Beaufort Sea Long-Term Nearshore Fish Monitoring Program:

2022 Annual Report

Prepared for

Hilcorp Alaska, LLC
3800 Centerpoint Drive, Ste. 1400
Anchorage, Alaska 99503

2022 Beaufort Sea Long-Term Nearshore Fish Monitoring

Beaufort Sea Long-Term Nearshore Fish Monitoring Program:

2022 Annual Report

2022 Beaufort Sea Long-Term Nearshore Fish Monitoring Program

By

Jonah A. Bacon

Anna M. V. Medina

Trent M. Sutton

University of Alaska Fairbanks
College of Fisheries and Ocean Sciences
Department of Fisheries
2150 Koyukuk Drive
Fairbanks, Alaska 99775

This report was prepared under contract to Hilcorp Alaska, LLC. Questions about this report may be addressed to: Hilcorp Alaska, LLC, Environmental Specialist, 3800 Centerpoint Drive, Anchorage, Alaska 99503.

This study was conducted under Alaska Department of Fish and Game Permit No. CF-22-007.

Report should be cited as:

Bacon, J. A., A. M. V. Medina, and T. M. Sutton. 2022. Beaufort Sea Long-Term Nearshore Fish Monitoring Program: 2022 Annual Report. Report for Hilcorp Alaska, LLC by the University of Alaska Fairbanks, College of Fisheries and Ocean Sciences, Department of Fisheries, Fairbanks, Alaska.

Executive Summary

The Beaufort Sea Long-Term Nearshore Fish Monitoring Program is the most comprehensive and continuous sampling effort to monitor the assemblage structure and health of anadromous and amphidromous fishes in nearshore waters of the central Beaufort Sea near Prudhoe Bay, Alaska. This program was initiated to monitor and, if necessary, direct mitigation of environmental impacts on nearshore fishes related to oil and gas development, with a particular emphasis on species of subsistence importance. Sampling in 2022, which represented year 40 of the monitoring program, took place from June 28 through August 24, and was conducted by personnel from the University of Alaska Fairbanks College of Fisheries and Ocean Sciences. Sampling was completed using paired fyke nets at four locations following standardized procedures. One hundred and seventy eight net nights of sampling effort were employed over the 2022 sampling period, and environmental conditions during sampling were generally within historical ranges for the summer open-water period. Winds were mostly easterly, and water temperatures were cooler than the long-term average, ranking as the 4th coolest summer since 2001. Salinity ranked as the least saline summer since 2001. Seventeen fish species were identified among the 40,390 fish that were captured and counted over the sampling period, which represented a decline relative to 2021 and 2020. The total catch in 2022 was the lowest since 2001, thus ranking 22nd out of 22 years. Typically, whitefishes from the subfamily *Coregoninae* comprise the highest proportion of the catch (> 50%). However, during the 2022 sampling season, *Coregoninae* comprised only 47.01% of the catch. The largest single-species contributor to the total catch was Rainbow Smelt (21.31%; 3rd highest catch since 2001), followed by Broad Whitefish (18.69%), Arctic Cisco (16.01%), Arctic Flounder (12.87%), Fourhorn Sculpin (10.93%), and Least Cisco (8.35%). In comparison to historical records, the catch of Arctic Cod and Saffron Cod in 2022 was the 8th and 9th lowest on record since 2001, respectively, while Fourhorn Sculpin, Arctic Flounder, and Pink Salmon catches were the 4th, 2nd, and 6th lowest on record, respectively, since 2001. Catches of Arctic Cisco, Broad Whitefish, Dolly Varden were higher than in 2021, yet within the middle of their catch range since 2001 (12th, 12th, and 7th highest catches since 2001, respectively). In contrast, catches of Least Cisco and Humpback Whitefish were on the low end of their range since 2001, with 2022 the 2nd and 11th lowest catches, respectively. Other notable catches included Arctic Grayling (2nd highest catch since 2021), Ninespine Stickleback, Threespine Stickleback, Capelin, Pacific Herring, and Round Whitefish (3rd lowest catch since 2001). Three species that have been commonly collected during sampling but were not captured in 2022 (or 2021) included Burbot, Chum Salmon, and Whitespotted Greenling. Sockeye Salmon and hybrid *Coregonus* were not collected in 2022 but were collected in 2021. Given the rapid rate of climate change that is occurring in the Arctic, coupled with ongoing oil and gas exploration in the Prudhoe Bay region, we recommend the continuation of the program to allow for continued monitoring and to increase our understanding of important data-limited fishes.

Table of Contents

List of Tables

List of Figures

Appendices

Introduction

The goal of the Beaufort Sea Long-Term Nearshore Fish Monitoring Project has been to monitor assemblages of anadromous and amphidromous fishes in nearshore waters of the Beaufort Sea near Prudhoe Bay during the open-water summer season (late June through early September) in compliance with North Slope Borough Ordinance 19.40.120(f). This program was conducted to monitor and, if necessary, direct mitigation of environmental impacts on nearshore fishes related to oil and gas development by British Petroleum PLC. (formerly) and Hilcorp Alaska, LLC. (currently) on Alaska's North Slope. This fish monitoring program was initiated in the early 1980s specifically to assess the impacts of the West Dock Causeway (Ross 1988), which was constructed in the late 1970s, on the health and status of resident estuarine fishes in Arctic waters of Alaska. The program was expanded through the 1990s in response to construction of the Endicott Causeway to the east following additional growth and development of the Prudhoe Bay oilfield. As a result, fish monitoring surveys have been conducted annually during the summer months since 1981, with the exception of two years (1999 and 2000). Sampling procedures were standardized beginning in 1985 in terms of gear type, sampling effort, and sampling timing, and those same protocols have been followed to the present time. Up until 2016, annual sampling activities were conducted strictly by personnel from LGL Alaska Research Associates Inc. (LGL). Starting in 2016, sampling was conducted as a joint effort between LGL and the University of Alaska Fairbanks (UAF) College of Fisheries and Ocean Sciences (CFOS), with UAF CFOS solely taking over the monitoring program, sampling, and reporting, effective at the start of 2017. Sampling in 2022 followed the historical sampling time frame and also followed standardized sampling protocols as in previous years.

The Beaufort Sea Nearshore Long-Term Fish Monitoring Program is one of the most comprehensive and continuous datasets on nearshore Arctic fishes, and these data are used to monitor the assemblage composition, catch, and (for select species) size structure of nearshore fishes in the central Alaskan Beaufort Sea. In addition, our understanding of fish life history, particularly for species of subsistence importance in the lower Colville River and its associated delta (such as whitefishes in the genus *Coregonus*), has increased as a result of these monitoring efforts. For example, the importance of easterly winds on the transport of age-0 Arctic Cisco *Coregonus autumnalis* from the Mackenzie River, Yukon-Northwest Territories, Canada, and their subsequent recruitment and year-class strength was identified by Gallaway et al. (1983). In addition, Fechhelm et al. (1994) described the effects of westerly and northerly wind patterns on the emigration of Least Cisco *Coregonus sardinella* from the Colville River to Prudhoe Bay. Although the construction of the Endicott Causeway has not impacted the abundance and size structure of Broad Whitefish *Coregonus nasus*, salinity in the delta on the east side of Prudhoe Bay (as influenced by discharge from the Sagavanirktok River) does affect abundance and distribution of this species in this region (Fechhelm and Raborn 2013).

Recent research since 2017 conducted by UAF CFOS has increased our understanding of nearshore fishes in the Beaufort Sea in relation to changing environmental conditions. For example, Priest (2020) and Priest et al. (2022) showed that species positively associated with shifts in the aquatic environment are generalist species such as Broad Whitefish and concluded that continued climate change, and especially Arctic warming, will likely increase growth, shift species assemblages, and alter abundance in the Arctic nearshore ecosystem. Green (2020) showed that the physiological effects of rising water temperatures have the potential to increase growth rates of juvenile Broad Whitefish, and suggested that climate-induced shifts in prey availability or prey quality are likely to be regulating factors in determining the magnitude and direction of changes in growth rates for this species. Gatt (2021), using a biochronology spanning 22 years from 1996–2018 found significant interannual variation in growth for Arctic Cisco, with faster growth rates in years with warmer and more saline waters during the ice-free summer feeding period (July-September). These results suggested that warming may benefit Arctic Cisco. Hamman (2022), using a laboratory-based thermal ramping study, found that recent increases in the abundance of Broad Whitefish and Saffron Cod *Eleginus gracilis* appear to be attributed to cellular mechanisms that are, in part, responsible for the observed shifts organismal thermotolerance, and further, that this plasticity could be used to respond to changing thermal conditions in the nearshore Beaufort Sea in the future. Such variations demonstrate that continued long-term changes in environmental conditions will likely favor generalist species, potentially causing substantial shifts within the Arctic nearshore ecosystem. As a result, ongoing research will assist our understanding of this unique ecosystem by assessing the food habits and trophic food-web structure of Arctic whitefishes as well as understanding the life-history of important forage fishes such as Rainbow Smelt *Osmerus mordax*.

As noted above, the primary goal of this study is to collect biological and physico-chemical data necessary to assess and monitor the population status of estuarine Arctic fishes in the nearshore waters of the Beaufort Sea near Prudhoe Bay during the open-water summer season, with an emphasis on those species that are important for subsistence purposes in the lower Colville River and its delta. Focal species include the aforementioned whitefishes (Arctic Cisco, Least Cisco, Broad Whitefish), Humpback Whitefish *Coregonus pidschian*, Dolly Varden *Salvelinus malma*, Arctic Cod *Boreogadus saida*, and Saffron Cod, as well as secondary species which include Arctic Flounder *Pleuronectes glacialis*, Fourhorn Sculpin *Myoxocephalus quadricornis*, Rainbow Smelt, and Pacific salmon (Chum Salmon *Oncorhynchus keta*, Pink Salmon *Oncorhynchus gorbuscha*, and Sockeye Salmon *Oncorhynchus nerka*). The specific objectives of this monitoring study were to: (1) collect data at the same four study locations using the standardized field sampling protocols that have been in place since 1985 so that the time series of these data will be continued and available for consistent ecological analyses; and (2) investigate trends in catch rates of age classes for fish species of interest. In addition, if collected data are sufficient, this study will also allow the prediction of catch rates for whitefish age classes using age-class data from the current sampling year. Not only will this study allow for an increased understanding of the potential impacts of oil and gas development on fish stocks in Prudhoe Bay, Alaska, but it will also allow for the examination of the effects of changing climate and environmental factors on fish assemblages in Alaskan waters of the Beaufort Sea.

Study Area

Prudhoe Bay is a semi-estuarine embayment formed near the mouth of the Sagavanirktok River delta (Figure 1). The surrounding coastal waters have several barrier islands in close proximity to shore and are shallow: the 6-m water depth contour is more than 5 km from most parts of natural, unaltered shore (Ross 1988). Much of the terrestrial environment around Prudhoe Bay has been developed for the extraction and processing of oil and gas, with many permanent structures inland from the coast. In addition, several oil and gas extraction and processing facilities have been constructed on man-made islands, connected to shore with gravel causeways and bridge breaches. The majority of the shoreline remains as natural tundra banks, although erosion has occurred at many locations (Gibbs and Richmond 2015). Shore-bound sea ice persists in the region until late June or early July (roughly the study start date). Historically, sea ice in the coastal Beaufort Sea begins to melt in June, accelerates through July, and reaches a minimum extent in September for the southern Beaufort Sea (Wendler et al. 2010). Climate warming has reduced the extent of summer ice and has extended the timing and duration of melt seasons across the Arctic, with the Beaufort Sea serving as an example of the most dramatic changes due to this environmental shift (Stroeve et al. 2014). Freeze up typically starts in September or October. The sampling sites for this study occur at four locations along the coast which are aligned roughly east-west and are spaced approximately 27 km apart (Figure 1). From west to east, these sites are identified as Site 220 (approximately 1 km west from the base of the West Dock causeway), Site 218 (on the west side of Prudhoe Bay at the West Beach drilling pad), Site 214 (at the Niakuk drilling pad on the tip of Heald Point), and Site 230 (on the western side of the Endicott Causeway, south of the middle of three causeway breaches).

Methods

Field Sampling Methods

At the four sampling locations, two fyke nets with an opening of 1.8 m by 1.7 m were set side-by-side, opening toward the coastline, with a 60-m blocker net leading to shore (Figure 2). A 15-m blocker wing was attached to the outer edge of each cod end (eight total cod ends). Using this bi-directional sampling method, the nets could intercept and catch fish moving along the shoreline in either direction. All blocker lead nets and wings were constructed from 2.5-cm stretch mesh, while the fyke net mesh consisted of 1.27-cm stretch mesh. Consecutive throats were located behind each 1.7-m frame opening, the outermost throat having a functional width of 11.4 cm. Net specifications are consistent with nets used throughout the span of the study, with the exception of a modification of the net throats to prevent incidental seal catches. Sampling sites in 2022 were operated from June 28th–August 24th, although the installation and removal of each sampling site varied. Each of the four sites was sampled with a minimum of effort of 46 net nights, for a total of 178 net nights (Table 1).

Each net was checked daily (depending on safe checking conditions), and all fish were identified to species and enumerated. Fork length to the nearest 1 mm was measured daily for fish from each net for the following indicator species: Arctic Cisco, Least Cisco, Broad Whitefish, Humpback Whitefish, Dolly Varden and all Pacific salmon species. Total length (to the nearest 1 mm) was also measured for Saffron Cod, Arctic Cod, and Rainbow Smelt. Up to 30 fish per size class from each of these species was measured from each net cod end for all sites. After 30 measurements were completed per size category, any additional fish were counted only. Size categories roughly correspond to historical breaks for age classes (Appendix 1). Several of these measured species were not historically split into length groups, and this protocol was maintained for consistency. After species identification, enumeration, and measurements were completed, fish were released away and offshore from the cod-end openings to minimize recapture of the same individual fish. All fish were identified following species-specific characteristics in Mecklenburg et al. (2002), George et al. (2009), and Thorsteinson and Love (2016).

Biological samples were also collected throughout the sampling period for later analyses. These included the removal of otoliths from Arctic Cisco (N = 57), Least Cisco (N = 44), Broad Whitefish (N = 48), Humpback Whitefish (N = 19), Pink Salmon (N = 3), and Rainbow Smelt (N = 147) for later aging and isotopic analyses in the laboratory (Appendix 2). All incidental mortalities of Arctic Cod (N = 18) and Saffron Cod (N = 30) were retained for future laboratory analyses at UAF.

Star-Oddi CTD Data Loggers (Star-Oddi, Garoabær, Iceland) were attached to rebar and placed approximately 0.5 m from the ocean floor next to and seaward from the cod-end of each fyke net. The CTD loggers measured temperature, salinity, depth, and conductivity every hour. Unfortunately, water temperature (°C) and salinity (ppt) data were not collected daily at each site using a calibrated handheld YSI 30 (YSI Inc., Yellow Springs, Ohio) at the bottom, mid-water column, and just below the surface as in previous years due to a failure of that device. Meteorological data were collected hourly by the National Weather Service at the Deadhorse Airport data collecting site (PASC), 12 km inland from Prudhoe Bay. Field sampling in 2022 followed the same basic established methods as documented in McCain and Raborn (2017), with the exception of daily water temperature and salinity data using the handheld YSI.

In 2022, additional protocols were added or previous protocols were modified to daily sampling activities to allow for the collection of additional samples without impacting the integrity of the existing study. These protocol modifications included the collection of otoliths from Pink Salmon and Rainbow Smelt for aging and isotopic analyses. The goal of these additional sampling measures was to collect data that have not been collected in previous years in an attempt to explain changes in the fish species assemblage and assemblage dynamics relative to previous years. Collecting fish samples in this manner will continue in future sampling seasons in an attempt to understand the origin of the fish and how their presence might continue to change in the nearshore area. In addition, a size-selective gill net was employed to catch whitefishes for use in a graduate student's research project (Appendix 23). Gill nets were set at the four monitoring sites at a distance far enough from the fyke nets to ensure that the gill-net catches had no impact on fyke-net catches (distance > 100 m). Adult whitefish were targeted and collected during sampling, which included Arctic Cisco (N = 100), Least Cisco (N = 89), Broad Whitefish (N = 55), and Humpback Whitefish (N = 62). Fish were processed to remove tissue samples (otoliths, eyes, and stomachs). Samples will be used for diet and isotope analyses to determine food habitats and food-web dynamics for the captured fish throughout their life history.

Analytical Methods

Fish abundance data were analyzed independently for each site, standardized with respect to effort (catch per unit effort; CPUE) per net night of fishing effort. Net nights were defined as the number of days that had elapsed since the last check of the cod end (occasionally poor weather or other conditions would prevent a check of the nets on a given day).

Species diversity (relative abundance of species) and evenness (whether proportionality is concentrated in a few species or spread out among species) were assessed using the Shannon-Wiener Diversity Index (H') and Species Evenness (J'; Pielou 1975):

Shannon-Weiner Index (H');   and the species evenness J';

$$H' = -\Sigma_i^R [P_i * ln\, ln\, (P_i)] \qquad J' = \frac{H'}{H_{max}},$$

where *Pi* was the proportion of the total catch of the *i*th species.

Most analyses compared the results from 2022 to data collected from 2001–2021. Catch, length, and age data prior to 2001 have not been digitized or made available. Some previous reports recorded total catches or unadjusted CPUE; when possible, comparisons to these data were used for additional analyses.

Results

Environmental Conditions

Wind patterns in 2022 were similar to most other sampling years since 1985, with winds characterized as predominantly easterly (Figure 3). Between June 28 and August 24, there were 13 days with an average westerly wind direction, 26 days with easterly winds, 14 days with northerly winds, and five days with southerly winds. Mean wind speed and direction were 16.9 km/h and 41.1°, respectively. Relative to sampling in previous years, 2022 was almost identical to the median in the number of easterly wind days. (Figure 4).

Water temperatures in 2022 were cooler than the long-term average, ranking as the 4th coolest year since 2001 (Table 2). The coldest average water temperature reported in 2022 was 0.76ºC on July 17. Sites 214 and 230 had the highest average temperatures (8.20 and 7.14°C , respectively) in 2022, followed by 218 (6.79ºC) and 220 (6.28ºC). Water temperatures were variable but became warmer over the sampling period until August when they began to decline (Figure 5).

Salinity in 2022 was the lowest since 2001 at 5.70 ppt (Table 2). The salinity was low following ice breakup in late June, increased throughout July, and began to decrease again towards the end of the season (Figure 5). The low salinity at all four sites can partially be explained by the discharge from the Sagavanirktok River. The mean discharge between June 28 and August 24 was 155.48 m^3/s, which was slightly higher than the long-term average of 133.77 m^3/s from 2000 to 2021 (https://waterdata.usgs.gov/ak/nwis/uv?site_no=15908000). The increase in freshwater input likely contributed to the reduced salinity, especially relative to the 2020 season, which had higher salinity levels with one of the lowest Sagavanirktok River discharge rates since 2001 at 97.62 m^3/s. However, discharge in 2021 was significantly higher than in 2022 (331.31 versus 133.77 m^3/s), yet mean salinity in 2021 (9.67 ppt) was higher than in 2022. While daily variations in river discharge and input impact salinity, wind direction and intensity also are determinants of salinity. For example, the proportion of days with easterly winds (and less saline waters) during the 2022 sampling period was greater than in 2021 (45 versus 39%, respectively). However, the proportion of days with westerly winds (and more saline waters) was much less in 2022 than in 2021 (22% versus 31%, respectively). Therefore, the combination of Sagavanirktok River discharge and easterly winds contributed significantly to lower salinities during 2022.

Similar to previous years, sites 218 and 220 had the highest mean salinities (9.80 and 6.87 ppt, respectively), while sites 230 and 214 had the lowest mean salinities (2.67 and 3.49 ppt, respectively). Lower salinities at sites 214 and 230 can be attributed to their closer proximity to the Sagavanirktok River relative to the other two sampling sites.

Species Composition and Total Catch

Over the 2022 sampling period, 17 different species were identified among the 40,390 fish that were enumerated (Table 3). In comparison, a total of 57,895 fish (19 different species) were captured in 2021 and 44,624 fish (18 different species) were captured in 2020. The largest contributor to the 2022 count was Rainbow Smelt (21.31% of total catch; Figure 7). Outside of Rainbow Smelt, other notable species included Broad Whitefish (18.69%), Arctic Cisco (16.01%), Arctic Flounder (12.87%), Fourhorn Sculpin (10.93%), and Least Cisco (8.35%). While the relative abundance of taxa varied during the 2022 sampling season (Figure 6) and among years (Figure 7), the subfamily *Coregoninae* generally comprises most of the catch except in years with high influxes of Arctic Cod (e.g., 2002 and 2016) or, more recently (e.g., 2020 and 2021), of Saffron Cod. The 2022 sampling season was no exception, with *Coregoninae* representing the majority of the catch at 47.01%. However, only 5.00% of the catch in 2022 was *Gadidae*. The total catch in 2022 of 40,390 fish ranked the lowest since 2001 (22nd out of the last 22 years; range: 40,390–468,663 fish).

The 2022 sampling year marked the 3rd highest catch for Rainbow Smelt (8,609 fish) and 2nd highest catch for Arctic Grayling (178 fish) since 2001. Other notable catches included Ninespine Stickleback (36 fish), Threespine Stickleback (18 fish), Capelin (15 fish), and Pacific Herring (6 fish). In contrast, 2022 had the third lowest catch for Round Whitefish (23 fish) since 2001. Three species that have been commonly collected during sampling but were not captured in 2022 (or 2021) included Burbot, Chum Salmon, and Whitespotted Greenling. In addition, Sockeye Salmon and hybrid *Coregonus* were not collected in 2022, but were collected in 2021.

Species-Specific Results

Arctic Cisco

Arctic Cisco have historically been categorized into three length groups (< 120 mm, 120-249 mm, ≥ 250 mm). The catch for length group 1 was higher in 2022 (2,608 fish) than for 2021 (961 fish) and 2020 (71 fish; Figure 8). In addition, CPUE for length group 1 was also higher in 2022 (14.8 fish/net night) than in 2021 (4.9 fish/net night) and 2020 (1.1 fish/net night). Catch and CPUE for length group 2 in 2022 (2,866 fish and 16.2 fish/net night, respectively) were also higher than in 2021 (2,275 fish and 11.6 fish/net night, respectively) and 2020 (453 fish and 6.9 fish/net night, respectively). However, catch and CPUE for length group 3 in 2022 (992 fish and 5.6 fish/net night, respectively) were intermediate between 2021 (1,191 fish and 6.1 fish/net night, respectively) and 2020 (124 fish and 1.9 fish/net night, respectively). In 2022, the mean length for Arctic Cisco was smaller than mean length in each length category, with the exception of length-category 3 fish in 2021 (length category 1 [2022: 105 mm; 2021: 106; 2020: 109 mm], 2 [2022: 158 mm; 2021: 163 mm; 2020: 196 mm], and 3 [2022: 300 mm; 2021: 291 mm; 2020: 325 mm]).

In 2022, 6,466 Arctic Cisco were caught, which was higher than in 2021 (4,428 fish) and 2020 (648 fish) catches. Similarly, CPUE of Arctic Cisco was higher in 2022 (36.6 fish/net night) than in 2021 (23.1 fish/net night) and 2020 (9.9 fish/net night; Figure 9). These comparisons were made without regard to age classes. The catch and CPUE of Arctic Cisco in 2022 were both ranked 12th highest since 2001. Catches and CPUE for Arctic Cisco varied among sampling sites (220: 281 fish and 7.3 fish/net night, respectively; 218: 976 fish and 24.6 fish/net night, respectively; 214: 3,399 fish and 68.4 fish/net night, respectively; 230: 1,810 fish and 37.0 fish/net night, respectively). Mean length was smaller for Arctic Cisco in 2022 (168 mm; Table 4) than in 2021 (182 mm) and 2020 (212 mm). The range in length for Arctic Cisco in 2022 (48-414 mm) was broader than in 2021 (60-415 mm) and 2020 (84-382 mm). These differences in mean length and length range are largely attributed to the strong year class of fish < 120 mm as well as a large number of fish in the 120-249 mm size class.

Least Cisco

Least Cisco have historically been categorized into two length groups for comparison purposes (< 180 mm and ≥ 180 mm), and these two length categories do not correspond to age categories. Both the catches and CPUE for length group 1 Least Cisco were intermediate in 2022 (306 fish and 1.7 fish/net night, respectively) relative to 2021 (2,202 fish and 11.5 fish/net night, respectively) and 2020 (229 fish and 3.5 fish/net night, respectively; Figure 10). The mean length for this length class was smaller in 2022 (114 mm) relative to the previous two sampling years (2021: 140 mm; 2020: 126 mm). Catch for length group 2 fish in 2022 (3,067 fish) was intermediate compared to 2021 (5,443 fish) and 2020 (1,850 fish), whereas CPUE for this size class was lower in 2022 (17.4 fish/net night) compared to the previous two years (2021: 28.4 fish/net night; 2020: 28.1 fish/net night). The mean length of length group 2 fish in 2022 (296 mm) was larger than in 2021 (264 mm) and 2020 (276 mm).

The total catch of Least Cisco in 2022 (3,373 fish), regardless of length group, was intermediate between catches in 2021 (7,645 fish) and 2020 (2,079 fish). However, the CPUE of Least Cisco in 2022 (19.1 fish/net night), regardless of length group, was lower than in 2021 (39.9 fish/net night) and 2020 (31.6 fish/net night; Figure 11). The catch of Least Cisco in 2022 was the 2nd lowest on record since before 2001, while CPUE was the lowest during this time period. Catch and CPUE of Least Cisco varied by sampling site (220: 563 fish and 14.7 fish/net night, respectively; 218: 1,357 fish and 34.2 fish/net night, respectively; 214: 1,195 fish and 24.0 fish/net night, respectively; 230: 258 fish and 5.3 fish/net night, respectively). The mean length of Least Cisco in 2021 (277 mm; Table 4) was larger than in 2021 (224 mm) and 2020 (253 mm). However, the length range in 2022 (79-425 mm) was generally skewed to larger fish than in 2021 (64-394 mm) and 2020 (89-398 mm).

Broad Whitefish

Broad Whitefish have historically been categorized into three length groups for comparison purposes (< 120 mm, 120–249 mm, ≥ 250 mm); these length categories generally relate to ages 0, 1, and 2+, respectively. The catch for Broad Whitefish in length group 1 was higher in 2022 (5,063 fish) than in 2021 (3,194 fish) and 2020 (491 fish; Figure 12), and CPUE was also higher in 2022 (28.7 fish/net night) than in 2021 (16.7 fish/net night) and 2020 (7.5 fish/net night). For this size category, the mean length was intermediate in size for fish in 2022 (96 mm) compared to 2021 (76 mm) and 2020 (108 mm). For length group 2, catch and CPUE were intermediate in

2022 (1,485 fish and 8.4 fish/net night, respectively) between 2021 (2,180 fish and 11.4 fish/net night, respectively) and 2020 (594 fish and 9.0 fish/net night, respectively). The mean length of fish in this size category was smaller in 2022 (159 mm) than in 2021 (175 mm) and 2020 (190 mm). For length group 3, catch was higher and CPUE was intermediate in 2022 (1,002 fish and 5.7 fish/net night, respectively) relative to 2021 (1,489 fish and 7.8 fish/net night, respectively) and 2020 (287 fish and 4.4 fish/net night, respectively). The mean length for this group was larger in 2022 (346 mm) than in 2021 (328 mm) and 2020 (338 mm).

The total catch and CPUE of Broad Whitefish in 2022 (7,550 fish and 42.8 fish/net night, respectively) was greater than in 2021 (6,863 fish and 35.8 fish/net night, respectively) and 2020 (1,372 fish and 20.9 fish/net night, respectively). The catch and CPUE in 2022 was the 12th and 13th highest, respectively, on record since 2001 (the highest catch and CPUE since 2001 occurred in 2013 with 24,978 fish and 154.5 fish/net night, respectively; Figure 13). Broad Whitefish catch and CPUE varied by sampling site, with catches and CPUE generally higher at lower salinity sites (214: 3,562 fish and 71.7 fish/net night, respectively; 230: 2,951 fish and 60.3 fish/net night, respectively) than higher salinity sites (220: 460 fish and 12.0 fish/net night, respectively; 218: 577 fish and 14.5 fish/net night, respectively). The mean length for Broad Whitefish in 2022 (164 mm) was smaller than in 2021 and 2020 (198 mm each year); however, the length range in 2022 (40-503 mm) was skewed to smaller fish compared to 2021 (46-574 mm) and 2020 (84-573 mm; Table 4). These differences in mean length and length range are largely attributed to the strong year class of fish < 120 mm.

Humpback Whitefish

Humpback Whitefish were larger in size in 2022 (mean length = 346 mm) relative to 2021 (mean length = 308 mm) and 2020 (mean length = 300 mm). Minimum and maximum lengths ranged from 145-475 mm in 2022, which were greater than in 2021 (length range 75-434 mm) and 2020 (length range = 84-442 mm; Figure 14). The catch for Humpback Whitefish in 2022 was 1,598 fish, which was lower than in 2021 (1,813 fish) but greater than in 2020 (330 fish; Figure 15). The CPUE for Humpback Whitefish in 2022 (9.0 fish/net night) was just below the CPUE in 2021 (9.5 fish/net night) but greater than the CPUE in 2020 (5.0 fish/net night). The Humpback Whitefish catch in 2022 was the 11th highest on record since 2001 and the 5th highest since 2010. For example, catches reported since 2001 have ranged from 330–3,428 fish and have been higher since 2010 (range = 1,032-2,706 fish). The CPUE of Humpback Whitefish in 2022 was the 10th highest on record since 2001 and the 5th highest since 2010. Catches and CPUE of Humpback Whitefish in 2022 varied by sampling site, with no apparent pattern respective to salinity (220: 274 fish and 7.2 fish/net night, respectively; 218: 916 fish and 23.1 fish/net night, respectively; 214: 325 fish and 6.5 fish/net night, respectively; 230: 83 fish and 1.7 fish/net night, respectively).

Dolly Varden

Although Dolly Varden have been segregated into two length groups (< 350 mm and ≥ 350 mm), these two length categories do not correspond to age classes for this species. However, we will continue to use these two length categories to make comparisons to previous years' data. In 2022, the catch and CPUE for length group 1 (< 350 mm) was 643 fish and 3.6 fish/net night, respectively, and 237 fish and 1.3 fish/net night, respectively, for length group 2 (≥ 350 mm; Figure 16). Catch and CPUE for length group 1 in 2022 exceeded that of 2021 (444 fish and 2.3 fish/net night, respectively) and 2020 (12 fish and 0.2 fish/net night, respectively). Catch and CPUE for length group 2 in 2022 was less than in 2021 (287 fish and 1.5 fish/net night, respectively) but greater than in 2020 (28 fish and 0.4 fish/net night, respectively). Dolly Varden were smaller in mean length and broader in length range in 2022 (196 mm and 94-347 mm, respectively) relative to 2021 (213 mm and 115-345 mm, respectively) and 2020 (277 mm and 150-340 mm, respectively) for length group 1 fish. The mean length of length group 2 fish in 2022 (485 mm) was larger than in 2021 (447 mm) and 2020 (460 mm), but the length range of fish in 2022 (355-650 mm) was intermediate to 2021 (350-680 mm) and 2020 (354-550 mm).

In 2022, 880 Dolly Varden were caught and CPUE was 5.0 fish/net night, regardless of size class. Total catch and CPUE in 2022 was greater than in 2021 (731 fish and 3.8 fish/net night, respectively) and 2020 (40 fish and 0.6 fish/net night, respectively; Figure 17). Catches and CPUE of Dolly Varden in 2022 were the 7th lowest since 2001. Catches and CPUE of Dolly Varden in 2022 varied by sampling site, with no apparent pattern respective to salinity (214: 478 fish and 9.6 fish/net night, respectively; 230: 88 fish and 1.8 fish/net night, respectively; 218: 203 fish and 5.1 fish/net night, respectively; 220: 111 fish and 2.9 fish/net night, respectively). These results were in contrast to previous years where Dolly Varden catches and CPUEs followed historic trends, where high salinity sites (214 and 230) had higher catch and CPUE values than lower salinity sites (218 and 220). The overall mean length of Dolly Varden (regardless of length-group category) was smaller in 2022 (275 mm) than in 2021 (325 mm) and

2020 (411 mm), and the length range in 2022 (94-650 mm) was skewed smaller than in 2021 (115-680 mm) and skewed larger than in 2020 (150-550 mm).

Marine Species

Arctic Cod

Arctic Cod catch and CPUE vary substantially from year to year, likely due to annual variability in wind direction and salinity. For example, the catch of Arctic Cod in 2022 (843 fish) was slightly higher than in 2021 (833 fish) but much higher than in 2020 (234 fish; Figure 18). Similarly, CPUE in 2022 (4.8 fish/net night) was slightly higher than in 2021 (4.3 fish/net night) and higher than in 2020 (3.6 fish/net night; Figure 19). The catch and CPUE of Arctic Cod in 2022 was the 8^{th} and 7^{th} lowest, respectively, on record since 2001. Catches and CPUE for Arctic Cod varied considerably among sampling sites: site 214 (78 fish and 1.6 fish/net night, respectively), site 218 (494 fish and 12.4 fish/net night, respectively), site 220 (237 fish and 6.2 fish/net night, respectively), and site 230 (34 fish and 0.7 fish/net night, respectively). The mean length for Arctic Cod caught in 2022 was 98 mm, with a range of 54-208 mm (Table 4; Figure 19). The mean length and length range for 2022 was similar to 2021 (97 mm and 64-198 mm, respectively) but smaller/lower than in 2020 (116 mm and 76-257 mm, respectively).

Saffron Cod

The total catch and CPUE of Saffron Cod in 2022 (1,176 fish and 6.7 fish/net night, respectively) was much lower than in 2021 (13,709 fish and 71.5 fish/net night, respectively) and 2020 (35,047 fish and 532.7 fish/net night, respectively; Figure 21). In comparison to historical records, the catch and CPUE of Saffron Cod in 2022 were the 9th lowest since 2001. Saffron Cod catches and CPUE highly variable among sites and not related to salinity (218: 512 fish and 12.9 fish/net night, respectively; 220: 83 fish and 2.2 fish/net night, respectively; Site 214: 431 fish and 8.7 fish/net night, respectively; Site 230: 150 fish and 3.1 fish/net night, respectively). The mean length for Saffron Cod in 2022 was 180 mm, with a range of 39-501 mm (Table 4; Figure 20). This mean size of Saffron Cod in 2022 was larger than in 2021 (172 mm) and 2020 (116 mm), but the length range was skewed to smaller minimum and maximum size fish relative to 2021 (58-508 mm) and 2020 (55-527 mm).

Rainbow Smelt

The catch and CPUE for Rainbow Smelt was 8,609 fish and 48.8 fish/net night, respectively, in 2022. The catch and CPUE were higher than in either of the past two years (2021: 5,267 fish and 27.5 fish/net night, respectively; 2020: 767 fish and 11.7 fish/net night, respectively); catch and CPUE in 2022 were the 3rd highest since 2001 (Figure 22). Catch and CPUE of Rainbow Smelt varied by site in relation to salinity. For example, catches and CPUE were lower at high salinity sites (218: 1,367 fish and 34.4 fish/net night, respectively; 220: 104 fish and 2.7 fish/net night, respectively) than at low salinity sites (214: 3,068 fish and 61.7 fish/net night, respectively; 230: 4.070 fish and 83.2 fish/net night, respectively), which are consistent with long-term trends for this species. Rainbow Smelt were measured for the first time in 2022; the mean length was 100 mm and the length range was 33-265 mm.

Arctic Flounder

The catch of Arctic Flounder in 2022 totaled 5,200 fish, with a CPUE of 29.4 fish/net night. Both catch and CPUE of Arctic Flounder were much lower than in 2021 (11,371 fish and 59.3 fish/net night, respectively) but higher than in 2020 (2,688 fish and 40.9 fish/net night, respectively; Figure 23). The catch of Arctic Flounder in 2022 was the 2nd lowest since 2001, while the CPUE was the lowest since 2001. Both catches and CPUE of Arctic Flounder were highly variable among sites, with the highest catches and CPUE at sites 214 (3,423 fish and 68.9 fish/net night, respectively) and 218 (990 fish and 24.9 fish/net night, respectively) and lowest catches and CPUE at sites 230 (566 fish and 11.6 fish/net night, respectively) and 220 (221 fish and 5.8 fish/net night, respectively). Arctic Flounder were not measured for length in 2022.

Fourhorn Sculpin

A total of 4,416 Fourhorn Sculpin were captured in 2022, with a CPUE of 25.0 fish/net night. The catch of Fourhorn Sculpin in 2022 was slightly below that of 2021 (4,917 fish) but much higher than in 2020 (1,060 fish). The CPUE in 2022 was similar to 2021 (25.6 fish/net night) but much higher than in 2020 (16.1 fish/net night). In general, both the catches and CPUE over the past four years have generally been well below the historical record for this species (Figure 24). Not only did catches of Fourhorn Sculpin vary among sites (214: 2,495 fish; 230: 763 fish; 218: 945 fish; 220: 213 fish), but CPUE also varied among sites 214 (50.2 fish/net night), 230 (15.6 fish/net night), 218 (23.8 fish/net night), and 220 (5.6 fish/net night). The catch and CPUE of Fourhorn Sculpin in 2022 were both the 4th lowest for this species since 2001. Fourhorn Sculpin were not measured for length in 2022.

Pacific Salmon

Until 2017, only adult Pink Salmon and Chum Salmon were collected in the Prudhoe Bay region during annual monitoring efforts. In general, few Pacific salmon have historically been captured in this region. Prior to 2020, a total of 1,265 salmon have been caught, with most of these fish being Pink Salmon (1,194 fish; Chum Salmon: 70 fish; Sockeye Salmon: 1 fish). The trend in low catches continued for Sockeye Salmon (only 2 fish have ever been caught during sampling efforts). While 2019 was a record year for both Chum Salmon (10 fish) and Pink Salmon (417 fish), no Chum Salmon have been captured since this year. However, 3 Pink Salmon were captured in 2022, including one juvenile fish.

Chum Salmon

No Chum Salmon were captured in 2022, which is similar to 2020 and 2021 (0 Chum Salmon). In comparison, the Chum Salmon catch (10 fish) and CPUE (0.1 fish/net night) in 2019 (a record year) was higher than in 2018 (two fish and 0.01 fish/net night, respectively) and 2017 (two fish and 0.01 fish/net night, respectively; Figure 25). Catches and CPUEs of Chum Salmon typically also varied by sampling site; for example, catches and CPUEs, respectively, by sampling site in 2019 were as follows: 214: five fish and 0.2 fish/net night; 218: three fish and 0.1 fish/net night; 220: one fish and 0.01 fish/net night; 230: one fish and 0.01 fish/net night.

Pink Salmon

A total of 3 Pink Salmon (1 juvenile and 2 adults; CPUE < 0.1 fish/net night) were captured in 2022. With the exception of 2020 (N = 98 fish), 2019 (N = 417 fish), and 2008 (N = 284 fish; Figure 26), catches of Pink Salmon have ranged from 0 to 31 fish since 2001. However, catches have been high for this species since 2015 (range, 22-417 fish/year), with the exception of 2021 and 2022. The total length for the juvenile Pink Salmon was 108 mm and both adult Pink Salmon were 411 mm. Catches and CPUEs of Pink Salmon in 2022 also varied by sampling site: 214 (0 fish and 0 fish/net night, respectively), 218 (1 adult fish and < 0.1 fish/net night, respectively), 220 (1 adult fish and < 0.1 fish/net night, respectively), and 230 (1 juvenile fish and < 0.1 fish/net night, respectively). The Pink Salmon catch and CPUE in 2022 were both tied for the 6th lowest for this species since 2001. Other years in which only 3 Pink Salmon were collected include 2007, 2011, and 2021.

Sockeye Salmon

In 2022, there were no Sockeye Salmon collected at any of the sample sites. Previously, only two Sockeye Salmon have been caught during sampling efforts as part of the Beaufort Sea Long-

Term Nearshore Fish Monitoring Program - a juvenile Sockeye Salmon in 2021 and a mature female Sockeye Salmon in 2017.

Discussion

Continuation of this project in 2022 represented year 40 of a mostly continuous standardized sampling program since 1981. Although there were some changes to the sampling protocols that were used in 2022, these modifications were implemented to either streamline sampling efforts or collect additional samples and data. In all cases, these changes did not alter data collection in a manner that would impact the study results. As a result, the integrity of the sampling protocols and locations were maintained in a standardized manner. The total number of fish caught in 2022 (40,390 fish) was less than in 2021 and 2020 (57,895 and 44,624 fish, respectively). The 2022 catch was below the median total catch since 2001 (range: 40,390–468,663 fish) and ranked lowest (22nd) out of the past 22 years. Rainbow Smelt (8,609 fish) comprised the largest catch of any fish species in 2022, which was a 60% increase in the catch for this species relative to 2021 (Hamman et al. 2021) and the largest Rainbow Smelt catch recorded since 2013. Rainbow Smelt catches were only higher than 2022 in 2001 and 2013 (11,237 and 9,891 fish, respectively; Fechhelm et al. 2002; McCain et al. 2014). The anomaly of such a high catch of Rainbow Smelt in 2022 is timely given a new UAF study that was initiated this past summer to examine the age structure, growth, and life history of this species in the nearshore Beaufort Sea (see Appendix 24).

Environmental conditions in 2022 were within the historical ranges for this time of year, with primarily easterly winds and water temperatures and salinities that were lower than the long-term average. The 2022 summer was the 4th coolest year since 2001, which is likely attributed to the heavy snow and ice pack from the 2021-2022 winter and cooler than average air temperatures. It is not clear if or to what extent the cooler water temperatures that occurred in 2022 influenced the species composition, catch (i.e., relative abundance), and size structure (for those species in which length was measured in 2022) for Arctic fishes collected during this project. The salinity conditions in 2022 were lowest on record since 2001. Not surprisingly, salinity was lowest early in the summer after ice breakup and increased progressively over the summer with declines in the discharge of the Sagavanirktok River. Further, salinity graded from being more freshwater at sites 230 and 214 to more estuarine/brackish salinities at sites 220 and 218. Although sites 218/220 and 230 had the highest and lowest salinities, on average, again in 2022 (9.80/8.67 and 2.67 ppt, respectively), these salinities were lower than those reported at these same sites (sites 218/220 and 230 [the highest and lowest average salinity sites] in 2021 (12.0/12.9 and 6.0 ppt, respectively), 2020 (23.5/21.8 and 13.0 ppt, respectively), and 2019 (18.1/17.5 and 7.1 ppt, respectively). However, salinities at all sites (but particularly at sites 230 and 214) were lower, on average, in 2022. Unlike 2020 and 2021, there were no uncharacteristically low and high discharge events from the Sagavanirktok River, respectively, to impact salinity in nearshore areas, particularly at sites 230 and 214. However, one difference in 2022 relative to previous years was that the handheld YSI 30 failed at the start of the field season and could not be used to measure water temperature and salinity at the bottom, mid-water column, and just below the surface at each sampling site. As a result, water temperature and salinity were measured at each net site using the Star-Oddi CTD Data Loggers. While these loggers provide finer-scale resolution (water-quality parameters are measured hourly rather than once per day using the YSI 30), they are fixed in place at 0.5 m from the bottom and, as a result, do not provide the depth distribution measurements from the YSI 30. A new YSI 30 will be in place for 2023 sampling which will allow for a resumption of the historical water-quality measurements.

Given the importance of water temperature and salinity on nearshore fish distribution, movements, and abundance, it will be critical to continue to track temperature and salinity given potential changes, as well as interannual variability, in discharge regimes from the Sagavanirktok River that may occur from increased permafrost melting within the drainage, transport of meltwater, and increased precipitation due to climate warming (Schuur et al. 2008). Increased meltwater will result in higher concentrations of dissolved organic matter (DOM) in nearshore areas (Mathis et al. 2009). Humics are an important component of DOM, and are the tea-colored compounds in river water that reduce light for phytoplankton (Cooper et al. 2005). These humics are also a carbon source for marine bacteria, which are the main competitors of phytoplankton for nitrogen and phosphorus (Kirchman et al. 2009). Because these changes are occurring at the base of the food web, the impact will ultimately affect production in upper trophic levels. While monitoring DOM and lower trophic levels have not historically been within the scope of the Beaufort Sea Nearshore Fish Monitoring program, our fish assemblage and catch data serve as a proxy of these and other environmental changes. Given the importance of abiotic factors on species composition, relative abundance, and size and age structure, there is a need to collect higher quality, more continuous data on key environmental drivers (e.g., water temperature, salinity, pH, currents, etc.) to better understand their dynamics relative to trends in fish data.

The predominant summer wind patterns in Prudhoe Bay during most years are northeasterly winds; however, in 2022 (which was similar to 2021 and 2020), wind patterns were predominantly easterly, with a mean wind direction of 41.1°. In contrast, wind patterns were predominantly easterly/north easterly in 2019 and 2018, with a mean wind direction of 30.6° and 11.7°, respectively. Easterly winds cause nearshore water levels to drop drastically in response to an offshore surface water movement event (Ross 1988), while westerly winds have the opposite effect and raise water level height in nearshore areas. The above average number of easterly wind days in 2022 resulted in lower than normal water depths at net sites. Water-level depth at the sampling sites can fluctuate from 0.5 to 2 m in height, sometimes in less than a 24-hour period. The effect of water level on either catch abundance or species composition has not been explored and warrants further in-depth analysis. Further, offshore surface (wind-driven) currents cause upwelling events to occur, which replace nearshore waters with deeper, colder, more saline marine water. In contrast, onshore surface currents push cold, saline waters offshore, resulting in warmer and fresher waters in the nearshore environment. As a result of these differences in temperature and salinity, wind patterns likely impact nearshore fish assemblages due to their influence on environmental conditions in these areas and collecting information on this dynamic will be important to understand variability in nearshore fish catch composition data.

The number of fish species caught in 2022 (17 species) was the lowest number of species captured since 2006. Since 2001, the number of fishes collected during the open-water sampling period has ranged from a low of 17 (2006, 2022) to a high of 24 (2017) species, with a mean and median of 19 and 20 species, respectively. The low number of species captured in 2022 (17 species) relative to previous years reflected the absence of five species (Burbot, Chum Salmon, Whitespotted Greenling, Sockeye Salmon, and Hybrid *Coregonus*). While causal mechanisms for the presence-absence of these species are unclear, it is likely tied to changing environmental conditions. However, it is not clear why Chum Salmon were not captured in 2021 or 2022 since the record catch of this species was recorded only two years ago (Gatt et al. 2019; Hamman et al.

2021). Similarly, it is not clear why Whitespotted Greenling were not captured in 2021 or 2022 given that they were captured in 2019 (48 fish; Gatt et al. 2019) and 2020 (19 fish; Hamman et al. 2020, 2021). In contrast, catches of Burbot are always low and Sockeye Salmon have only been captured in 2017 and 2021 in Prudhoe Bay (Priest et al. 2017; Hamman et al. 2021). Hybrid *Coregonus* are also infrequently caught, with one fish collected in 2021, one fish in 2018, and eight fish captured in 2017 (Green et al. 2019; Priest et al. 2017; Hamman et al. 2021). Previous to 2017, a Hybrid *Coregonus* had not been caught since 2006 (Fechhelm et al. 2006).

For the previous two years, Saffron Cod was the most abundant species caught during sampling (2021: 13,709 fish; 2020: 35,047 fish). However, the strong 2020 year class was no longer evident in 2022 and the catch of Saffron Cod (1,176 fish) ranked 9th lowest since 2001. The anomaly of high catches of Saffron Cod in 2020 and 2021 followed by a moderate catch in 2022 warrants further examination but is generally consistent with the higher catches of this species over the past two decades. Although the catch for this species in 2021 was driven by a strong year class the previous year, it is unclear why such a strong year class of Saffron Cod developed in 2020 since this species is euryhaline (Wootton 1984). However, the mean size in 2021 (172 mm) was larger than in 2020 (116 mm) but lower than in 2019 and 2018 (209 and 210 mm, respectively). These results suggest that the large number of Saffron Cod in 2020, in particular small individuals, was due to successful recruitment and a large year class. Further, the larger mean size of Saffron Cod in 2022 relative to 2021 and 2020 is consistent with a continuation of that 2020 year class. Interestingly, the catch of Saffron Cod in 2019 was the lowest that it has been since 2007 (catch range from 2008-2014 = 838-12,519 fish), but on the high end of the range of catches reported from 2001–2007. Saffron Cod catches have been notably higher from 2008-2019 (catch range, 838-12,519 fish) relative to 2001-2007 (catch range, 74-1,733 fish), which suggests a change in nearshore conditions that may be contributing to a greater relative abundance of this species. Given the bet-hedging reproductive strategy utilized by this species (Winemiller and Rose 1992), it is likely that environmental conditions were favorable for a strong year class (and hence the large catches of small fish). Likewise, Arctic Cod catches have continued to be relatively low since 2004 (with the exception of 2016), again suggesting changing nearshore conditions. This trend of changing nearshore conditions influencing Gadid abundance has also occurred in the Gulf of Alaska, where Saffron Cod abundance has increased while Pacific Cod *Gadus macrocephalus* and Walleye Pollock *Theragra chalcogramma* abundances have decreased (Johnson et al. 2009).

Rare species captured in 2022 were different than in 2021. In 2021, rare species included Sockeye Salmon (a juvenile, N = 1) and a hybrid *Coregonus* (N = 1); neither of these fishes were collected in 2022. Further, catches of other rare species differed between 2022 and 2021: Ninespine Stickleback (N = 36 and 25 fish, respectively), Threespine Stickleback (18 and 48 fish, respectively), Capelin (N = 15 and 4 fish, respectively), Pacific Herring (6 and 73 fish, respectively), Pink Salmon (N = 3 both years), Round Whitefish (23 and 140 fish, respectively), and Arctic Grayling (N = 178 and 23 fish, respectively). Further, Chum Salmon and Burbot, species that are commonly captured in Prudhoe Bay albeit in low numbers, were not captured in 2022 or 2021. Because Pink Salmon and Chum Salmon have commonly occurred in the catches, with 2019 being a record year for both species, it is not clear why these two species occurred at such a low abundance (three juvenile and three adult Pink Salmon combined in 2022 and 2021) or were absent from the catch (Chum Salmon) in 2022 and 2021. Because the rare and uncommon species that were and were not collected during sampling in 2022 consisted of a mix of marine, freshwater, and estuarine/amphidromous species, it is difficult to identify the role of environmental drivers (e.g., salinity, temperature, dissolved oxygen, etc.) in their presence or absence. For example, the nearshore Beaufort Sea in 2022 was less saline than in 2021, which should favor those species with a stronger affinity to freshwater (e.g., Ninespine Stickleback, Arctic Grayling). However, catches of Round Whitefish (a freshwater species) were lower in 2022 than in 2021 and catches of Capelin (a marine species) were lower in 2021 (a higher salinity year) than in 2022. As a result, water temperature (2022 was much cooler than 2021) as well as environmental drivers not measured in this study (e.g., pH, nutrients) likely influenced the distribution, occurrence, and abundance of nearshore fishes (Khalsa et al. 2021). As a result, including measurements of these physic-chemical factors and a more in-depth focus on these rare species should lead to a greater understanding of the fish assemblage structure in the nearshore Beaufort Sea under changing climate conditions.

Catches of most fish species in 2022 were less than catches in 2021 as well as below the median catches since 2001. Typically, whitefishes (*Coregoninae*) generally compose most of the catch (> 50%) except in years with high influxes of Arctic Cod or Saffron Cod. However, in

2022, the largest contributor to the total fish catch was Rainbow Smelt (21.31% of total catch). In contrast, whitefishes (N = 18,987 fish, which is the summation of the Arctic Cisco, Least Cisco, Broad Whitefish, and Humpback Whitefish catches) comprised 47.01% of the total catch in 2022. If the Rainbow Smelt catch (N = 8,609 fish) is removed from the total catch (N = 40,390), then the proportion of Coregonid whitefishes caught in 2022 is 60%. The lower than average proportion of this species complex is largely due to low catch of Least Cisco, in particular fish less than 180 mm. This occurrence likely reflects poor recruitment and low year-class strength in 2021-2022 given the low number of fish captured smaller than this size (306 fish in 2022 versus 2,202 fish in 2021). However, the catch of Least Cisco ≥ 180 mm, which corresponded to new recruits and older age classes, in 2022 was also less than in 2021 (3,067 versus 5,443 fish, respectively). However, both the catches of Arctic Cisco and Broad Whitefish were higher in 2022 relative to 2021 which was largely due to increases in the number of new recruits. For example, the number of Arctic Cisco < 120 mm increased from 961 in 2021 to 2,608 fish in 2022, while the catch of Broad Whitefish < 120 mm increased from 3,194 fish in 2021 to 5,063 fish in 2022. Clearly, there remains a need to develop a better understanding of the abiotic and biotic drivers of fish catches/abundance of all species in nearshore areas of the Beaufort Sea given their importance in the trophic food web as climate conditions continue to change at a rapid rate in the Arctic.

Acknowledgements

This project would not have been successful without the continued assistance of many people from a variety of organizations. Amy Peloza, Jen Dushane, and Samantha Beaman from Hilcorp Alaska, LLC provided assistance before, throughout, and after the field season with logistics, billeting, and overall project management. Jennifer Dole, Bob Henderson (all Hilcorp Alaska, LLC) provided additional assistance with in-season changes in field logistics, continual updates on sampling conditions, and details of COVID-19 safety protocols. Shannon Kramer (Hilcorp Alaska, LLC), Vic Richart and Fred Chace (Alaska Clean Seas) provided security detail while we were sampling, which kept the crew from getting eaten by polar bears. Vic Richart and Fred Chace also provided assistance with logistics in the setting up and taking down of our field equipment. A very large thank you goes to Jacob Buck (UAF technician), who participated in field and laboratory sampling and took phenomenal photos of wildlife and fish throughout the summer. LGL Alaska Research Associates, Inc. provided field data from the 2001–2016 sampling seasons. Thank you to the ACS crew for the endless adventures and assistance when we needed it. And thank you to the Endicott and MCC staff and crew for providing such a welcoming environment.

Literature Cited

Cooper, L. W., R. Benner, J. W. McClelland, B. J. Peterson, R. M. Holmes, P. A. Raymond, D. A. Hansell, J. M. Grebmeier, and L. A. Codispoti. 2005. Linkages among runoff, dissolved organic carbon, and the stable oxygen isotope composition of seawater and other water mass indicators in the Arctic Ocean. Journal of Geophysical Research 110:G02013, doi:02005JG000031.

Fechhelm, R. G., J. D. Bryan, W. B. Griffiths, W. J. Wilson, and B. J. Gallaway. 1994. Effect of coastal winds on the summer dispersal of young Least Cisco (Coregonus sardinella) from the Colville River to Prudhoe Bay, Alaska: A simulation model. Canadian Journal of Fisheries and Aquatic Sciences 51:890–899.

Fechhelm, R. G., S. P. Haskell, W. J. Wilson, and W. B. Griffiths. 2002. Nearshore Beaufort Sea fish monitoring in the Prudhoe Bay region, 2001. Report for BP Exploration (Alaska) Inc. by LGL Alaska Research Associates, Inc. Anchorage, Alaska.

Fechhelm, R. G., G. B. Buck, and M. R. Link. 2006. Year 24 of the long-term monitoring of nearshore Beaufort Sea fishes in the Prudhoe Bay region, 2006. Report for BP Exploration (Alaska) Inc. by LGL Alaska Research Associates, Inc., Anchorage, Alaska.

Fechhelm, R. G., and S. W. Raborn. 2013. Year 30 of the long-term monitoring of nearshore Beaufort Sea fishes in the Prudhoe Bay region: 2012 annual report. Report for BP Exploration (Alaska) Inc. by LGL Alaska Research Associates, Inc., Anchorage, Alaska.

Gallaway, B. J., W. B. Griffiths, P. C. Craig, W. J. Gazey, and J. W. Helmericks. 1983. An assessment of the Colville River Delta stock of Arctic Cisco: Migrants from Canada? Biological Papers of the University of Alaska 21:4–23.

Gatt, K. P. 2021. Assessing the long-term growth response and age estimation precision for Arctic whitefishes in a rapidly changing nearshore environment. Master’s Thesis, University of Alaska Fairbanks.

Gatt, K. P., C. R. Hamman, J. T. Priest, D. G. Green, and T. M. Sutton. 2019. Beaufort Sea Nearshore Fish Monitoring Study: 2019 Annual Report. Report for Hilcorp Alaska, LLC by the University of Alaska Fairbanks, College of Fisheries and Ocean Sciences, Department of Fisheries, Fairbanks, Alaska.

George, C., L. Moulton, and M. Johnson. 2009. A Field Guide to the Common Fishes of the North Slope of Alaska. North Slope Borough, Department of Wildlife Management, Barrow, Alaska.

Gibbs, A. E., and B. M. Richmond. 2015. National assessment of shoreline change – Historical shoreline change along the north coast of Alaska, U.S. – Canadian border to Icy Cape. U.S. Geological Survey, Open-File Report 2015–1048, 96 p.

Green, D. G. 2020. Impacts of climate change on juvenile Broad Whitefish *Coregonus nasus* in Arctic Alaska: bioenergetics model development and application. Master's Thesis, University of Alaska Fairbanks.

Green, D. G., J. T. Priest, K. P. Gatt, and T. M. Sutton. 2019. Beaufort Sea Nearshore Fish Monitoring Study: 2018 Annual Report. Report for Hilcorp Alaska, LLC by the University of Alaska Fairbanks, College of Fisheries and Ocean Sciences, Department of Fisheries, Fairbanks, Alaska.

Hamman, C. R. 2022. The influence of acclimation on the organismal and molecular thermotolerance parameters in two Arctic teleosts. Master's Thesis, University of Alaska Fairbanks.

Hamman, C. R., J. A. Bacon, and T. M. Sutton. 2021. Beaufort Sea Nearshore Fish Monitoring Study: 2021 Annual Report. Report for Hilcorp Alaska, LLC by the University of Alaska Fairbanks, College of Fisheries and Ocean Sciences, Department of Fisheries, Fairbanks, Alaska.

Hamman, C. R., K. P. Gatt, and T. M. Sutton. 2020. Beaufort Sea Nearshore Fish Monitoring Study: 2020 Annual Report. Report for Hilcorp Alaska, LLC by the University of Alaska Fairbanks, College of Fisheries and Ocean Sciences, Department of Fisheries, Fairbanks, Alaska.

Johnson, S. W., J. F. Thedinga, and A. D. Neff. 2009. Invasion by saffron cod *Eleginus gracilis* into nearshore habitats of prince William sound, Alaska USA. Marine Ecology Progress Series 389:203–212.

Kirchman, D. L., V. Hill, M. T. Cottrell, R. Gradinger, R. R. Malmstrom, and A. Parker. 2009. Standing stocks, production, and respiration of phytoplankton and heterotrophic bacteria in the western Arctic Ocean. Deep-Sea Research Part II 56:1237-1248.

Khalsa, N. S., K. P. Gatt, T. M. Sutton, and A. L. Kelly. 2021. Characterization of the abiotic drivers of abundance of nearshore Arctic fishes. Ecology and Evolution. In press.

Mathis, J. T., N. R. Bates, D. A. Hansell, and T. Babila. 2009. Net community production in the northeastern Chukchi Sea. Deep-Sea Research Part II 56:1213–1222.

McCain, K.M, S.W. Raborn and R.G. Fechhelm. 2014. Year 31 of the long-term monitoring of nearshore Beaufort Sea fishes in the Prudhoe Bay region: 2013 annual report. Report for BP Exploration (Alaska) Inc. by LGL Alaska Research Associates, Inc., Anchorage, Alaska.

McCain, K. M., and S. W. Raborn. 2017. Beaufort Sea Fish Monitoring Study of Nearshore Fishes in the Prudhoe Bay Region: 2016 Annual Report. Report for Hilcorp Alaska, LLC. by LGL Alaska Research Associates, Inc. Anchorage, Alaska.

Mecklenburg, C. W., T. A., Mecklenburg, and L. K. Thorsteinson. 2002. Fishes of Alaska. American Fisheries Society, Bethesda, Maryland.

Pielou, E. C. 1975. Ecological diversity. Wiley, New York.

Priest, J. T. 2020. Long-term shifts in community structure, growth, and relative abundance of nearshore Arctic fishes: a response to changing environmental conditions. Master’s Thesis, University of Alaska Fairbanks.

Priest, J. T., D. G. Green, B. M. Fletcher, and T. M. Sutton. 2017. Beaufort Sea Nearshore Fish Monitoring Study: 2017 Annual Report. Report for Hilcorp Alaska, LLC by the University of Alaska Fairbanks, College of Fisheries and Ocean Sciences, Department of Fisheries, Fairbanks, Alaska.

Priest, J. T., F. J. Mueter, S. W. Raborn, and T. M. Sutton. 2022. Effects of environmental variables on a nearshore Arctic fish community, 2001–2018. Polar Biology 45:585-599.

Ross, B. D. 1988. Causeways in the Alaskan Beaufort Sea. United States Environmental Protection Agency, Region 10, Washington.

Schuur, E. A. G., J. Bockheim, J. G. Canadell, E. Euskirchen, C. B. Field, S. V. Goryachkin, S. Hagemann, P. Kuhry, P. M. Lafleur, H. Lee, G. Mazhitova, F. E. Nelson, A. Rinke, V. E. Romanovsky, N. Shiklomanov, C. Tarnocai, S. Venevsky, J. G. Vogel, and S. A. Zimov. 2008. Vulnerability of permafrost carbon to climate change: Implications for the global carbon cycle. BioSciences 58:701-714.

Stroeve, J. C., T. Markus, L. Boisvert, J. Miller, and A. Barrett. 2014. Changes in Arctic melt season and implications for sea ice loss. Geophysical Research Letters 41:1216–1225.

Thorsteinson, L. K., and M. S. Love, eds. 2016. Alaska Arctic marine fish ecology catalog: U.S. Geological Survey Scientific Investigations Report 2016-5038 (OCS Study, BOEM 2016-048), 768 p.

USGS. 2019. USGS National Water Information System - Sagavanirktok River near Pump Station 3, Alaska. https://waterdata.usgs.gov/ak/nwis/uv?site_no=15908000.

Wendler, G., M. Shulski, and B. Moore. 2010. Changes in the climate of the Alaskan North Slope and the ice concentration of the adjacent Beaufort Sea. Theoretical and Applied Climatology 99:67–74.

Winemiller, K. O., and K. A. Rose. 1992. Patterns of life-history diversification in North American fishes: implications for population regulation. Canadian Journal of Fisheries and Aquatic Sciences 49:2196-2218.

Wootton, R. J. 1984. A functional biology of sticklebacks. University of California Press, Berkeley and Los Angeles.

Tables

Table 1. Sampling summary of site orientation, sampling duration, and total days fished per site in 2022.

Site	Site Name	Net Orientations	Start Date	End Date	Total Net Nights Sampled
220	West Dock	East/West	8-Jul	23-Aug	39
218	West Beach	East/West	8-Jul	23-Aug	40
214	Niakuk	East/West	28-Jun	24-Aug	50
230	Endicott	North/South	30-Jun	24-Aug	49

Table 2. Range of water temperatures (°C) and salinity (ppt), 2001–2022. All sites and water column measurements are combined. Data from 2001-2021 were collected using a YSI 30, whereas data from 2022 were collected using Star-Oddi CTD Data Loggers.

	Temperature (ºC)			Salinity (ppt)		
Year	Mean	Range	SD	Mean	Range	SD
2001	6.68	0.5–14.9	3.41	5.85	0.1–36	6.31
2002	6.91	0.7–18.8	2.50	12.97	0.1–30.2	7.48
2003	7.14	0.3–15.2	2.73	9.42	0.1–25.9	7.53
2004	8.05	1.7–15.2	2.67	13.10	0.1–29.9	8.66
2005	7.05	1.6–13.5	2.02	6.90	0.1–24	6.96
2006	8.92	0.1–17.9	2.21	10.22	0.1–26.9	6.10
2007	8.48	3.7–12.5	1.45	16.32	0.2–30.1	9.19
2008	8.38	0.4–19.1	2.08	14.79	0.1–29.1	9.16
2009	8.03	4.3–22.1	2.09	19.09	0.1–32.6	9.61
2010	8.19	3.7–14.2	1.95	10.05	0.1–27.2	7.57
2011	8.81	3.7–14.2	2.10	19.11	0.2–32.1	7.97
2012	9.89	3.6–17.1	2.27	15.10	0.1–27.5	8.17
2013	9.29	2.1–15.2	2.89	12.99	0.1–31.1	9.31
2014	7.62	2.2–13.3	2.17	9.19	0.1–28.8	8.49
2015	7.43	2.3–15	2.06	11.91	0.1–25.9	7.09
2016	8.15	2.9–17.8	2.31	12.81	0.1–26.8	7.87
2018	7.26	1.3–15.7	3.35	7.25	0.1–28.9	7.39
2019	9.01	4.2–16.9	1.94	14.16	0.2–30	9.30
2020	8.27	6.2–10.6	0.86	18.22	0.3–29.1	7.92
2021	8.67	1.4–16.1	2.65	9.67	0–29.5	8.30
2022	7.10	0.76-15.22	2.41	5.70	0.01-19.68	6.64

Table 3. Total catch of species at each site, 2022.

Species	Site 214	218	220	230	Total Catch
Arctic Cod	78	494	237	34	843
Arctic Cisco	3,399	976	281	1,810	6,466
Arctic Flounder	3,423	990	221	566	5,200
Broad Whitefish	3,562	577	460	2,951	7,550
Capelin	-	15	-	-	15
Dolly Varden	478	203	111	88	880
Fourhorn Sculpin	2,495	945	213	763	4,416
Arctic Grayling	98	1	-	79	178
Humpback Whitefish	325	916	274	83	1,598
Least Cisco	1,195	1,357	563	258	3,373
Ninespine Stickleback	3	20	7	6	36
Pacific Herring	1	4	1	-	6
Pink Salmon	-	1	1	1	3
Rainbow Smelt	3,068	1,367	104	4,070	8,609
Round Whitefish	13	-	-	10	23
Saffron Cod	431	512	83	150	1,176
Threespine Stickleback	4	10	2	2	18
Total Catch	18,573	8,388	2,558	10,871	40,390
Species Richness	15	16	14	15	17
Shannon-Wiener Diversity	1.99	2.23	2.17	1.65	2.09
Species Evenness	0.69	0.77	0.75	0.57	0.72

Table 4. Mean length of all measured fish species Prudhoe Bay, Alaska, 2022. All sampling sites are combined. All fish were measured to fork length (FL), except for Arctic Cod and Saffron Cod which were measured to total length (TL).

Species	Number Sampled	Mean Length (mm)	Length Range (mm)	Standard Deviation
Arctic Cisco	4,289	168.1	48–414	74.2
Arctic Cod	714	97.7	54–208	21.7
Broad Whitefish	4,565	163.6	40–503	101.7
Dolly Varden	801	275.1	94–650	140.3
Humpback Whitefish	1,292	346.2	145–475	40.1
Least Cisco	2,887	276.7	79–425	63.4
Pink Salmon	3	310	108–411	174.9
Rainbow Smelt	2,485	100.4	33–265	29.2
Saffron Cod	1,062	179.8	39–501	48.0

Figures

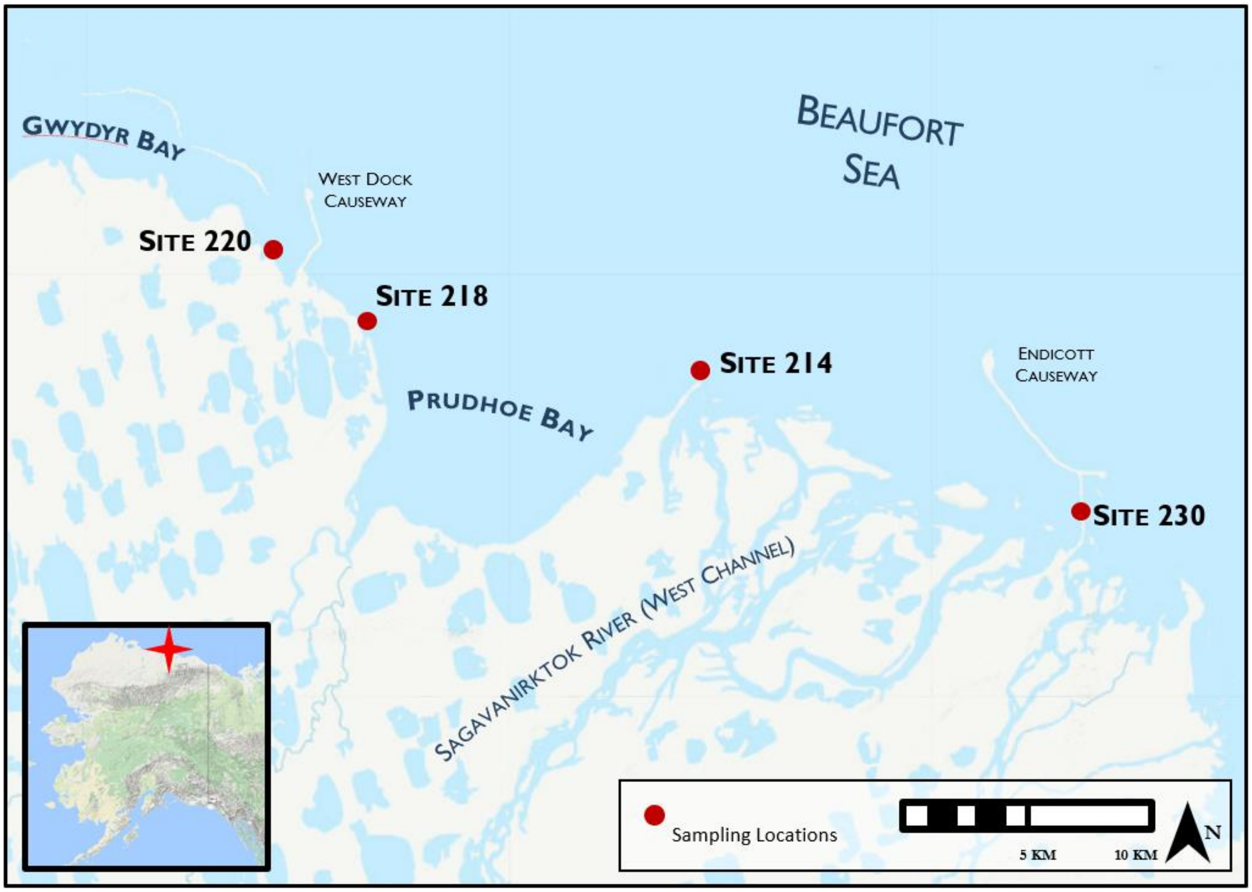

Figure 1. Overview map of study area and the four sampling sites near Prudhoe Bay, Alaska

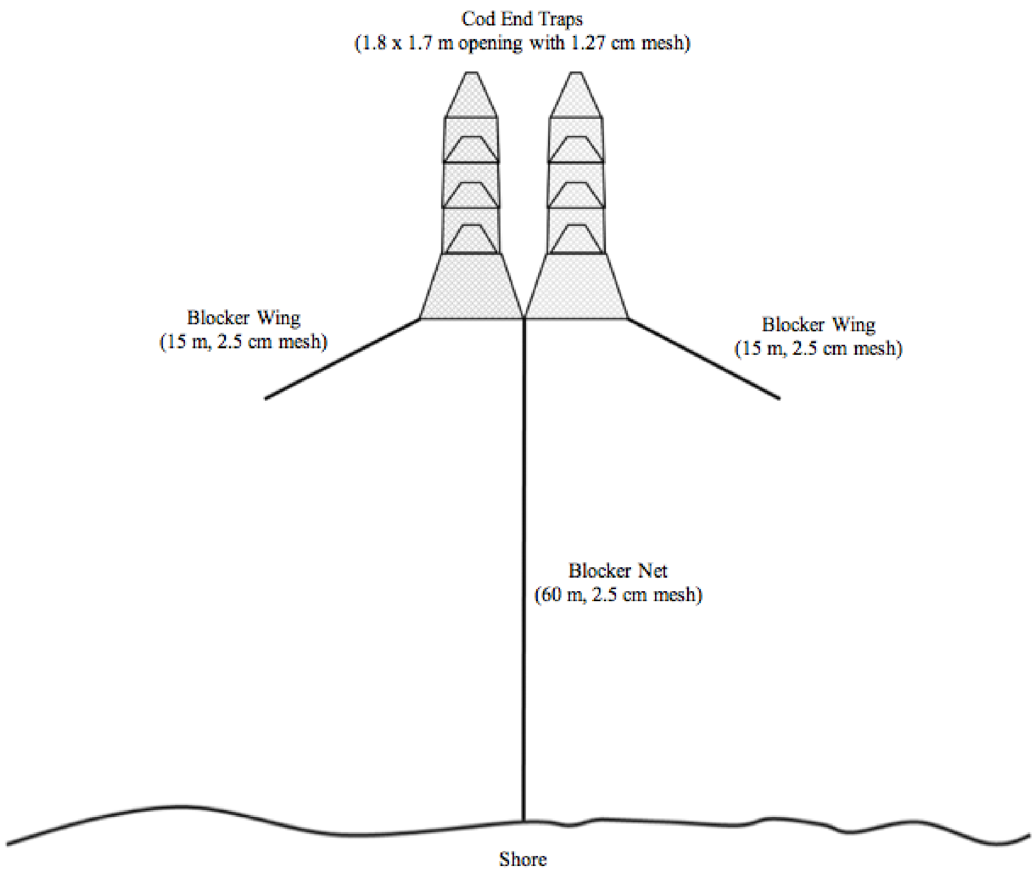

Figure 2. Fyke net diagram of the double-ended, cod-end nets used during sampling, 2022. Objects are not drawn to scale.

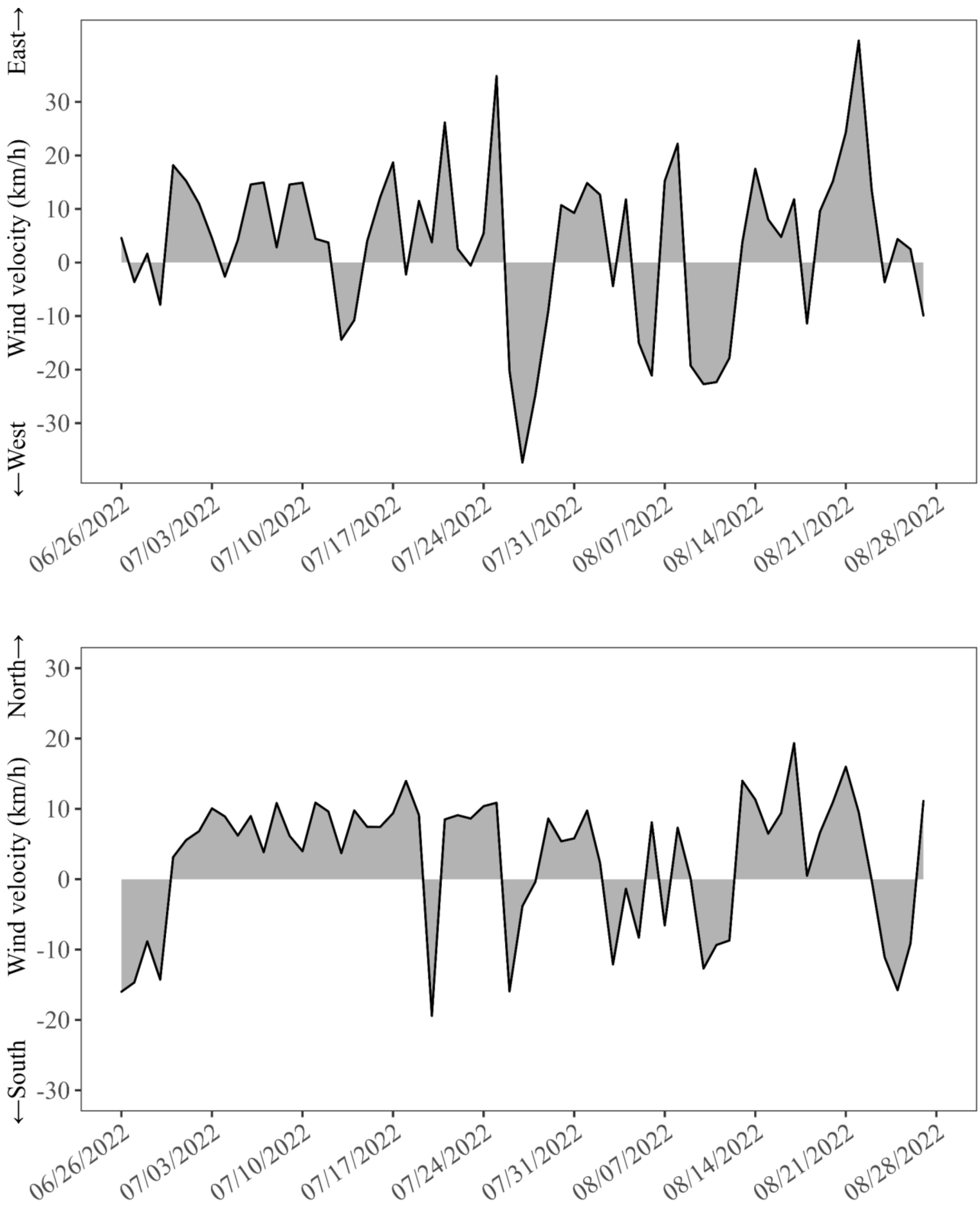

Figure 3. Wind velocity vectors over the 2022 sampling season. Meteorological data are from the NOAA National Weather Service station in Deadhorse, Alaska.

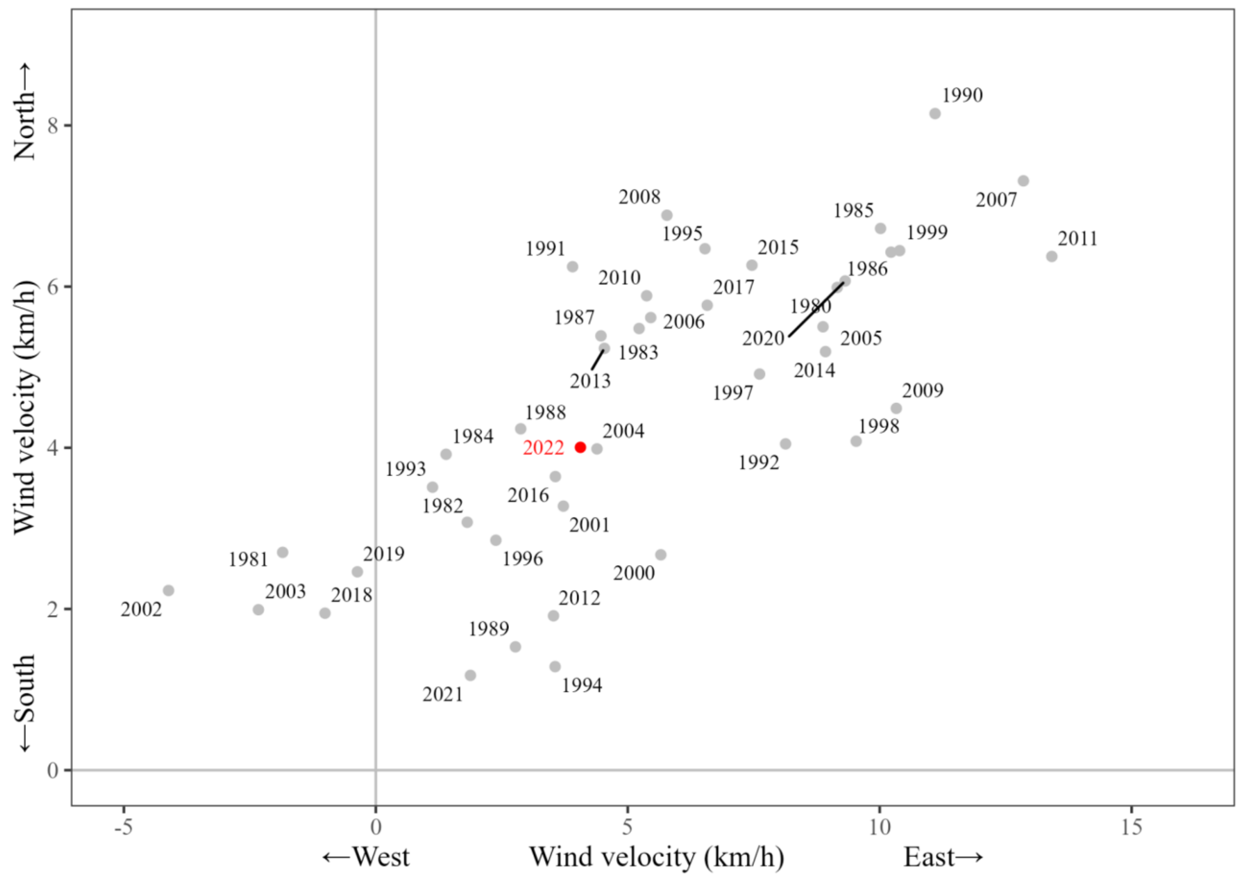

Figure 4. Wind velocity data, 1985–2022. Only July 1–August 31 from each year are included for analysis. Meteorological data are from the NOAA National Weather Service station in Deadhorse, Alaska.

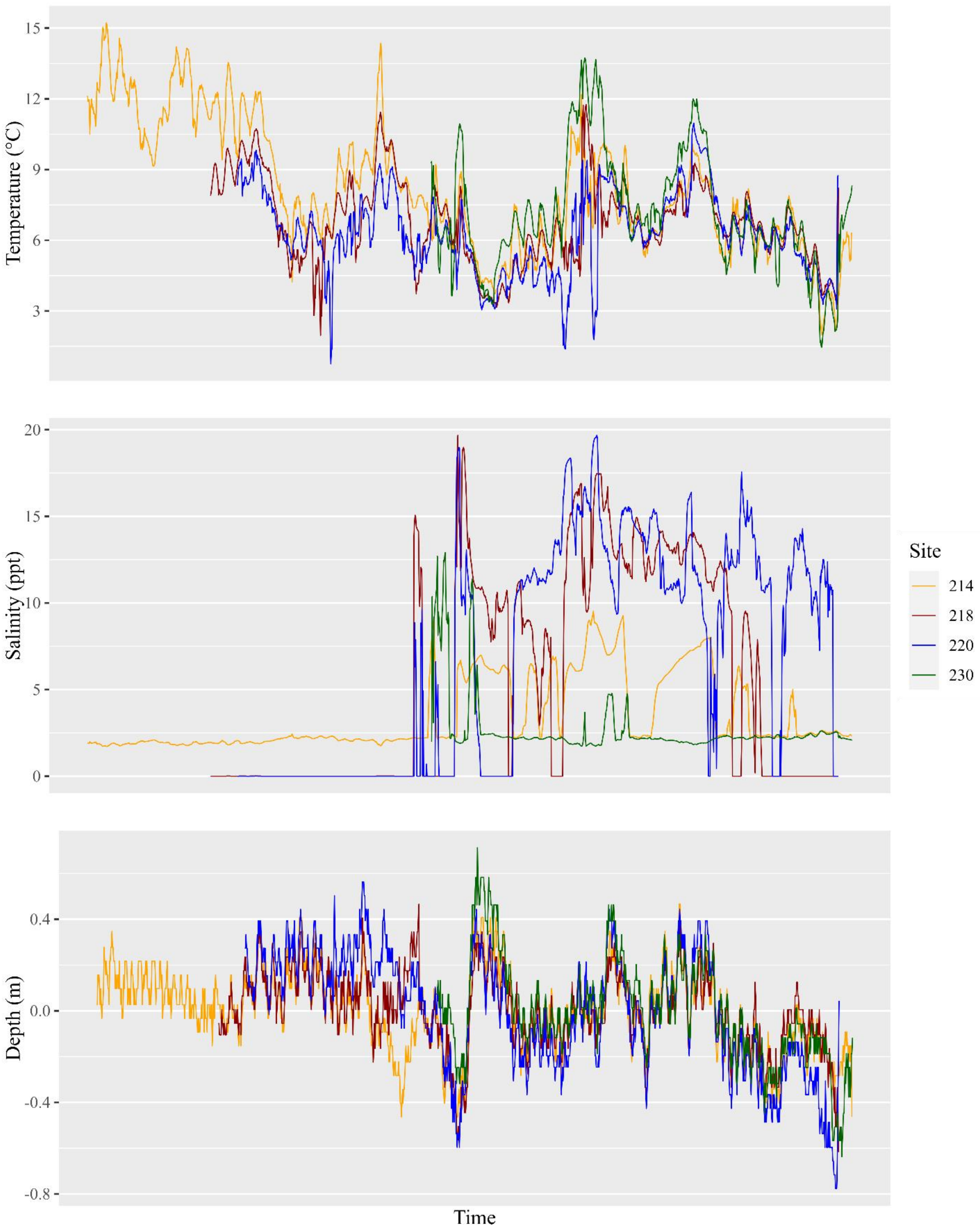

Figure 5. Depth (m), salinity (ppt) and water temperature (˚C) taken at hourly intervals at each sample site in Prudhoe Bay, Alaska, 2022. Depth data was mean centered; negative values represent water levels below the average depth. Data was collected using Star-Oddi CTD data loggers.

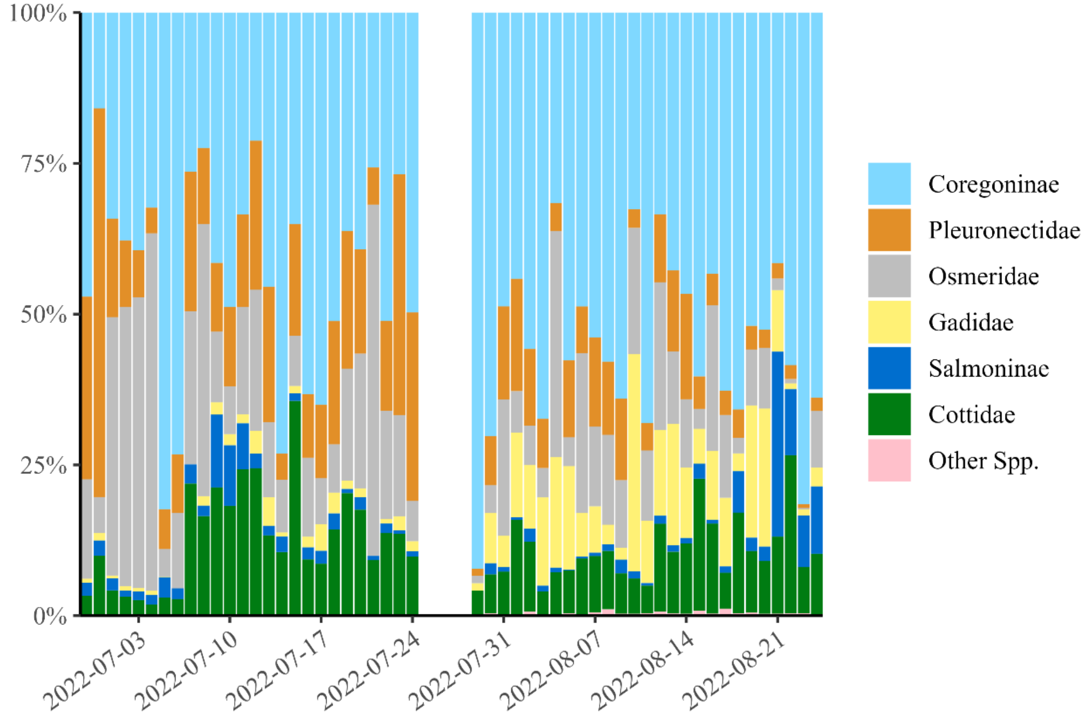

Figure 6. Proportion of daily catch by species family groups, 2022.

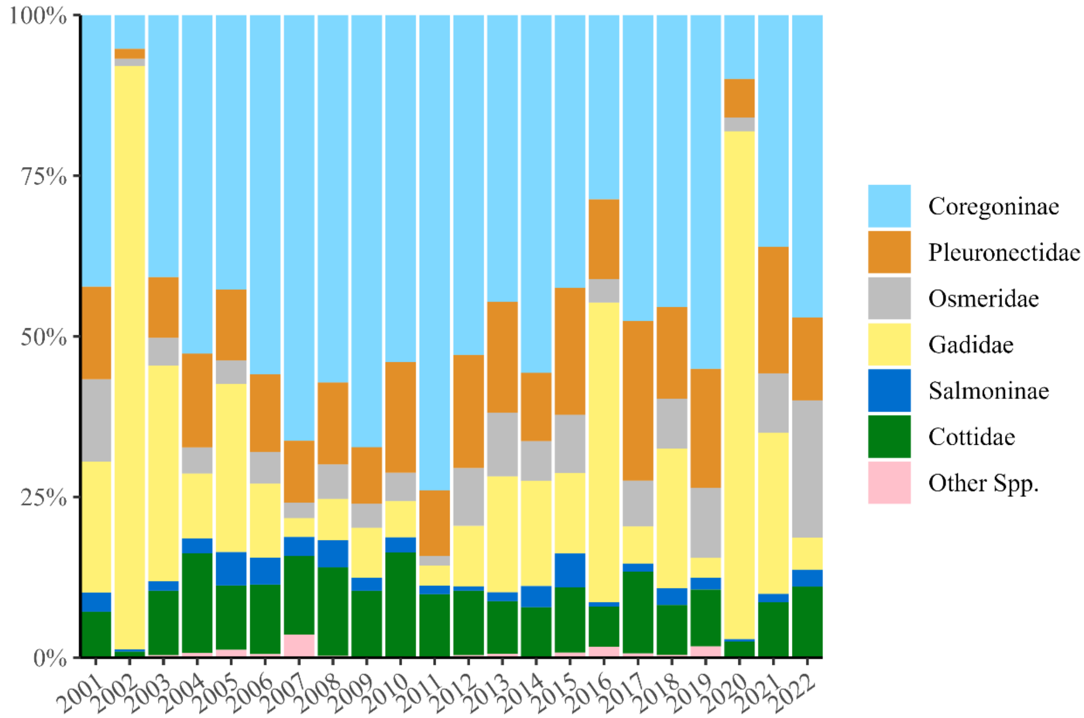

Figure 7. Proportion of annual catch by species family groups, 2001–2022.

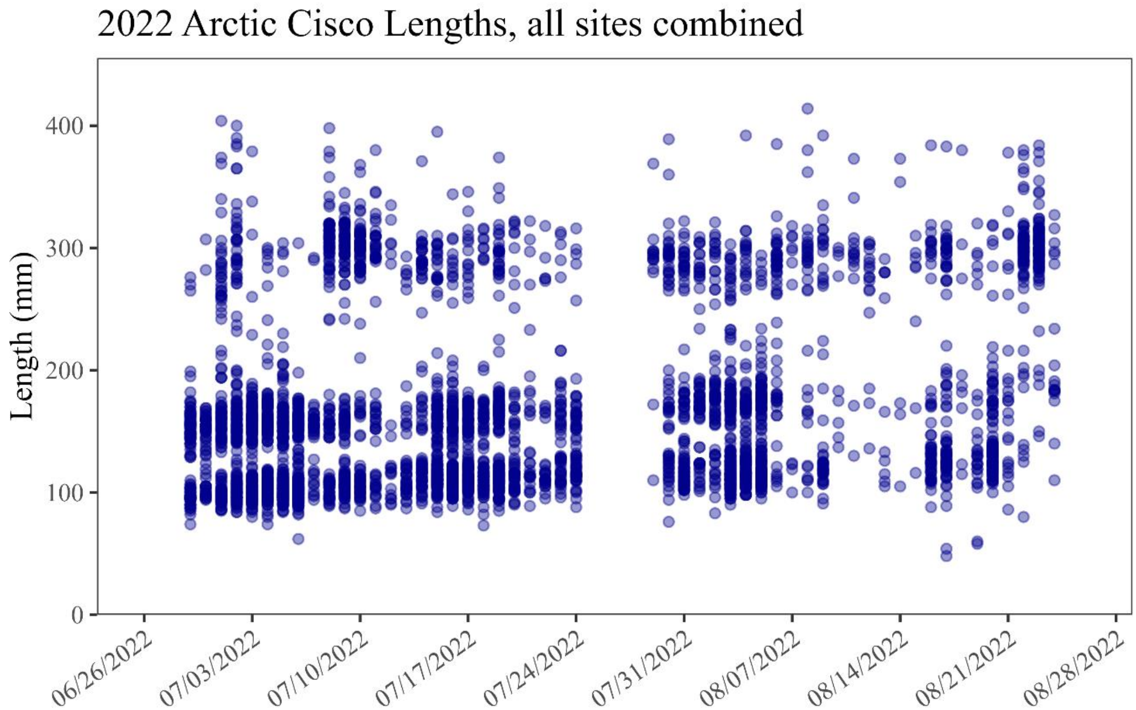

Figure 8. Scatterplot of all Arctic Cisco measured to fork length (FL) to the nearest mm, 2022. All sites were combined.

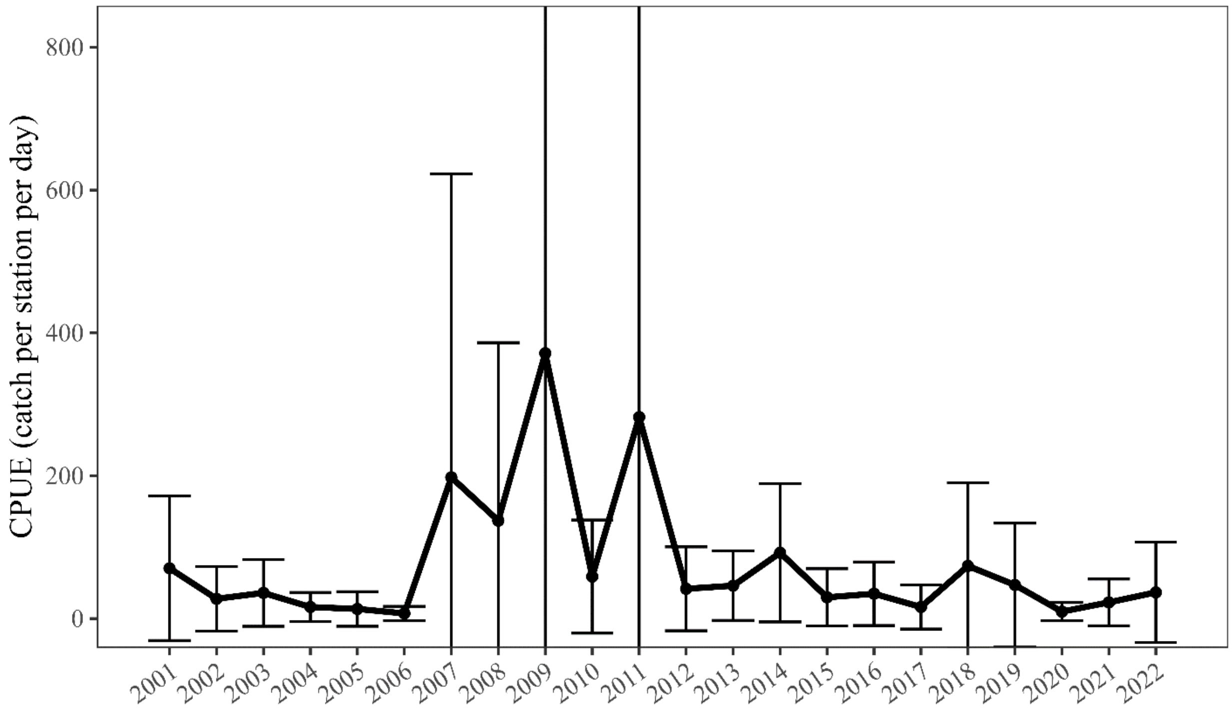

Figure 9. Annual CPUE of all Arctic Cisco caught, 2001–2022. Error bars were standard error of annual catches per site per year.

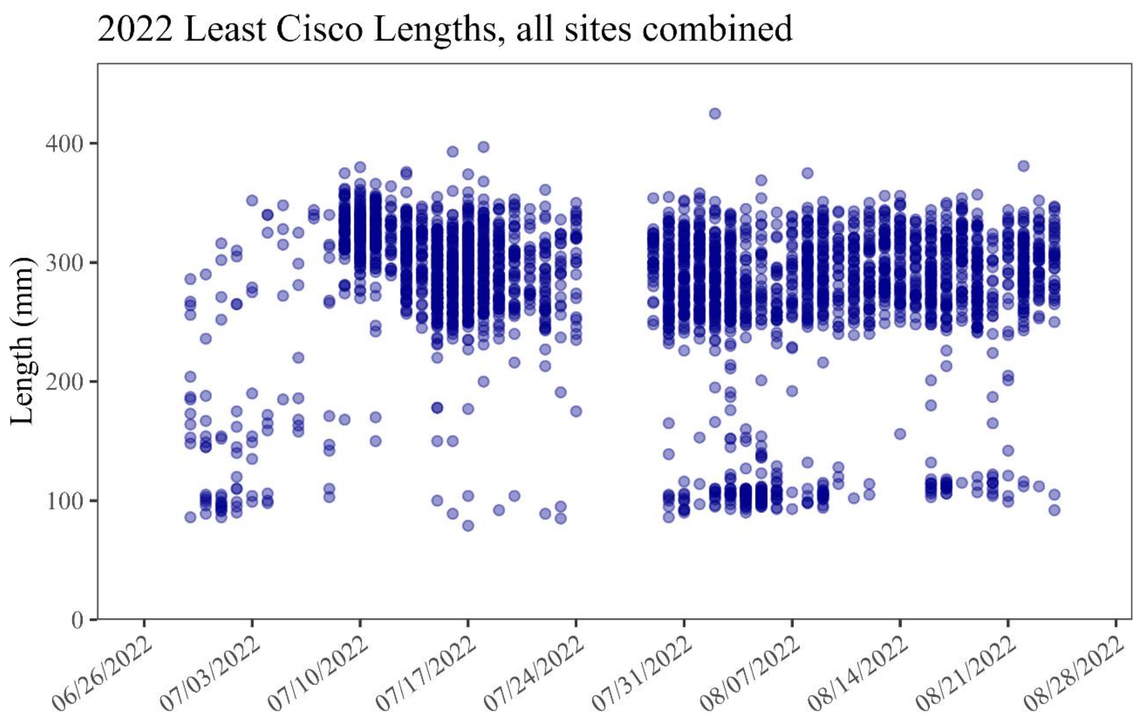

Figure 10. Scatterplot of all Least Cisco measured to fork length (FL) to the nearest mm, 2022. All sites were combined.

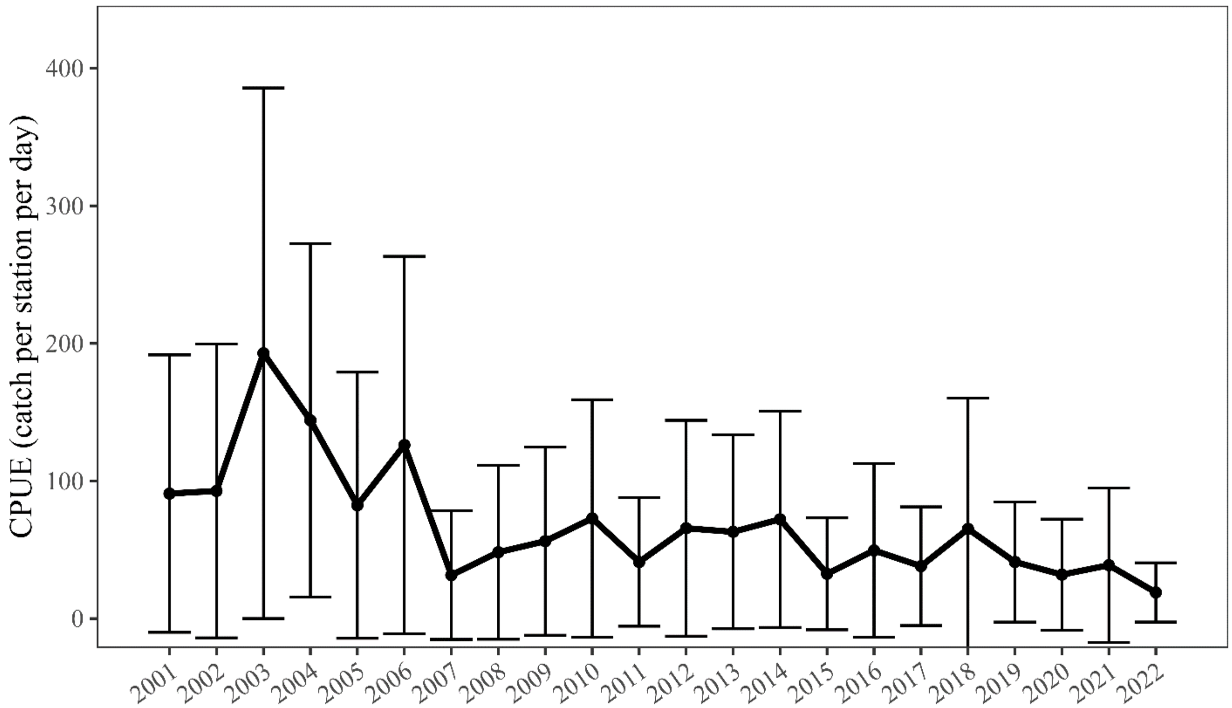

Figure 11. Annual CPUE of all Least Cisco caught, 2001–2022. Error bars were standard error of annual catches per site per year.

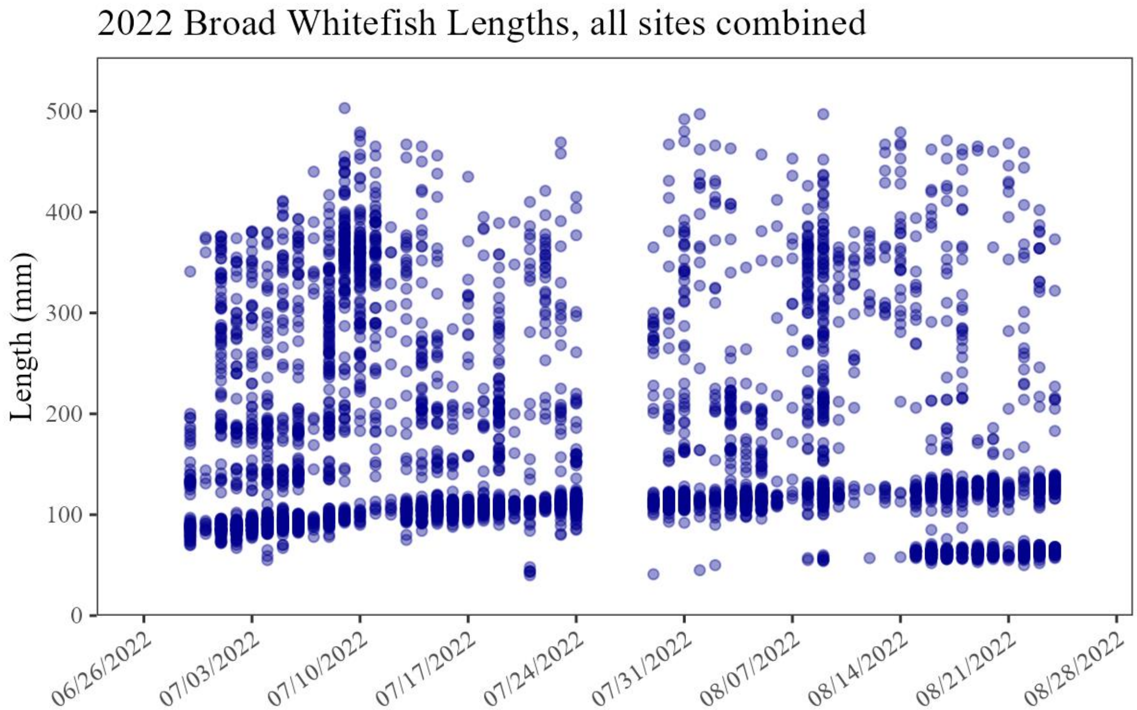

Figure 12. Scatterplot of all Broad Whitefish measured to fork length (FL) to the nearest mm, 2022. All sites were combined.

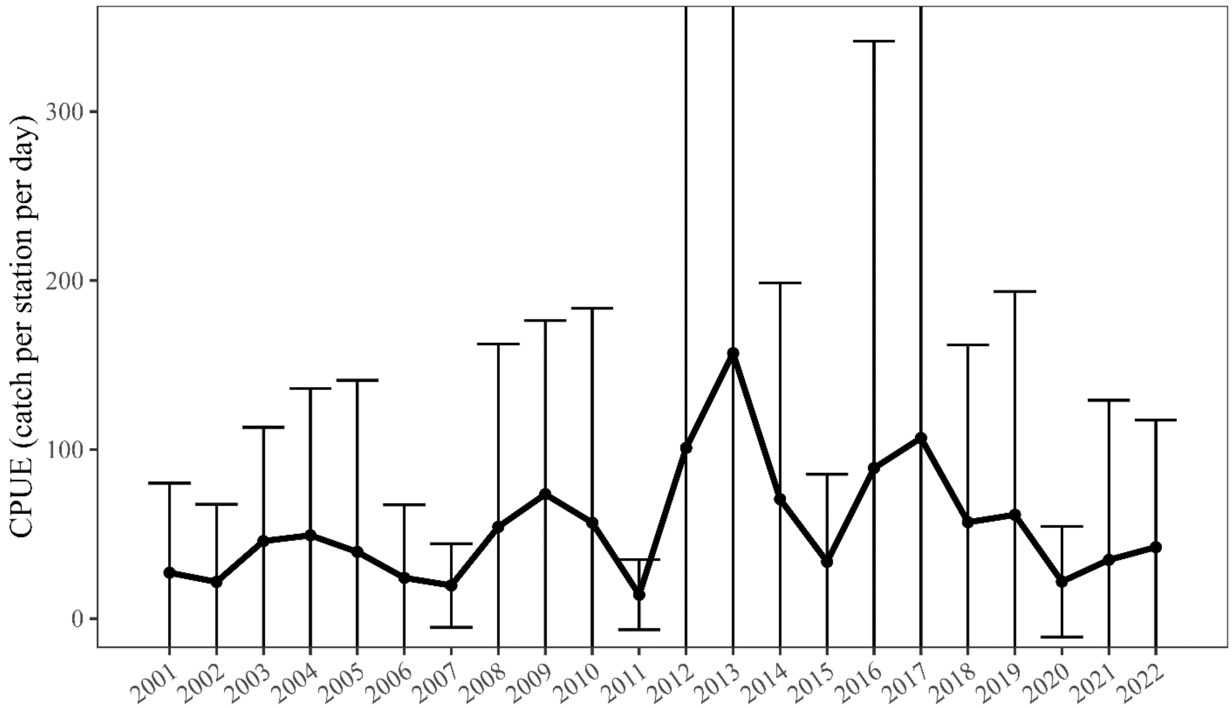

Figure 13. Annual CPUE of all Broad Whitefish caught, 2001–2022. Error bars were standard error of annual catches per site per year.

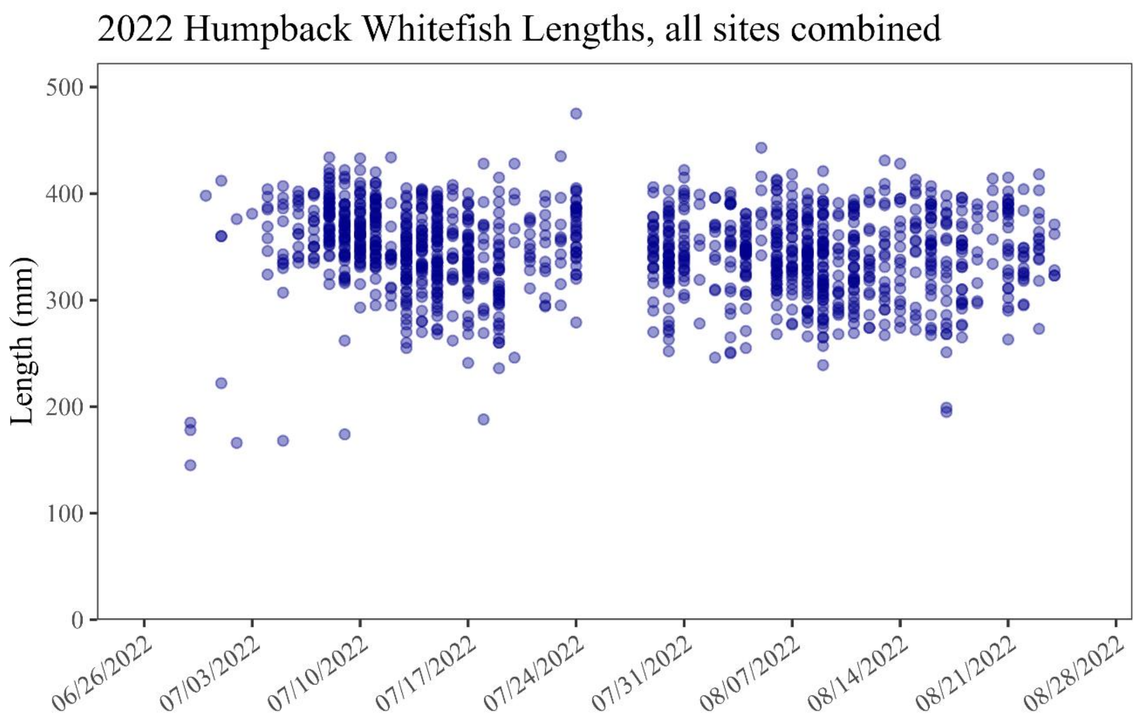

Figure 14. Scatterplot of all Humpback Whitefish measured to fork length (FL) to the nearest mm, 2022. All sites were combined.

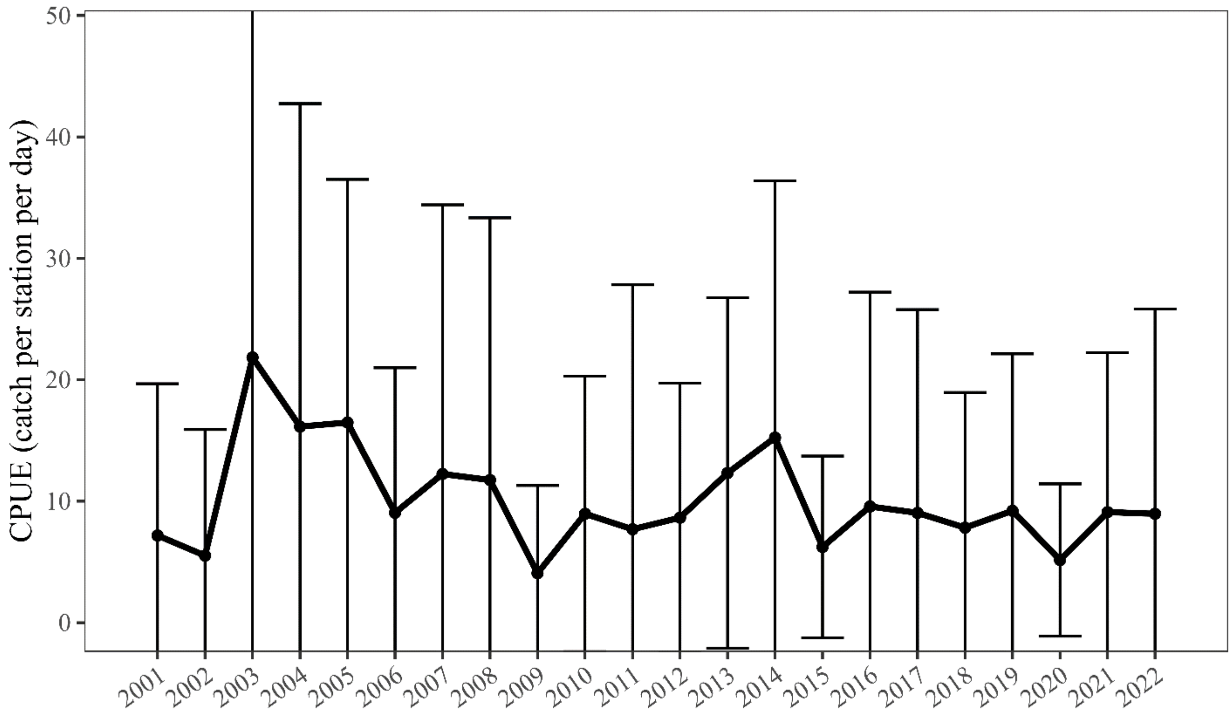

Figure 15. Annual CPUE of all Humpback Whitefish caught, 2001–2022. Error bars were standard error of annual catches per site per year.

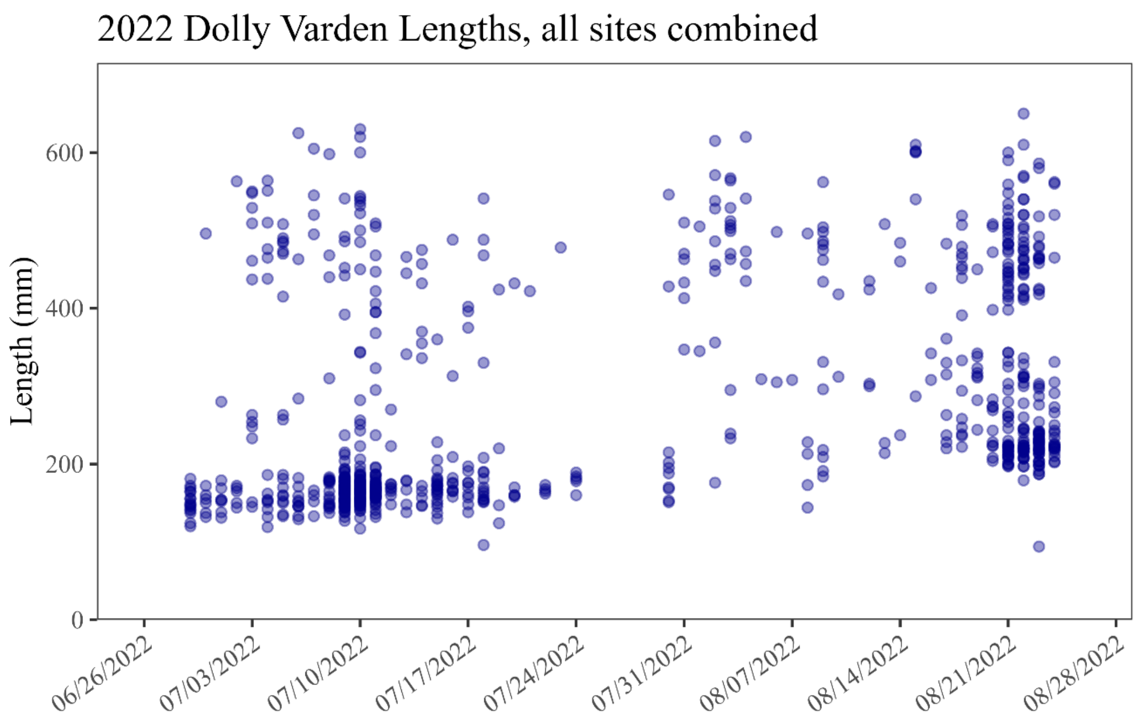

Figure 16. Scatterplot of all Dolly Varden measured to fork length (FL) to the nearest mm, 2022. All sites were combined.

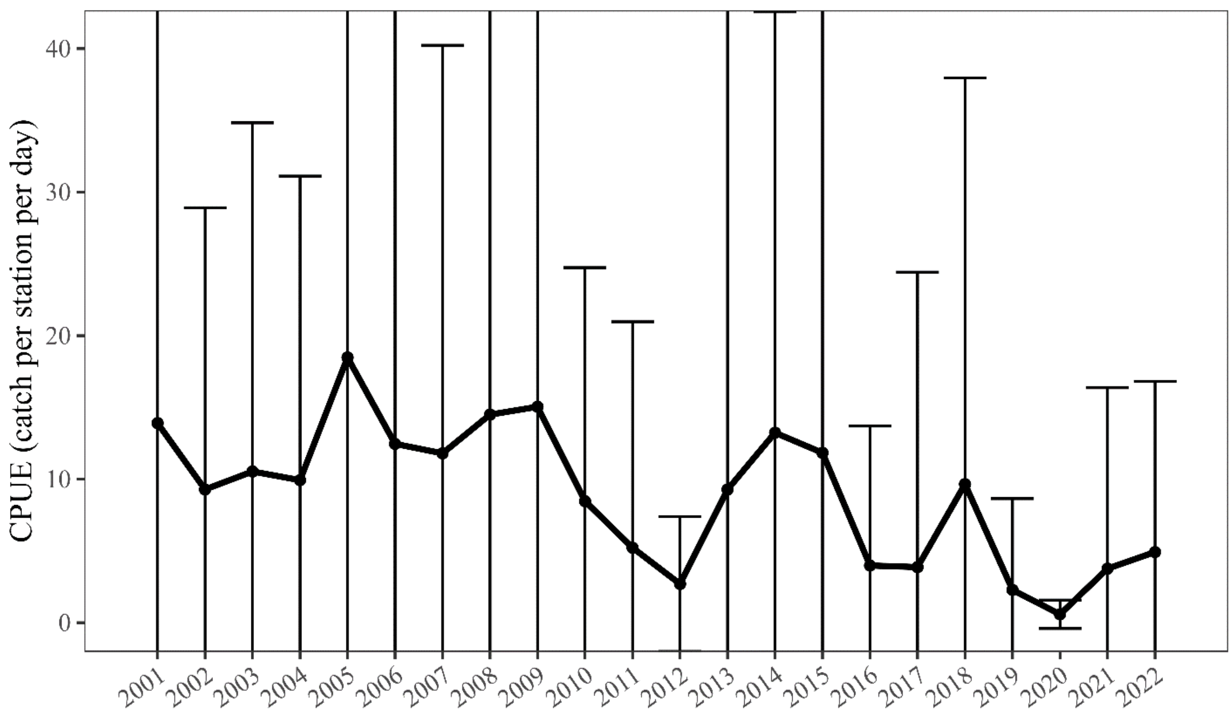

Figure 17. Annual CPUE of all Dolly Varden caught, 2001–2022. Error bars were standard error of annual catches per site per year.

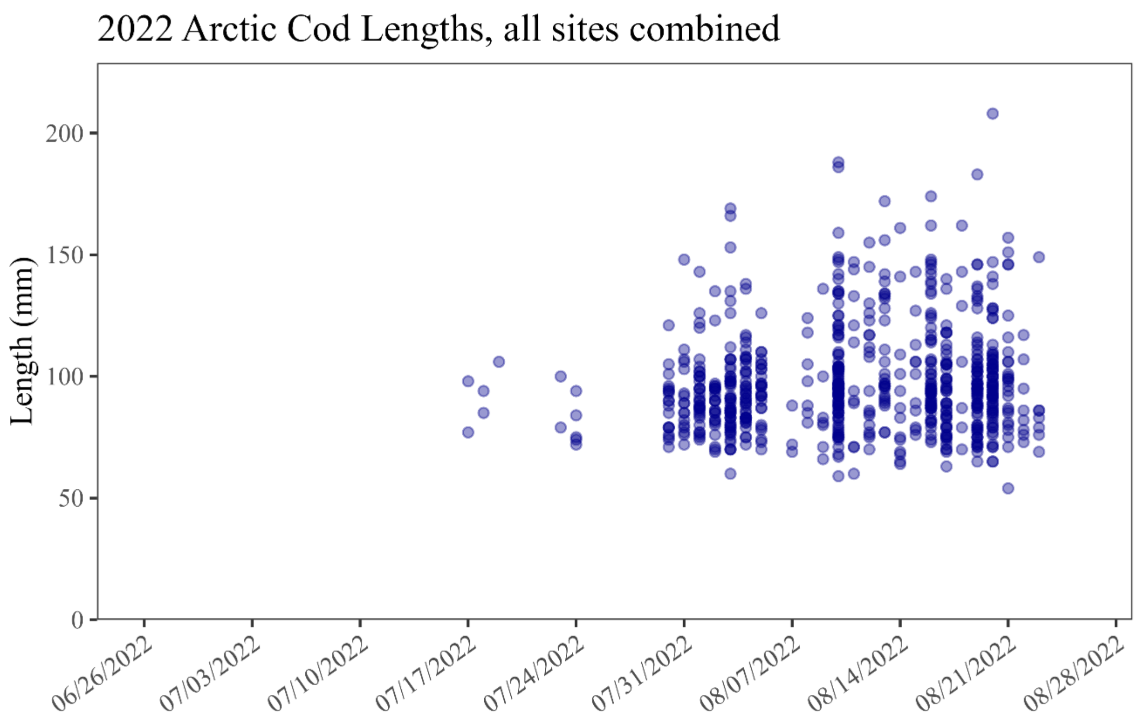

Figure 18. Scatterplot of all Arctic Cod measured for length, 2022. All sites were combined. Arctic Cod were measured to total length (TL) to the nearest mm.

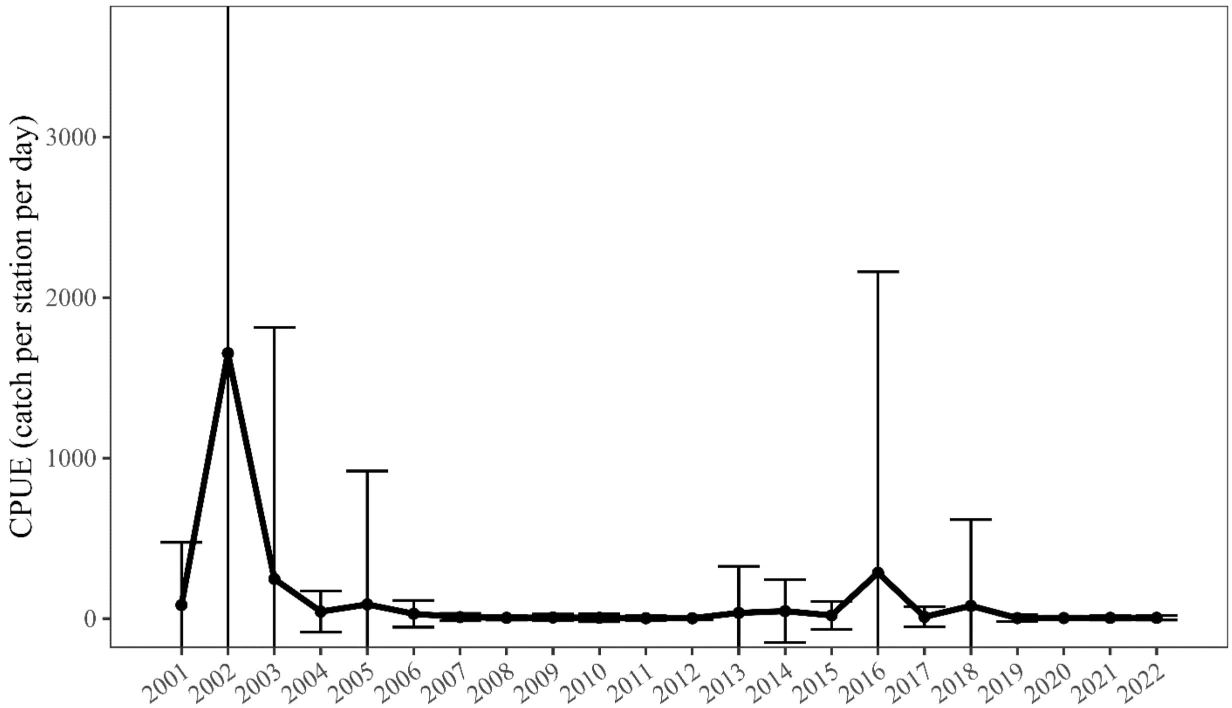

Figure 19. Annual CPUE of all Arctic Cod caught, 2001–2022. Error bars were standard error of annual catches per site per year.

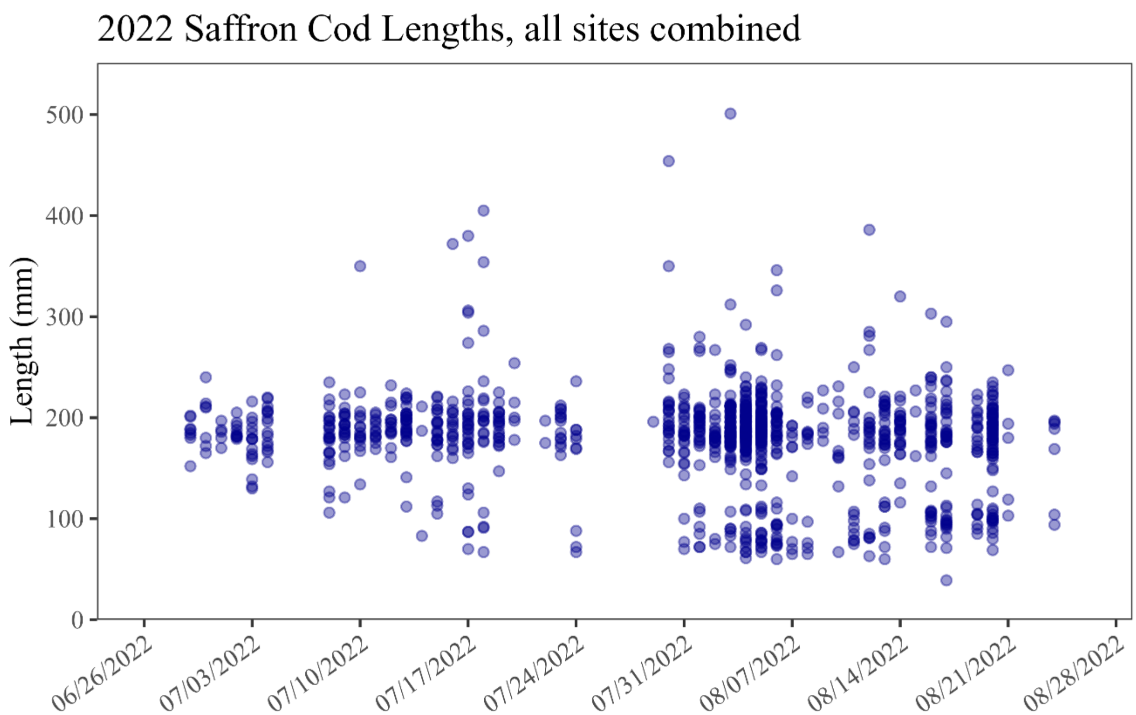

Figure 20. Scatterplot of all Saffron Cod measured for length, 2022. All sites were combined. Saffron Cod were measured to total length (TL) to the nearest mm.

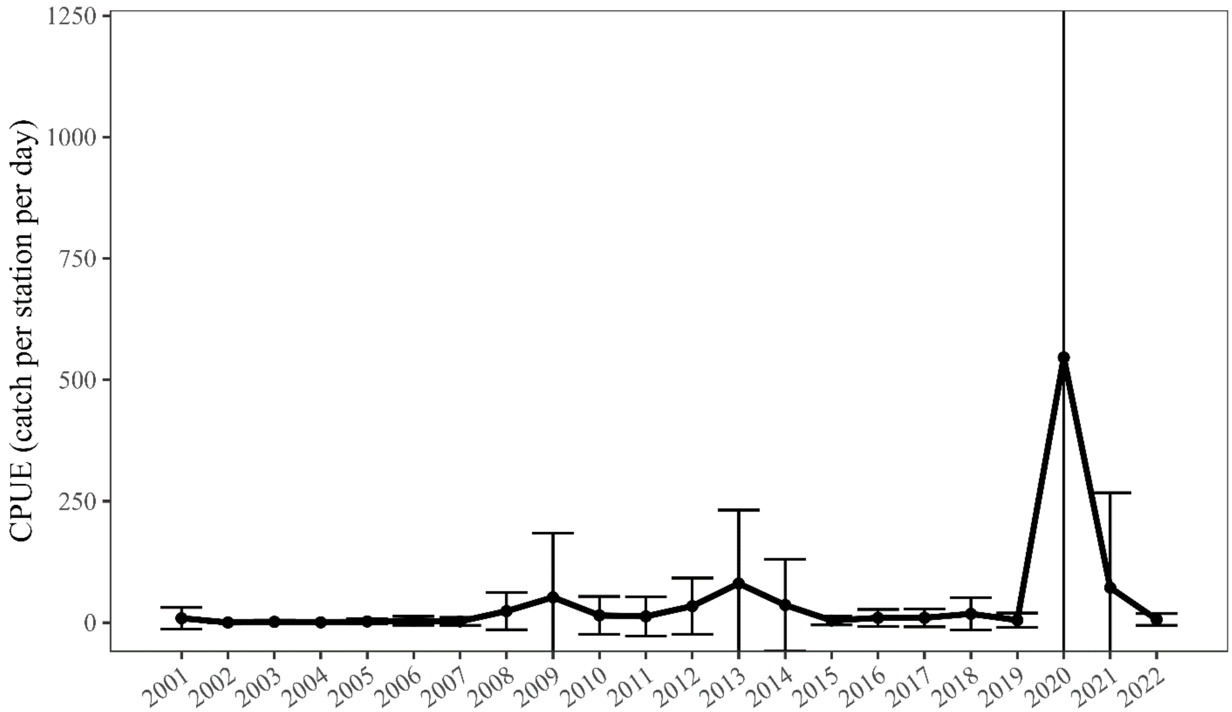

Figure 21. Annual CPUE of all Saffron Cod caught, 2001–2022. Error bars were standard error of annual catches per site per year.

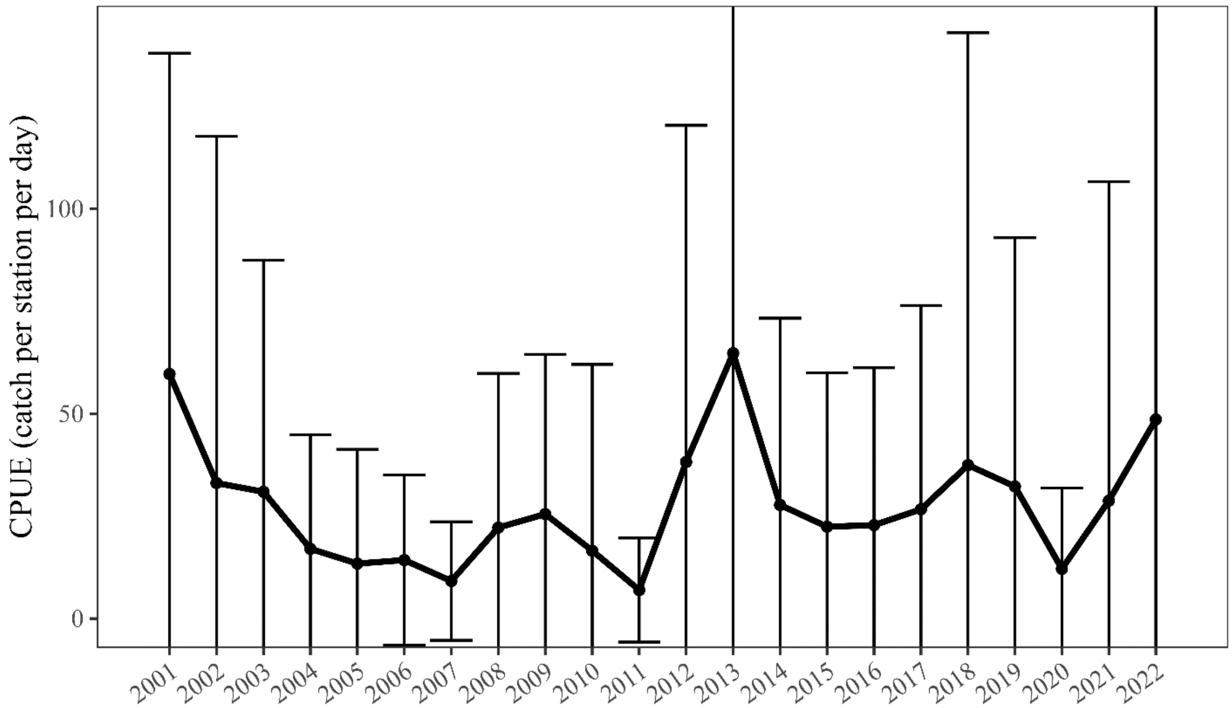

Figure 22. Annual CPUE of all Rainbow Smelt caught, 2001–2022. Error bars were standard error of annual catches per site per year.

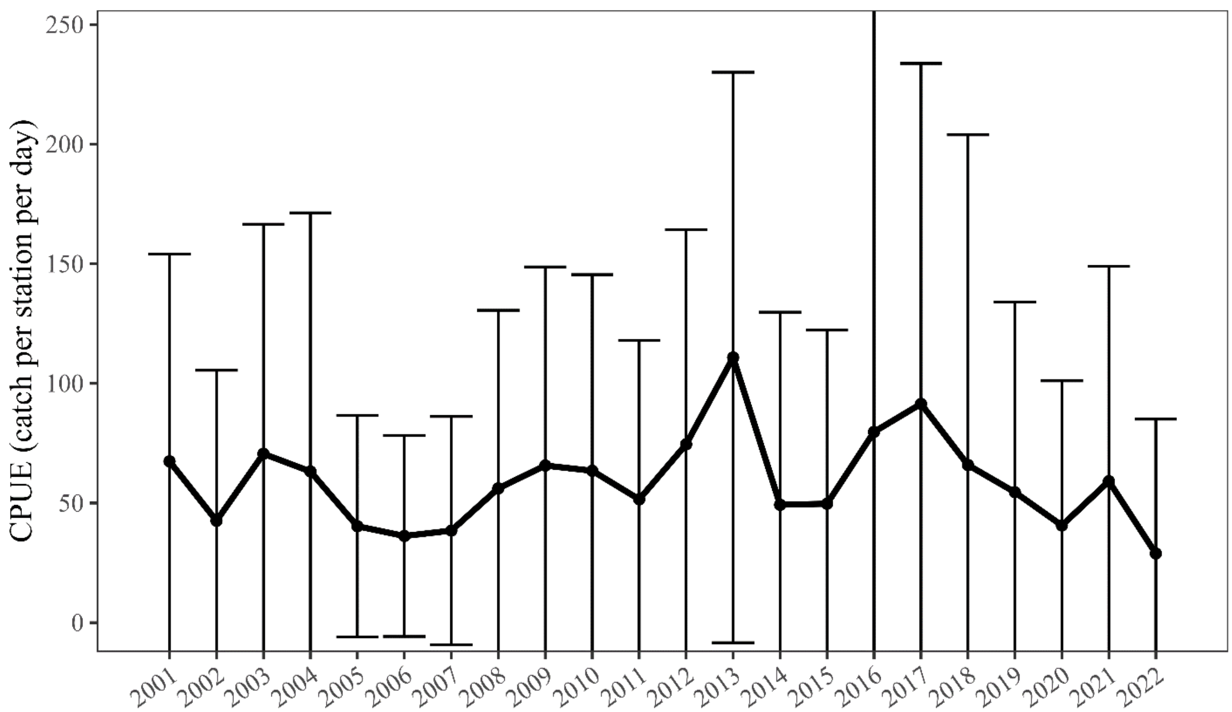

Figure 23. Annual CPUE of all Arctic Flounder caught, 2001–2022. Error bars were standard error of annual catches per site per year.

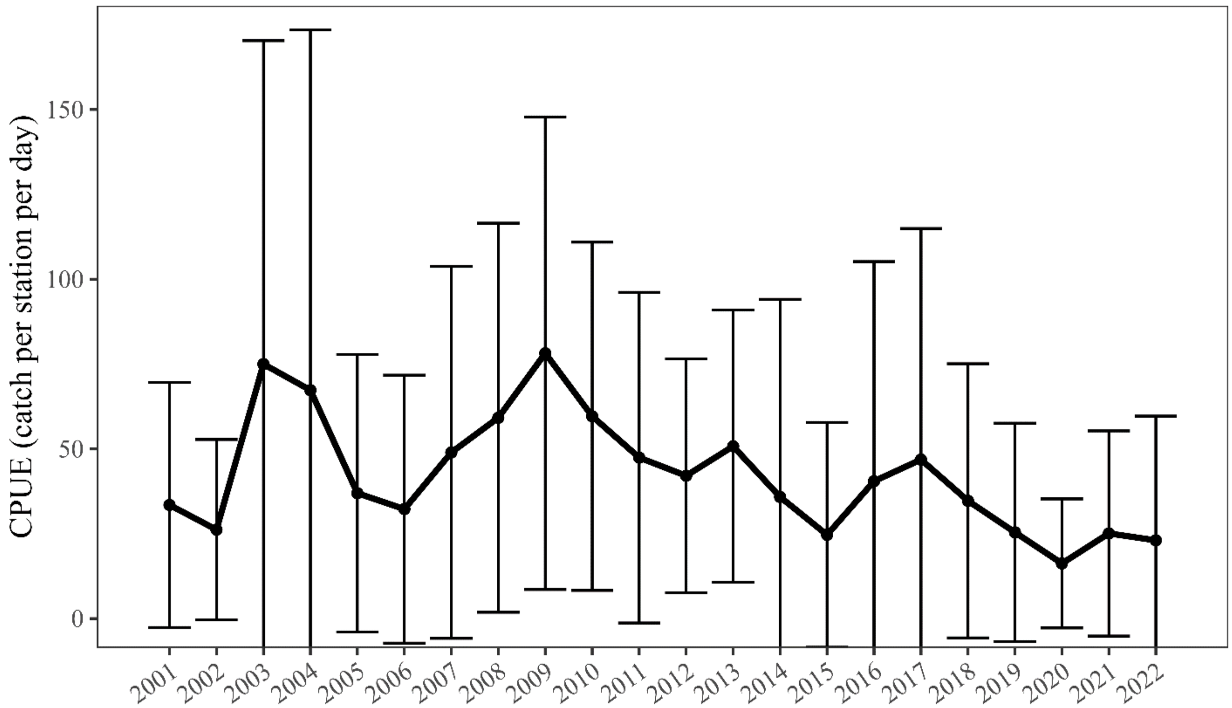

Figure 24. Annual CPUE of all Fourhorn Sculpin caught, 2001–2022. Error bars were standard error of annual catches per site per year.

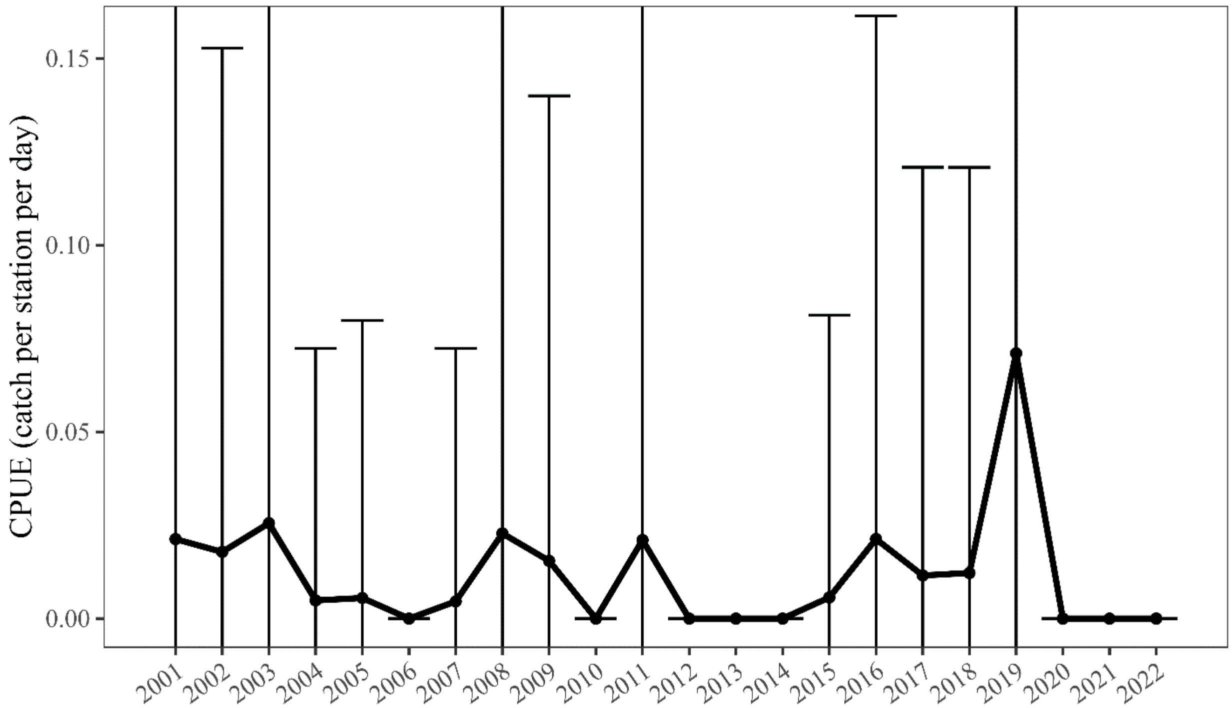

Figure 25. Annual CPUE of all Chum Salmon caught, 2001–2022. Error bars were standard error of annual catches per site per year.

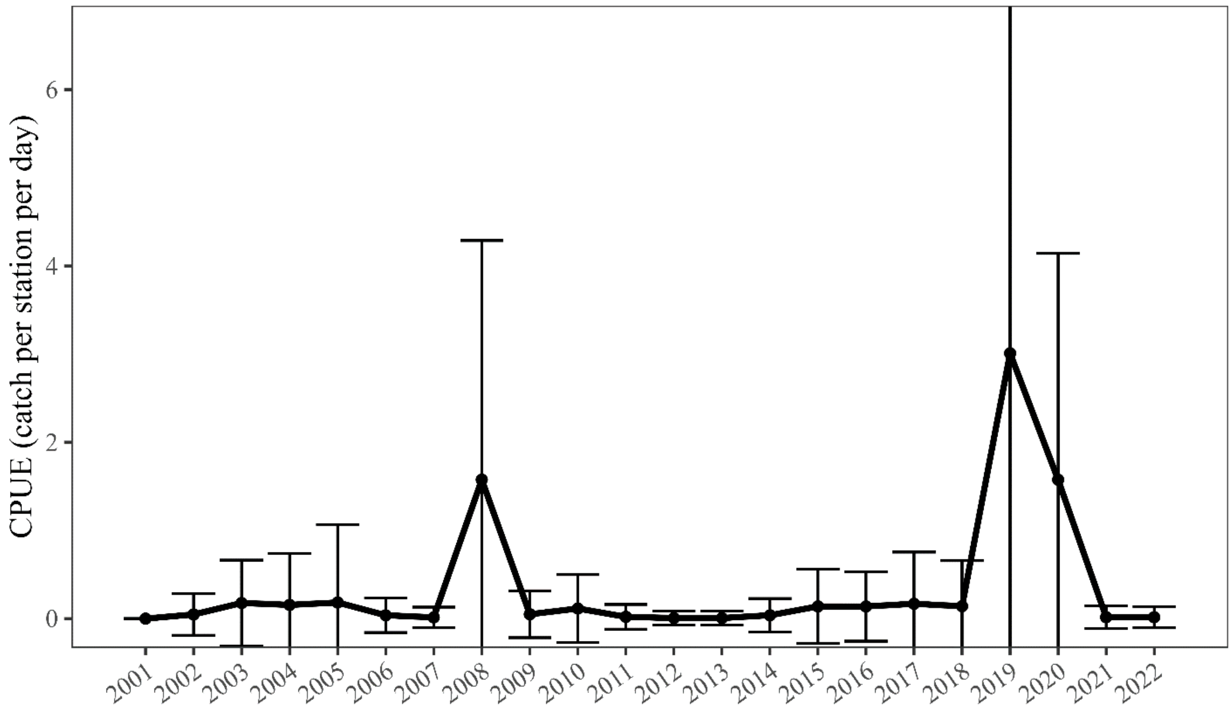

Figure 26. Annual CPUE of all Pink Salmon caught, 2001–2022. Error bars were standard error of annual catches per site per year.

Appendices

Appendix 1. Length group ranges for all measured species, 2022.

	Length Group 1	Length Group 2	Length Group 3
Arctic Cisco	<120 mm	120–249 mm	≥250 mm
Least Cisco	<180 mm	≥180 mm	-
Broad Whitefish	<120 mm	120–249 mm	≥250 mm
Dolly Varden	<350 mm	≥350 mm	-
Humpback Whitefish		No length groups	
Saffron Cod		No length groups	
Arctic Cod		No length groups	

Appendix 2. Number of Arctic Cisco (ARCS), Least Cisco (LSCS) Broad Whitefish (BDWF), Humpback Whitefish (HBWF), Saffron Cod (SFCD), Arctic Cod (ARCD), Dolly Varden (DLVN), Rainbow Smelt (RBSM), and Pink Salmon (PINK) sacrificed per length group for aging analyses in 2022.

Bin	ARCS	LSCS	BDWF	HBWF	SFCD	ARCD	DLVN	RBSM	PINK
<75	2		5		2				
75-99	5	5	5		3	5		22	
100-124	4	8	5		2	4		24	1
125-149	5	2	7		1	5		26	
150-174	9	3	3			3		21	
175-199	5	4	6	2	2			16	
200-224	3	1	3		3	1		28	
225-249			1	2	2			7	
250-274	3		1	3	1			3	
275-299	8	3	1	1					
300-324	6	7			5				
325-349	3	10	1		2				
350-374	2		4	2	3				
375-399	1			3	2				
400-424	1		2	6	1				2
425-449		1	1						
450-474			2				1		
475-499							3		
500-524			1		1		1		
525-549							2		
600-624							1		
Total	57	44	48	19	30	18	8	147	3

Appendix 3. CPUE (fish/net night) for Arctic Cisco (all length groups) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	34.00	354.00						
6/30/2022	15.00	42.00						
7/1/2022	11.00	76.00					13.00	21.00
7/2/2022	38.00	87.00					25.00	61.00
7/3/2022	23.00	98.00					60.00	293.00
7/4/2022	38.00	228.00					15.00	120.00
7/5/2022	38.00	268.00					74.00	92.00
7/6/2022	20.00	241.00					69.00	287.00
7/7/2022	8.00	29.00					1.00	0.00
7/8/2022	4.00	45.00					27.00	43.00
7/9/2022	5.00	26.00	18.00	46.00	12.00	11.00	8.00	15.00
7/10/2022	7.00	51.00	3.00	4.00	1.00	5.00	13.00	26.00
7/11/2022	1.00	19.00	1.00	4.00	6.00	3.00	7.00	17.00
7/12/2022	4.00	6.00	0.00	0.00	0.00	0.00	5.00	6.00
7/13/2022	13.00	8.00	0.00	0.00	5.00	1.00	14.00	6.00
7/14/2022			1.00	0.00	2.00	0.00	14.00	62.00
7/15/2022	34.00	58.00	3.00	3.00	2.00	7.00	14.00	11.00
7/16/2022	67.00	170.00	18.00	6.00	0.00	5.00	13.00	14.00
7/17/2022	16.00	25.00	42.00	17.00	7.00	6.00	10.00	24.00
7/18/2022	9.00	13.00	49.00	14.00		4.00	5.00	2.00
7/19/2022	19.00	77.00	23.00	46.00		4.00	6.00	25.00
7/20/2022	5.00	4.00	14.00	27.00			0.00	6.00
7/21/2022	3.00	6.00			1.00	2.00	4.00	12.00
7/22/2022	6.00	1.00				4.00	1.00	18.00
7/23/2022	3.00	15.00	6.00	15.00	2.00	5.00	1.00	7.00
7/24/2022	2.00	10.00	8.00	12.00	10.00	6.00	8.00	14.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			5.00	5.00			3.00	3.00
7/30/2022	4.00	34.00	16.00	8.00	0.00	4.00	0.00	1.00
7/31/2022	11.00	67.00	11.00	4.00	0.00	6.00	3.00	11.00
8/1/2022	1.00	56.00	7.00	5.00	7.00	0.00	1.00	6.00
8/2/2022	4.00	82.00	7.00	6.00	0.00	3.00	0.00	6.00
8/3/2022	9.00	172.00	52.00	26.00	5.00	25.00	4.00	6.00
8/4/2022	5.00	95.00	12.00	47.00	5.00	5.00	6.00	0.00
8/5/2022	1.00	162.00	63.00	18.00	0.00	0.00	1.00	0.00
8/6/2022	0.00	9.00	73.00	7.00	0.00	2.00		
8/7/2022	3.00	2.00	2.00	3.00	0.00	1.00		
8/8/2022	2.00	4.00	14.00	1.00	6.00	2.00	3.00	3.00
8/9/2022	3.00	9.00	6.00	1.00	6.00	0.00	10.00	15.00
8/10/2022	0.00	0.00	4.00	1.00	2.00	0.00	1.00	1.00
8/11/2022			4.00	3.00	3.00	0.00	3.00	1.00
8/12/2022			2.00	8.00	3.00	3.00	0.00	1.00
8/13/2022	0.00	3.00	2.00	2.00	1.00	0.00	3.00	0.00
8/14/2022	1.00	3.00	0.00	1.00	0.00	0.00	0.00	0.00
8/15/2022	0.00	5.00	0.00	2.00	0.00	0.00	0.00	1.00
8/16/2022	1.00	14.00	4.00	3.00	7.00	0.00	3.00	28.00
8/17/2022	2.00	31.00	25.00	6.00	1.00	0.00	5.00	10.00
8/18/2022	1.00	0.00	4.00	0.00	0.00	0.00	0.00	4.00
8/19/2022	4.00	9.00	4.00	0.00	2.00	4.00	1.00	4.00
8/20/2022	2.00	64.00	5.00	7.00	0.00	0.00	6.00	37.00
8/21/2022	1.00	4.00	1.00	0.00	9.00	0.00	2.00	8.00
8/22/2022	1.00	13.00	24.00	2.00	19.00	4.00	2.00	7.00
8/23/2022	1.00	21.00	77.00	6.00	31.00	4.00	1.00	3.00
8/24/2022	2.00	9.00					1.00	6.00
Total CPUE	11.10	62.85	16.75	10.89	6.23	5.05	10.96	30.29
SD	15.13	89.81	20.43	13.50	6.66	4.67	16.91	63.02

Appendix 4. CPUE (fish/net night) for Arctic Cisco (length group 1) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	5.00	151.00						
6/30/2022	8.00	12.00						
7/1/2022	7.00	24.00					4.00	9.00
7/2/2022	8.00	23.00					12.00	33.00
7/3/2022	10.00	50.00					42.00	218.00
7/4/2022	18.00	112.00					11.00	71.00
7/5/2022	20.00	106.00					62.00	33.00
7/6/2022	11.00	55.00					63.00	261.00
7/7/2022	1.00	9.00					0.00	0.00
7/8/2022	3.00	9.00					18.00	6.00
7/9/2022	4.00	2.00	12.00	22.00	2.00	0.00	6.00	3.00
7/10/2022	4.00	7.00	3.00	4.00	0.00	1.00	10.00	3.00
7/11/2022	1.00	6.00	1.00	0.00	0.00	0.00	2.00	5.00
7/12/2022	2.00	2.00	0.00	0.00	0.00	0.00	3.00	2.00
7/13/2022	6.00	5.00	0.00	0.00	0.00	0.00	10.00	3.00
7/14/2022			1.00	0.00	0.00	0.00	6.00	21.00
7/15/2022	20.00	34.00	0.00	0.00	0.00	0.00	7.00	4.00
7/16/2022	44.00	104.00	4.00	4.00	0.00	1.00	11.00	8.00
7/17/2022	5.00	8.00	22.00	9.00	1.00	2.00	2.00	16.00
7/18/2022	2.00	7.00	25.00	9.00		3.00	2.00	0.00
7/19/2022	11.00	39.00	15.00	20.00		3.00	2.00	6.00
7/20/2022	4.00	2.00	6.00	10.00			0.00	4.00
7/21/2022	2.00	2.00			1.00	0.00	4.00	3.00
7/22/2022	2.00	0.00				2.00	0.00	14.00
7/23/2022	1.00	3.00	3.00	3.00	0.00	0.00	1.00	5.00
7/24/2022	0.00	5.00	3.00	1.00	2.00	3.00	4.00	9.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			0.00	1.00			0.00	0.00
7/30/2022	0.00	4.00	2.00	3.00	0.00	1.00	0.00	1.00
7/31/2022	3.00	37.00	4.00	2.00	0.00	3.00	1.00	2.00
8/1/2022	0.00	2.00	2.00	0.00	1.00	0.00	1.00	2.00
8/2/2022	0.00	4.00	1.00	1.00	0.00	1.00	0.00	2.00
8/3/2022	3.00	26.00	28.00	6.00	0.00	9.00	1.00	2.00
8/4/2022	1.00	30.00	6.00	11.00	1.00	5.00	2.00	0.00
8/5/2022	1.00	30.00	23.00	3.00	0.00	0.00	0.00	0.00
8/6/2022	0.00	2.00	2.00	1.00	0.00	0.00		
8/7/2022	0.00	0.00	0.00	2.00	0.00	0.00		
8/8/2022	0.00	0.00	1.00	0.00	0.00	0.00	2.00	1.00
8/9/2022	2.00	3.00	0.00	0.00	1.00	0.00	5.00	7.00
8/10/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/11/2022			0.00	0.00	0.00	0.00	0.00	0.00
8/12/2022			0.00	0.00	0.00	0.00	0.00	0.00
8/13/2022	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00
8/14/2022	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/15/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
8/16/2022	0.00	3.00	0.00	0.00	0.00	0.00	2.00	9.00
8/17/2022	1.00	3.00	1.00	2.00	0.00	0.00	1.00	4.00
8/18/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
8/19/2022	3.00	3.00	0.00	0.00	0.00	1.00	1.00	0.00
8/20/2022	0.00	9.00	0.00	1.00	0.00	0.00	1.00	6.00
8/21/2022	0.00	0.00	0.00	0.00	2.00	0.00	1.00	1.00
8/22/2022	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
8/23/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/24/2022	0.00	1.00					0.00	0.00
Total CPUE	6.99	26.03	7.82	5.84	1.42	2.57	9.03	21.86
SD	9.57	40.68	9.01	6.47	0.53	2.19	15.25	54.98

Appendix 5. CPUE (fish/net night) for Arctic Cisco (length group 2) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	29.00	200.00						
6/30/2022	7.00	28.00						
7/1/2022	3.00	30.00					8.00	9.00
7/2/2022	26.00	51.00					13.00	13.00
7/3/2022	13.00	47.00					17.00	73.00
7/4/2022	19.00	112.00					4.00	48.00
7/5/2022	18.00	161.00					12.00	56.00
7/6/2022	8.00	186.00					6.00	26.00
7/7/2022	7.00	18.00					1.00	0.00
7/8/2022	1.00	14.00					5.00	6.00
7/9/2022	0.00	0.00	5.00	24.00	4.00	5.00	0.00	1.00
7/10/2022	1.00	6.00	0.00	0.00	0.00	0.00	2.00	5.00
7/11/2022	0.00	4.00	0.00	2.00	2.00	2.00	5.00	0.00
7/12/2022	1.00	3.00	0.00	0.00	0.00	0.00	1.00	1.00
7/13/2022	3.00	3.00	0.00	0.00	3.00	1.00	4.00	3.00
7/14/2022			0.00	0.00	1.00	0.00	5.00	19.00
7/15/2022	13.00	23.00	0.00	0.00	1.00	4.00	4.00	3.00
7/16/2022	23.00	63.00	8.00	0.00	0.00	3.00	2.00	6.00
7/17/2022	6.00	17.00	18.00	7.00	3.00	3.00	8.00	5.00
7/18/2022	7.00	6.00	16.00	5.00		1.00	2.00	2.00
7/19/2022	7.00	36.00	4.00	23.00		1.00	2.00	4.00
7/20/2022	0.00	1.00	4.00	14.00			0.00	2.00
7/21/2022	1.00	4.00			0.00	0.00	0.00	7.00
7/22/2022	2.00	1.00				2.00	0.00	2.00
7/23/2022	2.00	12.00	1.00	10.00	2.00	4.00	0.00	2.00
7/24/2022	1.00	5.00	5.00	9.00	6.00	3.00	4.00	5.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			0.00	0.00			1.00	1.00
7/30/2022	4.00	18.00	3.00	2.00	0.00	1.00	0.00	0.00
7/31/2022	1.00	23.00	6.00	2.00	0.00	3.00	1.00	2.00
8/1/2022	0.00	49.00	2.00	3.00	3.00	0.00	0.00	1.00
8/2/2022	1.00	71.00	3.00	4.00	0.00	2.00	0.00	2.00
8/3/2022	6.00	140.00	17.00	19.00	2.00	16.00	3.00	4.00
8/4/2022	4.00	64.00	3.00	22.00	4.00	0.00	4.00	0.00
8/5/2022	0.00	131.00	35.00	15.00	0.00	0.00	1.00	0.00
8/6/2022	0.00	7.00	6.00	6.00	0.00	0.00		
8/7/2022	0.00	1.00	0.00	1.00	0.00	0.00		
8/8/2022	2.00	2.00	2.00	1.00	0.00	0.00	0.00	2.00
8/9/2022	1.00	3.00	1.00	0.00	1.00	0.00	5.00	5.00
8/10/2022	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
8/11/2022			0.00	0.00	0.00	0.00	2.00	0.00
8/12/2022			0.00	3.00	0.00	1.00	0.00	0.00
8/13/2022	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00
8/14/2022	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00
8/15/2022	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
8/16/2022	0.00	10.00	0.00	0.00	0.00	0.00	1.00	19.00
8/17/2022	1.00	27.00	2.00	2.00	0.00	0.00	4.00	6.00
8/18/2022	1.00	0.00	1.00	0.00	0.00	0.00	0.00	3.00
8/19/2022	1.00	6.00	1.00	0.00	0.00	3.00	0.00	3.00
8/20/2022	2.00	55.00	3.00	5.00	0.00	0.00	4.00	29.00
8/21/2022	1.00	4.00	0.00	0.00	2.00	0.00	1.00	6.00
8/22/2022	1.00	3.00	0.00	1.00	1.00	0.00	1.00	2.00
8/23/2022	1.00	1.00	2.00	0.00	0.00	0.00	0.00	2.00
8/24/2022	0.00	4.00					1.00	6.00
Total CPUE	6.46	37.74	6.19	7.64	2.43	3.25	4.08	10.24
SD	8.16	57.19	7.88	7.96	1.51	3.48	3.99	17.38

Appendix 6. CPUE (fish/net night) for Arctic Cisco (length group 3) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	0.00	3.00						
6/30/2022	0.00	2.00						
7/1/2022	1.00	22.00					1.00	3.00
7/2/2022	4.00	13.00					0.00	15.00
7/3/2022	0.00	1.00					1.00	2.00
7/4/2022	1.00	4.00					0.00	1.00
7/5/2022	0.00	1.00					0.00	3.00
7/6/2022	1.00	0.00					0.00	0.00
7/7/2022	0.00	2.00					0.00	0.00
7/8/2022	0.00	22.00					4.00	31.00
7/9/2022	1.00	24.00	1.00	0.00	6.00	6.00	2.00	11.00
7/10/2022	2.00	38.00	0.00	0.00	1.00	4.00	1.00	18.00
7/11/2022	0.00	9.00	0.00	2.00	4.00	1.00	0.00	12.00
7/12/2022	1.00	1.00	0.00	0.00	0.00	0.00	1.00	3.00
7/13/2022	4.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00
7/14/2022			0.00	0.00	1.00	0.00	3.00	22.00
7/15/2022	0.00	2.00	3.00	3.00	1.00	3.00	3.00	4.00
7/16/2022	0.00	3.00	6.00	2.00	0.00	1.00	0.00	0.00
7/17/2022	5.00	0.00	2.00	1.00	3.00	1.00	0.00	3.00
7/18/2022	0.00	0.00	8.00	0.00		0.00	1.00	0.00
7/19/2022	1.00	2.00	4.00	3.00		0.00	2.00	15.00
7/20/2022	1.00	1.00	4.00	3.00			0.00	0.00
7/21/2022	0.00	0.00			0.00	2.00	0.00	2.00
7/22/2022	2.00	0.00				0.00	1.00	2.00
7/23/2022	0.00	0.00	2.00	2.00	0.00	1.00	0.00	0.00
7/24/2022	1.00	0.00	0.00	2.00	2.00	0.00	0.00	0.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			5.00	4.00			2.00	2.00
7/30/2022	0.00	12.00	11.00	3.00	0.00	2.00	0.00	0.00
7/31/2022	7.00	7.00	1.00	0.00	0.00	0.00	1.00	7.00
8/1/2022	1.00	5.00	3.00	2.00	3.00	0.00	0.00	3.00
8/2/2022	3.00	7.00	3.00	1.00	0.00	0.00	0.00	2.00
8/3/2022	0.00	6.00	7.00	1.00	3.00	0.00	0.00	0.00
8/4/2022	0.00	1.00	3.00	14.00	0.00	0.00	0.00	0.00
8/5/2022	0.00	1.00	5.00	0.00	0.00	0.00	0.00	0.00
8/6/2022	0.00	0.00	65.00	0.00	0.00	2.00		
8/7/2022	3.00	1.00	2.00	0.00	0.00	1.00		
8/8/2022	0.00	2.00	11.00	0.00	6.00	2.00	1.00	0.00
8/9/2022	0.00	3.00	5.00	1.00	4.00	0.00	0.00	3.00
8/10/2022	0.00	0.00	3.00	0.00	1.00	0.00	0.00	0.00
8/11/2022			4.00	3.00	3.00	0.00	1.00	1.00
8/12/2022			2.00	5.00	3.00	2.00	0.00	1.00
8/13/2022	0.00	0.00	2.00	2.00	1.00	0.00	0.00	0.00
8/14/2022	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
8/15/2022	0.00	3.00	0.00	2.00	0.00	0.00	0.00	0.00
8/16/2022	1.00	1.00	4.00	3.00	7.00	0.00	0.00	0.00
8/17/2022	0.00	1.00	22.00	2.00	1.00	0.00	0.00	0.00
8/18/2022	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00
8/19/2022	0.00	0.00	3.00	0.00	2.00	0.00	0.00	1.00
8/20/2022	0.00	0.00	2.00	1.00	0.00	0.00	1.00	2.00
8/21/2022	0.00	0.00	1.00	0.00	5.00	0.00	0.00	1.00
8/22/2022	0.00	10.00	24.00	1.00	18.00	3.00	1.00	5.00
8/23/2022	0.00	20.00	75.00	6.00	31.00	4.00	1.00	1.00
8/24/2022	2.00	4.00					0.00	0.00
Total CPUE	2.15	6.72	9.08	2.93	4.90	2.33	1.54	6.01
SD	1.67	8.20	16.12	2.80	6.85	1.54	0.81	6.63

Appendix 7. CPUE (fish/net night) for Broad Whitefish (all length groups) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	13.00	130.00						
6/30/2022	2.00	13.00						
7/1/2022	50.00	118.00					13.00	27.00
7/2/2022	13.00	32.00					78.00	166.00
7/3/2022	17.00	90.00					169.00	340.00
7/4/2022	10.00	141.00					38.00	61.00
7/5/2022	11.00	101.00					113.00	45.00
7/6/2022	10.00	67.00					132.00	402.00
7/7/2022	9.00	14.00					3.00	1.00
7/8/2022	4.00	20.00					77.00	60.00
7/9/2022	1.00	10.00	16.00	14.00	39.00	29.00	8.00	16.00
7/10/2022	7.00	10.00	20.00	4.00	53.00	10.00	12.00	19.00
7/11/2022	3.00	4.00	9.00	12.00	21.00	4.00	9.00	9.00
7/12/2022	0.00	3.00	2.00	0.00	1.00	0.00	7.00	2.00
7/13/2022	8.00	3.00	14.00	3.00	4.00	2.00	30.00	11.00
7/14/2022			2.00	2.00	2.00	2.00	52.00	88.00
7/15/2022	16.00	42.00	0.00	1.00	0.00	0.00	22.00	13.00
7/16/2022	30.00	87.00	2.00	2.00	0.00	0.00	15.00	7.00
7/17/2022	12.00	10.00	6.00	6.00	1.00	3.00	14.00	23.00
7/18/2022	4.00	16.00	20.00	11.00		3.00	4.00	3.00
7/19/2022	22.00	137.00	6.00	20.00		0.00	18.00	17.00
7/20/2022	2.00	3.00	4.00	9.00			6.00	3.00
7/21/2022	11.00	9.00			0.00	5.00	17.00	5.00
7/22/2022	4.00	9.00				15.00	8.00	14.00
7/23/2022	7.00	22.00	3.00	12.00	0.00	0.00	10.00	33.00
7/24/2022	13.00	150.00	32.00	9.00	2.00	7.00	16.00	58.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			2.00	1.00			37.00	37.00
7/30/2022	4.00	30.00	23.00	4.00	0.00	20.00	10.00	6.00
7/31/2022	8.00	52.00	12.00	3.00	0.00	4.00	9.00	11.00
8/1/2022	1.00	12.00	7.00	5.00	1.00	4.00	1.00	4.00
8/2/2022	1.00	20.00	2.00	4.00	0.00	5.00	2.00	5.00
8/3/2022	6.00	260.00	5.00	12.00	11.00	60.00	7.00	8.00
8/4/2022	7.00	59.00	2.00	29.00	4.00	90.00	6.00	0.00
8/5/2022	2.00	98.00	22.00	18.00	1.00	0.00	3.00	0.00
8/6/2022	0.00	4.00	12.00	6.00	0.00	0.00		
8/7/2022	7.00	3.00	0.00	1.00	0.00	4.00		
8/8/2022	8.00	6.00	57.00	0.00	5.00	6.00	17.00	3.00
8/9/2022	4.00	67.00	13.00	5.00	2.00	6.00	71.00	36.00
8/10/2022	0.00	5.00	0.00	5.00	2.00	0.00	13.00	8.00
8/11/2022			3.00	7.00	0.00	1.00	5.00	2.00
8/12/2022			1.00	1.00	1.00	0.00	9.00	1.00
8/13/2022	1.00	6.00	0.00	6.00	0.00	2.00	4.00	1.00
8/14/2022	0.00	17.00	5.00	3.00	0.00	0.00	4.00	0.00
8/15/2022	8.00	32.00	3.00	0.00	0.00	0.00	9.00	4.00
8/16/2022	29.00	96.00	3.00	0.00	2.00	4.00	7.00	52.00
8/17/2022	60.00	157.00	5.00	3.00	4.00	1.00	24.00	31.00
8/18/2022	9.00	25.00	0.00	0.00	0.00	0.00	21.00	11.00
8/19/2022	29.00	27.00	15.00	4.00	1.00	1.00	2.00	18.00
8/20/2022	24.00	102.00	7.00	6.00	0.00	2.00	11.00	38.00
8/21/2022	6.00	8.00	2.00	2.00	1.00	1.00	7.00	19.00
8/22/2022	88.00	215.00	3.00	1.00	2.00	4.00	2.00	3.00
8/23/2022	8.00	326.00	1.00	5.00	3.00	2.00	18.00	26.00
8/24/2022	18.00	30.00					13.00	21.00
Total CPUE	13.44	59.67	9.64	6.77	7.16	10.74	24.11	37.85
SD	16.26	70.24	10.54	6.30	12.78	20.02	35.74	75.85

Appendix 8. CPUE (fish/net night) for Broad Whitefish (length group 1) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	9.00	106.00						
6/30/2022	2.00	7.00						
7/1/2022	45.00	88.00					7.00	4.00
7/2/2022	2.00	21.00					73.00	149.00
7/3/2022	15.00	81.00					162.00	308.00
7/4/2022	7.00	123.00					31.00	34.00
7/5/2022	7.00	88.00					112.00	17.00
7/6/2022	3.00	33.00					132.00	368.00
7/7/2022	1.00	12.00					1.00	0.00
7/8/2022	1.00	2.00					39.00	19.00
7/9/2022	1.00	0.00	8.00	11.00	0.00	1.00	4.00	1.00
7/10/2022	3.00	1.00	4.00	1.00	1.00	0.00	3.00	1.00
7/11/2022	0.00	1.00	0.00	0.00	0.00	0.00	2.00	2.00
7/12/2022	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
7/13/2022	7.00	0.00	5.00	2.00	0.00	1.00	27.00	9.00
7/14/2022			1.00	0.00	0.00	0.00	36.00	66.00
7/15/2022	12.00	34.00	0.00	0.00	0.00	0.00	16.00	7.00
7/16/2022	27.00	76.00	2.00	2.00	0.00	0.00	14.00	7.00
7/17/2022	7.00	4.00	6.00	6.00	1.00	1.00	13.00	20.00
7/18/2022	4.00	9.00	19.00	8.00		1.00	1.00	3.00
7/19/2022	20.00	102.00	6.00	17.00		0.00	8.00	3.00
7/20/2022	2.00	2.00	3.00	8.00			5.00	1.00
7/21/2022	8.00	2.00			0.00	0.00	17.00	5.00
7/22/2022	3.00	0.00				1.00	8.00	10.00
7/23/2022	5.00	11.00	1.00	10.00	0.00	0.00	7.00	26.00
7/24/2022	9.00	137.00	27.00	5.00	1.00	7.00	12.00	52.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			2.00	1.00			20.00	20.00
7/30/2022	3.00	19.00	17.00	2.00	0.00	15.00	5.00	2.00
7/31/2022	4.00	25.00	7.00	2.00	0.00	2.00	4.00	2.00
8/1/2022	1.00	3.00	4.00	4.00	0.00	3.00	1.00	4.00
8/2/2022	0.00	4.00	2.00	2.00	0.00	4.00	2.00	3.00
8/3/2022	2.00	96.00	4.00	5.00	10.00	50.00	6.00	5.00
8/4/2022	3.00	45.00	2.00	18.00	3.00	84.00	4.00	0.00
8/5/2022	1.00	66.00	13.00	9.00	1.00	0.00	2.00	0.00
8/6/2022	0.00	2.00	10.00	2.00	0.00	0.00		
8/7/2022	0.00	0.00	0.00	0.00	0.00	2.00		
8/8/2022	4.00	1.00	0.00	0.00	0.00	1.00	2.00	1.00
8/9/2022	2.00	3.00	0.00	0.00	0.00	1.00	40.00	15.00
8/10/2022	0.00	1.00	0.00	1.00	0.00	0.00	6.00	0.00
8/11/2022			0.00	1.00	0.00	0.00	0.00	0.00
8/12/2022			0.00	0.00	0.00	0.00	1.00	0.00
8/13/2022	0.00	0.00	0.00	2.00	0.00	0.00	1.00	0.00
8/14/2022	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
8/15/2022	8.00	17.00	0.00	0.00	0.00	0.00	3.00	2.00
8/16/2022	29.00	82.00	1.00	0.00	0.00	0.00	2.00	9.00
8/17/2022	56.00	86.00	1.00	0.00	0.00	0.00	4.00	12.00
8/18/2022	6.00	7.00	0.00	0.00	0.00	0.00	6.00	6.00
8/19/2022	28.00	7.00	12.00	1.00	0.00	0.00	2.00	12.00
8/20/2022	22.00	21.00	0.00	0.00	0.00	1.00	4.00	9.00
8/21/2022	6.00	0.00	0.00	2.00	0.00	0.00	3.00	4.00
8/22/2022	87.00	203.00	0.00	0.00	1.00	0.00	1.00	2.00
8/23/2022	8.00	320.00	0.00	0.00	0.00	1.00	4.00	4.00
8/24/2022	18.00	21.00					0.00	1.00
Total CPUE	11.87	48.55	6.95	5.15	2.54	10.47	18.36	30.11
SD	16.75	63.64	7.04	5.07	3.30	22.78	34.94	74.37

Appendix 9. CPUE (fish/net night) for Broad Whitefish (length group 2) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	4.00	23.00						
6/30/2022	0.00	3.00						
7/1/2022	1.00	20.00					2.00	3.00
7/2/2022	6.00	8.00					3.00	8.00
7/3/2022	1.00	7.00					5.00	15.00
7/4/2022	3.00	13.00					6.00	17.00
7/5/2022	1.00	9.00					1.00	11.00
7/6/2022	4.00	30.00					0.00	17.00
7/7/2022	1.00	1.00					2.00	1.00
7/8/2022	1.00	5.00					23.00	10.00
7/9/2022	0.00	2.00	2.00	0.00	0.00	0.00	4.00	9.00
7/10/2022	0.00	1.00	0.00	0.00	0.00	0.00	5.00	4.00
7/11/2022	1.00	1.00	1.00	1.00	2.00	0.00	4.00	3.00
7/12/2022	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00
7/13/2022	1.00	2.00	0.00	0.00	0.00	0.00	2.00	2.00
7/14/2022			0.00	0.00	2.00	0.00	10.00	13.00
7/15/2022	2.00	3.00	0.00	0.00	0.00	0.00	5.00	6.00
7/16/2022	3.00	10.00	0.00	0.00	0.00	0.00	1.00	0.00
7/17/2022	2.00	2.00	0.00	0.00	0.00	0.00	0.00	2.00
7/18/2022	0.00	6.00	0.00	3.00		0.00	3.00	0.00
7/19/2022	1.00	27.00	0.00	3.00		0.00	5.00	11.00
7/20/2022	0.00	1.00	0.00	0.00			1.00	2.00
7/21/2022	2.00	3.00			0.00	0.00	0.00	0.00
7/22/2022	1.00	0.00				0.00	0.00	3.00
7/23/2022	0.00	8.00	1.00	0.00	0.00	0.00	3.00	4.00
7/24/2022	3.00	10.00	5.00	2.00	1.00	0.00	4.00	6.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			0.00	0.00			5.00	5.00
7/30/2022	1.00	7.00	6.00	1.00	0.00	4.00	3.00	2.00
7/31/2022	3.00	15.00	1.00	0.00	0.00	1.00	2.00	5.00
8/1/2022	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00
8/2/2022	0.00	10.00	0.00	1.00	0.00	1.00	0.00	0.00
8/3/2022	4.00	160.00	1.00	6.00	0.00	8.00	1.00	3.00
8/4/2022	4.00	14.00	0.00	11.00	1.00	6.00	0.00	0.00
8/5/2022	1.00	32.00	7.00	8.00	0.00	0.00	1.00	0.00
8/6/2022	0.00	2.00	1.00	1.00	0.00	0.00		
8/7/2022	1.00	1.00	0.00	0.00	0.00	2.00		
8/8/2022	2.00	4.00	7.00	0.00	0.00	4.00	11.00	1.00
8/9/2022	1.00	31.00	1.00	1.00	0.00	2.00	29.00	21.00
8/10/2022	0.00	0.00	0.00	2.00	0.00	0.00	5.00	6.00
8/11/2022			0.00	2.00	0.00	1.00	2.00	0.00
8/12/2022			0.00	1.00	0.00	0.00	0.00	0.00
8/13/2022	0.00	1.00	0.00	0.00	0.00	2.00	2.00	0.00
8/14/2022	0.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00
8/15/2022	0.00	9.00	0.00	0.00	0.00	0.00	4.00	2.00
8/16/2022	0.00	12.00	1.00	0.00	0.00	1.00	5.00	43.00
8/17/2022	4.00	66.00	3.00	2.00	1.00	0.00	20.00	19.00
8/18/2022	3.00	2.00	0.00	0.00	0.00	0.00	12.00	5.00
8/19/2022	1.00	18.00	3.00	3.00	1.00	1.00	0.00	6.00
8/20/2022	2.00	80.00	7.00	6.00	0.00	0.00	7.00	29.00
8/21/2022	0.00	3.00	1.00	0.00	1.00	0.00	3.00	11.00
8/22/2022	1.00	6.00	2.00	1.00	0.00	2.00	1.00	0.00
8/23/2022	0.00	4.00	0.00	0.00	1.00	0.00	14.00	22.00
8/24/2022	0.00	8.00					13.00	19.00
Total CPUE	2.12	14.52	2.79	2.87	1.20	2.69	5.85	9.35
SD	1.37	25.83	2.32	2.81	0.36	2.18	6.34	9.04

Appendix 10. CPUE (fish/net night) for Broad Whitefish (length group 3) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	0.00	1.00						
6/30/2022	0.00	3.00						
7/1/2022	4.00	10.00					4.00	20.00
7/2/2022	5.00	3.00					2.00	9.00
7/3/2022	1.00	2.00					2.00	17.00
7/4/2022	0.00	5.00					1.00	10.00
7/5/2022	3.00	4.00					0.00	17.00
7/6/2022	3.00	4.00					0.00	17.00
7/7/2022	7.00	1.00					0.00	0.00
7/8/2022	2.00	13.00					15.00	31.00
7/9/2022	0.00	8.00	6.00	3.00	39.00	28.00	0.00	6.00
7/10/2022	4.00	8.00	16.00	3.00	52.00	10.00	4.00	14.00
7/11/2022	2.00	2.00	8.00	11.00	19.00	4.00	3.00	4.00
7/12/2022	0.00	2.00	2.00	0.00	0.00	0.00	1.00	1.00
7/13/2022	0.00	1.00	9.00	1.00	4.00	1.00	1.00	0.00
7/14/2022			1.00	2.00	0.00	2.00	6.00	9.00
7/15/2022	2.00	4.00	0.00	1.00	0.00	0.00	1.00	0.00
7/16/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
7/17/2022	3.00	4.00	0.00	0.00	0.00	2.00	1.00	1.00
7/18/2022	0.00	1.00	1.00	0.00		2.00	0.00	0.00
7/19/2022	1.00	8.00	0.00	0.00		0.00	5.00	3.00
7/20/2022	0.00	0.00	1.00	1.00			0.00	0.00
7/21/2022	1.00	4.00			0.00	5.00	0.00	0.00
7/22/2022	0.00	9.00				14.00	0.00	1.00
7/23/2022	2.00	3.00	1.00	2.00	0.00	0.00	0.00	3.00
7/24/2022	1.00	3.00	0.00	2.00	0.00	0.00	0.00	0.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			0.00	0.00			12.00	12.00
7/30/2022	0.00	4.00	0.00	1.00	0.00	1.00	2.00	2.00
7/31/2022	1.00	12.00	4.00	1.00	0.00	1.00	3.00	4.00
8/1/2022	0.00	8.00	2.00	0.00	0.00	1.00	0.00	0.00
8/2/2022	1.00	6.00	0.00	1.00	0.00	0.00	0.00	2.00
8/3/2022	0.00	4.00	0.00	1.00	1.00	2.00	0.00	0.00
8/4/2022	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
8/5/2022	0.00	0.00	2.00	1.00	0.00	0.00	0.00	0.00
8/6/2022	0.00	0.00	1.00	3.00	0.00	0.00		
8/7/2022	6.00	2.00	0.00	1.00	0.00	0.00		
8/8/2022	2.00	1.00	50.00	0.00	5.00	1.00	4.00	1.00
8/9/2022	1.00	33.00	12.00	4.00	2.00	3.00	2.00	0.00
8/10/2022	0.00	4.00	0.00	2.00	2.00	0.00	2.00	2.00
8/11/2022			3.00	4.00	0.00	0.00	3.00	2.00
8/12/2022			1.00	0.00	1.00	0.00	8.00	1.00
8/13/2022	1.00	5.00	0.00	4.00	0.00	0.00	1.00	1.00
8/14/2022	0.00	16.00	5.00	2.00	0.00	0.00	1.00	0.00
8/15/2022	0.00	6.00	3.00	0.00	0.00	0.00	2.00	0.00
8/16/2022	0.00	2.00	1.00	0.00	2.00	3.00	0.00	0.00
8/17/2022	0.00	5.00	1.00	1.00	3.00	1.00	0.00	0.00
8/18/2022	0.00	16.00	0.00	0.00	0.00	0.00	3.00	0.00
8/19/2022	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
8/20/2022	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
8/21/2022	0.00	5.00	1.00	0.00	0.00	1.00	1.00	4.00
8/22/2022	0.00	6.00	1.00	0.00	1.00	2.00	0.00	1.00
8/23/2022	0.00	2.00	1.00	5.00	2.00	1.00	0.00	0.00
8/24/2022	0.00	1.00					0.00	1.00
Total CPUE	2.49	5.58	5.30	2.43	9.83	4.19	3.35	6.81
SD	1.81	6.16	9.06	2.05	15.80	6.90	3.29	7.06

Appendix 11. CPUE (fish/net night) for Least Cisco (all length groups) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	2.00	10.00						
6/30/2022	2.00	13.00						
7/1/2022	1.00	10.00					0.00	5.00
7/2/2022	0.00	1.00					8.00	5.00
7/3/2022	1.00	0.00					3.00	5.00
7/4/2022	0.00	9.00					0.00	0.00
7/5/2022	2.00	2.00					0.00	1.00
7/6/2022	0.00	5.00					0.00	3.00
7/7/2022	2.00	1.00					0.00	0.00
7/8/2022	1.00	3.00					4.00	3.00
7/9/2022	1.00	9.00	2.00	23.00	1.00	28.00	0.00	0.00
7/10/2022	1.00	32.00	24.00	9.00	9.00	19.00	0.00	2.00
7/11/2022	3.00	17.00	13.00	30.00	4.00	17.00	4.00	1.00
7/12/2022	1.00	10.00	2.00	9.00	1.00	0.00	1.00	4.00
7/13/2022	9.00	15.00	11.00	9.00	20.00	14.00	1.00	3.00
7/14/2022			3.00	18.00	8.00	12.00	4.00	2.00
7/15/2022	8.00	18.00	22.00	42.00	8.00	74.00	8.00	3.00
7/16/2022	12.00	33.00	9.00	3.00	0.00	45.00	10.00	3.00
7/17/2022	74.00	47.00	12.00	5.00	10.00	28.00	0.00	11.00
7/18/2022	47.00	58.00	23.00	18.00		3.00	4.00	0.00
7/19/2022	5.00	8.00	0.00	24.00		1.00	3.00	28.00
7/20/2022	14.00	1.00	20.00	3.00			1.00	4.00
7/21/2022	3.00	10.00			0.00	3.00	1.00	6.00
7/22/2022	5.00	11.00				10.00	4.00	12.00
7/23/2022	1.00	6.00	2.00	11.00	0.00	1.00	0.00	2.00
7/24/2022	7.00	2.00	0.00	13.00	0.00	3.00	1.00	0.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			11.00	20.00			0.00	0.00
7/30/2022	8.00	69.00	41.00	20.00	0.00	3.00	0.00	0.00
7/31/2022	10.00	83.00	52.00	7.00	0.00	0.00	2.00	5.00
8/1/2022	19.00	35.00	19.00	7.00	3.00	0.00	0.00	4.00
8/2/2022	20.00	33.00	26.00	5.00	0.00	4.00	0.00	8.00
8/3/2022	8.00	60.00	21.00	13.00	29.00	4.00	0.00	0.00
8/4/2022	5.00	22.00	10.00	19.00	3.00	8.00	3.00	5.00
8/5/2022	1.00	17.00	38.00	5.00	0.00	0.00	10.00	2.00
8/6/2022	1.00	11.00	29.00	6.00	0.00	0.00		
8/7/2022	14.00	5.00	4.00	12.00	0.00	1.00		
8/8/2022	6.00	10.00	47.00	5.00	4.00	0.00	8.00	3.00
8/9/2022	5.00	23.00	24.00	1.00	13.00	2.00	2.00	13.00
8/10/2022	1.00	20.00	9.00	4.00	10.00	0.00	1.00	0.00
8/11/2022			18.00	21.00	8.00	0.00	0.00	0.00
8/12/2022			29.00	12.00	8.00	1.00	1.00	1.00
8/13/2022	0.00	2.00	38.00	23.00	4.00	1.00	1.00	0.00
8/14/2022	0.00	10.00	78.00	11.00	0.00	1.00	0.00	0.00
8/15/2022	2.00	5.00	53.00	3.00	0.00	0.00	0.00	1.00
8/16/2022	1.00	8.00	22.00	10.00	50.00	2.00	0.00	9.00
8/17/2022	3.00	8.00	62.00	4.00	12.00	0.00	3.00	2.00
8/18/2022	4.00	7.00	32.00	9.00	0.00	0.00	0.00	0.00
8/19/2022	13.00	9.00	26.00	2.00	23.00	1.00	0.00	4.00
8/20/2022	4.00	8.00	10.00	2.00	0.00	1.00	0.00	5.00
8/21/2022	0.00	13.00	8.00	1.00	6.00	2.00	0.00	2.00
8/22/2022	0.00	16.00	24.00	5.00	28.00	3.00	0.00	0.00
8/23/2022	0.00	2.00	37.00	2.00	7.00	2.00	0.00	1.00
8/24/2022	3.00	33.00					1.00	1.00
Total CPUE	8.08	17.78	23.82	11.37	11.80	10.19	3.53	4.86
SD	13.05	18.77	17.17	9.25	11.86	16.46	2.92	5.11

Appendix 12. CPUE (fish/net night) for Least Cisco (length group 1) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	0.00	5.00						
6/30/2022	1.00	11.00						
7/1/2022	1.00	10.00					0.00	1.00
7/2/2022	0.00	0.00					7.00	3.00
7/3/2022	0.00	0.00					3.00	2.00
7/4/2022	0.00	6.00					0.00	0.00
7/5/2022	0.00	0.00					0.00	0.00
7/6/2022	0.00	1.00					0.00	2.00
7/7/2022	0.00	0.00					0.00	0.00
7/8/2022	0.00	2.00					2.00	1.00
7/9/2022	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
7/10/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/11/2022	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
7/12/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/13/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/14/2022			0.00	0.00	0.00	0.00	0.00	0.00
7/15/2022	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00
7/16/2022	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00
7/17/2022	0.00	2.00	0.00	0.00	1.00	0.00	0.00	0.00
7/18/2022	0.00	0.00	0.00	0.00		0.00	0.00	0.00
7/19/2022	0.00	0.00	0.00	1.00		0.00	0.00	0.00
7/20/2022	0.00	0.00	0.00	1.00			1.00	0.00
7/21/2022	0.00	0.00			0.00	0.00	0.00	0.00
7/22/2022	0.00	0.00				0.00	0.00	1.00
7/23/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
7/24/2022	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			0.00	0.00			0.00	0.00
7/30/2022	1.00	6.00	0.00	0.00	0.00	1.00	0.00	0.00
7/31/2022	1.00	5.00	3.00	0.00	0.00	0.00	1.00	0.00
8/1/2022	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
8/2/2022	0.00	2.00	3.00	1.00	0.00	2.00	0.00	3.00
8/3/2022	1.00	10.00	2.00	2.00	2.00	4.00	0.00	0.00
8/4/2022	3.00	14.00	9.00	2.00	1.00	7.00	1.00	0.00
8/5/2022	1.00	7.00	30.00	4.00	0.00	0.00	2.00	0.00
8/6/2022	0.00	3.00	8.00	5.00	0.00	0.00		
8/7/2022	0.00	1.00	1.00	0.00	0.00	0.00		
8/8/2022	0.00	0.00	4.00	0.00	0.00	0.00	2.00	0.00
8/9/2022	0.00	5.00	8.00	0.00	0.00	0.00	2.00	5.00
8/10/2022	0.00	1.00	2.00	0.00	0.00	0.00	0.00	0.00
8/11/2022			0.00	1.00	0.00	0.00	0.00	0.00
8/12/2022			1.00	0.00	1.00	0.00	0.00	0.00
8/13/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/14/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8/15/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/16/2022	0.00	4.00	0.00	0.00	0.00	0.00	0.00	6.00
8/17/2022	0.00	2.00	4.00	1.00	1.00	0.00	1.00	2.00
8/18/2022	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
8/19/2022	0.00	0.00	3.00	0.00	0.00	0.00	0.00	2.00
8/20/2022	0.00	2.00	3.00	1.00	0.00	0.00	0.00	3.00
8/21/2022	0.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
8/22/2022	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
8/23/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
8/24/2022	0.00	0.00					1.00	1.00
Total CPUE	1.20	4.21	4.75	1.80	1.16	2.60	1.96	2.24
SD	0.82	3.86	6.87	1.38	0.40	2.27	1.57	1.57

Appendix 13. CPUE (fish/net night) for Least Cisco (length group 2) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	2.00	5.00						
6/30/2022	1.00	2.00						
7/1/2022	0.00	0.00					0.00	4.00
7/2/2022	0.00	1.00					1.00	2.00
7/3/2022	1.00	0.00					0.00	3.00
7/4/2022	0.00	3.00					0.00	0.00
7/5/2022	2.00	2.00					0.00	1.00
7/6/2022	0.00	4.00					0.00	1.00
7/7/2022	2.00	1.00					0.00	0.00
7/8/2022	1.00	1.00					2.00	2.00
7/9/2022	1.00	9.00	2.00	23.00	0.00	28.00	0.00	0.00
7/10/2022	1.00	32.00	24.00	9.00	9.00	19.00	0.00	2.00
7/11/2022	3.00	17.00	13.00	30.00	4.00	17.00	2.00	1.00
7/12/2022	1.00	10.00	2.00	9.00	1.00	0.00	1.00	4.00
7/13/2022	9.00	15.00	11.00	9.00	20.00	14.00	1.00	3.00
7/14/2022			3.00	18.00	8.00	12.00	4.00	2.00
7/15/2022	7.00	18.00	22.00	42.00	8.00	72.00	8.00	3.00
7/16/2022	12.00	33.00	9.00	2.00	0.00	44.00	10.00	3.00
7/17/2022	74.00	45.00	12.00	5.00	9.00	28.00	0.00	11.00
7/18/2022	47.00	58.00	23.00	18.00		3.00	4.00	0.00
7/19/2022	5.00	8.00	0.00	23.00		1.00	3.00	28.00
7/20/2022	14.00	1.00	20.00	2.00			0.00	4.00
7/21/2022	3.00	10.00			0.00	3.00	1.00	6.00
7/22/2022	5.00	11.00				10.00	4.00	11.00
7/23/2022	1.00	6.00	2.00	11.00	0.00	1.00	0.00	0.00
7/24/2022	7.00	2.00	0.00	13.00	0.00	3.00	0.00	0.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			11.00	20.00			0.00	0.00
7/30/2022	7.00	63.00	41.00	20.00	0.00	2.00	0.00	0.00
7/31/2022	9.00	78.00	49.00	7.00	0.00	0.00	1.00	5.00
8/1/2022	19.00	34.00	18.00	7.00	3.00	0.00	0.00	4.00
8/2/2022	20.00	31.00	23.00	4.00	0.00	2.00	0.00	5.00
8/3/2022	7.00	50.00	19.00	11.00	27.00	0.00	0.00	0.00
8/4/2022	2.00	8.00	1.00	17.00	2.00	1.00	2.00	5.00
8/5/2022	0.00	10.00	8.00	1.00	0.00	0.00	8.00	2.00
8/6/2022	1.00	8.00	21.00	1.00	0.00	0.00		
8/7/2022	14.00	4.00	3.00	12.00	0.00	1.00		
8/8/2022	6.00	10.00	43.00	5.00	4.00	0.00	6.00	3.00
8/9/2022	5.00	18.00	16.00	1.00	13.00	2.00	0.00	8.00
8/10/2022	1.00	19.00	7.00	4.00	10.00	0.00	1.00	0.00
8/11/2022			18.00	20.00	8.00	0.00	0.00	0.00
8/12/2022			28.00	12.00	7.00	1.00	1.00	1.00
8/13/2022	0.00	2.00	38.00	23.00	4.00	1.00	1.00	0.00
8/14/2022	0.00	9.00	78.00	11.00	0.00	1.00	0.00	0.00
8/15/2022	2.00	5.00	53.00	3.00	0.00	0.00	0.00	1.00
8/16/2022	1.00	4.00	22.00	10.00	50.00	2.00	0.00	3.00
8/17/2022	3.00	6.00	58.00	3.00	11.00	0.00	2.00	0.00
8/18/2022	4.00	7.00	31.00	9.00	0.00	0.00	0.00	0.00
8/19/2022	13.00	9.00	23.00	2.00	23.00	1.00	0.00	2.00
8/20/2022	4.00	6.00	7.00	1.00	0.00	1.00	0.00	2.00
8/21/2022	0.00	12.00	7.00	1.00	6.00	1.00	0.00	1.00
8/22/2022	0.00	15.00	23.00	5.00	28.00	3.00	0.00	0.00
8/23/2022	0.00	2.00	37.00	2.00	7.00	2.00	0.00	0.00
8/24/2022	3.00	33.00					0.00	0.00
Total CPUE	8.25	15.92	21.57	10.87	12.02	9.91	3.14	4.33
SD	13.33	18.12	17.10	9.45	11.86	16.50	2.86	5.05

Appendix 14. CPUE (fish/net night) for Dolly Varden (all length groups) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	10.00	6.00						
6/30/2022	4.00	3.00						
7/1/2022	1.00	1.00					3.00	3.00
7/2/2022	2.00	1.00					1.00	2.00
7/3/2022	3.00	3.00					1.00	5.00
7/4/2022	4.00	3.00					2.00	5.00
7/5/2022	3.00	3.00					2.00	10.00
7/6/2022	1.00	3.00					1.00	8.00
7/7/2022	5.00	3.00					0.00	0.00
7/8/2022	5.00	9.00					0.00	6.00
7/9/2022	2.00	3.00	23.00	28.00	48.00	3.00	1.00	2.00
7/10/2022	9.00	16.00	16.00	11.00	19.00	4.00	1.00	4.00
7/11/2022	1.00	6.00	29.00	7.00	6.00	3.00	0.00	9.00
7/12/2022	2.00	0.00	4.00	1.00	0.00	1.00	0.00	1.00
7/13/2022	1.00	2.00	2.00	0.00	2.00	1.00	0.00	0.00
7/14/2022			2.00	2.00	2.00	0.00	1.00	4.00
7/15/2022	1.00	6.00	3.00	1.00	1.00	0.00	1.00	0.00
7/16/2022	2.00	1.00	6.00	1.00	0.00	0.00	0.00	0.00
7/17/2022	0.00	0.00	6.00	0.00	0.00	4.00	1.00	1.00
7/18/2022	2.00	4.00	8.00	2.00		0.00	1.00	0.00
7/19/2022	1.00	0.00	2.00	1.00		0.00	0.00	0.00
7/20/2022	0.00	1.00	4.00	0.00			0.00	0.00
7/21/2022	0.00	1.00			0.00	0.00	0.00	0.00
7/22/2022	0.00	0.00				3.00	0.00	1.00
7/23/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
7/24/2022	0.00	0.00	1.00	4.00	0.00	0.00	0.00	0.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			0.00	0.00			0.00	0.00
7/30/2022	0.00	1.00	8.00	0.00	0.00	0.00	0.00	1.00
7/31/2022	0.00	4.00	1.00	1.00	0.00	0.00	0.00	0.00
8/1/2022	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
8/2/2022	0.00	8.00	1.00	0.00	0.00	0.00	0.00	0.00
8/3/2022	1.00	10.00	0.00	0.00	1.00	0.00	0.00	0.00
8/4/2022	0.00	3.00	0.00	1.00	0.00	1.00	0.00	0.00
8/5/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8/6/2022	0.00	1.00	1.00	0.00	0.00	0.00		
8/7/2022	0.00	0.00	1.00	0.00	0.00	0.00		
8/8/2022	0.00	1.00	3.00	0.00	1.00	0.00	0.00	0.00
8/9/2022	0.00	10.00	3.00	0.00	0.00	0.00	0.00	1.00
8/10/2022	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8/11/2022			0.00	0.00	0.00	0.00	0.00	0.00
8/12/2022			2.00	1.00	0.00	0.00	1.00	0.00
8/13/2022	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00
8/14/2022	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00
8/15/2022	0.00	5.00	0.00	1.00	0.00	0.00	0.00	0.00
8/16/2022	0.00	0.00	1.00	2.00	0.00	0.00	0.00	1.00
8/17/2022	0.00	4.00	3.00	0.00	0.00	0.00	0.00	1.00
8/18/2022	0.00	16.00	0.00	0.00	0.00	0.00	0.00	0.00
8/19/2022	0.00	8.00	0.00	0.00	0.00	1.00	0.00	0.00
8/20/2022	0.00	13.00	1.00	0.00	0.00	0.00	0.00	0.00
8/21/2022	0.00	93.00	0.00	0.00	0.00	2.00	0.00	1.00
8/22/2022	1.00	77.00	0.00	2.00	0.00	0.00	0.00	2.00
8/23/2022	1.00	47.00	2.00	3.00	0.00	7.00	0.00	1.00
8/24/2022	0.00	23.00					0.00	1.00
Total CPUE	2.79	9.94	5.25	3.97	9.07	2.71	1.28	2.98
SD	2.53	19.14	6.78	7.02	16.71	1.77	0.61	2.63

Appendix 15. CPUE (fish/net night) for Dolly Varden (length group 1) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	10.00	6.00						
6/30/2022	3.00	3.00						
7/1/2022	1.00	1.00					3.00	3.00
7/2/2022	2.00	0.00					1.00	2.00
7/3/2022	0.00	0.00					1.00	5.00
7/4/2022	3.00	1.00					2.00	2.00
7/5/2022	1.00	2.00					1.00	7.00
7/6/2022	0.00	3.00					0.00	8.00
7/7/2022	4.00	0.00					0.00	0.00
7/8/2022	5.00	7.00					0.00	5.00
7/9/2022	2.00	1.00	22.00	27.00	47.00	2.00	0.00	2.00
7/10/2022	9.00	9.00	16.00	11.00	16.00	4.00	1.00	3.00
7/11/2022	1.00	6.00	25.00	6.00	2.00	3.00	0.00	9.00
7/12/2022	2.00	0.00	4.00	1.00	0.00	1.00	0.00	1.00
7/13/2022	0.00	2.00	1.00	0.00	2.00	1.00	0.00	0.00
7/14/2022			1.00	1.00	0.00	0.00	1.00	3.00
7/15/2022	0.00	6.00	3.00	1.00	0.00	0.00	1.00	0.00
7/16/2022	2.00	0.00	6.00	1.00	0.00	0.00	0.00	0.00
7/17/2022	0.00	0.00	5.00	0.00	0.00	3.00	1.00	0.00
7/18/2022	2.00	1.00	8.00	2.00		0.00	1.00	0.00
7/19/2022	1.00	0.00	2.00	0.00		0.00	0.00	0.00
7/20/2022	0.00	1.00	3.00	0.00			0.00	0.00
7/21/2022	0.00	0.00			0.00	0.00	0.00	0.00
7/22/2022	0.00	0.00				3.00	0.00	1.00
7/23/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/24/2022	0.00	0.00	1.00	4.00	0.00	0.00	0.00	0.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			0.00	0.00			0.00	0.00
7/30/2022	0.00	0.00	7.00	0.00	0.00	0.00	0.00	1.00
7/31/2022	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
8/1/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8/2/2022	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
8/3/2022	0.00	2.00	0.00	0.00	1.00	0.00	0.00	0.00
8/4/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/5/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8/6/2022	0.00	1.00	0.00	0.00	0.00	0.00		
8/7/2022	0.00	0.00	1.00	0.00	0.00	0.00		
8/8/2022	0.00	0.00	3.00	0.00	1.00	0.00	0.00	0.00
8/9/2022	0.00	2.00	3.00	0.00	0.00	0.00	0.00	1.00
8/10/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8/11/2022			0.00	0.00	0.00	0.00	0.00	0.00
8/12/2022			1.00	1.00	0.00	0.00	0.00	0.00
8/13/2022	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00
8/14/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8/15/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8/16/2022	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00
8/17/2022	0.00	3.00	2.00	0.00	0.00	0.00	0.00	1.00
8/18/2022	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00
8/19/2022	0.00	7.00	0.00	0.00	0.00	1.00	0.00	0.00
8/20/2022	0.00	9.00	1.00	0.00	0.00	0.00	0.00	0.00
8/21/2022	0.00	52.00	0.00	0.00	0.00	1.00	0.00	1.00
8/22/2022	1.00	48.00	0.00	2.00	0.00	0.00	0.00	2.00
8/23/2022	1.00	33.00	2.00	2.00	0.00	7.00	0.00	1.00
8/24/2022	0.00	19.00					0.00	1.00
Total CPUE	2.98	7.91	5.12	4.72	10.20	2.57	1.28	2.67
SD	2.71	13.19	6.46	7.85	18.36	1.80	0.63	2.22

Appendix 16. CPUE (fish/net night) for Dolly Varden (length group 2) collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	0.00	0.00						
6/30/2022	1.00	0.00						
7/1/2022	0.00	0.00					0.00	0.00
7/2/2022	0.00	1.00					0.00	0.00
7/3/2022	3.00	3.00					0.00	0.00
7/4/2022	1.00	2.00					0.00	3.00
7/5/2022	2.00	1.00					1.00	3.00
7/6/2022	1.00	0.00					1.00	0.00
7/7/2022	1.00	3.00					0.00	0.00
7/8/2022	0.00	2.00					0.00	1.00
7/9/2022	0.00	2.00	1.00	1.00	1.00	1.00	1.00	0.00
7/10/2022	0.00	7.00	0.00	0.00	3.00	0.00	0.00	1.00
7/11/2022	0.00	0.00	4.00	1.00	4.00	0.00	0.00	0.00
7/12/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/13/2022	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
7/14/2022			1.00	1.00	2.00	0.00	0.00	1.00
7/15/2022	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
7/16/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
7/17/2022	0.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00
7/18/2022	0.00	3.00	0.00	0.00		0.00	0.00	0.00
7/19/2022	0.00	0.00	0.00	1.00		0.00	0.00	0.00
7/20/2022	0.00	0.00	1.00	0.00			0.00	0.00
7/21/2022	0.00	1.00			0.00	0.00	0.00	0.00
7/22/2022	0.00	0.00				0.00	0.00	0.00
7/23/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
7/24/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			0.00	0.00			0.00	0.00
7/30/2022	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
7/31/2022	0.00	4.00	1.00	0.00	0.00	0.00	0.00	0.00
8/1/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8/2/2022	0.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00
8/3/2022	1.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00
8/4/2022	0.00	3.00	0.00	1.00	0.00	1.00	0.00	0.00
8/5/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/6/2022	0.00	0.00	1.00	0.00	0.00	0.00		
8/7/2022	0.00	0.00	0.00	0.00	0.00	0.00		
8/8/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8/9/2022	0.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00
8/10/2022	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/11/2022			0.00	0.00	0.00	0.00	0.00	0.00
8/12/2022			1.00	0.00	0.00	0.00	1.00	0.00
8/13/2022	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
8/14/2022	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
8/15/2022	0.00	4.00	0.00	1.00	0.00	0.00	0.00	0.00
8/16/2022	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00
8/17/2022	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
8/18/2022	0.00	9.00	0.00	0.00	0.00	0.00	0.00	0.00
8/19/2022	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8/20/2022	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00
8/21/2022	0.00	41.00	0.00	0.00	0.00	1.00	0.00	0.00
8/22/2022	0.00	29.00	0.00	0.00	0.00	0.00	0.00	0.00
8/23/2022	0.00	14.00	0.00	1.00	0.00	0.00	0.00	0.00
8/24/2022	0.00	4.00					0.00	0.00
Total CPUE	1.36	5.68	1.22	1.11	2.05	1.03	0.98	1.63
SD	0.70	8.76	0.78	0.35	1.08	0.05	0.14	1.13

Appendix 17. CPUE (fish/net night) for Humpback Whitefish collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	0.00	3.00						
6/30/2022	0.00	1.00						
7/1/2022	1.00	1.00					1.00	1.00
7/2/2022	0.00	1.00					0.00	1.00
7/3/2022	0.00	1.00					0.00	0.00
7/4/2022	1.00	7.00					0.00	0.00
7/5/2022	2.00	8.00					1.00	1.00
7/6/2022	4.00	9.00					0.00	0.00
7/7/2022	7.00	8.00					0.00	0.00
7/8/2022	2.00	14.00					1.00	32.00
7/9/2022	0.00	7.00	2.00	6.00	9.00	23.00	0.00	1.00
7/10/2022	1.00	17.00	1.00	1.00	18.00	13.00	0.00	2.00
7/11/2022	2.00	9.00	7.00	11.00	12.00	8.00	0.00	1.00
7/12/2022	0.00	6.00	1.00	6.00	0.00	2.00	0.00	0.00
7/13/2022	4.00	3.00	2.00	23.00	21.00	1.00	0.00	1.00
7/14/2022			1.00	23.00	10.00	3.00	0.00	7.00
7/15/2022	1.00	8.00	3.00	43.00	6.00	3.00	0.00	0.00
7/16/2022	0.00	3.00	6.00	0.00	0.00	10.00	0.00	0.00
7/17/2022	3.00	0.00	2.00	1.00	27.00	11.00	0.00	1.00
7/18/2022	3.00	3.00	3.00	4.00		2.00	0.00	1.00
7/19/2022	3.00	19.00	2.00	5.00		0.00	3.00	5.00
7/20/2022	0.00	0.00	2.00	3.00			0.00	1.00
7/21/2022	1.00	9.00			1.00	0.00	0.00	0.00
7/22/2022	2.00	9.00				0.00	1.00	0.00
7/23/2022	2.00	1.00	2.00	5.00	0.00	0.00	0.00	0.00
7/24/2022	2.00	1.00	1.00	60.00	0.00	0.00	0.00	0.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			18.00	4.00			4.00	4.00
7/30/2022	0.00	6.00	53.00	13.00	0.00	0.00	1.00	1.00
7/31/2022	2.00	9.00	17.00	0.00	0.00	0.00	0.00	0.00
8/1/2022	0.00	0.00	5.00	0.00	1.00	0.00	0.00	0.00
8/2/2022	3.00	1.00	5.00	1.00	0.00	0.00	2.00	0.00
8/3/2022	1.00	11.00	4.00	4.00	4.00	0.00	0.00	0.00
8/4/2022	1.00	1.00	0.00	51.00	1.00	1.00	0.00	1.00
8/5/2022	0.00	0.00	5.00	3.00	0.00	0.00	0.00	0.00
8/6/2022	0.00	0.00	135.00	14.00	0.00	0.00		
8/7/2022	7.00	0.00	27.00	2.00	0.00	0.00		
8/8/2022	2.00	0.00	92.00	3.00	15.00	1.00	0.00	1.00
8/9/2022	1.00	21.00	18.00	2.00	13.00	0.00	0.00	1.00
8/10/2022	1.00	3.00	6.00	1.00	8.00	0.00	0.00	0.00
8/11/2022			77.00	3.00	2.00	1.00	1.00	1.00
8/12/2022			12.00	1.00	6.00	0.00	0.00	0.00
8/13/2022	0.00	1.00	14.00	2.00	3.00	0.00	1.00	0.00
8/14/2022	0.00	0.00	16.00	1.00	1.00	0.00	0.00	0.00
8/15/2022	0.00	6.00	9.00	3.00	0.00	0.00	0.00	0.00
8/16/2022	1.00	0.00	21.00	0.00	11.00	0.00	0.00	0.00
8/17/2022	0.00	4.00	11.00	1.00	7.00	0.00	0.00	0.00
8/18/2022	0.00	12.00	10.00	4.00	0.00	0.00	0.00	0.00
8/19/2022	1.00	0.00	2.00	1.00	5.00	0.00	0.00	0.00
8/20/2022	0.00	0.00	3.00	3.00	0.00	0.00	0.00	0.00
8/21/2022	0.00	19.00	1.00	1.00	5.00	1.00	0.00	0.00
8/22/2022	0.00	8.00	1.00	0.00	5.00	0.00	1.00	0.00
8/23/2022	0.00	1.00	10.00	0.00	2.00	1.00	0.00	0.00
8/24/2022	0.00	3.00					1.00	1.00
Total CPUE	2.28	6.87	15.36	9.31	7.93	5.43	1.57	2.96
SD	1.74	5.75	26.55	15.12	6.70	6.75	1.21	5.64

Appendix 18. CPUE (fish/net night) for Arctic Cod collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	0.00	0.00						
6/30/2022	0.00	0.00						
7/1/2022	0.00	0.00					0.00	0.00
7/2/2022	0.00	0.00					0.00	0.00
7/3/2022	0.00	0.00					0.00	0.00
7/4/2022	0.00	0.00					0.00	0.00
7/5/2022	0.00	0.00					0.00	0.00
7/6/2022	0.00	0.00					0.00	0.00
7/7/2022	0.00	0.00					0.00	0.00
7/8/2022	0.00	0.00					0.00	0.00
7/9/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/10/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/11/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/12/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/13/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/14/2022			0.00	0.00	0.00	0.00	0.00	0.00
7/15/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/16/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/17/2022	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
7/18/2022	0.00	0.00	0.00	0.00		0.00	0.00	2.00
7/19/2022	0.00	0.00	0.00	0.00		0.00	0.00	1.00
7/20/2022	0.00	0.00	0.00	0.00			0.00	0.00
7/21/2022	0.00	0.00			0.00	0.00	0.00	0.00
7/22/2022	0.00	0.00				0.00	0.00	0.00
7/23/2022	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00
7/24/2022	1.00	0.00	2.00	1.00	1.00	0.00	0.00	0.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			0.00	0.00			0.00	0.00
7/30/2022	2.00	0.00	10.00	2.00	0.00	5.00	0.00	0.00
7/31/2022	3.00	4.00	3.00	2.00	1.00	4.00	0.00	0.00
8/1/2022	11.00	3.00	10.00	2.00	3.00	5.00	0.00	0.00
8/2/2022	1.00	6.00	1.00	1.00	0.00	16.00	0.00	0.00
8/3/2022	0.00	1.00	31.00	13.00	4.00	5.00	0.00	0.00
8/4/2022	0.00	0.00	119.00	8.00	0.00	4.00	1.00	1.00
8/5/2022	3.00	9.00	11.00	1.00	1.00	1.00	3.00	0.00
8/6/2022	0.00	0.00	0.00	0.00	0.00	0.00		
8/7/2022	2.00	0.00	0.00	0.00	0.00	1.00		
8/8/2022	0.00	0.00	1.00	0.00	4.00	2.00	0.00	0.00
8/9/2022	0.00	0.00	4.00	1.00	1.00	1.00	0.00	0.00
8/10/2022	0.00	0.00	23.00	42.00	13.00	30.00	0.00	0.00
8/11/2022			3.00	3.00	1.00	4.00	0.00	0.00
8/12/2022			3.00	0.00	3.00	2.00	6.00	5.00
8/13/2022	6.00	1.00	2.00	0.00	2.00	4.00	8.00	4.00
8/14/2022	2.00	0.00	4.00	5.00	0.00	2.00	0.00	0.00
8/15/2022	1.00	1.00	7.00	2.00	0.00	0.00	0.00	0.00
8/16/2022	6.00	5.00	31.00	1.00	7.00	13.00	0.00	0.00
8/17/2022	0.00	1.00	21.00	11.00	7.00	8.00	1.00	0.00
8/18/2022	0.00	0.00	5.00	1.00	0.00	1.00	0.00	0.00
8/19/2022	0.00	0.00	24.00	3.00	24.00	17.00	0.00	0.00
8/20/2022	5.00	3.00	49.00	9.00	2.00	17.00	0.00	0.00
8/21/2022	0.00	1.00	5.00	2.00	6.00	13.00	0.00	0.00
8/22/2022	0.00	0.00	4.00	2.00	0.00	2.00	0.00	0.00
8/23/2022	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00
8/24/2022	0.00	0.00					0.00	0.00
Total CPUE	3.67	3.19	15.91	5.46	5.03	7.18	3.33	2.32
SD	3.13	2.66	25.64	9.35	6.21	7.62	3.10	1.71

Appendix 19. CPUE (fish/net night) for Saffron Cod collected at each sampling site and net in Prudhoe Bay, Alaska, 2022.

Date	214E	214W	218E	218W	220E	220W	230N	230S
6/29/2022	0.00	8.00						
6/30/2022	2.00	5.00						
7/1/2022	0.00	4.00					0.00	1.00
7/2/2022	1.00	7.00					0.00	2.00
7/3/2022	2.00	3.00					3.00	7.00
7/4/2022	1.00	13.00					1.00	0.00
7/5/2022	0.00	1.00					0.00	0.00
7/6/2022	0.00	0.00					0.00	0.00
7/7/2022	0.00	0.00					0.00	0.00
7/8/2022	10.00	14.00					0.00	0.00
7/9/2022	4.00	2.00	6.00	3.00	2.00	2.00	0.00	0.00
7/10/2022	1.00	1.00	6.00	2.00	4.00	1.00	0.00	0.00
7/11/2022	7.00	1.00	2.00	1.00	0.00	0.00	1.00	0.00
7/12/2022	1.00	12.00	1.00	0.00	0.00	0.00	0.00	0.00
7/13/2022	5.00	20.00	0.00	0.00	1.00	0.00	1.00	0.00
7/14/2022			1.00	0.00	0.00	0.00	2.00	0.00
7/15/2022	3.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00
7/16/2022	3.00	6.00	3.00	0.00	0.00	2.00	0.00	2.00
7/17/2022	2.00	5.00	6.00	1.00	6.00	0.00	4.00	5.00
7/18/2022	1.00	5.00	3.00	3.00		0.00	4.00	4.00
7/19/2022	7.00	7.00	2.00	1.00		1.00	0.00	1.00
7/20/2022	1.00	0.00	1.00	1.00			1.00	1.00
7/21/2022	0.00	0.00			0.00	0.00	0.00	0.00
7/22/2022	1.00	1.00				0.00	0.00	0.00
7/23/2022	3.00	1.00	3.00	5.00	1.00	0.00	0.00	0.00
7/24/2022	3.00	3.00	2.00	0.00	0.00	0.00	1.00	1.00
7/25/2022								
7/26/2022								
7/27/2022								
7/28/2022								
7/29/2022			0.00	0.00			1.00	1.00
7/30/2022	9.00	13.00	1.00	0.00	0.00	3.00	0.00	0.00
7/31/2022	1.00	12.00	5.00	2.00	0.00	5.00	0.00	1.00
8/1/2022	5.00	2.00	20.00	4.00	2.00	0.00	0.00	0.00
8/2/2022	1.00	18.00	2.00	2.00	0.00	0.00	0.00	0.00
8/3/2022	4.00	38.00	69.00	8.00	0.00	3.00	4.00	0.00
8/4/2022	4.00	43.00	72.00	10.00	0.00	1.00	14.00	15.00
8/5/2022	3.00	20.00	39.00	10.00	2.00	1.00	10.00	26.00
8/6/2022	0.00	3.00	31.00	11.00	0.00	1.00		
8/7/2022	4.00	3.00	3.00	0.00	0.00	1.00		
8/8/2022	0.00	0.00	2.00	1.00	1.00	0.00	1.00	7.00
8/9/2022	0.00	0.00	3.00	1.00	0.00	1.00	0.00	0.00
8/10/2022	0.00	0.00	3.00	2.00	0.00	4.00	0.00	0.00
8/11/2022			9.00	4.00	0.00	1.00	0.00	0.00
8/12/2022			19.00	1.00	3.00	1.00	0.00	0.00
8/13/2022	2.00	5.00	16.00	1.00	1.00	3.00	1.00	1.00
8/14/2022	0.00	2.00	16.00	1.00	1.00	3.00	1.00	1.00
8/15/2022	0.00	0.00	2.00	0.00	0.00	0.00	1.00	0.00
8/16/2022	5.00	7.00	8.00	0.00	3.00	8.00	2.00	6.00
8/17/2022	3.00	1.00	22.00	7.00	2.00	1.00	3.00	0.00
8/18/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/19/2022	1.00	0.00	14.00	0.00	5.00	1.00	0.00	1.00
8/20/2022	4.00	17.00	21.00	15.00	0.00	4.00	2.00	4.00
8/21/2022	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
8/22/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/23/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/24/2022	0.00	4.00					0.00	3.00
Total CPUE	3.21	8.89	12.11	3.87	2.31	2.31	2.83	4.38
SD	2.19	9.69	17.48	3.88	1.57	1.86	3.42	6.08

Appendix 20. Life-history classifications and alternate names of fish. Arctic Char in the North Slope of Alaska are considered to be a strictly freshwater species but are anadromous in other regions.

Life History Classification	Common Name	Scientific Name	Iñupiaq Name
Anadromous	Arctic Cisco	*Coregonus autumnalis*	Qaaktaq
	Chum Salmon	*Oncorhynchus keta*	Iqalugruaq
	Pink Salmon	*Oncorhynchus gorbuscha*	Amaqtuuq
	Rainbow Smelt	*Osmerus mordax*	Iłhuaġniq
	Sockeye Salmon	*Oncorhynchus nerka*	N/A
Amphidromous	Broad Whitefish	*Coregonus nasus*	Aanaakłiq
	Dolly Varden	*Salvelinus malma*	Iqalukpik
	Humpback Whitefish	*Coregonus pidschian*	Pikuktuuq
	Least Cisco	*Coregonus sardinella*	Iqalusaaq
Freshwater	Arctic Char*	*Salvelinus alpinus*	Iqalukpik
	Arctic Grayling	*Thymallus arcticus*	Sulukpaugaq
	Burbot	*Lota lota*	Tittaaliq
	Ninespine Stickleback	*Pungitius pungitius*	Kakalisauraq
	Round Whitefish	*Prosopium cylindraceum*	Saviġuunnaq
	Threespine Stickleback	*Gasterosteus aculeatus*	Kakiḷaġnaq
Marine	Arctic Cod	*Boreogadus saida*	Iqalugaq
	Arctic Flounder	*Pleuronectes glacialis*	Nataaġnaq
	Capelin	*Mallotus villosus*	Paŋmaksraq
	Fourhorn Sculpin	*Myoxocephalus quadricornis*	Kanayuq
	Kelp Snailfish	*Liparis tunicatus*	N/A
	Pacific Herring	*Clupea pallasii*	Uqsruqtuuq
	Saffron Cod	*Eleginus gracilis*	Uugaq
	Shorthorn Sculpin	*Myoxocephalus scorpius*	N/A
	Whitespotted Greenling	*Hexagrammos stelleri*	N/A

Appendix 21. List of presentations given during 2022 as well as completed theses, submitted and in-preparation manuscripts, and funded proposals on or related to the Beaufort Sea Long-Term Nearshore Fish Monitoring Program.

Graduate Student Thesis Defense Seminars

1. Hamman, C. R. 2022. The influence of acclimation on the organismal and molecular thermotolerance parameters in two Arctic teleosts. Master's Student Thesis Defense, University of Alaska Fairbanks, June 2022, Fairbanks, Alaska.

Completed Graduate Student Theses

1. Hamman, C. R. 2022. The influence of acclimation on the organismal and molecular thermotolerance parameters in two Arctic teleosts. Master's Degree, University of Alaska Fairbanks, Fairbanks, Alaska.

Peer-Reviewed Publications

1. Priest, J. T., F. J. Mueter, S. W. Raborn, and T. M. Sutton. 2022. Effects of environmental variables on a nearshore Arctic fish community, 2001–2018. Polar Biology 45:585-599.

Submitted and In-Preparation Manuscripts

1. Gatt, K. P., L. M. Hynes, and T. M. Sutton. In review. Evaluation of age estimation precision using hard structures for Arctic whitefishes. Submitted to North American Journal of Fisheries Management.

2. Priest, J. T., F. J. Mueter, S. W. Raborn, and T. M. Sutton. In preparation. Effects of nearshore water temperature and salinity on the growth and abundance of two juvenile Arctic whitefishes. In preparation for submission to Journal of Environmental Biology of Fishes.

3. Green, D. G., C. J. Cunningham, and T. M. Sutton. In preparation. Impacts of climate change on juvenile broad whitefish *Coregonus nasus* in Arctic Alaska: Bioenergetics model development and application. In preparation for submission to Journal of Fish Biology.

4. Gatt, K. P., V. R. von Biela, T. M. Sutton and M. V. McPhee. In preparation. Reading between the lines: using an otolith biochronology to assess interannual growth rate variation and identify drivers of growth in an Arctic fish. In preparation for submission to Polar Biology.

5. Hamman, C. R., A. L. Kelley, J. A. Lopez, and T. M. Sutton. In preparation. The influence of acclimation on the organismal and molecular thermotolerance parameters in two Arctic teleosts. In preparation for submission to Conservation Physiology.

Meeting Presentations

1. Hamman, C., T. M. Sutton, A. Kelley, and J. A. Lopez. 2022. Thermotolerance traits of broad whitefish *Coregonus nasus* and saffron cod *Eleginus gracilis*. Annual Meeting of the American Fisheries Society, August 2022, Spokane, Washington.

2. Bateman, B., J. Bacon, and T. Sutton. 2022. Ontogenetic stable isotope analysis of whitefishes. 2022 Virtual UAF Undergraduate Research and Creative Activity Day, April 2022.

3. Hamman, C., T. M. Sutton, A. Kelley, and J. A. Lopez. 2022. Molecular and physiological thermotolerance traits of Broad Whitefish *Coregonus nasus* and Saffron Cod *Eleginus gracilis*. Virtual Alaska Chapter Meeting of the American Fisheries Society, March 2022.

4. Bacon, J., T. M. Sutton, and M. Wooller. 2022. Ecological studies through a novel lens: stable isotope analyses of fish eye lens laminae as ontogenetic trophic markers. Virtual Alaska Chapter Meeting of the American Fisheries Society, March 2022.

5. Glass, J. R., P. A. H. Westley, T. M. Sutton, K. C. Neumann, and W. A Larson. 2022. Harnessing the power of eDNA as a real-time assessment tool of nearshore Arctic marine communities. Virtual Meeting of the Alaska Marine Sciences Symposium, January 2022.

6. Wilkinson, S., V. von Biela, L. Horstmann, T. Sformo, T. Sutton, C. Simskayotuk, N. J. Burns, K. Dunton, and K. Iken. 2022. Resource use by Arctic fishes across Beaufort Sea coastal lagoons. Virtual Meeting of the Alaska Marine Sciences Symposium, January 2022.

The following two supplementary funded proposals (one to UAF undergraduate student Elle Nelson and one to UAF graduate student Jonah Bacon) were secured in 2022 in support of the Beaufort Sea Nearshore Long-Term Fish Monitoring study research components:

1. Nelson, E. 2022. Determining diet composition, ontogenetic changes, and ecological importance of four whitefish species. Funding for $3,000.00 from the University of Alaska Fairbanks Office of Undergraduate Research and Scholarly Activity (2022 Fall Project Award; Mentor: Jonah Bacon).

Nearshore waters of the Beaufort Sea, Alaska, are rapidly changing due to climate warming and human activity. Changes in this environment can affect fish species through impacts on the prey they rely on, such as changes in prey presence, phenology, and abundance. Whitefishes in this region of the Arctic (e.g., Arctic Cisco, Least Cisco, Broad Whitefish, Humpback Whitefish) are ecologically and anthropogenically important, providing a critical middle link in the Arctic food web between lower and higher trophic-level organisms as well as providing nutrition, food security, and cultural significance to Indigenous peoples of the region. Determining feeding habits of whitefishes will provide information on how the food habits, ecology, and health of these critical whitefish species may change due to anthropogenic disturbance. My research project aims to identify essential prey species for each life stage of the four most abundant whitefish species in the nearshore Beaufort Sea, the extent of dietary overlap and segregation between these four fishes, and how these fish may be affected by changes in their environment through impacts on their prey resources. To accomplish these goals, I will assess prey contents within fish stomachs, age otoliths and prepare eye lens samples for stable isotope analysis.

2. Bacon, J. 2022. Ontogenetic trophic dynamics in four whitefish species in the Beaufort Sea. Funding for $5,117.80 from the University of Alaska Fairbanks Office of Undergraduate Research and Scholarly Activity (2022 Mentor Project Award).

Climate change is warming the Arctic twice as fast as the global average. Rapid environmental change is disrupting the dynamics and flow of energy within food webs. Four species of fish

(Arctic Cisco, Least Cisco, Broad Whitefish, Humpback Whitefish; collectively termed "whitefish") are critical members of the Beaufort Sea/Arctic aquatic food chain. Additionally, these species are important for human subsistence in Indigenous communities along the Beaufort Sea. As the habitat of these fish is altered by climate change, the effects upon each species' growth, survival, and overall population health is unclear. Determining the food web interactions of these species is a critical knowledge gap that needs to be addressed to understand the risks these four important fish species may be facing. An undergraduate student will perform stable isotope analysis of tissues from collected fish to address this knowledge gap. Stable isotope analysis of eye lenses provides information regarding the feeding history of a fish over its entire lifetime. Results from this analysis can tell what level of the food web a fish was feeding at, which prey a fish was consuming, and even where the fish was moving for every point within a fish's life. By studying eye lens stable isotopes in whitefish species of the Beaufort Sea, Alaska, we will gain a better understanding of the feeding ecology of these species and better understand risks they may be facing as a result of climate change.

Appendix 22. Master's thesis abstract for the graduate research project completed by former UAF graduate student Carolyn Hamman.

Graduate Study Progress Overview – Carolyn Hamman

Thesis Title: The influence of acclimation on the organismal and molecular thermotolerance parameters in two Arctic teleosts.

Thesis Completion: June 2022

Abstract:

The nearshore Beaufort Sea is a highly dynamic thermal environment that is faced with climate change-driven increases in temperature. Analyzing the thermotolerance of important Arctic subsistence and prey fishes, such as broad whitefish *Coregonus nasus* and saffron cod *Eleginus gracilis,* will provide an understanding of the relative species-specific responses to current and future temperature changes. The objectives of this study were to determine if acclimating broad whitefish and saffron cod to two different temperatures (5 and 15°C) affected their critical thermal maximum (CT_{max}) and their HSP70 protein and mRNA transcript concentrations in brain, muscle, and liver tissues. Following acclimation, fish were exposed to a thermal ramping rate of 3.4°C · h^{-1}. The CT_{max} temperature was recorded when the fish expressed a loss of equilibrium. Tissue samples were then collected and analyzed via western blotting and transcriptome sequencing. Broad whitefish and saffron cod acclimated to 15°C had a significantly higher mean $CT\text{-}_{max}$ (27.3°C and 25.9°C, respectively) than 5°C fish (23.7°C and 23.2°C, respectively). Broad whitefish had a significantly higher CT_{max} than saffron cod at 15°C in addition to significantly higher HSP70 protein concentrations in liver and muscle tissues at both acclimation temperatures. Brain and muscle tissues had the highest and lowest HSP70 protein concentrations, respectively, for both species and acclimation temperatures. The only significant difference in protein concentration between acclimation temperatures was in saffron cod liver tissues where 5°C samples had a significantly higher concentration than 15°C. Brain and liver tissues for broad whitefish acclimated to 15°C had significantly higher HSP70 mRNA transcript concentrations than the control group that remained in lab-acclimation conditions of 8°C. Transcript B expressed a higher quantity of transcripts than transcript A, but both transcripts followed similar expression profiles and there were no differences in transcript concentration between tissues. The molecular data from this study demonstrates the cellular

mechanisms that are, in part, responsible for the observed shifts in broad whitefish and saffron cod organismal thermotolerance, and this plasticity could be used to respond to changing thermal conditions in the nearshore Beaufort Sea in the future.

Appendix 23. Overview of the graduate research project being conducted by UAF Master's degree student Jonah Bacon.

Graduate Study Progress Overview – Jonah Bacon

Summer 2022 marked my second year on the Beaufort Sea Long-Term Nearshore Fish Monitoring Program. During this summer, I was the lead field technician in charge of field work duties. In the previous year, I completed my first summer of field work on the project as well as my first and second semesters of Master's degree coursework. I'm currently in my third semester as a graduate student with one semester of coursework remaining. My anticipated thesis completion and graduation date is July 2023.

For my thesis research, I am studying how four co-occurring whitefish in the nearshore Beaufort environment utilize the prey resources of the area and how diet preferences change across their life spans. The four species I am studying are Arctic Cisco, Least Cisco, Broad Whitefish, and Humpback Whitefish. These four species are both ecologically important (being that they are a key link between lower and upper levels of their food web) and anthropogenically important (being that they are targeted by subsistence users in communities across the North Slope). Climate change is rapidly changing the environment within which these four species reside. Thus, determining food habits for the four species is crucial for a number of reasons.

Over the past two summers, I collected nearly 450 individual fish across the four species (114 Arctic Cisco, 101 Broad Whitefish, 101 Humpback Whitefish, 133 Least Cisco) using both fyke nets and gill nets. Each individual fish was weighed, measured, and processed to remove their stomach, eye balls, and otoliths, and tissue samples were brought back to the University of Alaska Fairbanks for further processing. Stomach contents were removed from the stomachs, identified to the lowest taxonomic level, counted, and weighed. Otolith samples from each individual were set in epoxy resin, thin-sectioned, and photographed under a stereomicroscope. Images of otolith cross sections were analyzed to produce age estimates for each whitefish collected. Finally, eye lenses were removed from the eyes of each whitefish. Eye lenses were cross-sectioned as well, photographed under a stereomicroscope, and analyzed to determine the diameter length of each lens and to determine the number of layers present within each lens. For a subsample of fish, the eye lens from the second eye was dissected to remove each individual eye lens layer. These layers were then dried, pulverized, weighed, and subjected to stable isotope techniques, either carbon/nitrogen bulk stable isotope analysis or nitrogen compound-specific stable isotope analysis.

Stomach-content results will be analyzed to reveal differences in the dietary preference between the four species as well as between two size classes of each species. An eye lens growth chronology will be developed for each species based upon fish length, age, and eye lens diameter and number of layers. Eye lens stable isotope results will be used to reconstruct trophic dynamics across the life span of each species and individual. In combination, the results of my thesis research will reveal both how short-term dietary habits differ between the four species and how the prey resources exploited by the four species change across each species' lifespan. These results will have implications for the future of each species in light of ongoing climate change.

Appendix 24. Overview of the graduate research project being conducted by UAF Master's degree student Anna Medina.

Graduate Study Progress Overview – Anna Medina

My first year on the Beaufort Sea Long-Term Nearshore Fish Monitoring Program began in summer 2022 as a new graduate student on the project. I assisted with summer fieldwork and took samples for my thesis research that I will be conducting during my time at the University of Alaska Fairbanks (UAF). I began my first semester of graduate school this fall and will be returning as the lead field technician for summer 2023 sampling.

The research that I am conducting for my graduate thesis is based on the age and growth of Rainbow Smelt and determining what method of aging is the most cost efficient depending on management goals. Very little data collection and monitoring has occurred for Rainbow Smelt in the Arctic, leaving their status unknown and unclear. Since Rainbow Smelt are an important forage fish for many sea birds, marine and terrestrial mammals, and other fishes, it is essential to gain an understanding of the status and trends of the population. Studying the age and growth of Rainbow Smelt can be a good indicator of health for both the individuals and the population within the nearshore waters of the Beaufort Sea.

For my first summer of fieldwork, I took aging structures from 147 Rainbow Smelt along with fork length, total weight, and determined sex for each fish sampled. Three hard parts (aging structures) were taken from each fish, which include the sagittal otoliths, left pectoral fin, and up to 10 scales to evaluate precision and efficiency of each structure. All samples were transported back to UAF for further processing in the laboratory. When placed under magnification, these hard parts show distinguishable growth rings (circuli). Periods of slow growth are discernable under magnification by areas of closely spaced circuli and occur on an annual basis. The annual variations in the circuli pattern are thus termed annuli. The age of Rainbow Smelt can be determined by counting the annuli present on these hard parts. Otoliths and pectoral fins are to be set in epoxy resin, thin sectioned, and digitally photographed to produce age estimates. Scales are to be placed on microscope slides and digitally photographed to determine age estimates as well. Comparison of the process for each structure will allow me to determine which aging method is best depending on management priorities. Additionally, data gathered from age estimates will determine length-frequency distribution and allow for the separation of age classes. By comparing the mean lengths between age classes, I can determine the approximate growth rates at various ages. Growth constitutes the conversion of excess energy converted into biomass gains, with healthy fish usually demonstrating significant growth rates.

The results of my thesis research will gather data and increase our understanding of the Rainbow Smelt population in the nearshore waters of the Beaufort Sea. Because there is little data on Rainbow Smelt populations in Alaska in general, this research is imperative for this species. As changes in climate continue in the Arctic, there is a need to understand the population dynamics of the forage fishes within this system as they are connected to multiple predators that live within this area.