

**Integrated Pelagic Ecosystem Surveys on the
Vancouver Island Continental Shelf,
July 7 - August 2, 2017 and
July 5 - July 29, 2018**

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ON THE VANCOUVER ISLAND CONTINENTAL SHELF,
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by

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Abstract

King, J., J.L. Boldt, H. Dennis-Bohm, T. Zubkowski, E. Anderson, L. Flostrand and S. Tucker.
2019. Integrated Pelagic Ecosystem Surveys on the Vancouver Island Continental Shelf,
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Fisheries and Oceans Canada (DFO) mandates and policies require the development and application of an ecosystem based approach to fisheries management as well as cumulative risk assessments. Required to meet these mandates is a comprehensive understanding of factors that affect the distribution and abundance of fish and prey species, trophic structure, predator-prey dynamics, and species interdependencies. The Integrated Pelagic Ecosystem Survey (IPES) is the only broad-scale pelagic ecosystem survey in the Pacific Region that collects this type of information. The goal of the IPES survey is to understand factors affecting the distribution, abundance, and food web linkages of pelagic fish species, such as Pacific Herring and juvenile Pacific Salmon. To accomplish this goal, we conducted a random stratified survey with 8 strata on the north and west continental shelf of Vancouver Island during 2017 and 2018. The IPES survey provides comprehensive biological sampling and stomach analyses of all caught species, along with physical and biological oceanographic sampling. The survey produces data required for ecosystem monitoring and modelling, data for SARA-listed species, and supports both DFO's State of the Pacific Ocean reporting and the State of the Salmon program. This report summarizes the IPES survey design, methods, and results from the 2017 and 2018 surveys. The majority of sample catch weight per unit effort (CPUE) in both years comprised Pacific Herring, Coho Salmon, Chum Salmon, and Chinook Salmon. Depending on year, other dominant species included: Rockfishes (namely young of year), Northern Anchovy, North Pacific Spiny Dogfish, and Pacific Hake. Pacific Herring dominated biomass estimates in both years and Chum Salmon and Coho Salmon comprised the largest biomass of juvenile salmon species in 2017 and 2018, respectively. The dominant invertebrate CPUEs comprised Water Jellyfish and Pyrosomes; 2017 was the first time Pyrosomes were observed in BC waters. Fish diet analyses indicated that the most common prey items were Euphausiids, fish, and crab larvae. Data generated from the survey supports research into linkages between oceanographic conditions and fish abundance or community composition, Pacific Salmon and other fish ocean ecology, forecasting adult fish returns, and food-web dynamics.

Résumé

King, J., J.L. Boldt, H. Dennis-Bohm, T. Zubkowski, E. Anderson, L. Flostrand and S. Tucker. 2019. Integrated Pelagic Ecosystem Surveys on the Vancouver Island Continental Shelf, July 7 - August 2, 2017 and July 5 - July 29, 2018. Can. Tech. Rep. Fish. Aquat. Sci. 3318: xi + 115 p.

Les mandats et les politiques de Pêches et Océans Canada (MPO) exigent l'élaboration et l'application d'une approche écosystémique de la gestion des pêches ainsi que des évaluations des risques cumulatifs. Pour remplir ces mandats, il est nécessaire de bien comprendre les facteurs qui influent sur la répartition et l'abondance des poissons et des proies, la structure trophique, la dynamique prédateur-proie et les interdépendances des espèces. Les relevés intégrés des écosystèmes pélagiques (RIEP) sont la seule étude à grande échelle de l'écosystème pélagique dans la région du Pacifique qui recueille ce type d'information. Le but des RIEP est de comprendre les facteurs ayant une incidence sur la distribution, l'abondance et les liens du réseau trophique des espèces de poissons pélagiques, comme le hareng du Pacifique et le saumon du Pacifique jeune. Pour atteindre cet objectif, nous avons effectué un relevé aléatoire stratifié de huit strates sur le plateau continental nord et ouest de l'île de Vancouver en 2017 et 2018. Les RIEP fournissent des échantillonnages biologiques complets et des analyses d'estomac de toutes les espèces capturées, ainsi que des échantillonnages océanographiques physiques et biologiques. Ils génèrent les données nécessaires à la surveillance et à la modélisation de l'écosystème, les données sur les espèces inscrites sur la liste de la LEP et appuient les rapports du MPO sur l'état de l'océan Pacifique et le programme sur l'état du saumon. Le présent rapport résume la conception, les méthodes et les résultats des RIEP de 2017 et 2018. Pendant les deux années, la majorité des échantillons de prises par unité d'effort (PUE) comprenaient du hareng du Pacifique, du saumon coho, du saumon kéta et du saumon quinnat. Selon l'année, d'autres espèces dominantes ont été relevées, notamment du sébaste (à savoir, jeune de l'année), des anchois du Pacifique Nord, de l'aiguillat commun du Pacifique Nord et du merlu du Pacifique. Le hareng du Pacifique a dominé les estimations de la biomasse au cours des deux années; le saumon kéta et le saumon coho constituaient la plus grande biomasse de jeunes saumons en 2017 et 2018, respectivement. Les prises PUE d'invertébrés dominants comprenaient des méduses et des pyrosomes; en 2017, c'était la première fois que des pyrosomes étaient observés dans les eaux de la Colombie-Britannique. Les analyses du régime alimentaire des poissons ont indiqué que les proies les plus courantes étaient les euphausiacés, les poissons et les larves de crabe. Les données générées par les relevés appuient la recherche sur les liens entre les conditions océanographiques et l'abondance ou la composition des communautés de poissons, le saumon du Pacifique et d'autres espèces de poissons, la prévision des montaisons de poissons adultes et la dynamique de la chaîne alimentaire.

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Introduction

The Vancouver Island (VI) continental shelf (< 200 m) is a productive ecosystem found off the island's west and north coasts from Juan de Fuca Strait in the south, northward through the Scott Islands and eastward to include southern Queen Charlotte Sound (QCS, Figure 1). Off the west coast, the continental shelf ecosystem is the northern extent of the California Current upwelling system, with a typical northern boundary around Brooks Peninsula (Figure 1). The ecosystem supports important pelagic Indigenous, commercial, and recreational fisheries, namely for Pacific Salmon (*Oncorhynchus* spp.) and Pacific Herring (*Clupea pallasi*).

The region has been a focus for pelagic fish research surveys for decades. Most notable are the Pacific Sardine (*Sardinops sagax*) ecology trawl surveys conducted in July/August from 1997-2010, juvenile Pacific Salmon trawl surveys conducted in June/July 1998-2015, the nighttime pelagic ecosystem trawl survey 2010-2014 and the La Perouse acoustic-trawl pelagic fish and ecosystem survey conducted during 2011-2015. The Pacific Sardine ecology trawl survey conducted sub-surface trawls (15 m headrope depths) along transects during the daytime from 1997-2005, then during the nighttime from 2006 to 2009. In 2010, the survey was redesigned as a nighttime pelagic ecosystem survey, with nighttime surface (4 m headrope depths) trawling using a random stratified survey design instead of transects. The juvenile Pacific Salmon surveys conducted daytime surface trawling (0 m, 15 m and 30 m headrope depths) along transects. The La Perouse acoustic-trawl survey included the collection of acoustic data along parallel transects in a core survey area; acoustic echosign was verified using a midwater trawl net and cameras to collect biological samples.

The DFO Pelagic Integrated Ecosystem Science (PIES) team was formed to address challenges and implement collaborative monitoring and integrated research plans on pelagic ecosystems in British Columbia (BC). Challenges included limited resources and vessel time; therefore, one recommendation was to combine multiple surveys while addressing all survey goals and objectives. The three above-mentioned surveys were integrated into the Integrated Pelagic Ecosystem Survey (IPES), initiated in July 2017, and repeated in July 2018. The nighttime pelagic ecosystem and the juvenile Pacific Salmon surveys have been integrated and the La Perouse acoustic-trawl survey has been partly integrated. The three surveys previously deployed the same trawl gear, with some overlaps in survey timing and locations that provided an opportunity for collaborative research. The goal of the IPES survey is to understand factors affecting the distribution, abundance, and food web linkages of pelagic fish species, such as juvenile Pacific Salmon and Pacific Herring. To accomplish this goal, specific objectives of the survey are to: 1) examine species distribution, composition, and abundance; 2) collect morphometric data, diet data, and biological samples; 3) examine the prey environment by sampling zooplankton (vertical bongo net hauls) and conducting oceanographic monitoring (temperature, salinity, fluorescence). The IPES is currently the only broad-scale pelagic ecosystem survey in the Pacific Region, providing comprehensive biological sampling and stomach analyses of all caught species, along with physical and biological oceanographic sampling. The survey produces data required for ecosystem monitoring and modelling, data for SARA-listed species (e.g., Tope Sharks, *Galeorhinus galeus*), and supports State of the Pacific Ocean reporting and the State of the Salmon program of DFO. Data generated from the survey supports research into linkages between oceanographic conditions and fish abundance or community composition, Pacific Salmon ocean ecology and forecasting adult returns and trophic-level dynamics. The objectives of this report are

to summarize methods used and data collected during the 2017 and 2018 IPES surveys to address research goals.

Methods

Survey Area and Design

The survey was conducted on the continental shelf, west and north of Vancouver Island, between the 50 and 200 m isobaths (Figure 1).

Available data for planning purposes

Catch data from summer juvenile Pacific Salmon surveys (Jackie King, unpublished data), nighttime pelagic ecosystem surveys (Linnea Flostrand, unpublished data) and daytime acoustic-trawl pelagic ecosystem surveys (Jennifer Boldt, unpublished data) provided insight into the expected species composition in surface and 15 m trawl tows and provided guidance in selection of appropriate strata. In addition, the DFO zooplankton database (Moira Galbraith, Institute of Ocean Sciences, Sidney, BC, unpublished data) provided insight into possible ecosystem distinctions between northern VI and WCVI.

Survey strata and blocks

A random, stratified survey design was used. The survey area was divided into 8 distinct strata, based on bathymetry (50-100; 100-200 m) and known ecosystem distinctions (as noted above) (Figure 1). The survey area was divided into a contiguous grid of 4 km² blocks, representing possible trawl tow locations. For each survey year, random blocks were selected within each stratum, with the number of blocks based on stratum area so that the total number of blocks was about 70 (i.e. the estimated total number of stations that could be completed given the number of fishing days available) (Table 1, Table 2). Within a stratum, an equal number of tows with the headrope at 0 m (surface) and at 15 m were selected. The total number of blocks to be selected was estimated by the number of total fishing days available and assuming 6 tows per day.

Vessel and Fishing Gear

2017

The fishing vessel for the 2017 survey was the M.V. Sea Crest, a 24 m stern trawler. Mid-water trawl tows were conducted using a three-bridle CanTrawl 250 net (CanTrawl Pacific Ltd., Richmond, BC; Appendix Table A - 1, Appendix Figure A - 1) with a codend liner. The midwater trawl is made up of the four following sections: 1) a heavy-duty front end of hexagonal web of 3/8 inch (9.5 mm) and 5/16 inch (7.9 mm) Tenex rope; 2) a tapered body with 64 inch (163 cm), 32 inch (81.3 cm), 16 inch (40.6 cm), 8 inch (20.3 cm), and 4 inch (10.2 cm) polypropylene sections; 3) an intermediate section of 3 inch (7.6 cm) polypropylene; and 4) a codend of 1.5 inch (3.8 cm) knotted nylon, lined with ½ inch (12.7 mm) stretched mesh insert. The net was connected to Thyboron Type 15 4.5 m² mid-water doors each weighing 583 kg. The vessel was equipped with a Marport Trawl System and Marport Trawleye that provided realtime

doorspread, headline depth and net opening values.

2018

In 2018, the survey was conducted on the *M.V. Nordic Pearl*, a 35 m stern trawler. Tows were conducted with a two-bridle LFS 7742 mid-water trawl net (LFS Net Systems, Bellingham, USA; Appendix Table A - 2, Appendix Figure A - 2) with a codend liner. The front end consists of a 252 foot headline of 5/8 inch coated spectra rope. The next section is diamond mesh 512 inch of 13 mm, and 10 mm synthetic rope. A tapered body of 256 inch, 128 inch, 64 inch, 32 inch, 16 inch, 8 inch, and 4 inch. The intermediate section of the net is 4 in mesh with 1 in-8 strand riblines. The cod end is 4 inch web with a ½ inch (12.7 mm) stretched mesh insert. The net was connected to Thyboron Type 15 4 m² mid-water doors each weighing 340 kg. The vessel was equipped with a Scanmar Trawl Sensor system to provide realtime doorspread values and a Scanmar Trawleye to provide realtime headline depth and net opening values.

Fishing Operations

Time and duration of tows

To provide a continuous time series for both the former juvenile Pacific Salmon survey (fishing conducted during daytime hours) and the former nighttime pelagic ecosystem survey (fishing conducted during nighttime hours), each selected block was fished once during daytime hours and a second time during nighttime hours. Fishing operations began at approximately 16:00 and ended at approximately 04:00 the following day. The net was towed at 4 to 5 knots for a target duration of 20 minutes (with a minimum acceptable tow duration of 15 minutes). The start time and location of the tow was recorded when the doors were locked, and the end time and location when the retrieval of the doors was initiated.

Other data recorded during tows

Vessel speed, direction, bottom depth, weather conditions (Appendix Table B - 1), vertical net opening, and trawl door spread were recorded for each tow. A RBR concerto data logger (RBR Ltd, Ottawa, ON) recording conductivity, temperature, depth, salinity and dissolved oxygen at 1 second intervals (1 Hz), was mounted inside a protective housing and attached via a mesh bag to the top of the trawl net behind the center of the headrope. In addition, two RBRduet data loggers (RBR Ltd., Ottawa, ON) recording depth at 30 second intervals (0.033 Hz) were also mounted inside protective housings with one attached to the center of the headrope and one attached to the center of the footrope using stainless steel shackles. These sensors were attached to the net by the deck crew at the start of each day, and retrieved by the crew at the end of the day for downloading by science crew. The vertical net opening was calculated from the difference in the head rope and foot rope depth sensors after the doors were locked. The horizontal net opening was calculated from the door spread and the net dimensions (Appendix A) using trigonometry.

Acoustic Transects

In 2018, continuous acoustic data were collected and recorded during daylight hours when fishing was not occurring (i.e., between approximately 06:30 and 15:00). Acoustic data were collected with a SIMRAD EK60 scientific echo sounder operating at 38 kHz and 120 kHz. Data

were collected along predetermined parallel transects, which were selected based on DFO's biennial Pacific Hake survey and spaced 10 nautical miles apart (Figure 2). Data were collected from the 50 m to the 200 m isobath, or deeper if time allowed. Although there were no trawl tows conducted to verify species composition of the echosign, the echosign patterns and trawl catches from this randomized survey were used to determine the spatial distribution of euphausiids, coastal pelagic fish (primarily Pacific Herring), and Pacific Hake. Previous surveys have validated echosigns for these three taxonomic groupings.

Oceanographic Data

Within each selected block, a vertical conductivity-temperature-depth (CTD) cast was conducted with a Seabird SBE 25 CTD profiler (Sea-Bird Scientific, Seattle, USA) to 250 m or to within 10 m of the bottom. One CTD cast was conducted per block. In addition seawater samples for nitrate, phosphate, and silicate were collected with a Niskin bottle at 10 m from the surface, placed in acid-washed glass test tubes and frozen. Seawater for chlorophyll a (*chl* a) estimation were filtered with GF/F glass fibre filter disks. Filter disks were then placed in polypropylene scintillation vials and frozen. Seawater and *chl* a samples were sent for analyses at DFO's Institute of Ocean Sciences, Sidney, BC.

Zooplankton Sampling

Within each selected block, vertical zooplankton tows were conducted to approximately 250 m or within 10 m of the bottom with two paired 60 cm diameter, 253 μm Nitex zooplankton nets mounted in a bongo-drum style black frame. Zooplankton tows were conducted immediately following the CTD cast. A RBRsolo data logger (RBR Ltd., Ottawa, ON) collecting depth was mounted inside a protective housing and attached to the bongo frame at the start of each survey, and retrieved at the end of each survey for downloading. Zooplankton collected from the flow meter-side net were preserved in 10% formalin and sent to the zooplankton laboratory at DFO's Institute of Ocean Sciences, for species classification and enumeration. Zooplankton collected from the net without the flowmeter were sorted into four size fractions by successively sieving through 8.0, 1.7, 1.0, and 0.25 mm screens. Each size fraction was individually frozen in a pre-weighed Ziploc bag for future stable isotopes, bomb calorimetry, and proximate analyses.

Catch Processing

At the end of each trawl, the net was retrieved and the catch dumped into a: 1) sorting table on the aft-deck for sorting on deck, in 2017; or 2) hopper in the fish processing lab for sorting on a conveyor belt, in 2018. Large catches were randomly subsampled prior to sorting. The catch was sorted to the lowest taxonomic group possible. Juvenile Pacific Salmon (<300 mm total length) were recorded separately from adult Pacific Salmon. The total catch (or the subsample) of each species or taxonomic group, was weighed to the nearest 0.1 kg using a large capacity, motion-compensating electronic balance (Marel Model M1100, 60 kg capacity). For catches of a species or taxonomic group which totalled less than 0.01 kg, "trace" weight was recorded. Where practical, the number of individuals was recorded. In 2017, catch volumes and weights of jellyfish species were recorded; in 2018, only catch weights were recorded (catch weights and volumes were significantly correlated; therefore, it was not necessary to collect both).

Biological Sampling

Time permitting, all fish species captured were measured for length (nearest mm) and weight (nearest 0.01 g) if the specimen was large enough to be accurately weighed using a benchtop electronic scale (Marel Model M1100, 3 kg capacity) and stomach contents recorded. For each species, a target number of 50 randomly selected specimens per tow were sampled, with 10 random specimens selected for stomach content analyses. If the catch count was less than the target number, all specimens in that tow were sampled. Additional biological sampling occurred for Pacific Salmon, Pacific Herring, Pacific Sardines and Eulachon (*Thaleichthys pacificus*), as outlined below. When collected, tissue for genetic stock identification was stored on Whatman paper. All sharks were sampled as per DFO survey sampling protocol (Appendix D). In 2017, the bell diameter (nearest mm) of intact jellyfish specimens was recorded.

Pacific Salmon

Biological sampling was done separately for juvenile and adult Pacific Salmon. In 2017, the target number of juvenile or adult Pacific Salmon specimens per tow was 30; in 2018, this number was reduced to 10, with an additional 20 specimens with only length and weight recorded. Full biological samples included: measuring fork length and weight, collecting otoliths, taking a caudal fin clip for genetic stock identification, noting if the adipose fin was clipped (denoting hatchery released fish), retaining heads if a coded wire tag (CWT, denoting hatchery released fish) was detected with a CWT wand, analyzing stomach contents, collecting whole body or muscle tissue (as per below).

Pacific Herring

The target number of specimens per tow was 100. An additional 100 specimens were frozen for subsequent length and weight measurements and scale collections for age determination in the laboratory. On the vessel, full biological samples included: measuring standard length and weight, analyzing stomach contents, and collecting whole body or muscle tissue (as per below).

Pacific Sardine

The target number of specimens per tow was 100. Full biological samples included measuring fork length and weight, sex and maturity stage determination (Appendix Table C - 1). An additional 100 specimens were to be frozen for laboratory stomach analyses. No stomachs were sampled at sea, therefore if catches of Pacific Sardines were less than the target number, all specimens were frozen for laboratory analyses.

Eulachon

The target number of specimens per tow was 50. Full biological sampling included measuring standard length and weight, collecting a caudal fin clip for genetic stock identification, analyzing stomach contents, and collecting whole body or muscle tissue (as per below).

Other fish

For all other species, the target number of specimens per tow was 50. Full biological sampling included measuring length (standard for smelt species, fork or total for other species) and weight, analyzing stomach contents, and collecting whole body or muscle tissue (as per below).

Stomach Contents Sampling

Stomach contents were analyzed for the first 10 random specimens or for all specimens for catches with fewer than 10 individuals. The target sample size for stomachs analysed per species per stratum was 30. Stomach content sampling followed the recommended at-sea protocol for DFO Pacific Region surveys (King et al., 2018):

1. The stomach was removed from the anterior end of the oesophagus to the pyloric sphincter.
2. Empty stomachs were identified and recorded.
3. Any specimens with everted, regurgitated stomachs, or in-net feeding were identified, recorded and rejected for further sampling.
4. The bolus was removed from pyloric and cardiac parts of the stomach to petri dish and prey taxa were sorted.
5. Prey were identified to lowest taxonomic level that the sampler was comfortable with using their naked eye or a hand lens.
6. The volume of prey categories were measured to the nearest 0.1 cm³ using a volume measuring tool made of plexiglass (see Figure 5, King et al. 2018). The tool has a ruler (mm) embedded on one side of a trench that is 1 cm wide and 1 cm deep. Prey items were placed in the trench, and packed such that they filled the trench evenly and did not extend past 1 cm high. Once packed, the volume (cm³) was measured as the length along the ruler and recorded.
7. Digestion state for each prey category was estimated. In 2017, five digestion states were used (0%, 25%, 50%, 75% and 100% digested). In 2018, this was simplified to Fresh, Partial, or Well digested as per King et al. (2018).

Once stomach contents were enumerated, the empty stomach was replaced back in the fish body. Up to five whole bodies per tow were frozen for future energy density estimation, after which, if there were additional specimens, muscle tissue was frozen for future stable isotope analyses.

Biomass Estimates

Design-based biomass estimates were produced for each juvenile Pacific Salmon species (based on daytime fishing events) and for Pacific Herring (based on nighttime fishing events). The annual biomass estimate (B) is the sum of the product of catch per unit effort densities (CPUE; kg·km⁻³) and the volume (km³) of each stratum across m strata:

$$B = \sum_{i=1}^m V_i \delta_i \quad (\text{Eqn. 1})$$

where δ_i is the mean CPUE density ($\text{kg}\cdot\text{km}^{-3}$) for stratum i

V_i is the volume (km^3) of the upper 30 m of stratum i

and m is the number of strata.

Individual CPUE values were adjusted for catchability, prior to analysis. Catchability for juvenile Pacific Salmon was assumed to be 0.4 (Volvenko, 2003) and 1.0 for Pacific Herring. When calculating CPUE, if net opening data were not available, the survey mean width (m) or height (m) was used instead. Variance of the annual biomass estimate was estimated as per Thompson (1992):

$$\sigma^2 = \sum_{i=1}^m V_i (V_i - v_i) \frac{s^2}{n_i} \quad (\text{Eqn. 2})$$

where V_i is the volume (km^3) of the upper 30 m of stratum i

v_i is the total swept volume (km^3) of tows in stratum i

n_i is the total number of tows in stratum i

s^2 is the sample variance of δ_i from stratum i

and m is the number of strata.

Results

Fishing Operations

2017

The survey was divided into two 14 day legs: July 7 – 19; and July 19 – August 2. We conducted a total of 106 tows, of which 103 were useable. On average, we were able to conduct about 6 tows per day. There were three and a half days with bad weather that prevented fishing and oceanographic sampling. During the daytime on July 25, high swells prevented CTD casts and bongo tows from being conducted even though fishing was useable. In total there were 21 fishing days. Bridge log data collected for each tow are contained in Appendix Table E - 1.

A total of 53 survey blocks were successfully fished during the day, and 50 during the night (Table 1, Figure 3). Rough weather precluded all blocks being fished in both day and night, but a minimum of 50 blocks were fished successfully during each period. Fishing effort was distributed across strata such that the proportion of successful tows was within $\pm 4\%$ of each stratum's target proportion (Table 1).

2018

The survey was divided into two legs of 13 days each: July 5-17; and July 17-29. There were five and a half days with bad weather that prevented fishing and oceanographic sampling. In total there were 22 fishing days. We conducted a total of 98 tows, of which

97 were useable. As with 2017, we were able to conduct, on average, about 6 tows per day. Bridge log data for each tow are contained in Appendix Table E - 2.

A total of 51 survey blocks were successfully fished during the day, and 46 during the night (Table 2, Figure 3). Rough weather precluded all blocks being fished in both day and night, but a minimum of 46 blocks were fished successfully during each period. Fishing effort was distributed across strata such that the proportion of successful tows was within $\pm 3\%$ of each stratum's target proportion (Table 2).

Gear Sensors

Data from the trawl systems were collected throughout the surveys, but the data were of poor quality; data collection appeared sporadic and there were many spurious values mainly associated with turbulence while trawling at the surface. Doorspread and net opening data, where available, are in Appendix Table E - 1 and Appendix Table E - 2.

Acoustic Transects

In 2018, during daylight hours, acoustic backscatter, attributed to coastal pelagic species (primarily Pacific Herring), was observed in areas where Pacific Hake were absent (Boldt et al. 2019). Areas of higher coastal pelagics backscatter were located off the north, central and southwest coasts of Vancouver Island. Echosign attributed to Pacific Hake tended to be distributed in the offshore portions of the survey area. The spatial distribution of the Euphausiid-like echosign was similar to that attributed to Pacific Hake (Boldt et al. 2019).

Oceanographic Data

Oceanographic data from CTD casts, including Niskin bottle samples for nitrate, phosphate, silicate, and chlorophyll a, were processed, analyzed, and archived in the Ocean Sciences Data Inventory at the Institute of Ocean Sciences. In 2017, CTD casts and Niskin bottle sampling were completed in 51 blocks (Appendix Table E - 3) representing 91% of the blocks that were successfully fished either during the day or the night. The depth of CTD casts ranged from 35 – 155 m (Appendix Table E - 3). In 2018, CTD casts and Niskin bottle sampling were conducted in 47 blocks (90% of the blocks that were successfully fished either during the day or the night), with depths of CTD casts ranging from 35 – 205 m (Appendix Table E - 4).

Zooplankton Samples

In 2017, vertical zooplankton tows were completed in the same 51 blocks that CTD casts were completed (Appendix Table E - 3). However, in 2018 rough weather precluded the deployment of the bongo nets, and as such, vertical zooplankton tows were conducted in only 43 blocks (Appendix Table E - 4). In 2017, vertical zooplankton tows were completed from depths ranging from 35-155 m (Appendix Table E - 3); in 2018 the starting depths ranged from 35-200 m (Appendix Table E - 4). Formalin-preserved zooplankton samples are being enumerated at the Institute of Ocean Sciences and data will be archived in the DFO zooplankton database. Frozen zooplankton samples are being processed at the Pacific Biological Station and results are not reported here.

Catch Composition

2017

Catch composition for each tow is presented in Appendix Table E - 5. Sixty-four species or taxonomic groups were identified, of which 47 were vertebrates and 17 were invertebrates (Table 3). The mean catch weight per tow was 145 kg, with catches ranging from 0 – 2,302 kg for each usable tow (Appendix Table E - 5). The total catch for the survey from usable tows was 15, 406 kg (Table 3).

For each species captured during the survey, the number of tows in which the species occurred, total catch weight, maximum catch weight, and mean catch weight per tow for usable tows is presented in Table 3. Pacific herring dominated much of the survey catch; approximately 69% of the total survey catch (Table 3). Approximately 63% of the remaining catch was comprised of four species or groups (in relative order of contribution), including two invertebrates: Water Jellyfish (*Aequorea* spp.), Rockfishes (*Sebastes* spp.; namely unidentified young of year), Northern Anchovy (*Engraulis mordax*), and Pyrosomes (*Pyrosoma atlanticum*) (Table 3). After Pacific Herring, the top five fish species by catch weight were Rockfishes, Northern Anchovy, Coho Salmon, Chum Salmon and Chinook Salmon (Table 3). However, Northern Anchovy was not frequently encountered, only two tows captured this species, one of which was the majority of the species' total catch weight. Water Jellyfish were the most frequently encountered species, occurring in 76% of the useable tows (Table 3). Other invertebrates encountered in about half of the tows were Pyrosomes, and Fried Egg Jellyfish (*Phacellophora camtschatica*) (Table 3). Codfishes (*Gadidae*, namely unidentified young of year), Pacific Herring, Rockfishes, Coho Salmon, Chinook Salmon and Chum Salmon were the most frequently encountered fish species, all of which were captured in at least 25% of the tows (Table 3).

2018

Catch composition for each tow is presented in Appendix Table E - 6. Fifty-nine species or taxonomic groups were identified, of which 43 were vertebrates and 16 were invertebrates (Table 4). The mean catch weight per tow was 51 kg, with catches ranging from 0 - 1,024 kg for each usable tow (Appendix Table E - 6). The total catch for the survey from usable tows was 13, 140 kg (Table 4).

For each species captured during the survey, the number of tows in which the species occurred, total catch weight, maximum catch weight, and mean catch weight per tow for usable tows is presented in Table 3. Pacific Herring and North Pacific Spiny Dogfish (*Squalus suckleyii*) dominated the catch as 42% and 41% of the total survey catch respectively. However, North Pacific Spiny Dogfish was only encountered in 8% of the useable tows (Table 4), and the majority of the species' total catch weight was captured in two consecutive tows, one of 1,575 and the other of 3,800 kg (Appendix Table E - 6). Approximately 64% of the remaining catch was comprised of four species or groups (in relative order of contribution): Euphausiids, Coho Salmon, Water Jellyfish (*Aequorea* spp.), and Pacific Hake (*Merluccius productus*) (Table 4). After Pacific Herring and North Pacific Spiny Dogfish, the top five fish species by catch weight were Coho Salmon, Pacific Hake, Chinook Salmon, Sockeye Salmon and Chum Salmon (Table 4). Moon Jellyfish (*Aurelia labiate*), Water Jellyfish and Pyrosomes were the most frequently encountered species, each occurring in 54% of the useable tows (Table 4). Pacific Herring, Coho Salmon,

Chinook Salmon, Codfishes (namely unidentified young of year), Flatfishes (namely unidentified young of year), and Black Rockfish (*Sebastes melanops*) were the most frequently encountered fish species, all of which were captured in at least 25% of the tows (Table 4).

Biological Samples

Samples

2017

A total of 352 biological samples were collected from 40 species, which included 7,886 individual specimens (Table 5). Sample size, statistics of length and weight are presented in Table 5 for each species sampled.

2018

A total of 336 biological samples were collected from 34 species, which included 6,220 individual specimens (Table 6). Sample size, statistics of length and weight are presented in Table 6 for each species sampled.

Length and weight

Length frequencies and length-weight relationships are presented for species where at least 100 specimens were measured in survey years (Figure 4 to Figure 19). Length frequency plots for Pacific Salmon (Figure 5, Figure 6, Figure 8, Figure 15 and Figure 18) illustrate that this survey encounters both juveniles (<300 mm) and adults, with a higher proportion of juvenile specimens. Based on lengths, three or four size classes of Pacific Herring are sampled by this survey; however, this does not imply the same number of age classes, since there is overlap in lengths among age classes (Figure 14). The catches of unidentified Codfishes (Figure 7) and Rockfishes (Figure 17) and most Black Rockfish (Figure 4) comprised fish < 100 mm (i.e. young of year). In 2017, the high catch of Northern Anchovy (Figure 10) comprised specimens approximately 150 mm in length. In 2018, the Eulachon specimens were dominated by specimens < 150 mm (likely immature; Figure 9). Two dominate size classes of Pacific Hake were evident in survey catches, corresponding to juvenile and adult size ranges (Figure 13)

Double log-transformed length-weight regressions are shown for fish species, where more than 100 individuals were measured in a survey year (Figure 3). Generally, for Pacific Salmon species, the coefficients (slopes and intercepts) of the regressions were similar between 2017 and 2018. In 2018, there was more variability in Pacific Herring lengths for a given weight compared to 2017. Pacific Herring were also generally heavier for a given length (i.e., in better condition) in 2018 compared to 2017.

Stomach Content Samples

2017

In 2017, a total of 938 stomach specimens were processed at sea from 17 species (Table 7). Of the stomachs examined, on average almost 25% were empty (Table 7). We were able to obtain stomach samples from at least 13 tows for Pacific Salmon and Pacific Herring with sample sizes of 394 and 396 specimens respectively (Table 7). These species were present in the highest number of tows for the survey; the number of tows with stomach analyses represented over 85% and 50% of the tows in which Pacific Salmon or Pacific Herring respectively were captured. We were unable to process young of year Codfishes or Rockfishes at sea, and retained samples for laboratory processing.

2018

In 2018, a total of 1,173 stomach specimens were processed at sea from 18 species (Table 7). Of the stomachs examined, on average almost 29% were empty (Table 7). We were able to obtain stomach samples for the species that occurred in at least 14% of the survey tows: Pacific Salmon, Pacific Herring, Pacific Hake, Eulachon and Wolf Eel (*Anarrhichthys ocellatus*). For these species, the stomach sampling occurred in at least half of the tows that they were captured in. We were able to obtain stomach samples from at least 13 tows for Pacific Salmon and Pacific Herring with sample sizes of 548 and 290 specimens respectively (Table 7). We were unable to process young of year Codfishes or Rockfishes at sea, and retained samples for laboratory processing.

Diet Summaries

2017

Detailed stomach contents for each predator species are presented in Table 8. Unidentifiable prey items, which are generally items too digested to retain identifiable features, were recorded in 34% of the stomachs examined (Table 8). Based on stomachs that contained prey, the most frequently consumed prey item among predators were Euphausiids (in 46% of the stomachs examined), teleosts (21%) and crab larvae (13%) (Table 8). Most teleost prey were unidentifiable to species (54%), but the most frequently occurring species was young of year Rockfishes (24%), Pacific Herring (18%), with small amounts of Flatfishes (2%) (Table 8).

2018

Detailed stomach contents for each predator species are presented in Table 8. Unidentifiable prey items were recorded in 24% of the stomachs examined (Table 8). As in 2017, the most frequently consumed prey item across predators were Euphausiids (in 50% of the stomachs examined), teleosts (27%) and crab larvae (13%) (Table 8). Most teleosts prey were unidentifiable to species (46%), but the most frequently occurring species was Pacific Herring (38%), with small amounts of young of year Rockfishes (7%) and Pacific Sand Lance (*Ammodytes hexapterus*, 4%) (Table 8).

Biomass Estimates

2017

Biomass estimates based on day time tows only indicate that Chum Salmon was the most abundant juvenile Pacific Salmon in the upper 30 m of the Vancouver continental shelf, with an estimated 128 tonnes, followed by Coho Salmon with an estimated 79 tonnes (Table 9).

Juvenile Pink Salmon, were exceptionally low in abundance in 2017, with a biomass estimate of only 0.3 tonnes (Table 9), reflecting the cyclical nature of Pink Salmon production. Biomass estimates for both juvenile Chinook Salmon and Sockeye Salmon were less than 10 tonnes (10 and 2 tonnes respectively [Table 9]). Pacific Herring was the dominate fish species captured, and biomass estimates for the upper 30 m of the Vancouver continental shelf based on night-time tows, were over 92,000 tonnes (Table 9). For juvenile Chum Salmon, Pink Salmon and Sockeye Salmon the Coefficient of Variation (CV) for biomass estimates was greater than 0.50, indicating relatively imprecise estimates; consequently, 95% Confidence Intervals (CI) included zero. Pacific Herring had the lowest CV indicating this species' biomass estimates were the most precise, followed by juvenile Coho Salmon and Chinook Salmon (Table 9).

2018

For all species, except juvenile Pink Salmon, the biomass estimates in 2018 were lower than in 2017 (Table 9). In 2018, Coho Salmon was the most abundant juvenile Pacific Salmon in the upper 30 m of the Vancouver continental shelf, with an estimated biomass of 36 tonnes (Table 9) based on day time tows only. The biomass estimate of juvenile Chum Salmon (approximately 12 tonnes) was 10 times lower than in 2017 (Table 9). Juvenile Pink Salmon biomass estimates in 2018 (2.3 tonnes, Table 9), were higher in 2018 than in 2017 as per the species' cyclical productivity. The least abundant juvenile Pacific Salmon was Sockeye Salmon (less than 1 tonnes, Table 9). The biomass estimate for juvenile Chinook Salmon was similar to 2017 at approximately 9 tonnes (Table 9). As in 2017, Pacific Herring was the dominate fish species captured, and the biomass estimate for the upper 30 m of the Vancouver continental shelf based on night-time tows, was over 34,562 tonnes (Table 9). This estimate however was 3 times lower than the biomass estimate for 2017. All biomass estimates had CV less than 0.5, indicating improved precision from 2017. Pacific Herring and Coho Salmon had the lowest CV indicating their biomass estimates were the most precise, followed by Chinook Salmon (Table 9).

Discussion

The IPES data generated in 2017 and 2018 covers physical and biological oceanographic conditions, fish abundance and composition for the pelagic community, along with comprehensive sampling and stomach analyses of all caught species. With a combination of day and night time fishing, the IPES extends long-term time series in relative abundance for juvenile Pacific Salmon, Pacific Herring, and other important pelagic fish species. If Pacific Sardine re-establish high migratory rates into Canadian waters to feed in summer, the IPES will provide documentation and also extend the long-term time series in that species' relative abundance. Acoustic data on Pacific Herring and Pacific Hake distributional patterns have also been reported in the State of the Pacific Ocean report (Boldt et al., 2019). IPES data from 2017 and 2018 for relative catch rates and condition for juvenile Pacific Salmon have extended a 20-year time series off the west coast of Vancouver Island and have been reported in State of the Pacific Ocean reports (King and Tucker, 2018; King et al., 2019) and in the Fraser River Sockeye Salmon Forecasting Supplement (MacDonald et al., 2019). It is important to maintain the long-term time series for juvenile Pacific Salmon relative abundance along the continental shelf, since linking IPES survey results to similar surveys from Oregon, up through the Gulf of Alaska and into the Bering Sea provide indication of broad-scale responses to regional drivers (King et al., 2019). The IPES also provides the opportunity to document unusual occurrences, such as the unprecedented, and broad-scale Pyrosome bloom (IPES data reported in Brodeur

et al. (2018)). It is intended to complete IPES annually, and this survey will be a key platform supporting ecosystem research and empirical-based linkages of climate and ocean variability to fish abundance or community composition fundamental to ecosystem-based fisheries management.

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References

- Boldt, J., H. Dennis-Bohm, C. Stanley, J. King, E. Anderson, T. Zubkowski, and S. Gauthier. 2019. Pacific Herring Summer Distribution and Abundance off the Vancouver Island Continental Shelf. *In:* Chandler, P.C. and J. Boldt (Eds.). State of the physical, biological and selected fishery resources of Pacific Canadian marine ecosystems in 2018. Can. Tech. Rep. Fish. Aquat. Sci. *In press.*
- Brodeur, R., I. Perry, J., L. Flostrand, M. Galbraith, J. King, J. Murphy, K. Sakuma and A. Thompson. 2018. An unusual gelatinous plankton event in the NE Pacific: The Great Pyrosome Bloom of 2017. PICES Press Vol. 26(1): 22-27.
- King, J., J. Boldt, and S. King. 2018. Proceedings of the Pacific Region workshop on stomach content analyses, February 27-March 1 2018, Nanaimo, British Columbia. Can. Tech. Rep. Fish. Aquat. Sci. 3274: v + 55 p.
- King, J., and S. Tucker. 2018. 2017 Juvenile Salmon Catch Rates on the Vancouver Island Continental Shelf. *In:* Chandler, P.C., King, S.A., and Boldt, J. (Eds.). State of the physical, biological and selected fishery resources of Pacific Canadian marine ecosystems in 2017. Can. Tech. Rep. Fish. Aquat. Sci. 3266: viii + 245 p.
- King, J., E. Anderson, J. Boldt, T. Zubkowski and H. Denis-Bohm. 2019. 2018 Juvenile Salmon Surveys on the Continental Shelf of Vancouver Island. *In:* Chandler, P.C. and J. Boldt (Eds.). State of the physical, biological and selected fishery resources of Pacific Canadian marine ecosystems in 2018. Can. Tech. Rep. Fish. Aquat. Sci. *In press.*
- King, J., J. Boldt, B. Burke, C. Greene, J. Moss and C. Neville. 2019. Northeast Pacific juvenile salmon summer surveys in 2018. PICES Press Vol. 27(1): 19-26.
- MacDonald, B., S. Grant, D. Patterson, K. Robinson, J. Boldt, K. Benner, L. Pon, C. Neville, J. Tadey and D. Selbie. 2019. State of the Salmon: Informing the survival of Fraser Sockeye returning in 2019 through life cycle observations. Can. Tech. Rep. Fish. Aquat. Sci. *In press.*
- Thompson, S.K. 1992. Sampling. John Wiley and Sons, Inc. New York. 343 p.
- Volvenko, I.V. 2003. GIS and Atlas of Salmons Spatial-Temporal Distribution in the Okhotsk Sea.(NPAFC Doc. 729) 32p. Pacific Research Fisheries Centre, TINRO-Centre, 4, Shevchenko Alley, Vladivostok, 690600, Russia.

Table 1. Strata utilized during the Integrated Pelagic Ecosystem Survey July 7-August 2, 2017 aboard the MV Sea Crest. Actual bottom depths during the survey may differ from the depth (bathymetry for strata designation) of any given block; actual tow depth during the survey may differ from the targeted depth.

Stratum		Stratum Size		Target No. Blocks			No. Blocks Successfully Fished			
Location	Bathymetry (m)	Total Blocks	Proportion	0 m	15 m	Total	0 m	15 m	Total	Proportion
<i>2017 Daytime</i>										
504	QCS	50-100	98	0.1	3	3	6	2	3	5
505	QCS	100-200	153	0.15	5	5	10	3	4	7
506	NWVI	50-100	52	0.05	2	2	4	2	2	4
507	NWVI	100-200	84	0.08	3	3	6	3	3	6
508	CWVI	50-100	79	0.08	3	3	6	2	3	5
509	CWVI	100-200	93	0.09	3	3	6	2	2	4
510	SWVI	50-100	190	0.19	7	7	14	4	6	10
511	SWVI	100-200	254	0.25	9	9	18	6	6	12
Total			1	35	35	70	24	29	53	1
<i>2017 Nighttime</i>										
504	QCS	50-100	98	0.1	3	3	6	2	3	5
505	QCS	100-200	153	0.15	5	5	10	3	5	8
506	NWVI	50-100	52	0.05	2	2	4	2	1	3
507	NWVI	100-200	84	0.08	3	3	6	3	3	6
508	CWVI	50-100	79	0.08	3	3	6	2	3	5
509	CWVI	100-200	93	0.09	3	3	6	2	2	4
510	SWVI	50-100	190	0.19	7	7	14	4	3	7
511	SWVI	100-200	254	0.25	9	9	18	6	6	12
Total			1	35	35	70	24	26	50	1

Table 2. Strata utilized during the Integrated Pelagic Ecosystem Survey July 5-July 29, 2018 aboard the MV Nordic Pearl. Actual bottom depths during the survey may differ from the depth (bathymetry for strata designation) of any given block; actual tow depth during the survey may differ from the targeted depth.

Stratum		Stratum Size		Target No. Blocks			No. Blocks Successfully Fished				
Location	Bathymetry (m)	Total Blocks	Proportion	0 m	15 m	Total	0 m	15 m	Total	Proportion	
<i>2018 Daytime</i>											
504	QCS	50-100	98	0.1	3	3	6	2	1	3	0.06
505	QCS	100-200	153	0.15	5	5	10	4	3	7	0.14
506	NWVI	50-100	52	0.05	2	2	4	1	2	3	0.06
507	NWVI	100-200	84	0.08	3	3	6	1	2	3	0.06
508	CWVI	50-100	79	0.08	3	3	6	1	2	3	0.06
509	CWVI	100-200	93	0.09	3	3	6	2	1	3	0.06
510	SWVI	50-100	190	0.19	7	7	14	7	5	12	0.24
511	SWVI	100-200	254	0.25	9	9	18	9	8	17	0.33
Total			1	35	35	70	27	24	51	1	
<i>2018 Nighttime</i>											
504	QCS	50-100	98	0.1	3	3	6	2	1	3	0.07
505	QCS	100-200	153	0.15	5	5	10	4	3	7	0.15
506	NWVI	50-100	52	0.05	2	2	4	1	2	3	0.07
507	NWVI	100-200	84	0.08	3	3	6	1	2	3	0.07
508	CWVI	50-100	79	0.08	3	3	6	1	2	3	0.07
509	CWVI	100-200	93	0.09	3	3	6	2	1	3	0.07
510	SWVI	50-100	190	0.19	7	7	14	7	4	11	0.24
511	SWVI	100-200	254	0.25	9	9	18	8	5	13	0.28
Total			1	35	35	70	26	20	46	1	

Table 3. All captured species (or taxonomic group), ordered by total catch weight, showing number of tows in which the species occurred, total catch weight, minimum (if not zero), maximum and mean catch weights per tow for usable tows from the 2017 Integrated Pelagic Ecosystem Survey, July 7-August 2, 2017 aboard the MV Sea Crest. Zero total catch indicates specimens could not be weighed accurately with Marel platform scale.

Common Name	Scientific Name	Number of Tows	Catch (kg)		
			Total	Max	Mean
<i>Vertebrates</i>					
PACIFIC HERRING	<i>Clupea pallasii</i>	56	10610.6	2296.14	200.2
ROCKFISHES	<i>Sebastes</i>	43	642.31	203.26	21.41
NORTHERN ANCHOVY	<i>Engraulis mordax</i>	2	514.97	514.97	514.97
COHO SALMON	<i>Oncorhynchus kisutch</i>	29	189.569	37.25	6.54
CHUM SALMON	<i>Oncorhynchus keta</i>	26	159.595	30.5	6.14
CHINOOK SALMON	<i>Oncorhynchus tshawytscha</i>	29	140.162	24.93	4.83
PINK SALMON	<i>Oncorhynchus gorbuscha</i>	22	133.4	13.52	6.06
SOCKEYE SALMON	<i>Oncorhynchus nerka</i>	14	28.613	7.26	2.04
PACIFIC SANDDAB	<i>Citharichthys sordidus</i>	9	16.87	9.56	2.81
PACIFIC HAKE	<i>Merluccius productus</i>	9	13.94	5.43	1.74
BLACK ROCKFISH	<i>Sebastes melanops</i>	11	13.13	6.87	1.31
EULACHON	<i>Thaleichthys pacificus</i>	4	8.56	8.41	2.85
STARRY FLOUNDER	<i>Platichthys stellatus</i>	3	7.86	5.22	2.62
SABLEFISH	<i>Anoplopoma fimbria</i>	7	5.02	2.39	0.72
CODFISHES	<i>Gadidae</i>	63	4.47	1	0.11
CANARY ROCKFISH	<i>Sebastodes pinniger</i>	7	4.31	2.14	0.86
WOLF EEL	<i>Anarrhichthys ocellatus</i>	20	3.56	0.77	0.22
PACIFIC BONITO	<i>Sarda chiliensis</i>	1	3.08	3.08	3.08
REX SOLE	<i>Glyptocephalus zachirus</i>	2	2.78	1.83	1.39
WHITEBAIT SMELT	<i>Allosmerus elongatus</i>	1	2.26	2.26	2.26
AMERICAN SHAD	<i>Alosa sapidissima</i>	1	1.97	1.97	1.97
REDSTRIPE ROCKFISH	<i>Sebastes proriger</i>	4	1.36	1.07	0.34
CHUB MACKEREL	<i>Scomber japonicus</i>	1	0.59	0.59	0.59
RAGFISH	<i>Icosteus aenigmaticus</i>	3	0.58	0.4	0.19
ARROWTOOTH FLOUNDER	<i>Reinhardtius stomaticus</i>	2	0.57	0.57	0.57
WHITE SPOTTED RATFISH	<i>Hydrolagus colliei</i>	1	0.43	0.43	0.43
MEDUSAFISH	<i>Ichthys lockingtoni</i>	5	0.27	0.12	0.05
NORTH PACIFIC SPINY DOGFISH	<i>Squalus suckleyi</i>	1	0.11	0.11	0.11
PACIFIC SAND LANCE	<i>Ammodytes hexapterus</i>	2	0.02	0.02	0.02
LANternfish	<i>Tarletonbeania</i>	3	0.01	0.01	0.01
SNAILFISHES	<i>Liparidae</i>	3	0.01	0.01	0.01
FLATFISHES	<i>Pleuronectiformes</i>	6	0	--	--
LARVAL FISH	<i>Unknown larval fish</i>	4	0	--	--
EELPOUT	<i>Lycenchelys</i>	3	0	--	--
OCEAN SUNFISH	<i>Mola mola</i>	3	0	--	--
TOPE SHARK	<i>Galeorhinus galeus</i>	3	0	--	--
EELS	<i>Anguilliformes</i>	2	0	--	--
PROWFISH	<i>Zaprora silenus</i>	2	0	--	--
SALMON SHARK	<i>Lamna ditropis</i>	2	0	--	--
GARNET LANTERNFISH	<i>Stenobrachius nannochir</i>	1	0	--	--
GOBIES	<i>Gobiidae</i>	1	0	--	--
KELP GREENLING	<i>Hexagrammos decagrammus</i>	1	0	--	--
NORTHERN SPEARNOSE POACHER	<i>Agonopsis vulsa</i>	1	0	--	--
PACIFIC WHITE-SIDED DOLPHIN	<i>Lagenorhynchus obliquidens</i>	1	0	--	--
SANDFISHES	<i>Trichodontidae</i>	1	0	--	--
STURGEON POACHER	<i>Podothecus accipenserinus</i>	1	0	--	--
UNKNOWN FISH	<i>Unknown fish</i>	1	0	--	--
<i>Total vertebrates</i>			12 510.98		

Common Name	Scientific Name	Number of Tows	Catch (kg)		
			Total	Max	Mean
<i>Invertebrates</i>					
WATER JELLYFISH	<i>Aequorea</i>	78	1415.74	173.1	18.39
PYROSOME	<i>Pyrosoma atlanticum</i>	55	459.17	216.71	8.66
LIONS MANE JELLYFISH	<i>Cyanea capillata</i>	42	346.8	22.2	8.26
JELLYFISH	<i>Scyphozoa</i>	10	313.31	258.37	34.81
FRIED EGG JELLYFISH	<i>Phacellophora camtschatica</i>	52	136.86	14.42	2.68
EUPHAUSIIDS	<i>Euphausiacea</i>	13	102.45	35.4	9.31
MOON JELLYFISH	<i>Aurelia labiata</i>	46	41.32	4.83	0.9
PACIFIC SEA NETTLE	<i>Chrysaora fuscescens</i>	11	33.94	12.89	3.09
SIPHONOPHORES	<i>Siphonophorae</i>	40	31.56	13.7	0.83
SQUIDS	<i>Teuthida</i>	9	5.55	3.86	1.39
PINK SHRIMP (SMOOTH)	<i>Pandalus jordani</i>	4	3.35	1.94	0.84
SALPS	<i>Salpida</i>	9	2.87	1.33	0.32
COMB JELLY	<i>Ctenophora</i>	27	1.28	0.65	0.14
OPALESCENT INSHORE SQUID	<i>Doryteuthis opalescens</i>	13	0.71	0.28	0.1
PINK SHRIMP (SPINY)	<i>Pandalus borealis</i>	1	0	--	--
SHRIMP	<i>Dendrobranchiata</i>	1	0	--	--
TUSK SHELLS	<i>Gadiliida</i>	1	0	--	--
<i>Total invertebrates</i>			2 894.91		
<i>Total catch</i>			15 405.89		

Table 4. All captured species (or taxonomic group), ordered by total catch weight, showing number of tows in which the species occurred, total catch weight, maximum catch weight, and mean catch weight per tow for usable tows from the 2018 Integrated Pelagic Ecosystem Survey, July 5-July 29, 2018 aboard the MV Sea Crest. Zero catch indicates specimens could not be weighed accurately with Marel platform scale.

Common Name	Scientific Name	Number of Tows	Catch (kg)		
			Total	Max	Mean
<i>Vertebrates</i>					
PACIFIC HERRING	<i>Clupea pallasii</i>	50	5569.12	1283.64	111.38
NORTH PACIFIC SPINY DOGFISH	<i>Squalus suckleyi</i>	8	5391.42	3800	673.93
COHO SALMON	<i>Oncorhynchus kisutch</i>	49	320.83	45.37	6.55
PACIFIC HAKE	<i>Merluccius productus</i>	19	236.58	84.6	13.14
CHINOOK SALMON	<i>Oncorhynchus tshawytscha</i>	44	206.83	41.25	4.7
SOCKEYE SALMON	<i>Oncorhynchus nerka</i>	15	62.44	19.03	4.16
CHUM SALMON	<i>Oncorhynchus keta</i>	21	44.38	11.63	2.11
JACK MACKEREL	<i>Trachurus symmetricus</i>	4	24	17.39	6
EULACHON	<i>Thaleichthys pacificus</i>	18	22.89	12.91	1.43
PINK SALMON	<i>Oncorhynchus gorbuscha</i>	14	11.32	3.59	0.81
BLACK ROCKFISH	<i>Sebastodes melanops</i>	31	11.04	5.51	0.53
BLUE SHARK	<i>Prionace glauca</i>	2	7.67	7.67	7.67
PACIFIC SANDDAB	<i>Citharichthys sordidus</i>	8	4.35	1.68	0.54
LINGCOD	<i>Ophiodon elongatus</i>	2	0.9	0.89	0.45
ARROWTOOTH FLOUNDER	<i>Reinhardtius stomias</i>	1	0.88	0.88	0.88
BLUE LANTERNFISH	<i>Tarletonbeania crenularis</i>	1	0.7	0.7	0.7
WOLF EEL	<i>Anarrhichthys ocellatus</i>	37	0.62	0.22	0.03
CODFISHES	<i>Gadidae</i>	14	0.59	0.19	0.08
AMERICAN SHAD	<i>Alosa sapidissima</i>	1	0.48	0.48	0.48
NORTHERN ANCHOVY	<i>Engraulis mordax</i>	18	0.29	0.09	0.02
CANARY ROCKFISH	<i>Sebastodes pinniger</i>	1	0.25	0.25	0.25
PACIFIC SARDINE	<i>Sardinops sagax</i>	2	0.24	0.23	0.12
PACIFIC OCEAN PERCH	<i>Sebastodes alutus</i>	2	0.19	0.17	0.1
WHITEBAIT SMELT	<i>Allosmerus elongatus</i>	1	0.14	0.14	0.14
FLATFISHES	<i>Pleuronectiformes</i>	1	0.14	0.14	0.14
PLAINFIN MIDSHIPMAN	<i>Porichthys notatus</i>	32	0.14	0.01	0.01
SHORTBELLY ROCKFISH	<i>Sebastodes jordani</i>	1	0.11	0.11	0.11
ROCKFISHES	<i>Sebastodes</i>	14	0.11	0.03	0.01
RIVER LAMPREY	<i>Lampetra ayresii</i>	2	0.1	0.08	0.05
BIG SKATE	<i>Raja binoculata</i>	2	0.08	0.04	0.04
PACIFIC LAMPREY	<i>Lampetra tridentata</i>	1	0.08	0.08	0.08
BROWN ROCKFISH	<i>Sebastodes auriculatus</i>	4	0.03	0.01	0.01
QUILLFISH	<i>Ptilichthys goodei</i>	3	0.03	0.01	0.01
FISH	<i>Pisces</i>	3	0.03	0.01	0.01
SMELOTS	<i>Osmeridae</i>	2	0.02	0.01	0.01
PACIFIC SAND LANCE	<i>Ammodytes hexapterus</i>	11	0.01	0.01	0.01
POACHERS	<i>Agonidae</i>	1	0.01	0.01	0.01
UNKNOWN FISH	<i>Unknown fish</i>	6	0	--	--
TOPE SHARK	<i>Galeorhinus galeus</i>	2	0	--	--
BARRACUDINAS	<i>Paralepididae</i>	1	0	--	--
DARKBLOTCHED ROCKFISH	<i>Sebastodes crameri</i>	1	0	--	--
SPLITNOSE ROCKFISH	<i>Sebastodes diploproa</i>	1	0	--	--
WIDOW ROCKFISH	<i>Sebastodes entomelas</i>	1	0	--	--
		<i>Total vertebrates</i>	11 919.04		

Common Name	Scientific Name	Number of Tows	Catch (kg)		
			Total	Min	Mean
<i>Invertebrates</i>					
EUPHAUSIIDS	<i>Euphausiacea</i>	24	530.04	342.56	23.05
WATER JELLYFISH	<i>Aequorea Victoria</i>	54	305.99	50.76	5.77
PYROSOME	<i>Pyrosoma atlanticum</i>	54	171.19	30.24	3.23
MOON JELLYFISH	<i>Aurelia labiate</i>	54	84.18	12.28	1.59
PACIFIC SEA NETTLE	<i>Chrysaora fuscescens</i>	33	58.66	7.59	1.78
LIONS MANE JELLYFISH	<i>Cyanea capillata</i>	16	38.58	8.04	2.57
FRIED EGG JELLYFISH	<i>Phacellophora camtschatica</i>	8	20.33	6.1	2.54
SALPS	<i>Salpida</i>	15	5.24	2.99	0.48
OPALESCENT INSHORE SQUID	<i>Doryteuthis opalescens</i>	5	2.03	0.74	0.68
SQUIDS	<i>Teuthida</i>	14	1.27	0.38	0.12
SIPHONOPHORAE	<i>Siphonophorae</i>	18	1.15	0.23	0.08
COMB JELLYFISH	<i>Ctenophora</i>	4	0.92	0.39	0.31
PINK SHRIMP (SMOOTH)	<i>Pandalus jordani</i>	2	0.92	0.53	0.46
BOREAL CLUBHOOK SQUID	<i>Onychoteuthis borealijaponicus</i>	1	0.13	0.13	0.13
SHRIMP	<i>Dendrobranchiatata</i>	2	0.01	0.01	0.01
UNIDENTIFIED LARVAE		1	0	--	--
<i>Total invertebrates</i>			1 220.64		
<i>Total catch</i>			13 139.68		

Table 5. Sample size (n), statistics of length and weight for each species (alphabetically listed) sampled during the 2017 Integrated Pelagic Ecosystem Survey, July 7-August 2, 2017 aboard the MV Sea Crest. (Species with a zero weight counts were excluded from the table).

Year	Species	Number of Samples	Number Specimens Measured	Length (mm)			Number Specimens Weighed	Weight (g)		
				min	max	mean		min	max	mean
2017	AMERICAN SHAD	1	5	287	330	301.6	5	344	490	390.8
2017	ARROWTOOTH	1	1	406	406	406.0	1	568	568	568.0
2017	BLACK ROCKFISH	2	3	294	375	333.3	3	411	832	583.7
2017	CHINOOK SALMON	28	143	190	766	383.4	142	89	9430	960.9
2017	CHUM SALMON	25	282	97	801	184.3	282	9	8180	337.9
2017	CODFISHES	23	572	25	83	60.9	60	1	8	2.3
2017	COHO SALMON	29	150	159	708	392.9	151	49	4350	1181.9
2017	COMB JELLIES	2	7	53	95	74.4				
2017	EELPOUT	1	5	36	41	38.8				
2017	EULACHON	2	60	78	191	155.7	60	4	63	37.9
2017	FRIED EGG JELLYFISH	1	1	443	443	443.0				
2017	LIONS MANE JELLYFISH	14	44	159	687	382.0				
2017	MEDUSAFISH	4	4	120	215	148.3	4	26	100	52.3
2017	MOON JELLYFISH	12	25	107	744	205.1	2	96	518	307.0
2017	NORTHERN ANCHOVY	1	110	133	165	145.3	110	25	49	34.1
2017	OCEAN SUNFISH	3	3	130	1495	605.0				
2017	OPALESCENT INSHORE	4	34	17	116	66.2	1	14	14	14.0
2017	PACIFIC BONITO	1	2	505	510	507.5	2	1478	1592	1535.0
2017	PACIFIC HAKE	9	19	57	653	390.2	18	20	1744	589.4
2017	PACIFIC HERRING	42	4427	39	248	152.9	4349	1	183	55.5
2017	PACIFIC SANDDAB	4	63	61	287	192.5	63	4	265	103.5
2017	PACIFIC SEA NETTLE	6	14	215	408	314.6	1	1134	1134	1134.0
2017	PACIFIC WHITE-SIDED	1	2	121	180	150.5				
2017	PINK SALMON	20	66	138	564	493.6	67	24	2654	1739.6
2017	PYROSOME	27	780	33	445	140.5				
2017	REDSTRIPE ROCKFISH	4	19	103	216	167.3	18	15	146	79.9
2017	REX SOLE	2	19	146	300	228.2	19	32	358	143.9
2017	ROCKFISHES	13	513	35	738	61.0	8	1	2	1.6
2017	SABLEFISH	6	14	297	359	327.4	14	270	426	334.9
2017	SALMON SHARK	2	2	169	218	193.5				
2017	SALPS	1	10	125	144	134.2				
2017	SOCKEYE SALMON	13	35	99	602	245.5	37	11	2626	686.4
2017	SQUIDS	4	45	29	118	86.2	37	12	42	25.7
2017	STARRY FLOUNDER	1	1	578	578	578.0				
2017	TOPE SHARK	3	28	138	188	169.2				
2017	WALLEYE POLLOCK	2	4	126	353	286.0	3	298	354	322.0
2017	WATER JELLYFISH	21	323	41	167	95.7				
2017	WHITE SPOTTED	1	1	463	463	463.0	1	464	464	464.0
2017	WHITEBAIT SMELT	1	21	138	178	154.0	21	22	51	35.2
2017	WOLF EEL	15	29	411	595	536.0	29	28	136	99.6

Table 6. Sample size (n), statistics of length and weight for each species (alphabetically listed) sampled during the 2018 Integrated Pelagic Ecosystem Survey, July 5-July 29, 2018 aboard the MV Nordic Pearl. (Species with a zero weight counts were excluded from the table).

Year	Species	Number of Samples	Number Specimens Measured	Length (mm)			Number Specimens Weighed	Weight (g)		
				min	max	mean		min	max	mean
2018	AMERICAN SHAD	1	1	320	320	320.0	1	478	478	478.0
2018	ARROWTOOTH	1	1	490	490	490.0	1	898	898	898.0
2018	BIG SKATE	2	2	185	193	189.0	2	34	35	34.5
2018	BLACK ROCKFISH	8	100	43	461	65.2	72	1	1776	41.4
2018	BLUE LANTERNFISH	1	54	38	79	57.7	54	1	7	2.8
2018	BLUE SHARK	2	2	129	146	137.5	1	7670	7670	7670.0
2018	BOREAL CLUBHOOK	1	1	163	163	163.0	1	161	161	161.0
2018	CANARY ROCKFISH	3	53	30	55	42.4				
2018	CHINOOK SALMON	47	165	99	837	408.0	165	10	7770	1285.6
2018	CHUM SALMON	25	246	93	748	157.0	246	9	6520	179.3
2018	CODFISHES	3	6	35	72	52.2	3	1	2	1.7
2018	COHO SALMON	53	282	135	702	368.3	282	33	4680	1089.2
2018	EULACHON	19	412	79	182	109.6	410	3	62	12.2
2018	JACK MACKEREL	4	16	51	536	473.3	16	1061	1738	1485.3
2018	LINGCOD	2	2	129	470	299.5	2	9	834	421.5
2018	NORTH PACIFIC	11	257	87	1062558.4	257		65	6660	1149.0
2018	NORTHERN ANCHOVY	3	7	105	138	116.4	7	9	30	16.4
2018	OPALESCENT	4	165	23	111	75.0	165	1	35	15.7
2018	PACIFIC HAKE	19	225	121	655	334.7	225	11	1601	354.5
2018	PACIFIC HERRING	44	3127	34	1777160.6	3017		1	167	60.9
2018	PACIFIC LAMPREY	1	2	192	224	208.0	2	14	29	21.5
2018	PACIFIC SANDDAB	5	34	35	330	171.3	32	1	375	115.0
2018	PACIFIC SARDINE	1	1	271	271	271.0	1	245	245	245.0
2018	PINK SALMON	14	61	98	477	169.5	61	9	1397	176.1
2018	PLAINFIN	1	1	216	216	216.0	1	82	82	82.0
2018	PYROSOME	27	908	31	347	137.9				
2018	RIVER LAMPREY	1	1	331	331	331.0	1	75	75	75.0
2018	ROCKFISHES	1	6	29	36	32.3				
2018	SHORTBELLY	1	3	134	162	146.0	3	24	45	32.3
2018	Sockeye Salmon	15	44	87	618	378.8	44	8	3286	1399.3
2018	TOPE SHARK	6	18	136	1640331.8					
2018	WALLEYE POLLOCK	1	1	301	301	301.0	1	220	220	220.0
2018	WHITEBAIT SMELT	1	7	107	122	113.1	7	8	12	10.0
2018	WOLF EEL	8	9	329	538	474.7	9	14	99	59.8

Table 7. Number of samples (tows), number of stomachs examined, number usable stomachs (not everted), and proportion (%) of stomachs that were empty or contained unidentified and identifiable prey for species sampled (alphabetically listed) during the 2017 Integrated Pelagic Ecosystem Survey, July 7-August 2, 2017 aboard the MV Sea Crest and July 5-July 29, 2018 aboard the MV Nordic Pearl.

Year	Species	Number of tows	Number of stomachs examined	Number of empty stomachs	Percent empty stomachs
2017	CHINOOK SALMON	26	97	11	11
2017	CHUM SALMON	23	80	6	8
2017	COHO SALMON	29	116	5	4
2017	EULACHON	1	10	1	10
2017	MEDUSAFISH	4	4	4	100
2017	PACIFIC BONITO	1	2	1	50
2017	PACIFIC HAKE	7	17	3	18
2017	PACIFIC HERRING	28	396	63	16
2017	PACIFIC SANDDAB	3	23	8	35
2017	PINK SALMON	20	67	7	10
2017	REDSTRIPE ROCKFISH	4	16	7	44
2017	REX SOLE	1	7	1	14
2017	SABLEFISH	5	13	1	8
2017	SOCKEYE SALMON	13	34	8	24
2017	WALLEYE POLLOCK	5	26	4	15
2017	WHITEBAIT SMELT	1	10	3	30
2017	WOLF EEL	9	20	1	5
2018	ARROWTOOTH FLOUNDER	1	1	1	100
2018	CHINOOK SALMON	47	142	14	10
2018	CHUM SALMON	25	107	10	9
2018	COHO SALMON	49	200	7	4
2018	EULACHON	16	95	29	31
2018	JACK MACKEREL	4	14	3	21
2018	LINGCOD	2	2	1	50
2018	NORTH PACIFIC SPINY DOGFISH	5	37	6	16
2018	NORTHERN ANCHOVY	3	7	2	29
2018	OPALESCENT INSHORE SQUID	3	30	16	53
2018	PACIFIC HAKE	19	114	17	15
2018	PACIFIC HERRING	31	290	71	24
2018	PACIFIC SANDDAB	5	23	4	17
2018	PINK SALMON	14	55	2	4
2018	PLAINFIN MIDSHIPMAN	1	1	1	100
2018	SOCKEYE SALMON	15	44	18	41
2018	WALLEYE POLLOCK	2	4	2	50
2018	WOLF EEL	6	7	1	14

Table 8. Prey items identified in the stomach contents of species sampled (alphabetically listed) during Integrated Pelagic Ecosystem Survey, July 7-August 2, 2017 aboard the MV Sea Crest and July 5-July 29, 2018 aboard the MV Nordic Pearl. N is the number of occurrences of each prey type and cm³ is the average volume of identifiable prey across stomachs.

Year	Species	Prey species	Average prey volume (cm ³)	Count of prey
2017	AMERICAN SHAD	EUPHAUSIIDS	3.5	5
2017	AMERICAN SHAD	CTENOPHORA	0.5	1
2017	BLACK ROCKFISH	TRUE CRABS	3	1
2017	BLACK ROCKFISH	PACIFIC HERRING	2.5	2
2017	CHINOOK SALMON	PACIFIC HERRING	23.1	17
2017	CHINOOK SALMON	EUPHAUSIIDS	11.3	51
2017	CHINOOK SALMON	ROCKFISHES	8.1	13
2017	CHINOOK SALMON	SQUIDS	7	2
2017	CHINOOK SALMON	UNID. FISHES	4.9	24
2017	CHINOOK SALMON	PANDALID SHRIMP	1.8	4
2017	CHINOOK SALMON	TRUE CRABS	1.8	12
2017	CHINOOK SALMON	PACIFIC SAND LANCE	1.2	2
2017	CHINOOK SALMON	OPALESCENT INSHORE SQUID	0.9	4
2017	CHINOOK SALMON	UNID. REMAINS	0.9	2
2017	CHINOOK SALMON	LOWER HETEROBRANCHIA	0	1
2017	CHUM SALMON	ROCKFISHES	61.8	2
2017	CHUM SALMON	PACIFIC HERRING	34.5	2
2017	CHUM SALMON	JELLYFISH	22.1	5
2017	CHUM SALMON	AEQUOREA	4.8	1
2017	CHUM SALMON	UNID. REMAINS	3.5	35
2017	CHUM SALMON	UNID. FISHES	1.3	15
2017	CHUM SALMON	AMPHIPODS	1.2	9
2017	CHUM SALMON	CTENOPHORA	0.5	2
2017	CHUM SALMON	TRUE CRABS	0.5	3
2017	CHUM SALMON	EUPHAUSIIDS	0.4	8
2017	CHUM SALMON	MYSIDS	0.1	1
2017	COHO SALMON	PACIFIC HERRING	64.7	9
2017	COHO SALMON	EUPHAUSIIDS	21.2	56
2017	COHO SALMON	ROCKFISHES	9.7	19
2017	COHO SALMON	FLATFISHES	5.8	2
2017	COHO SALMON	UNID. REMAINS	5.2	9
2017	COHO SALMON	UNID. FISHES	4.6	35
2017	COHO SALMON	TRUE CRABS	2.7	34
2017	COHO SALMON	AMPHIPODS	0.1	1
2017	COHO SALMON	COPEPODS	0.1	1
2017	COHO SALMON	LOWER HETEROBRANCHIA	0.1	1

Year	Species	Prey species	Average prey volume (cm ³)	Count of prey
2017	COHO SALMON	ROUNDWORM	0	1
2017	COHO SALMON	SEGMENTED WORMS	0	1
2017	EULACHON	EUPHAUSIIDS	0.3	9
2017	NORTHERN ANCHOVY	EUPHAUSIIDS	0.4	6
2017	NORTHERN ANCHOVY	UNID. REMAINS	0.2	4
2017	PACIFIC BONITO	EUPHAUSIIDS	10.3	1
2017	PACIFIC HAKE	EUPHAUSIIDS	10.7	11
2017	PACIFIC HAKE	ROCKFISHES	7.5	2
2017	PACIFIC HAKE	UNID. REMAINS	1.9	2
2017	PACIFIC HERRING	EUPHAUSIIDS	1.4	155
2017	PACIFIC HERRING	MYSIDS	1.3	7
2017	PACIFIC HERRING	LOWER HETEROBRANCHIA	0.7	6
2017	PACIFIC HERRING	UNID. FISHES	0.5	1
2017	PACIFIC HERRING	UNID. REMAINS	0.3	173
2017	PACIFIC HERRING	AMPHIPODS	0.2	7
2017	PACIFIC HERRING	TRUE CRABS	0.1	6
2017	PACIFIC HERRING	ROUNDWORM	0	1
2017	PACIFIC SANDDAB	CTENOPHORA	6.6	4
2017	PACIFIC SANDDAB	CHRYSORA FUSCESCENS	4	1
2017	PACIFIC SANDDAB	JELLYFISH	2.4	4
2017	PACIFIC SANDDAB	EUPHAUSIIDS	0.5	5
2017	PACIFIC SANDDAB	UNID. FISHES	0.5	2
2017	PACIFIC SANDDAB	UNID. REMAINS	0.2	1
2017	PACIFIC SANDDAB	GASTROPODS	0	1
2017	PINK SALMON	ROCKFISHES	15.4	4
2017	PINK SALMON	EUPHAUSIIDS	9.2	34
2017	PINK SALMON	TRUE CRABS	8	32
2017	PINK SALMON	UNID. FISHES	6.1	7
2017	PINK SALMON	UNID. REMAINS	4.9	3
2017	PINK SALMON	LOWER HETEROBRANCHIA	4.5	9
2017	PINK SALMON	WALLEYE POLLOCK	0.7	1
2017	PINK SALMON	OPALESCENT INSHORE SQUID	0.3	1
2017	PINK SALMON	SQUIDS	0.1	1
2017	RED STRIPE ROCKFISH	UNID. REMAINS	0.2	6
2017	RED STRIPE ROCKFISH	AMPHIPODS	0.1	1
2017	RED STRIPE ROCKFISH	EUPHAUSIIDS	0.1	3
2017	REX SOLE	CTENOPHORA	11.6	4
2017	REX SOLE	AEQUOREA	7.5	1
2017	REX SOLE	UNID. REMAINS	2.5	4
2017	SABLEFISH	UNID. FISHES	12	1
2017	SABLEFISH	EUPHAUSIIDS	3.7	6

Year	Species	Prey species	Average prey volume (cm ³)	Count of prey
2017	SABLEFISH	UNID. REMAINS	3.4	4
2017	SABLEFISH	TRUE CRABS	0.8	2
2017	SABLEFISH	CTENOPHORA	0.5	1
2017	SABLEFISH	UNIDENTIFIED ALGAE	0	1
2017	SOCKEYE SALMON	EUPHAUSIIDS	3.7	3
2017	SOCKEYE SALMON	ROCKFISHES	3	1
2017	SOCKEYE SALMON	TRUE CRABS	2	8
2017	SOCKEYE SALMON	mysids	1	1
2017	SOCKEYE SALMON	UNID. FISHES	0.9	3
2017	SOCKEYE SALMON	AMPHIPODS	0.6	4
2017	SOCKEYE SALMON	UNID. REMAINS	0.2	4
2017	SOCKEYE SALMON	COPEPODS	0.1	5
2017	SOCKEYE SALMON	PANDALID SHRIMP	0	1
2017	SOCKEYE SALMON	SEGMENTED WORMS	0	1
2017	WALLEYE POLLOCK	EUPHAUSIIDS	0.6	3
2017	WALLEYE POLLOCK	CTENOPHORA	0.2	1
2017	WALLEYE POLLOCK	UNID. REMAINS	0.2	19
2017	WHITEBAIT SMELT	EUPHAUSIIDS	0.2	7
2017	WOLF EEL	UNID. FISHES	1.3	4
2017	WOLF EEL	TRUE CRABS	0.9	8
2017	WOLF EEL	PANDALID SHRIMP	0.8	2
2017	WOLF EEL	EUPHAUSIIDS	0.6	4
2017	WOLF EEL	FLATFISHES	0.6	2
2017	WOLF EEL	UNID. REMAINS	0.4	6
2018	AMERICAN SHAD	EUPHAUSIIDS	13.2	1
2018	BLACK ROCKFISH	UNID. FISHES	4.8	2
2018	BLACK ROCKFISH	mysids	0.1	1
2018	BLACK ROCKFISH	UNID. REMAINS	0	9
2018	BOREAL CLUBHOOK SQUID	UNID. REMAINS	3.8	1
2018	BOREAL CLUBHOOK SQUID	EUPHAUSIIDS	0	1
2018	BOREAL CLUBHOOK SQUID	TRUE CRABS	0	1
2018	CHINOOK SALMON	PACIFIC HERRING	30.4	39
2018	CHINOOK SALMON	EUPHAUSIIDS	13.9	49
2018	CHINOOK SALMON	UNID. FISHES	5.4	31
2018	CHINOOK SALMON	BLACK ROCKFISH	5.3	2
2018	CHINOOK SALMON	OCTOPUS	3	2
2018	CHINOOK SALMON	ROCKFISHES	2.8	5
2018	CHINOOK SALMON	TRUE CRABS	2.1	24
2018	CHINOOK SALMON	WALLEYE POLLOCK	1.7	4
2018	CHINOOK SALMON	CANARY ROCKFISH	1.2	1
2018	CHINOOK SALMON	PACIFIC SAND LANCE	0.8	4

Year	Species	Prey species	Average prey volume (cm ³)	Count of prey
2018	CHINOOK SALMON	CEPHALOPODS	0.5	1
2018	CHINOOK SALMON	UNID. REMAINS	0.3	5
2018	CHINOOK SALMON	SQUIDS	0.2	1
2018	CHINOOK SALMON	AMPHIPODS	0.1	2
2018	CHINOOK SALMON	MYSIDS	0	1
2018	CHINOOK SALMON	SEGMENTED WORMS	0	1
2018	CHUM SALMON	CTENOPHORA	6.5	2
2018	CHUM SALMON	EUPHAUSIIDS	1.5	15
2018	CHUM SALMON	UNID. FISHES	1.3	11
2018	CHUM SALMON	UNID. REMAINS	1.3	67
2018	CHUM SALMON	JELLYFISH	0.6	6
2018	CHUM SALMON	AMPHIPODS	0.1	9
2018	CHUM SALMON	MISC. NON-MARINE	0.1	2
2018	CHUM SALMON	TRUE CRABS	0.1	9
2018	CHUM SALMON	LOWER HETEROBRANCHIA	0	1
2018	CHUM SALMON	MYSIDS	0	3
2018	CHUM SALMON	PINK SHRIMP	0	1
2018	COHO SALMON	PACIFIC HERRING	33.1	37
2018	COHO SALMON	NORTHERN ANCHOVY	14.1	1
2018	COHO SALMON	EUPHAUSIIDS	13.8	81
2018	COHO SALMON	UNID. FISHES	3.8	57
2018	COHO SALMON	TRUE CRABS	3.3	63
2018	COHO SALMON	POUND SMELT	3	1
2018	COHO SALMON	ROCKFISHES	2.6	8
2018	COHO SALMON	PACIFIC SAND LANCE	2	7
2018	COHO SALMON	SMELOTS	2	1
2018	COHO SALMON	FLATFISHES	1.8	5
2018	COHO SALMON	SQUIDS	1.4	2
2018	COHO SALMON	CANARY ROCKFISH	1.3	2
2018	COHO SALMON	MYSIDS	0.5	9
2018	COHO SALMON	AMPHIPODS	0.2	11
2018	COHO SALMON	UNID. REMAINS	0.2	6
2018	COHO SALMON	SEGMENTED WORMS	0.1	1
2018	COHO SALMON	MISC. NON-MARINE	0	1
2018	COHO SALMON	POLYCHAETE WORMS	0	2
2018	EULACHON	EUPHAUSIIDS	0.3	59
2018	EULACHON	UNID. REMAINS	0	7
2018	JACK MACKEREL	EUPHAUSIIDS	52.4	6
2018	JACK MACKEREL	MYSIDS	1.3	4
2018	JACK MACKEREL	UNID. FISHES	0.8	1
2018	LINGCOD	PACIFIC HERRING	228	1

Year	Species	Prey species	Average prey volume (cm ³)	Count of prey
2018	NORTH PACIFIC SPINY DOGFISH	UNID. FISHES	66.7	3
2018	NORTH PACIFIC SPINY DOGFISH	EUPHAUSIIDS	41.4	15
2018	NORTH PACIFIC SPINY DOGFISH	PACIFIC HERRING	19.8	13
2018	NORTH PACIFIC SPINY DOGFISH	PYROSOME	1.8	1
2018	NORTH PACIFIC SPINY DOGFISH	PINK SHRIMP (SMOOTH)	0.1	1
2018	NORTH PACIFIC SPINY DOGFISH	AMPHIPODS	0	1
2018	NORTH PACIFIC SPINY DOGFISH	UNID. REMAINS	0	1
2018	NORTHERN ANCHOVY	EUPHAUSIIDS	0.3	2
2018	NORTHERN ANCHOVY	MYSDS	0.1	1
2018	NORTHERN ANCHOVY	UNID. REMAINS	0.1	3
2018	OPALESCENT INSHORE SQUID	UNID. REMAINS	0	14
2018	PACIFIC HAKE	PACIFIC HERRING	37.1	8
2018	PACIFIC HAKE	EUPHAUSIIDS	4.9	84
2018	PACIFIC HAKE	UNID. FISHES	3.6	5
2018	PACIFIC HAKE	UNID. REMAINS	0.4	6
2018	PACIFIC HERRING	SQUIDS	4.2	1
2018	PACIFIC HERRING	EUPHAUSIIDS	2.8	128
2018	PACIFIC HERRING	UNID. FISHES	0.5	1
2018	PACIFIC HERRING	ROUNDWORM	0.4	1
2018	PACIFIC HERRING	UNID. REMAINS	0.2	83
2018	PACIFIC HERRING	COPEPODS	0.1	2
2018	PACIFIC HERRING	TRUE CRABS	0.1	11
2018	PACIFIC HERRING	AMPHIPODS	0	6
2018	PACIFIC HERRING	MYSDS	0	1
2018	PACIFIC HERRING	PINK SHRIMP	0	3
2018	PACIFIC SANDDAB	PINK SHRIMP	18	1
2018	PACIFIC SANDDAB	UNID. REMAINS	1.5	4
2018	PACIFIC SANDDAB	EUPHAUSIIDS	0.9	5
2018	PACIFIC SANDDAB	UNID. FISHES	0.3	2
2018	PACIFIC SANDDAB	GREEN ALGA	0.2	1
2018	PACIFIC SANDDAB	JELLYFISH	0.1	6
2018	PACIFIC SANDDAB	AMPHIPODS	0	2
2018	PACIFIC SANDDAB	TRUE CRABS	0	3
2018	PACIFIC SARDINE	EUPHAUSIIDS	5.3	1
2018	PINK SALMON	BLACK ROCKFISH	238	1
2018	PINK SALMON	TRUE CRABS	1	13
2018	PINK SALMON	EUPHAUSIIDS	0.8	23
2018	PINK SALMON	AMPHIPODS	0.2	10
2018	PINK SALMON	MYSDS	0.2	2
2018	PINK SALMON	PINK SHRIMP	0.2	1
2018	PINK SALMON	UNID. REMAINS	0.2	16

Year	Species	Prey species	Average prey volume (cm ³)	Count of prey
2018	PINK SALMON	INVERTEBRATES	0.1	2
2018	PINK SALMON	LOWER HETEROBRANCHIA	0.1	1
2018	PINK SALMON	MISC. NON-MARINE	0.1	5
2018	PINK SALMON	UNIDENTIFIED PLANKTON	0.1	1
2018	PINK SALMON	UNID. FISHES	0	1
2018	SHORTBELLY ROCKFISH	EUPHAUSIIDS	0.1	1
2018	SHORTBELLY ROCKFISH	UNID. REMAINS	0.1	1
2018	SHORTBELLY ROCKFISH	MYSTIDS	0	1
2018	SOCKEYE SALMON	EUPHAUSIIDS	3.5	12
2018	SOCKEYE SALMON	MYSTIDS	0.7	3
2018	SOCKEYE SALMON	TRUE CRABS	0.7	3
2018	SOCKEYE SALMON	UNID. FISHES	0.6	2
2018	SOCKEYE SALMON	AMPHIPODS	0.1	12
2018	SOCKEYE SALMON	UNID. REMAINS	0.1	2
2018	SOCKEYE SALMON	LOWER HETEROBRANCHIA	0	1
2018	SOCKEYE SALMON	UNIDENTIFIED ALGAE	0	1
2018	WALLEYE POLLOCK	UNID. REMAINS	0	2
2018	WOLF EEL	TRUE CRABS	1.1	3
2018	WOLF EEL	UNID. FISHES	0.6	4
2018	WOLF EEL	UNID. REMAINS	0	1
2018	WOLF EEL	UNIDENTIFIED ALGAE	0	1

Table 9. Biomass estimates in tonnes (coefficient of variance [CV], standard error [S.E.], 95% confidence intervals [CI]) for the upper 30 m pelagic layer for juvenile Pacific Salmon (day time tows only) and Pacific Herring (night time tows only) from the Integrated Pelagic Ecosystem Survey, July 7-August 2, 2017 aboard the MV Sea Crest and July 5-July 29, 2018 aboard the MV Nordic Pearl. If estimated lower confidence interval (CI) was negative, it is reported as zero.

Year	Species	Biomass (t)	CV	S.E.	Lower CI (t)	Upper CI (t)
2017	Chinook Salmon	9.98	0.47	0.64	0.79	19.18
	Chum Salmon	128.17	0.58	10.13	0	272.69
	Coho Salmon	79.25	0.34	3.68	26.75	131.75
	Pink Salmon	0.29	0.64	0.03	0	0.66
	Sockeye Salmon	1.61	0.72	0.16	0	3.87
	Pacific Herring	92,174.69	0.36	4717.21	26,797.55	157,551.8
2018	Chinook Salmon	8.88	0.37	0.46	2.47	15.29
	Chum Salmon	11.92	0.45	0.76	1.32	22.51
	Coho Salmon	35.97	0.33	1.64	12.95	58.98
	Pink Salmon	2.32	0.45	0.15	0.28	4.37
	Sockeye Salmon	0.8	0.44	0.05	0.1	1.49
	Pacific Herring	34,562.24	0.33	1667.39	12,397.02	56,727.46

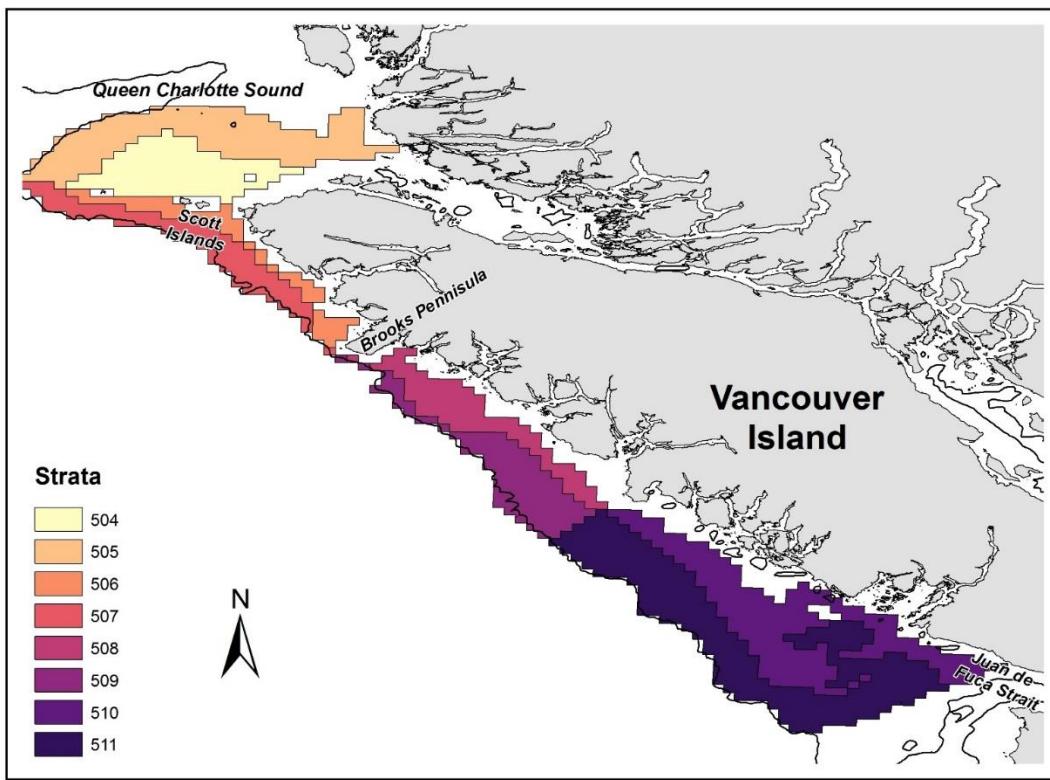


Figure 1. Survey area and strata for the Integrated Pelagic Ecosystem Survey on the Vancouver Island continental shelf.

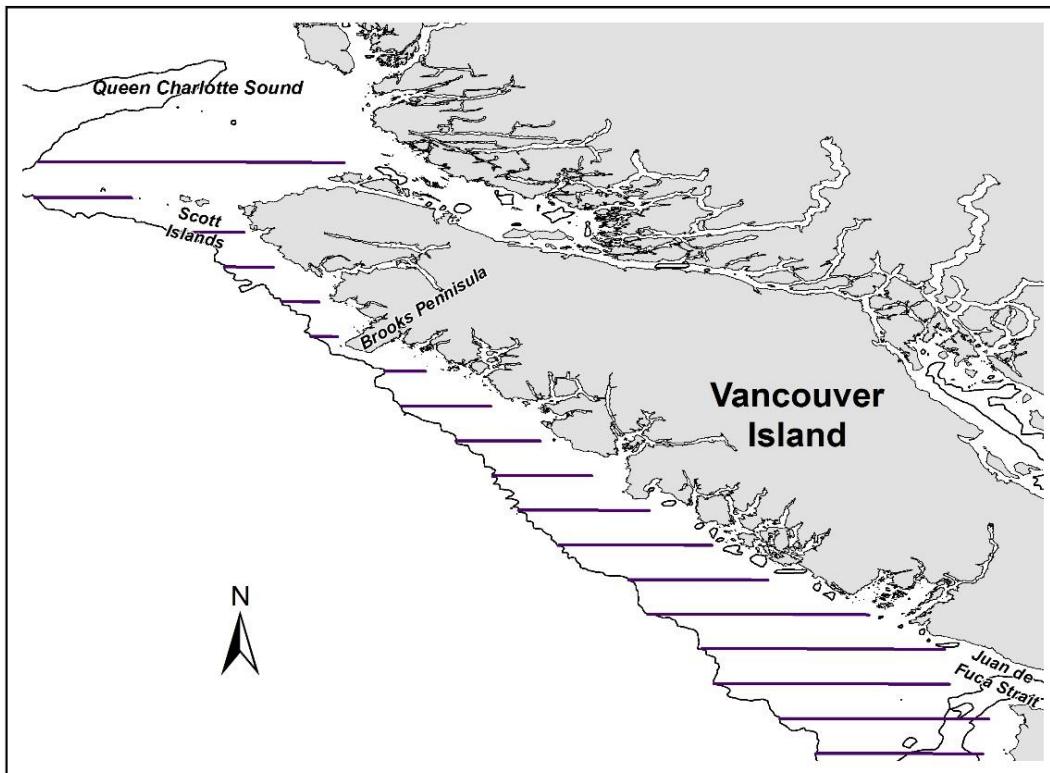


Figure 2. Transects for acoustic data collection during non-fishing hours for the 2018 Integrated Pelagic Ecosystem Survey, based on DFO's Pacific Hake survey acoustic transects. The 200 m isobath is shown with black lines. Pacific Hake survey transects extend beyond the 200 m isobath, however, on the IPES survey, data were only collected to the 200 m isobath, where time allowed.

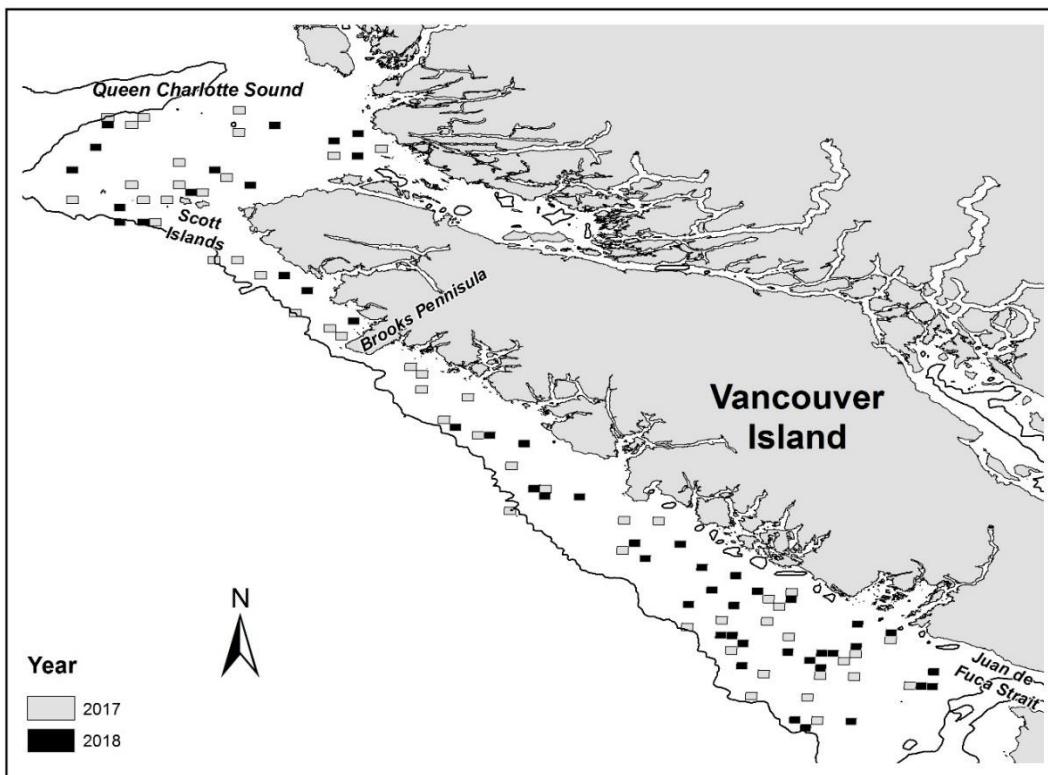
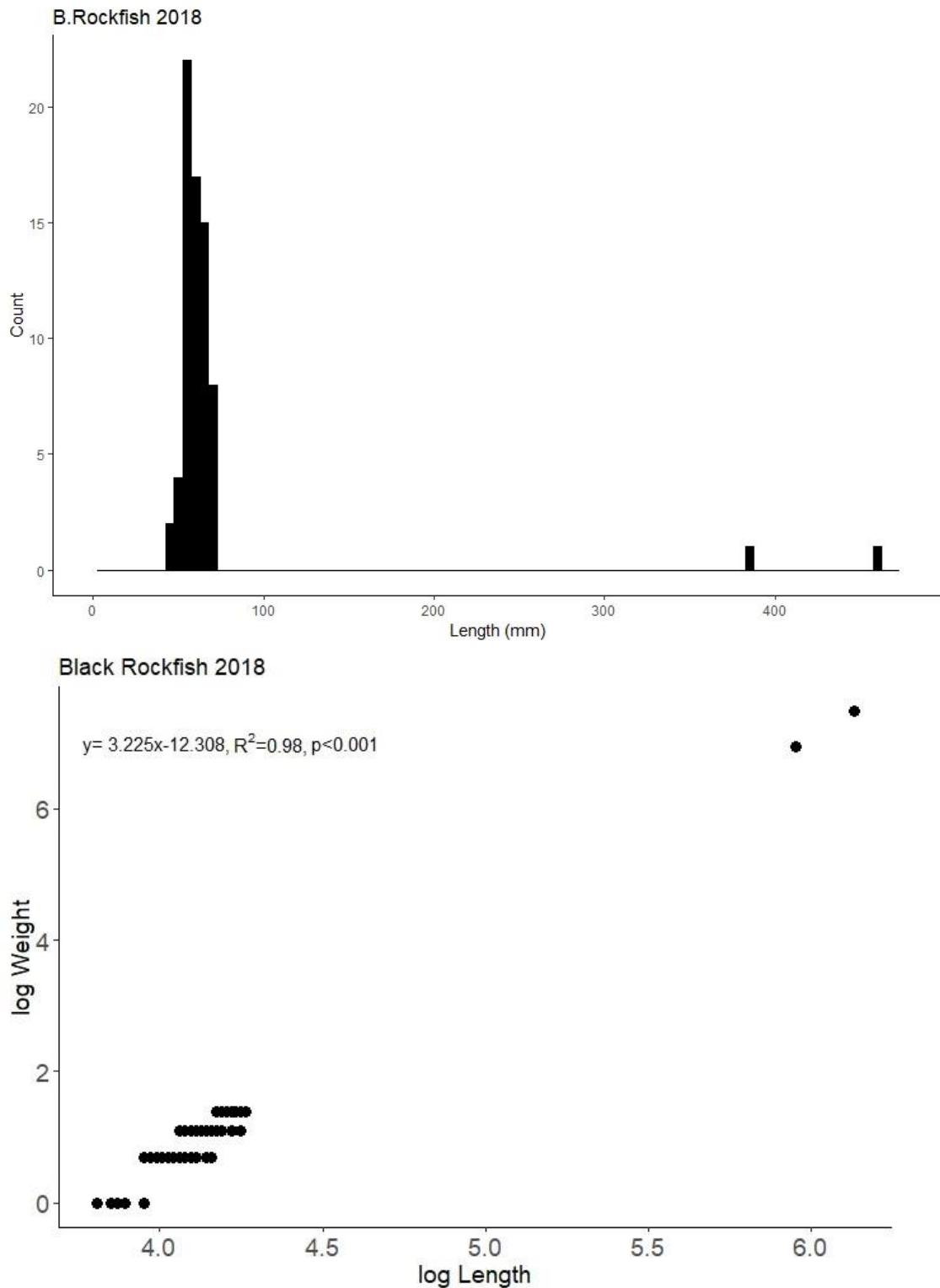


Figure 3. Blocks fished during the July 7-August 2, 2017 and July 5-July 29, 2018 Integrated Pelagic Ecosystem Surveys on the Vancouver Island continental shelf.



*Figure 4. Black Rockfish (*Sebastes melanops*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey July 5-July 29, 2018 aboard the MV Nordic Pearl (top panel). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).*

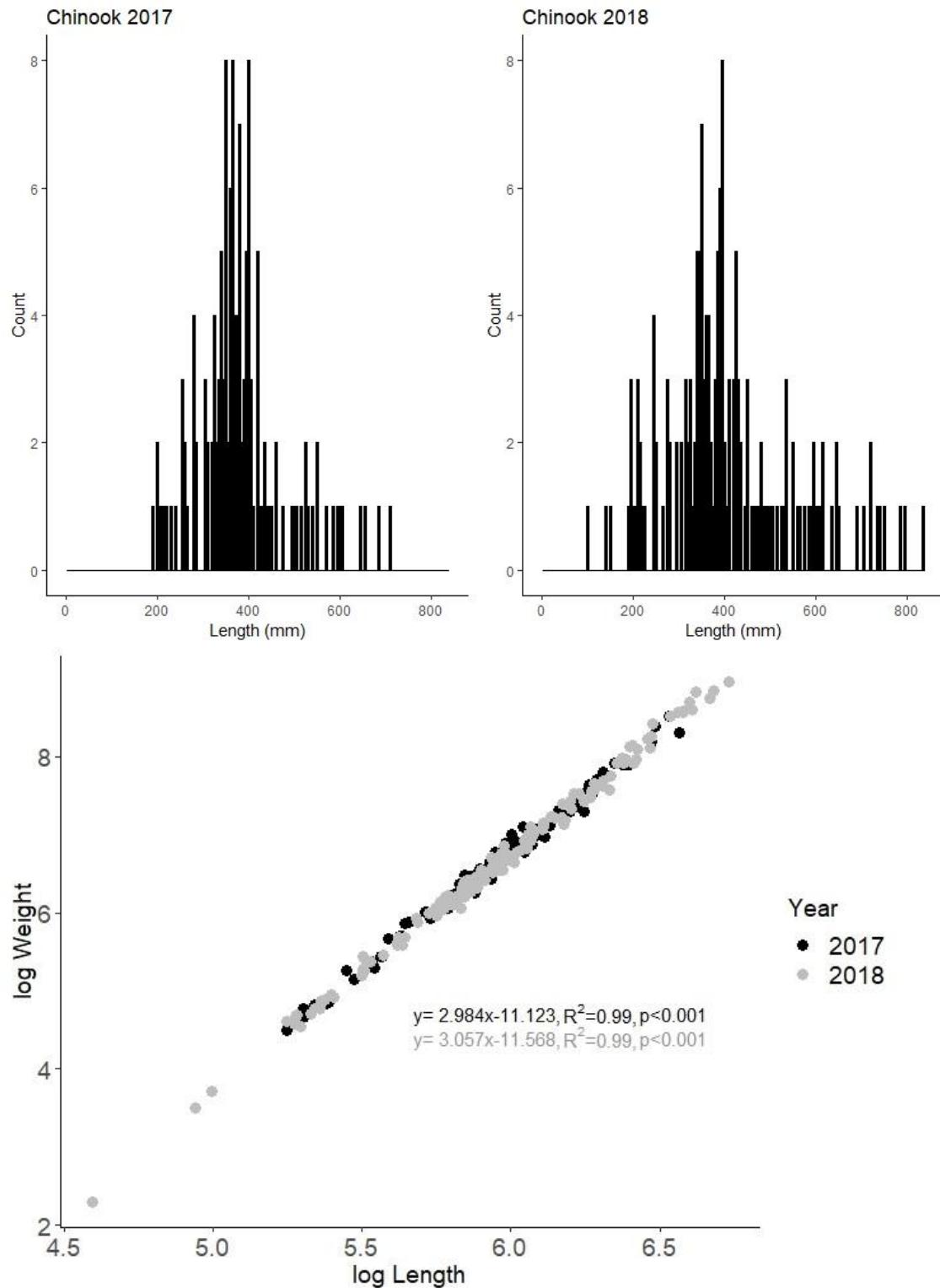


Figure 5. Chinook Salmon (*Oncorhynchus tshawytscha*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017 and July 5-July 29, 2018 aboard the MV Nordic Pearl (top panels). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).

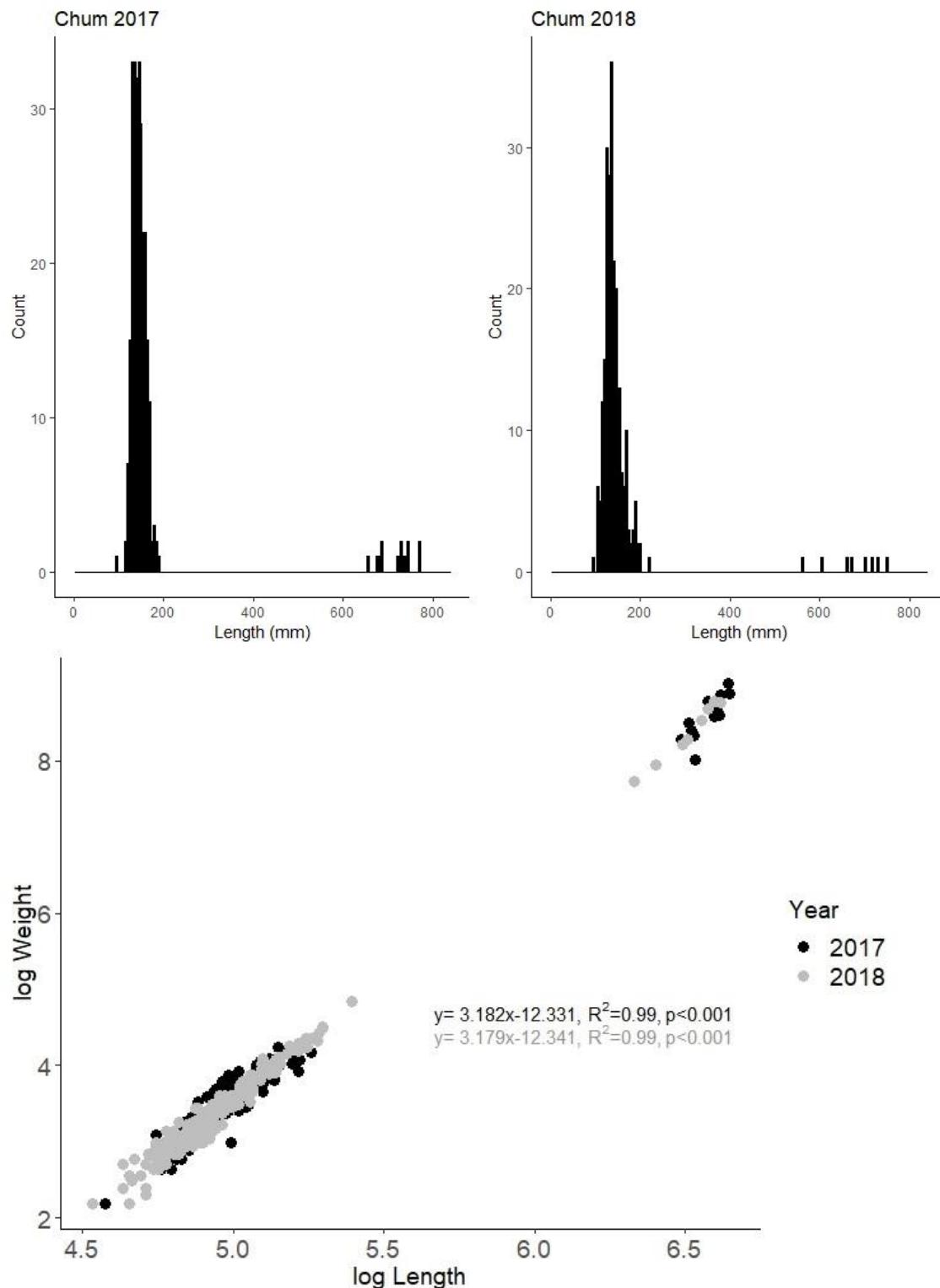


Figure 6. Chum Salmon (*Oncorhynchus keta*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017 and July 5-July 29, 2018 aboard the MV Nordic Pearl (top panels). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).

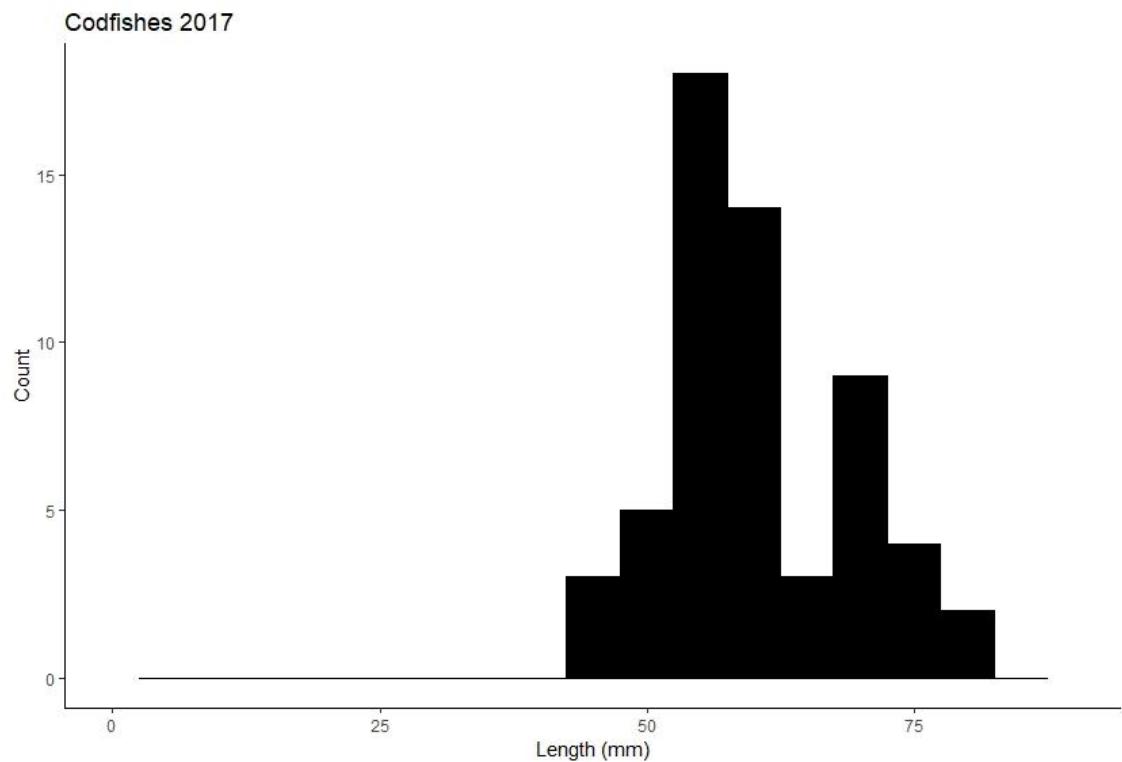
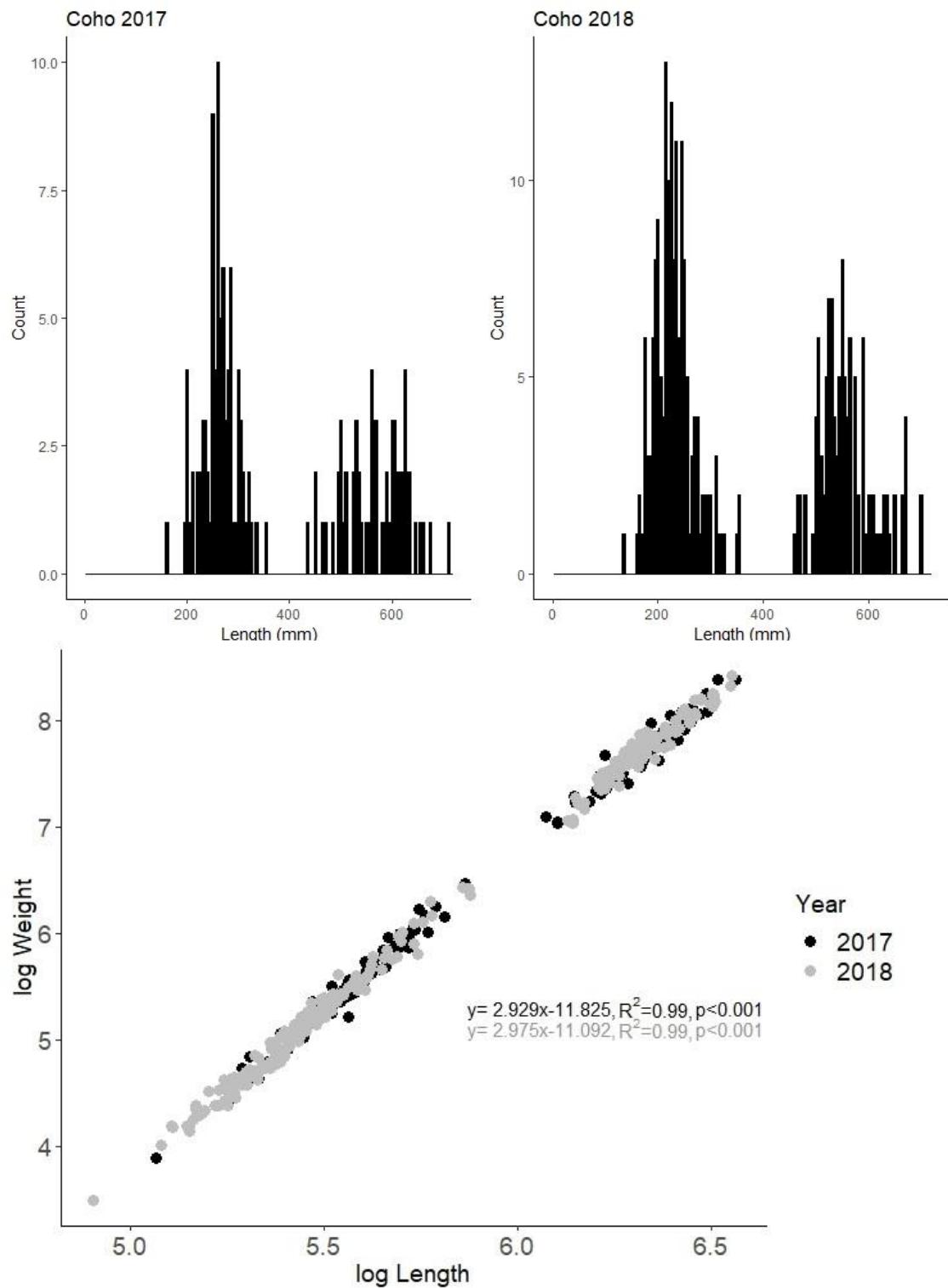


Figure 7. Unidentified young-of-year codfishes (Gadidae) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017.



*Figure 8. Coho Salmon (*Oncorhynchus kisutch*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017 and July 5-July 29, 2018 aboard the MV Nordic Pearl (top panels). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).*

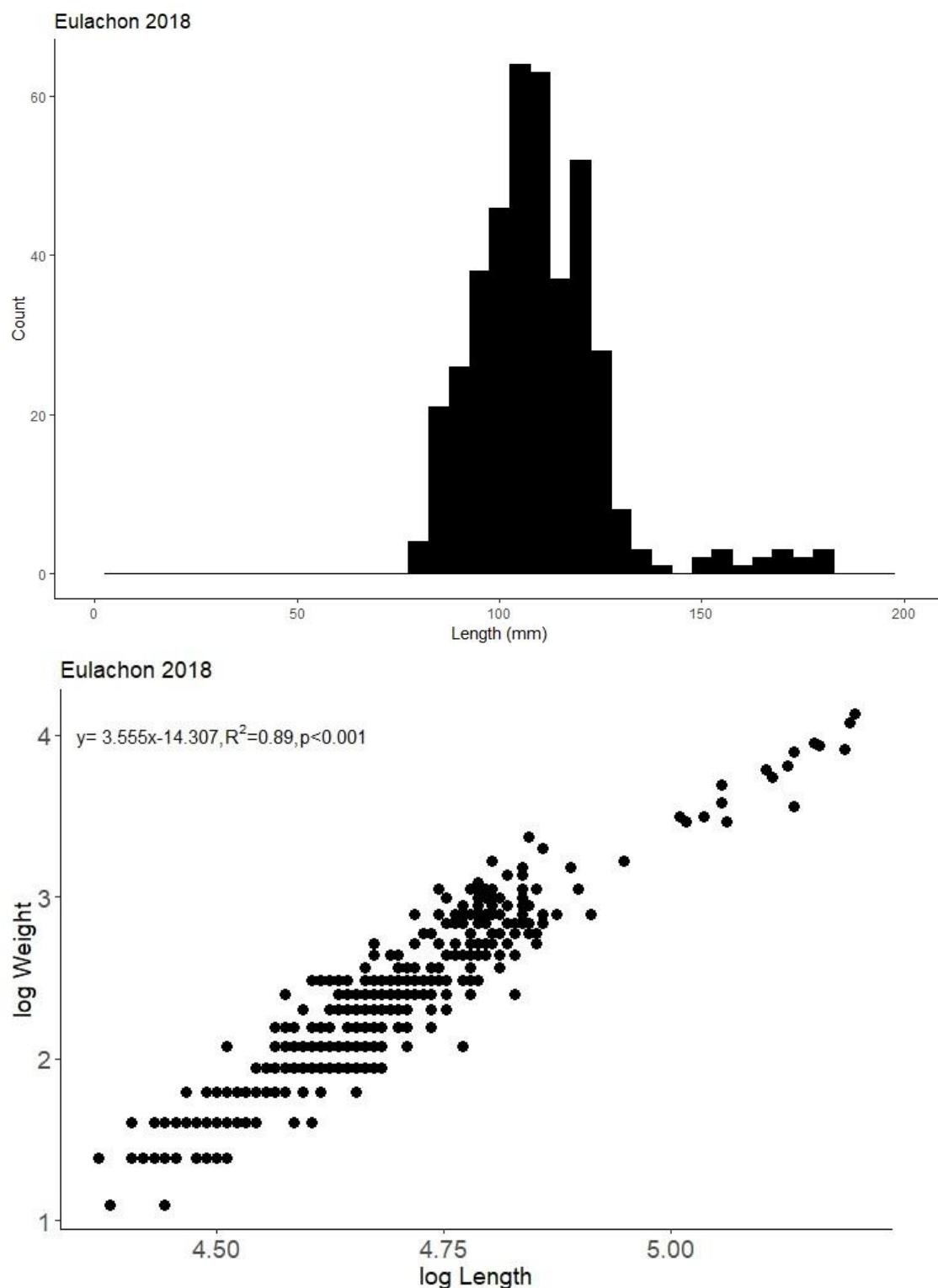


Figure 9. *Eulachon* (*Thaleichthys pacificus*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey July 5-July 29, 2018 aboard the MV Nordic Pearl (top panel). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).

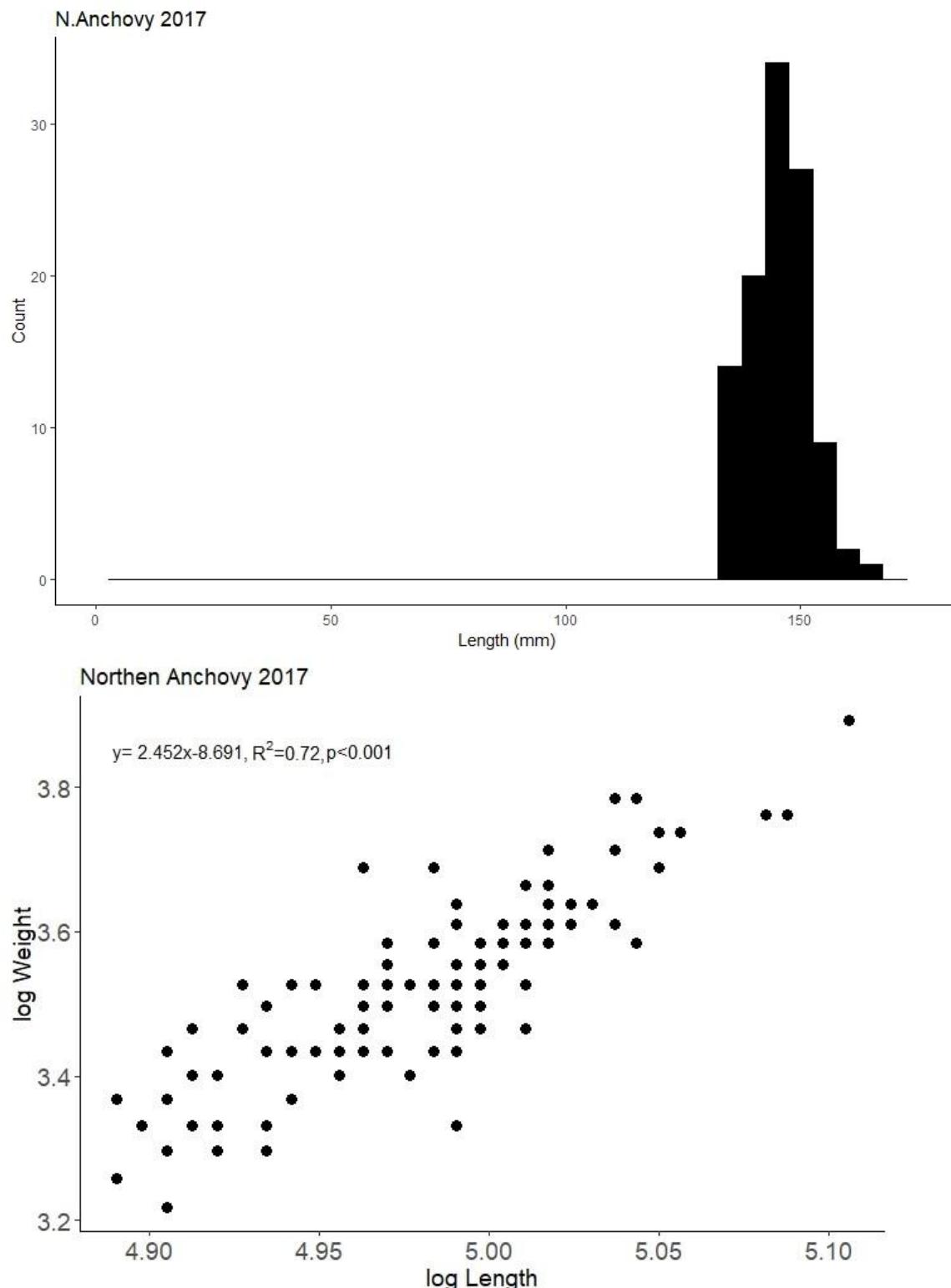


Figure 10. Northern Anchovy (*Engraulis mordax*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017 (top panel). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).

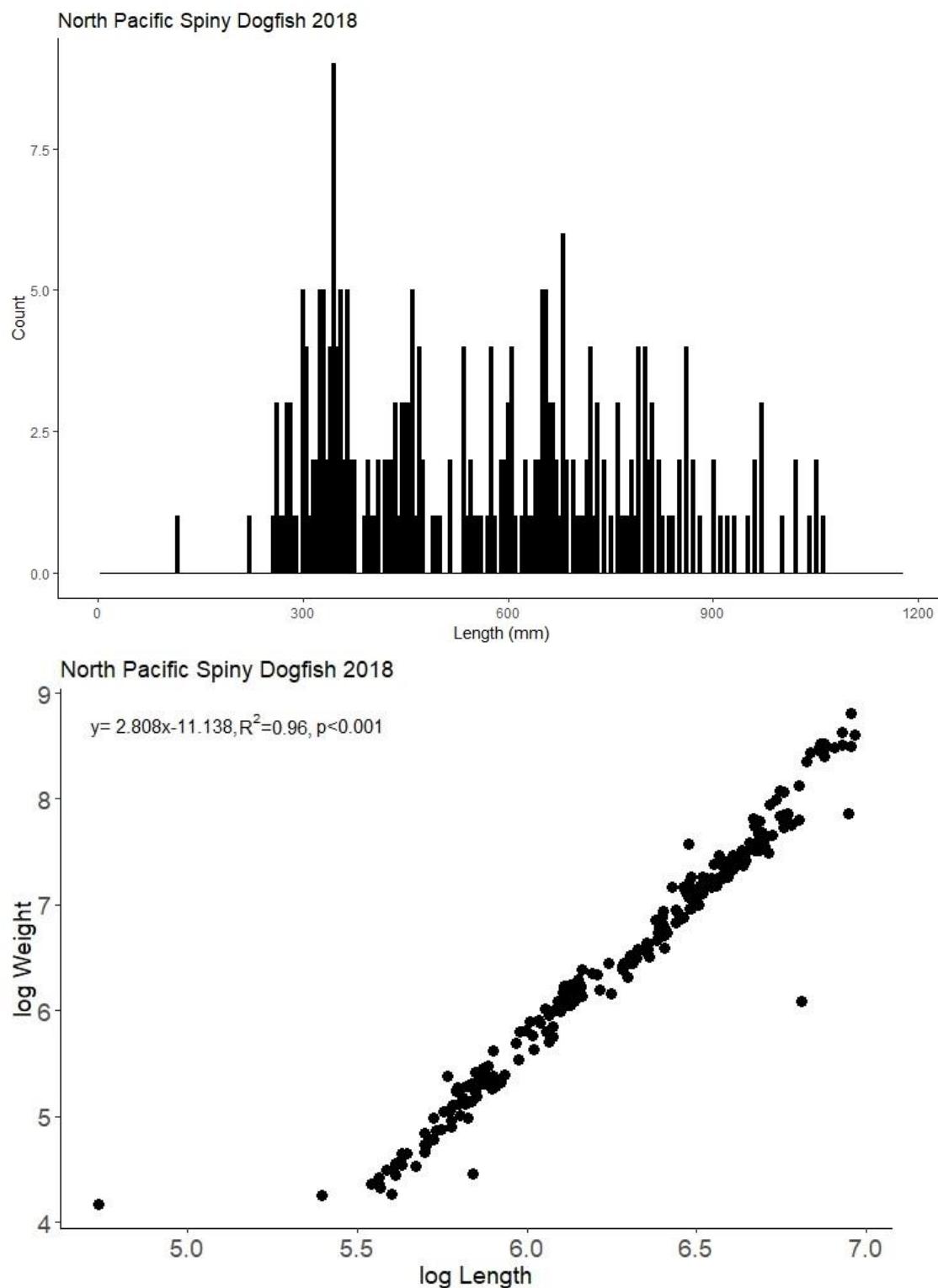


Figure 11. North Pacific Spiny Dogfish (*Squalus suckleyii*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey July 5-July 29, 2018 aboard the MV Nordic Pearl (top panel). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).

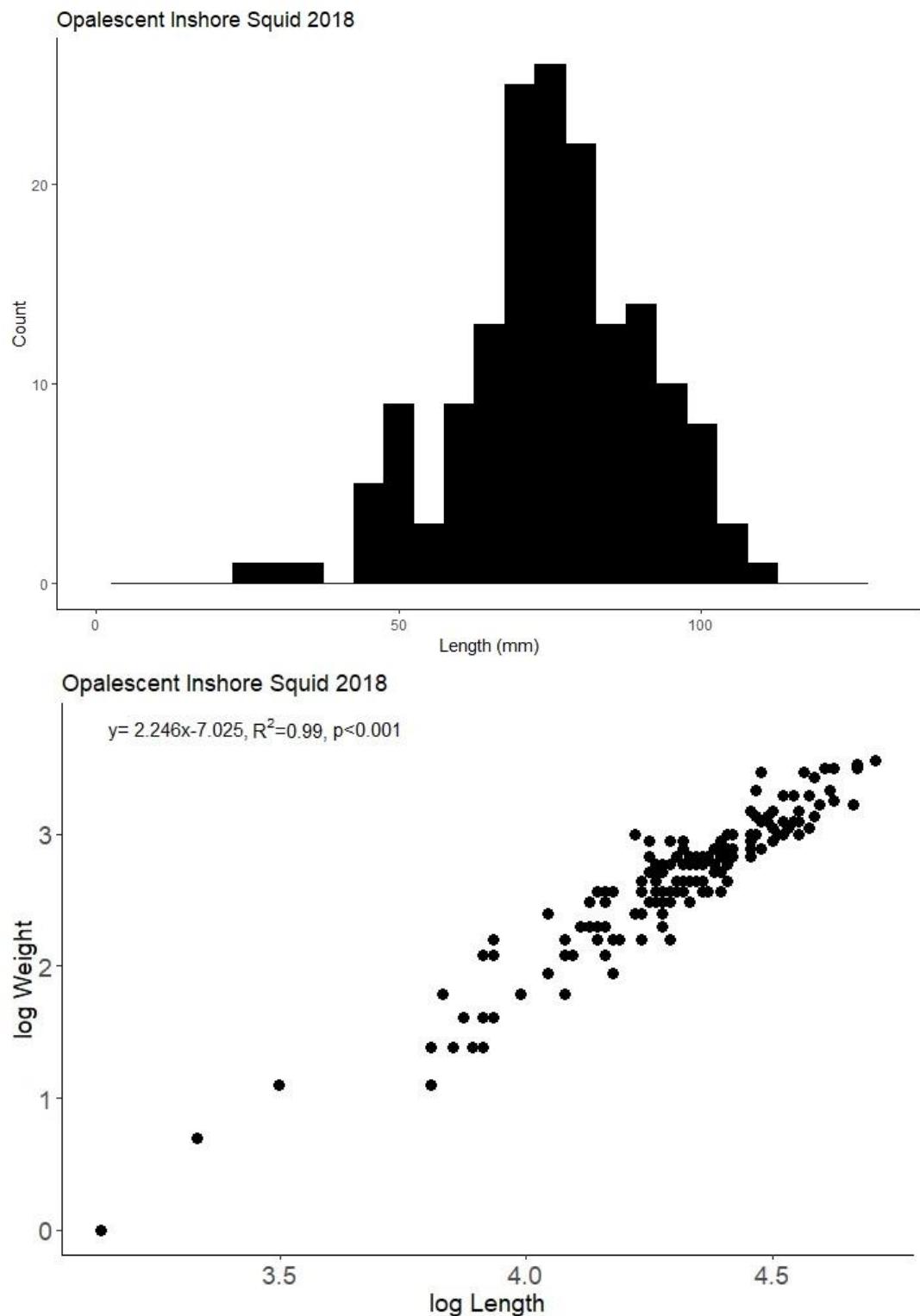


Figure 12. Opalescent Inshore Squid (*Doryteuthis opalescens*) mantle length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey July 5-July 29, 2018 aboard the MV Nordic Pearl (top panel). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).

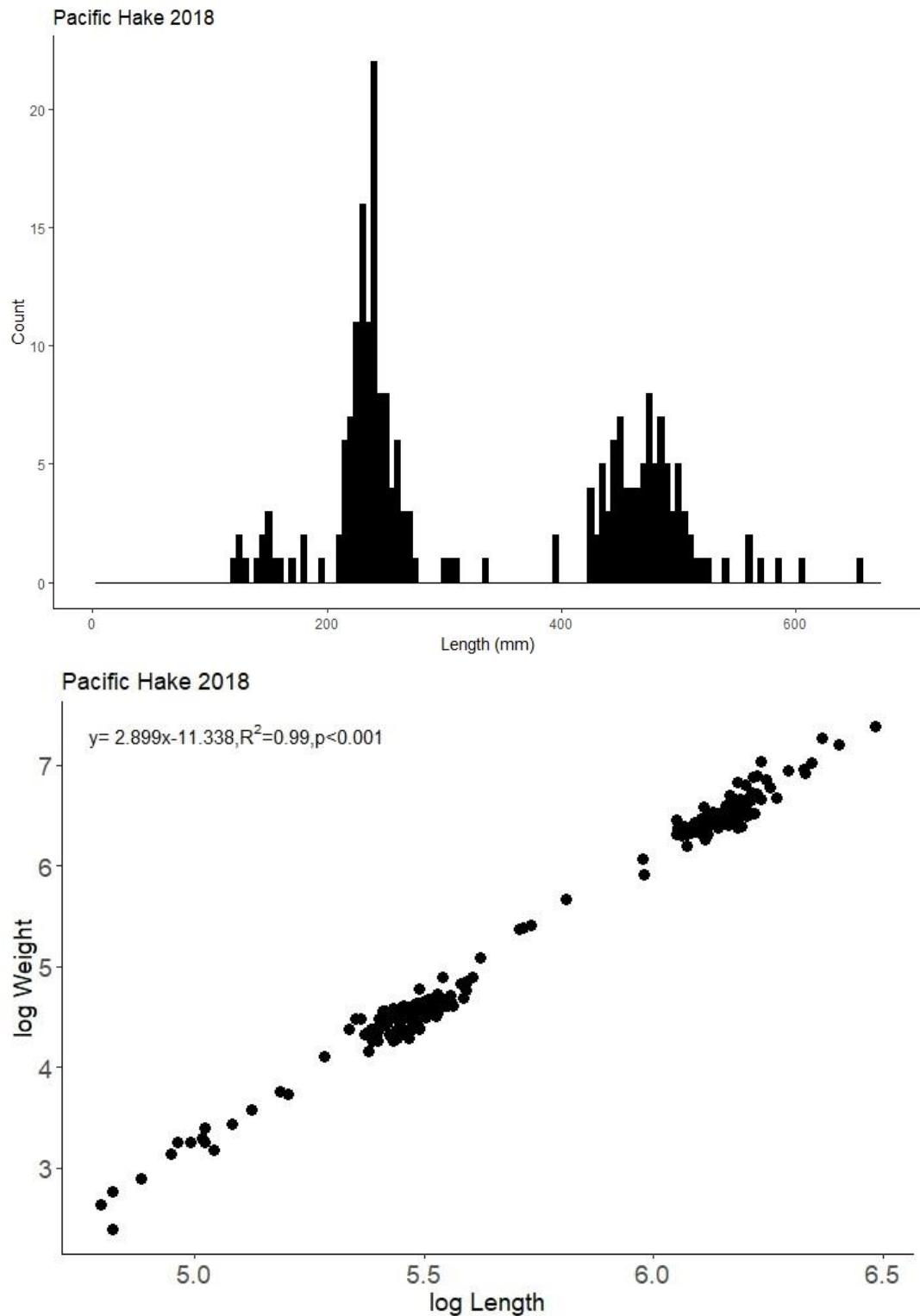


Figure 13. Pacific Hake (*Merluccius productus*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey July 5-July 29, 2018 aboard the MV Nordic Pearl (top panel). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).

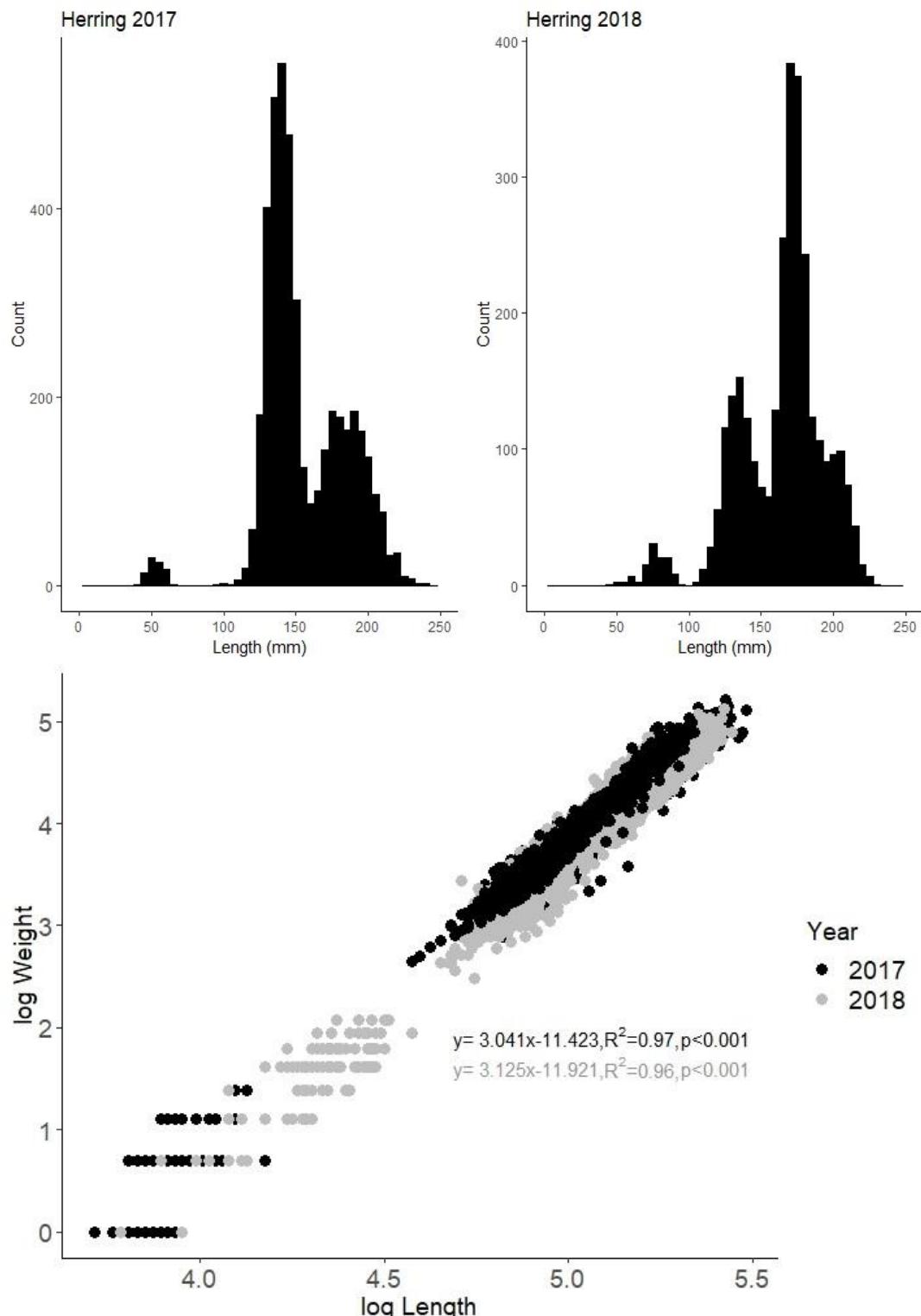


Figure 14. Pacific Herring (*Clupea pallasii*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017 and July 5-July 29, 2018 aboard the MV Nordic Pearl (top panels). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).

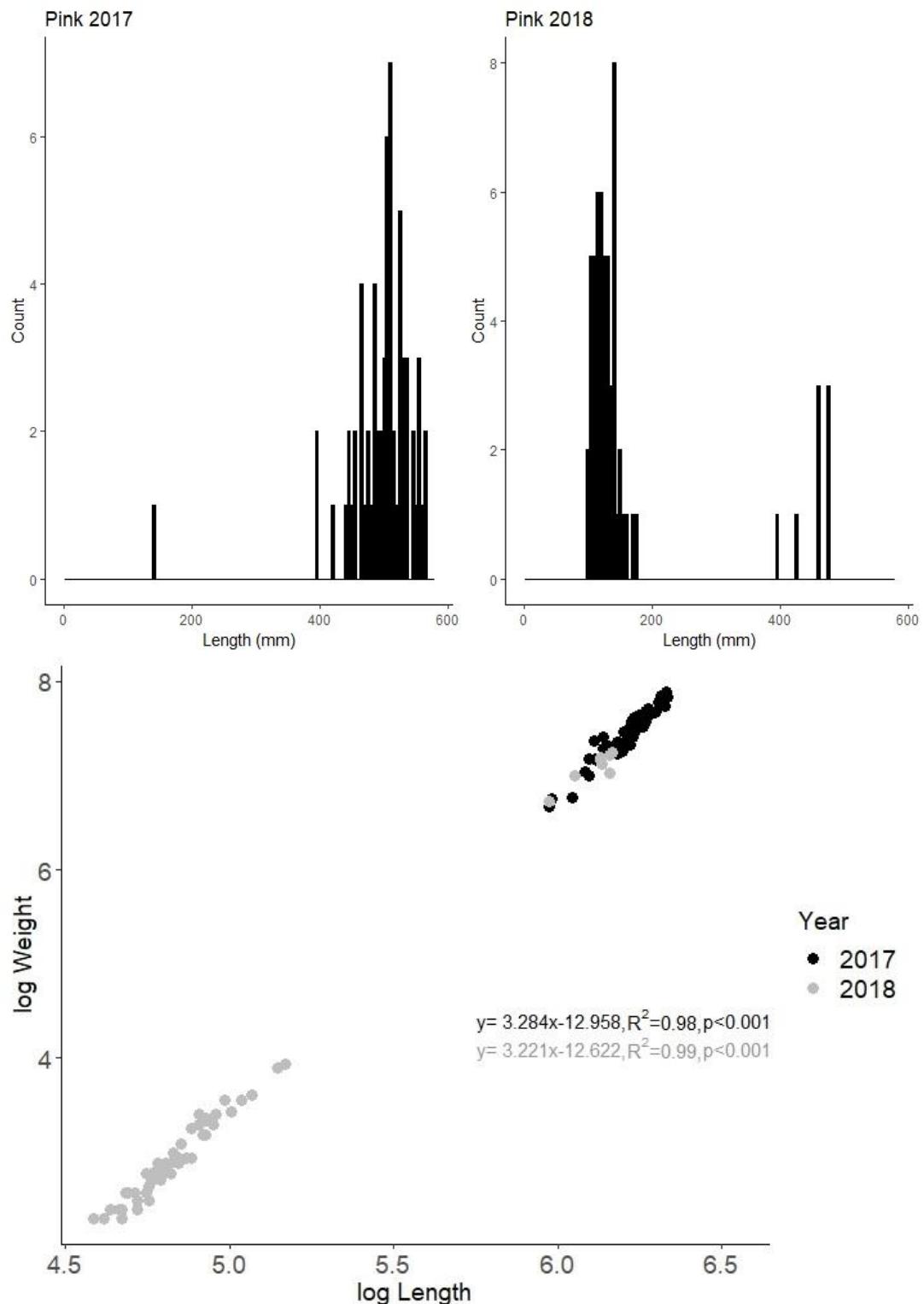


Figure 15. Pink Salmon (*Onchorhynchus gorbuscha*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017 and July 5-July 29, 2018 aboard the MV Nordic Pearl (top panels). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).

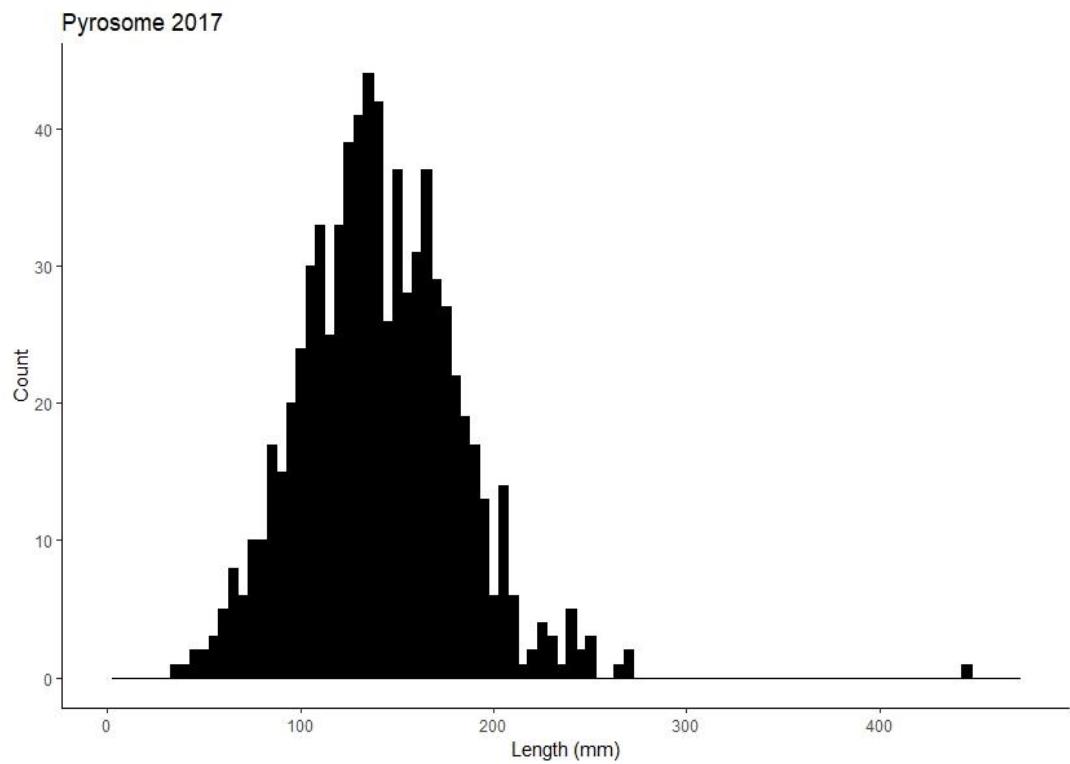


Figure 16. Pyrosome (*Pyrosoma atlanticum*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017.

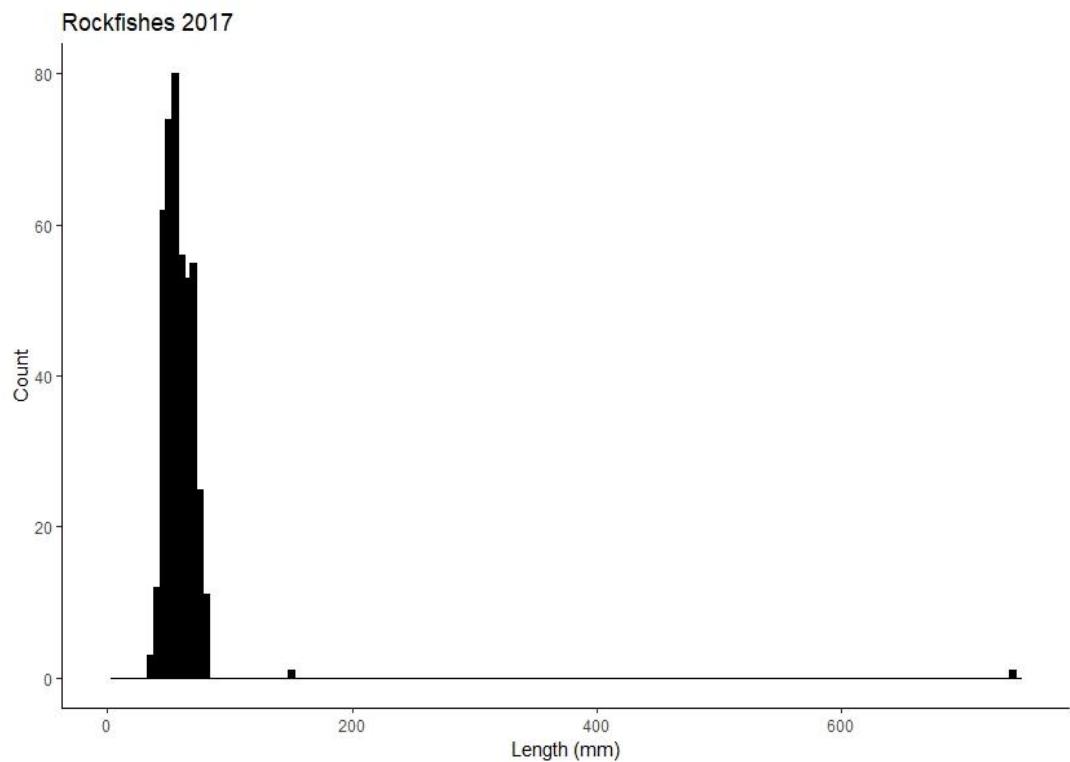


Figure 17. Unidentified young-of-year Rockfishes (*Sebastodes* spp.) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017.

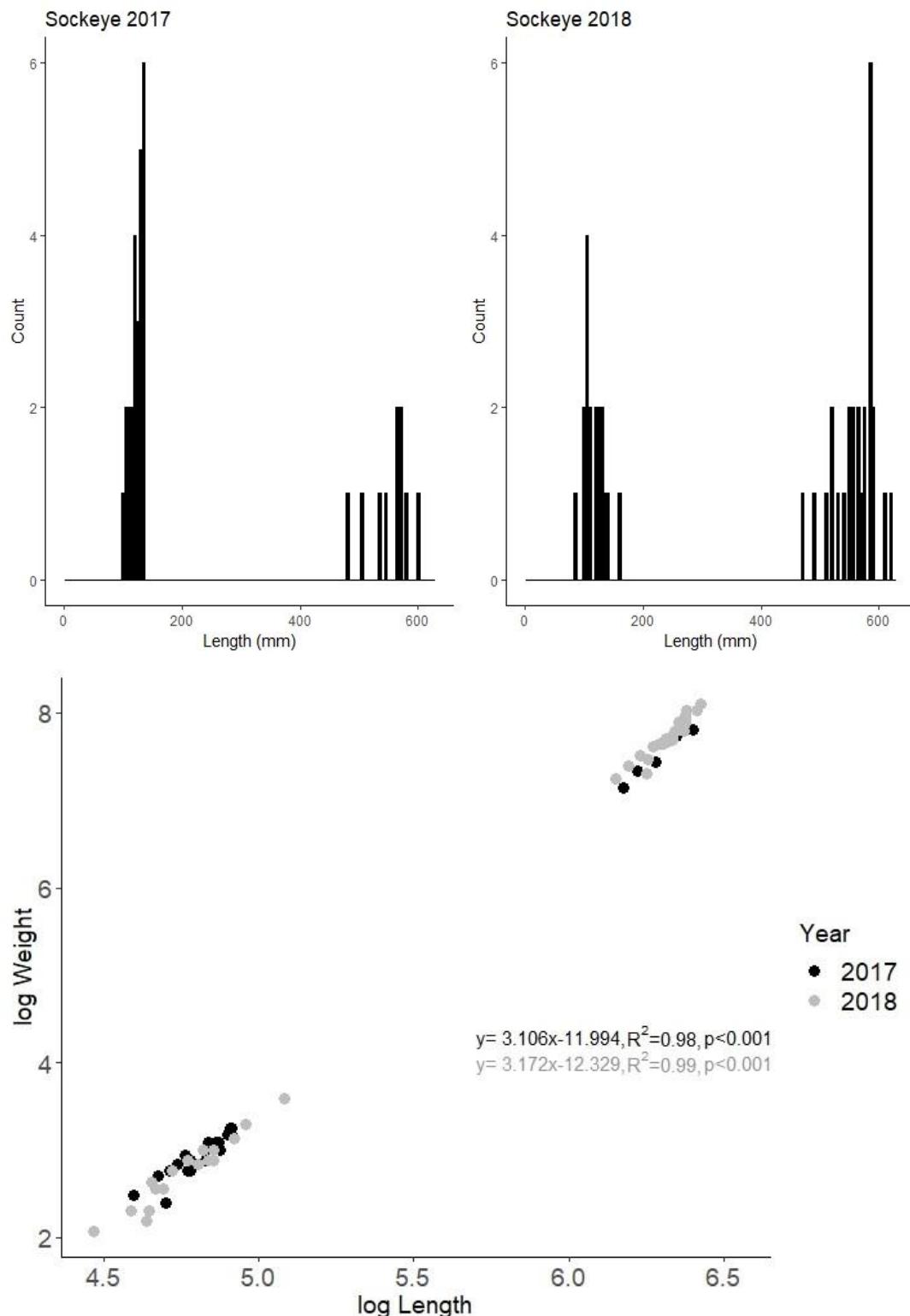


Figure 18. Sockeye Salmon (*Onchorhynchus nerka*) length frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017 and July 5-July 29, 2018 aboard the MV Nordic Pearl (top panels). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (bottom panel).

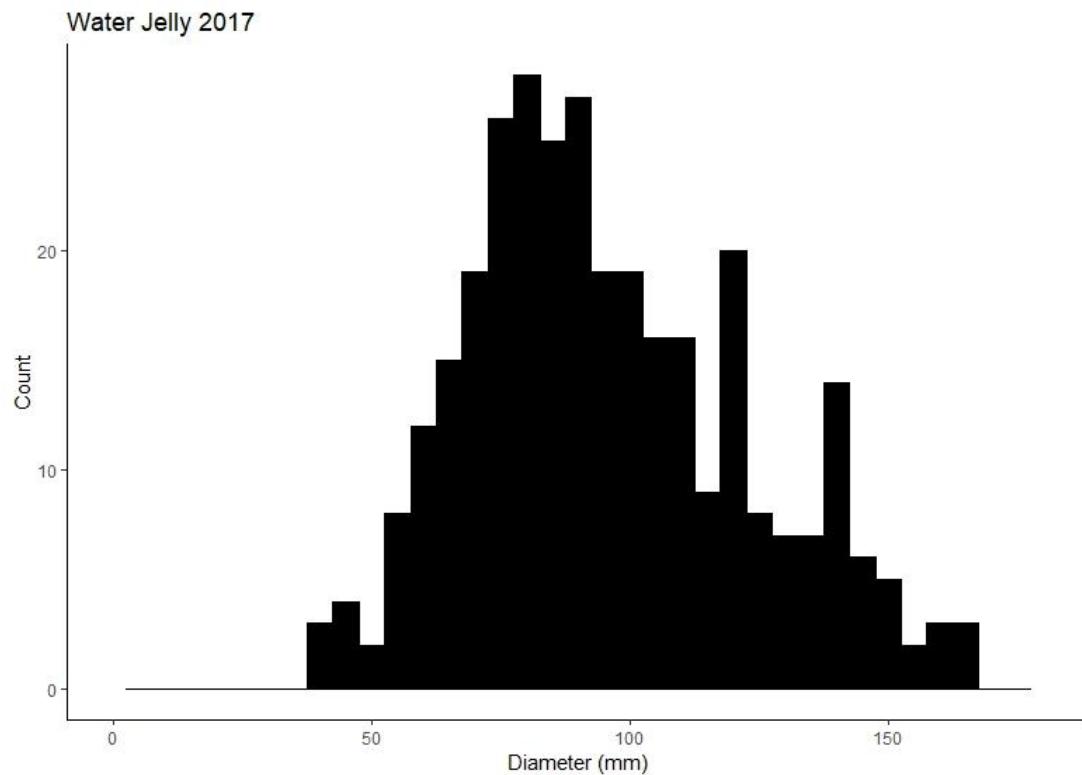


Figure 19. Water Jellyfish (*Aequorea* spp.) bell diameter frequency plots (5 mm size bins) for specimens sampled during the Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017.

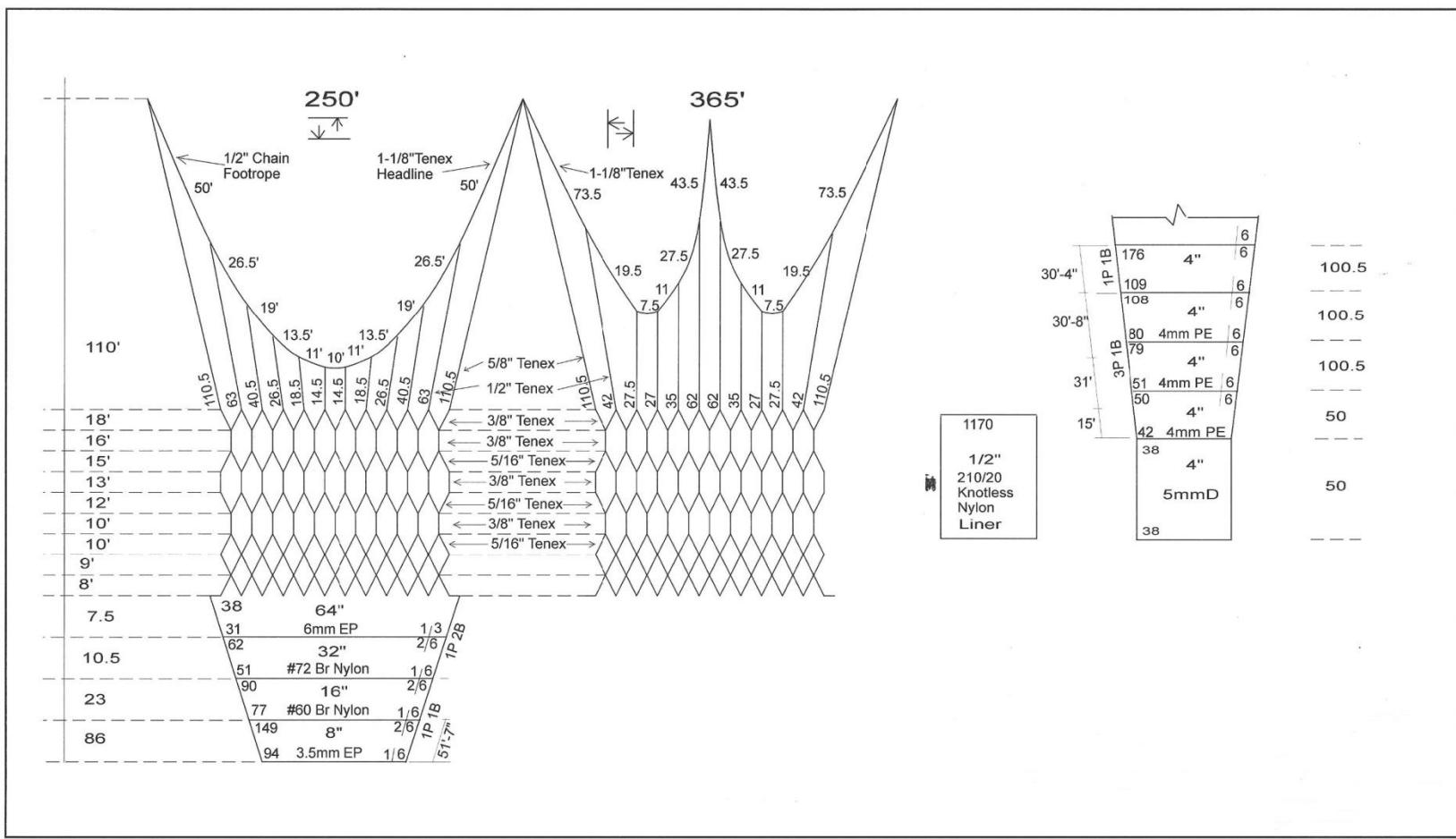
Appendix A. Nets utilized during the 2017 and 2018 Integrated Pelagic Ecosystem Surveys

Appendix Table A - 1. Net specifications for the CanTrawl 250 mid-water Trawl Net used during the 2017 Integrated Pelagic Ecosystem Survey aboard the M.V. Sea Crest, July 7-August 2, 2017.

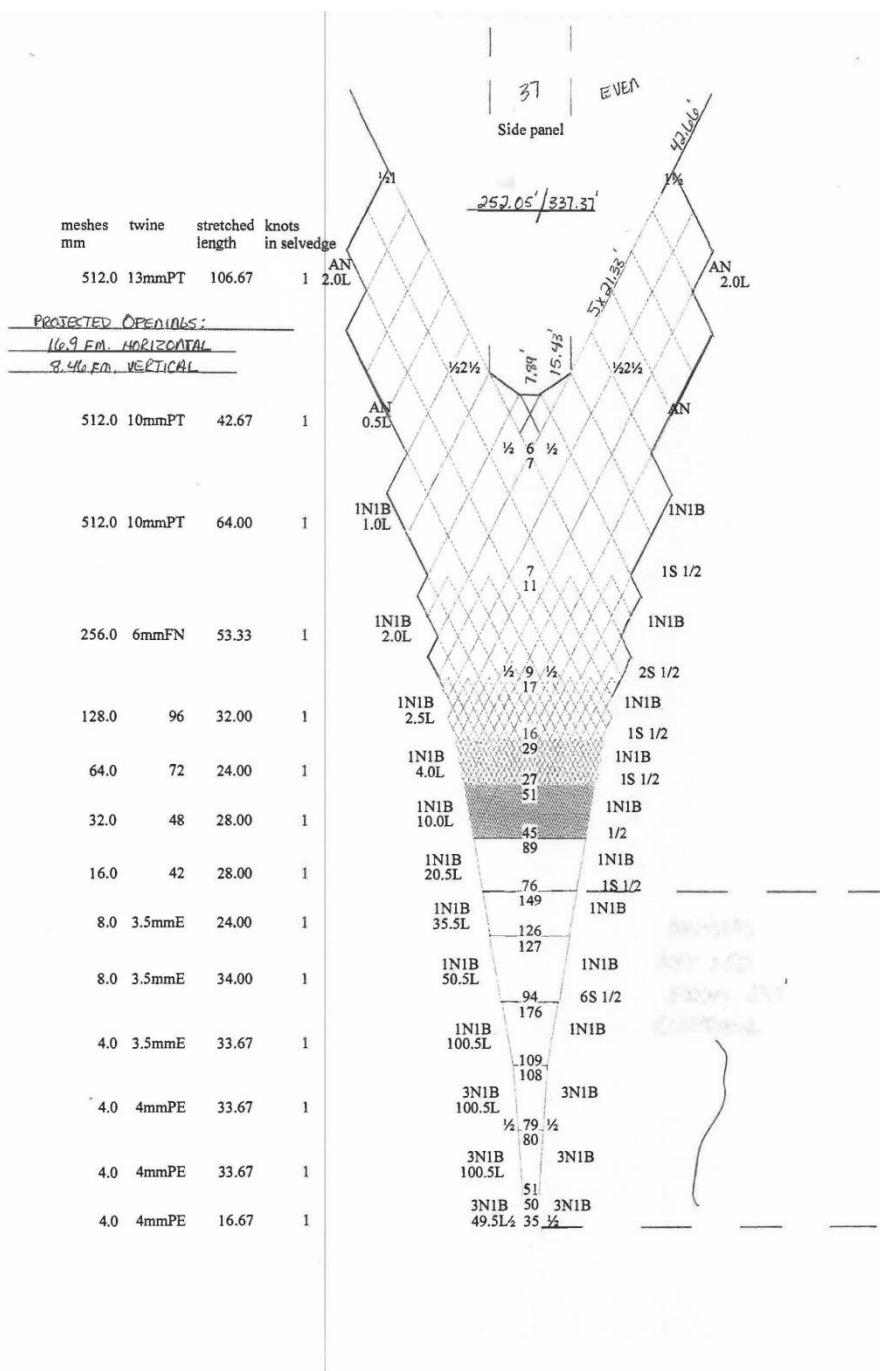
Part	Size	Material
Rigging		
Doors		Thyboron Type 15 4.5 m ²
Door Legs	12.2 m (6.67 fm)	1" Spectra rope
Bridles	45.72 m (25 fm)	5/8" wire rope
Net Frame		
Head Line	76.2 m (41.7 fm)	1 1/8" Tenex
Foot Rope		
Foot Rope	76.2 m (41.7 fm)	½" Chain
Web		
Mesh, including Codend	3.8 cm (1.5")	Knotted nylon
Codend Liner	12.7 mm (.5") stretched	210/20 knotless liner

Appendix Table A - 2. Net specifications for the LFS 7742 mid-water Trawl Net used during the 2018 Integrated Pelagic Ecosystem Survey aboard the M.V. Nordic Pearl, July 5-July 29, 2018.

Part	Size	Material
Rigging		
Doors		Thyboron Type 15 4 m ²
Door Legs	12.2 m (6.67 fm)	1" Spectra rope
Bridles	45.72 m (25 fm)	¾" TS2P Spectra rope
Net Frame		
Head Line	102.83 m (56.2 fm)	5/8" coated Spectra rope
Foot Rope		
Foot Rope	102.83 m (56.2 fm)	9/16" coated Spectra rope with 13mm chain
Web		
Mesh, including Codend	3.8 cm (1.5")	Knotted nylon
Codend Liner	12.7 mm (.5") stretched	210/20 knotless liner



Appendix Figure A - 1. Diagram of CanTrawl 250 mid-water Trawl Net used during the 2017 Integrated Pelagic Ecosystem Survey aboard the M.V. Sea Crest, July 7-August 2, 2017.



Appendix Figure A - 2. Diagram of LFS 7742 mid-water Trawl Net used during the 2018 Integrated Pelagic Ecosystem Survey aboard the M.V. Nordic Pearl, July 5-July 29, 2018.

Appendix B. The Beaufort Scale

Appendix Table B - 1. The Beaufort Scale used to describe weather conditions.

Beaufort Force	Description	Wind Speed (knots)	Sea State
0	Calm	<1	Sea like mirror
1	Light Air	1 – 3	Ripples, no foam crests
2	Light Breeze	4 – 6	Small wavelets
3	Gentle Breeze	7 – 10	Crests breaking
4	Moderate Breeze	11 – 16	Whitecaps
5	Fresh Breeze	17 – 21	Moderate waves - spray
6	Strong Breeze	22 – 27	Large waves
7	Moderate Gale	28 – 33	Sea heaps up
8	Fresh Gale	34 – 40	Moderately high waves
9	Strong Gale	41 – 47	High waves, spray
10	Whole Gale	48 – 55	Overhanging crests, sea white
11	Storm	56 – 63	Exceptionally high waves
12	Hurricane	64 – 118	Sea white

Appendix C. Sardine Maturity Code Convention

Appendix Table C - 1. Description of maturity stages for Pacific sardine maturity determination.

MATURITY CODE	APPEARANCE	MATURITY	DESCRIPTION
1	torpedo-shaped	F - immature	Clearly Immature: oocytes not visible, ovary is very small, translucent/clear, and thin but with rounded edges (torpedo shape).
2	oocytes not visible	F - intermediate	Intermediate: Individual oocytes are not visible to unaided eye (no visible yolk or hydrate oocytes in the ovaries) and ovary is not Clearly immature. Includes possible maturing and regressed ovaries.
3	oocytes visible	F - active	Active: Yolked oocytes visible, any size or amount as long as you can see them by the unaided eye in ovaries. This includes the smaller opaque oocytes (around 0.4-0.5 mm) to the large yellowish oocytes (about 0.6-0.8mm). If hydrated oocytes are also present
4	hydrated oocytes	F - mature	Hydrated oocytes present, yolked oocytes may, or not, also be seen; any amount of hydrated oocytes (large and transparent) qualifies for this class from few to many or even if loose or "oozing/running" from ovary.
5	knife-shaped	M - immature	Clearly Immature: testis is very small, knife-shaped, translucent/clear, thin with a flat ventral edge
6	no milt present	M - intermediate	Intermediate: no milt evident and is not clearly immature; includes maturing or regressed testes
7	milt present	M - mature	Milt is present: either oozing from pore, in the duct, or when testis is cut with a knife
8	unknown	unknown	Unknown

Appendix D. Shark Sampling Protocol for use on DFO Research Surveys

DFO SHARK SAMPLING PROTOCOL

When handling live sharks be careful. They will normally calm down when their eyes are covered.

FOR LIVE OR DEAD SHARKS:

1. TAKE PHOTOS (ONE PER SPECIES PER TOW)

Side views of:

- whole shark alongside measuring tape
- head & gill openings
- tail fin

Ventral views of:

- claspers of males

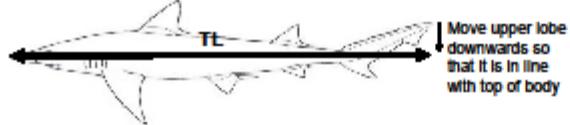
TO KEEP TRACK OF PHOTOS

Include a piece of paper in the photo with:

- Species
- Tow

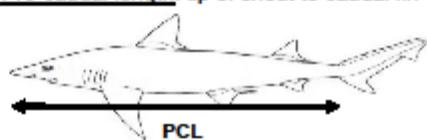
2. RECORD LENGTHS

- Total length: tip of snout to tip of upper lobe of caudal fin with fin in a straight line with top of body



AND

- Pre-caudal length: tip of snout to caudal fin

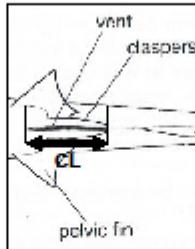


3. RECORD SEX

- Males have claspers associated with pelvic fin

IF TIME PERMITS ALSO RECORD:

- Clasper length (CL) and note if they are rigid or red



- Females do not have claspers

4. COLLECT DNA TISSUE SAMPLE

- clip 1 cm of tissue from any fin tip
- place in vials with ethanol and record vial number

FOR DEAD SHARKS (Can be subsampled if > 20 sharks in tow):

5. PRESENCE AND SAMPLING OF PUPS

- number of pups

IF TIME PERMITS RECORD OR COLLECT:

- total length (cm) of pups
- muscle tissue from pups (see 7 below)—can be subsampled if there are >10 pups
- Pup numbers can be Mother's fish number + P1, P2, etc.

6. SAMPLE AND RECORD STOMACH CONTENTS

- Sort and identify to lowest taxonomic group you feel confident with
- For each prey group or item measure a) volume (L) and/or length (mm)
- For each prey group or item record digestion state as Fresh, Partial or Well

7. COLLECT MUSCLE TISSUE

- the size of an ice cube (about 1 cm³)
- freeze in a small ziploc provided and label

LABEL ALL FROZEN SAMPLES

- Species
- Fish number (P1, P2 etc if pups)
- Date collected
- Tow number

Appendix E. Raw data from the 2017 and 2018 Integrated Pelagic Ecosystem Surveys

Appendix Table E - 1. Bridge log information for trawl tows from the 2017 Integrated Ecosystem Pelagic Survey aboard the MV Sea Crest, July 7 - August 2, 2017. Beaufort Scale code for sea state definitions are provided in Appendix B.

Tow Number	25	26	27	28	29	30	31	32
Date	12-Jul-17	12-Jul-17	13-Jul-17	13-Jul-17	13-Jul-17	13-Jul-17	13-Jul-17	13-Jul-17
Event Number	25	26	27	28	29	30	31	32
Stratum	504	504	507	506	504	506	507	507
Block Number	10524	10524	10269	10275	10405	10277	9901	9901
Start Time (PDT)	20:25	22:37	1:46	3:55	16:09	17:52	19:45	22:26
Duration (min)	18	20	20	11	20	21	21	21
Start Latitude	50°53'14 N	50°53'27 N	50°49'57 N	50°48'43 N	50°50'50 N	50°50'17 N	50°43'24 N	50°43'19 N
Start Longitude	128°57'17 W	128°55'58 W	129°13'01 W	128°51'59 W	128°35'00 W	128°45'06 W	128°48'49 W	128°49'33 W
End Latitude	50°54'13 N	50°54'31 N	50°48'39 N	50°49'12 N	50°51'55 N	50°49'04 N	50°42'11 N	50°41'58 N
End Longitude	128°58'16 W	128°58'02 W	129°12'32 W	128°51'49 W	128°36'22 W	128°46'59 W	128°50'35 W	128°49'57 W
Distance Towed (km)	2.14	--	2.47	0.92	2.57	3.15	3.05	2.54
Direction of Tow (°)	328	327	167	11	321	224	222	191
Vessel Speed (km/h)	7.7	9.3	7.3	9.8	7.4	9.3	9.5	7.6
Swell Height (m)	--	--	--	--	--	--	--	--
Beaufort Scale	--	--	--	--	2	2	2	--
Cloud Cover (%)	--	--	--	--	--	--	--	--
Bottom depth (m)	91	75	92	55	50	61	138	142
Net Opening Height (m)	13	13	13	13	13	13	13	12
Door Spread (m)	73	73	55	60	55	59	70	77
Target Headrope Depth (m)	15	15	0	15	0	0	15	15
Usable	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes

64

65

Tow Number	105	106
Date	31-Jul-17	01-Aug-17
Event Number	105	106
Stratum	510	511
Block Number	2585	2837
Start Time (PDT)	0:00	2:31
Duration (min)	21	20
Start Latitude	48°32'51 N	48°36'52 N
Start Longitude	125°40'20 W	125°32'23 W
End Latitude	48°32'14 N	48°35'58 N
End Longitude	125°38'25 W	125°30'56 W
Distance Towed (km)	--	2.44
Direction of Tow (°)	98	131
Vessel Speed (km/h)	7.8	7.2
Swell Height (m)	2	1.5
Beaufort Scale	--	--
Cloud Cover (%)	--	--
Bottom depth (m)	71	133
Net Opening Height (m)	13	13
Door Spread (m)	71	55
Target Headrope Depth (m)	15	0
Usable	Yes	Yes

Appendix Table E - 2. Bridge log information for trawl tows from the 2018 Integrated Ecosystem Pelagic Survey aboard the MV Nordic Pearl, July 5 – July 29, 2018. Beaufort Scale code for sea state definitions are provided in Appendix B.

75

Tow Number	49	50	51	52	53	54	55	56
Date	18-Jul-18	18-Jul-18	18-Jul-18	18-Jul-18	19-Jul-18	19-Jul-18	20-Jul-18	20-Jul-18
Event Number	103	106	109	112	113	114	115	117
Stratum	511	511	511	511	511	510	511	510
Block Number	3698	3451	3202	3202	3451	3588	3463	3341
Start Time (PDT)	16:11	18:11	20:07	22:31	0:32	16:05	16:40	18:29
Duration (min)	20	20	20	20	20	21	20	21
Start Latitude	48°54'13 N	48°49'23 N	48°44'45 N	48°45'11 N	48°49'05 N	48°49'52 N	48°48'12 N	48°45'29 N
Start Longitude	126°18'12 W	126°07'55 W	126°04'52 W	126°04'28 W	126°07'34 W	125°28'02 W	125°28'47 W	125°18'43 W
End Latitude	48°53'02 N	48°48'11 N	48°43'29 N	48°44'01 N	48°48'02 N	48°48'44 N	48°47'11 N	48°44'38 N
End Longitude	126°16'37 W	126°06'40 W	126°03'37 W	126°02'56 W	126°05'51 W	125°26'27 W	125°27'10 W	125°16'52 W
Distance Towed (km)	2.91	2.69	2.79	2.87	2.87	2.87	2.73	2.77
Direction of Tow (°)	136	143	145	137	131	135	131	122
Vessel Speed (km/h)	8.5	7.8	8.2	8.4	8.3	8.3	8.0	8.1
Swell Height (m)	1	1.5	--	1	--	2.2	1.8	--
Beaufort Scale	4	3	3	--	4	5	4	4
Cloud Cover (%)	10	10	10	10	--	50	20	20
Bottom depth (m)	146	112	112	105	108	98	105	93
Net Opening Height (m)	11.3	17.4	16.8	19	18	11.3	6	6
Door Spread (m)	80	74.1	76	66.3	63	82	87	74.3
Target Headrope Depth (m)	15	0	0	0	0	15	15	15
Usable	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes

80

81

Tow Number	97	98
Date	27-Jul-18	28-Jul-18
Event Number	197	198
Stratum	511	511
Block Number	2961	3088
Start Time (PDT)	23:31	0:47
Duration (min)	18	20
Start Latitude	48°38'07 N	48°41'49 N
Start Longitude	125°36'01 W	125°29'15 W
End Latitude	48°39'07 N	48°40'54 N
End Longitude	125°34'57 W	125°27'29 W
Distance Towed (km)	2.28	2.76
Direction of Tow (°)	33	126
Vessel Speed (km/h)	7.7	8.1
Swell Height (m)	1.5	1.2
Beaufort Scale	2	2
Cloud Cover (%)	100	--
Bottom depth (m)	85	155
Net Opening Height (m)	11	16
Door Spread (m)	79.5	75
Target Headrope Depth (m)	15	0
Usable	Yes	Yes

Appendix Table E - 3. Bridge log information for CTD casts and vertical zooplankton tows on the 2017 Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017.

Date	Stratum	Block	CTD Event			Bongo Event		
			Start Time (PDT)	Bottom Depth (m)	Gear Depth (m)	Start Time (PST)	Bottom Depth (m)	Gear Depth (m)
08-Jul-17	505	11170	17:50	100	90	18:00	95.4	90
08-Jul-17	505	11041	20:18	141	130	20:29	142	130
09-Jul-17	505	11668	23:53	117	105	0:36	11	105
09-Jul-17	504	10657	17:14	76	65	17:20	74	65
09-Jul-17	504	10528	21:15	83	70	21:23	82	70
10-Jul-17	505	11647	16:59	161	150	17:09	155	150
10-Jul-17	505	11650	19:15	122	110	19:23	122	110
10-Jul-17	505	11399	22:20	112	100	22:31	113	100
11-Jul-17	505	11783	16:19	125	110	16:28	122	110
11-Jul-17	505	11408	18:31	189	150	18:39	189	150
11-Jul-17	504	10903	21:24	66	55	21:31	66	55
12-Jul-17	507	10269	17:03	106	95	17:11	100	90
12-Jul-17	504	10524	21:19	66	55	21:26	66	55
13-Jul-17	506	10275	4:35	62	50	4:39	69	50
13-Jul-17	504	10405	16:55	55	45	17:02	54	--
13-Jul-17	506	10277	18:39	55	45	18:45	58	45
13-Jul-17	507	9901	20:34	179	150	20:43	180	150
14-Jul-17	507	9035	16:49	168	150	16:59	168	150
14-Jul-17	507	9283	18:24	182	150	18:33	182	150
14-Jul-17	507	9281	20:07	194	150	20:19	195	150
15-Jul-17	507	8413	17:36	152	140	17:45	149	140
15-Jul-17	506	8166	21:30	57	45	21:37	56	45
15-Jul-17	506	8042	23:42	65	55	23:48	50	40
16-Jul-17	508	7548	16:51	56	45	16:57	55	45
16-Jul-17	508	7424	18:15	52	40	18:20	52	40
16-Jul-17	508	7174	20:06	75	65	20:14	79	65
17-Jul-17	509	6429	16:55	125	115	17:03	125	115
17-Jul-17	508	6676	18:52	82	72	18:59	82	72
17-Jul-17	508	7053	21:08	70	60	21:15	70	60
18-Jul-17	509	5182	17:14	156	140	17:24	157	140
18-Jul-17	509	5560	19:19	118	105	19:28	118	105
18-Jul-17	509	5932	21:36	128	115	21:45	128	115
20-Jul-17	510	3957	16:49	52	40	16:55	52	40
20-Jul-17	510	3830	18:57	51	40	19:02	52	40
20-Jul-17	510	3706	20:31	51	40	20:36	51	40
26-Jul-17	510	3455	18:32	62	50	18:37	62	50
26-Jul-17	511	3207	20:29	80	70	20:33	80	70
27-Jul-17	511	2209	15:58	113	100	16:06	114	100
27-Jul-17	511	2588	18:20	119	110	18:39	96	85
27-Jul-17	511	2468	21:09	143	130	21:17	143	130
28-Jul-17	511	2204	17:00	152	140	17:09	151	140
28-Jul-17	511	1833	19:37	149	140	19:44	149	140
28-Jul-17	511	1835	21:11	140	130	21:19	139	130
29-Jul-17	511	4567	17:07	129	120	17:15	129	120
29-Jul-17	510	5067	19:14	96	85	19:22	96	85
29-Jul-17	510	5070	21:22	47	35	21:27	47	35
30-Jul-17	511	2952	16:59	114	105	17:04	114	105
30-Jul-17	511	3323	19:49	165	155	19:57	165	155
30-Jul-17	511	3451	22:00	106	95	22:06	106	95
31-Jul-17	510	2585	16:36	80	70	16:40	80	70
31-Jul-17	510	2580	19:21	87	75	19:27	87	75

Appendix Table E - 4. Bridge log information for CTD casts and vertical zooplankton tows on the 2018 Integrated Pelagic Ecosystem Survey aboard the MV Nordic Pearl, July 5-July 29, 2018. No bongo events occurred in four blocks due to rough seas.

Date	Stratum	Block	CTD Event			Bongo Event		
			Start Time (PDT)	Bottom Depth (m)	Gear Depth (m)	Start Time (PST)	Bottom Depth (m)	Gear Depth (m)
06-Jul-18	505	11536	20:57	111	100	21:17	120	100
07-Jul-18	505	11043	16:46	149	140	17:02	149	140
07-Jul-18	505	11418	19:54	75	65	20:11	73	65
08-Jul-18	505	11291	2:05	135	125	2:16	138	125
08-Jul-18	505	10769	16:52	144	135	17:02	144	135
08-Jul-18	505	11522	20:05	147	135	20:15	148	135
09-Jul-18	505	11146	0:45	143	130	0:56	143	130
09-Jul-18	504	10404	16:56	83	75	17:06	84	--
09-Jul-18	504	10534	20:29	47	35	20:35	50	35
10-Jul-18	504	10781	1:08	61	50	1:16	60	50
10-Jul-18	507	9900	16:52	152	140	17:02	152	140
10-Jul-18	507	10148	19:37	105	95	19:46	106	95
11-Jul-18	507	9898	0:09	217	205	0:20	208	200
11-Jul-18	506	9037	17:18	84	75	--	--	--
11-Jul-18	506	8293	20:49	83	70	--	--	--
14-Jul-18	510	4202	16:56	57	50	17:03	52	40
14-Jul-18	510	3832	19:51	106	95	20:04	108	100
15-Jul-18	510	3954	0:24	53	45	0:30	53	45
15-Jul-18	511	4444	16:59	130	120	17:08	130	120
15-Jul-18	510	4697	21:06	64	50	21:13	64	50
16-Jul-18	511	1833	16:54	162	150	17:03	160	150
16-Jul-18	511	1838	20:40	130	120	20:54	130	120
17-Jul-18	511	1709	1:05	165	150	1:16	170	160
18-Jul-18	511	3698	16:56	140	130	17:06	140	130
18-Jul-18	511	3451	19:00	109	100	19:24	108	100
18-Jul-18	511	3202	20:55	110	100	21:05	109	100
20-Jul-18	511	3463	17:26	107	100	--	--	--
20-Jul-18	510	3341	19:26	61	50	--	--	--
21-Jul-18	511	2720	17:02	121	110	17:10	121	110
21-Jul-18	511	2470	19:06	143	130	19:15	144	134
22-Jul-18	509	5559	16:59	136	125	17:08	135	125
22-Jul-18	508	5438	19:59	96	85	20:08	94	85
23-Jul-18	508	6552	16:51	96	85	16:59	96	85
23-Jul-18	509	6430	18:44	121	110	18:54	123	110
23-Jul-18	508	6308	20:28	92	80	20:36	92	80
24-Jul-18	510	4324	16:53	76	65	17:00	76	65
24-Jul-18	510	3950	18:37	95	85	18:44	94	85
24-Jul-18	510	3702	20:12	76	65	20:19	76	65
25-Jul-18	511	3201	16:49	119	110	16:58	119	110
25-Jul-18	511	3078	18:26	102	90	18:32	102	90
25-Jul-18	511	2703	20:24	123	110	20:33	114	100
26-Jul-18	510	2957	16:48	64	50	16:55	64	50
26-Jul-18	510	2834	18:14	60	50	18:20	60	50
26-Jul-18	510	2710	19:31	66	55	19:37	66	55
27-Jul-18	511	3088	16:54	66	55	17:01	66	55
27-Jul-18	511	2961	18:39	133	120	18:51	105	95
27-Jul-18	510	2960	20:06	166	155	20:19	149	120

Appendix Table E - 5. Catch (kg) of species (or taxonomic groups where species identification could not be made with certainty) captured during the 2017 Integrated Pelagic Ecosystem Survey aboard the MV Sea Crest, July 7-August 2, 2017. NW= species captured in tow but no weight available. Unusable tows are denoted with no catches (--) for tow total.

Tow Number	Catch (kg)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Event Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
AMERICAN SHAD														
ARROWTOOTH FLOUNDER														
BLACK ROCKFISH		0.52												
CANARY ROCKFISH														
CHINOOK SALMON	3.82	2.23	0.35					1.00						0.19
CHUB MACKEREL														
CHUM SALMON	19.51	16.68	5.81	0.02	0.12			0.04	0.03	0.52		0.69	0.13	
CODFISHES		0.06			0.05	0.01		0.17	0.03	0.02	0.09	0.03	0.13	0.03
COHO SALMON		1.04				0.08								
COMB JELLYFISH						0.06								0.03
EELPOUT														NW
EELS														
EULACHON														
EUPHAUSIIDS														
FLATFISHES														
FRIED EGG JELLYFISH					0.25					0.60				
GARNET LANTERNFISH														
GOBIES														
JELLYFISH														
KELP GREENLING														
LANTERNFISH														NW
LARVAL FISH														
LIONS MANE JELLYFISH					0.83	0.44		4.18	3.73	16.35	3.95	0.08	14.22	12.89
MEDUSAFISH														
MOON JELLYFISH	1.05				0.36	0.10		1.23	0.27	0.26				
NORTH PACIFIC SPINY DOGFISH														
NORTHERN ANCHOVY														
NORTHERN SPEARNOSE POACHER														
OCEAN SUNFISH														
OPALESCENT INSHORE SQUID														
PACIFIC BONITO														
PACIFIC HAKE			0.08											
PACIFIC HERRING	0.86	1.55	394.95	2296.14	3.10			11.45	1.25			0.10		0.76
PACIFIC SAND LANCE														
PACIFIC SANDDAB									0.70					

Tow Number	Catch (kg)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Event Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PACIFIC SEA NETTLE													0.46	
PACIFIC WHITE-SIDED DOLPHIN														
PINK SALMON	0.02									1.71		0.01		
PINK SHRIMP (SMOOTH)			1.10		1.94									
PINK SHRIMP (SPINY)														
PROWFISH														
PYROSOME			0.06							0.24	0.58		0.08	0.40
RAGFISH														
REDSTRIPE ROCKFISH														
REX SOLE														
ROCKFISHES							0.01		NW		0.04	NW		
SABLEFISH														
SALMON SHARK														
SALPS														
SANDFISHES														
SHRIMP														
SIPHONORES				0.02				0.06		0.13			0.03	0.13
SNAILFISHES													0.01	
SOCKEYE SALMON	0.82	0.01								0.29			0.02	
SQUIDS		0.06	1.62	3.86				0.01						
STARRY FLOUNDER											NW			
STURGEON POACHER														
TOPE SHARK														
TUSK SHELL														
UNKNOWN FISH														
WATER JELLYFISH	1.87	9.14	0.01		15.67	14.97		8.70	16.59	52.64	16.33	30.37	15.90	5.99
WHITE SPOTTED RATFISH														
WHITEBAIT SMELT			2.26											
WOLF EEL		0.25			0.46			0.77			0.11	0.43		
Total	27.95	31.54	406.24	2301.96	21.00	15.53	--	27.61	22.84	73.14	20.48	31.71	30.97	20.43

Tow Number	Catch (kg)													
	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Event Number	15	16	17	18	19	20	21	22	23	24	25	26	27	28
AMERICAN SHAD														
ARROWTOOTH FLOUNDER								NW						
BLACK ROCKFISH														
CANARY ROCKFISH														
CHINOOK SALMON														
CHUB MACKEREL														
CHUM SALMON														
CODFISHES	0.02	0.16	0.07	0.09			0.12			0.04	0.14	0.04	0.05	5.38 0.02
COHO SALMON					2.85									
COMB JELLYFISH				0.12			0.02				0.05	0.04		
EELPOUT					NW									
EELS					NW					NW				
EULACHON														
EUPHAUSIIDS							3.00	1.80						
FLATFISHES														
FRIED EGG JELLYFISH		0.98	0.05	4.14	3.38			1.80			0.30			
GARNET LANTERNFISH														
GOBIES														
JELLYFISH														
KELP GREENLING														
LANTERNFISH														NW
LARVAL FISH														
LIONS MANE JELLYFISH	21.71	6.48	4.90	16.39	20.08	22.20	9.32	4.00	22.12	22.13	10.05	7.67	8.40	
MEDUSAFISH									0.01					
MOON JELLYFISH			0.45						0.40	0.55	0.60			
NORTH PACIFIC SPINY DOGFISH														
NORTHERN ANCHOVY														
NORTHERN SPEARNOSE POACHER														
OCEAN SUNFISH	NW													
OPALESCENT INSHORE SQUID														
PACIFIC BONITO														
PACIFIC HAKE														
PACIFIC HERRING	170.87	53.41		0.07		231.76	41.67	77.00			0.22	13.89		0.02
PACIFIC SAND LANCE														
PACIFIC SANDDAB														
PACIFIC SEA NETTLE														
PACIFIC WHITE-SIDED DOLPHIN														
PINK SALMON														
PINK SHRIMP (SMOOTH)							0.04	0.27						

Tow Number	Catch (kg)													
	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Event Number	15	16	17	18	19	20	21	22	23	24	25	26	27	28
PINK SHRIMP (SPINY)														
PROWFISH														
PYROSOME	0.05	12.55	1.01	5.30	9.05	0.30	3.52	NW	0.60	16.79	4.21	0.49		
RAGFISH														
REDSTRIPE ROCKFISH								0.14						0.08
REX SOLE														
ROCKFISHES								NW						0.03
SABLEFISH	0.36	0.28												
SALMON SHARK														
SALPS														
SANDFISHES														
SHRIMP														
SIPHONORES	13.70			0.09						0.60	0.23			
SNAILFISHES														
SOCKEYE SALMON		2.10												0.02
SQUIDS		NW		NW										
STARRY FLOUNDER														
STURGEON POACHER														
TOPE SHARK														
TUSK SHELL														
UNKNOWN FISH														
WATER JELLYFISH	30.30	12.08	18.64	15.01	33.40	11.29	5.50	2.92	57.68	13.53	17.40	21.22	6.48	
WHITE SPOTTED RATFISH														
WHITEBAIT SMELT														
WOLF EEL					0.01									
Total	236.58	72.04	40.14	33.09	65.87	277.68	60.11	91.31	80.25	37.55	45.48	33.41	34.79	--

Tow Number	Catch (kg)													
	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Event Number	29	30	31	32	33	34	35	36	37	38	39	40	41	42
AMERICAN SHAD														
ARROWTOOTH FLOUNDER														
BLACK ROCKFISH							0.36							1.15
CANARY ROCKFISH														
CHINOOK SALMON			0.77										0.40	5.61
CHUB MACKEREL														
CHUM SALMON	7.18						1.80							4.15
CODFISHES	NW	0.05	0.06				NW	0.02	0.03	NW	NW		0.09	NW
COHO SALMON	2.56						3.36		5.03	2.74	3.03			1.04
COMB JELLYFISH														
EELPOUT								NW						
EELS														
EULACHON														
EUPHAUSIIDS				19.05										
FLATFISHES								NW						
FRIED EGG JELLYFISH	0.09	0.27	0.67		12.50			0.17						0.20
GARNET LANTERNFISH														
GOBIES														
JELLYFISH														258.37
KELP GREENLING														
LANTERNFISH														
LARVAL FISH														
LIONS MANE JELLYFISH	10.22	5.14	15.40			3.85	1.70		3.82	14.97		9.56	4.28	
MEDUSAFISH														
MOON JELLYFISH	0.32	1.08												0.20
NORTH PACIFIC SPINY DOGFISH														
NORTHERN ANCHOVY														
NORTHERN SPEARNOSE POACHER														
OCEAN SUNFISH														
OPALESCENT INSHORE SQUID						0.28								
PACIFIC BONITO														
PACIFIC HAKE														
PACIFIC HERRING	0.93			275.95	922.06	112.38				0.12	23.91	1500.00	662.25	NW 0.07
PACIFIC SAND LANCE							NW							
PACIFIC SANDDAB														
PACIFIC SEA NETTLE							0.68							
PACIFIC WHITE-SIDED DOLPHIN														
PINK SALMON							13.30							1.78

	Catch (kg)													
Tow Number	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Event Number	29	30	31	32	33	34	35	36	37	38	39	40	41	42
PINK SHRIMP (SMOOTH)														
PINK SHRIMP (SPINY)														
PROWFISH														
PYROSOME														
RAGFISH														0.02
REDSTRIPE ROCKFISH														
REX SOLE														
ROCKFISHES	0.02							0.12						
SABLEFISH														
SALMON SHARK								NW						0.21
SALPS														
SANDFISHES														
SHRIMP														
SIPHONORES	0.75		0.13											
SNAILFISHES														
SOCKEYE SALMON														
SQUIDS	NW							NW						
STARRY FLOUNDER														
STURGEON POACHER														
TOPE SHARK														
TUSK SHELL														
UNKNOWN FISH														
WATER JELLYFISH	54.08	32.72	8.44					4.56	2.63	18.36	30.24	24.19		12.85
WHITE SPOTTED RATFISH														
WHITEBAIT SMELT														
WOLF EEL														0.03
Total	76.15	40.16	24.64	295.00	934.68	146.36	6.88	23.42	36.92	72.21	1500.00	707.09	18.04	274.38

	Catch (kg)													
Tow Number	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Event Number	43	44	45	46	47	48	49	50	51	52	53	54	55	56
PINK SHRIMP (SPINY)														
PROWFISH														
PYROSOME	NW				1.14	1.31	0.22			1.55	0.93	1.68		
RAGFISH														
REDSTRIPE ROCKFISH														
REX SOLE														
ROCKFISHES						0.02	NW				0.09	0.03		
SABLEFISH											0.30			
SALMON SHARK												NW	0.04	
SALPS						0.16						1.33	0.10	
SANDFISHES														
SHRIMP														
SIPHONORES						0.36							0.06	
SNAILFISHES												0.79	0.96	
SOCKEYE SALMON	7.26										2.20		2.13	
SQUIDS							NW							
STARRY FLOUNDER							1.05							
STURGEON POACHER														
TOPE SHARK														
TUSK SHELL														
UNKNOWN FISH														
WATER JELLYFISH					18.86	15.03	40.90	27.32	4.56	12.73	127.98	14.57	3.72	10.45
WHITE SPOTTED RATFISH														9.35
WHITEBAIT SMELT														
WOLF EEL	0.11					0.26	NW	0.06		0.04	0.03		NW	
Total	181.72	908.03	21.92	46.20	43.79	73.07	37.04	16.62	310.68	147.38	27.41	18.35	24.30	30.26

Tow Number	Catch (kg)													
	57	58	59	60	61	62	63	64	65	66	67	68	69	70
Event Number	57	58	59	60	61	62	63	64	65	66	67	68	69	70
AMERICAN SHAD														
ARROWTOOTH FLOUNDER														
BLACK ROCKFISH														
CANARY ROCKFISH														
CHINOOK SALMON														
CHUB MACKEREL														
CHUM SALMON														
CODFISHES	NW	NW			NW	0.02	0.07			NW	NW	NW	NW	0.01 0.08
COHO SALMON														
COMB JELLYFISH					NW		NW	NW		NW				
EELPOUT														
EELS														
EULACHON														0.08
EUPHAUSIIDS														
FLATFISHES														
FRIED EGG JELLYFISH					14.42	7.98	6.55	3.68	0.76	0.80	1.51	3.35	0.32	3.97
GARNET LANTERNFISH														
GOBIES														
JELLYFISH	7.36													
KELP GREENLING														
LANTERNFISH														
LARVAL FISH														
LIONS MANE JELLYFISH		6.57	1.58	3.85	2.19	11.27								
MEDUSAFISH				0.12										
MOON JELLYFISH		0.68	0.42	0.41	0.08				0.78	0.38	2.06	0.31		0.20
NORTH PACIFIC SPINY DOGFISH														
NORTHERN ANCHOVY														
NORTHERN SPEARNOSE POACHER														
OCEAN SUNFISH														
OPALESCENT INSHORE SQUID										0.11	NW	0.03		0.08
PACIFIC BONITO														
PACIFIC HAKE														
PACIFIC HERRING	356.99	12.03				1.32	0.26		0.03	0.08	0.10	0.03	10.81	2.24
PACIFIC SAND LANCE														
PACIFIC SANDDAB														
PACIFIC SEA NETTLE														
PACIFIC WHITE-SIDED DOLPHIN														
PINK SALMON														
PINK SHRIMP (SMOOTH)							1.55							0.98

	Catch (kg)													
Tow Number	57	58	59	60	61	62	63	64	65	66	67	68	69	70
Event Number	57	58	59	60	61	62	63	64	65	66	67	68	69	70
PINK SHRIMP (SPINY)														
PROWFISH														
PYROSOME	5.92	216.71	13.31		0.85	9.26	15.39	9.90						
RAGFISH														
REDSTRIPE ROCKFISH														
REX SOLE													1.83	0.95
ROCKFISHES	NW	0.15	168.92	13.45	16.80	2.37	0.50	63.83		NW		NW		
SABLEFISH														
SALMON SHARK													NW	
SALPS													0.18	
SANDFISHES														
SHRIMP														
SIPHONORES		0.59	0.05					0.05			2.67	0.49	0.39	0.06
SNAILFISHES														
SOCKEYE SALMON														
SQUIDS														
STARRY FLOUNDER													5.22	
STURGEON POACHER														
TOPE SHARK														
TUSK SHELL														
UNKNOWN FISH														
WATER JELLYFISH		10.77	6.74	3.18	20.47	6.07			55.06	14.42	49.30	22.59	16.08	173.10
WHITE SPOTTED RATFISH									0.43					
WHITEBAIT SMELT														
WOLF EEL		0.13		NW		0.68		0.08			NW	0.11		
Total	370.27	228.89	200.97	36.66	34.19	43.81	37.97	74.49	58.74	19.71	55.33	25.47	27.90	186.25

Tow Number	Catch (kg)													
	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Event Number	71	72	73	74	75	76	77	78	79	80	81	82	83	84
PINK SHRIMP (SPINY)														
PROWFISH														
PYROSOME					4.39	6.44	22.75	16.25	0.84					0.48
RAGFISH														
REDSTRIPE ROCKFISH														
REX SOLE														
ROCKFISHES						NW	NW		0.05					0.85
SABLEFISH											2.39	0.22	1.26	
SALMON SHARK														
SALPS	0.12					0.06								0.44
SANDFISHES														
SHRIMP														
SIPHONORES	0.22		NW	0.25					0.14	0.39	1.01	1.18		
SNAILFISHES					NW				NW					
SOCKEYE SALMON														
SQUIDS														
STARRY FLOUNDER														
STURGEON POACHER														
TOPE SHARK														
TUSK SHELL					NW									
UNKNOWN FISH														
WATER JELLYFISH	1.25	1.54			10.76		3.11	1.50		NW				
WHITE SPOTTED RATFISH														
WHITEBAIT SMELT														
WOLF EEL														
Total	17.23	11.39	60.40	41.36	48.82	1576.26	163.67	10.20	2.78	8.72	16.34	86.72	170.91	0.00

	Catch (kg)													
Tow Number	85	86	87	88	89	90	91	92	93	94	95	96	97	98
Event Number	85	86	87	88	89	90	91	92	93	94	95	96	97	98
PINK SHRIMP (SPINY)														
PROWFISH							NW	NW						
PYROSOME	0.73	14.32	23.76	4.70	2.08		0.37			5.76		0.03		
RAGFISH												0.08		
REDSTRIPE ROCKFISH										1.07				
REX SOLE														
ROCKFISHES	138.83	0.23	0.33	17.03	4.43		0.03		0.11			NW	203.26	6.87
SABLEFISH														
SALMON SHARK					0.41		0.07							
SALPS														
SANDFISHES														
SHRIMP														
SIPHONORES	0.29	0.15	NW					1.28	0.43				0.95	
SNAILFISHES														
SOCKEYE SALMON						0.02								
SQUIDS														
STARRY FLOUNDER														
STURGEON POACHER							NW				NW			NW
TOPE SHARK														
TUSK SHELL														
UNKNOWN FISH														
WATER JELLYFISH	0.75			4.58	22.48		10.80		10.70	6.53		1.27	3.99	1.14
WHITE SPOTTED RATFISH														
WHITEBAIT SMELT														
WOLF EEL														
Total	147.83	20.91	59.91	544.39	49.82	20.69	20.54	3.18	15.78	154.41	127.09	8.84	207.25	18.50

Tow Number	Catch (kg)							
	99	100	101	102	103	104	105	106
Event Number	99	100	101	102	103	104	105	106
PINK SHRIMP (SPINY)			NW					
PROWFISH								
PYROSOME	0.17	6.92	0.80		0.50			
RAGFISH		0.40			0.10			
REDSTRIPE ROCKFISH								
REX SOLE								
ROCKFISHES	1.44	0.25	2.18			NW		
SABLEFISH								
SALMON SHARK								
SALPS								
SANDFISHES								
SHRIMP								
SIPHONORES	0.14	1.44	1.03	0.12			0.20	
SNAILFISHES								
SOCKEYE SALMON						4.19		
SQUIDS								
STARRY FLOUNDER						1.59		
STURGEON POACHER								
TOPE SHARK								
TUSK SHELL								
UNKNOWN FISH		NW						
WATER JELLYFISH	6.08	3.85	9.66	2.30	16.18		10.31	2.01
WHITE SPOTTED RATFISH								
WHITEBAIT SMELT								
WOLF EEL								
Total	11.65	16.85	27.81	15.11	60.56	--	17.34	59.58

Appendix Table E - 6. Catch (kg) of species (or taxonomic groups where species identification could not be made with certainty) captured during the 2018 Integrated Pelagic Ecosystem Survey aboard the MV Nordic Pearl, July 5-July 29, 2018. NW= species captured in tow but no weight available. Unusable tows are denoted with no catches (--) for tow total.

Tow Number	Catch (kg)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Event Number	1	4	5	8	9	12	13	16	17	20	21	24	25	28
PACIFIC SEA NETTLE		1.78							1.05		2.02	2.47		
PINK SALMON			1.35			1.33	0.32			1.42				0.53
PINK SHRIMP (SMOOTH)														
PLAINFIN MIDSHIPMAN														
POACHERS														
PYROSOME											0.03	0.58	0.3	NW 0.05
QUILLFISH														
RIVER LAMPREY														
ROCKFISHES														
RONQUILS														
SALPS														NW
SHORTBELLY ROCKFISH														
SHRIMP														
SIPHONOPHORAE	NW										0.06			
SMELOTS														
SOCKEYE SALMON			0.1	0.05			2.07							
SPLITNOSE ROCKFISH														
SQUIDS														
TOPE SHARK														
UNIDENTIFIED LARVAE														NW
UNKNOWN FISH														
WATER JELLYFISH	5.57	1.15	1.74	1.23	1.13					15.28	6.41	6.54	1.38	NW
WHITEBAIT SMELT														
WIDOW ROCKFISH														
WOLF EEL														NW NW
Total	22.93	187.7	4.11	4.43	1.64	161.81	1060.54	1284.71	19.03	25.24	9.62	20.02	109.37	144.26

Tow Number	Catch (kg)													
	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Event Number	29	32	33	36	37	40	41	44	45	48	49	52	53	55
PYROSOME				0.06		0.61		0.63	0.38	7.32	1.29	4.09		1.83
QUILLFISH														
RIVER LAMPREY														
ROCKFISHES													NW	NW
RONQUILS														
SALPS					NW			NW	0.53	0.4				2.99
SHORTBELLY ROCKFISH														
SHRIMP														
SIPHONOPHORAE					NW					0.15	0.23			
SMELETS														
SOCKEYE SALMON		0.08					2.67						0.09	
SPLITNOSE ROCKFISH														
SQUIDS								NW						
TOPE SHARK														
UNIDENTIFIED LARVAE														
UNKNOWN FISH														
WATER JELLYFISH	14.43	8.93	16.85	14.3	0.55	5.25	23.37	8.02	11.74	8.3	1.89	1.09	50.76	37.78
WHITEBAIT SMELT														
WIDOW ROCKFISH														
WOLF EEL	NW	0.19					0.04						NW	
Total	39.95	19.73	27.35	22.36	46.73	29.18	42.98	9.7	17.14	18.84	45.32	540.94	62.2	42.84

Tow Number	Catch (kg)													
	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Event Number	56	58	59	60	71	74	75	78	79	82	83	86	87	90
AMERICAN SHAD														
ARROWTOOTH FLOUNDER														
BARRACUDINAS														
BIG SKATE														
BLACK ROCKFISH		0.07	NW					NW	NW	1.16		NW		
BLUE LANTERNFISH														
BLUE SHARK													NW	
BOREAL CLUBHOOK SQUID														
BROWN ROCKFISH													NW	
CANARY ROCKFISH								NW		NW	NW			NW
CHINOOK SALMON	0.03	40.88			1.23	1.35		3.93	1.29	7.25			0.76	5.72
CHUM SALMON	0.08		2.35	2.19						0.15		1.41	0.15	
CODFISHES	0.03	0.14	NW						NW	NW	NW			
COHO SALMON		4.48	11.84	9.94	2.69			4.43				5.18	3.73	38.01
COMB JELLYFISH														
DARKBLOTTCHED ROCKFISH														
EULACHON		0.56						12.91	NW					NW
EUPHAUSIIDS								3						
FLATFISHES							NW		NW		NW		NW	
FRIED EGG JELLYFISH														
JACK MACKEREL													17.39	
LINGCOD									0.01					
LIONS MANE JELLYFISH														
MOON JELLYFISH		4.72			0.71	0.34				0.31	0.45		0.2	
NORTH PACIFIC SPINY DOGFISH									4.76					
NORTHERN ANCHOVY										0.02				
OPALESCENT INSHORE SQUID	0.62	NW						0.67		0.74				
PACIFIC HAKE		1.34												
PACIFIC HERRING	0.23	5.2	25.86	303.51				7.85	0.3	9.19		0.23		6.41
PACIFIC LAMPREY														
PACIFIC OCEAN PERCH														
PACIFIC SAND LANCE							NW	NW	NW	NW	NW			
PACIFIC SANDDAB		0.44						0.35	0.05	0.37				
PACIFIC SARDINE														
PACIFIC SEA NETTLE	1.4	3.7	1.84		0.21				0.17		0.58		0.09	0.3
PINK SALMON														
PINK SHRIMP (SMOOTH)								0.39						
PLAINFIN MIDSHIPMAN									0.14					

Tow Number	Catch (kg)													
	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Event Number	56	58	59	60	71	74	75	78	79	82	83	86	87	90
POACHERS														
PYROSONME				1.08	1.4	0.22	0.47	0.07		0.35	2.62	1.67	0.99	0.43
QUILLFISH														0.73
RIVER LAMPREY							0.11							
ROCKFISHES														NW
RONQUILS														NW
SALPS														
SHORTBELLY ROCKFISH				0.14										
SHRIMP														
SIPHONOPHORAE								NW			0.15			
SMEAITS														
SOCKEYE SALMON					0.05						19.03		0.05	
SPLITNOSE ROCKFISH														
SQUIDS														NW
TOPE SHARK														NW
UNIDENTIFIED LARVAE														
UNKNOWN FISH														
WATER JELLYFISH	16.59	13.92	4.54		1.16	0.83	0.21			0.65		5.42		1.36
WHITEBAIT SMELT											0.17			
WIDOW ROCKFISH														
WOLF EEL						NW	NW					0.11		
Total	18.98	75.38	47.72	317.04	6.38	2.99	0.28	33.53	7.87	41.1	8.12	25.66	6.63	51.6

Tow Number	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Event Number	91	94	95	98	99	102	103	106	109	112	113	114	115	117
PYROSOME	21.57	18.42			30.24	8.94	14.12	3.45	1	17.85	11.16			
QUILLFISH														
RIVER LAMPREY														
ROCKFISHES	NW	NW								0.01		0.01	0.03	
RONQUILS		NW												
SALPS	NW	0.07						0.05				0.01		
SHORTBELLY ROCKFISH														
SHRIMP														
SIPHONOPHORAE							0.09							NW
SMELETS									0.01					
SOCKEYE SALMON														
SPLITNOSE ROCKFISH		NW												
SQUIDS	NW								0.01					
TOPE SHARK									NW		NW	NW		
UNIDENTIFIED LARVAE								0.01						
UNKNOWN FISH														
WATER JELLYFISH	2.89													
WHITEBAIT SMELT														
WIDOW ROCKFISH		NW												
WOLF EEL	NW	0.04						0.06						0.1
Total	29.35	27.98	1573.29	3817.48	428.6	12.65	15.75	8.75	12.81	54.49	23.53	--	0.22	0.11

Tow Number	Catch (kg)													
	57	58	59	60	61	62	63	64	65	66	67	68	69	70
Event Number	119	122	125	126	127	128	129	132	133	136	137	138	139	142
AMERICAN SHAD														
ARROWTOOTH FLOUNDER														
BARRACUDINAS														
BIG SKATE														
BLACK ROCKFISH							0.01	0.01						0.01
BLUE LANTERNFISH														
BLUE SHARK														
BOREAL CLUBHOOK SQUID														
BROWN ROCKFISH									0.01					
CANARY ROCKFISH											0.01	0.01		0.03
CHINOOK SALMON	0.87	3.23	41.25	2.87	4.52			0.5	2.95					
CHUM SALMON								1.37	3.95	0.02				
CODFISHES							0.01	0.02	0.01		0.01	0.01	0.01	
COHO SALMON	2.25	6.52	16.33	45.37	11.04	1.64		22.35	0.37					0.28
COMB JELLYFISH														
DARKBLOTCHED ROCKFISH														
EULACHON						0.05	0.02			0.13	1.01			
EUPHAUSIIDS					4.51	2.98	1.35			3.03	0.3			
FLATFISHES								0.01	0.01	0.01		0.01	0.01	0.01
FRIED EGG JELLYFISH								6.1	0.9		5.02			0.37
JACK MACKEREL		3.39			1.68									
LINGCOD														
LIONS MANE JELLYFISH														
MOON JELLYFISH								1	0.21	1.02	0.47	0.15		0.64
NORTH PACIFIC SPINY DOGFISH									4.4					0.23
NORTHERN ANCHOVY														
OPALESCENT INSHORE SQUID														
PACIFIC HAKE										0.62	1.27			1.32
PACIFIC HERRING										21.47	44.74	2.71		
PACIFIC LAMPREY														
PACIFIC OCEAN PERCH														
PACIFIC SAND LANCE														
PACIFIC SANDDAB														
PACIFIC SARDINE														
PACIFIC SEA NETTLE										1.63	0.15			7.59
PINK SALMON									0.25					
PINK SHRIMP (SMOOTH)														
PLAINFIN MIDSHIPMAN														
POACHERS												0.01		

Tow Number	Catch (kg)													
	57	58	59	60	61	62	63	64	65	66	67	68	69	70
Event Number	119	122	125	126	127	128	129	132	133	136	137	138	139	142
PYROSOME					0.01		0.36	0.1	0.41	6.35	1.13	1.45	1.61	
QUILLFISH														0.01
RIVER LAMPREY														
ROCKFISHES		0.01												
RONQUILS														
SALPS						0.01		0.05		0.97				0.08
SHORTBELLY ROCKFISH														
SHRIMP														0.01
SIPHONOPHORAE	0.01													
SMELETS														0.01
Sockeye Salmon											7.59			18.86
SPLITNOSE ROCKFISH														
SQUIDS		0.01							0.05	0.01	0.01			
TOPE SHARK														
UNIDENTIFIED LARVAE														
UNKNOWN FISH														
WATER JELLYFISH							0.01	0.02		4.7	1.14	0.14	1.39	1.16
WHITEBAIT SMELT														0.67
WIDOW ROCKFISH														
WOLF EEL														
Total	2.26	7.4	22.96	92.01	20.49	8.03	7.57	25.76	9.14	52.12	47.62	12.03	11.03	21.8

Tow Number	Catch (kg)													
	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Event Number	145	148	149	150	151	154	157	160	161	162	163	166	169	172
PYROSOME	0.31	0.94	0.86	1.18		0.03			0.26	0.01			0.51	
QUILLFISH	0.01												0.01	
RIVER LAMPREY														
ROCKFISHES														
RONQUILS														
SALPS	0.08													
SHORTBELLY ROCKFISH														
SHRIMP														
SIPHONOPHORAE		0.13		0.05			0.05		0.08			0.01		
SMELETS														
SOCKEYE SALMON		2.3	5.76		1.68									
SPLITNOSE ROCKFISH														
SQUIDS			0.06					0.31				0.24		
TOPE SHARK												NW	NW	
UNIDENTIFIED LARVAE													0.01	
UNKNOWN FISH		0.01												
WATER JELLYFISH	0.28	0.18		0.18		0.06	0.05		0.24	1.93				
WHITEBAIT SMELT									0.02					
WIDOW ROCKFISH														
WOLF EEL			0.05											
Total	6.82	69.71	1023.59	9.38	5.26	4.7	0.66	10.93	135.29	74.85	3.37	46.06	1.38	107.19

Tow Number	Catch (kg)													
	85	86	87	88	89	90	91	92	93	94	95	96	97	98
Event Number	173	174	175	178	181	184	185	186	187	190	193	196	197	198
PYROSOME	0.54	0.9		0.07			0.11	0.1						
QUILLFISH														
RIVER LAMPREY														
ROCKFISHES		0.01						0.01						
RONQUILS														
SALPS														
SHORTBELLY ROCKFISH														
SHRIMP		NW												
SIPHONOPHORAE		0.11			0.02		0.01							
SMELETS														
SOCKEYE SALMON								2.06						
SPLITNOSE ROCKFISH														
SQUIDS							0.38	0.15				0.04		
TOPE SHARK														
UNIDENTIFIED LARVAE														
UNKNOWN FISH														
WATER JELLYFISH	1.7	0.01	0.13					0.01						
WHITEBAIT SMELT														
WIDOW ROCKFISH														
WOLF EEL														
Total	98.82	5.61	2.08	8.59	1.72	40.06	121	10.38	21.65	1.9	10.61	146.73	54.42	107.74