visibilities ranged from 2 to 8 m, with a mean of 4.6 m.

Seasonal patterns in plankton settled volumes, SV, were evident from the 20-m NORPAC (243-Φm mesh) vertical hauls, although SV was highly variable among habitats (Table 5; Figure 2c). Qualitative, visual examination of samples indicated a wide diversity of mesozooplankton taxa and phytoplankton present. However, the oikopleuran (Larvacea) slub prevalent in June in inshore and strait habitat samples prevented the determination of SVs for this period. This slub corresponded with the seasonal peak in oikopleuran density estimated from the shallow and deep bongo (333-Φm) samples from Icy Strait (Figure 3). Phytoplankton was present in the inshore and strait habitats only in May. Zooplankton SV declined steadily over the season in strait habitats (mean SV in May = 40 ml; mean SV in August = 6 ml), was uniformly low and stable in the inshore habitat (~9 ml), and declined rapidly early in the season in coastal habitats (mean SV in May = 27 ml; mean SV in June = 2 ml) (Figure 2c). Adjusting for the volume of water filtered to obtain these SV measurements, peak standing stock for the mesozooplankton collected in 20-m NORPAC samples in strait habitat, where values were highest, reached approximately 10 ml/m^3.

Zooplankton displacement volumes (DV, ml) of bongo (333-Φm mesh) samples varied dramatically across the Icy Strait stations with different sampling depths; DV ranged from 3 to 183 ml over the season (Table 6). Shallow bongo samples were not collected in May. Mean DV across the transect for both shallow and deep samples was highest in late June, at 64 and 141 ml, respectively. Adjusting for the volume of water filtered at each station emphasized this seasonal peak. Peak standing stock (mean DV/m^3) of zooplankton was <3 ml/m^3 for shallow samples and was approximately 1 ml/m^3 for deep samples in June.

Zooplankton mean total density in shallow (20-m) 333-Φm bongo samples was approximately twice as great as that of the density in deep (=200 m) samples, indicating a surface water distribution for taxa sampled during the day. Density values ranged from approximately 1,251 to 4,237 organisms/m^3 in shallow samples and from 799 to 1,870 organisms/m^3 in deep samples (Table 6, Figure 3). Mean density for both shallow and deep samples peaked in June, with similar values early and late in the month.

Zooplankton taxa present in Icy Strait across the season included small calanoid copepods, large calanoid copepods, euphausiids, oikopleurans, decapod larvae, and combined minor taxa (Figure 3). The minor taxa mainly included chaetognaths, cladocera, bryozoan larvae, pteropods, hyperiid amphipods, barnacle larvae, and coelenterates. Small calanoid copepods clearly dominated the percent composition in both sample types in every month except late June. Small calanoids constituted 46 to 88% of the taxonomic compositions from shallow and deep samples; low values occurred in late June for shallow samples, when oikopleurans co-dominated as 45% of zooplankters, and in May and late June for deep samples, when oikopleurans and large calanoids were relatively large components of total zooplankters. Large calanoid copepods were usually the second-most abundant taxa in both sample types. This taxon contributed a steady 3 to 8.5% to shallow daytime samples, but showed a seasonal pattern of contribution to deep samples; they made up 21 to 29% of deep samples in May and June, dropping to 8 to 15% of zooplankton in July and August. Oikopleurans and young euphausiids generally contributed a few percent to composition of daytime zooplankters in either type of sample, while contributions in excess of 5% were rare for all other taxa.

Catch composition

For the entire season across all habitats, a total of 10,724 fish and squid, representing 23 taxa, were captured in 64 rope trawl hauls from June to August (Table 7). These catches do not include fish from the 10 two-boat trawl hauls; salmonids catches from these hauls are reported in Appendix 1. Juvenile salmon comprised 29% of the total fish catch and 98% of the total salmonid catch. Juvenile salmon were generally the most frequently occurring species, with chum occurring in 66% of the hauls, pink in 56%, coho in 55%, sockeye in 50%, and chinook salmon in 2% (Table 8). Non-salmonid species making up more than 1% of total catch included walleye pollock (*Theragra chalcogramma*) and Pacific herring (*Clupea pallasi*); these species occurred in 30% and 6% of the trawl hauls.

Seasonal catches differed by habitat for juvenile salmon and for the most abundant non-salmonids. Juvenile salmon comprised 20–75% of the catch in the strait habitat from late June to August, while in the coastal habitat, juvenile salmon were absent in June, then made up 90% of the catch in July; no sampling occurred in August (Figure 4). Walleye pollock was the dominant non-salmonid species in the strait habitat and was most abundant in June. Catches and life history stages of the salmon are listed by date, haul number, and station in Appendix 1.

Distribution of juvenile salmon differed for the months, habitats, and species sampled; however, the patterns were generally consistent with observations from previous years (Orsi et al. 1997, 1998, 1999, 2000a, 2000b, 2001a, 2001b, 2002, 2003). In June, juvenile salmon were captured in low numbers in the strait habitat but were absent in the coastal habitat. In July, the catch rates of pink, chum, and coho salmon increased dramatically in the strait habitat and all species except chinook were captured in the coastal habitat (Figure 5). Peak catches of most species occurred during July in both habitats, with the exception of chinook in June and coho in August.

Size and condition of juvenile salmon differed among the species and sampling periods (Tables 9–13; Figures 6–8). Juvenile coho and chinook salmon were consistently 25 to 100 mm longer than sockeye, chum, and pink salmon in a given time period. 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 June, July, and early August were: 105.4, 121.8, and 133.4 mm for pink; 116.3, 125.8, and 138.0 mm for chum; 120.1, 128.5, and 145.3 mm for sockeye; 172.8, 202.6, and 215.4 mm for coho; and 169.0 mm for chinook salmon (June only). Mean weights of juvenile salmon in June, July, and early August were: 11.1, 17.4, and 23.4 g for pink; 13.9, 20.0, and 26.6 g for chum; 17.7, 22.3, and 33.2 g for sockeye; 62.1, 97.5, and 120.0 g for coho; and 58.7 g for chinook salmon (June only). Mean condition factor values for juvenile salmon in June, July, and early August were: 0.9, 0.9, and 0.9 for pink; 0.9, 1.0, and 1.0 for chum; 1.0, 1.0, and 1.0 for sockeye; 1.2, 1.1, and 1.2 for coho; and 1.2 for chinook salmon (June only). Condition factor generally increased seasonally; mean values near 1.0 indicated healthy feeding environments.

Three of the five juvenile and immature salmon lacking adipose fins contained CWTs (Table 14). Two CWTs were recovered from juvenile coho and one CWT was recovered from an immature chinook, all in the strait habitat during August. All specimens originated from wild and hatchery stocks indigenous to the northern region of southeastern Alaska. Both CWT coho salmon were from wild systems, whereas the CWT immature chinook had been at sea for one ocean winter and was from a hatchery stock. Marine migration rates were 1.1 and 1.3 km/d for the juvenile coho salmon and 0.2 km/d for the immature chinook salmon.

For juvenile chum salmon, stock-specific information was derived from the otoliths of a subsample of 847 fish, representing 69% of those caught (Table 15). These fish were the same individuals sampled for weight and condition. Of all chum salmon otoliths examined, 273 (32%) were marked: 156 (18%) were from DIPAC, 98 (12%) were from HF, and 19 (2%) were from Neets Bay (NB). Neets Bay is an enhancement facility located more than 500 km south of the study area near Ketchikan, in the southern region of southeastern Alaska; this facility began releasing thermally marked juvenile salmon in 2003. The remaining 574 (68%) chum salmon examined were unmarked and included both wild stocks and possibly unmarked hatchery stocks from southern release localities. Seasonally, the greatest contribution of hatchery stocks of chum salmon (>90%) occurred in June in the strait habitat (Figure 9). The greatest contribution of hatchery stocks of chum salmon (30%) was observed in July in the coastal habitat. No samples were obtained in June (no catch) or August (no fishing).

For juvenile sockeye salmon, stock-specific information was derived from the otoliths of a subsample of 274 fish, representing 87% of those caught (Table 16). These fish were the same individuals sampled for weight and condition. Of all the sockeye salmon otoliths examined, 124 (45%) were marked and originated from four stock groups: 119 from Snettisham (41%), 3 from Sweetheart Lake (2%), 1 from Tahltan (1%), and 1 from Chilkat River (1%). The contribution of marked stocks of sockeye salmon was highest, 80%, in the strait habitat in June and declined to 0% in August (Figure 10). In the coastal habitat, about 10% of the fish were found to be marked in July. No samples were obtained in June (no catch) or August (no fishing).

For juvenile coho salmon, stock-specific information was derived from the otoliths of all 136 fish (Table 17). These fish were the same individuals sampled for weight and condition. Of all the coho salmon otoliths examined, 15 (11%) were marked and all originated from DIPAC hatchery. In the strait habitat, hatchery stock contribution of coho salmon increased from 0% in June to about 20% in August (Figure 11). In the coastal habitat, none of the fish were found to be marked in July, and no samples were obtained in June (no catch) or August (no fishing).

For juvenile chinook salmon, stock-specific information was derived from the otoliths of both fish that were caught (Table 18). These fish were the same individuals sampled for weight and condition. Both fish were caught in the strait habitat and originated from the HF hatchery (Figure 12).

Monthly samples of thermally marked juvenile chum, sockeye, coho, and chinook salmon were used to examine stock-specific growth trajectories. Weights of juvenile salmon from marked stocks were compared with weights of juvenile salmon from unmarked stocks (Figures 13 and 14). The marked salmon stocks were from DIPAC, HF, NB, and Snettisham hatcheries; these fish were released in 2003 at the following approximate dates and size ranges: chum in April–May (1–4 g); sockeye in April–June (5–10 g); coho in May–June (15–23 g); and chinook salmon in May–July (9–59 g). In general, stock-specific size of salmon increased for all groups except unmarked sockeye (Figures 13 and 14).

Stomachs of 248 potential predators of juvenile salmon were examined, representing 10 species of fish (in order of abundance): 132 immature walleye pollock, 31 adult pink salmon, 28 immature chinook salmon, 24 adult spiny dogfish (*Squalus acanthias*), 15 adult chum salmon, 10 Pacific cod (*Gadus macrocephalus*), three adult coho salmon, three Pacific herring, one Pacific hake (*Merluccius productus*), and one adult sockeye salmon (Table 19). The greatest diversity and numbers of potential predators were caught in June; eight species and 110 individuals were examined from that time period, compared to four to six species and 69 individuals from July or August. Overall, 88.3% of the stomachs contained food. Relatively low rates of feeding (54–67% with food) were observed for the spiny dogfish and adult coho salmon (Table 19). Only one incidence of predation on juvenile salmon was observed, by a spiny dogfish caught at Icy Point station IPB in July. The stomach of this 930-mm predator was approximately 50% full, containing three fairly fresh pink salmon at lengths of 127–141 mm (Table 20).

Although juvenile salmon were not prominent prey items for any of the potential predators, other fish prey were common (Figure 15a). Overall, fish prey dominated the diets of immature chinook salmon, adult coho salmon, and Pacific hake; pink and chum salmon, walleye pollock, and Pacific herring stomachs also contained substantial weight percentages of fish prey. The taxa observed included capelin, Pacific herring, lanternfish, flatfish larvae, poachers, sandlance, and walleye pollock, as well as unidentifiable larvae and digested remains. Monthly, in accordance with the temporal pattern of predator catches, fish prey were most common in diets of June fish; 50 of the 110 individuals examined consumed some fish, particularly capelin, flatfish larvae, or unidentified fish larvae. The most piscivorous species, immature chinook salmon, ate six different types of fish prey in June (95% of prey weight in stomachs) and four types in August (96% of prey weight in stomachs; Figure 15b).

A wide variety of pelagic invertebrate prey was consumed by the potential predators examined, including decapod larvae, euphausiids, amphipods, cephalopods, copepods, gelatinous taxa (salps, ctenophores, and cnidarians), oikopleurans, and pteropods (Figure 15a). Decapod larvae were prominent, frequent prey of pink salmon (55%), walleye pollock (30%), Pacific herring (77%), and Pacific hake (35%). Euphausiids were frequent prey of pink salmon and walleye pollock, yet they made up only 5–17% of prey weight; they were the sole prey of the single sockeye salmon examined and were present in Pacific herring and immature chinook salmon diets. Among other taxa, amphipods contributed the greatest prey weight, 13%, to spiny dogfish; they also made up =7% of prey weight of pink and chum salmon and walleye pollock, with the greatest frequency of occurrence, 32%, in pink salmon. Cephalopods appeared only in immature chinook and adult pink salmon stomachs. Copepods comprised most of the prey weight of Pacific cod (99%) and walleye pollock (35%). Gelatinous taxa (jellyfish) were only consumed by chum salmon (19% prey weight) and spiny dogfish (37% prey weight). Oikopleurans were only consumed by chum salmon and made up 7% of the prey weight. Pteropods were consumed primarily by chum salmon and made up 9% of the prey weight.

Monthly feeding and diet composition could only be examined for pink salmon, walleye pollock, and immature chinook salmon (June and August) (Figure 15b). Pink salmon stomach fullness declined from 51% to 24% from June to August, walleye pollock fullness varied little (33–41%) per month, and immature chinook salmon stomach fullness increased from 56% to 79% from June to August (Table 19). Diets varied across months for all three species, although some overlap occurred between months (Figure 15b). The fish weight component of pink salmon diet dropped from 50% to 2% weight from June to August, concomitant with the monthly decline in stomach fullness. Walleye pollock ate fish in June (larvae) and August (capelin and unidentifiable fish), but not in July; among invertebrate prey of walleye pollock, copepods dominated in June, copepods, decapods and amphipods in July, and euphausiids in August. For immature chinook salmon, of the few invertebrate prey consumed, decapods made up a large component in June, while cephalopods made up a large component in August.

In the past 7 years, coastal monitoring in southeastern Alaska has shown both similar and contrasting patterns with respect to the temporal and spatial occurrence of biophysical data from prior years. A common annual pattern of seasonality existed in surface temperatures and salinity levels, which increased progressively westward from inshore to coastal habitats. In 2003, surface temperatures were generally warmer than in previous years; however, seasonal patterns were consistent with previous years. The El NiZo conditions of 1997–1998 contrasted with the La NiZa conditions of 1999 as reflected in higher temperatures and greater zooplankton volumes in the study area, which may have led to the higher growth observed for juvenile salmon in 1997–1998 compared to 1999 (Orsi et al. 2000). The coastal monitoring of stations in the northern region of southeastern Alaska is currently ongoing; in 2004, stations in each habitat were sampled monthly from May to August. Long-term ecological monitoring of key juvenile salmon stocks, including ocean sampling programs that operate at appropriate spatial and temporal scales and encompass a variety of environmental conditions, is needed to understand relationships of habitat use, marine growth, and hatchery and wild stock interactions to year-class strength and ocean carrying capacity for salmon.

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Table 1.—Localities and coordinates of stations sampled in the marine waters of the northern region of southeastern Alaska using the NOAA ship *John N. Cobb*, May–August 2003. Station positions are shown in Figure 1.

Station	Latitude North	Longitude West	Distance offshore km	Distance between km	bottom depth m
			Inshore		
			Auke Bay		
ABM	58°22.00'	134°40.00'	1.5	—	60
			Strait		
			Upper Chatham Strait transect		
UCA	58°04.57'	135°00.08'	3.2	—	400
UCB	58°06.22'	135°00.91'	6.4	3.2	100
UCC	58°07.95'	135°01.69'	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	—	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
			Coastal		
			Icy Point transect		
IPA	58°20.12'	137°07.16'	6.9	—	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	58°53.50'	137°42.60'	65.0	24.8	1,300

Table 2.—Numbers and types of data collected in different habitats sampled monthly in marine waters of the northern region of southeastern Alaska, May–August 2003.

		Data collection type[1]						
Dates (days)	Habitat	Rope trawl	Two-boat trawl	CTD cast	Oblique bongo	20-m vertical	WP-2 vertical	Chlorophyll & nutrients
21-25 May	Inshore	0	0	2	4	6	1	1
(5 days)	Strait	0	0	16	20	16	8	8
	Coastal	0	0	4	10	4	4	4
12-15 June (4 days)	Strait	9	6	9	16	9	0	4
21-30 June	Inshore	0	0	1	4	3	1	1
(10 days)	Strait	15	4	13	24	13	4	8
	Coastal	2	0	5	10	5	4	4
23-29 July	Inshore	0	0	1	4	3	1	1
(7 days)	Strait	17	0	17	24	17	4	8
	Coastal	4	0	4	10	4	4	4
8-11 August	Inshore	0	0	2	4	6	1	0
(4 days)	Strait	13	0	13	20	13	0	0
21-22 August	Inshore	0	0	1	4	3	1	1
(2 days)	Strait	4	0	8	20	8	4	8
Total		64	10	96	174	110	37	52

[1]Rope trawl = 20-min hauls with NORDIC 264 surface trawl 18 m deep by 24 m wide; Two-boat trawl = 10-min hauls with KODIAK pair trawl, 3 m deep by 6 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 depths were also included in these totals); 20-m vertical = 50-cm diameter frame, 243-µm conical net 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 surface seawater samples that are summarized in Table 4.

Table 3.—Surface (2-m) temperature and salinity data collected monthly in marine waters of the northern region of southeastern Alaska, May–August 2003. Station code acronyms are listed in Table 1.

Month	Temp (°C)	Salinity (PSU)	Temp (°C)	Salinity (PSU)	Temp (°C)	Salinity (PSU)	Temp (°C)	Salinity (PSU)
Inshore								
Auke Bay								
			ABM					
May			9.5	28.1				
early June			—	—				
June			11.4	22.4				
July			13.1	15.5				
early August			13.4	20.2				
August			11.1	18.5				
Strait								
Upper Chatham Strait transect								
	UCA		UCB		UCC		UCD	
May	7.7	31.2	8.0	31.2	8.3	30.2	8.2	30.3
early June	—	—	—	—	—	—	—	—
June	11.0	29.2	11.4	27.8	11.1	27.0	11.6	26.3
July	13.4	21.8	12.9	23.6	13.2	22.6	13.2	22.8
early August	14.0	16.4	14.2	20.1	14.7	16.5	14.0	19.6
August	11.4	29.6	12.4	28.9	12.5	25.0	12.5	25.0
Icy Strait transect								
	ISA		ISB		ISC		ISD	
May	7.6	31.3	7.7	31.3	7.7	31.3	8.1	30.9
early June	9.8	30.6	9.6	30.7	9.4	30.8	10.2	30.6
June	10.6	29.9	11.1	29.1	10.4	29.8	11.4	27.9
July	13.5	25.7	13.3	26.1	13.0	26.5	13.3	25.5
early August	13.8	22.3	13.7	21.8	14.6	18.4	14.4	18.1
August	10.8	29.3	11.9	26.9	12.2	25.6	13.1	25.0
Coastal								
Icy Point transect								
	IPA		IPB		IPC		IPD	
May	8.8	31.8	10.0	31.7	9.7	31.7	10.2	31.9
early June	—	—	—	—	—	—	—	—
June	9.7	31.7	11.0	31.5	11.3	31.3	11.7	32.0
July	13.5	31.1	14.9	31.7	14.7	31.6	15.8	31.0
early August	—	—	—	—	—	—	—	—
August	—	—	—	—	—	—	—	—

Table 4.—Nutrient and chlorophyll concentrations from 250-ml surface water samples in marine waters of the northern region of southeastern Alaska, May–August 2003. Station code acronyms are listed in Table 1.

		Nutrients [µM]						
Station	Date	[PO_4]	[$Si(OH)_4$]	[NO_3]	[NO_2]	[NH_4]	Chlorophyll (mg/m^3)	Phaeopigment (mg/m^3)
ABM	24 May	0.25	3.26	0.14	0.10	0.43	7.45	0.60
	21 June	0.09	4.43	0.00	0.00	1.48	2.08	0.24
	29 July	0.04	2.11	0.00	0.00	0.07	0.47	0.36
	21 Aug.	0.20	5.31	0.00	0.01	0.60	1.78	0.22
UCA	23 May	1.44	13.22	10.48	0.39	1.48	2.28	0.38
	24 June	0.36	5.70	0.35	0.04	5.39	1.66	0.24
	25 July	0.15	2.43	0.00	0.00	0.44	0.19	0.08
	21 Aug.	0.82	13.40	5.71	0.23	0.21	1.32	0.57
UCB	23 May	1.29	13.91	10.44	0.34	1.00	2.37	0.33
	24 June	0.21	5.32	0.08	0.01	0.24	2.05	0.23
	25 July	0.97	1.67	0.09	0.00	2.69	0.23	0.10
	21 Aug.	0.36	5.57	0.35	0.04	0.31	1.06	0.34
UCC	23 May	1.07	9.46	5.09	0.24	1.80	2.16	0.88
	24 June	0.35	4.26	0.16	0.03	0.92	1.53	0.28
	25 July	0.23	1.58	0.06	0.00	0.25	0.35	0.20
	21 Aug.	0.41	4.90	0.51	0.06	1.33	0.39	0.10
UCD	23 May	0.90	10.34	5.46	0.26	1.97	4.81	1.52
	24 June	0.30	4.56	0.01	0.02	0.75	1.06	0.15
	25 July	0.29	1.78	0.02	0.01	0.29	0.22	0.11
	21 Aug.	0.66	3.64	0.39	0.03	1.82	0.15	0.03
ISA	22 May	1.58	24.41	14.42	0.36	1.62	0.50	0.34
	13 June	0.90	14.17	5.11	0.13	0.67	1.54	0.62
	22 June	0.37	10.13	0.22	0.07	0.27	2.88	0.46
	24 July	0.28	2.51	0.00	0.03	0.52	0.51	0.22
	22 Aug.	0.97	21.81	8.40	0.19	0.26	1.22	0.57
ISB	22 May	1.61	26.74	16.73	0.31	1.33	0.36	0.24
	13 June	0.76	10.98	2.40	0.06	1.16	2.52	0.90
	23 June	0.11	6.36	0.00	0.00	0.42	4.31	0.08
	24 July	0.38	1.55	0.00	0.00	0.35	0.25	0.11
	22 Aug.	0.97	8.74	2.83	0.09	0.87	0.73	0.30

Table 4.—(Cont.)

Station	Date	Nutrients [μM] [PO_4]	[$Si(OH)_4$]	[NO_3]	[NO_2]	[NH_4]	Chlorophyll (mg/m^3)	Phaeopigment (mg/m^3)
ISC	22 May	1.34	18.71	12.18	0.34	1.09	1.98	0.37
	13 June	1.04	18.93	5.88	0.12	0.97	2.67	0.82
	23 June	0.25	10.24	0.01	0.02	0.05	3.38	0.62
	24 July	0.16	1.36	0.00	0.00	0.39	0.42	0.18
	22 Aug.	0.28	5.07	0.35	0.04	0.27	0.61	0.12
ISD	22 May	1.22	16.68	9.15	0.30	1.80	1.77	0.49
	13 June	1.28	19.91	8.16	0.15	0.73	2.29	0.60
	23 June	0.25	7.05	0.00	0.02	0.30	2.57	0.32
	24 July	1.16	1.56	0.02	0.01	0.64	0.20	0.11
	22 Aug.	0.46	5.37	0.54	0.06	0.95	0.56	0.14
IPA	21 May	1.26	17.69	10.59	0.22	0.72	1.66	0.34
	22 June	0.76	8.13	2.78	0.15	1.05	1.60	0.77
	23 July	0.52	6.90	0.21	0.02	0.05	0.33	0.15
IPB	21 May	0.65	5.21	0.37	0.07	0.77	1.28	0.34
	22 June	0.59	7.75	0.17	0.06	0.17	0.90	0.39
	23 July	0.59	6.62	0.18	0.03	0.34	0.09	0.05
IPC	21 May	0.53	2.79	0.33	0.05	1.17	0.49	0.20
	22 June	0.49	4.76	0.14	0.01	1.30	0.99	0.35
	23 July	1.22	8.18	0.19	0.05	1.02	0.11	0.05
IPD	21 May	1.00	9.10	4.32	0.13	0.97	0.52	0.09
	22 June	0.66	7.48	2.07	0.10	0.68	0.57	0.16
	23 July	0.81	7.31	0.15	0.06	0.52	0.10	0.04

Table 5.— Mean zooplankton settled volumes (SV, ml) and total plankton settled volumes (TSV, ml) from vertical 20-m NORPAC hauls sampled in marine waters of the northern region of southeastern Alaska, May–August 2003. Station code acronyms are listed in Table 1. Asterisk denotes that separation of zooplankton from phytoplankton and slub was not distinct. Standing stock (ml/m^3) can be computed by dividing by the water volume filtered, a factor of 3.9 m^3.

Month	*n*	SV	TSV	*n*	SV	TSV	*n*	SV	TSV	*n*	SV	TSV
				Inshore								
				Auke Bay								
				ABM								
May				6	10	23						
early June				—	—	—						
June				3	*	54						
July				3	8	23						
early August				3	7	11						
August				3	4	21						
				Strait								
				Upper Chatham Strait transect								
	UCA			UCB			UCC			UCD		
May	2	57	60	2	35	36	2	44	44	2	41	41
early June	—	—	—	—	—	—	—	—	—	—	—	—
June	2	*	289	1	*	270	1	*	250	1	*	143
July	2	5	5	2	5	6	2	3	6	2	4	12
early August	1	5	7	1	8	9	1	4	5	1	2	5
August	1	2	2	1	3	3	1	8	8	1	4	4
				Icy Strait transect								
	ISA			ISB			ISC			ISD		
May	2	74	85	2	13	159	2	29	32	2	28	29
early June	2	15	20	2	20	35	2	15	25	3	28	35
June	2	*	178	2	*	179	2	*	195	2	*	215
July	2	60	255	2	25	95	3	21	65	2	20	38
early August	2	12	12	2	7	10	3	17	19	2	5	9
August	1	5	5	1	4	4	1	6	6	1	10	10
				Coastal								
				Icy Point transect								
	IPA			IPB			IPC			IPD		
May	1	15	15	1	29	29	1	5	5	1	55	55
early June	—	—	—	—	—	—	—	—	—	—	—	—
June	1	1	6	2	1	6	1	3	4	1	5	11
July	1	2	10	1	2	7	1	6	6	1	2	10
early August	—	—	—	—	—	—	—	—	—	—	—	—
August	—	—	—	—	—	—	—	—	—	—	—	—

Table 6.—Zooplankton displacement volumes (DV, ml), standing stock (DV/m^3), and total density (#/m^3) from shallow (20-m) and deep (=200-m) double oblique bongo (333-µm mesh) hauls sampled in marine waters of Icy Strait in the northern region of southeastern Alaska, May–August 2003. Station codes acronyms for the Icy Strait transect are listed in Table 1.

Month	depth	DV	DV/m^3	Total density	depth	DV	DV/m^3	Total density	depth	DV	DV/m^3	Total density	depth	DV	DV/m^3	Total density
	ISA				ISB				ISC				ISD			
May	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	80	69	1	3,193	170	72	<1	940	200	111	1	1,165	220	132	1	1,216
early June	20	19	1	3,111	20	29	1	3,985	20	25	1	3,199	20	37	2	4,784
	40	47	1	2,552	175	183	1	2,331	180	144	1	1,520	220	140	1	1,077
June	20	54	3	4,868	20	61	3	4,584	20	65	3	5,477	20	77	3	2,019
	80	83	1	2,607	140	143	1	1,545	230	170	1	1,247	210	166	1	1,496
July	20	22	1	2,886	20	20	1	2,728	20	19	1	3,012	20	9	<1	1,934
	90	64	1	1,322	160	127	1	1,108	220	134	1	1,191	200	140	1	853
early August	20	8	<1	1,497	20	10	<1	1,117	20	12	<1	1,792	20	9	<1	597
	75	42	1	1,067	180	139	1	892	200	183	1	779	230	97	<1	454
August	20	3	<1	996	20	15	1	2,487	20	15	1	1,591	20	28	1	2,763
	90	47	1	1,065	140	116	1	1,015	200	155	1	744	180	141	1	855

Table 7.—Numbers of fish and squid captured in marine waters of the northern region of southeastern Alaska by rope trawl, June–August 2003.

Common Name	Scientific name	Number caught early June	June	July	early August	August	Total
		Salmonids					
Pink salmon[1]	*Oncorhynchus gorbuscha*	0	27	1,290	181	2	1,500
Chum salmon[1]	*O. keta*	0	278	788	157	0	1,223
Sockeye salmon[1]	*O. nerka*	0	162	138	14	1	315
Coho salmon[1]	*O. kisutch*	0	4	78	35	19	136
Chinook salmon[1]	*O. tshawytscha*	0	2	0	0	0	2
Chinook salmon[2]	*O. tshawytscha*	6	16	0	6	0	28
Pink salmon[3]	*O. gorbuscha*	0	13	12	4	2	31
Chum salmon[3]	*O. keta*	2	12	0	1	0	15
Coho salmon[3]	*O. kisutch*	0	1	0	2	0	3
Sockeye salmon[3]	*O. nerka*	1	0	0	0	0	1
Total salmonids							3,254
		Non-salmonids					
Walleye pollock	*Theragra chalcogramma*	4,034	2,034	473	478	0	7,019
Pacific herring larvae	*Clupea pallasi*	0	121	0	0	0	121
Crested sculpin	*Blepsias bilobus*	0	3	40	36	5	84
Squid	Gonatidae	0	1	47	33	0	81
Walleye pollock larvae	*Theragra chalcogramma*	1	32	6	7	0	46
Prowfish	*Zaprora silenus*	0	7	25	10	1	43
Spiny dogfish	*Squalus acanthias*	0	2	22	0	0	24
Lampfish	Myctophidae	0	0	0	19	0	19
Pacific cod	*Gadus macrocephalus*	10	0	0	0	0	10
Wolf-eel	*Anarrhichthys ocellatus*	0	3	1	1	0	5
Pacific herring	*Clupea pallasi*	0	2	1	1	0	4
Fish larvae (unid.)	Teleostomi	0	1	2	0	0	3
Soft sculpin	*Psychrolutes sigalutes*	1	1	0	0	0	2
Pacific sandfish	*Trichodon trichodon*	1	0	0	1	0	2
Smooth lumpsucker	*Aptocyclus ventricosus*	0	1	1	0	0	2
Capelin	*Mallotus villosus*	1	0	0	0	0	1
Lingcod	*Ophiodon elongates*	0	1	0	0	0	1
Salmon shark	*Lamna ditropis*	0	0	0	1	0	1
unknown flatfish larvae	Pleuronectidae	1	0	0	0	0	1
Pacific hake	*Merluccius productus*	0	0	0	1	0	1
Total non-salmonids							7,470
Total fish and squid		4,058	2,724	2,924	988	30	10,724

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

Table 8.—Frequency of occurrence of fishes and squid captured in marine waters of the northern region of southeastern Alaska by rope trawl, June–August 2003. The percent occurrence of fish per 64 total hauls is shown in parentheses.

Common name	Scientific name	Frequency of occurrence early June	late June	July	early August	late August	Total	(%)
		Salmonids						
Pink salmon[1]	*Oncorhynchus gorbuscha*	0	7	17	10	2	36	(56)
Chum salmon[1]	*O. keta*	0	11	20	11	0	42	(66)
Sockeye salmon[1]	*O. nerka*	0	9	16	6	1	32	(50)
Coho salmon[1]	*O. kisutch*	0	2	19	10	4	35	(55)
Chinook salmon[1]	*O. tshawytscha*	0	1	0	0	0	1	(2)
Chinook salmon[2]	*O. tshawytscha*	3	7	0	5	0	15	(23)
Pink salmon[3]	*O. gorbuscha*	0	7	8	3	2	20	(31)
Chum salmon[3]	*O. keta*	2	5	0	1	0	8	(13)
Coho salmon[3]	*O. kisutch*	0	1	0	2	0	3	(5)
Sockeye salmon[3]	*O. nerka*	1	0	0	0	0	1	(2)
		Non-salmonids						
Walleye pollock	*Theragra chalcogramma*	2	6	6	5	0	19	(30)
Pacific herring larvae	*Clupea pallasi*	0	4	0	0	0	4	(6)
Crested sculpin	*Blepsias bilobus*	0	3	15	11	3	32	(50)
Squid	Gonatidae	0	1	3	1	0	5	(8)
Walleye pollock larvae	*Theragra chalcogramma*	1	5	3	2	0	11	(17)
Prowfish	*Zaprora silenus*	0	5	12	6	1	24	(38)
Spiny dogfish	*Squalus acanthias*	0	1	3	0	0	4	(6)
Lampfish	Myctophidae	0	0	0	1	0	1	(2)
Pacific cod	*Gadus macrocephalus*	1	0	0	0	0	1	(2)
Wolf-eel	*Anarrhichthys ocellatus*	0	2	1	1	0	4	(6)
Pacific herring	*Clupea pallasi*	0	1	1	1	0	3	(5)
Fish larvae (unid.)	Teleostomi	0	1	2	0	0	3	(5)
Soft sculpin	*Psychrolutes sigalutes*	1	1	0	0	0	2	(3)
Pacific sandfish	*Trichodon trichodon*	1	0	0	1	0	2	(3)
Smooth lumpsucker	*Aptocyclus ventricosus*	0	1	1	0	0	2	(3)
Capelin	*Mallotus villosus*	1	0	0	0	0	1	(2)
Lingcod	*Ophiodon elongates*	0	1	0	0	0	1	(2)
Salmon shark	*Lamna ditropis*	0	0	0	1	0	1	(2)
unknown flatfish larvae	Pleuronectidae	1	0	0	0	0	1	(2)
Pacific hake	*Merluccius productus*	0	0	0	1	0	1	(2)

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

Table 9.—Length (mm, fork), weight (g), and condition $[(g/mm^3)\cdot(10^5)]$ of juvenile pink salmon captured in different marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2003. No juvenile pink salmon were captured in early June.

		June				July				early August				August			
Locality	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Upper	Length	22	83-142	103.4	15.3	536	85-166	120.7	11.5	44	115-171	136.3	15.0	2	165-192	178.5	19.1
Chatham	Weight	22	4.7-27.4	10.2	5.6	291	6.3-31.5	16.1	4.8	44	13.2-47.6	25.2	9.2	2	45.0-60.8	52.9	11.1
Strait	Condition	22	0.8-1.0	0.9	0.1	291	0.7-1.1	0.9	0.1	44	0.8-1.2	1.0	0.1	2	0.9-1.0	0.9	0.1
Icy	Length	5	87-133	114.6	18.9	181	101-156	124.7	11.3	137	95-177	132.5	15.3	—	—	—	—
Strait	Weight	3	8.8-21.6	17.2	7.3	181	8.5-36.4	18.5	5.6	137	7.2-51.6	22.8	8.7	—	—	—	—
	Condition	3	0.8-1.1	0.9	0.1	181	0.8-1.1	0.9	0.1	137	0.8-1.1	0.9	0.1	—	—	—	—
Icy	Length	—	—	—	—	328	86-159	122.0	12.5	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	100	7.7-38.7	18.8	6.1	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	100	0.8-1.0	0.9	0.1	—	—	—	—	—	—	—	—
Total	Length	27	83-142	105.4	16.2	1045	85-166	121.8	11.9	181	95-177	133.4	15.3	2	165-192	178.5	19.1
	Weight	25	4.7-27.4	11.1	6.1	572	6.3-38.7	17.4	5.4	181	7.2-51.6	23.4	8.8	2	45.0-60.8	52.9	11.1
	Condition	25	0.8-1.1	0.9	0.1	572	0.7-1.1	0.9	0.1	181	0.8-1.2	0.9	0.1	2	0.9-1.0	0.9	0.1

Table 10.—Length (mm, fork), weight (g), and condition [(g/mm^3)·(10^5)] of juvenile chum salmon captured in different marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2003. No juvenile chum salmon were captured in early June.

		June				July				early August				August			
Locality	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Upper	Length	242	88-138	116.4	9.6	309	81-183	120.9	14.1	37	95-179	137.1	16.9	—	—	—	—
Chatham	Weight	78	6.0-23.2	13.7	4.5	255	5.1-63.4	17.6	7.4	37	7.8-6.5	27.1	10.5	—	—	—	—
Strait	Condition	78	0.7-1.3	0.9	0.1	255	0.7-1.3	1.0	0.1	37	0.9-1.2	1.0	0.1	—	—	—	—
Icy	Length	36	93-136	115.7	9.7	191	103-179	129.6	12.9	120	89-186	138.3	15.7	—	—	—	—
Strait	Weight	36	7.1-23.7	14.4	3.5	187	10.4-56.7	21.9	7.4	120	5.6-63.4	26.5	9.3	—	—	—	—
	Condition	36	0.8-1.1	0.9	0.1	187	0.8-1.2	1.0	0.1	120	0.8-1.4	1.0	0.1	—	—	—	—
Icy	Length	—	—	—	—	231	5-203	129.3	13.0	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	134	8.0-64.6	22.1	7.1	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	134	0.6-1.1	1.0	0.1	—	—	—	—	—	—	—	—
Total	Length	278	88-137	116.3	9.6	731	81-203	125.8	14.1	157	89-186	138.0	16.0	—	—	—	—
	Weight	114	6.03-23.7	13.9	4.2	576	5.1-64.6	20.0	7.6	157	5.6-63.4	26.6	9.5	—	—	—	—
	Condition	114	0.7-1.3	0.9	0.1	576	0.6-1.3	1.0	0.1	157	0.8-1.4	1.0	0.1	—	—	—	—

Table 11.—Length (mm, fork), weight (g), and condition [(g/mm^3)·(10^5)] of juvenile sockeye salmon captured in different marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2003. No juvenile sockeye salmon were captured in early June.

		June				July				early August				August			
Locality	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Upper	Length	150	83-173	119.9	15.0	81	98-200	125.7	16.5	4	122-148	131.5	12.1	1	253	253.0	0.0
Chatham	Weight	109	4.2-56.5	17.6	9.1	81	8.3-86.3	21.5	11.0	4	17.9-31.1	23.5	5.9	1	181.9	181.9	0.0
Strait	Condition	109	0.7-1.5	1.0	0.1	81	0.6-1.6	1.0	0.1	4	1.0-1.1	1.0	0.1	1	1.1	1.1	0.0
Icy	Length	12	106-155	122.4	14.3	12	110-142	123.3	10.4	10	125-197	150.8	20.9	—	—	—	—
Strait	Weight	12	11.7-34.9	18.5	7.4	12	11.7-32.1	19.6	6.4	10	18.6-81.5	37.0	18.1	—	—	—	—
	Condition	12	0.8-1.1	1.0	0.1	12	0.9-1.1	1.0	0.1	10	1.0-1.1	1.0	0.0	—	—	—	—
Icy	Length	—	—	—	—	45	112-161	134.9	11.9	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	45	13.4-41.7	24.5	7.0	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	45	0.9-1.1	1.0	0.1	—	—	—	—	—	—	—	—
Total	Length	162	83-173	120.1	14.9	138	98-200	128.5	15.3	14	122-197	145.3	20.4	1	253	253.0	0.0
	Weight	121	4.2-56.5	17.7	8.9	138	8.3-86.3	22.3	9.6	14	17.9-81.5	33.2	16.6	1	181.9	181.9	0.0
	Condition	121	0.7-1.5	1.0	0.1	138	0.6-1.6	1.0	0.1	14	1.0-1.1	1.0	0.0	1	1.1	1.1	0.0

Table 12.—Length (mm, fork), weight (g), and condition [(g/mm^3)·(10^5)] of juvenile coho salmon captured in different marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2003. No juvenile coho salmon were captured in early June.

		June				July				early August				August			
Locality	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Upper	Length	—	—	—	—	30	152-243	196.2	20.6	22	179-264	220.2	23.1	19	194-268	234.3	23.7
Chatham	Weight	—	—	—	—	30	40.5-161.0	86.4	29.1	22	65.2-230.2	127.6	41.0	19	74.2-237.2	158.7	48.1
Strait	Condition	—	—	—	—	30	1.0-1.3	1.1	0.1	22	1.0-1.3	1.2	0.1	19	1.0-1.4	1.2	0.1
Icy	Length	4	144-190	172.8	20.0	44	160-260	204.2	19.4	13	171-243	207.3	23.9	—	—	—	—
Strait	Weight	4	35.1-82.0	62.1	19.6	44	43.8-224.3	99.5	32.3	13	56.6-156.4	107.1	35.6	—	—	—	—
	Condition	4	1.1-1.2	1.2	0.1	44	1.0-1.3	1.1	0.1	13	1.1-1.3	1.2	0.1	—	—	—	—
Icy	Length	—	—	—	—	4	205-266	233.3	30.8	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	4	93.0-232.9	157.8	68.8	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	4	1.1-1.2	1.2	0.1	—	—	—	—	—	—	—	—
Total	Length	4	144-190	172.8	20.0	78	152-266	202.6	21.7	35	171-264	215.4	23.9	19	194-268	234.3	23.7
	Weight	4	35.1-82.0	62.1	19.6	78	40.5-232.9	97.5	36.4	35	56.6-230.2	120.0	39.8	19	74.2-237.2	158.7	48.1
	Condition	4	1.1-1.2	1.2	0.1	78	1.0-1.3	1.1	0.1	35	1.0-1.3	1.2	0.1	19	1.0-1.4	1.2	0.1

Table 13.—Length (mm, fork), weight (g), and condition [(g/mm^3)·(10^5)] of juvenile chinook salmon captured in different marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2003. No juvenile chinook salmon were captured in early June.

		June				July				early August				August			
Locality	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Upper Chatham Strait	Length	2	162-176	169.0	9.9	—	—	—	—	—	—	—	—	—	—	—	—
	Weight	2	54.1-63.4	58.7	6.6	—	—	—	—	—	—	—	—	—	—	—	—
	Condition	2	1.2-1.3	1.2	0.1	—	—	—	—	—	—	—	—	—	—	—	—
Icy Strait	Length	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Weight	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Icy Point	Length	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Weight	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	Length	2	162-176	169.0	9.9	—	—	—	—	—	—	—	—	—	—	—	—
	Weight	2	54.1-63.4	58.7	6.6	—	—	—	—	—	—	—	—	—	—	—	—
	Condition	2	1.2-1.3	1.2	0.1	—	—	—	—	—	—	—	—	—	—	—	—

Table 14.—Data on salmon with a missing adipose fin, in addition to release and recovery information of coded-wire tagged chinook and coho salmon captured in marine waters of the northern region of southeastern Alaska by rope trawl, June–August 2003. 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	(mm)	(g)	Locality	Station code	Date	(mm)	(g)	Age	Days since release	Distance traveled (km)
							July								
Coho	No tag	—	—	—	—	—	—	Icy Point	IPB	07/23/03	266	234.3	—	—	—
Coho	No tag	—	—	—	—	—	—	Chatham Strait	UCC	07/27/03	173	52.3	—	—	—
							August								
Coho	04:04/86	2000[2]	ADFG	Berners R., AK (Wild)	05/18/03[3]	105	24.0	Icy Strait	ISA	08/08/03	213	103.5	1.0	82	105
Coho	04:08/01	2000	ADFG	Auke Cr., AK (Wild)	06/25/03	107	—	Chatham Strait	UCA	08/21/03	234	160.2	2.0	57	65
Chinook	04:48/28	2000	NSRAA	Kasnyku Bay, AK	06/03/02	—	43.0	Chatham Strait	UCA	08/09/03	480	1,650	1.1	432	100

[1]ADFG = Alaska Department of Fish and Game; NSRAA = Northern Southeast Regional Aquaculture Association.

[2] Assumed to be a 2000 brood year.

[3] Released between 09 and 28 May.

Table 15.—Stock-specific information on juvenile chum salmon captured in different marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2003. Length (mm, fork), weight (g), and condition [$(g/mm^3)\cdot(10^5)$] are reported for each stock group. No juvenile chum salmon were captured in early June or late August.

		June				July				early August				August			
Locality	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
DIPAC																	
Upper	Length	76	88-136	112.8	11.2	13	111-175	135.8	16.6	2	160-179	169.5	13.4	—	—	—	—
Chatham	Weight	76	6.0-23.2	13.7	4.5	13	11.6-51.0	25.4	10.1	2	37.7-60.5	49.1	16.1	—	—	—	—
Strait	Condition	76	0.7-1.3	0.9	0.1	13	0.9-1.0	1.0	0.0	2	0.9-1.1	1.0	0.1	—	—	—	—
Icy	Length	32	93-134	115.1	9.1	10	131-157	140.4	8.1	7	129-160	141.1	12.1	—	—	—	—
Strait	Weight	32	7.1-20.2	14.0	3.1	10	22.5-36.2	28.8	4.9	7	19.6-39.2	27.4	8.3	—	—	—	—
	Condition	32	0.8-1.1	0.9	0.1	10	0.9-1.2	1.0	0.1	7	0.9-1.1	0.9	0.1	—	—	—	—
Icy	Length	—	—	—	—	16	121-150	131.1	7.4	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	16	17.6-33.8	21.9	4.5	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	16	0.8-1.1	1.0	0.1	—	—	—	—	—	—	—	—
Total	Length	108	88-136	113.5	10.6	39	111-175	135.1	11.8	9	129-179	147.4	17.0	—	—	—	—
	Weight	108	6.0-23.2	13.8	4.1	39	11.6-51.0	24.8	7.3	9	19.6-60.5	32.2	13.2	—	—	—	—
	Condition	108	0.7-1.3	0.9	0.1	39	0.8-1.2	1.0	0.1	9	0.9-1.1	1.0	0.1	—	—	—	—
Hidden Falls																	
Upper	Length	1	121	121.0	0.0	38	103-152	127.2	11.5	4	131-175	149.5	18.5	—	—	—	—
Chatham	Weight	1	14.9	14.9	0.0	38	10.4-33.1	19.9	5.6	4	23.6-52.2	35.3	12.1	—	—	—	—
Strait	Condition	1	0.8	0.8	0.0	38	0.8-1.1	0.9	0.1	4	1.0-1.1	1.0	0.0	—	—	—	—

Table 15.—(Cont.)

		June				July				early August				August			
Locality	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Icy	Length	—	—	—	—	27	111-153	131.5	10.0	14	119-169	144.7	13.8	—	—	—	—
Strait	Weight	—	—	—	—	27	14.0-34.5	22.2	5.3	14	16.4-45.3	29.9	8.3	—	—	—	—
	Condition	—	—	—	—	27	0.9-1.0	1.0	0.0	14	0.8-1.1	1.0	0.1	—	—	—	—
Icy	Length	—	—	—	—	14	126-191	138.9	16.3	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	14	18.9-64.6	26.0	11.6	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	14	0.9-1.0	0.9	0.0	—	—	—	—	—	—	—	—
Total	Length	1	121	121.0	0.0	79	103-191	130.7	12.6	18	119-175	145.8	14.5	—	—	—	—
	Weight	1	14.9	14.9	0.0	79	10.4-64.6	21.8	7.2	18	16.4-52.2	31.1	9.1	—	—	—	—
	Condition	1	0.8	0.8	0.0	79	0.8-1.1	0.9	0.1	18	0.8-1.1	1.0	0.1	—	—	—	—
Neets Bay																	
Upper	Length	—	—	—	—	4	111-183	149.3	29.5	—	—	—	—	—	—	—	—
Chatham	Weight	—	—	—	—	4	13.6-63.4	35.4	20.7	—	—	—	—	—	—	—	—
Strait	Condition	—	—	—	—	4	0.9-1.0	1.0	0.1	—	—	—	—	—	—	—	—
Icy	Length	—	—	—	—	3	148-167	155.7	10.0	—	—	—	—	—	—	—	—
Strait	Weight	—	—	—	—	3	33.4-47.0	39.0	7.1	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	3	1.0	1.0	0.0	—	—	—	—	—	—	—	—
Icy	Length	—	—	—	—	12	132-173	147.8	13.2	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	12	16.1-44.2	29.9	8.7	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	12	0.6-1.0	0.9	0.1	—	—	—	—	—	—	—	—
Total	Length	—	—	—	—	19	111-183	149.4	16.5	—	—	—	—	—	—	—	—
	Weight	—	—	—	—	19	13.6-63.4	32.5	11.7	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	19	0.6-1.0	0.9	0.1	—	—	—	—	—	—	—	—

Table 15.—(Cont.)

Locality	Factor	June				July				early August				August			
		n	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Unmarked																	
Upper	Length	1	125	125.0	0.0	200	81-175	118.2	13.3	31	95-165	133.4	14.1	—	—	—	—
Chatham	Weight	1	16.3	16.3	0.0	200	5.1-55.0	16.3	6.2	31	7.8-46.1	24.6	7.9	—	—	—	—
Strait	Condition	1	0.8	0.8	0.0	200	0.7-1.3	0.9	0.1	31	0.9-1.2	1.0	0.1	—	—	—	—
Icy	Length	4	103-136	121.0	14.1	147	103-179	128.0	12.9	99	89-186	137.1	16.1	—	—	—	—
Strait	Weight	4	9.9-23.7	17.0	5.8	147	10.4-56.7	21.0	7.2	99	5.5-63.4	25.9	9.4	—	—	—	—
	Condition	4	0.9-1.0	0.9	0.0	147	0.8-1.1	1.0	0.1	99	0.8-1.4	1.0	0.1	—	—	—	—
Icy	Length	—	—	—	—	92	95-157	128.0	11.2	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	92	8.0-38.7	20.6	5.3	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	92	0.8-1.1	1.0	0.1	—	—	—	—	—	—	—	—
Total	Length	5	103-136	121.8	12.3	439	81-179	123.5	13.6	130	89-186	136.2	15.6	—	—	—	—
	Weight	5	9.9-23.7	16.8	5.0	439	5.1-56.7	18.8	6.8	130	5.5-63.4	25.6	9.1	—	—	—	—
	Condition	5	0.8-1.0	0.9	0.0	439	0.7-1.3	1.0	0.1	130	0.8-1.4	1.0	0.1	—	—	—	—

Table 16.—Stock-specific information on juvenile sockeye salmon captured in different marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2003. Length (mm, fork), weight (g), and condition [$(g/mm^3)\cdot(10^5)$] are reported for each stock group. No juvenile sockeye salmon were caught in early June.

		June				July				early August				August			
Locality	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Snettisham																	
Upper	Length	89	89-136	115.4	9.7	16	104-156	128.7	14.0	—	—	—	—	—	—	—	—
Chatham	Weight	89	6.9-23.8	14.9	3.7	16	15.7-36.9	23.0	6.4	—	—	—	—	—	—	—	—
Strait	Condition	89	0.8-1.5	1.0	0.1	16	0.9-1.4	1.1	0.1	—	—	—	—	—	—	—	—
Icy	Length	10	106-130	117.1	7.3	—	—	—	—	1	197	197.0	0.0	—	—	—	—
Strait	Weight	10	11.6-20.2	15.5	2.6	—	—	—	—	1	81.5	81.5	0.0	—	—	—	—
	Condition	10	0.8-1.0	1.0	0.1	—	—	—	—	1	1.1	1.1	0.0	—	—	—	—
Icy	Length	—	—	—	—	3	116-143	134.0	15.6	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	3	13.9-32.5	24.8	9.7	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	3	0.9-1.1	1.0	0.1	—	—	—	—	—	—	—	—
Total	Length	99	89-136	115.5	9.4	19	104-156	129.5	13.9	1	197	197.0	0.0	—	—	—	—
	Weight	99	6.9-23.8	14.9	3.6	19	13.9-36.9	23.3	6.7	1	81.5	81.5	0.0	—	—	—	—
	Condition	99	0.8-1.5	1.0	0.1	19	0.9-1.4	1.1	0.1	1	1.1	1.1	0.0	—	—	—	—
Sweetheart Lake																	
Upper	Length	1	124	124.0	0.0	1	160	160.0	0.0	—	—	—	—	—	—	—	—
Chatham	Weight	1	17.5	17.5	0.0	1	45.2	45.2	0.0	—	—	—	—	—	—	—	—
Strait	Condition	1	0.9	0.9	0.0	1	1.1	1.1	0.0	—	—	—	—	—	—	—	—

Table 16.—(Cont.)

Locality	Factor	June				July				early August				August			
		n	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Icy Strait	Length	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Weight	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Icy Point	Length	—	—	—	—	1	147	147	0.0	—	—	—	—	—	—	—	—
	Weight	—	—	—	—	1	29.8	29.8	0.0	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	1	0.9	0.9	0.0	—	—	—	—	—	—	—	—
Total	Length	1	124	124.0	0.0	2	147-160	153.5	9.2	—	—	—	—	—	—	—	—
	Weight	1	17.5	17.5	0.0	2	29.8-45.2	37.5	10.9	—	—	—	—	—	—	—	—
	Condition	1	0.9	0.9	0.0	2	0.9-1.1	1.0	0.1	—	—	—	—	—	—	—	—
Chilkat River																	
Upper Chatham Strait	Length	1	151	151.0	0.0	—	—	—	—	—	—	—	—	—	—	—	—
	Weight	1	34.1	34.1	0.0	—	—	—	—	—	—	—	—	—	—	—	—
	Condition	1	1.0	1.0	0.0	—	—	—	—	—	—	—	—	—	—	—	—
Icy Strait	Length	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Weight	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Icy Point	Length	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Weight	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	Length	1	151	151.0	0.0	—	—	—	—	—	—	—	—	—	—	—	—
	Weight	1	34.1	34.1	0.0	—	—	—	—	—	—	—	—	—	—	—	—
	Condition	1	1.0	1.0	0.0	—	—	—	—	—	—	—	—	—	—	—	—

Table 16.—(Cont.)

Locality	Factor	June *n*	June range	June mean	June sd	July *n*	July range	July mean	July sd	early August *n*	early August range	early August mean	early August sd	August *n*	August range	August mean	August sd
Tahltan																	
Total	Length	—	—	—	—	1	157	157.0	0.0	—	—	—	—	—	—	—	—
(Upper	Weight	—	—	—	—	1	37.9	37.9	0.0	—	—	—	—	—	—	—	—
Chatham)	Condition	—	—	—	—	1	1.0	1.0	0.0	—	—	—	—	—	—	—	—
Unmarked																	
Upper	Length	18	83-173	140.1	24.8	63	98-200	123.9	16.2	4	122-148	131.5	12.1	1	253	253.0	0.0
Chatham	Weight	18	4.2-56.5	30.3	15.1	63	8.3-86.3	20.5	11.4	4	17.9-31.1	23.5	5.9	1	181.9	181.9	0.0
Strait	Condition	18	0.7-1.1	1.0	0.1	63	0.6-1.6	1.0	0.1	4	1.0-1.1	1.0	0.1	1	1.1	1.1	0.0
Icy	Length	2	143-155	149.0	8.5	12	110-142	123.3	10.4	9	125-174	145.7	13.9	—	—	—	—
Strait	Weight	2	31.9-34.9	33.4	2.1	12	11.7-32.1	19.6	6.4	9	18.6-52.4	32.1	9.6	—	—	—	—
	Condition	2	0.9-1.1	1.0	0.1	12	0.9-1.1	1.0	0.1	9	1.0-1.1	1.0	0.0	—	—	—	—
Icy	Length	—	—	—	—	41	112-161	134.7	11.9	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	41	13.4-41.7	24.4	7.0	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	41	0.9-1.1	1.0	0.0	—	—	—	—	—	—	—	—
Total	Length	20	83-173	141.0	23.7	116	98-200	127.7	15.1	13	122-174	141.3	14.5	1	253	253.0	0.0
	Weight	20	4.2-56.5	30.6	14.3	116	8.3-86.3	21.8	9.8	13	17.9-52.4	29.5	9.3	1	181.9	181.9	0.0
	Condition	20	0.7-1.1	1.0	0.1	116	0.6-1.6	1.0	0.1	13	1.0-1.1	1.0	0.0	1	1.1	1.1	0.0

Table 17.—Stock-specific information on juvenile coho salmon captured in different marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2003. Length (mm, fork), weight (g), and condition $[(g/mm^3)\cdot(10^5)]$ are reported for each stock group. No juvenile coho salmon were captured in early June.

		June				July				early August				August			
Locality	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
DIPAC																	
Upper	Length	—	—	—	—	5	173-207	190.2	15.0	3	179-209	189.7	16.8	3	195-236	209.0	23.4
Chatham	Weight	—	—	—	—	5	51.6-92.4	72.1	18.9	3	65.2-90.6	74.5	14.0	3	74.2-169.8	108.1	53.6
Strait	Condition	—	—	—	—	5	1.0-1.1	1.0	0.0	3	1.0-1.1	1.1	0.1	3	1.0-1.3	1.1	0.2
Icy	Length	—	—	—	—	3	182-185	184.0	1.7	1	189	189.0	0.0	—	—	—	—
Strait	Weight	—	—	—	—	3	64.6-68.4	66.0	2.1	1	82.1	82.1	0.0	—	—	—	—
	Condition	—	—	—	—	3	1.0-1.1	1.1	0.0	1	1.2	1.2	0.0	—	—	—	—
Icy	Length	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	Length	—	—	—	—	8	173-207	187.9	11.8	4	179-209	189.5	13.7	3	195-236	209.0	23.4
	Weight	—	—	—	—	8	51.6-92.4	69.8	14.6	4	65.2-90.6	76.4	12.0	3	74.2-169.8	108.1	53.6
	Condition	—	—	—	—	8	1.0-1.1	1.0	0.0	4	1.0-1.2	1.1	0.1	3	1.0-1.3	1.1	0.2
Unmarked																	
Upper	Length	—	—	—	—	25	152-243	197.4	21.6	19	188-264	225.1	20.3	16	194-268	239.1	21.2
Chatham	Weight	—	—	—	—	25	40.5-161.0	89.2	30.2	19	72.0-230.2	136.0	37.3	16	80.8-237.2	168.2	42.2
Strait	Condition	—	—	—	—	25	1.0-1.3	1.1	0.1	19	1.0-1.3	1.2	0.1	16	1.0-1.4	1.2	0.1

Table 17.—(Cont.)

		June				July				early August				August			
Locality	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Icy	Length	4	144-190	172.8	20.0	41	160-260	205.7	19.2	12	171-243	208.8	24.3	—	—	—	—
Strait	Weight	4	35.1-82.0	62.1	19.6	41	43.8-224.3	102.0	32.1	12	56.6-156.4	109.2	36.4	—	—	—	—
	Condition	4	1.1-1.2	1.2	0.0	41	1.0-1.3	1.1	0.1	12	1.1-1.3	1.2	0.1	—	—	—	—
Icy	Length	—	—	—	—	4	205-266	233.3	30.8	—	—	—	—	—	—	—	—
Point	Weight	—	—	—	—	4	93.0-232.9	157.8	68.8	—	—	—	—	—	—	—	—
	Condition	—	—	—	—	4	1.1-1.2	1.2	0.1	—	—	—	—	—	—	—	—
Total	Length	4	144-190	172.8	20.0	70	152-266	204.3	22.0	31	171-364	218.8	23.0	16	194-268	239.1	21.2
	Weight	4	35.1-82.0	62.1	19.6	70	40.5-232.9	100.6	36.8	31	56.6-230.2	125.6	38.7	16	80.8-237.2	168.2	42.2
	Condition	4	1.1-1.2	1.2	0.0	70	1.0-1.3	1.1	0.1	31	1.0-1.3	1.2	0.1	16	1.0-1.4	1.2	0.1

Table 18.—Stock-specific information on juvenile chinook salmon captured in different marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2003. Length (mm, fork), weight (g), and condition [(g/mm^3)·(10^5)] are reported for each stock group. No juvenile chinook salmon were captured in early June.

		June				July				early August				August			
Locality	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
Hidden Falls																	
Total	Length	2	162-176	169.0	9.9	—	—	—	—	—	—	—	—	—	—	—	—
(Upper	Weight	2	54.1-63.4	58.7	6.6	—	—	—	—	—	—	—	—	—	—	—	—
Chatham)	Condition	2	1.2-1.3	1.2	0.1	—	—	—	—	—	—	—	—	—	—	—	—

Table 19.—Number of potential predators of juvenile salmon examined at sea, captured by rope trawl in the marine waters of the northern region of southeastern Alaska, June–August 2003.

Predator species	Life history stage	Number examined	Number empty	Percent feeding	Number with salmon	Percent feeders with salmon
			Salmonids			
Pink salmon	Adult	31	4	87.1	0	0
Chum salmon	Adult	15	1	93.3	0	0
Sockeye salmon	Adult	1	0	100.0	0	0
Coho salmon	Adult	3	1	66.7	0	0
Chinook salmon	Immature	28	4	85.7	0	0
			Non-salmonids			
Pacific herring	Adult	3	0	100.0	0	0
Pacific cod	Adult	10	2	80.0	0	0
Pacific hake	Adult	1	0	100.0	0	0
Spiny dogfish	Adult	24	11	54.2	1	7.7
Walleye pollock	Immature	132	6	95.5	0	0
Total		248	29	88.3	1	0.5

Table 20.—Length (mm, fork), weight (g), and stomach percent fullness of potential predators of juvenile salmon captured in different marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2003.

		June (early and late)				July				August (early and late)			
Species	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
						Salmonids							
Pink	Length	13	485-590	539	32	12	433-595	515	39	6	450-530	497	28
salmon	Weight	13	1400-3550	2092	565	12	1000-2500	1637	372	6	1100-1550	1418	166
	Fullness	13	0-95	51	31	12	0-100	43	35	6	0-75	24	30
Chum	Length	14	595-691	635	33	—	—	—	—	1	542	—	—
salmon	Weight	14	2200-3810	2851	515	—	—	—	—	1	2050	—	—
	Fullness	14	1-100	24	30	—	—	—	—	1	0	—	—
Sockeye	Length	1	669	—	—	—	—	—	—	—	—	—	—
salmon	Weight	1	2500	—	—	—	—	—	—	—	—	—	—
	Fullness	1	1	—	—	—	—	—	—	—	—	—	—
Coho	Length	1	640	—	—	—	—	—	—	2	667-770	719	73
salmon	Weight	1	3300	—	—	—	—	—	—	2	3450-6600	5025	2227
	Fullness	1	100	—	—	—	—	—	—	2	0-100	50	71
Chinook	Length	22	265-437	321	59	—	—	—	—	6	370-545	465	75
salmon	Weight	22	215-1100	459	197	—	—	—	—	6	700-3100	1618	916
	Fullness	22	1-100	56	35	—	—	—	—	6	15-100	79	33

Table 20.—(Cont.)

		June (early and late)				July				August (early and late)			
Species	Factor	*n*	range	mean	sd	*n*	range	mean	sd	*n*	range	mean	sd
						Non-salmonids							
Spiny	Length	2	655-688	672	23	22	535-930	715	99	—	—	—	—
dogfish	Weight	2	1400-1700	1550	212	22	700-4800	2194	1024	—	—	—	—
	Fullness	2	0-1	1	1	22	0-50	5	13	—	—	—	—
Walleye	Length	45	260-353	314	19	34	260-414	335	29	53	279-376	326	20
pollock	Weight	45	105-350	236	52	34	185-490	303	74	53	140-405	279	57
	Fullness	45	0-100	41	29	34	0-100	40	32	53	1-100	33	26
Pacific	Length	10	284-338	309	16	—	—	—	—	—	—	—	—
Cod	Weight	10	130-310	229	52	—	—	—	—	—	—	—	—
	Fullness	10	0-75	31	25	—	—	—	—	—	—	—	—
Pacific	Length	2	223-233	228	7	1	227	—	—	—	—	—	—
herring	Weight	2	105-140	123	25	1	120	—	—	—	—	—	—
	Fullness	2	50	50	0	1	50	—	—	—	—	—	—
Pacific	Length	—	—	—	—	—	—	—	—	1	415	—	—
hake	Weight	—	—	—	—	—	—	—	—	1	600	—	—
	Fullness	—	—	—	—	—	—	—	—	1	70	—	—

Appendix 1.—Catch and life history stage of salmonids captured in marine waters of the northern region of southeastern Alaska by rope trawl, June–August 2003. Nocturnal rope trawl hauls are denoted by one asterisk and nocturnal two-boat trawls are denoted by two asterisks.

			Juvenile					Immature	Adult			
Date	Haul#	Station	Pink	Chum	Sockeye	Coho	Chinook	Chinook	Pink	Chum	Sockeye	Coho
12-June	7023	ISD	?	?	?	?	?	3	?	?	?	?
12-June	7024	ISC	?	?	?	?	?	?	?	1	?	?
12-June	7025	ISB	?	?	?	?	?	?	?	?	?	?
12-June	7026	ISA	?	?	?	?	?	?	?	?	?	?
12-June	7027	ISA	?	?	?	?	?	?	?	?	?	?
13-June	7028	ISB	?	?	?	?	?	2	?	?	?	?
13-June	7029	ISC	?	?	?	?	?	?	?	?	?	?
13-June	7030	ISD	?	?	?	?	?	?	?	?	?	?
14-June	7032**	ISA	?	?	?	?	?	?	?	?	?	?
14-June	7033**	ISD	?	?	?	?	?	?	?	?	?	?
14-June	7034**	ISD	?	?	?	?	?	?	?	?	?	?
14-June	7035**	ISD	?	?	?	?	?	?	?	?	?	?
15-June	7031*	ISD	?	?	?	?	?	1	?	1	1	?
15-June	7036**	ISB	?	?	?	?	?	?	?	?	?	?
15-June	7037**	ISB	?	?	?	?	?	?	?	?	?	?
22-June	7041	IPB	?	?	?	?	?	?	?	?	?	?
22-June	7042	IPB	?	?	?	?	?	?	2	?	?	?
23-June	7044	ISA	2	10	2		?	1	?	?	?	?
23-June	7045	ISB	1	19	5	2	?	1				
23-June	7046	ISC	?	1	?	?	?	?	?	?	?	?
23-June	7047	ISD	1	4	2	2	?	?	?	?	?	?
24-June	7048	UCA	8	189	117		2	5	?	?	?	?
24-June	7049	UCB	3	10	5		?	3		1	?	?

Appendix 1.—(Cont.)

			Juvenile					Immature	Adult			
Date	Haul#	Station	Pink	Chum	Sockeye	Coho	Chinook	Chinook	Pink	Chum	Sockeye	Coho
24-June	7050	UCC	?	23	15	?	?	1	?	1	?	?
24-June	7051	UCD	11	19	11		?	2	?	?	?	?
24-June	7052	UCA	?	1	2	?	?	3	3	1	?	?
25-June	7053	UCA	?	?	?	?	?	?	3	5	?	1
28-June	7054	ISD	1	1	3	?	?	?	?	?	?	?
28-June	7055	ISC	?		?	?	?	?	1	?	?	?
28-June	7056	ISB	?	1	?	?	?	?	1	?	?	?
28-June	7057	ISA	?	?	?	?	?	?	1	?	?	?
29-June	7058**	ISA	?	?	?	?	?	?	?	?	?	?
29-June	7059**	ISB	?	?	?	?	?	?	?	?	?	?
29-June	7060**	ISC	1	3	?	?	?	?	?	?	?	?
29-June	7061**	ISD	833	514	55	5	?	?	?	?	?	?
30-June	7062*	ISD	?	?	?	?	?	?	2	4	?	?
23-July	7063	IPA	?	1	?	1	?	?	?	?	?	?
23-July	7064	IPA	?	3	?	1	?	?	1	?	?	?
23-July	7065	IPB	128	79	10	1	?	?	?	?	?	?
23-July	7066	IPB	322	147	35	1	?	?	?	?	?	?
24-July	7069	ISA	18	27		22	?	?	1	?	?	?
24-July	7070	ISB	?	3	?	1	?	?	3	?	?	?
24-July	7071	ISC	23	88	3	2	?	?	?	?	?	?
24-July	7072	ISD	73	28	3	5	?	?	?	?	?	?
25-July	7073	UCA	129	59	8		?	?	1	?	?	?
25-July	7074	UCB	50	9	9	3	?	?	?	?	?	?
25-July	7075	UCC	57	41	2		?	?	?	?	?	?
25-July	7076	UCD	92	76	2	7	?	?	1	?	?	?
26-July	7077	ISA	10	16	1	4	?	?	?	?	?	?

Appendix 1.—(Cont.)

Date	Haul#	Station	Juvenile Pink	Chum	Sockeye	Coho	Chinook	Immature Chinook	Adult Pink	Chum	Sockeye	Coho
26-July	7078	ISB	2	22		2	?		?	?	?	?
26-July	7079	ISC	9	16	1	2	?	?	3	?	?	?
26-July	7080	ISD	39	13	3	2	?	?	?	?	?	?
27-July	7081	UCD	?	?	2	9	?	?	?	?	?	?
27-July	7082	UCC	203	92	37	5	?	?	?	?	?	?
27-July	7083	UCB	124	51	19	2	?	?	?	?	?	?
27-July	7084	UCA	5	12	2	4	?	?	1	?	?	?
29-July	7085*	ISC	6	5	1	4	?		1	?	?	?
8-August	7088	UCD	1	2		3	?	?	?	?	?	?
8-August	7089	UCC	12	9	3	4	?	1	?	?	?	?
8-August	7090	UCB	27	19	1	3	?	1	1	?	?	?
8-August	7091	UCA	4	7		12	?	?	?	?	?	?
9-August	7092	ISA	17	32		2	?	1	?	?	?	1
9-August	7093	ISB	73	42	3	4	?	2	?	?	?	?
9-August	7094	ISC	8	11	2	1	?	?	?	?	?	?
9-August	7095	ISD	20	10	1		?	?	?	?	?	?
10-August	7096	ISD	?	4	?	3	?	?	?	?	?	?
10-August	7097	ISC	?	?	?	1	?	?	2	1	?	1
10-August	7098	ISB	?	?	?	?	?	?	?	?	?	?
10-August	7099	ISA	17	19	4	2	?	?	1	?	?	?
11-August	7100*	ISC	2	2			?	1	?	?	?	?
21-August	7102	UCD	1	?	?	2	?	?	?	?	?	?
21-August	7103	UCC	1	?	?	6	?	?	1	?	?	?
21-August	7104	UCB	?	?	?	4	?	?	?	?	?	?
21-August	7105	UCA	?	?	1	7	?	?	1	?	?	?

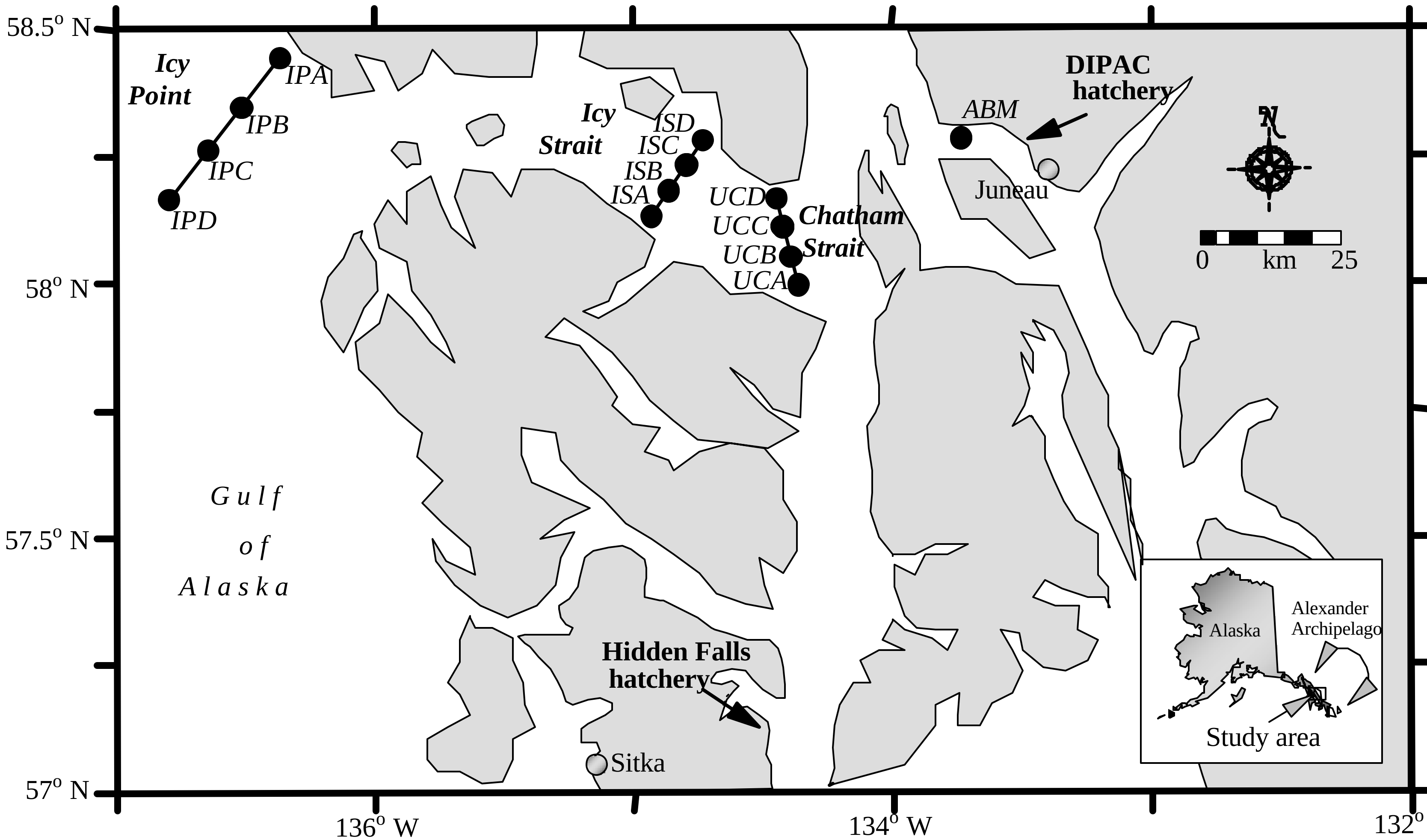

Figure 1.—Stations sampled in marine waters of the northern region of southeastern Alaska, May–August 2003. Small arrows indicate two major enhancement facilities: Douglas Island Pink and Chum (DIPAC) hatchery, and Hidden Falls hatchery.

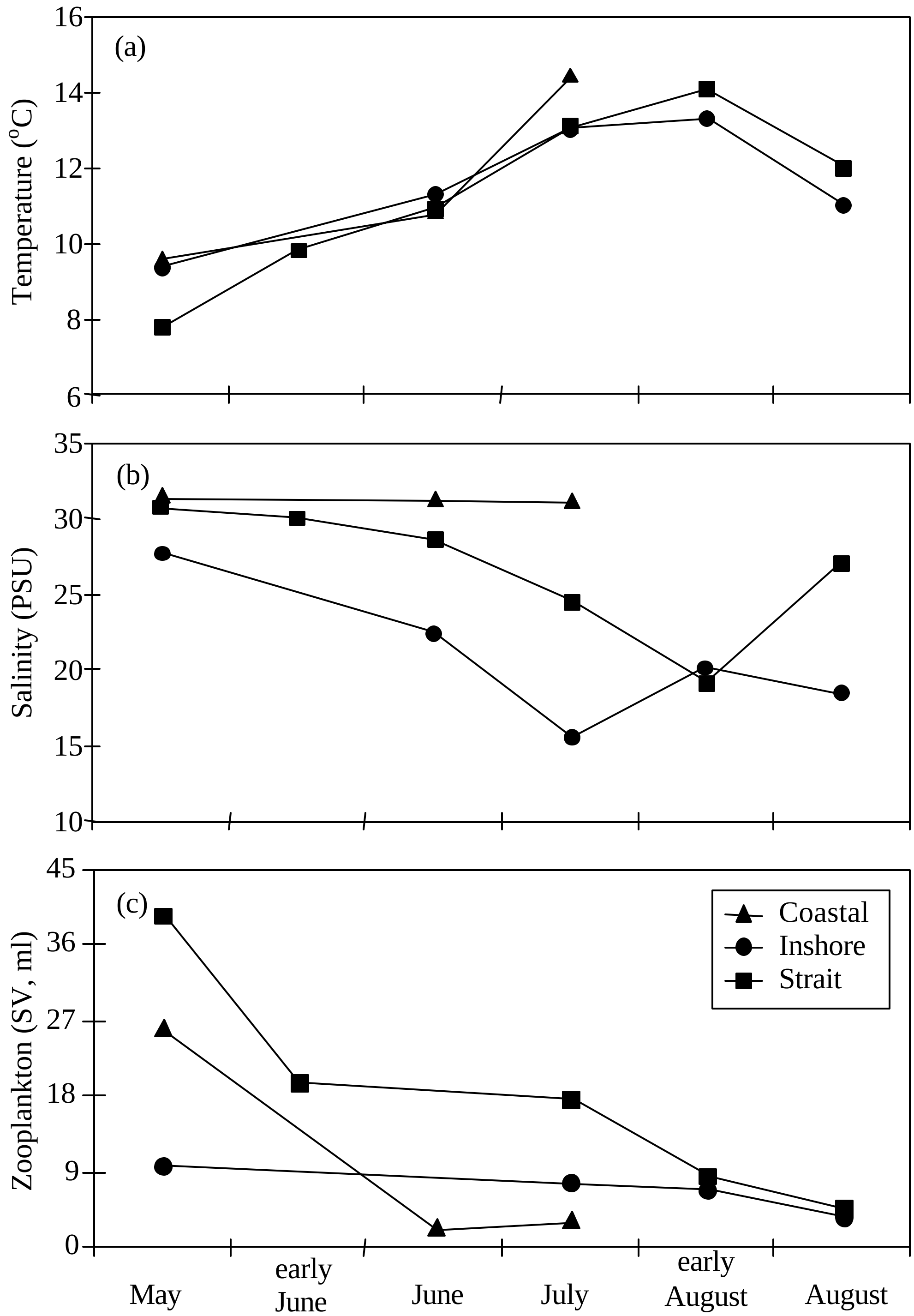

Figure 2.—Surface temperature (2 m, a), salinity (2 m, b), and zooplankton settled volumes from vertical NORPAC hauls (20 m, c) in inshore, strait, and coastal marine habitats of the northern region of southeastern Alaska, May–August 2003. Zooplankton standing stock (ml/m^3) can be computed by dividing by water volume filtered, a factor of 3.9 m^3 for these samples.

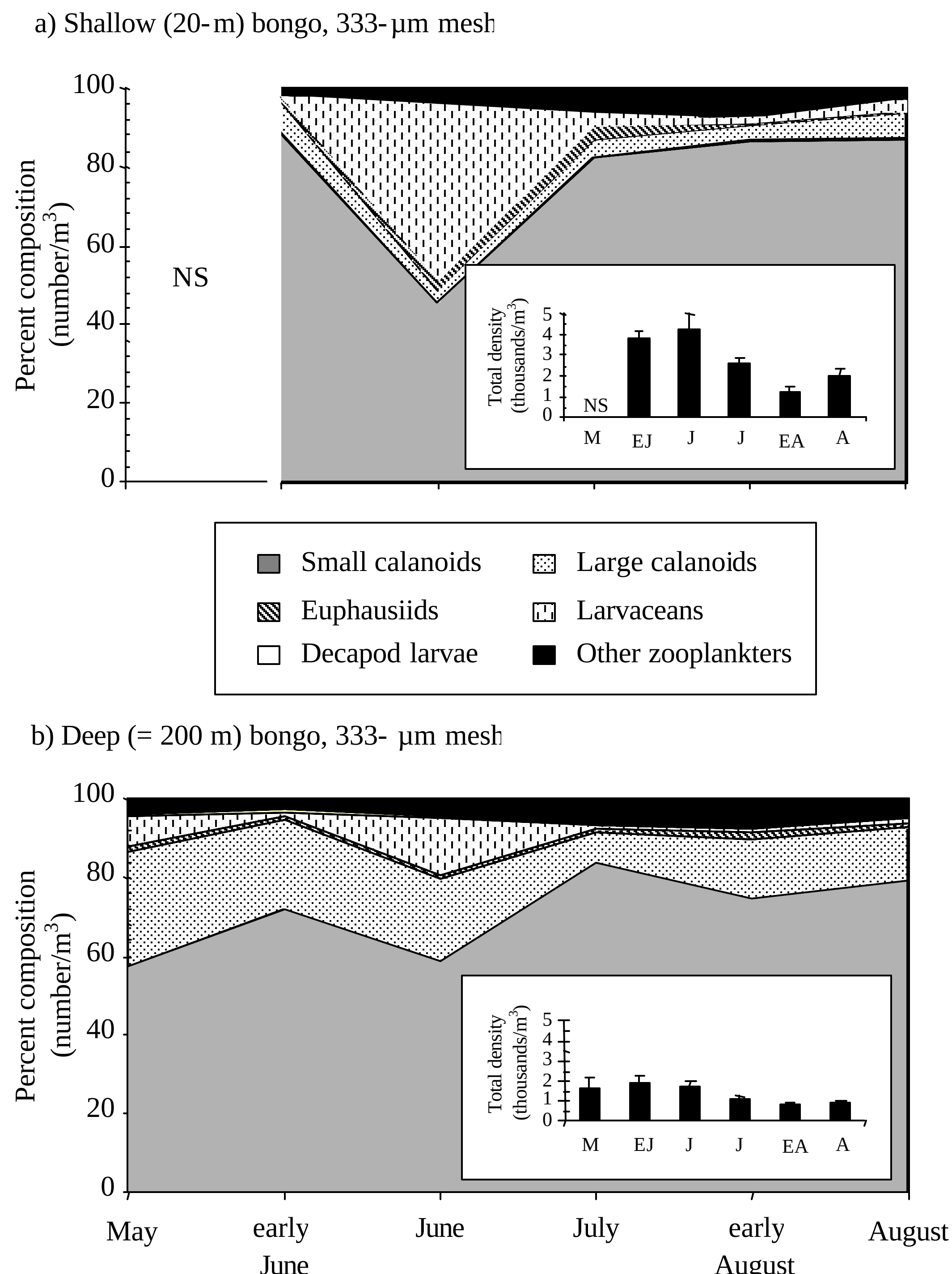

Figure 3.—Monthly zooplankton composition (percent number per m^3) and total density (thousands per m^3) in shallow (20-m) and deep (=200 m), 333-µm mesh, bongo net samples from Icy Strait in the northern region of southeastern Alaska, May–August 2003. Total density means and standard errors are based on four samples in each time period. NS = no sample.

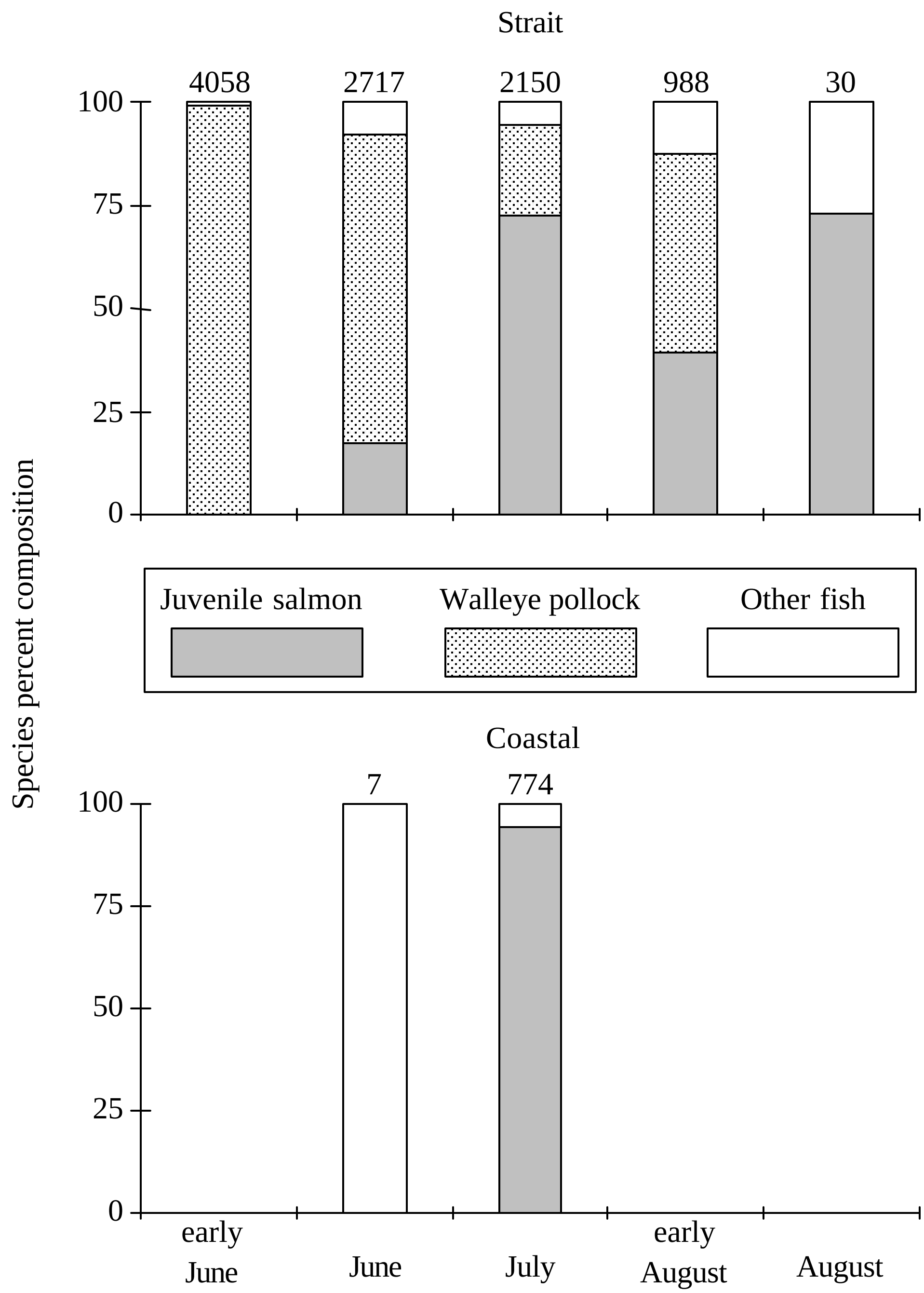

Figure 4.—Fish composition from rope trawl catches in strait and coastal marine habitats of the northern region of southeastern Alaska, June–August 2003. Number of fish is indicated above each bar.

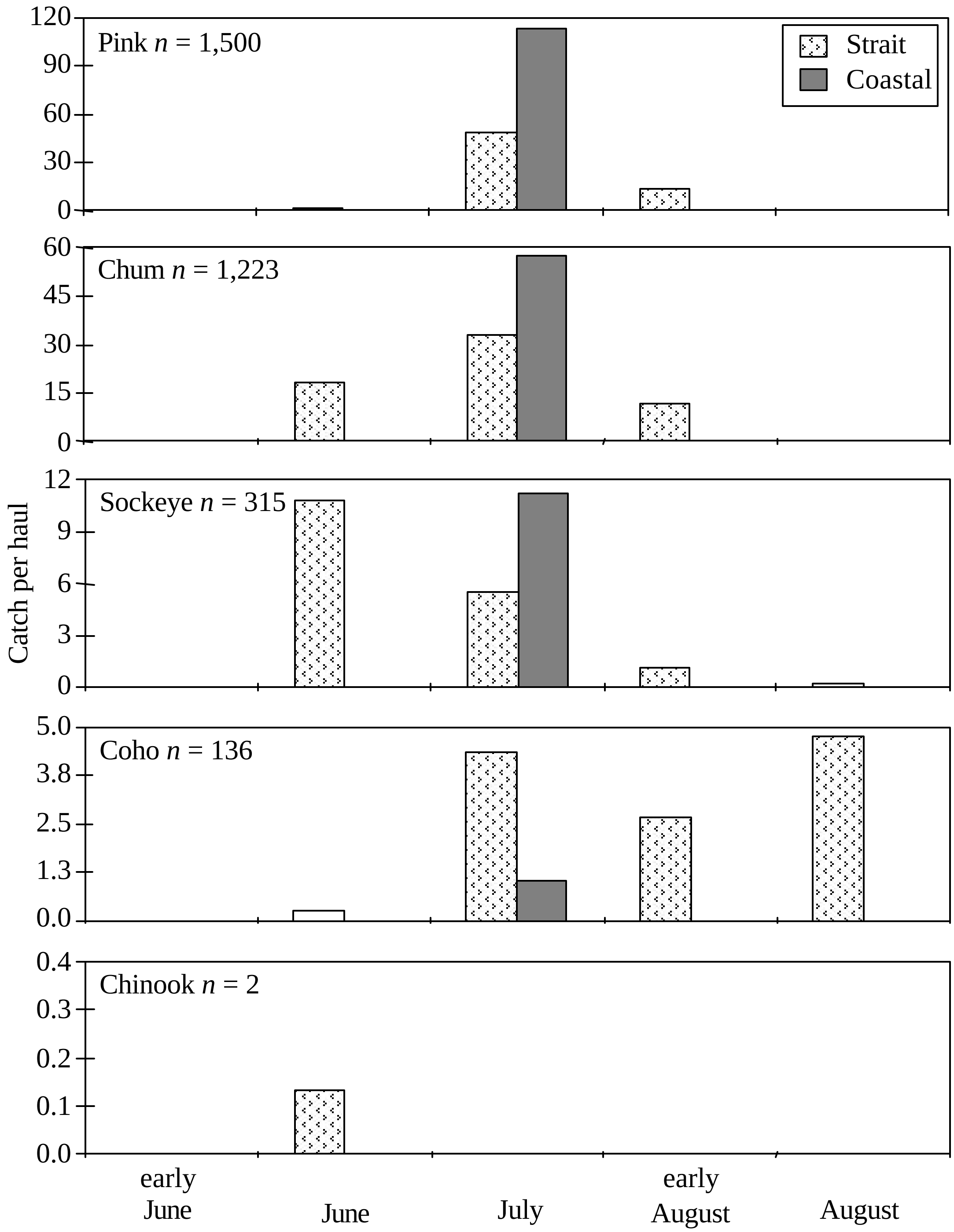

Figure 5.—Mean catch per rope trawl haul of juvenile salmon in strait and coastal marine habitats of the northern region of southeastern Alaska, June–August, 2003.

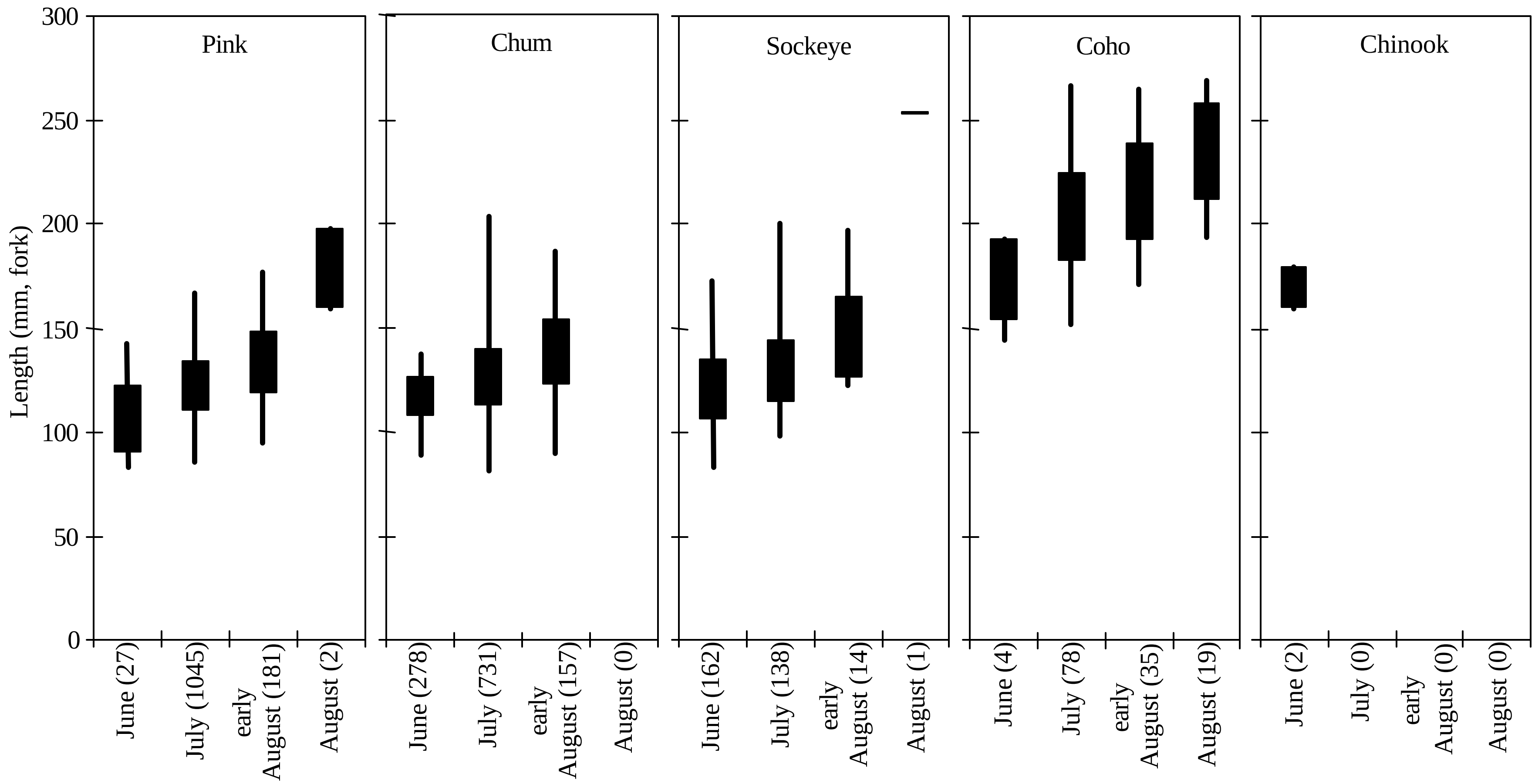

Figure 6.—Length (mm, fork) of juvenile salmon captured in marine waters of the northern region of southeastern Alaska by rope trawl, June–August 2003. Length of vertical bars is the size range for each sample, and the boxes within the size range are one standard deviation on either side of the mean. Sample sizes are shown in parentheses.

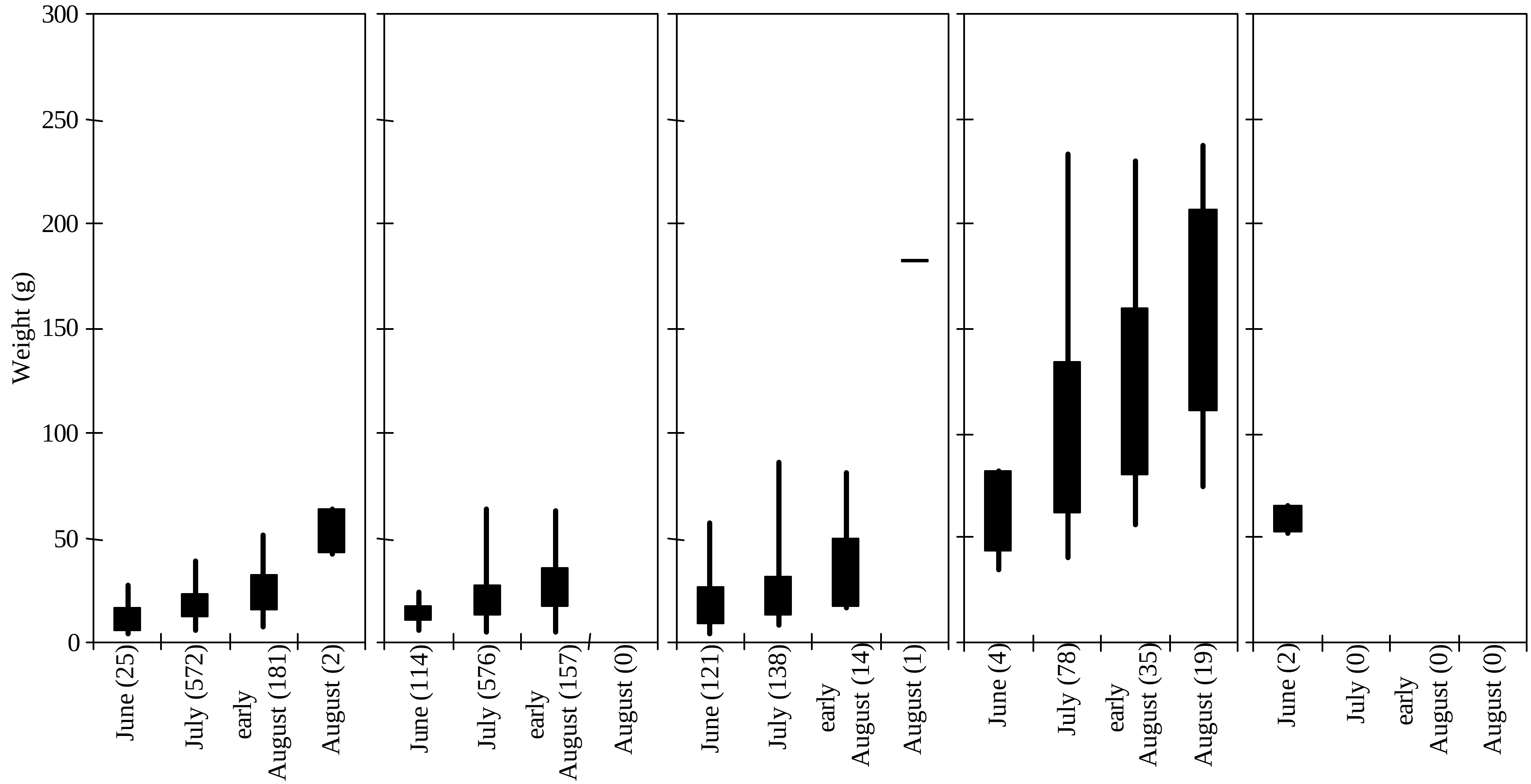

Figure 7.—Weight (g) of juvenile salmon captured in marine waters of the northern region of southeastern Alaska by rope trawl, June–August 2003. Length of vertical bars is the size range for each sample, and the bars within the size range are one standard deviation on either side of the mean. Sample sizes are shown in parentheses.

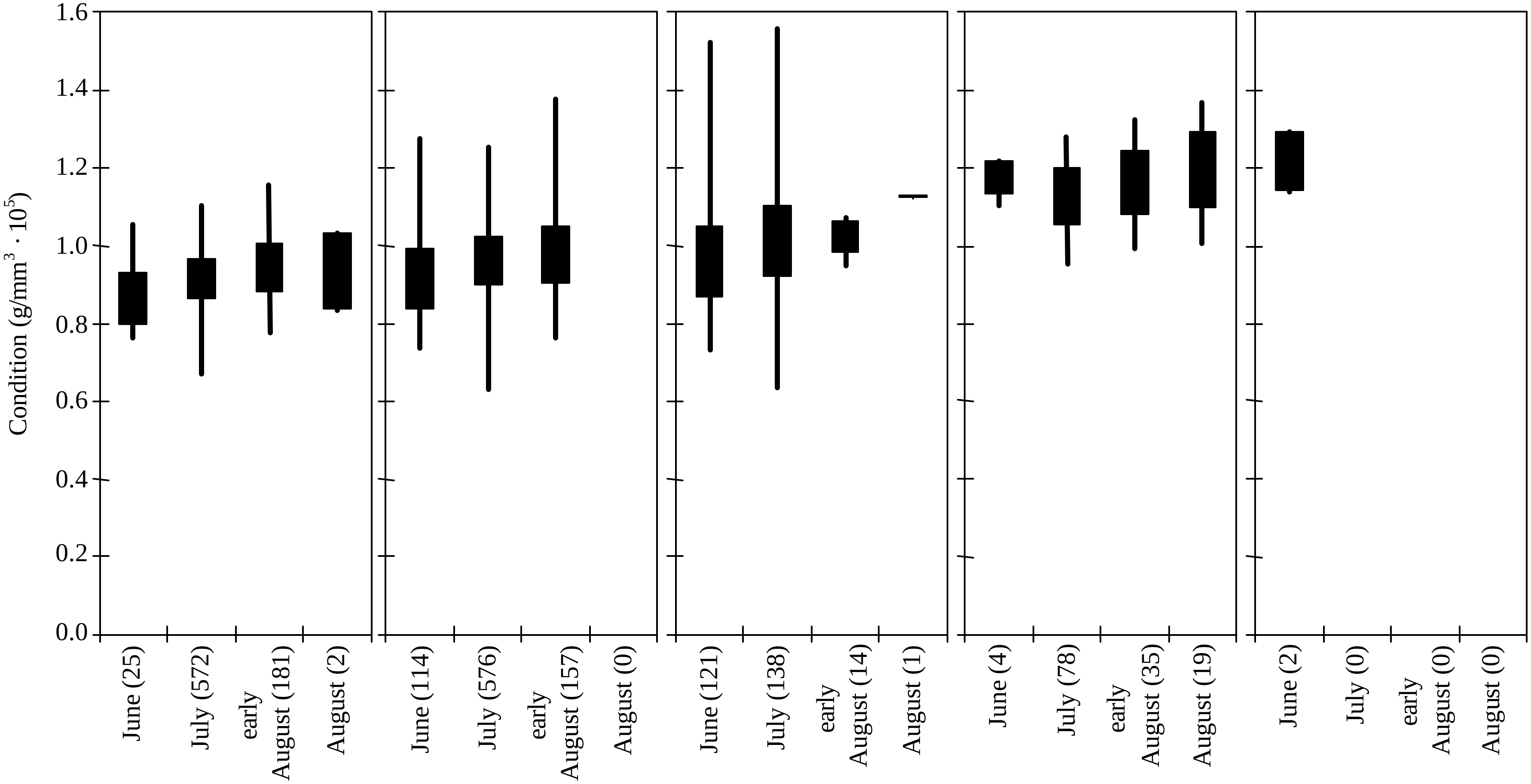

Figure 8.—Condition (g/mm^3 · 10^5) of juvenile salmon captured in marine waters of the northern region of southeastern Alaska by rope trawl, June–August 2003. Length of vertical bars is the size range for each sample, and the boxes within the size range are one standard deviation on either side of the mean. Sample sizes are shown in parentheses.

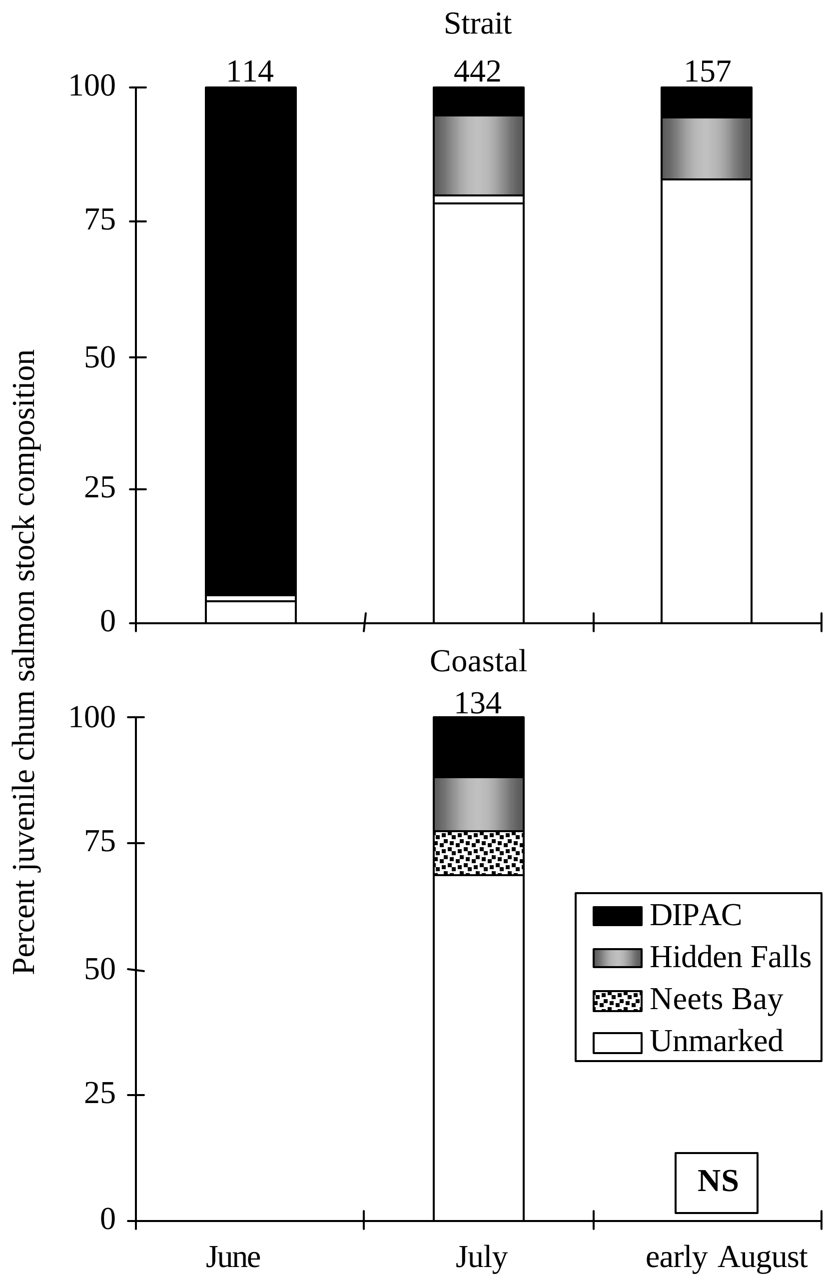

Figure 9.—Monthly stock composition of juvenile chum salmon based on otolith thermal marks in strait and coastal marine habitats of the northern region of southeastern Alaska, June–August 2003. Number of salmon sampled per month and habitat is indicated above each bar.

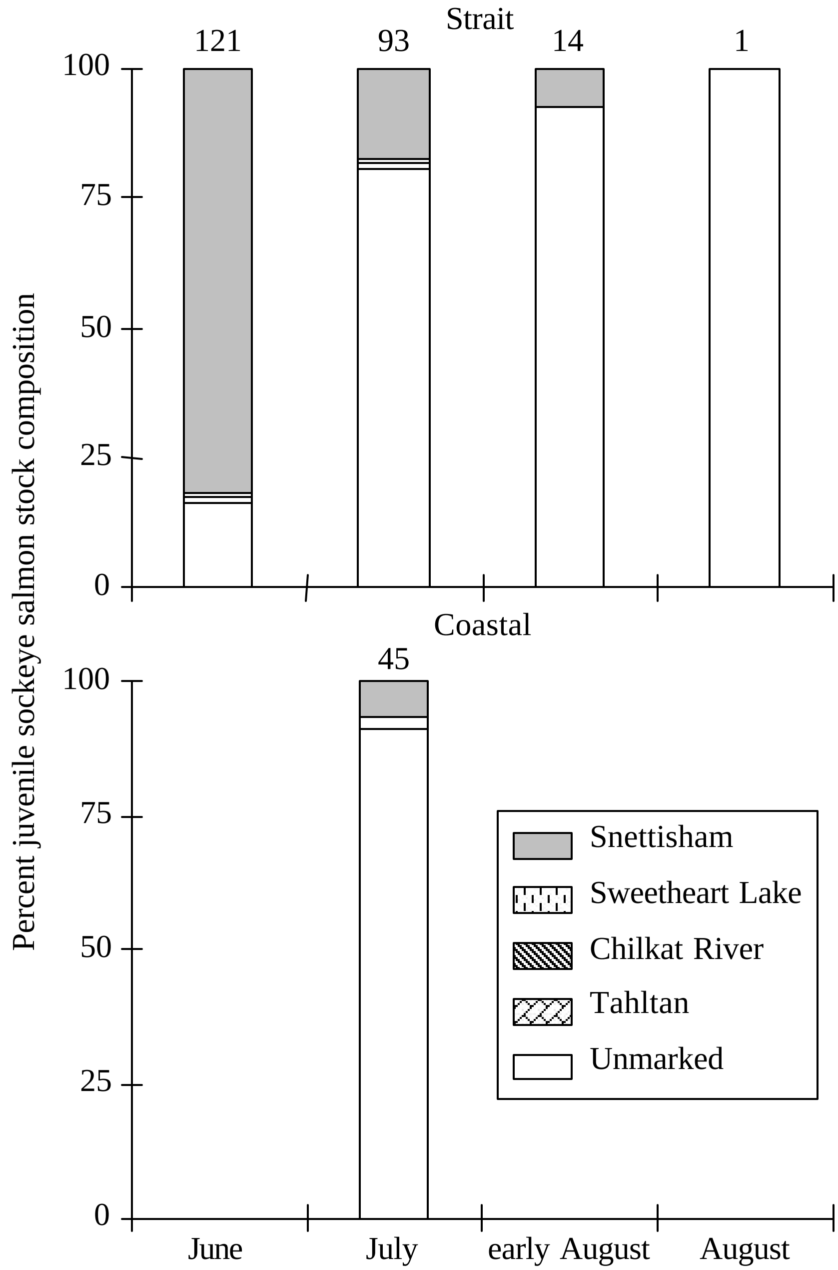

Figure 10.—Monthly stock composition of juvenile sockeye salmon based on otolith thermal marks in strait and coastal marine habitats of the northern region of southeastern Alaska, June–August 2003. Number of salmon sampled per month and habitat is indicated above each bar.

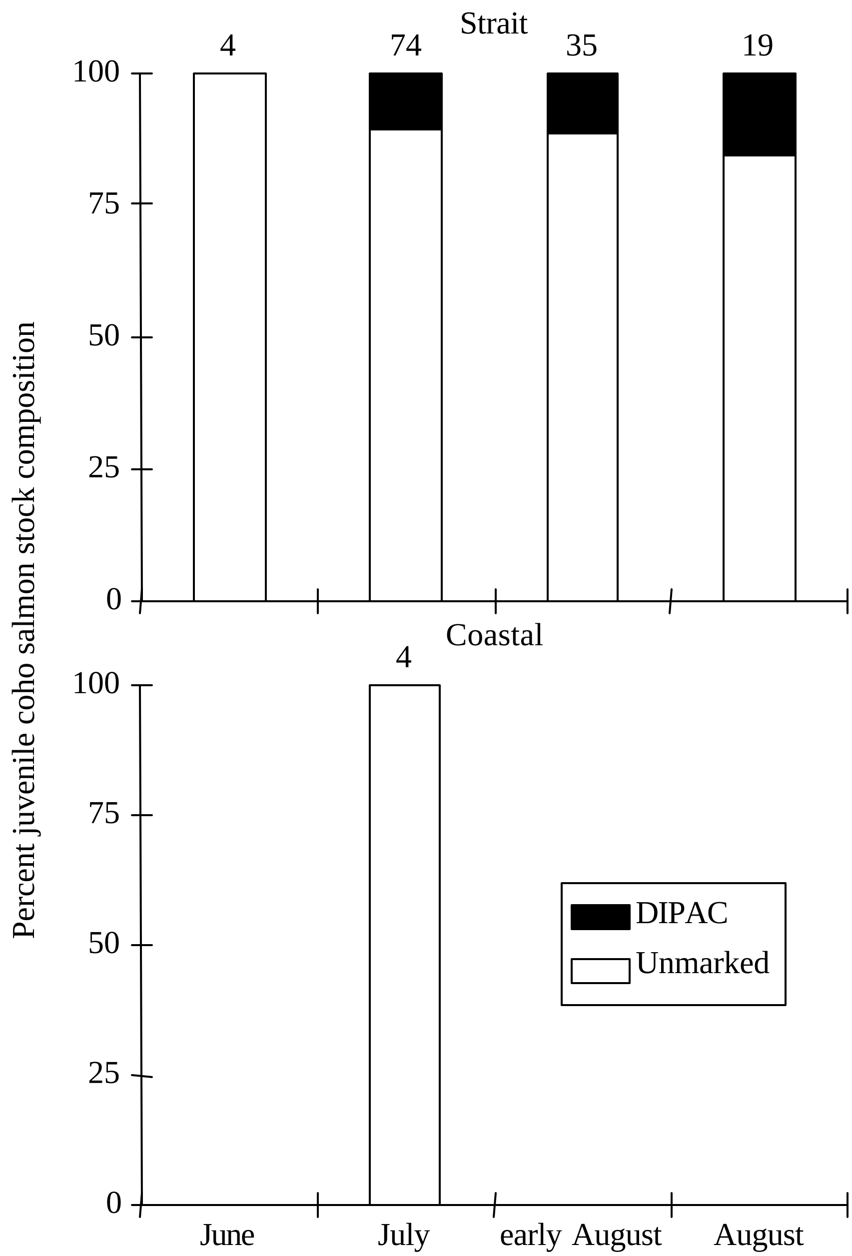

Figure 11.—Monthly stock composition of juvenile coho salmon based on otolith thermal marks in strait and coastal marine habitats of the northern region of southeastern Alaska, June–August 2003. Number of salmon per month and habitat is indicated above each bar.

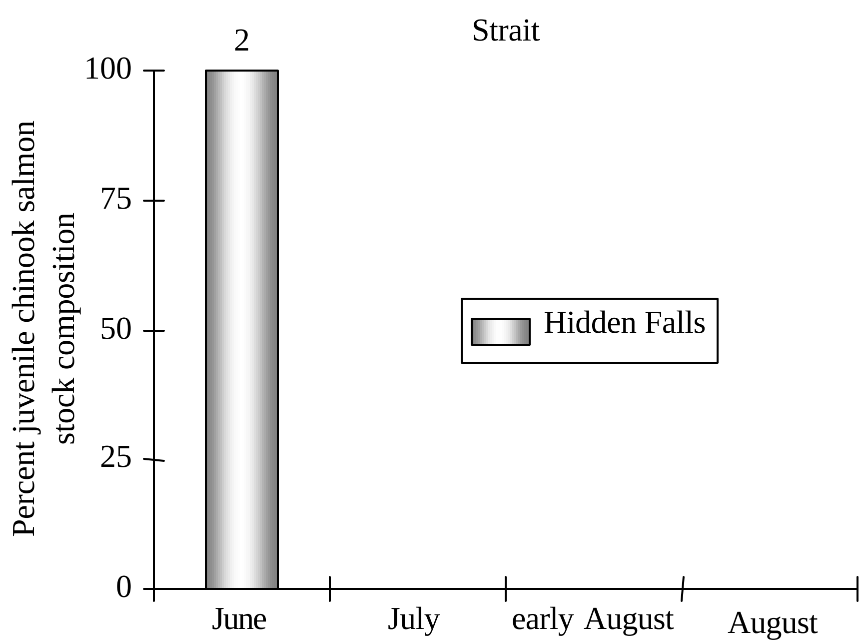

Figure 12.—Monthly stock composition of juvenile chinook salmon based on otolith thermal marks in the strait and coastal marine habitats of the northern region of southeastern Alaska, June–August 2003. Number of salmon per month and habitat is indicated above each bar.

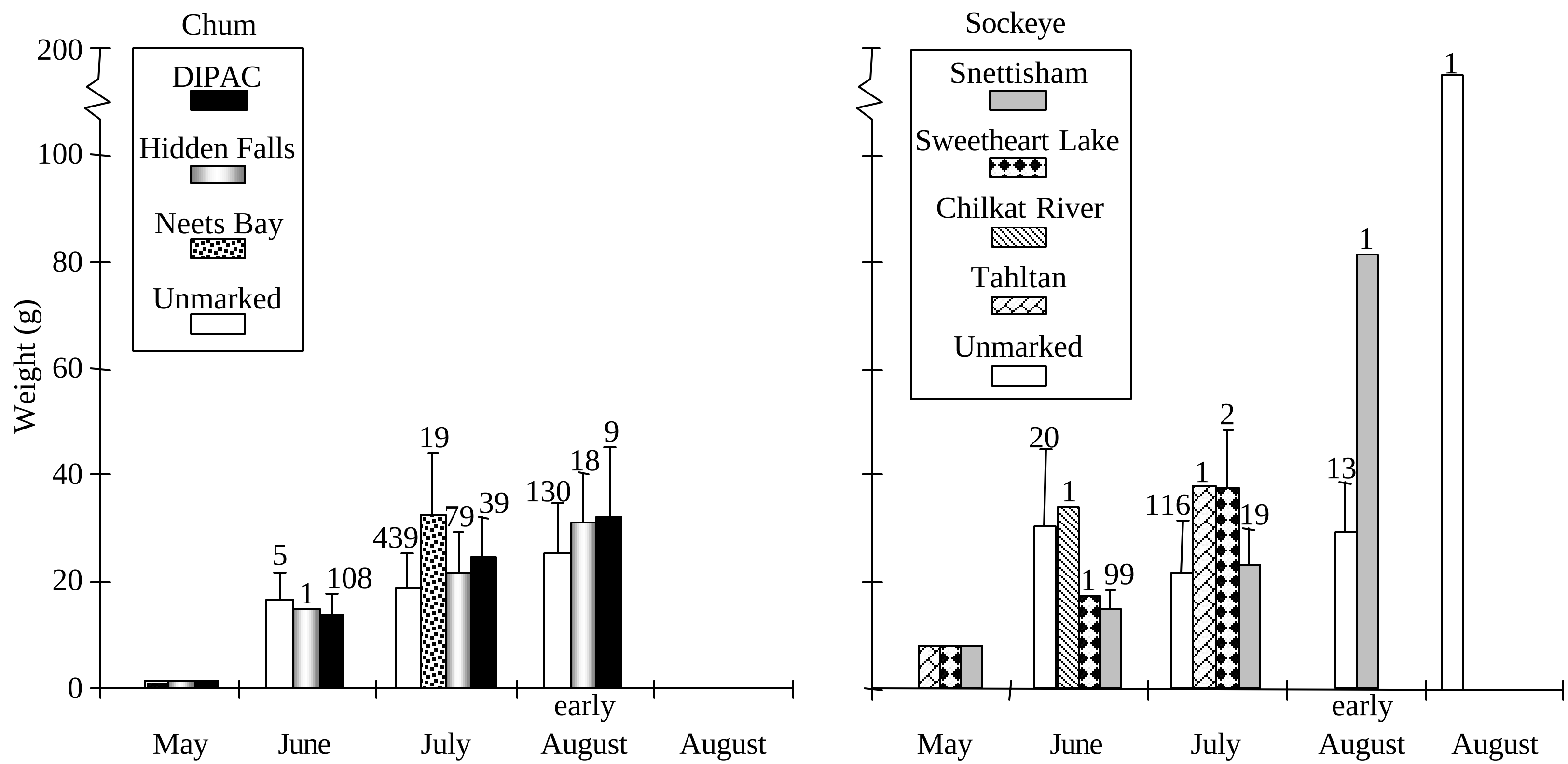

Figure 13.—Stock-specific growth trajectories of juvenile chum and sockeye salmon captured in marine waters of the northern region of southeastern Alaska by rope trawl, June–August 2003. Weight of May fish are mean values at time of hatchery release. The sample sizes and the standard deviation are indicated above each bar.

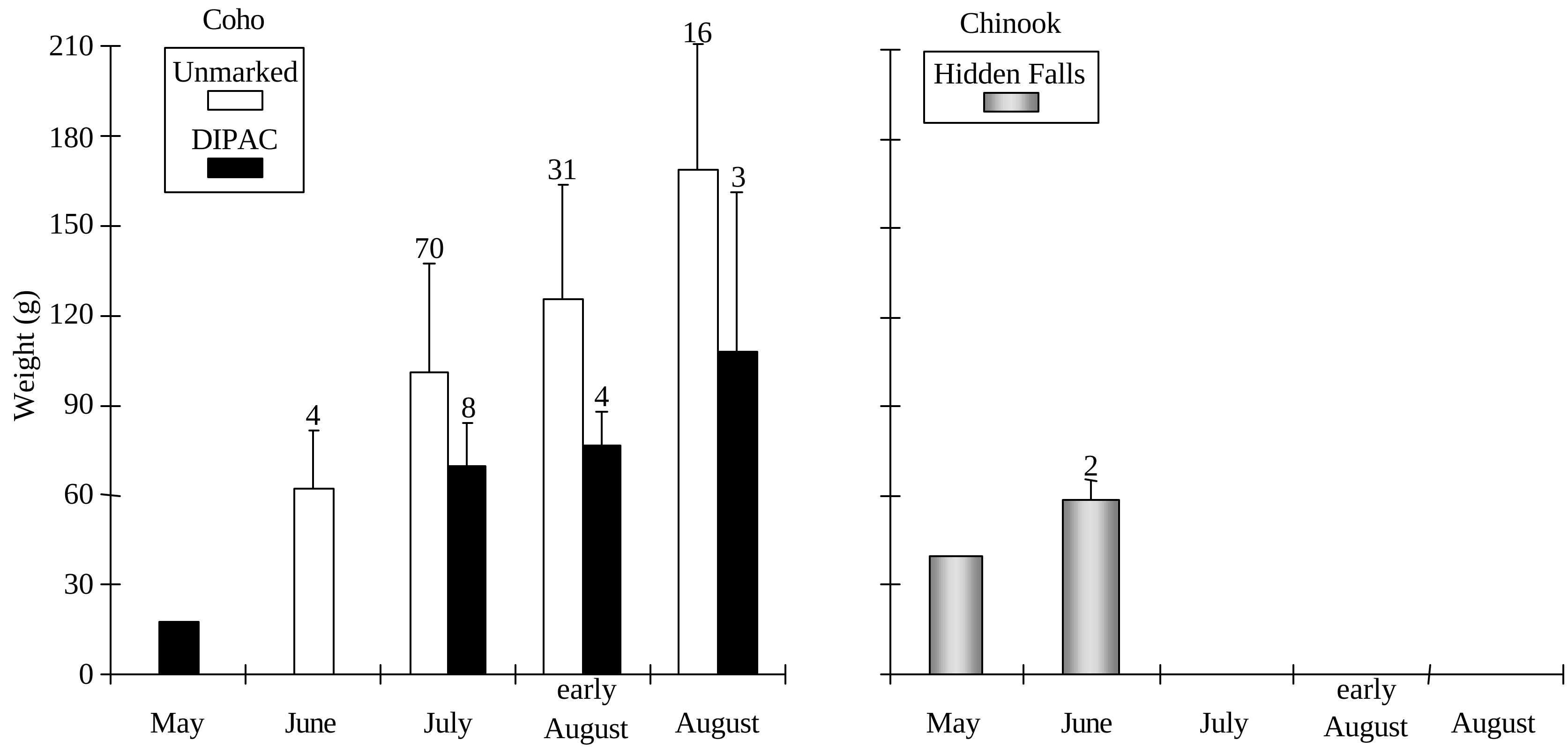

Figure 14.—Stock-specific growth trajectories of juvenile coho and chinook salmon captured in marine waters of the northern region of southeastern Alaska by rope trawl, June–August 2003. Weight of May fish are mean values at time of hatchery release. The sample sizes and the standard deviation are indicated above each bar.

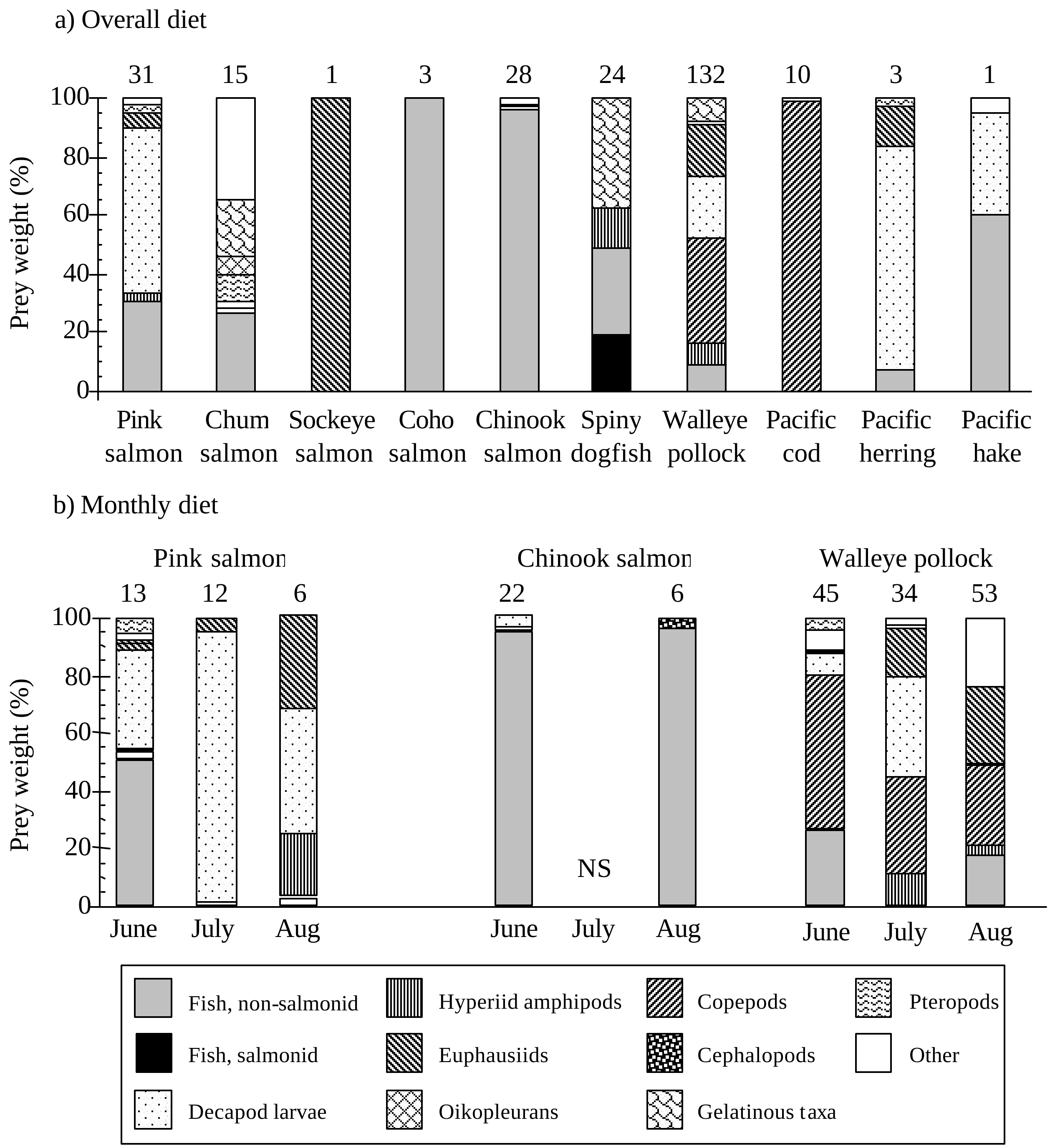

Figure 15.—Prey composition of potential salmon predator species captured in marine habitats of the northern region of southeastern Alaska by rope trawl, June–August 2003, pooled a) annually, and b) monthly (where sufficient specimens). See also Table 19 for feeding rates. The numbers of fish examined are shown above the bars.