Ecosystem-Based Juvenile Pacific Salmon (*Oncorhynchus* spp.) Trawl Survey off North and West Coast Vancouver Island, British Columbia, October 4 - 17, 2021

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Les numéros 1 à 25 de cette série ont été publiés à titre de Records statistiques, Service des pêches et de la mer. Les numéros 26-160 ont été publiés à titre de Rapports statistiques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom de la série a été modifié à partir du numéro 161.

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2021

ECOSYSTEM-BASED JUVENILE PACIFIC SALMON (*ONCORHYNCHUS* SPP.) TRAWL SURVEY OFF NORTH AND WEST COAST VANCOUVER ISLAND, BRITISH COLUMBIA, OCTOBER 4 - 17, 2021

by

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Anderson, E.D., Tabata, A.T., Zubkowski, T.B. and King, J.R. 2021. Ecosystem-Based Juvenile Pacific Salmon (*Oncorhynchus* spp.) Trawl Survey off North and West Coast Vancouver Island, British Columbia, October 4 - 17, 2021. Can. Tech. Rep. Fish. Aquat. Sci. 1350: vi + 39 p.

Fisheries and Oceans Canada conducted an ecosystem-based trawl survey from October 4-17, 2021 on the *CFV Nordic Pearl*. This study targeted juvenile Pacific Salmon off the North and West Coast of Vancouver Island. There were 30 species sampled in 924 kg of catch, with 55% Pacific Salmon caught by weight. Overall, the genus Aequorea (226 kg), adult Chum Salmon (170 kg), and juvenile Chum Salmon (166 kg) were the most abundant catch by weight. There were 1626 individual lengths and 1161 individual weights recorded, including all 5 Pacific Salmon species (*Oncorhynchus* spp.). Juvenile Chum Salmon were the most abundant juvenile Pacific Salmon species with catches throughout the study area. Juvenile Chinook Salmon were the second most abundant juvenile Pacific Salmon species, mainly caught within West Coast Vancouver Island Inlets. Juvenile Pink Salmon were only found in Queen Charlotte Strait, whereas juvenile Sockeye were localized in Clayoquot Sound. Juvenile Pink Salmon had the highest percentage of empty stomach (14%). Common prey species for juvenile salmon included Pacific Herring, amphipods, euphausiids, and unidentified remains. Biological samples for genetic stock composition, otoliths, energy density, muscles, gills, blood, and coded wire tags are at the Pacific Biological Station, Fisheries and Oceans Canada (Nanaimo, BC). Associated information on the physical oceanography (31 stations) and zooplankton composition (30 stations) was collected and will be analysed at the Institute of Ocean Sciences, Fisheries and Oceans Canada (Sidney, BC).

RÉSUMÉ

Anderson, E.D., Tabata, A.T., Zubkowski, T.B. and King, J.R. 2021. Ecosystem-Based Juvenile Pacific Salmon (*Oncorhynchus* spp.) Trawl Survey off North and West Coast Vancouver Island, British Columbia, October 4 - 17, 2021. Can. Tech. Rep. Fish. Aquat. Sci. 1350: vi + 39 p.

Pêches et Océans Canada a mené une étude écosystémique au chalutage pélagique du 4 au 17 octobre, 2021 sur le *CFV Nordic Pearl*. Cette étude ciblait les saumons du Pacifique juvéniles de la région du nord et ouest de l'isle de Vancouver. Il y avait 30 espèces échantillonnées dans 924 kg de prises, avec 55% de saumon du Pacifique capturé en poids. Dans l'ensemble, le genre *Aequorea* (226 kg), le saumon kéta adulte (170 kg) et la saumon kéta juvénile (166 kg) étaient les espèces les plus abondantes en poids. On a enregistré 1626 longueurs individuelles et 1161 poids individuels, dont les 5 espèces de saumon du Pacifique (*Oncorhynchus* spp.). Le saumon kéta juvénile était l'espèce de saumon du Pacifique juvénile les plus largement distribué. Le saumon quinnat juvénile était la deuxième espèce de saumon du Pacifique juvénile la plus abondante, principalement capturé dans les bras de mer de la côte ouest de l'île de Vancouver. Les saumons roses juvéniles ne se trouvaient que dans le détroit de la région de Queen Charlotte Sound, tandis que les saumons rouges juvéniles étaient localisés de Clayoquot. Les saumons roses juvéniles avaient le plus haut pourcentage d'estomac vide (14%). Les espèces de proies communes aux saumons juvéniles comprenaient le hareng du Pacifique, les amphipodes, les euphausiacés, et des restes non identifiés. Les échantillons biologiques pour la composition génétique des populations, les otolithes, la densité énergétique, les muscles, les branchies, le sang et les micromarques magnétisées codées se trouvent à la Station biologique du Pacifique de Pêches et Océans Canada (Nanaimo, Colombie-Britannique). Des informations sur l'océanographie physique (31 stations) et la composition du zooplancton (30 stations) ont été recueillies auprès de 31 stations et seront analysées à l'Institut des sciences de la mer, Pêches et Océans Canada (Sidney, C.-B.).

1 INTRODUCTION

Fisheries and Oceans Canada conducted an ecosystem-based midwater trawl survey, targeting juvenile Pacific Salmon (*Oncorhynchus* spp.) from October 4 to 17, 2021 on the *CFV Nordic Pearl*. The main objectives of this surveys were:

1. to determine the abundance, condition, distribution, and genetic stock composition of juvenile Pacific Salmon present off the north and west coast of Vancouver Island in the fall,
2. the associated physical oceanography, and
3. the distribution and biomass of prey species, including zooplankton.

This survey supports research into linkages between oceanographic conditions, fish abundance and community composition, Pacific Salmon ocean ecology and forecasting adult returns. This data report documents the biological, oceanographic, and zooplankton data and samples collected during the ecosystem-based juvenile Pacific Salmon survey from October 4 to 17, 2021.

2 METHODS

2.1 SURVEY LOCATIONS

Fishing (Figure 1), oceanographic (Figure 2), and zooplankton (Figure 3) sampling occurred off the north and west coast of Vancouver Island, including Queen Charlotte Strait, Queen Charlotte Sound, and west coast Vancouver Island.

2.2 FISHING OPERATIONS

The vessel deployed a coastal LFS 7742 trawl net (Appendix A, manufactured by LFS Trawl (LFS Net Systems, Bellingham, USA). This two-bridle mid-water net has a codend liner (12.7 mm stretched) to retain smaller species. The coastal LFS 7742 trawl net was designed to have a net opening of 30 m wide by 15 m high, or an area of 450 m^2 (Figure A.1). On this survey, the trawl net opening averaged 48 m wide by 12 m high, or an area of 576 m^2.

The trawl net was fished with Thyborøn Type 15 VF, 4.5 m^2 mid water doors (approximately 798 kg each). Two chain clumps were attached to the footrope with approximately 204 kg (450 lbs) per chain clump. The vessel was equipped with a SCANMAR Trawl System and wireless SS4 Catch Sensor that provided real time door spread, headline depth and net opening values (SCANMAR, Åsgårdstrand, Norway). Wireless Marport sensors provided wingspread values (Marport Americas Inc., Washington, USA). In addition, RBR (RBR Ltd., Ottawa, ON, Canada) temperature and depth sensors were attached to the headrope and footrope to record depth and temperature every 30 seconds. The vertical net opening was plotted over time to show the net opening and depth.

Tow speed averaged 8.5 km/hr (4.6 knots), and varied between 6.4 to 10.4 km/hr (3.5 - 5.6 knots) speed over ground, depending on the wind, tide, and current. The target headrope depths were 0 m (surface) and 15 m (depth). Two A-6 floats 86.4 cm x 118.1 cm (34" x 46.5") were attached to the headrope for surface tows. Warp length ranged from 188 m to 229 m (Appendix B). Target tow duration was 20 min once the trawls doors were locked and the net fishing.

2.3 BIOLOGICAL SAMPLES

All salmon species were measured for fork length (mm) and weight (g). Pacific Salmon were divided into juveniles and adults based on their fork lengths to account for different migratory behavior. All Pacific Salmon species, except for Coho Salmon, were considered juveniles < 350 mm. Coho Salmon were considered juveniles < 400 mm. Stomachs were analysed at sea following an established protocol (King et al. 2018). For each species in the tow, up to five whole bodies and five muscle tissues were collected for energy density and stable isotope analyses. Additional collections included: fin clips for genetic stock identification (GSI), salmon gill tissues for for infectious agents and fitness, otoliths, blood for growth hormone, adipose fin status (i.e. clipped vs. non-clipped), and coded wire tags (CWTs).

2.4 OCEANOGRAPHY

A standalone Sea-bird 25 CTD (conductivity-temperature-depth) was used for oceanographic profiles (Sea-bird Electronics Bellevue Washington, USA) at 31 locations (Figure 2, Appendix C). A Niskin bottle at 10 m from the surface was used for nutrient and chlorophyll (chl a) collections. Seawater samples for nitrate, phosphate, and silicate were placed in acid-washed glass test tubes and frozen. Seawater for chl a estimation were filtered with a 25 mm GF/F glass fibre filter disks. Filter disks were then placed in polypropylene scintillation vials and frozen. Both the nutrient and chl a samples were frozen and maintained at -20℃. Nutrient and chl a samples were returned for analyses at the Institute of Ocean Sciences, Fisheries and Oceans Canada (Sidney, BC).

2.5 ZOOPLANKTON

At 30 locations (Figure 3, Appendix C), vertical tows to sample zooplankton were conducted to approximately 250 m or within 10 m of the bottom with two 60 cm diameter, 253 micrometer mesh nets mounted in a bongo-drum style frame, one of which was equipped with a flow meter. Zooplankton collected from the flow meter side were preserved in 10% formalin and sent to the zooplankton laboratory at the Institute of Ocean Sciences, Fisheries and Oceans Canada (Sidney, BC) for species enumeration. The other zooplankton sample was sorted into four size fractions by successively sieving through 8.0, 1.7, 1.0, and 0.25 mm screens. Individual size fractions were frozen for future stable isotope, energy density, and proximate analyses.

2.6 ACOUSTIC DATA

Acoustic data was collected throughout the survey using a SIMRAD EK80 echo sounder (Kongsberg Maritime CM Canada Lid, Vancouver, Canada).

3 RESULTS

3.1 FISHING OPERATIONS

This survey conducted 54 trawl net tows off the north and west coast of Vancouver Island (Appendix B) with 52 trawls completed successfully. There were 2 unusable tows due to problems with equipment deployment and are identified by Usable = N in Appendix B.

3.2 CATCH COMPOSITION

Total catch for the survey from usable tows was 924 kg, with 507 kg (55%) Pacific Salmon. All species of juvenile Pacific Salmon were caught, although there were no adult Sockeye and Pink Salmon. The order of abundance by weight of Pacific Salmon was: Chum Salmon (Adults), Chum Salmon (Juveniles), Chinook Salmon (Juveniles), Pink Salmon (Juveniles), Chinook Salmon (Adults), Coho Salmon (Juveniles), Sockeye Salmon (Juveniles), Coho Salmon (Adults). Detailed catch composition for each tow is included in Appendix D. For each species captured during the survey, the number of tows in which the species was present, total catch weight, maximum catch weight, and mean catch weight for usable tows is presented in Table 1. The most abundant species caught by weight were Water Jellyfish (226 kg), caught in 69% or the tows, Chum Salmon (Adults) (170 kg), caught in 29% of the tows, and Chum Salmon (Juveniles) (166 kg) caught in 62% of the tows (Table 1).

Juvenile Chinook Salmon were caught within the majority of west coast Vancouver Island inlets (Figure 4). Adult Chinook Salmon were only caught in Juan de Fuca Strait (Figure 5). Juvenile Chum Salmon were found throughout the survey area, although the two largest catches were near San Juan Bay (Figure 6). Adult Chum Salmon were found throughout the survey area, except within Queen Charlotte Strait. The largest catch of adult Chum Salmon was off Brooks Peninsula (Figure 7). Juvenile Coho Salmon were found in smaller numbers throughout the survey, except for Queen Charlotte Sound. There was one large catch of juvenile Coho Salmon within Quatsino Sound (Figure 8). Adult Coho Salmon were only caught within Juan de Fuca Strait (Figure 9). Juvenile Pink Salmon were caught within Queen Charlotte Strait (Figure 10), and there were no adult Pink Salmon caught (Figure 11). Juvenile Sockeye Salmon were primarily caught within Clayoquot Sound (Figure 12), and there were no adult Sockeye Salmon caught (Figure 13).

3.3 BIOLOGICAL SAMPLES

Samples were collected for DNA stock composition (542), otoliths (524), energy density (316), stable isotope analysis (262), coded wire tags (23), gill samples for infectious agents (206), and blood for growth hormones (53). These biological samples were returned to the Pacific Biological Station, Fisheries and Oceans Canada (Nanaimo, BC).

3.4 LENGTH AND WEIGHT

Length frequencies and length-weight relationships are presented for juvenile Pacific Salmon species in Figures 14 to 18. Double log transformed length-weight regressions coefficients were similar in Chinook Salmon, Chum Salmon,and Coho Salmon. Juvenile Pink Salmon had a slightly smaller coefficient, whereas juvenile sockeye salmon had slightly larger coefficient. A larger coefficient typically represents better condition, whereas a smaller coefficient typically represents worse condition. Lengths and weights of 19 species were recorded (Table 2). Within juvenile Pacific salmon, Coho Salmon had the largest maximum length (265 mm) and weight (241 g), whereas Sockeye Salmon had the smallest maximum length (161 mm) and weight (44 g).

3.5 STOMACH CONTENTS

Stomachs of 598 individual fish, from 12 species, were analysed at sea (Table 3). Juvenile Pink Salmon (14%) had the highest percentage of empty stomachs, whereas juvenile Sockeye and juvenile Coho Salmon (7%) had the lowest percentage of empty stomachs within Pacific Salmon species. Juvenile Chum Salmon (9%) and juvenile Coho Salmon (7%) had intermediate percentages of empty stomachs (Table 3).

The most common prey for juvenile Chinook Salmon was amphipods, although the most voluminous prey was Pacific Herring (Table 4). For juvenile Chum Salmon, the most common prey was unidentified remains, and the most voluminous was ctenophores (Table 4). Since gelatinous prey are digested quickly, it is likely that the unidentified remains in the juvenile Chum Salmon may be ctenophores and jellyfish. More juvenile Coho Salmon stomach contained euphausiids compared to other prey, although similar to juvenile Chinook Salmon, the most voluminous prey was Pacific Herring (Table 4). The most common prey for juvenile Pink Salmon was amphipods, although the most voluminous prey was unidentified remains. Finally, most juvenile Sockeye Salmon stomachs contained amphipods and euphausiids by count and volume (Table 4).

3.6 OCEANOGRAPHY

CTD casts and water samples were completed at 31 sites with cast depths ranging from 30 m to 223 m (Appendix C). Samples were collected for nutrients and chlorophyll at approximately 10 m below the surface. Oceanographic data from the CTD casts and nutrient analysis of the water

samples will be archived online within the Water Properties Data Inventory under cruise number 2021-034, as well as Canadian Integrated Ocean Observing System or CIOOS.

3.7 ZOOPLANKTON

Vertical bongo tows were conducted at 30 stations to depths ranging from 50 m to 250 m (Appendix C). One station (CS01) had a CTD event but did not have an associated bongo tow due to net repairs being conducted. Formalin-preserved zooplankton samples will be identified and enumerated at the Institute of Ocean Sciences, Fisheries and Oceans Canada (Sidney, BC). Data will be archived in the zooplankton database. Fractionated zooplankton samples are frozen at the Pacific Biological Station, Fisheries and Oceans Canada (Nanaimo, BC).

3.8 ACOUSTIC DATA

Acoustic data was returned to the Institute of Ocean Sciences, Fisheries and Oceans Canada (Sidney, BC) for analysis.

4 DISCUSSION

This ecosystem-based juvenile Pacific Salmon trawl survey collected valuable information on distribution, abundance, condition, and genetic stock composition for juvenile Pacific Salmon off the north and west coast of Vancouver Island. Overall, juvenile Chum Salmon were most abundant, whereas juvenile Sockeye Salmon were least abundant by weight. Distributions ranged from widespread for juvenile Chum Salmon, or localized for juvenile Pink Salmon (Queen Charlotte Strait) and juvenile Sockeye Salmon (Clayoquot Sound). Juvenile Pink Salmon had the highest percentage of empty stomachs. Amphipods and euphausiids were found in the most number of stomachs, and Pacific Herring and unidentified remains (e.g. jellyfish and squid) were the most voluminous prey in juvenile Pacific Salmon. Prey items depended on the size of the predator species. We collected 31 physical oceanographic water profiles, and 30 zooplankton samples associated with the Pacific Salmon caught. As it becomes available, the data from laboratory analysis (i.e. GSI, energy density, isotopic analysis, zooplankton composition) will be integrated into the survey data. This data supplements historic juvenile Pacific Salmon surveys, and will be reported in Fisheries and Oceans Canada State of the Pacific Ocean, and is being incorporated into longer term and broader scope research projects.

5 REFERENCES

King, J., Boldt, J.L., and King, S. 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.

6 ACKNOWLEDGEMENTS

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7 FIGURES

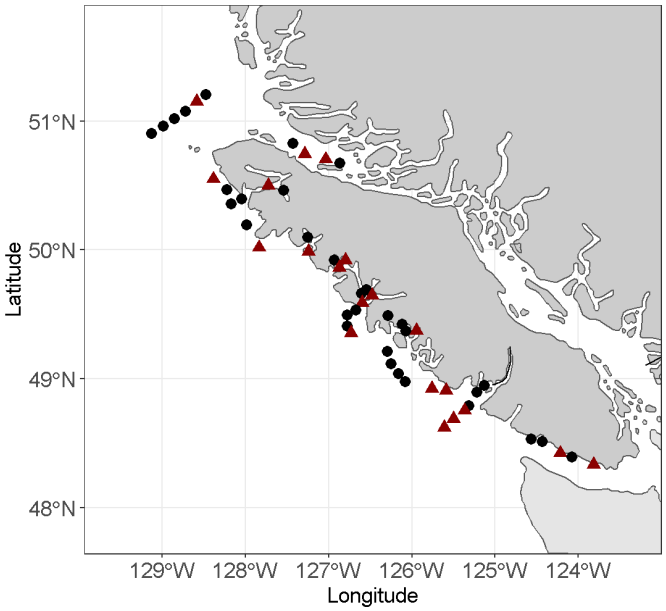

Figure 1. Fishing tow locations during the ecosystem-based juvenile Pacific Salmon survey from October 4 to 17, 2021 on the *CFV Nordic Pearl*. The target head rope depth was 0 m (black circles) or 15 m (red triangles).

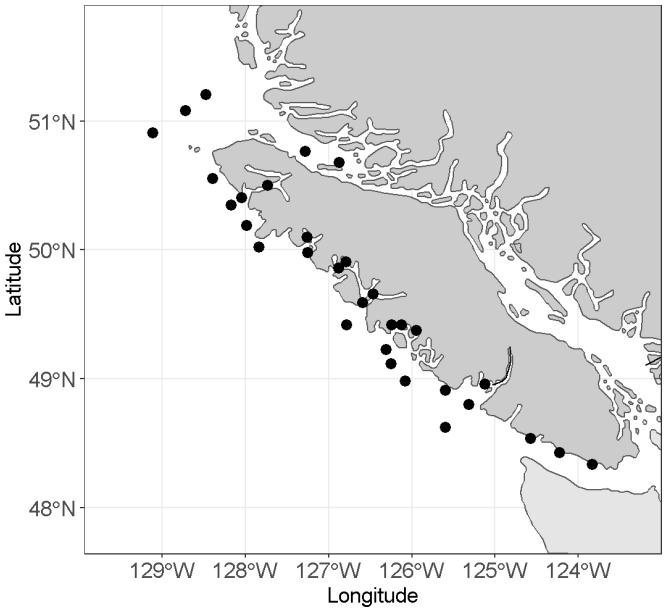

Figure 2. Oceanographic sampling locations during the ecosystem-based juvenile Pacific Salmon survey from October 4 to 17, 2021 on the *CFV Nordic Pearl*. There were 31 CTD casts.

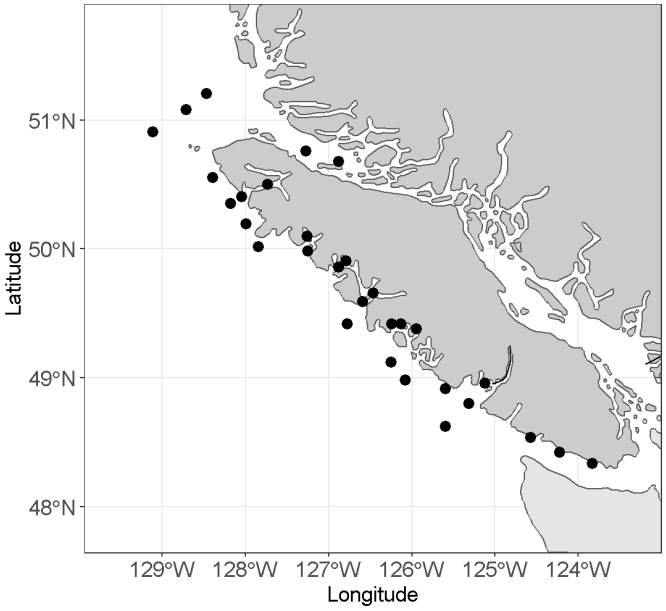

Figure 3. Zooplankton sampling locations during the ecosystem-based juvenile Pacific Salmon survey from October 4 to 17, 2021 on the *CFV Nordic Pearl*. There were 30 zooplankton vertical tows.

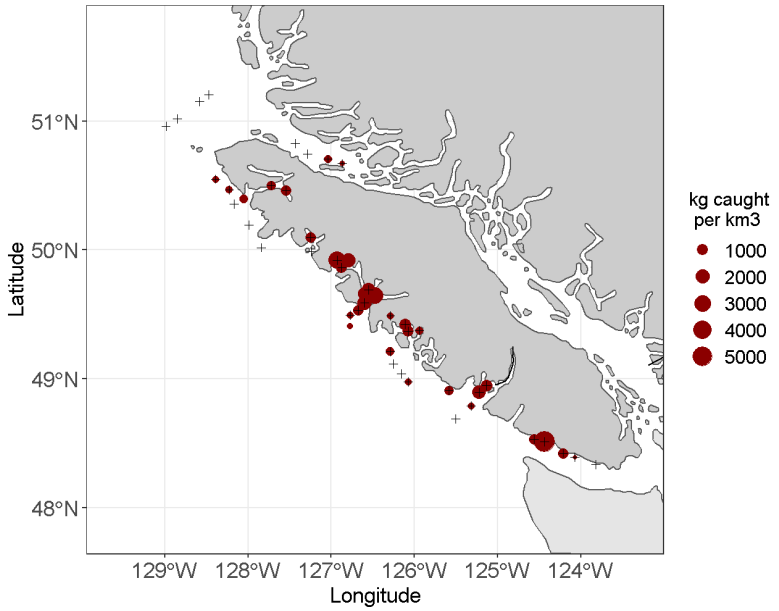

Figure 4. Juvenile Chinook Salmon (*Oncorhynchus tschawytscha*) catch per km^3 for each tow. Circles are proportional to catch abundance, and zero catches are shown with a cross (+).

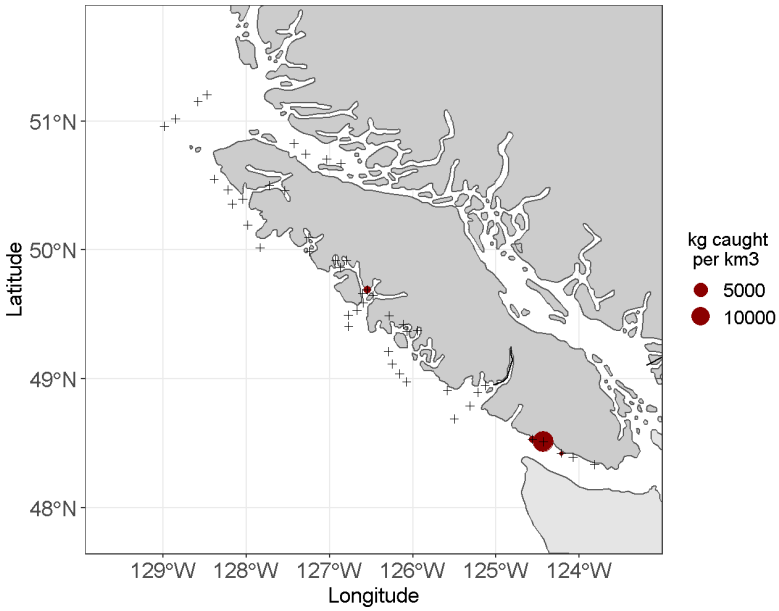

Figure 5. Adult Chinook Salmon (*Oncorhynchus tschawytscha*) catch per km^3 for each tow. Circles are proportional to catch abundance, and zero catches are shown with a cross (+). The survey targets juvenile Pacific Salmon so the catches of adult Pacific Salmon should be interpreted with care.

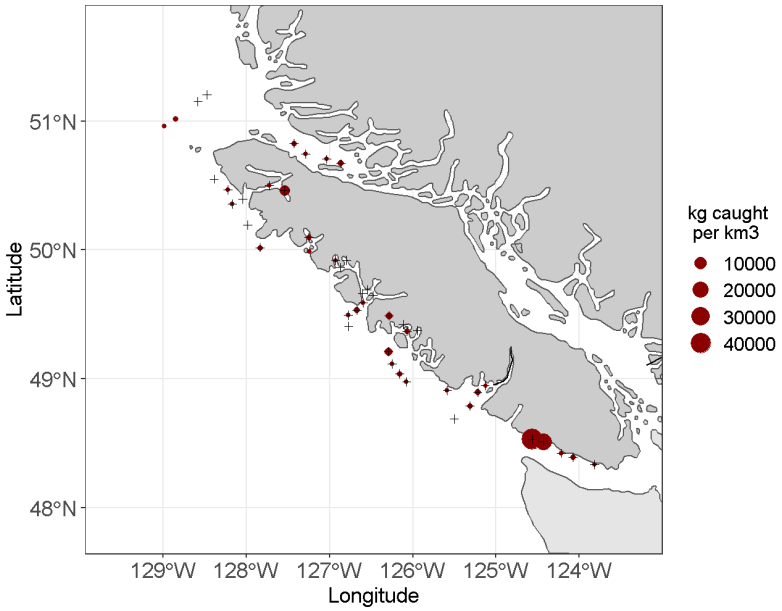

Figure 6. Juvenile Chum Salmon (*Oncorhynchus keta*) catch per km^3 for each tow. Circles are proportional to catch abundance, and zero catches are shown with a cross (+).

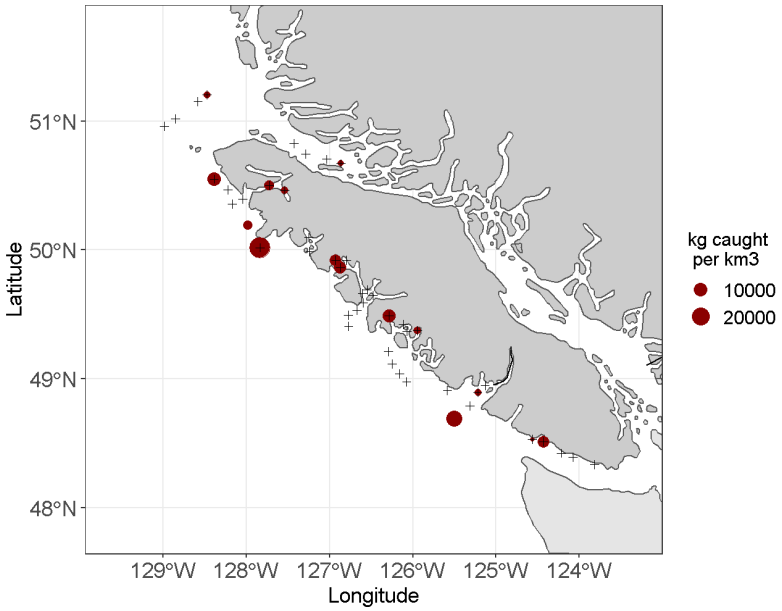

Figure 7. Adult Chum Salmon (*Oncorhynchus keta*) catch per km^3 for each tow. Circles are proportional to catch abundance, and zero catches are shown with a cross (+). The survey targets juvenile Pacific Salmon so the catches of adult Pacific Salmon should be interpreted with care.

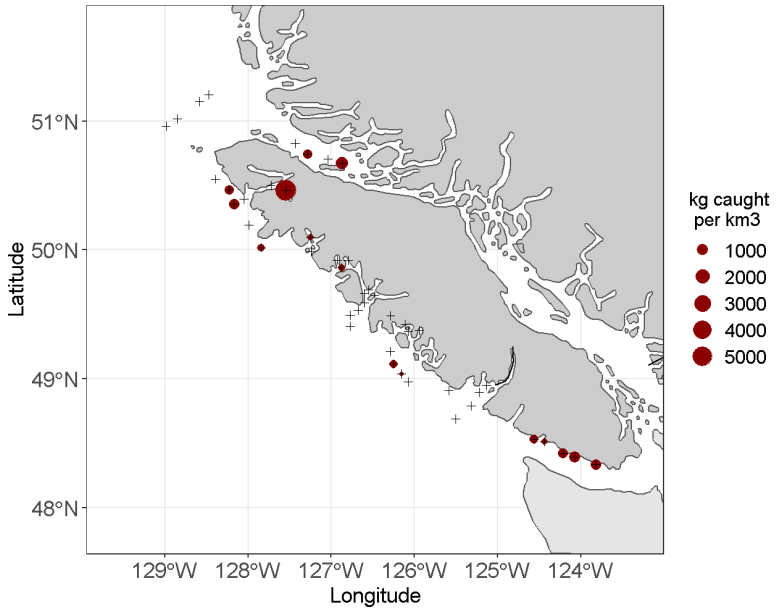

Figure 8. Juvenile Coho Salmon (*Oncorhynchus kitsutch*) catch per km^3 for each tow. Circles are proportional to catch abundance, and zero catches are shown with a cross (+).

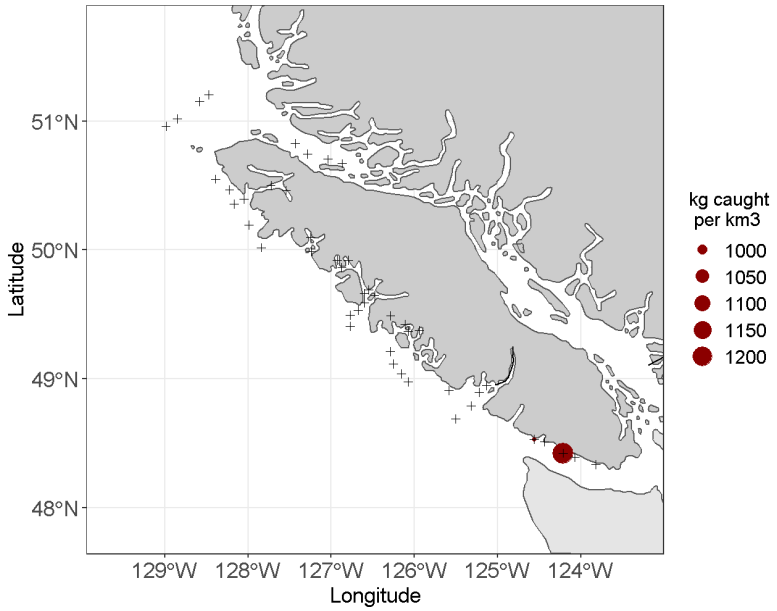

Figure 9. Adult Coho Salmon (*Oncorhynchus kitsutch*) catch per km^3 for each tow. Circles are proportional to catch abundance, and zero catches are shown with a cross (+). The survey targets juvenile Pacific Salmon so the catches of adult Pacific Salmon should be interpreted with care.

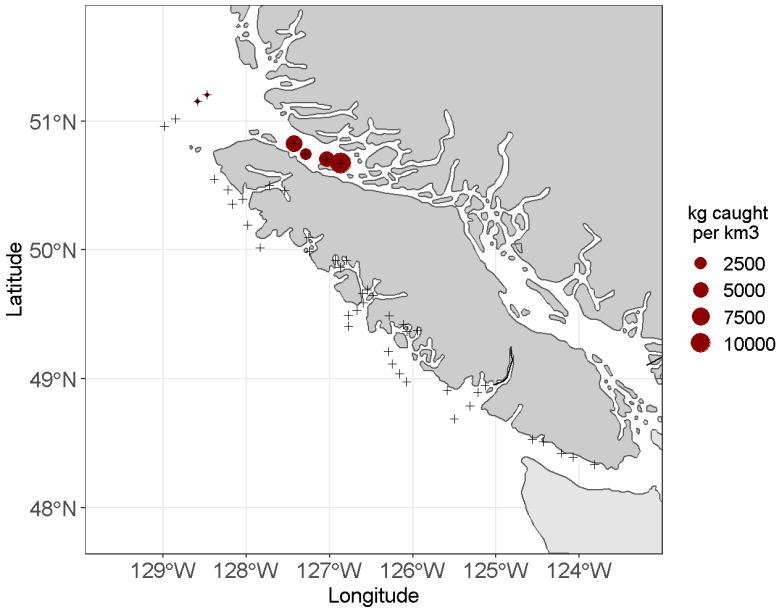

Figure 10. Juvenile Pink Salmon (*Oncorhynchus gorbusha*) catch per km^3 for each tow. Circles are proportional to catch abundance, and zero catches are shown with a cross (+).

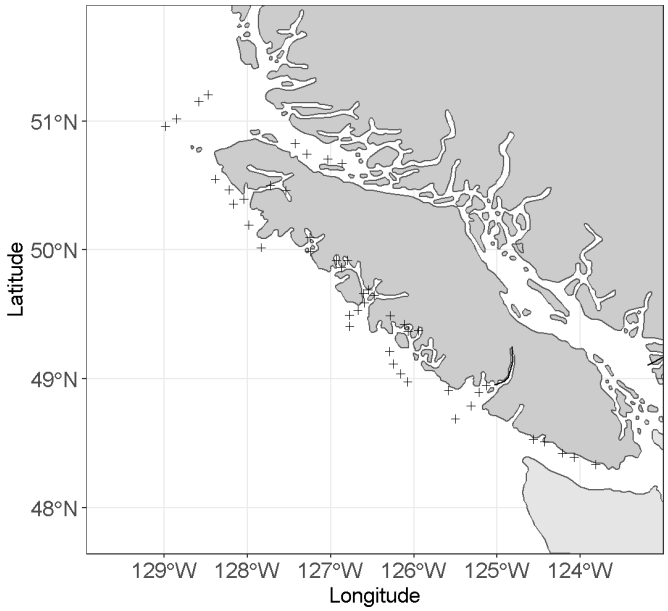

Figure 11. Adult Pink Salmon (*Oncorhynchus gorbusha*) catch per km^3 for each tow. Circles are proportional to catch abundance, and zero catches are shown with a cross (+). The survey targets juvenile Pacific Salmon so the catches of adult Pacific Salmon should be interpreted with care.

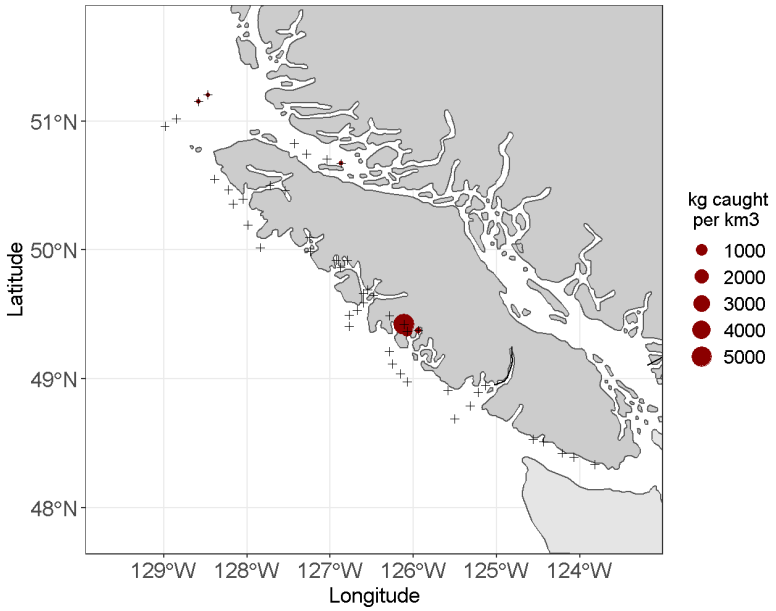

Figure 12. Juvenile Sockeye Salmon (*Oncorhynchus nerka*) catch per km^3 for each tow. Circles are proportional to catch abundance, and zero catches are shown with a cross (+).

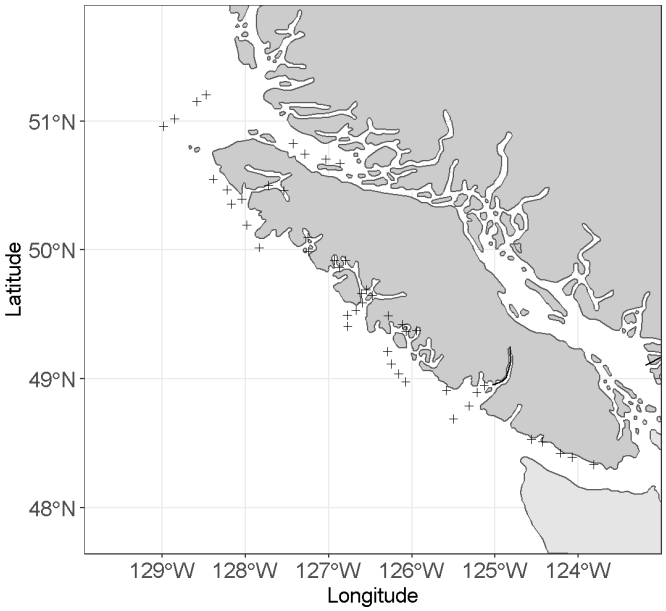

Figure 13. Adult Sockeye Salmon (*Oncorhynchus nerka*) catch per km^3 for each tow. Circles are proportional to catch abundance, and zero catches are shown with a cross (+). The survey targets juvenile Pacific Salmon so the catches of adult Pacific Salmon should be interpreted with care.

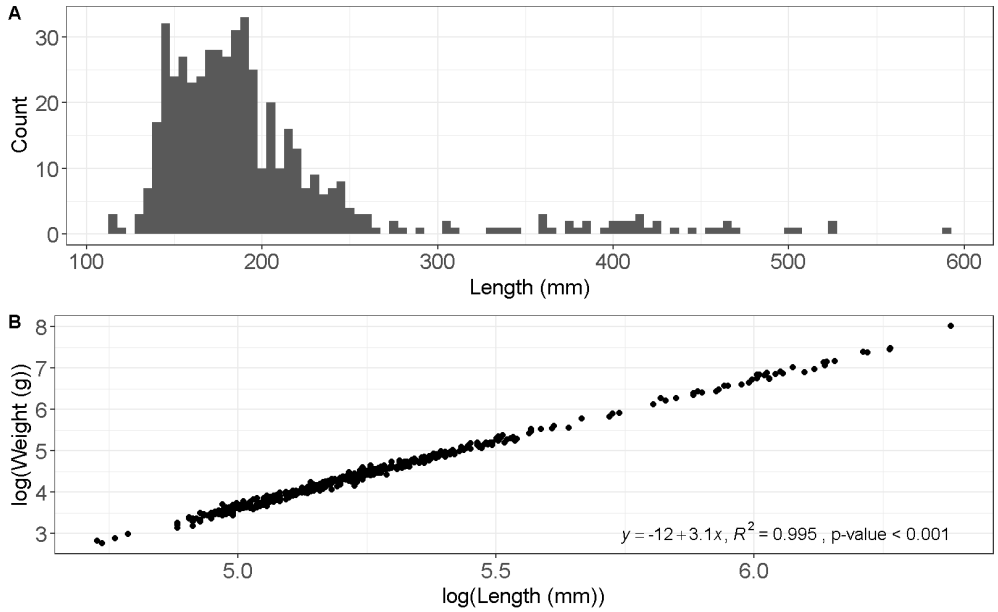

Figure 14. Chinook Salmon (*Oncorhynchus tshawytscha)*) length frequency plot as sampled during the ecosystem-based juvenile Pacific Salmon survey aboard the *CFV Nordic Pearl*, October 4 to 17, 2021 (A). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (B).

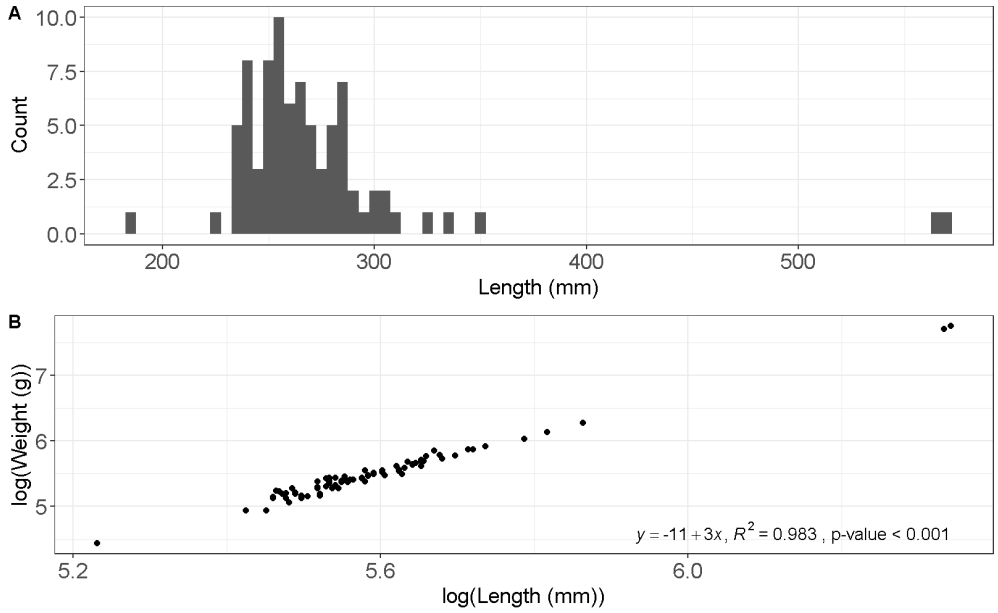

Figure 15. Coho Salmon (*Oncorhynchus kisutch*) length frequency plot as sampled during the ecosystem-based juvenile Pacific Salmon survey aboard the *CFV Nordic Pearl*, October 4 to 17, 2021 (A). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (B).

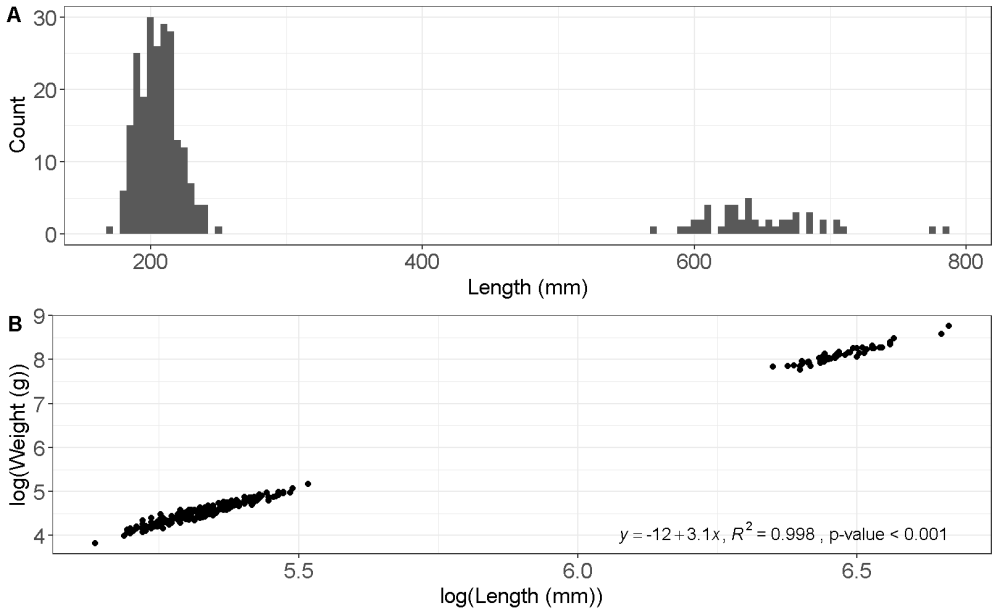

Figure 16. Chum Salmon (*Oncorhynchus keta*) length frequency plot as sampled during the ecosystem-based juvenile Pacific Salmon survey aboard the *CFV Nordic Pearl*, October 4 to 17, 2021 (A). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (B).

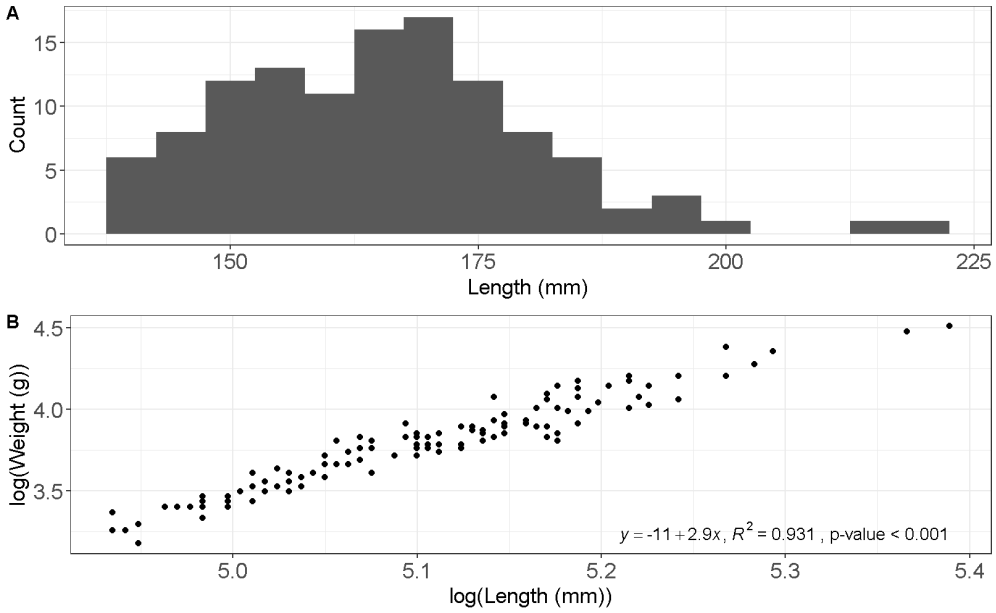

Figure 17. Pink Salmon (*Oncorhynchus gorbusha*) length frequency plot as sampled during the ecosystem-based juvenile Pacific Salmon survey aboard the *CFV Nordic Pearl*, October 4 to 17, 2021 (A). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (B).

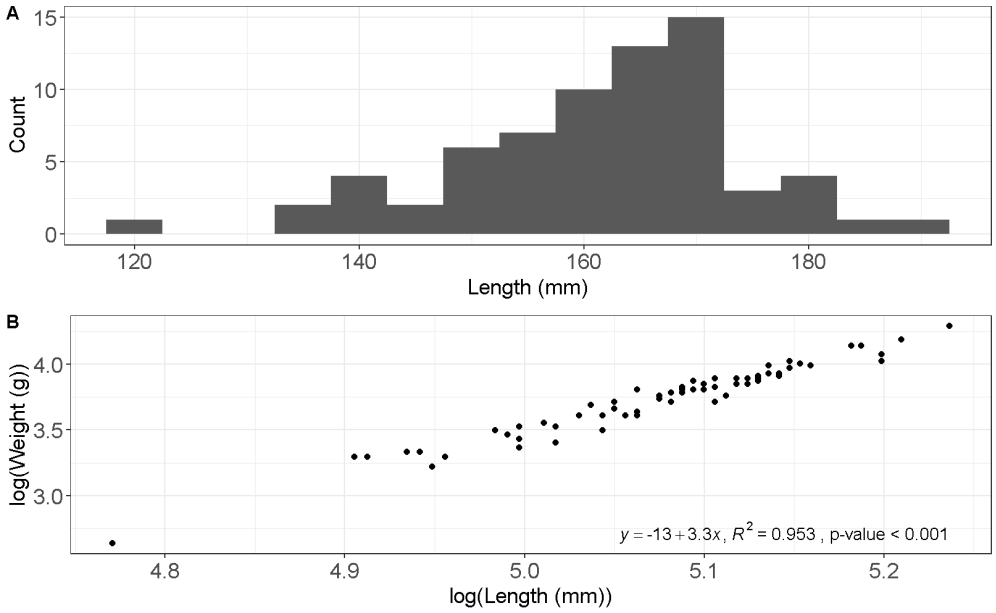

Figure 18. Sockeye Salmon (*Oncorhynchus nerka*) length frequency plot as sampled during the ecosystem-based juvenile Pacific Salmon survey aboard the *CFV Nordic Pearl*, October 4 to 17, 2021 (A). Double log-transformed length-weight regression with outliers removed, using a Bonferroni outlier test (B).

8 TABLES

Table 1. All captured species (or taxonomic group), ordered by total catch weight (in grams), showing number of tows in which the species occurred, total catch weight, maximum catch weight, and mean catch weight per tow for usable tows during the ecosystem-based juvenile Pacific Salmon survey aboard the *CFV Nordic Pearl*, October 4 to 17, 2021. Blank weights indicate specimens which could not be weighed accurately (either released alive or too small).

Common Name	Scientific Name	Tows	Total	Max	Mean
Water Jellyfish	Aequorea	36	225.80	26.40	6
Chum Salmon (Adults)	Oncorhynchus keta	15	170.30	40.44	11
Chum Salmon (Juveniles)	Oncorhynchus keta	32	165.57	92.99	5
Chinook Salmon (Juveniles)	Oncorhynchus tshawytscha	32	59.80	12.40	2
Lions Mane	Cyanea capillata	13	50.72	13.61	4
Moon Jellyfish	Aurelia labiata	29	44.88	8.31	2
Fried Egg Jellyfish	Phacellophora camtschatica	9	37.82	12.34	4
Pink Salmon (Juveniles)	Oncorhynchus gorbuscha	6	36.71	18.15	6
Opalescent Inshore Squid	Doryteuthis opalescens	14	36.22	12.65	3
Chinook Salmon (Adults)	Oncorhynchus tshawytscha	4	35.39	30.56	9
Coho Salmon (Juveniles)	Oncorhynchus kisutch	15	23.45	10.35	2
Pacific Herring	Clupea pallasii	10	11.96	9.27	1
Sockeye Salmon (Juveniles)	Oncorhynchus nerka	6	10.82	8.75	2
Jellyfish	Scyphozoa	1	6.14	6.14	6
Coho Salmon (Adults)	Oncorhynchus kisutch	2	4.50	2.30	2
Sea Nettle	Chrysaora fuscescens	4	2.19	1.13	1
Walleye Pollock	Gadus chalcogrammus	2	1.17	1.17	1
Sablefish	Anoplopoma fimbria	3	0.52	0.22	0
Yellowtail Rockfish	Sebastes flavidus	3	0.18	0.18	0
Ragfish	Icosteus aenigmaticus	1	0.13	0.13	0
Pacific Saury	Cololabis saira	1	0.07	0.07	0
Rockfishes	Sebastes	2	0.02	0.02	0
Shiner Perch	Cymatogaster aggregata	1	0.01	0.01	0
Flatfishes	Pleuronectiformes	5			
Pacific Tomcod	Microgadus proximus	2			
Canary Rockfish	Sebastes pinniger	1			
Corynidae	Corynidae	1			
Pacific Sand Lance	Ammodytes personatus	1			
Pacific Spiny Lumpsucker	Eumicrotremus orbis	1			
Tiger Rockfish	Sebastes nigrocinctus	1			
Unknown Fish	Unknown fish	1			
Wolf Eel	Anarrhichthys ocellatus	1			

Table 2. Lengths and weights for each species (arranged descending by the number of length measurements for each by species) sampled during the ecosystem-based juvenile Pacific Salmon survey aboard the *CFV Nordic Pearl*, October 4 to 17, 2021. (Tows = number of tows, Measured = number of length measurements, Weighed = number of weight measurements).

		Length (mm)				Weight (g)			
Species	**Tows**	**Measured**	**Min**	**Max**	**Mean**	**Weighed**	**Min**	**Max**	**Mean**
Opalescent Inshore Squid	11	476	11	56	37	12	2	9	4
Chinook Salmon (Juveniles)	32	461	113	347	185	461	16	529	87
Chum Salmon (Juveniles)	32	221	170	249	206	221	46	177	94
Pacific Herring	10	143	71	214	104	100	4	120	25
Pink Salmon (Juveniles)	6	117	139	219	165	117	24	91	46
Coho Salmon (Juveniles)	15	80	187	352	265	80	85	531	241
Sockeye Salmon (Juveniles)	6	69	118	188	161	69	14	73	44
Chum Salmon (Adults)	15	50	572	784	649	50	2366	6370	3390
Moon Jellyfish	16	48	80	322	214				
Chinook Salmon (Adults)	4	34	359	591	427	34	569	3032	1040
Pacific Sand Lance	1	12	41	70	53				
Sablefish	3	5	221	248	233	5	92	129	109
Lions Mane	3	4	310	570	427				
Yellowtail Rockfish	2	3	60	247	128	3	2	180	62
Coho Salmon (Adults)	2	2	563	568	566	2	2222	2315	2268
Fried Egg Jellyfish	1	2	161	399	280				
Shiner Perch	1	2	61	65	63	2	6	6	6
Walleye Pollock	1	2	361	449	405	2	396	771	584
Pacific Saury	1	1	261	261	261	1	68	68	68
Ragfish	1	1	221	221	221	1	125	125	125
Rockfishes	1	1	141	141	141	1	25	25	25
Sea Nettle	1	1	231	231	231				

Table 3. Number of tows with stomach samples (Tows), number of stomachs examined (Stomachs), number of empty stomachs (empty), and percentage of empty stomachs for each species (Percent), arranged descending by number of tows, during the ecosystem-based juvenile Pacific Salmon survey aboard the *CFV Nordic Pearl*, October 4 to 17, 2021.

Species	**Tows**	**Stomachs**	**Empty**	**Percent**
Chum Salmon (Juveniles)	32	132	12	9
Chinook Salmon (Juveniles)	32	213	19	9
Chum Salmon (Adults)	15	49	40	82
Coho Salmon (Juveniles)	15	59	4	7
Pacific Herring	9	45	17	38
Pink Salmon (Juveniles)	6	42	6	14
Sockeye Salmon (Juveniles)	6	29	2	7
Chinook Salmon (Adults)	4	15	5	33
Sablefish	3	5	3	60
Coho Salmon (Adults)	2	2	0	0
Walleye Pollock	1	2	2	100
Pacific Saury	1	1	0	0
Shiner Perch	1	2	1	50
Ragfish	1	1	1	100
Yellowtail Rockfish	1	1	1	100

Table 4. Prey items (Prey) identified in the stomach contents of predator species (Species) sampled (alphabetical by Species) during during the ecosystem-based juvenile Pacific Salmon survey aboard the *CFV Nordic Pearl*, October 4 to 17, 2021. Volume is average volume in cm^3; Count is the number of stomachs observed with each prey.

Species	Prey	Volume	Count
Chinook Salmon (Adults)	Pacific Herring	8.70	3
Chinook Salmon (Adults)	Euphausiids	4.80	8
Chinook Salmon (Adults)	Unid. Fishes	4.35	2
Chinook Salmon (Adults)	Mysids	0.01	1
Chinook Salmon (Juveniles)	Pacific Herring	4.60	28
Chinook Salmon (Juveniles)	Opalescent Inshore Squid	2.45	2
Chinook Salmon (Juveniles)	Squid	1.44	9
Chinook Salmon (Juveniles)	Unid. Fishes	1.22	37
Chinook Salmon (Juveniles)	Euphausiids	0.81	41
Chinook Salmon (Juveniles)	Amphipods	0.50	86
Chinook Salmon (Juveniles)	True Crabs	0.50	31
Chinook Salmon (Juveniles)	Decapods	0.38	16
Chinook Salmon (Juveniles)	Mysids	0.37	9
Chinook Salmon (Juveniles)	Unid. Remains	0.36	2
Chinook Salmon (Juveniles)	Poachers	0.20	1
Chinook Salmon (Juveniles)	Cephalopods	0.06	2
Chinook Salmon (Juveniles)	Polychaete Worms	0.04	3
Chinook Salmon (Juveniles)	Unidentified Plankton	0.01	1
Chum Salmon (Adults)	Comb Jellyfish	2.60	6
Chum Salmon (Adults)	Unid. Remains	1.96	8
Chum Salmon (Adults)	Squid	0.10	1
Chum Salmon (Juveniles)	Euphausiids	2.01	22
Chum Salmon (Juveniles)	True Crabs	1.45	11
Chum Salmon (Juveniles)	Amphipods	1.08	30
Chum Salmon (Juveniles)	Comb Jellyfish	0.90	1
Chum Salmon (Juveniles)	Arrow Worms	0.70	1
Chum Salmon (Juveniles)	Unid. Remains	0.62	63
Chum Salmon (Juveniles)	Mysids	0.16	5
Chum Salmon (Juveniles)	Unidentified Plankton	0.11	9
Chum Salmon (Juveniles)	Flatfishes	0.10	1
Chum Salmon (Juveniles)	Jellyfish	0.09	6
Chum Salmon (Juveniles)	Decapods	0.07	3
Coho Salmon (Adults)	Codfishes	45.00	1
Coho Salmon (Adults)	Pacific Herring	10.50	1
Coho Salmon (Adults)	Unid. Fishes	9.00	1
Coho Salmon (Adults)	Euphausiids	3.50	1
Coho Salmon (Adults)	Amphipods	0.20	1
Coho Salmon (Juveniles)	Pacific Herring	6.86	5
Coho Salmon (Juveniles)	Unid. Fishes	3.77	14
Coho Salmon (Juveniles)	Decapods	1.10	3

Species	Prey	Volume	Count
Coho Salmon (Juveniles)	Unid. Fishes	3.77	14
Coho Salmon (Juveniles)	Decapods	1.10	3
Coho Salmon (Juveniles)	Flatfishes	1.00	1
Coho Salmon (Juveniles)	Euphausiids	0.97	26
Coho Salmon (Juveniles)	Squid	0.80	1
Coho Salmon (Juveniles)	True Crabs	0.42	7
Coho Salmon (Juveniles)	Amphipods	0.21	18
Coho Salmon (Juveniles)	Unidentified Plankton	0.15	2
Coho Salmon (Juveniles)	Unid. Remains	0.12	5
Pacific Herring	Amphipods	0.48	4
Pacific Herring	Euphausiids	0.31	19
Pacific Herring	Unid. Remains	0.02	8
Pacific Herring	True Crabs	0.01	1
Pacific Saury	Unid. Remains	0.01	1
Pink Salmon (Juveniles)	Unid. Remains	1.40	10
Pink Salmon (Juveniles)	Amphipods	0.13	32
Pink Salmon (Juveniles)	Squid Bait	0.10	1
Pink Salmon (Juveniles)	Unidentified Plankton	0.01	3
Sablefish	Euphausiids	1.15	2
Sablefish	Unid. Remains	0.40	1
Shiner Perch	Unid. Remains	0.01	1
Sockeye Salmon (Juveniles)	Euphausiids	0.41	13
Sockeye Salmon (Juveniles)	Amphipods	0.19	22
Sockeye Salmon (Juveniles)	Jellyfish	0.01	1
Sockeye Salmon (Juveniles)	Unid. Remains	0.01	2

APPENDIX A NET SPECIFICATIONS

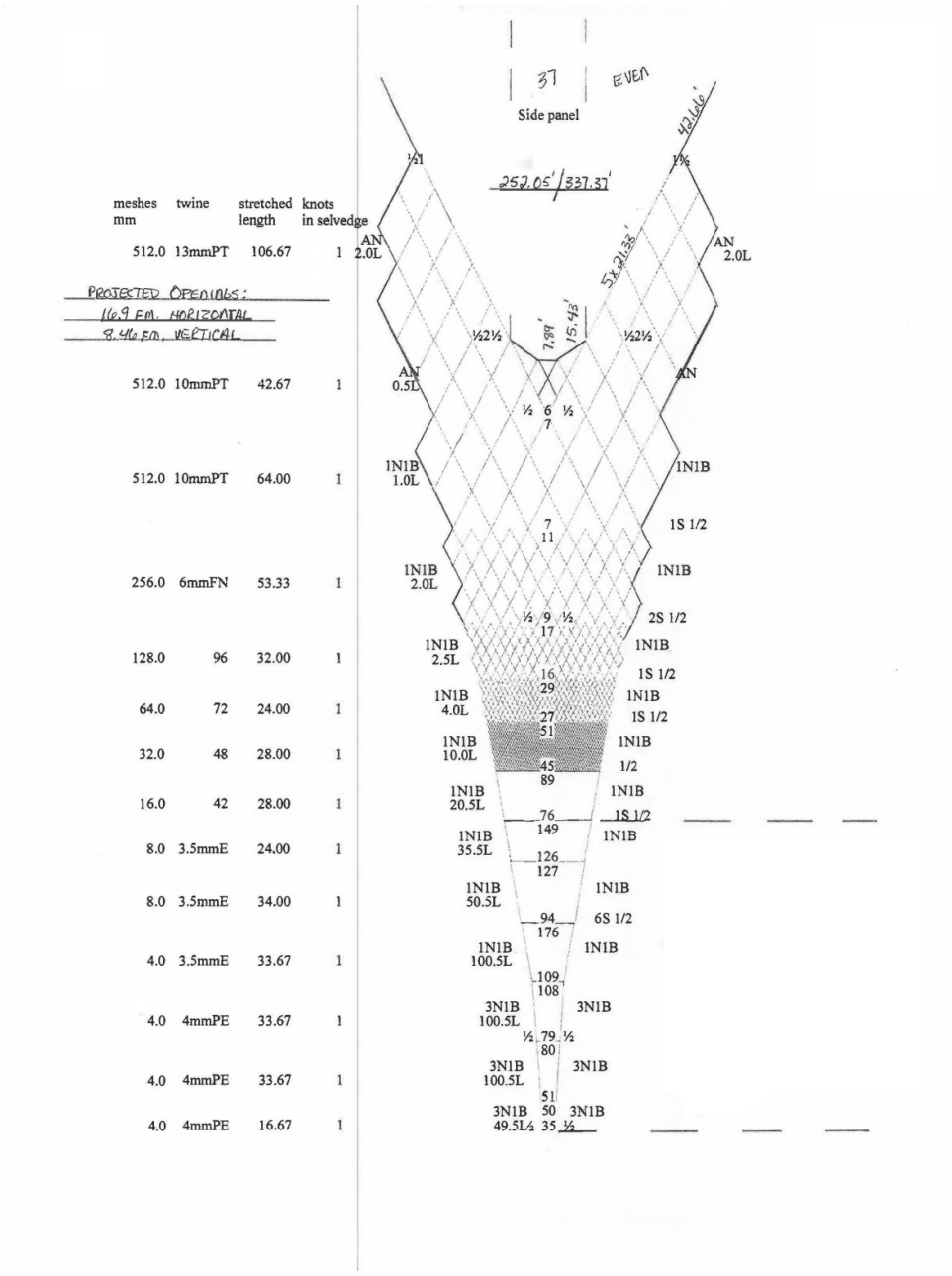

Figure A.1. Net specifications (side view) for the LFS 7742 trawl net used during the ecosystem-based juvenile Pacific Salmon survey from October 4 to 17, 2021 on the *CFV Nordic Pearl*.

APPENDIX B TRAWL BRIDGE LOG DATA

Table B.1. Bridge log information for trawl tows during the ecosystem-based juvenile Pacific Salmon survey aboard the *CFV Nordic Pearl*, October 4 to 17, 2021.

Tow Number	**1**	**2**	**3**	**4**	**5**	**6**
Event Number	3	4	7	8	11	12
Date	2021-10-05	2021-10-05	2021-10-05	2021-10-05	2021-10-06	2021-10-06
Station ID	QCST01	QCST02	QCST03	QCST04	T01	T02
Net	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742
Start Time (PDT)	08:49	11:24	13:45	17:23	08:27	09:54
Duration (min)	19	19	16	20	20	20
Start Latitude	50° 40’ 16" N	50° 42’ 15" N	50° 44’ 48" N	50° 49’ 36" N	51° 12’ 19" N	51° 09’ 08" N
Start Longitude	126° 52’ 01" W	127° 02’ 17" W	127° 17’ 13" W	127° 25’ 48" W	128° 28’ 21" W	128° 34’ 57" W
End Latitude	50° 41’ 17" N	50° 42’ 54" N	50° 44’ 04" N	50° 49’ 10" N	51° 11’ 23" N	51° 08’ 05" N
End Longitude	126° 53’ 23" W	127° 03’ 51" W	127° 18’ 40" W	127° 24’ 09" W	128° 29’ 59" W	128° 35’ 54" W
Direction of Tow (deg)	318	301	230	111	227	209
Vessel Speed (km/h)	7.8	7.0	8.3	6.4	7.8	6.7
Distance Towed (km)	2.46	2.20	2.20	2.09	2.57	2.25
Net Opening Width (m)	47.3	50.1	47.8	46.1	47.3	45.4
Net Opening Height (m)	17.0	11.0	20.1	14.8	11.0	11.5
Warp Length (m)	190.2	201.2	212.2	201.2	192.0	210.3
Target Headrope Depth (m)	0	15	15	0	0	15
Start Bottom Depth (m)	188	172	231	217	192	151
End Bottom Depth (m)	192	168	230	245	196	133
Usable	Y	Y	Y	Y	Y	Y

Tow Number	**7**	**8**	**9**	**10**	**11**	**12**
Event Number	15	16	17	20	23	24
Date	2021-10-06	2021-10-06	2021-10-06	2021-10-06	2021-10-07	2021-10-07
Station ID	T03	T04	T05	T06	VI01	VI02
Net	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742
Start Time (PDT)	11:49	13:16	14:36	16:14	08:12	09:44
Duration (min)	20	20	20	19	20	19
Start Latitude	51° 04’ 30" N	51° 01’ 03" N	50° 57’ 41" N	50° 54’ 17" N	50° 33’ 02" N	50° 28’ 07" N
Start Longitude	128° 42’ 56" W	128° 51’ 07" W	128° 59’ 12" W	129° 07’ 25" W	128° 23’ 19" W	128° 13’ 23" W
End Latitude	51° 03’ 34" N	50° 59’ 54" N	50° 56’ 31" N	50° 53’ 30" N	50° 31’ 53" N	50° 27’ 06" N
End Longitude	128° 44’ 14" W	128° 53’ 00" W	129° 01’ 09" W	129° 10’ 00" W	128° 21’ 59" W	128° 12’ 01" W
Direction of Tow (deg)	221	226	226	244	143	139
Vessel Speed (km/h)	7.1	9.3	9.6	10.3	8.2	7.5
Distance Towed (km)	2.29	3.05	3.16	3.36	2.67	2.46
Net Opening Width (m)	50.3	50.3	47.3	50.1	49.3	48.6
Net Opening Height (m)	12.8	12.8	13.2	11.9	11.3	11.9
Warp Length (m)	188.4	193.9	190.2	195.7	215.8	188.4
Target Headrope Depth (m)	0	0	0	0	15	0
Start Bottom Depth (m)	66	60	69	55	136	78
End Bottom Depth (m)	61	64	70	67	134	93
Usable	Y	Y	Y	Y	Y	Y

Tow Number	**13**	**14**	**15**	**16**	**17**	**18**
Event Number	27	30	31	34	37	40
Date	2021-10-07	2021-10-07	2021-10-07	2021-10-08	2021-10-08	2021-10-09
Station ID	VI03	QS01	QS02	QS03	BP01	BP02
Net	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742
Start Time (PDT)	11:36	14:58	17:03	08:17	10:48	08:35
Duration (min)	19	20	19	19	19	19
Start Latitude	50° 21’ 25" N	50° 30’ 03" N	50° 27’ 42" N	50° 23’ 47" N	50° 11’ 37" N	50° 01’ 07" N
Start Longitude	128° 10’ 03" W	127° 43’ 32" W	127° 32’ 25" W	128° 02’ 45" W	127° 59’ 13" W	127° 50’ 15" W
End Latitude	50° 20’ 50" N	50° 29’ 45" N	50° 29’ 07" N	50° 22’ 51" N	50° 10’ 16" N	50° 00’ 08" N
End Longitude	128° 07’ 59" W	127° 45’ 54" W	127° 33’ 51" W	128° 04’ 18" W	127° 59’ 10" W	127° 48’ 51" W
Direction of Tow (deg)	113	258	326	226	178	136
Vessel Speed (km/h)	8.3	8.7	9.5	7.8	7.8	7.6
Distance Towed (km)	2.68	2.85	3.10	2.52	2.49	2.49
Net Opening Width (m)	44.7	50.3	50.7	46.4	46.9	50.1
Net Opening Height (m)	11.0	11.3	11.3	12.3	12.3	12.3
Warp Length (m)	188.4	214.0	195.7	192.0	190.2	223.1
Target Headrope Depth (m)	0	15	0	0	0	15
Start Bottom Depth (m)	139	115	187	80	70	313
End Bottom Depth (m)	116	141	166	75	81	470
Usable	Y	Y	Y	Y	Y	Y

Tow Number	19	20	21	22	23	24
Event Number	43	46	47	48	51	54
Date	2021-10-09	2021-10-09	2021-10-09	2021-10-10	2021-10-10	2021-10-10
Station ID	KS01	KS02	KS02	EI01	EI02	EI03
Net	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742
Start Time (PDT)	12:53	14:49	15:30	07:44	09:21	11:02
Duration (min)	21	6	19	20	20	20
Start Latitude	49° 59’ 12" N	50° 06’ 04" N	50° 05’ 59" N	49° 55’ 14" N	49° 51’ 54" N	49° 55’ 20" N
Start Longitude	127° 14’ 23" W	127° 14’ 52" W	127° 14’ 52" W	126° 55’ 42" W	126° 52’ 23" W	126° 47’ 50" W
End Latitude	50° 00’ 07" N	50° 05’ 36" N	50° 04’ 34" N	49° 53’ 48" N	49° 52’ 24" N	49° 53’ 59" N
End Longitude	127° 12’ 01" W	127° 14’ 56" W	127° 15’ 06" W	126° 55’ 46" W	126° 50’ 16" W	126° 47’ 11" W
Direction of Tow (deg)	57	184	185	180	68	161
Vessel Speed (km/h)	9.9	8.8	8.1	8.1	8.2	8.3
Distance Towed (km)	3.30	0.86	2.63	2.67	2.71	2.63
Net Opening Width (m)	51.2		49.3	50.3	48.1	48.8
Net Opening Height (m)	12.4	11.0	12.3	11.3	11.3	11.5
Warp Length (m)	219.5	197.5	228.6	193.9	228.6	219.5
Target Headrope Depth (m)	15		0	0	15	15
Start Bottom Depth (m)	143	121	121	274	156	220
End Bottom Depth (m)	188	160	212	266	231	203
Usable	Y	N	Y	Y	Y	Y

Tow Number	**25**	**26**	**27**	**28**	**29**	**30**
Event Number	55	56	59	62	63	64
Date	2021-10-10	2021-10-10	2021-10-10	2021-10-11	2021-10-11	2021-10-11
Station ID	NS01	NS02	NS03	NS04	NS05	NS06
Net	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742
Start Time (PDT)	13:39	14:34	16:16	08:02	09:13	10:38
Duration (min)	18	20	20	19	20	20
Start Latitude	49° 39’ 46" N	49° 41’ 21" N	49° 38’ 57" N	49° 35’ 30" N	49° 31’ 53" N	49° 29’ 44" N
Start Longitude	126° 36’ 08" W	126° 32’ 56" W	126° 28’ 44" W	126° 35’ 53" W	126° 40’ 29" W	126° 46’ 29" W
End Latitude	49° 40’ 49" N	49° 41’ 42" N	49° 37’ 50" N	49° 34’ 16" N	49° 30’ 34" N	49° 28’ 14" N
End Longitude	126° 34’ 37" W	126° 30’ 42" W	126° 30’ 06" W	126° 37’ 17" W	126° 41’ 48" W	126° 46’ 21" W
Direction of Tow (deg)	41	75	217	214	212	175
Vessel Speed (km/h)	8.8	8.5	8.1	9.0	9.0	8.6
Distance Towed (km)	2.69	2.76	2.64	2.86	2.91	2.81
Net Opening Width (m)	43.0	42.8	51.0	50.1	41.8	50.3
Net Opening Height (m)	11.9	12.4	12.3	11.3	11.0	11.5
Warp Length (m)	199.4	195.7	219.5	223.1	190.2	190.2
Target Headrope Depth (m)	0	0	15	15	0	0
Start Bottom Depth (m)	158	205	248	105	45	52
End Bottom Depth (m)	175	250	182	90	45	55
Usable	Y	Y	Y	Y	Y	Y

Tow Number	**31**	**32**	**33**	**34**	**35**	**36**
Event Number	67	68	70	71	76	77
Date	2021-10-11	2021-10-11	2021-10-11	2021-10-12	2021-10-12	2021-10-12
Station ID	VI04	VI05	CS01	CS02	CS04	CS05
Net	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742
Start Time (PDT)	12:11	13:13	15:56	07:51	10:38	12:48
Duration (min)	19	15	19	19	19	19
Start Latitude	49° 24’ 27" N	49° 21’ 22" N	49° 12’ 40" N	49° 29’ 24" N	49° 25’ 15" N	49° 22’ 12" N
Start Longitude	126° 46’ 20" W	126° 43’ 39" W	126° 17’ 30" W	126° 17’ 13" W	126° 06’ 52" W	126° 04’ 21" W
End Latitude	49° 23’ 04" N	49° 20’ 43" N	49° 14’ 01" N	49° 27’ 57" N	49° 25’ 34" N	49° 20’ 44" N
End Longitude	126° 45’ 11" W	126° 41’ 54" W	126° 18’ 10" W	126° 16’ 25" W	126° 04’ 43" W	126° 03’ 59" W
Direction of Tow (deg)	150	118	340	158	75	168
Vessel Speed (km/h)	8.9	9.3	8.3	8.9	8.3	8.6
Distance Towed (km)	2.90	2.44	2.63	2.85	2.66	2.75
Net Opening Width (m)	50.5	48.6	47.6	42.8	42.8	48.1
Net Opening Height (m)	11.5	11.3	12.3	11.0	11.9	11.5
Warp Length (m)	192.0	219.5	190.2	192.0	193.9	192.0
Target Headrope Depth (m)	0	15	0	0	0	0
Start Bottom Depth (m)	78	89	52	109	150	109
End Bottom Depth (m)	77	89	46	122	152	102
Usable	Y	Y	Y	Y	Y	Y

Tow Number	**37**	**38**	**39**	**40**	**41**	**42**
Event Number	80	83	84	87	88	91
Date	2021-10-12	2021-10-13	2021-10-13	2021-10-13	2021-10-13	2021-10-13
Station ID	CS06	CS07	CS08	CS09	VI06	VI07
Net	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742
Start Time (PDT)	14:55	08:04	09:18	10:42	12:46	14:30
Duration (min)	20	19	19	20	20	20
Start Latitude	49° 22’ 27" N	49° 06’ 56" N	49° 02’ 26" N	48° 58’ 39" N	48° 55’ 24" N	48° 54’ 35" N
Start Longitude	125° 56’ 40" W	126° 15’ 05" W	126° 09’ 26" W	126° 04’ 29" W	125° 45’ 39" W	125° 35’ 05" W
End Latitude	49° 21’ 02" N	49° 05’ 52" N	49° 01’ 08" N	48° 57’ 31" N	48° 55’ 20" N	48° 53’ 41" N
End Longitude	125° 57’ 20" W	126° 13’ 45" W	126° 08’ 08" W	126° 02’ 57" W	125° 43’ 15" W	125° 33’ 10" W
Direction of Tow (deg)	195	138	145	136	90	123
Vessel Speed (km/h)	8.3	8.0	8.9	8.8	8.9	8.8
Distance Towed (km)	2.73	2.55	2.87	2.83	2.95	2.87
Net Opening Width (m)	50.0	50.3	48.1	47.8	45.5	45.5
Net Opening Height (m)	11.5	11.9	11.5	11.9	11.9	11.5
Warp Length (m)	221.3	193.9	193.9	192.0	219.5	219.5
Target Headrope Depth (m)	15	0	0	0	15	15
Start Bottom Depth (m)	138	66	67	62	97	94
End Bottom Depth (m)	139	69	67	56	99	99
Usable	Y	Y	Y	Y	Y	Y

Tow Number	**43**	**44**	**45**	**46**	**47**	**48**
Event Number	94	95	98	99	100	101
Date	2021-10-14	2021-10-14	2021-10-14	2021-10-14	2021-10-14	2021-10-14
Station ID	BS01	BS02	BS03	BS04	BS05	BS05
Net	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742
Start Time (PDT)	08:09	09:25	11:05	12:26	13:43	14:37
Duration (min)	19	19	20	19	8	20
Start Latitude	48° 56’ 49" N	48° 53’ 37" N	48° 47’ 21" N	48° 45’ 15" N	48° 41’ 16" N	48° 41’ 21" N
Start Longitude	125° 07’ 55" W	125° 13’ 15" W	125° 18’ 56" W	125° 21’ 51" W	125° 29’ 57" W	125° 30’ 10" W
End Latitude	48° 55’ 43" N	48° 52’ 10" N	48° 46’ 12" N	48° 43’ 56" N	48° 41’ 01" N	48° 40’ 44" N
End Longitude	125° 09’ 30" W	125° 14’ 05" W	125° 20’ 21" W	125° 22’ 45" W	125° 30’ 47" W	125° 32’ 18" W
Direction of Tow (deg)	221	198	216	202	243	243
Vessel Speed (km/h)	8.6	8.8	8.6	8.4	9.0	8.8
Distance Towed (km)	2.80	2.85	2.76	2.68	1.12	2.87
Net Opening Width (m)	46.4	50.3	50.5	50.0		50.7
Net Opening Height (m)	12.4	12.8	12.3	12.3		11.3
Warp Length (m)	192.0	197.5	195.7	217.7	221.3	219.5
Target Headrope Depth (m)	0	0	0	15	15	15
Start Bottom Depth (m)	85	94	82	94	111	166
End Bottom Depth (m)	86	90	88	98	150	162
Usable	Y	Y	Y	Y	N	Y

Tow Number	**49**	**50**	**51**	**52**	**53**	**54**
Event Number	104	107	108	111	112	115
Date	2021-10-14	2021-10-15	2021-10-15	2021-10-15	2021-10-15	2021-10-15
Station ID	BS06	JdF01	JdF02	JdF03	JdF04	JdF05
Net	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742	LFS 7742
Start Time (PDT)	16:15	08:09	10:08	12:51	13:58	16:09
Duration (min)	18	19	17	19	19	19
Start Latitude	48° 37’ 16" N	48° 31’ 57" N	48° 30’ 47" N	48° 25’ 23" N	48° 23’ 28" N	48° 20’ 07" N
Start Longitude	125° 36’ 28" W	124° 33’ 46" W	124° 25’ 59" W	124° 12’ 50" W	124° 04’ 28" W	123° 49’ 02" W
End Latitude	48° 36’ 29" N	48° 31’ 29" N	48° 30’ 08" N	48° 24’ 40" N	48° 22’ 50" N	48° 19’ 49" N
End Longitude	125° 38’ 23" W	124° 31’ 31" W	124° 23’ 49" W	124° 10’ 30" W	124° 02’ 02" W	123° 47’ 06" W
Direction of Tow (deg)	235	104	111	111	108	99
Vessel Speed (km/h)	8.9	9.0	10.4	9.7	9.9	7.5
Distance Towed (km)	2.77	2.90	2.91	3.19	3.21	2.46
Net Opening Width (m)	50.3	50.5	51.7	52.5	45.0	51.5
Net Opening Height (m)	10.4	11.3	11.5	11.3	12.4	12.3
Warp Length (m)	219.5	193.9	197.5	219.5	193.9	219.5
Target Headrope Depth (m)	15	0	0	15	0	15
Start Bottom Depth (m)	117	87	69	105	86	140
End Bottom Depth (m)	69	99	77	108	107	138
Usable	Y	Y	Y	Y	Y	Y

APPENDIX C CTD CASTS AND ZOOPLANKTON TOWS

Table C.1. CTD casts and vertical bongo tow times and depths during the ecosystem-based juvenile Pacific Salmon survey from October 4 to 17, 2021 on the *CFV Nordic Pearl*.

				CTD			BONGO		
Date	**Station**	**Latitude**	**Longitude**	**Start Time (PDT)**	**Bottom Depth (m)**	**Gear Depth (m)**	**Start Time (PDT)**	**Bottom Depth (m)**	**Gear Depth (m)**
2021-10-05	QCST01	50° 40' 40" N	126° 52' 26" W	07:43:38	184	174	08:06	184	174
2021-10-05	QCST03	50° 45' 58" N	127° 16' 39" W	13:00:06	195	185	13:16	245	235
2021-10-06	T01	51° 12' 14" N	128° 28' 26" W	07:43:40	192	182	07:55	190	175
2021-10-06	T03	51° 04' 50" N	128° 43' 01" W	11:14:31	63	52	11:21	64	52
2021-10-06	T06	50° 54' 30" N	129° 06' 41" W	15:39:32	67	50	15:48	64	50
2021-10-07	VI01	50° 33' 04" N	128° 23' 32" W	07:39:14	139	130	07:50	138	129
2021-10-07	VI03	50° 20' 55" N	128° 10' 24" W	11:03:57	147	140	11:13	145	135
2021-10-07	QS01	50° 29' 55" N	127° 44' 01" W	14:25:36	117	110	14:34	117	105
2021-10-08	QS03	50° 24' 16" N	128° 02' 36" W	07:41:01	74	65	07:49	75	65
2021-10-08	BP01	50° 11' 22" N	127° 59' 17" W	10:19:18	59	50	10:26	72	72
2021-10-09	BP02	50° 01' 10" N	127° 50' 23" W	07:50:16	306	200	08:09	437	250
2021-10-09	KS01	49° 58' 46" N	127° 15' 13" W	12:22:27	148	138	12:32	146	135
2021-10-09	KS02	50° 05' 53" N	127° 15' 19" W	14:16:46	126	115	14:24	130	120
2021-10-10	EI02	49° 51' 37" N	126° 52' 38" W	08:44:02	233	223	08:57	229	220
2021-10-10	EI03	49° 54' 18" N	126° 47' 29" W	10:17:46	217	210	10:29	217	205
2021-10-10	NS03	49° 39' 29" N	126° 27' 47" W	15:43:11	190	180	15:53	190	180
2021-10-11	NS04	49° 35' 30" N	126° 35' 23" W	07:33:41	96	85	07:40	93	80
2021-10-11	VI04	49° 24' 56" N	126° 46' 46" W	11:40:05	76	63	11:47	75	62
2021-10-11	CS01	49° 13' 36" N	126° 18' 29" W	15:27:49	41	30			
2021-10-12	CS03	49° 25' 04" N	126° 14' 40" W	09:05:04	65	65	09:12	65	55
2021-10-12	CS04	49° 25' 05" N	126° 07' 31" W	10:04:09	157	145	10:13	157	148
2021-10-12	CS06	49° 22' 36" N	125° 56' 35" W	14:27:12	137	125	14:35	136	125
2021-10-13	CS07	49° 07' 01" N	126° 15' 03" W	07:32:56	67	55	07:39	67	55
2021-10-13	CS09	48° 58' 49" N	126° 04' 43" W	10:16:40	61	50	10:22	61	50
2021-10-13	VI07	48° 54' 44" N	125° 35' 42" W	13:56:50	94	85	14:04	95	85

					CTD			BONGO	
Date	**Station**	**Latitude**	**Longitude**	**Start Time (PDT)**	**Bottom Depth (m)**	**Gear Depth (m)**	**Start Time (PDT)**	**Bottom Depth (m)**	**Gear Depth (m)**
2021-10-14	BS01	48° 57’ 21" N	125° 07’ 14" W	07:30:15	91	81	07:38	90	80
2021-10-14	BS03	48° 48’ 04" N	125° 19’ 01" W	10:34:30	82	72	10:41	81	70
2021-10-14	BS06	48° 37’ 21" N	125° 35’ 46" W	15:45:35	122	110	15:53	124	112
2021-10-15	JdF01	48° 32’ 05" N	124° 34’ 28" W	07:37:02	88	75	07:43	82	70
2021-10-15	JdF03	48° 25’ 27" N	124° 13’ 31" W	12:22:46	108	100	12:30	108	95
2021-10-15	JdF05	48° 20’ 10" N	123° 49’ 38" W	15:32:05	143	133	15:40	141	130

APPENDIX D CATCH DATA

Table D.1. Catch (kg) of species (or taxonomic groups where species identification could not be made with certainty) captured during the ecosystem-based juvenile Pacific Salmon survey from October 4 to 17, 2021 on the *CFV Nordic Pearl*. Species with no weights (released alive or too small) are not included in this table.

Tow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Event Number	**3**	**4**	**7**	**8**	**11**	**12**	**15**	**16**	**17**	**20**	**23**	**24**	**27**	**30**	**31**
Canary Rockfish															
Chinook Salmon (Adults)															
Chinook Salmon (Juveniles)	0.07	0.37									0.19	0.33		0.79	1.60
Chum Salmon (Adults)	2.81				3.56						14.61			6.43	4.22
Chum Salmon (Juveniles)	0.69	0.06	0.11	0.50				0.46	0.14			0.10	0.09	0.20	10.74
Coho Salmon (Adults)															
Coho Salmon (Juveniles)	2.26		0.60									0.95	1.54		10.35
Corynidae															
Flatfishes															
Fried Egg Jellyfish															
Jellyfish															
Lions Mane	9.10	9.99	13.61	2.93				0.06	0.65						
Moon Jellyfish		0.79		0.21	1.08	4.93	1.35	1.67	0.46	2.86	3.12	8.31	1.77		
Opalescent Inshore Squid											5.03				
Pacific Herring					0.66	0.17			0.26	0.05					
Pacific Sand Lance															
Pacific Saury							0.07								
Pacific Spiny Lumpsucker															
Pacific Tomcod															
Pink Salmon (Juveniles)	18.15	6.28	2.34	9.76	0.09	0.09									
Ragfish															
Rockfishes															
Sablefish	0.22			0.22											
Sea Nettle		0.47			1.13										
Shiner Perch															
Sockeye Salmon (Juveniles)	0.08				0.08	0.06									
Tiger Rockfish													0.00		
Unknown Fish															
Walleye Pollock													0.00		
Water Jellyfish	0.55	2.39	0.52	1.93	5.81	5.67	12.34	4.39	7.67	6.42	1.52	6.32	19.98		
Wolf Eel															
Yellowtail Rockfish													0.00		
TOTAL	33.93	20.35	17.18	15.55	12.41	10.92	13.76	6.58	9.18	9.33	24.47	16.01	23.38	7.42	26.91

Tow	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Event Number	**34**	**37**	**40**	**43**	**47**	**48**	**51**	**54**	**55**	**56**	**59**	**62**	**63**	**64**	**67**
Canary Rockfish										0.00					
Chinook Salmon (Adults)										1.63					
Chinook Salmon (Juveniles)	0.72				1.56	7.15	1.21	2.91	2.58	3.06	4.94	2.99	1.35	0.32	0.17
Chum Salmon (Adults)		7.25	40.44			15.34	10.89								
Chum Salmon (Juveniles)			0.37	0.09	0.30	0.09						0.08	0.62	0.17	
Coho Salmon (Adults)															
Coho Salmon (Juveniles)			0.40		0.26		0.30								
Corynidae															
Flatfishes															
Fried Egg Jellyfish					2.21				7.16	9.27	3.74		1.11		
Jellyfish		6.14													
Lions Mane							1.71	1.73		0.13					
Moon Jellyfish	1.78	1.17	1.72	1.10	0.49		0.25	0.69	0.63		0.26		3.02		2.10
Opalescent Inshore Squid	0.46	9.88						0.00				0.31		12.65	3.53
Pacific Herring												0.69	0.70		
Pacific Sand Lance															
Pacific Saury															
Pacific Spiny Lumpsucker															
Pacific Tomcod										0.00		0.00			
Pink Salmon (Juveniles)															
Ragfish					0.13										
Rockfishes							0.00		0.02						
Sablefish	0.08														
Sea Nettle													0.53		
Shiner Perch															
Sockeye Salmon (Juveniles)															
Tiger Rockfish															
Unknown Fish															
Walleye Pollock															
Water Jellyfish	3.55		26.40	2.23	0.35		0.35						17.68	1.79	6.14
Wolf Eel															0.00
Yellowtail Rockfish									0.00	0.18					
TOTAL	6.59	24.44	69.33	3.42	5.30	22.58	14.71	5.33	10.39	14.27	8.94	4.07	25.01	14.93	11.94

Tow	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Event Number	**68**	**70**	**71**	**76**	**77**	**80**	**83**	**84**	**87**	**88**	**91**	**94**	**95**	**98**	**99**
Canary Rockfish															
Chinook Salmon (Adults)															
Chinook Salmon (Juveniles)		0.68	0.20	1.95	1.79	0.41			0.23		0.77	2.39	3.32	0.24	
Chum Salmon (Adults)			14.84			3.33							3.50		
Chum Salmon (Juveniles)		3.90	1.70		0.32		0.20	0.52	0.13		0.18	0.07	0.94	0.48	
Coho Salmon (Adults)															
Coho Salmon (Juveniles)							0.58	0.17							
Corynidae														0.00	
Flatfishes		0.00								0.00			0.00	0.00	0.00
Fried Egg Jellyfish			12.34	0.44							1.35				
Jellyfish															
Lions Mane				1.53	2.21	6.90							0.17		
Moon Jellyfish	0.47				0.33			0.93					3.06	0.14	
Opalescent Inshore Squid		0.94	0.03		0.88		1.76	0.75					0.00		0.00
Pacific Herring			0.02									9.27	0.03		
Pacific Sand Lance															
Pacific Saury															
Pacific Spiny Lumpsucker															
Pacific Tomcod															
Pink Salmon (Juveniles)															
Ragfish															
Rockfishes															
Sablefish															
Sea Nettle															0.06
Shiner Perch			0.01												
Sockeye Salmon (Juveniles)				8.75	1.68	0.17									
Tiger Rockfish															
Unknown Fish													0.00		
Walleye Pollock															
Water Jellyfish	2.59	16.03			0.27		2.27	8.95	2.21	7.01	1.18	0.08	18.39	9.13	9.11
Wolf Eel															
Yellowtail Rockfish															
TOTAL	3.06	21.55	29.14	12.67	7.48	10.81	4.81	11.32	2.57	7.01	3.48	11.81	29.41	9.99	9.17

Tow	46	47	48	49	50	51	52
Event Number	**101**	**104**	**107**	**108**	**111**	**112**	**115**
Canary Rockfish							
Chinook Salmon (Adults)			2.13	30.56	1.07		
Chinook Salmon (Juveniles)			1.65	12.40	1.42	0.04	
Chum Salmon (Adults)	24.32		3.20	15.56			
Chum Salmon (Juveniles)			92.99	48.58	0.21	0.41	0.13
Coho Salmon (Adults)			2.20		2.30		
Coho Salmon (Juveniles)			1.01	0.38	1.31	2.11	1.23
Corynidae							
Flatfishes							
Fried Egg Jellyfish		0.20					
Jellyfish							
Lions Mane							
Moon Jellyfish				0.16	0.03		
Opalescent Inshore Squid							
Pacific Herring							0.11
Pacific Sand Lance				0.00			
Pacific Saury							
Pacific Spiny Lumpsucker				0.00			
Pacific Tomcod							
Pink Salmon (Juveniles)							
Ragfish							
Rockfishes							
Sablefish							
Sea Nettle							
Shiner Perch							
Sockeye Salmon (Juveniles)							
Tiger Rockfish							
Unknown Fish							
Walleye Pollock							1.17
Water Jellyfish	9.26	5.19				0.13	
Wolf Eel							
Yellowtail Rockfish							
TOTAL	33.58	5.39	103.18	107.64	6.34	2.69	2.64