NPAFC
Doc. 2048
Rev. 1
(Apr. 25, 2022)

Preliminary Findings of the International Year of the Salmon Pan-Pacific Winter High Seas Expedition Onboard the CCGS *Sir John Franklin* during February 19–March 21, 2022

by

Jackie King, Cameron Freshwater, Amy Tabata, and Tyler Zubkowski

Fisheries and Oceans Canada
Pacific Biological Station
3190 Hammond Bay Road, Nanaimo, BC, Canada V9T 6N7

Submitted to the

NORTH PACIFIC ANADROMOUS FISH COMMISSION

by

Canada

April 2022

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:
King, J., C. Freshwater, A. Tabata, and T. Zubkowski. 2022. Preliminary findings of the International Year of the Salmon Pan-Pacific Winter High Seas Expedition onboard the CCGS *Sir John Franklin* during February 19–March 21, 2022. NPAFC Doc. 2048 (Rev. 1). 9 pp. Fisheries and Oceans Canada, Pacific Biological Station (Available at https://npafc.org).

Abstract

The objective of the 2022 International Year of the Salmon Pan-Pacific Winter High Seas Expedition was to understand how climate variability in the North Pacific Ocean and the associated changes in the physical environment influence the abundance, distribution, migration, and growth of Pacific salmon. The 2022 IYS Pan-Pacific Expedition was carried out between January and April of 2022 and involved five research vessels and covered portions of the central and eastern North Pacific Ocean. The *CCGS Sir John Franklin* conducted a trawl survey in eastern Gulf of Alaska from February 19-March 21, 2022. This survey was led, conducted and funded by Fisheries and Oceans Canada. This report provides an overview of the samples collected and preliminary results from the *Sir John Franklin* survey in eastern Gulf of Alaska. A total of 221 Pacific salmon were captured: 85 sockeye salmon (*Onchorhynchus nerka*); 83 chum salmon (*O. keta*); 33 pink salmon (*O. gorbuscha*); 16 coho salmon (*O. kisutch*); and 4 chinook salmon (*O. tshawytscha*). The most abundant species encountered by weight was northern sea nettle (*Chrysaora melanaster*) and by numbers was northern lampfish (*Stenobrachius leucopsarus*).

Keywords: Pacific salmon, North Pacific Ocean, international collaboration, winter ecology

Introduction

The 2022 International Year of the Salmon Pan-Pacific Winter High Seas Expedition was an international collaborative effort between Canada, Japan, the Republic of Korea, the Russian Federation and the United States of America. The 2022 Expedition is the largest ever multinational survey to study Pacific salmon in the North Pacific Ocean during the winter and builds on previous International Year of the Salmon (IYS) Expeditions into the Eastern Gulf of Alaska coordinated by the Pacific Salmon Foundation (Vancouver, BC, Canada) in 2019 and 2020 (Pakhomov et al. 2019, Somov et al. 2020).

Given that changing climate and associated anomalous events in the North Pacific Ocean are progressively exposing Pacific salmon (*Onchorhynchus* spp.) to conditions outside normal conditions. Significant knowledge about freshwater, and coastal ocean ecology of Pacific salmon exists, but little is known about the open ocean ecology for Pacific salmon particularly during winter. The IYS 2019, 2020 and 2022 Expeditions have begun to address this gap in knowledge regarding the open ocean phase of the Pacific salmon life cycle and have offered excellent opportunities for collaborating multilaterally with Pacific salmon-producing countries across the North Pacific.

The overall objective is to understand how climate variability in the North Pacific Ocean and the associated changes in the physical environment influence the abundance, distribution, migration, and growth of Pacific salmon. The specific sub-objectives were as follows:

1. Determine species and stock-specific ocean distributions and relative abundances, and condition of juvenile, immature/mature Pacific salmon within the study area;
2. Document the spatial and temporal variation in physical and biological oceanographic conditions;
3. Document the distribution, condition, and standing stocks of zooplankton, and nekton that serve as the prey base for Pacific salmon and associated marine fishes;

The 2022 IYS Pan-Pacific Expedition was carried out between January and April of 2022 and involved five research vessels and covered portions of the central and eastern North Pacific Ocean. This is a preliminary report of the results from the 2022 IYS Expedition led, funded and conducted by Fisheries and Oceans Canada onboard the *CCGS Sir John Franklin*. A more detailed report for the *CCGS Sir John Franklin* will be published as a Technical Report of Fisheries and Oceans Canada (June 2022) and a synthesis cruise report across all vessels will be published as a NPAFC Technical Document (Fall 2022).

Materials and Methods

The survey design included concurrent surveys between January–April 2022 within the central and eastern North Pacific Ocean (Figure 1). The *CCGS Sir John Franklin* conducted a trawl survey in eastern Gulf of Alaska (Figure 1) from February 19-March 21, 2022. This portion of the 2022 IYS Expedition was led, conducted and funded by Fisheries and Oceans Canada. The sixteen person science team was comprised of oceanographers and biologists. The survey onboard the *CCGS Sir John Franklin* was divided into two legs: Leg 1 (departing from Victoria) February 18-March 8; Leg 2 (returning to Port Hardy) March 8-21. A science crew change on March 8 occurred in Port Hardy.

The detailed sampling protocols are outlined in NPAFC Doc. 1995. The oceanographic and fishing operations during either daytime or nighttime consisted of:

1. CTD casts down to 300 m (2,000 m for Argo Float deployment stations)
2. Rosette niskin bottle samples for:
    a. Dissolved oxygen from 5, 25, 50, 75, 100, 150, 200, 300 m (0, 5, 10, 25, 50, 60, 75, 100, 125, 150, 175, 200, 250, 300, 400, 600, 800, 1000, 1250, 1500, 2000 m)
    b. Dissolved nutrients (nitrates, phosphates, silicates) from 5, 25, 50, 75, 100, 125, 150, 200, 300 m (0, 5, 10, 25, 50, 60, 75, 100, 125, 150, 175, 200, 250, 300, 400, 600, 800, 1000, 1250, 1500, 2000 m)
    c. Chlorophyll-a from 5, 25, 50, 75, 100, 150 m (5, 25, 50, 75, 100, 150 m)
    d. eDNA from 5, 25, 50, 100 m (none from 2,000 m casts)
    e. Particulate organic matter (POM) from 5 m (5 m)
    f. High-performance liquid chromatography (HPLC) pigments 5, 25, 50 m (5, 25, 50 m)
    g. Metal binding ligands from 5, 25, 50, 100, 150 m (none from 2,000 m casts)
    h. Flow cytometry from 5 m (5 m)
3. Paired Bongo nets (253 μm mesh size) to sample zooplankton, deployed vertically to 300 m
4. Tucker trawl nets to sample nekton, deployed obliquely to 400 m; 3 nets deployed (0-400 m; 400-200 m; 200-0 m)
5. LFS 1142 mid-water trawl net with 11 m codend mesh liner (LFS Trawl (LFS Net Systems, Bellingham, USA) towed at 4-5 knots for one hour in the top 30 meters of the water column. RBR duet^3 temperature and depth sensors (RBR Ltd., Ottawa, ON, Canada) were deployed on the headrope and footrope of the trawl net to record depth and provide estimate of net opening throughout the tow
6. Deployment of 6 Argo floats (with corresponding 2,000 m CTD casts)
7. Hydroacoustic measurements throughout the survey area using EK80 echosounder operating at 18, 38, 70, 120, 200, 333 kHz
8. Flow-through thermosalinograph measurements throughout the survey area
9. Observations of marine mammal and seabirds in the area
10. GoPro cameras attached to outside railing to record macroplastics in the open ocean during daylight transit.

Preliminary Results

In total, there were 22 days with fishing or oceanographic operations at 36 stations. Four of the 38 planned stations (51-138; 50-144; 51-144; 52-144) did not having any fishing or oceanographic sampling completed due to poor weather; however 2 additional stations (46-144; 51-132) were opportunistically added. Poor weather and sea state prevented fishing operations at stations 49-144 and 57-141 and oceanographic operations at 47-141. In total, there were 34 trawl events, 35 CTD and rosette events (n=30 to 300 m; n=5 to 2,000 m casts, 35 bongo net events, 32 Tucker trawl events and 6 Argo floats were deployed (Figure 2).

A total of 221 Pacific salmon were captured: 85 sockeye salmon (*O. nerka*) ; 83 chum salmon (*O. keta*); 33 pink salmon (*O. gorbuscha*); 16 coho salmon (*O. kisutch*); and 4 chinook salmon (*O. tshawytscha*) (Table 1). Broadly speaking, sockeye salmon were encountered in northern and western stations, while chum, chum and pink salmon were encountered in south-eastern stations (Figure 3).

The five most dominant species by catch weight (kg) were northern sea nettle (*Chrysaora melanaster*), water jellyfish (*Aequorea* spp.) sockeye salmon, chum salmon and fried egg jellyfish (*Phacellophora camtschatica*) (Table 1). It is important to note that individual counts for jellyfish species are underestimates since only whole individuals could be counted and pieces, if identifiable to species, are included in catch weights but not counts. Any jellyfish pieces not identifiable to species are included only in catch weight as "Jellyfish". The five most dominant species by individual counts were northern lampfish (*Stenobrachius leucopsarus*), threespine stickleback (*Gasterosteus aculeatus*) and blue lanternfish (*Tarletonbeania crenularis*), smallfin gonate squid (*Berryteuthis anonychus*) and comb jellies (Ctenophora) (Table 1). Threespine sticklebacks were unexpected, since they are typically associated with freshwater and coastal ecosystems, but rare encounters far from shore in the Gulf of Alaska have been documented (see Mecklenburg et al., 2002 for references). We encountered this species in the most northerly stations, i.e. closest to the coastal region of Alaska, and it is important to note that occurrence of threespine stickleback was *not* limited to stations with a freshwater lens.

References

Mecklenburg, C., T. Mecklenburg and L. Thorsteinson. 2002. Fishes of Alaska. American Fisheries Society, Bethesda, Maryland. 1037 pp.

Pakhomov, E.A, C. Deeg, S. Esenkulova, G. Foley, B.P.V. Hunt, A. Ivanov, H.K. Jung, G. Kantakov, A. Kanzeparova, A. Khleborodov, C. Neville, V. Radchenko, I. Shurpa, A. Slabinsky, A. Somov, S. Urawa, A. Vazhova, P.S. Vishnu, C. Waters, L. Weitkamp, M. Zuev, and R. Beamish. 2019. Summary of preliminary findings of the International Gulf of Alaska expedition onboard the R/V Professor Kaganovskiy during February 16–March 18, 2019. NPAFC Doc. 1858. 25 pp. Canada, Japan, Korea, Russia, and USA (Available at https://npafc.org).

Pakhomov, E.A., R. Beamish, E. Farley, C. Freshwater, J. King, C. Neville, V. Radchenko, B. Riddell, S. Sato, A. Somov, S. Urawa, T. van der Stap, L. Weitkamp, C. Graham, and M. Saunders. 2021. Preliminary cruise plan for the NPAFC International Year of the Salmon (IYS) 2022 Pan-Pacific Winter High Seas Expedition. NPAFC Doc. 1995. 92 pp. (Available at https://npafc.org).

Somov, A., T. Blaine, C.M. Deeg, S. Esenkulova, T.J. Frost, S. Garcia, I.V. Grigorov, B.P.V. Hunt, A. Kanzeparova, R.V. LaForge, J.E. Lerner, N. Mahara, C.M. Neville, E.A. Pakhomov, B. Riddell, W.W. Strasburger, and R.J. Beamish. 2020. Preliminary findings of the second salmon Gulf of Alaska expedition onboard the R/V Pacific Legacy March 11–April 7, 2020 as part of the International Year of the Salmon. NPAFC Doc. 1930. 48 pp. Russia, Canada, and USA (Available at https://npafc.org).

Table 1: Total catch by weight (kg) and number of individuals for species encountered in the eastern Gulf of Alaska during the NPAFC International Year of the Salmon Pan-Pacific Survey from February 19 to March 21, 2021 on the *CCGS Sir John Franklin*. Individual counts for jellyfish species are underestimates since only whole individuals could be counted and pieces, if identifiable to species, are included in catch weights but not counts. Any jellyfish pieces not identifiable to species are included only in catch weight as "Jellyfish".

Common name	Scientific Name	Total catch weight (kg)	Total catch count
Northern sea nettle	*Chrysaora melanaster*	78.33	311
Water jellyfish	*Aequorea* spp.	63.3	11
Sockeye Salmon	*Oncorhynchus nerka*	56.6	85
Chum Salmon	*Oncorhynchus keta*	51.99	83
Fried egg jellyfish	*Phacellophora camtschatica*	51.2	58
Euphausiids	Euphausiacea	42.72	--
Jellyfish	Scyphozoa	34.68	--
Threespine Stickleback	*Gasterosteus aculeatus*	15.09	3298
Northern Lampfish	*Stenobrachius leucopsarus*	9.45	4104
Coho Salmon	*Oncorhynchus kisutch*	9.12	16
Moon Jelly	*Aurelia aurita*	8.87	21
Pink Salmon	*Oncorhynchus gorbuscha*	7.48	33
Chinook Salmon	Oncorhynchus tshawytscha	5.14	4
Smallfin Gonate Squid	*Berryteuthis anonychus*	4.14	830
Blue Lanternfish	*Tarletonbeania crenularis*	3.66	2785
Boreal Clubhook Squid	*Onychoteuthis borealijaponica*	3.5	39
Aurelia Labiata	*Aurelia labiata*	3.14	15
Comb jelly unidentified	Ctenophora	2.23	74
Black Rockfish	*Sebastes melanops*	1.48	1
Boreopacific Gonate Squid	Gonatopsis borealis	1.13	120
Comb jelly	*Hormiphora cucumis*	0.91	216
Lanternfish (unidentified)	Myctophidae	0.89	20
Ragfish	*Icosteus aenigmaticus*	0.28	1
Popeye Blacksmelt	*Lipolagus ochotensis*	0.16	26
Daggertooth	*Anotopterus pharao*	0.09	3
California Headlightfish	*Diaphus theta*	0.07	28
Opalescent Inshore Squid	*Doryteuthis opalescens*	0.05	20
Calycopsis (Genus)	Calycopsis spp.	0.01	6
Abraliopsis Felis	*Abraliopsis felis*	--	8
Amphipods	Amphipoda	--	4

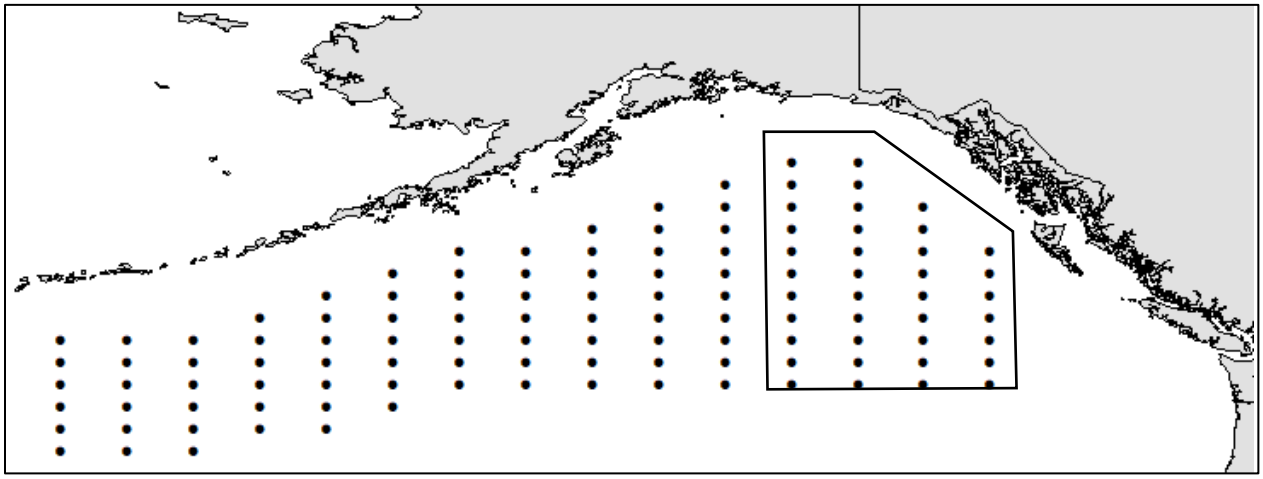

Figure 1. Planned stations of the 2022 International Year of the Salmon Pan-Pacific Winter High Seas Expedition. The survey grid assigned to Canada, and completed by the *CCGS Sir John Franklin* indicated by the polygon. The Canadian survey grid was bounded by 138°W; 47°N; 144°W and 57°N and had 38 planned stations.

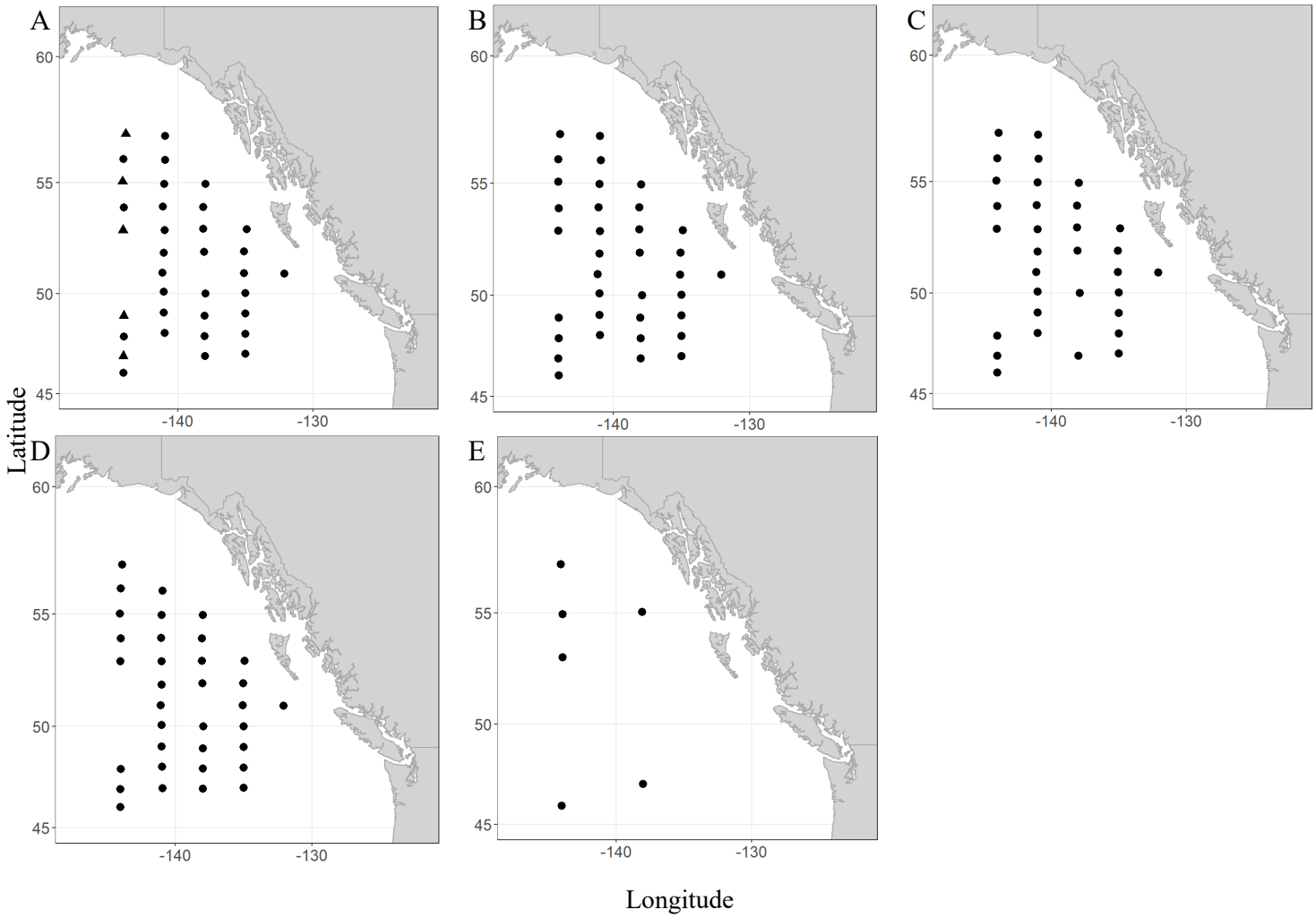

Figure 2: Sampling locations (n=36) in the eastern Gulf of Alaska with: A) CTD and rosette casts (circles are casts to 300 m; triangles are casts to 2,000 m); B) Bongo net deployment; C) Tucker trawl net deployment; D) trawl operations; and E) Argo float deployment during the NPAFC International Year of the Salmon Pan-Pacific Survey from February 19 to March 21, 2021 on the *CCGS Sir John Franklin*.

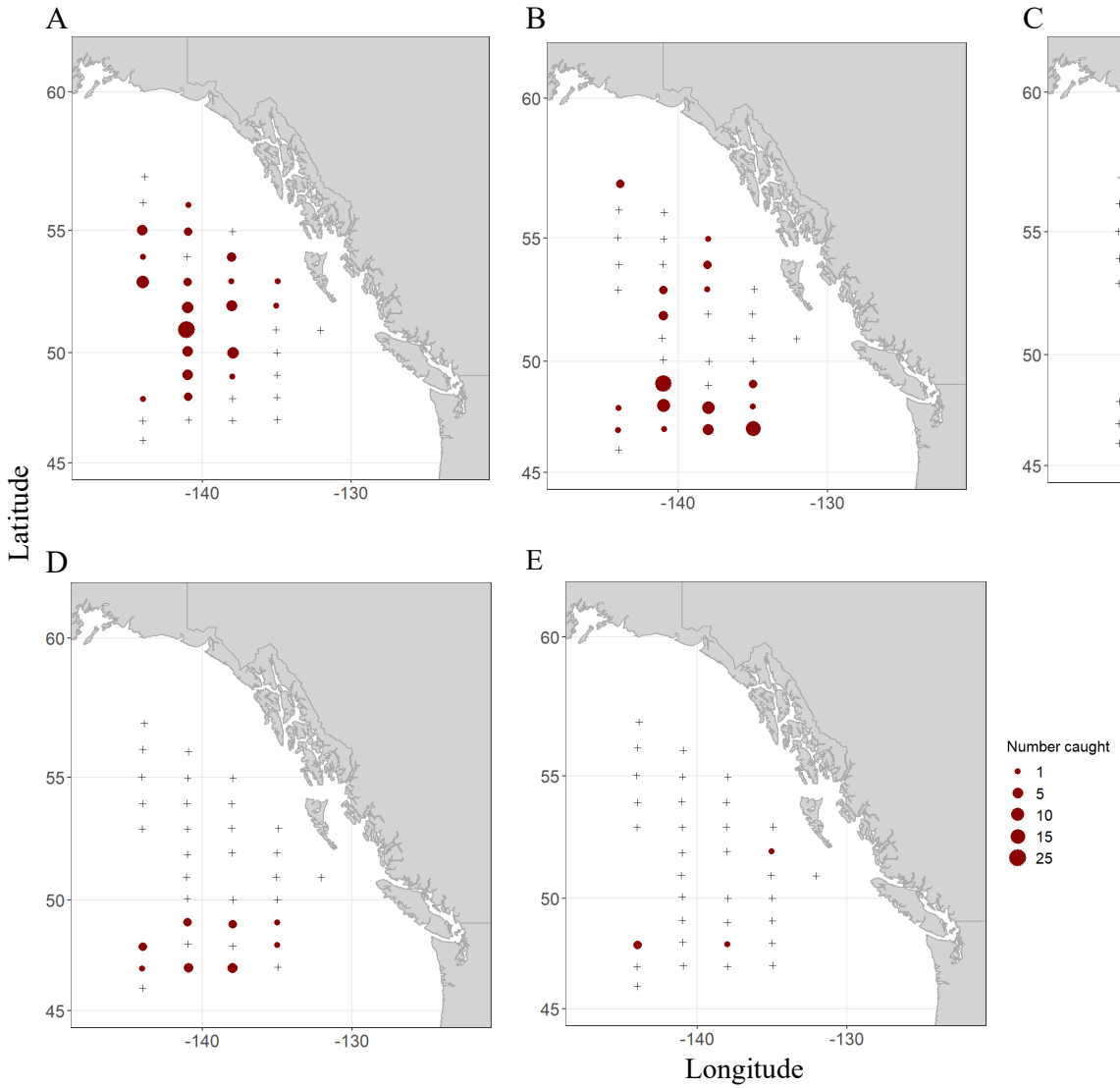

Figure 3: Distribution of Pacific salmon (n=221) caught per tow in the eastern Gulf of Alaska for: A) sockeye salmon; B) chum salmon; C) pink salmon; D) coho salmon; and E) chinook salmon during the NPAFC International Year of the Salmon Pan-Pacific Survey from February 19 to March 21, 2021 on the *CCGS Sir John Franklin*.