NOAA Technical Memorandum NMFS-AFSC-487

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June 2024

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center

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This document should be cited as follows:

Markowitz, E. H., Dawson, E. J., Wassermann, S. N., Anderson, C. B., Rohan, S. K., Charriere, N. E., and Stevenson, D. E. 2024. Results of the 2023 eastern and northern Bering Sea continental shelf bottom trawl survey of groundfish and invertebrate fauna. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-487, 242 p.

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NOAA FISHERIES

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Abstract

In 2023, the Resource Assessment and Conservation Engineering (RACE) Division of the National Marine Fisheries Service's (NMFS) Alaska Fisheries Science Center (AFSC) conducted the Eastern Bering Sea (EBS) Crab/Groundfish Bottom Trawl Survey and Northern Bering Sea (NBS) Crab/Groundfish Bottom Trawl Survey. The survey covered the eastern Bering Sea continental shelf (bottom depths between 20 and 200 m) from the Alaska mainland coast to the U.S.-Russia Maritime Boundary between the Alaska Peninsula and the Bering Strait. Survey sampling was conducted using two chartered commercial stern trawlers, the 43.9-m FV *Alaska Knight* and 49.4-m FV *Northwest Explorer*, across 376 (of 376) stations in the eastern Bering Sea and 116 (of 144) stations in the northern Bering Sea. The 2023 mean bottom and surface temperatures in the eastern Bering Sea (2.3°C and 6.3°C) were near the time-series averages of 2.5°C and 6.8°C, respectively. The estimated total biomass in the eastern Bering Sea was 11.8 million metric tons (t) in 2023, a decrease from 14.5 million t in 2022 and less than the five-year average of 13.2 million t. The estimated total biomass in the northern Bering Sea was 2.8 million t in 2023, a decrease from 3.3 million t in 2022 and less than the time series average of 3.4 million t. A total of 128 species of fishes and 264 invertebrate taxa were identified on the eastern and northern Bering Sea surveys in 2023. This report compares the distribution and relative abundance of 37 fish species and two invertebrate taxa with side-by-side maps from the 2022 and 2023 eastern and northern Bering Sea shelf bottom trawl surveys. Changes in the abundance of some species between the 2022 and 2023 surveys may represent distributional shifts, as mobile species may be more abundant in the northern Bering Sea during recent warm years, but may have shifted farther south again as the seasonal sea ice cover during the winters of 2020-2021 and 2021-2023 became more extensive. This annual variation underscores the need to continue regular survey monitoring of eastern and northern Bering Sea fish and invertebrate populations, as well as their responses to a changing climate.

Contents

Introduction

In 2023, the Resource Assessment and Conservation Engineering (RACE) Division of National Marine Fisheries Service's (NMFS') Alaska Fisheries Science Center (AFSC) conducted the 41st Eastern Bering Sea (EBS) Crab/Groundfish Bottom Trawl Survey from May to August 2023 and 6th Northern Bering Sea (NBS) Crab/Groundfish Survey - Eastern Bering Sea Shelf Survey Extension from July to August 2023. The eastern and northern Bering Sea shelf bottom trawl surveys collect information about fish and invertebrate populations and environmental conditions to support fisheries stock assessment and management. The eastern Bering Sea survey has occurred annually (except in 2020 due to the COVID-19 pandemic) since 1982 and is the longest-running, standardized time series of fish and invertebrate data in the region (Conner and Lauth, 2017a). The standardized northern Bering Sea survey (Lauth, 2011) has only been conducted in 2010, 2017, 2019, 2021, and 2022. The full completion of the 2023 northern Bering Sea survey stations this year was not possible.

The data collected during the eastern and northern Bering Sea bottom trawl surveys are vital for managing fisheries resources and for ecosystem monitoring. Fishery-independent abundance estimates, in addition to other biological and oceanographic information from Bering Sea shelf bottom trawl surveys, are used by the AFSC, North Pacific Fishery Management Council (NPFMC), and the Alaska Department of Fish and Game (ADF&G). These organizations use the survey data products to manage groundfish and crab stocks and conduct ecosystem forecast modeling, which are requirements of the Bering Sea and Aleutian Island (BSAI) Fishery Management Plan (FMP) established under the Magnuson-Stevens Fishery Conservation and Management Act (https://www.fisheries.noaa.gov/topic/laws-policies).

Detailed information on bottom trawl survey results for commercial crab species stocks, including Tanner crab (*Chionoecetes bairdi*), snow crab (*Chionoecetes opilio*), red king crab (*Paralithodes camtschaticus*), blue king crab (*Paralithodes platypus*), and hair crab (*Erimacrus isenbeckii*), are discussed and analyzed separately in the AFSC Shellfish Assessment Program's annual data report (Zacher et al., 2023). Commercial crab stocks are managed by the ADF&G with federal oversight by NOAA Fisheries. The most recent modeling results on the status of these commercial crab stocks are reported in the annual Stock Assessment and Fishery Evaluation report prepared by the NPFMC (The Plan Team for the Groundfish Fisheries of the Bering Sea and Aleutian Islands).

This technical memorandum compares results from the 2023 survey with results from the prior year's surveys in the same regions (Markowitz et al., 2023). Specifically, the 2023 eastern Bering Sea survey results are compared with those from the 2022 eastern Bering Sea shelf bottom trawl survey and the 2023 northern Bering Sea survey results are compared with those from the 2022 northern Bering Sea shelf bottom trawl survey. Past survey data report technical memoranda can be found on the NOAA (https://repository.library.noaa.gov/) and AFSC websites (https://www.fisheries.noaa.gov/resource/publication-database/alaska-fisheries-science-center-technical-memorandums and https://www.fisheries.noaa.gov/alaska/science-data/groundfish-assessment-program-bottom-trawl-surveys).

History of Bering Sea Bottom Trawl Surveys

Federal government agencies have conducted bottom trawl surveys of the eastern Bering Sea continental shelf since the 1940s. These early surveys were often exploratory efforts to locate commercial fisheries resources (Zimmermann et al., 2009) and led to the development of a red king crab fishery. Bottom trawl

surveys by the United States continued into the 1970s with private industry involvement to study the biology, distribution, abundance, and best fishing practices for red king crab (Zimmermann et al., 2009). The first large-scale survey of the Bering Sea shelf was conducted in 1975 under contract from the U.S. Bureau of Land Management. The purpose was to collect baseline data for assessing the potential impact of the growth in the offshore oil industry on the development of Bering Sea groundfish and crab fishery resources (Pereyra et al., 1976). During the 1975 baseline survey, sampling was conducted over the shelf between the 20 meter (m) and 200 m isobaths from the Alaska Peninsula north to approximately 62°N.

In subsequent years, the areal coverage of the annual surveys was reduced. However, in 1979, a comprehensive survey of the Bering Sea shelf was undertaken in cooperation with the Japan Fisheries Agency (Bakkala and Wakabayashi, 1985). That survey encompassed the entire region sampled in the 1975 baseline study and included the upper continental slope waters between St. Matthew and St. Lawrence islands.

Following the 1979 survey, annual bottom trawl surveys have resampled the areas and stations established during the 1975 survey, with slight modifications in sampling design in some years. Beginning in 1979 and continuing triennially until 1991, the survey was extended to include the continental slope and area between St. Matthew and St. Lawrence islands. After a hiatus from 1992 to 1999 due to lack of funding, the Bering Sea slope survey was resumed in 2002 as an independent, standardized bottom trawl survey series that has been conducted on a quasi-biennial basis dependent on funding (Stauffer, 2004; Hoff and Britt, 2011; Hoff, 2016). The most recent slope survey was conducted in 2016 (Hoff, 2016).

The current eastern Bering Sea shelf survey design has been used since 1982. In 1982, the bottom trawl survey gear (Stauffer, 2004), methods, and temporal stationarity were standardized and the survey has used a systematic grid design that includes 376 stations arranged on a regularly-spaced 37.04 × 37.04 km (20 × 20 nautical mile) sampling grid (Figs. **1** and **2**; Bakkala et al., 1985) and 26 stations located at the intersection points of 4 stations or “corner stations”. Corner station locations are grouped near the Pribilof Islands and St. Matthew Island and aim to better sample blue king crab populations. Beginning in 1987, 20 new stations that comprise Strata 82 and 90 (Fig. **1**) were added to monitor more northerly distributions of snow crab and walleye pollock. Annual sampling has continued since 1982 because the region encompasses major portions of the commercially exploited Bering Sea groundfish and crab populations that require management actions under the BSAI FMP.

The northern Bering Sea survey was initiated by the AFSC as part of the Loss of Sea Ice (LOSI) Research Plan, to monitor long-term climate trends in the transition zone between the temperate waters of the eastern Bering Sea and the Arctic waters of the Chukchi Sea, where climate change can have a significant effect on physical and biological ecosystem processes (Hollowed et al., 2007; Hunt et al., 2011; Stabeno, Kachel, et al., 2012; Stevenson and Lauth, 2012, 2019). Although LOSI funding for the northern Bering Sea extension was discontinued after the 2010 northern Bering Sea survey, the survey resumed as a biennial survey in 2017 to monitor the effects of changing ocean conditions on fish and crab distributions (Sigler et al., 2015). The northern Bering Sea survey consists of 144 bottom trawl stations extending the eastern Bering Sea survey grid northward to the Bering Strait and the U.S.-Russia Maritime Boundary; the region also includes all of Norton Sound and the Chirikov Basin (Fig. **2**). In addition to the eastern Bering Sea shelf, the northern Bering Sea shelf was also surveyed in 2010, 2017, 2019, 2021, 2022, and 2023 (Lauth, 2011; Lauth et al., 2019; Markowitz, Dawson, Charriere, Prohaska, Rohan, Haehn, et al., 2022; Markowitz, Dawson, Charriere, Prohaska, Rohan, Stevenson, et al., 2022a, 2022b). In 2018, a rapid response survey was conducted in the northern Bering Sea using a different sampling design than the standard northern Bering Sea survey. Therefore, the survey results from the 2018 northern Bering Sea rapid response survey

are not directly comparable to the results from the 2010, 2017, 2019, 2021, 2022, and 2023 northern Bering Sea surveys. In 2020, no Bering Sea bottom trawl surveys were conducted due to the COVID-19 pandemic.

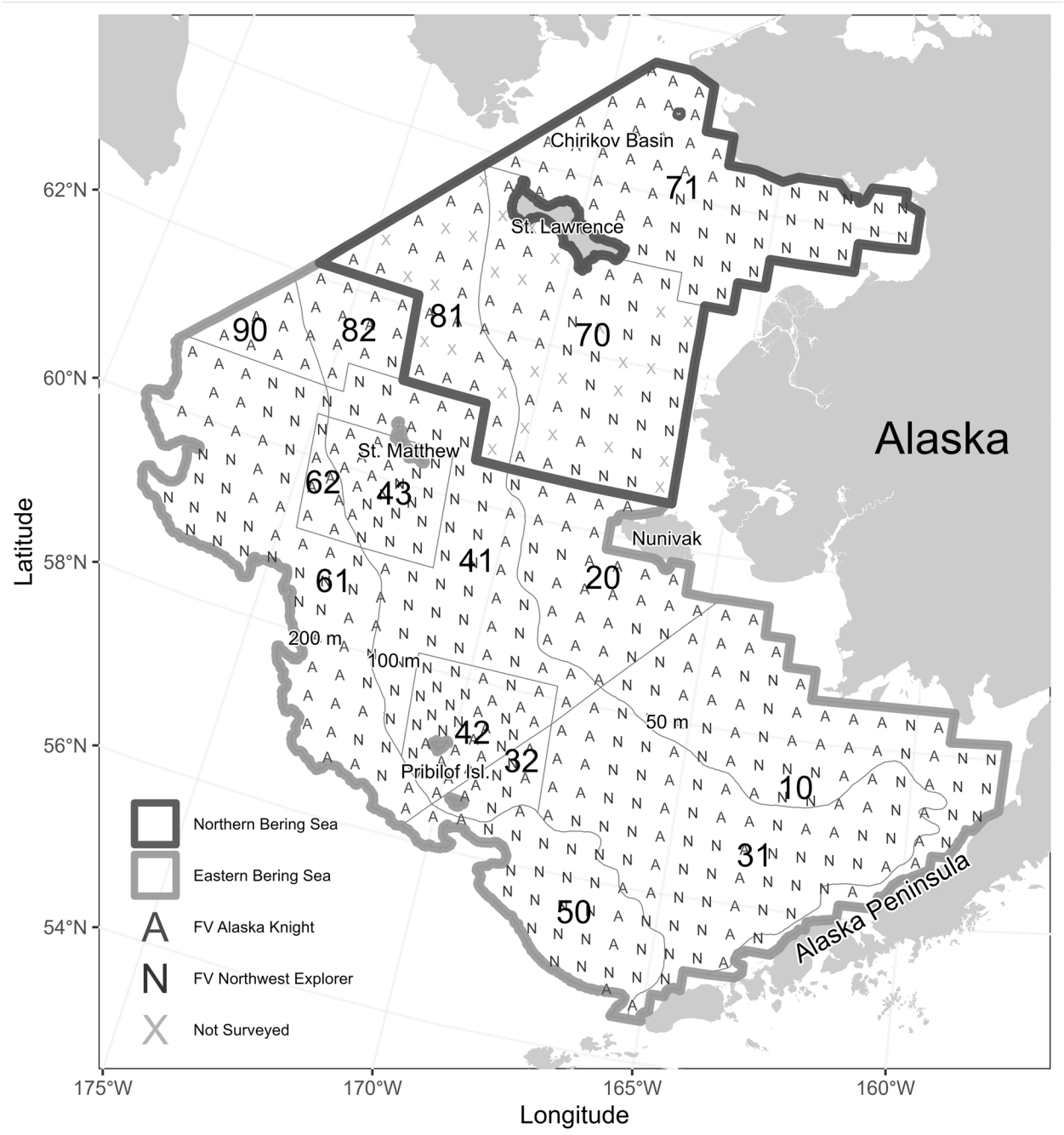

Figure 1. -- Stratification scheme used for data analysis of the 2023 eastern Bering Sea and northern Bering Sea shelf bottom trawl surveys. The map also depicts the stations sampled by the FV *Alaska Knight* (A), FV *Northwest Explorer* (N), and stations that were not surveyed (X).

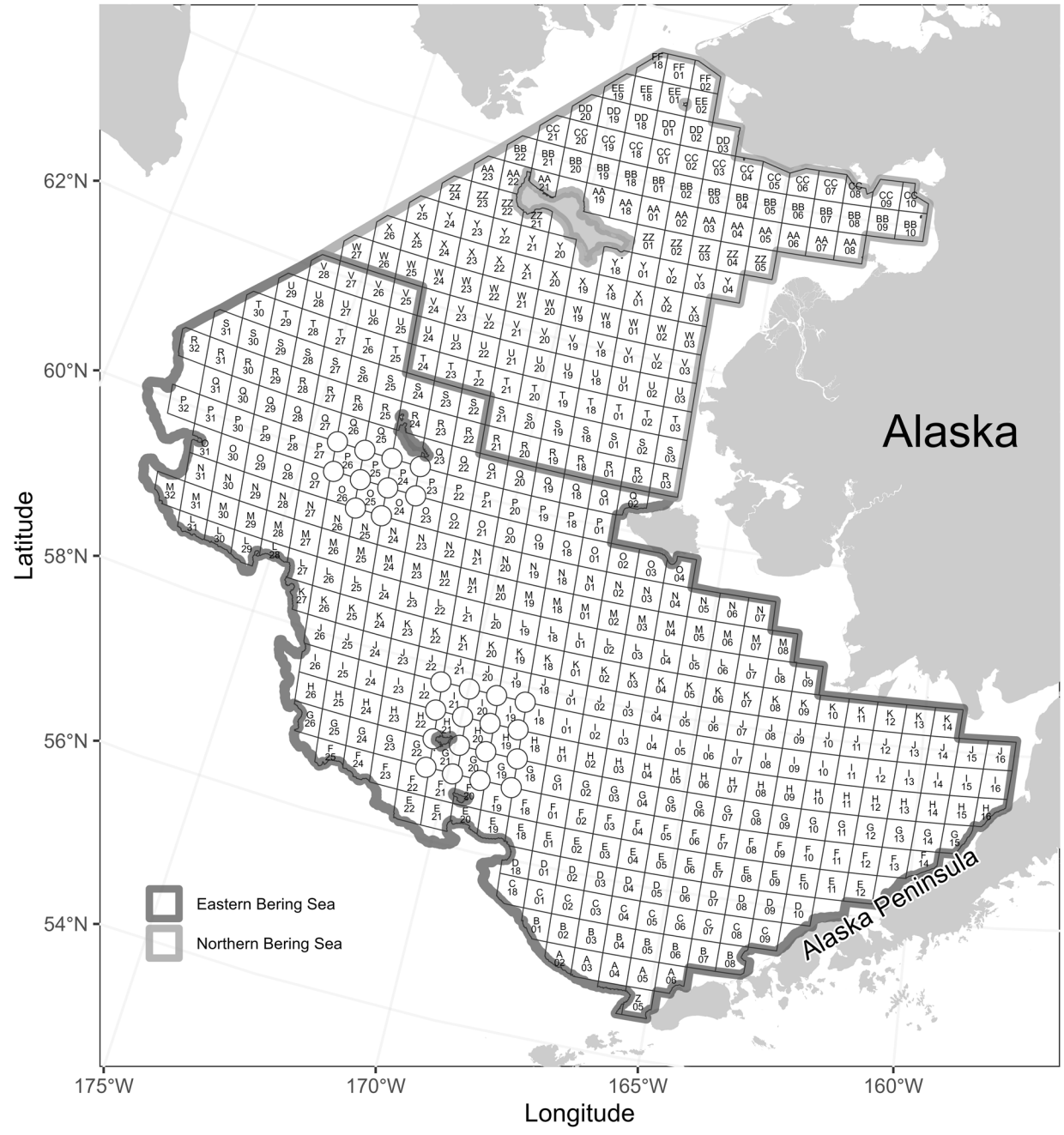

Figure 2. -- Sampling grid and station identifiers for the 2023 eastern Bering Sea and northern Bering Sea continental shelf bottom trawl surveys. Corner stations (denoted by circles) are not labeled for legibility.

Methods

Survey Area and Sampling Design

The standardized eastern and northern Bering Sea bottom trawl surveys use a systematic design with 376 fixed sampling stations in the eastern Bering Sea and 144 fixed sampling stations in the northern Bering Sea arranged on a regularly spaced 37.04 × 37.04 km grid (20 × 20 nautical mile; Fig. **2**). Of these 376 stations, 26 of these are corner stations to better sample regions of historically high blue king crab abundances. Corner stations are located at the intersections of the grid lines in the waters surrounding St. Matthew and the Pribilof Islands (Fig. **2**). Pribilof island corner stations were added in 1982 and corner stations around St. Matthew's were added in 1983. These corner stations are sampled in addition to the grid cells. The 2023 northern Bering Sea shelf bottom trawl survey was conducted using the same systematic sampling design for stations bounded by the U.S.-Russian Maritime Boundary and the Bering Strait, including Norton Sound.

Survey Vessels and Sampling Gear

The 2023 eastern and northern Bering Sea surveys were conducted aboard the chartered commercial stern-trawlers FV *Alaska Knight* and FV *Northwest Explorer* (Fig. **3**). Both vessels are house-forward trawlers with stern ramps. The overall length of the FV *Alaska Knight* is 43.9 m (144 ft) and the FV *Northwest Explorer* is 49.4 m (162 ft). All fishing operations were conducted in compliance with national and regional protocols detailed in Stauffer (2004). Trawl sampling was conducted using 83-112 eastern otter trawls, each with a 25.3 m (83 ft) headrope and 34.1 m (112 ft) footrope (Fig. **4**). The net was attached to tail chains with 54.9 m (180 ft or 30 fm) paired dandylines. Each lower dandyline had a 0.61 m (2 ft) chain extension connected to the lower wing edge to improve bottom tending. Steel "V" doors measuring 1.8 × 2.7 m (6 × 9 ft) and weighing 816 kg (1,800 lbs) each were used for spreading the net opening while the trawl was fishing on the seafloor.

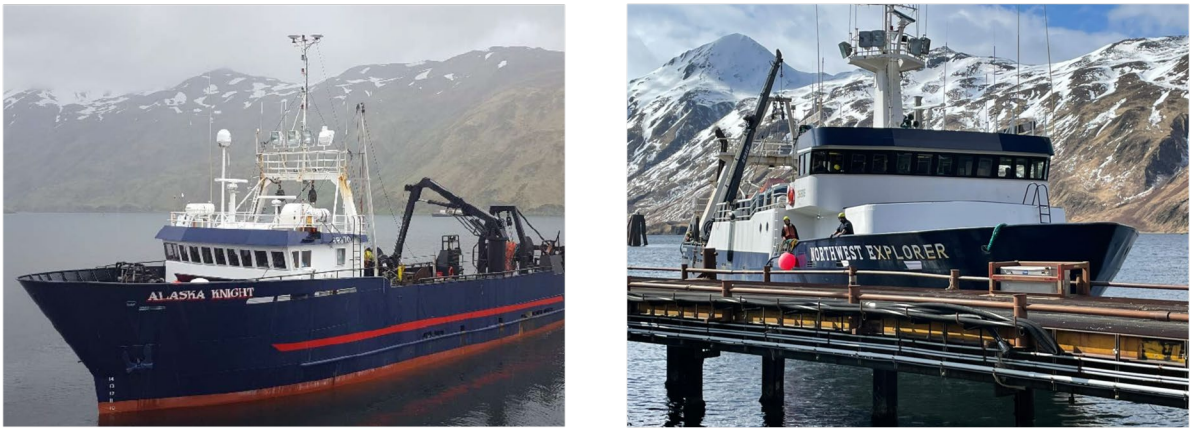

Figure 3. -- Fishing vessels FV *Alaska Knight* (left) and FV *Northwest Explorer* (right) contracted to conduct the 2023 eastern and northern Bering Sea bottom trawl survey.

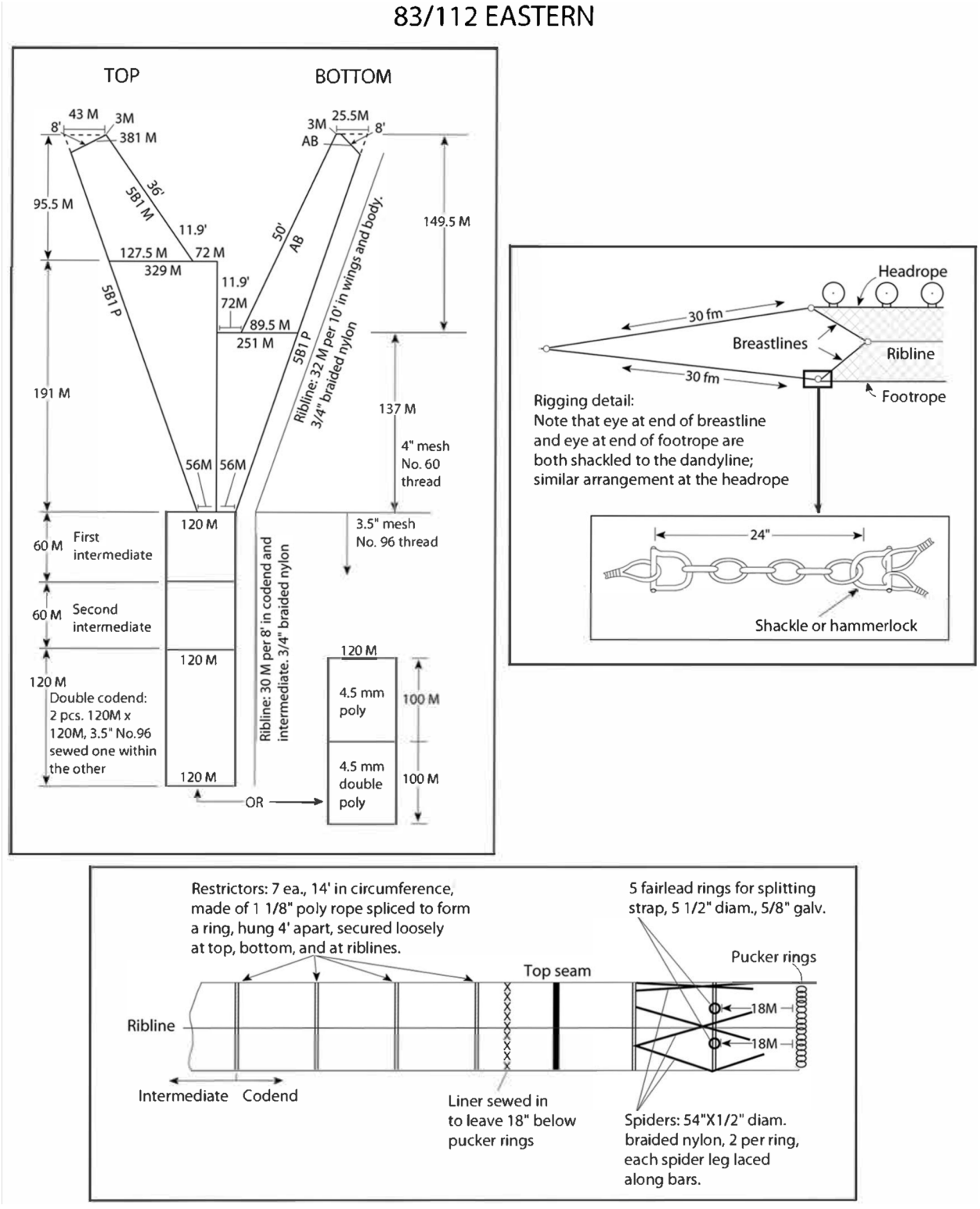

Figure 4. -- Schematic diagram of the 83-112 eastern otter trawl gear used during the 2023 eastern and northern Bering Sea bottom trawl surveys.

The Marport Deep Sea Technologies Inc. net mensuration system was used during each tow to record net spread and net height. Net spread was measured as the horizontal distance between two sensors attached at wing tips immediately forward of the junction of the upper breastline and the dandyline. Net height was measured from the headrope to the seafloor. Mean net spread values for estimating area swept per tow were calculated according to methods described by Lauth and Kotwicki (2014). A customized Onset HOBO Pendant G Data Logger (accelerometer) in custom-made housing was attached to the center of the footrope and used as a bottom contact sensor to determine tow duration based on footrope contact with the seafloor.

Temperature and depth profiles were recorded using a Sea-Bird SBE-39 temperature-depth recorder (Sea-Bird Electronics Inc., Bellevue, WA) attached to the headrope of the trawl. Observations were made at 3-second intervals at each station. Average bottom depth was calculated by adding the average net height to the average depth of the headrope while the net was in contact with the seafloor.

In the eastern Bering Sea, the net mensuration system failed to record either height or spread data for 49 tows on the FV *Alaska Knight* and 54 tows on the FV *Northwest Explorer*. In the northern Bering Sea, the net mensuration system failed to record either height or spread data for zero tows on the FV *Alaska Knight* and one tow on the FV *Northwest Explorer*. To estimate missing net width values, the *mgcv* R package (Wood, 2004) was used to relate mean net width with the inverse scope (m) and mean net height (m) from valid tows following the relationship investigated by Rose and Walters (1990), where w is the net width (m), h is the net height (m), s is the scope, and ϵ represents the modeled error

$$w \sim s^{-1} + h + \frac{h}{s} + \epsilon$$

$$\epsilon \sim N(0, \sigma^2).$$

Eastern Bering Sea Sampling Logistics and Stratification Scheme

At the beginning of the survey, scientists boarded the chartered vessels in Dutch Harbor, Alaska, and transited to eastern Bristol Bay to begin sampling. From Bristol Bay, the survey proceeded westward completing north-south columns of grid cells to the shelf edge (Fig. **1**). The east-to-west survey progression is based on an understanding of historical trends in fish movement and intended to ensure the survey moves in the opposite direction of the seasonal on-shelf (eastward) migration patterns typical of yellowfin sole and other species. This strategy reduces the likelihood of encountering a portion of these populations multiple times (Smith and Bakkala, 1982; Nichol et al., 2019). In the eastern Bering Sea, both vessels started sampling on May 28, 2023. Sampling ended on July 25, 2023 for the FV *Northwest Explorer* and on August 3, 2023 for the FV *Alaska Knight*.

The survey footprint included bathymetry between 20 m and 200 m. For design-based index catch analysis, this footprint was separated into 12 strata by the 50 m and 100 m isobaths and a biogeographic boundary line running from the southwest to the northeast (Fig. **1**; Halliday and Sassano, 1988). The stratum boundaries correspond with different oceanographic domains and biological communities (Coachman, 1986). This stratification scheme reflects some differences observed in Bering Sea groundfish distributions across the oceanographic domains, while the overall intention of the design was to reduce the variances of population and biomass estimates (Bakkala, 1993). The purpose of high-density sampling in strata 32, 42, 43, and 62 is to increase sampling resolution and thereby reduce variance estimates for blue king crab (Stevens and MacIntosh, 1990). Overall sampling density across the eastern Bering Sea shelf was one

station per 1,311 km^2, and within-stratum sampling density ranged from one station per 778 km^2 (Stratum 42) to one per 1,496 km^2 (Stratum 82; Table **1**). For some analyses (e.g., abundance-at-length), each high-density stratum was combined with its respective depth-region stratum, resulting in eight subareas: 10, 20, 30 (31+32), 40 (41+42+43), 50, 60 (61+62), 82, and 90 (Fig. **1**; Table **1**).

Northern Bering Sea Sampling Logistics and Stratification Scheme

After the completion of the eastern Bering Sea shelf survey, both vessels began sampling survey stations in the northern Bering Sea survey region. In the northern Bering Sea, the FV *Northwest Explorer* started sampling on July 29, 2023, and ended on August 18, 2023 and the FV *Alaska Knight* started sampling on August 3, 2023, and ended on August 20, 2023. After the northern Bering Sea survey was completed, both vessels returned to Dutch Harbor. The northern Bering Sea shelf is divided into three strata: one including the area north of St. Lawrence Island and Norton Sound, and two others south of St. Lawrence Island separated by the 50 m isobath (Fig. **1**). Sampling density was 1,981 km^2/station for stratum 70, 1,401 km^2/station for stratum 71, and 2,131 km^2/station for stratum 81. Overall sampling density for the northern Bering Sea survey area was 1,714 km^2/station (Table **1**).

Table 1. -- Stratum areas and sampling densities used during the 2023 eastern and northern Bering Sea bottom trawl surveys. Stratum area calculations were updated in 2022.

Stratum		Representative area (km^2)	Stations in stratum	Stations successfully sampled	Sampling density (km^2/stations successfully sampled)
Eastern Bering Sea					
Inner Shelf	10	78,706	58	58	1,357
	20	41,193	31	31	1,329
Middle Shelf	31	94,978	69	69	1,376
	32	8,847	8	8	1,106
	41	62,310	44	44	1,416
	42	24,122	31	31	778
	43	21,064	22	22	957
	82	17,954	12	12	1,496
Outer Shelf	50	38,039	26	26	1,463
	61	87,777	60	60	1,463
	62	6,462	7	7	923
	90	11,539	8	8	1,442
Total		492,990	376	376	1,311
Northern Bering Sea					
Inner Shelf	70	79,260	58	40	1,981
	71	81,255	58	58	1,401
Middle Shelf	81	38,352	28	18	2,131
Total		198,867	144	116	1,714
Eastern and northern Bering Sea combined					
Total		691,857	520	492	1,406

Catch Sampling Procedures

Standard catch sampling procedures used in these Bering Sea bottom trawl surveys are described in detail by Wakabayashi et al. (1985) and Stauffer (2004). In summary, samples were collected by trawling near the center of each grid square (or intersection of grid lines, in the case of corner stations) for a target fishing time of 30 minutes at a speed of 1.54 m/sec (3 knots). If the center of grid cell was not considered trawlable due to obstructions visible on the depth sounder or known history of obstructions, the nearest trawlable site within the same grid square was used. Hauls that resulted in significant gear damage, contained debris (e.g., derelict crab pots), or had visible changes in net mensuration data during the haul were redeployed to obtain a successful sample.

Catches estimated to be less than approximately 1,000 kg (2,205 lbs) were fully sorted and enumerated, while larger catches were weighed in aggregate or volumetrically measured and subsampled before sorting. The goal of subsampling was to obtain a representative sample, which required some variation in catch processing methods among hauls. Specific methods used for subsampling were dependent on the overall size and species composition of the catches. After sorting subsampled catches, individual species were weighed and counted in aggregate. Weights and numbers were then expanded proportionally to the total catch. Fish and invertebrate species were sorted and identified to the lowest reliable taxonomic level.

All commercial crab species were sorted from the entire catch and weighed. Other select species including Pacific halibut (*Hippoglossus stenolepis*), Greenland turbot (*Reinhardtius hippoglossoides*), large skates, rockfish (*Sebastes* spp.), Atka mackerel (*Pleurogrammus monopterygius*), prowfish (*Zaprora silenus*), Bering wolffish (*Anarhichas orientalis*), Pacific cod (*Gadus macrocephalus*), some sculpins, sharks, and any other large, rare species that are not represented in the subsample were completely sorted from the catch in most cases.

Sub-sampling for length measurements was dependent on the size range of that fish species in the haul, up to a maximum target of 100 specimens. For each fish in a length subsample, sex was determined and then the fork length or total length (depending on the species) was measured to the nearest 1.0 cm. Unless retained for biological sampling by the International Pacific Halibut Commission (IPHC), Pacific halibut were measured to fork length upon capture, then immediately returned to the sea in an effort to reduce mortality. The weights of all Pacific halibut were estimated using an IPHC length-weight regression (Webster and Stewart, 2023).

Sagittal otoliths were collected from 10 fish species in the eastern Bering Sea and northern Bering Sea (Table **2**). Otolith samples were collected following random-by-haul sampling methods in both the eastern Bering Sea and northern Bering Sea. Otoliths were preserved in a glycerol-thymol solution and then later shipped to the Age and Growth Program of the AFSC's Resource Ecology and Fisheries Management (REFM) Division for age determination. Weight and length were collected for each fish from which age structures were taken. For walleye pollock, age structure sampling effort was further divided into low-density and high-density regions based on historical population densities and an isobath of approximately 70 m.

Stomachs were collected from six fish species and preserved in 10% formalin for later laboratory diet analysis (Table **3**). Arrowtooth flounder and Kamchatka flounder (*Atheresthes* spp.) stomachs were collected as one genus because they occupy a similar trophic niche in the Bering Sea (Yang and Livingston, 1986).

Table 2. -- Otolith collection types and counts during the 2023 eastern Bering Sea and northern Bering Sea shelf bottom trawl surveys.

Common name	Target collection number per haul
Eastern Bering Sea	
random-by-haul	
Pacific cod	4 adults and 1 juvenile; collect when ≥4 individuals caught in each haul
Alaska plaice	2 individuals
Greenland turbot	8 adults and 1 juvenile
Kamchatka flounder	8 individuals; collect when ≥10 individuals caught in each haul
Pacific halibut	100% of individuals caught during Leg 1 on the *FV Northwest Explorer* and Leg 3 on the *FV Alaska Knight*
Walleye pollock	3 adults and 1 juvenile in low-density area, and 5 adults and 1 juvenile in high-density area; collect when ≥20 individuals caught in each haul
Arrowtooth flounder	3 individuals; collect when ≥10 individuals caught in each haul
Flathead sole	3 individuals; collect when ≥10 individuals caught in each haul
Yellowfin sole	3 individuals; collect when ≥10 individuals caught in each haul
Northern rock sole	4 individuals; collect when ≥10 individuals caught in each haul
Northern Bering Sea	
random-by-haul	
Pacific cod	4 adults and 1 juvenile; collect when ≥4 individuals caught in each haul
Alaska plaice	2 individuals
Greenland turbot	3 individuals; collect when ≥10 individuals caught in each haul
Kamchatka flounder	3 individuals; collect when ≥10 individuals caught in each haul
Pacific halibut	100% of individuals caught on the FV *Alaska Knight*
Walleye pollock	3 adults and 1 juvenile; collect when ≥20 individuals caught in each haul
Arrowtooth flounder	3 individuals; collect when ≥10 individuals caught in each haul
Flathead sole	3 individuals; collect when ≥10 individuals caught in each haul
Yellowfin sole	3 individuals; collect when ≥10 individuals caught in each haul
Northern rock sole	3 individuals; collect when ≥10 individuals caught in each haul

Table 3. -- Stomach collection target size category bins (cm) used to collect each study fish during the 2023 eastern Bering Sea and northern Bering Sea shelf bottom trawl survey.

	Target collection size categories per haul	
	Eastern Bering Sea	**Northern Bering Sea**
Flathead sole	1-19; 20-29; 30+ cm	1-19; 20-29; 30+ cm
Alaska plaice	1-19; 20-39; 40+ cm	1-19; 20-39; 40+ cm
Walleye pollock	1-24; 25-39; 40-54; 55+ cm	1-24; 25-39; 40-54; 55+ cm
Arrowtooth flounder and Kamchatka flounder	1-29; 30-49; 50+ cm	1-29; 30-49; 50+ cm
Pacific cod	1-29; 30-59; 60+ cm	1-29; 30-59; 60+ cm
Pacific halibut	1-49; 50-69; 70+ cm	-

Catch Data Analysis

Estimates of biomass, population, and size structure of fishes and invertebrate species were calculated from eastern and northern Bering Sea survey data. The standard sampling procedures used are described in detail by Wakabayashi et al. (1985) and Stauffer (2004). Some species were grouped by family for catch data analysis because of an inability to identify to lower taxonomic level while in the field.

Mean catch per unit effort (CPUE) for each species was calculated in kilograms per square kilometer (kg/km^2) and number of fish per square kilometer (no/km^2) for each stratum (Alverson and Pereyra, 1969; Lauth and Kotwicki, 2014). Area swept (km^2) was computed as the linear distance towed, multiplied by the mean net width (m; Alverson and Pereyra, 1969; Lauth and Kotwicki, 2014). Mean CPUE was calculated for individual strata and summed proportionally for the overall survey area. Design-based biomass (t) and population (count) estimates were calculated for each stratum by multiplying the stratum mean CPUE by the stratum area. Stratum estimates were then summed for total survey area estimates in the eastern and northern Bering Sea.

For size composition estimates, the proportion of fish at each centimeter length interval (from subsamples at each station), weighted by CPUE (no/km^2), was expanded to the stratum population. Stratum abundance-at-length estimates were summed for the total estimated size composition for the overall survey area in the eastern and northern Bering Sea.

Age estimates were obtained from otolith samples by the AFSC's Age and Growth Program for all fish except for Pacific halibut, whose otoliths are processed by the IPHC. The most current information about age, growth, and population analyses are presented in the 2023 NPFMC Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Region (https://www.fisheries.noaa.gov/alaska/population-assessments/north-pacific-groundfish-stock-assessments-and-fishery-evaluation).

Non-Core Scientific Collections and Research Projects

In addition to standard survey operations, 26 non-core scientific collections and research projects were conducted in eastern and northern Bering Sea, 10 projects were conducted in the eastern Bering Sea, and three projects were conducted in the northern Bering Sea during the 2023 survey season (Table **4**). A request for research proposals was issued on January 27, 2023. Project requests were prioritized and modified based on their potential support of AFSC Strategic Science Plans and mission and the feasibility of proposed projects given available survey resources and time. Some of the approved projects were new for 2023, while many continued multi-year observations of supplementary data. Data for these projects were collected at sea and disseminated to the requesting principal investigator(s). To acquire the details about a project or collection, please contact the principal investigator(s) identified in Table **4**.

Table 4. -- Non-core scientific collections and research projects undertaken during the 2023 eastern Bering Sea and northern Bering Sea shelf bottom trawl survey, sorted by principal investigator and agency.

Project title	Principal investigator	Agency[1]
Eastern and northern Bering Sea		
Population genetics and age structure sampling of Pacific sleeper and salmon sharks	Cindy Tribuzio	AFSC-ABL
Collection of frozen yellowfin sole for FMA observer program training	Adriana Myers	AFSC-FMA
Acoustic data collection to augment the MACE acoustic-trawl survey time series of walleye pollock abundance	MACE	AFSC-MACE
Fat-meter fish condition index for pollock and cod	Bianca Prohaska	AFSC-RACE
Juvenile yellowfin sole collection	Cynthia Yeung	AFSC-RACE
Bitter crab disease monitoring in snow crab	Erin Fedewa	AFSC-RACE
Bitter crab disease snow crab live collection	Erin Fedewa	AFSC-RACE
Snow crab condition	Erin Fedewa	AFSC-RACE
Impacts of temperature and dietary lipid on the survival, growth, and lipid condition in juvenile snow crab	Louise Copeman	AFSC-RACE
Morphological and genetic identification of larval Pacific and Arctic sand lances	Melanie Paquin	AFSC-RACE
Shrimp condition and lipid biomarkers as a metric of ecosystem variability and groundfish prey resources in the Bering Sea	Michelle Stowell	AFSC-RACE
Light meter calibration	Ned Laman	AFSC-RACE
Specimen collection for outreach events	Nicole Charriere	AFSC-RACE
Fish collections for FMA training	Sarah Friedman	AFSC-RACE
Conductivity, temperature, and depth (CTD) device data collection	Sean Rohan	AFSC-RACE
Dissolved oxygen and pH data collection	Sean Rohan	AFSC-RACE
Pacific cod tagging in the Bering Sea and Gulf of Alaska	Susanne McDermott	AFSC-RACE
Live crab and brittle star collections for ocean acidification experiments	William Long	AFSC-RACE
Arctic and saffron cod growth studies	Esther Goldstein	AFSC-REFM
Flatfish collections for genomic analysis of Alaskan flatfish	Ingrid Spies	AFSC-REFM
Harmful algal bloom toxins in Alaskan food webs	Gay Sheffield	ASG
Live snow crab collection in support of black eye syndrome characterization	Reyn Yoshioka	BLOS
Snow crab eyestalk and lipid sampling in support of black eye syndrome characterization	Reyn Yoshioka	BLOS
IPHC participation on surveys	Kayla Ualesi	IPHC
Ichthyology voucher collection	Abi Wells	NWFSC & UW Ichth. Collection
Marine ecology of Arctic and Pacific lampreys	Trent Sutton	UAF
Eastern Bering Sea		
ADFG crab observer training collections	Jared Weems	ADF&G
Tracking movement of legal tanner crab using acoustic tags and an autonomous underwater vehicle glider relative to the 166°W stock management boundary	Jared Weems	ADF&G
Characterization of isotopic niche space of two co-occurring species, Pacific cod and walleye pollock	Matthew Rogers	AFSC-ABL
Observer training crab collection	Adriana Myers	AFSC-FMA

Project title	Principal investigator	Agency[1]
Blood collection for stress physiology	Bianca Prohaska	AFSC-RACE
Shell condition classification error rates in snow crab	Jonathan Richar	AFSC-RACE
Tagging mature male and female Bristol Bay red king crab	Leah Zacher	AFSC-RACE
Eastern Bering Sea slope test tows	Lukas DeFilippo	AFSC-RACE
Survey gear redesign test tows	Lukas DeFilippo	AFSC-RACE
Palatability and occurrence of juvenile Prowfish in the Bering Sea and Gulf of Alaska	Melanie Paquin	AFSC-RACE
Northern Bering Sea		
Norton Sound red king crab collections for functional maturity study	Leah Zacher	AFSC-RACE
Gastropod and chiton collection	Roger Clark	SBMNH & LACMNH
Fish collection for foraging habits of beluga	Mi-Ling Li	UD

[1]ADF&G - Alaska Department of Fish & Game; AFSC-FMA - Alaska Fisheries Science Center's Fisheries Monitoring & Assessment Division; IPHC - International Pacific Halibut Commission; NWFSC - Northwest Fisheries Science Center; AFSC-RACE - Alaska Fisheries Science Center's Resource Assessment & Conservation Engineering Division; AFSC-REFM - Alaska Fisheries Science Center's Resource Ecology & Fisheries Management Division; UAF - University of Alaska Fairbanks; AFSC-ABL - Alaska Fisheries Science Center's Auke Bay Laboratories; ASG - Alaska Sea Grant; SBMNH - Santa Barbara Museum of Natural History; BLOS - Bigelow Laboratory for Ocean Sciences; UW Ichth. Collection - University of Washington Ichthyology Collection; UD - University of Delaware; LACMNH - Natural History Museum of Los Angeles County; AFSC-MACE - Alaska Fisheries Science Center's Midwater Assessment & Conservation Engineering Division

Results and Discussion

A total of 376 (of 376) stations in the eastern Bering Sea and 116 (of 144) stations in the northern Bering Sea were successfully sampled in 2023 (Fig. **1**).

Ocean Temperatures and the Cold Pool

Bottom (Figs. **5** and **6**) and surface (Figs. **7** and **8**) water temperatures varied spatially and among years due to variation in atmospheric and oceanic conditions that influence temperature patterns in the eastern Bering Sea (Stabeno, Farley, et al., 2012). The warmest bottom temperatures were typically observed in the inner domain (<50 m) along the Alaska mainland where the water column is fully mixed during summer, which allows solar heat transfer throughout the water column (Coachman, 1986). The coldest bottom temperatures typically occurred in the middle domain (50–100 m) where strong two-layer stratification during the summer inhibits heat transfer to the bottom layer, which allows a seasonal 'cold pool' to persist from spring though the end of fall. In the eastern Bering Sea, surface temperatures generally increased from the interior of Bristol Bay to the northwestern outer shelf and into Norton Sound. These surface temperature patterns reflect seasonal warming that occurs as the survey progresses from Bristol Bay, to the outer shelf, and into Norton Sound over the duration of the survey (Cokelet, 2016; Rohan et al., 2022).

The mean eastern Bering Sea shelf bottom temperature was 2.3°C in 2023, which was 0.3°C colder than in 2022 and was near the 2.5°C time-series average from 1982 to 2023 (Fig. **9**). The near-average bottom temperatures observed during the 2022 and 2023 surveys represent a departure from recent years (2016–2021), which included four of the five warmest years in the 41-year time series. Over the 41-year time series (1982–2023) of the eastern Bering Sea shelf bottom trawl survey, annual mean summer bottom temperatures have ranged from 0.7°C to 4.4°C and surface temperatures have ranged from 3.9°C to 9.5°C. The 2023 mean eastern Bering Sea shelf surface temperature (6.3°C) was colder than the times-series average surface temperature (6.8°C) and the mean surface temperature in 2022 (7.5°C).

In the northern Bering Sea, mean bottom temperatures have ranged from 1.9°C to 5.6°C and surface temperatures have ranged from 8.1°C to 10.8°C over the six years of the survey (2010, 2017, 2019, 2021, 2022, and 2023). The mean northern Bering Sea bottom temperature in 2023 was 3.7°C, which was 0.2°C colder than 2022 (Fig. **9**). The mean northern Bering Sea surface temperature was 9.1°C, which was 1°C warmer than the mean surface temperature in 2022 (8.1°C).

The cold pool area is defined as the extent (km^2) of the eastern Bering Sea bottom trawl survey area with bottom temperatures less than or equal to 2°C (Rohan et al., 2022). The size and location of the cold pool is primarily influenced by the extent of seasonal sea ice cover during the preceding winter and spring and the timing of sea ice retreat during spring (Stabeno and Bell, 2019). The cold pool is primarily found in the middle domain (50–100 m), which is fully mixed during the winter and has two-layer stratification during the summer. Years with extensive sea ice that persists into spring have a larger cold pool that can extend into Bristol Bay and as far south as the Alaska Peninsula. Years with smaller sea ice extent result in smaller cold pools that are limited to the northern edge of the eastern Bering Sea shelf survey area. The cold pool area is strongly correlated ($r^2 = 0.94$) with mean bottom temperature on the eastern Bering Sea shelf.

The cold pool covered 36.4% (179,550 km^2) of the eastern Bering Sea shelf survey area in 2023, including nearly the entire middle domain north of 57.5°N (Fig. **10**). The cold pool was nearly identical in area to the cold pool of 2022 (36.2%; 178,625 km^2; Fig. **9**). The area of the cold pool was similar to the area of other near-average years (i.e., 2011, 2017, 2022) and was near the time series mean (36.6%; 180,982 km^2; Fig. **5**). During the 41-year time series, the cold pool area has ranged from a minimum of 6,150 km^2 in 2018 to a maximum of 385,975 km^2 in 1999, respectively comprising 1.2% to 78.2% of the total eastern Bering Sea shelf survey area. Notably, 2023 was the first year since 2015 that bottom temperatures ≤ 1°C were observed south of St. Matthew Island (Fig. **5**).

Interannual variation in bottom temperature and cold pool area influences the distribution (Kotwicki and Lauth, 2013; Stevenson et al., 2022; Stevenson and Lauth, 2019; Thorson et al., 2020), migration (Nichol et al., 2019), recruitment (Cooper et al., 2020), and biological productivity (Grüss et al., 2021) of fishes and crabs in the Bering Sea. The size of the cold pool influences the availability of demersal species to bottom-trawl surveys by mediating migration between the eastern Bering Sea shelf, northern Bering Sea, western Bering Sea, and the deeper waters of the continental slope (Zador et al., 2011; O'Leary et al., 2022). Subarctic fish species tend to avoid areas with bottom temperatures below 0°C or 1°C, depending on the species (Eisner et al., 2020; Baker, 2021). Meanwhile, colder temperatures may also provide a habitat refuge for cold-adapted species (Fedewa et al., 2020). Similar to 2017, it is unlikely that the cold pool posed a major temperature barrier to the northward migration of mobile subarctic species from the eastern Bering Sea shelf to the northern Bering Sea, such as walleye pollock and Pacific cod. Mean temperatures and the size of the cold pool in 2023 were near the time series average for the eastern Bering Sea. Previous average years, such as 2017, were associated with a northward distribution shift of mobile subarctic species, including Pacific cod and walleye pollock, into the northern Bering Sea, presumably by reducing thermal barriers to migration (Stevenson and Lauth, 2019). Therefore, the average conditions in 2023 may have alleviated thermal barriers, therbeby allowing a northward distribution shift of subarctic species into the northern Bering Sea.

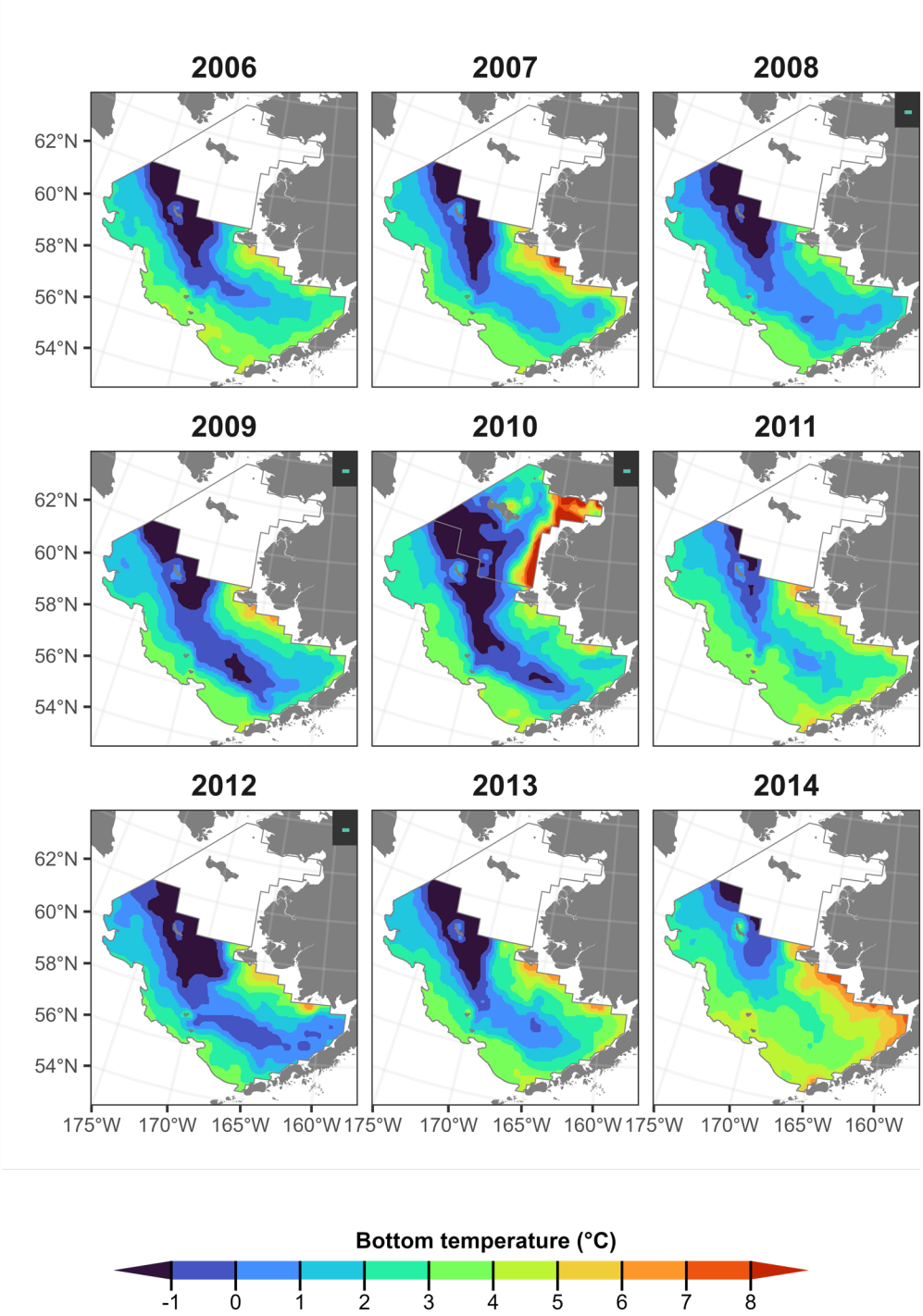

Figure 5. -- Bottom temperatures (°C) during the 2006-2014 eastern and northern Bering Sea shelf bottom trawl surveys. Years in which the mean bottom temperature is 1 or more standard deviations above or below the time-series mean bottom temperature are denoted with '+' and '-' in the upper right-hand corner of each subplot, respectively.

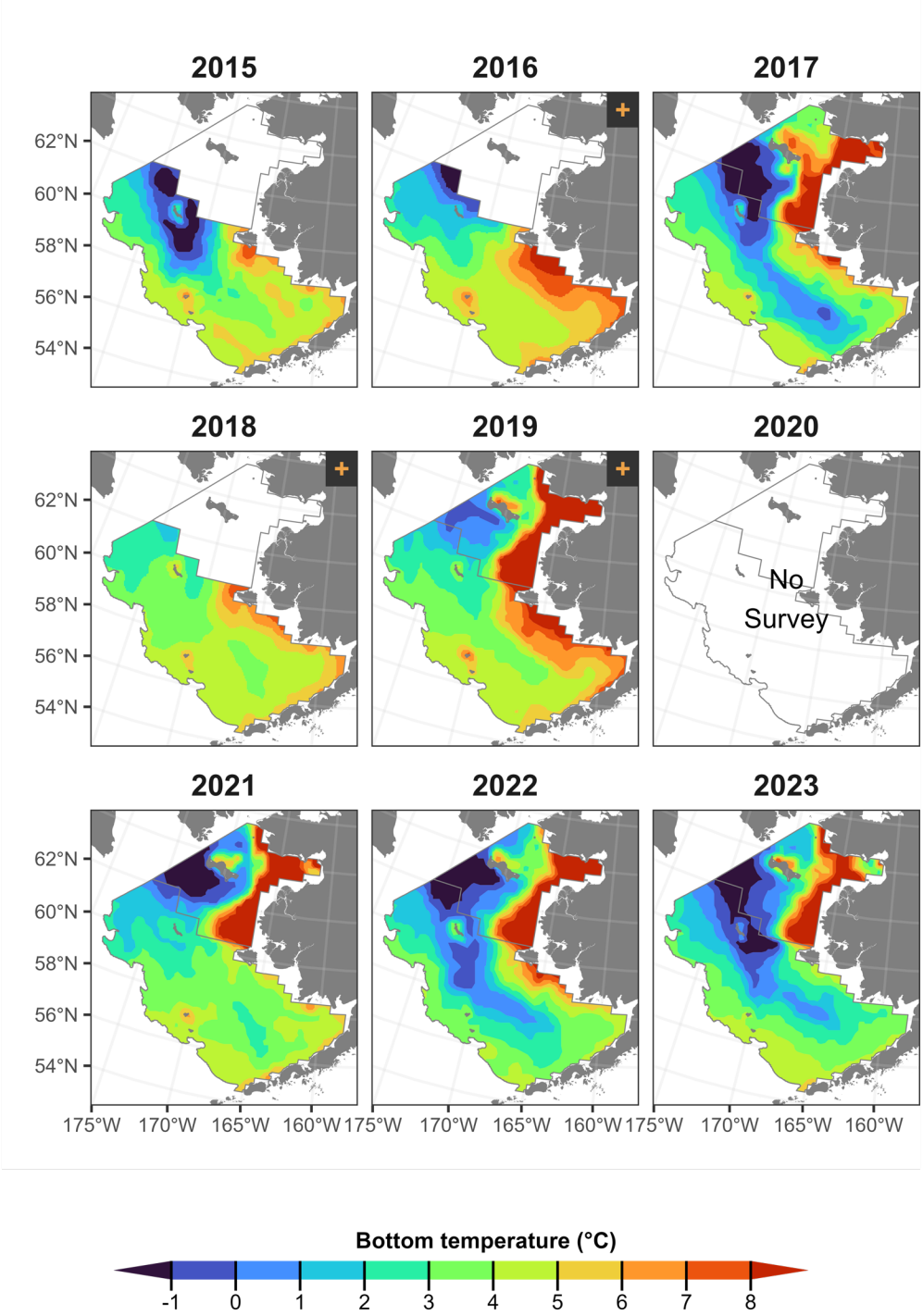

Figure 6. -- Bottom temperatures (°C) during the 2015-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Years in which the mean bottom temperature is 1 or more standard deviations above or below the time-series mean bottom temperature are denoted with '+' and '-' in the upper right-hand corner of each subplot, respectively.

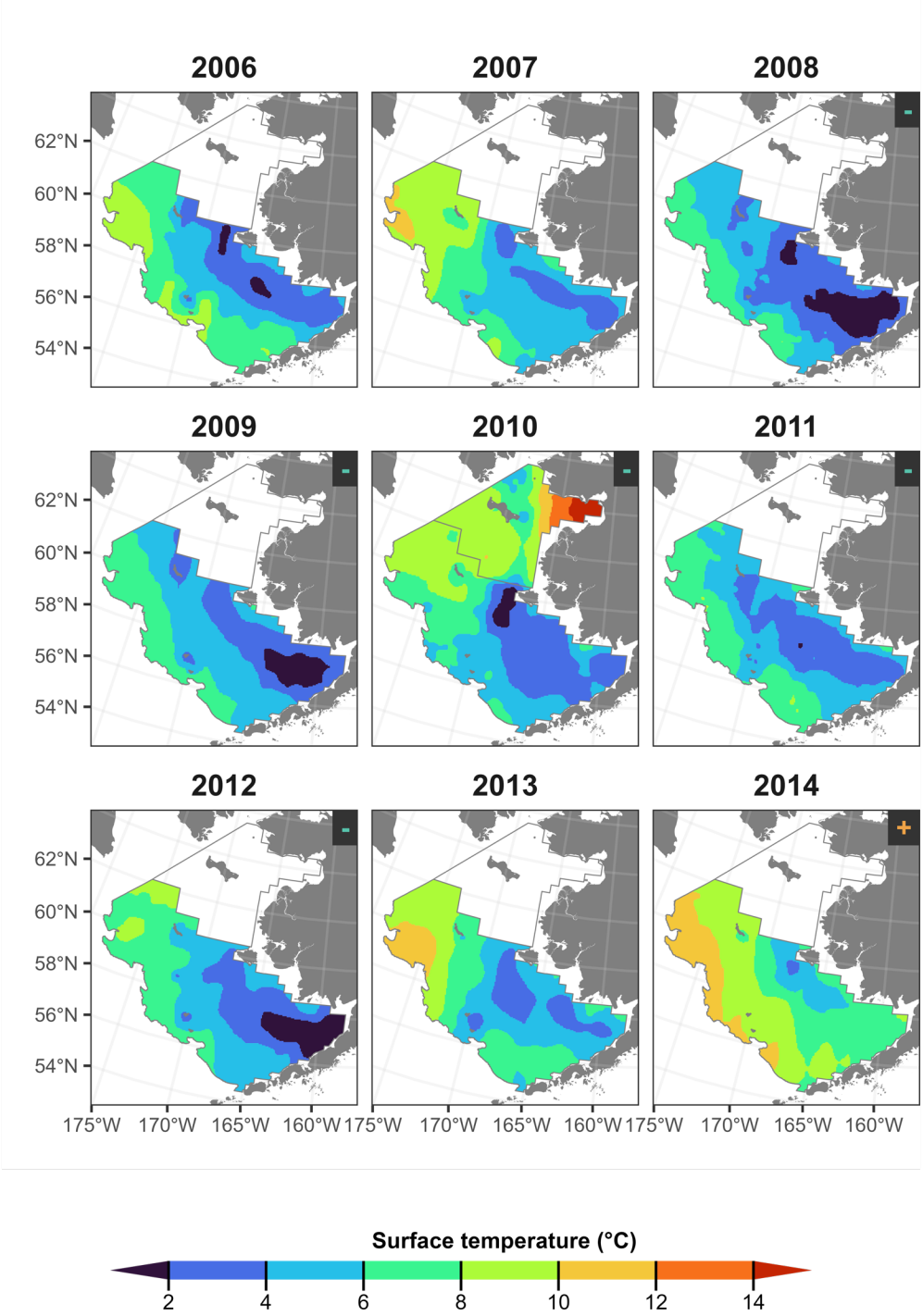

Figure 7. -- Surface temperatures (°C) during the 2006-2014 eastern and northern Bering Sea shelf bottom trawl surveys. Years in which the mean surface temperature is 1 or more standard deviations above or below the time-series mean surface temperature are denoted with '+' and '-' in the upper right-hand corner of each subplot, respectively.

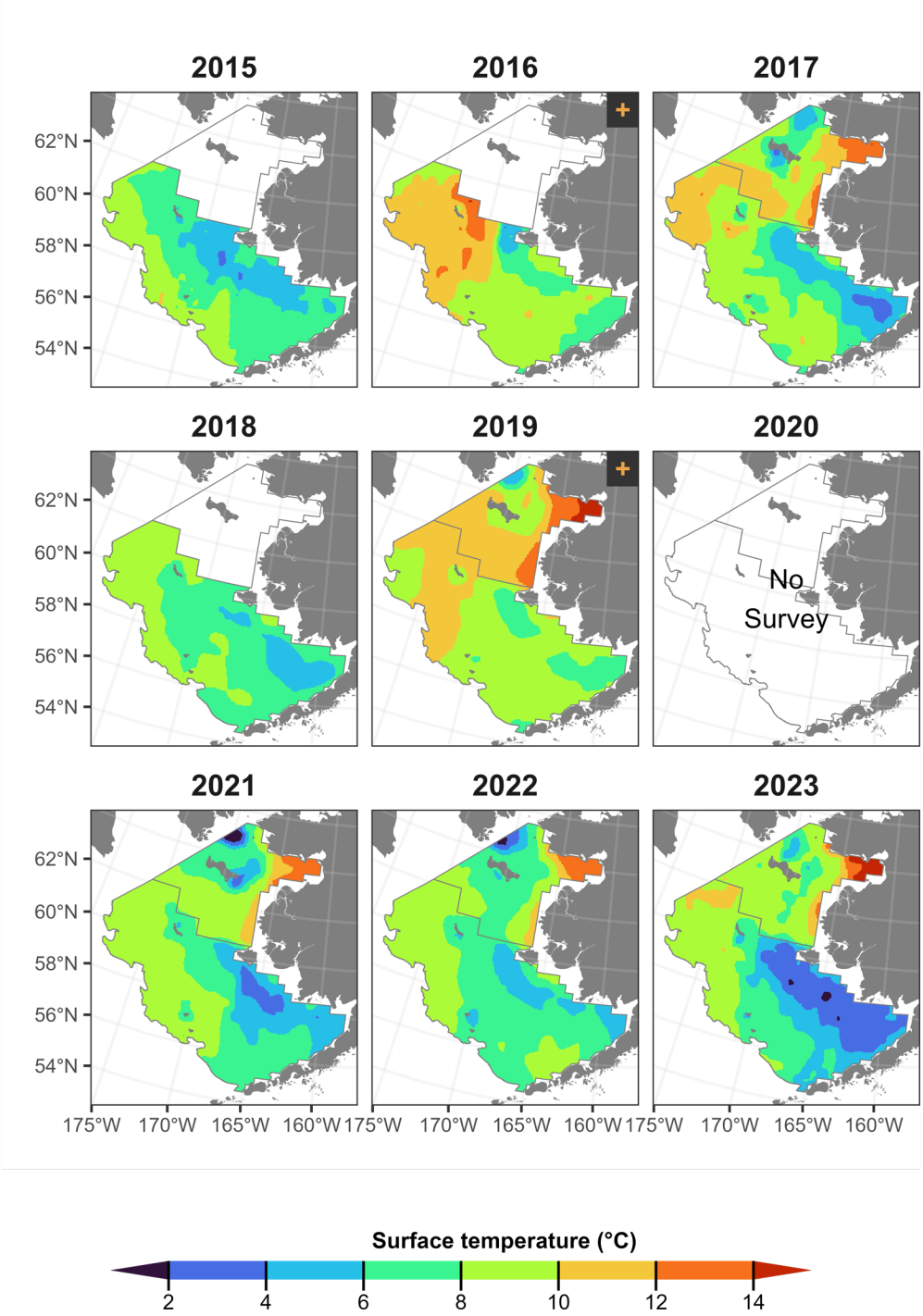

Figure 8. -- Surface temperatures (°C) during the 2015-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Years in which the mean surface temperature is 1 or more standard deviations above or below the time-series mean surface temperature are denoted with '+' and '-' in the upper right-hand corner of each subplot, respectively.

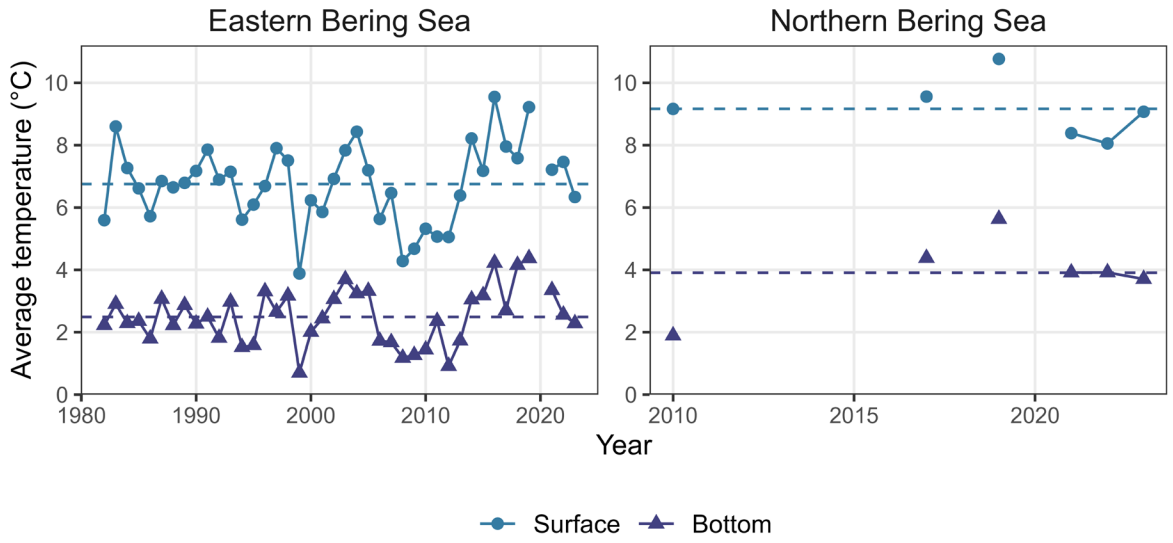

Figure 9. -- Average summer surface and bottom, and time-series average surface and bottom (dashed lines) temperatures (°C) on the eastern Bering Sea shelf, based on data collected during standardized summer bottom trawl surveys from 1982–2023 (left), and northern Bering Sea shelf based on data collected during standardized summer bottom trawl surveys (right).

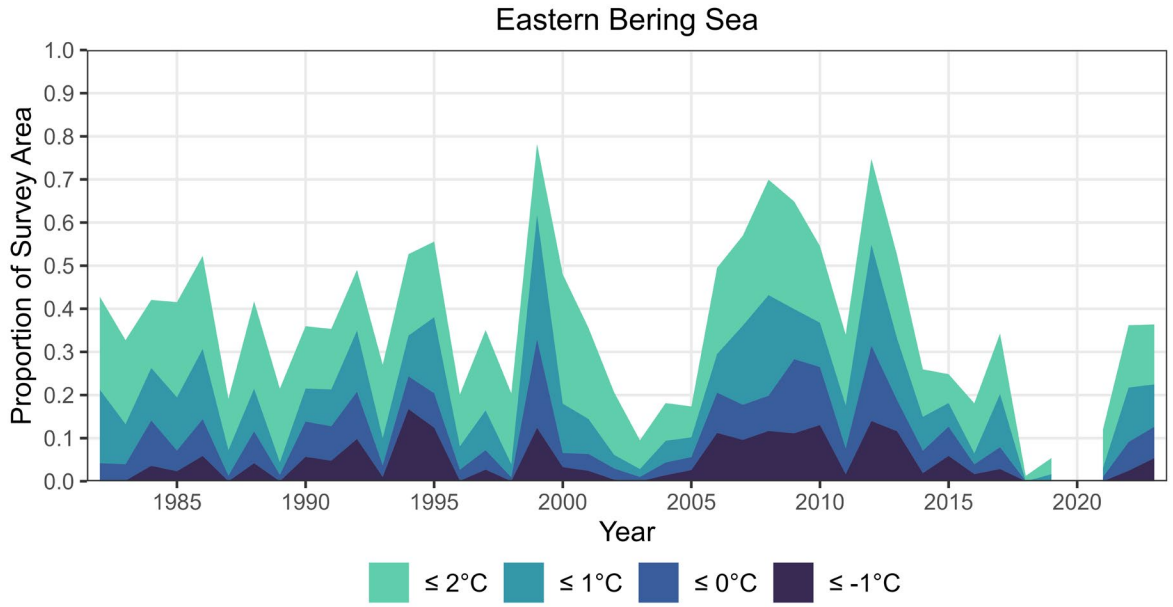

Figure 10. -- Annual extent of the summer cold pool on the eastern Bering Sea shelf, based on observations from the eastern Bering Sea bottom trawl survey. The extent of the cold pool is shown as a percentage of the total eastern Bering Sea shelf survey area. Note that northern Bering Sea areas are not included in this figure. Shading denotes near-bottom temperatures ≤ 2°C, ≤ 1°C, ≤ 0°C, and ≤ -1°C.

Survey Data and Specimen Collections

Specimens collected during the 2023 eastern and northern Bering Sea shelf trawl surveys are shown in Tables **5** and **6**. Other special collections are listed in Table **4**.

Table 5. -- Biological data collected during the 2023 eastern Bering Sea shelf bottom trawl survey.

Eastern Bering Sea	Length measurements	Otolith age structure samples	Stomach samples	Fat-meter condition samples	Genetic samples	Genetic fin clip samples
Alaska plaice	7,092	424	535	-	-	-
Alaska skate	3,688	-	-	-	-	-
Aleutian skate	71	-	-	-	-	-
Arctic cod	1	-	-	-	-	-
Arrowtooth flounder	10,217	494	-	-	-	50
Arrowtooth flounder and Kamchatka flounder	65	-	757	-	-	-
Atka mackerel	1	-	-	-	-	-
Bering flounder	1,095	-	-	-	-	50
Bering skate	281	-	-	-	-	-
Big skate	63	-	-	-	-	-
Bigmouth sculpin	150	-	-	-	-	-
Blackspotted rockfish	1	-	-	-	-	-
Butter sole	316	-	-	-	-	-
Butterfly sculpin	3	-	-	-	-	-
Chinook salmon	1	-	-	-	-	-
Dover sole	16	-	-	-	-	-
Dusky rockfish	4	-	-	-	-	-
Flathead sole	16,420	670	743	-	-	50
Great sculpin	565	-	-	-	-	-
Greenland turbot	127	70	-	-	-	12
Hybrid starry flounder X Alaska plaice	1	-	-	-	-	-
Kamchatka flounder	906	198	-	-	-	-
Longhead dab	1,270	-	-	-	-	-
Longnose skate	2	-	-	-	-	-
Mud skate	2	-	-	-	-	-
Northern rock sole	19,596	841	-	-	-	-
Northern rockfish	18	-	-	-	-	-
Pacific cod	14,398	1,424	1,203	72	-	-
Pacific halibut	3,435	222	399	-	-	-
Pacific ocean perch	416	-	-	-	-	-
Pacific sleeper shark	1	-	-	-	3	-
Pink salmon	1	-	-	-	-	-
Plain sculpin	1,098	-	-	-	-	-
Prowfish	2	-	-	-	-	-
Rex sole	1,525	-	-	-	-	-
Rougheye rockfish	8	-	-	-	-	-
Sablefish	165	-	-	-	-	-

Eastern Bering Sea	Length measurements	Otolith age structure samples	Stomach samples	Fat-meter condition samples	Genetic samples	Genetic fin clip samples
Saffron cod	4	-	-	-	-	-
Sakhalin sole	12	-	-	-	-	-
Shorthorn sculpin	16	-	-	-	-	-
Southern rock sole	95	-	-	-	-	-
Starry flounder	835	-	-	-	-	-
Walleye pollock	38,618	1,688	1,720	82	-	-
White spotted red rockfish unid.	1	-	-	-	-	-
Whiteblotched skate	1	-	-	-	-	-
Yellow Irish lord	683	-	-	-	-	-
Yellowfin sole	15,501	514	-	-	-	-
Total	**138,787**	**6,545**	**5,357**	**154**	**3**	**162**

Table 6. -- Biological data collected during the 2023 northern Bering Sea shelf bottom trawl survey.

Northern Bering Sea	Length measurements	Otolith age structure samples	Stomach samples	Fat-meter condition samples
Alaska plaice	6,089	212	384	-
Alaska skate	277	-	-	-
Arctic cod	25	-	-	-
Arrowtooth flounder	-	-	-	-
Bering flounder	1,725	-	-	-
Butterfly sculpin	8	-	-	-
Chum salmon	2	-	-	-
Flathead sole	5	-	2	-
Great sculpin	128	-	-	-
Greenland turbot	3	3	-	-
Irish lord	1	-	-	-
Longhead dab	429	-	-	-
Northern rock sole	1,656	121	-	-
Pacific cod	1,216	273	254	24
Pacific halibut	178	-	14	-
Plain sculpin	1,099	-	-	-
Saffron cod	3,416	-	-	-
Sakhalin sole	669	-	-	-
Shorthorn sculpin	555	-	-	-
Sockeye salmon	1	-	-	-
Starry flounder	1,414	-	-	-
Walleye pollock	7,236	361	398	44
Yellow Irish lord	1	-	-	-
Yellowfin sole	9,760	316	-	-
Total	**35,893**	**1,286**	**1,052**	**68**

Species Composition

A total of 128 fish species representing 27 families and 74 genera were identified during the 2023 eastern and northern Bering Sea surveys (Appendix Tables A **119** and B **121**). In 2023, the eastern Bering Sea survey recorded 99 total taxa, of which 85 were identified to the species level, and the northern Bering Sea survey recorded 76 total taxa, of which 68 were identified to the species level. The remaining fish taxa in each survey area were identified to the genus level or higher. Of the 99 fish species found in the eastern Bering Sea, 45 did not occur in the northern Bering Sea (Table **7**). In comparison, 23 of the 76 fish species encountered in the northern Bering Sea were not encountered in the eastern Bering Sea (Table **7**). In 2023, nine flatfish species were encountered in the eastern Bering Sea but not in the northern Bering Sea (Dover sole (*Microstomus pacificus*), English sole (*Parophrys vetulus*), Kamchatka flounder (*Atheresthes evermanni*), arrowtooth flounder (*Atheresthes stomias*), butter sole (*Isopsetta isolepis*), hybrid starry flounder X Alaska plaice (*Platichthys stellatus X Pleuronectes quadrituberculatus hybrid*), rex sole (*Glyptocephalus zachirus*), sand sole (*Psettichthys melanostictus*), and southern rock sole (*Lepidopsetta bilineata*)) and one flatfish species was encountered in the northern Bering Sea but not in the eastern Bering Sea (Arctic flounder (*Liopsetta glacialis*); Table **7**).

There were 264 different invertebrate taxa representing 13 phyla identified during the 2023 eastern and northern Bering Sea surveys (Appendix Tables A **120** and B **122**). In 2023, 240 invertebrate taxa were recorded in the eastern Bering Sea survey, of which 138 were identified to the species level, and 141 invertebrate taxa were recorded in the northern Bering Sea survey, of which 74 were identified to the species level. The remaining invertebrate taxa in each survey area were identified to the genus level or higher. The lack of species level identifications among invertebrates was due to a variety of factors that are outlined in Stevenson and Hoff (2009) and Stevenson et al. (2016).

Table 7. -- List of fish taxa encountered in the eastern Bering Sea shelf (EBS) and northern Bering Sea shelf (NBS) survey catches.

Encountered in EBS, not in NBS **Common name *(scientific name)***	**Encountered in NBS, not in EBS** **Common name *(scientific name)***
Aleutian skate (*Bathyraja aleutica*)	Arctic flounder (*Liopsetta glacialis*)
Atka mackerel (*Pleurogrammus monopterygius*)	Arctic shanny (*Stichaeus punctatus*)
Bering skate (*Bathyraja interrupta*)	Arctic staghorn sculpin (*Gymnocanthus tricuspis*)
Dover sole (*Microstomus pacificus*)	Antlered sculpin (*Enophrys diceraus*)
English sole (*Parophrys vetulus*)	Bearded warbonnet (*Chirolophis snyderi*)
Kamchatka flounder (*Atheresthes evermanni*)	Belligerent sculpin (*Megalocottus platycephalus*)
Pacific ocean perch (*Sebastes alutus*)	Brightbelly sculpin (*Microcottus sellaris*)
Pacific sandfish (*Trichodon trichodon*)	Chum salmon (*Oncorhynchus keta*)
Pacific sleeper shark (*Somniosus pacificus*)	Eyeshade sculpin (*Nautichthys pribilovius*)
Armorhead sculpin (*Gymnocanthus galeatus*)	Festive snailfish (*Liparis marmoratus*)
Arrowtooth flounder (*Atheresthes stomias*)	Fourhorn sculpin (*Myoxocephalus quadricornis*)
Big skate (*Beringraja binoculata*)	Fourline snakeblenny (*Eumesogrammus praecisus*)
Bigmouth sculpin (*Hemitripterus bolini*)	Kelp snailfish (*Liparis tunicatus*)
Blackspotted rockfish (*Sebastes melanostictus*)	Ninespine stickleback (*Pungitius pungitius*)
Bride sculpin (*Artediellus miacanthus*)	Pighead prickleback (*Acantholumpenus mackayi*)

Encountered in EBS, not in NBS **Common name *(scientific name)***	**Encountered in NBS, not in EBS** **Common name *(scientific name)***
Butter sole (*Isopsetta isolepis*)	Pimpled lumpsucker (*Eumicrotremus andriashevi*)
Chinook salmon (*Oncorhynchus tshawytscha*)	Polar eelpout (*Lycodes turneri*)
Darkfin sculpin (*Malacocottus zonurus*)	Purplegray sculpin (*Gymnocanthus detrisus*)
Daubed shanny (*Leptoclinus maculatus*)	Rainbow smelt (*Osmerus mordax*)
Dragon poacher (*Percis japonica*)	Roughskin sculpin (*Rastrinus scutiger*)
Dusky rockfish (*Sebastes variabilis*)	Saddled eelpout (*Lycodes mucosus*)
Dwarf wrymouth (*Cryptacanthodes aleutensis*)	Showy snailfish (*Liparis pulchellus*)
Eulachon (*Thaleichthys pacificus*)	Sockeye salmon (*Oncorhynchus nerka*)
Gray starsnout (*Bathyagonus alascanus*)	
Hybrid starry flounder X Alaska plaice (*Platichthys stellatus X Pleuronectes quadrituberculatus hybrid*)	
Longnose skate (*Beringraja rhina*)	
Mud skate (*Bathyraja taranetzi*)	
Northern rockfish (*Sebastes polyspinis*)	
Pink salmon (*Oncorhynchus gorbuscha*)	
Prowfish (*Zaprora silenus*)	
Rex sole (*Glyptocephalus zachirus*)	
Rougheye rockfish (*Sebastes aleutianus*)	
Roughspine sculpin (*Triglops macellus*)	
Sablefish (*Anoplopoma fimbria*)	
Sand sole (*Psettichthys melanostictus*)	
Searcher (*Bathymaster signatus*)	
Shortfin eelpout (*Lycodes brevipes*)	
Snake prickleback (*Lumpenus sagitta*)	
Southern rock sole (*Lepidopsetta bilineata*)	
Spectacled sculpin (*Triglops scepticus*)	
Spinycheek starsnout (*Bathyagonus infraspinatus*)	
Spinyhead sculpin (*Dasycottus setiger*)	
Thorny sculpin (*Icelus spiniger*)	
Whitebarred prickleback (*Poroclinus rothrocki*)	
Whiteblotched skate (*Bathyraja maculata*)	

Biomass, Abundance, and Catch per Unit Effort

The total demersal organismal biomass for the eastern Bering Sea was estimated at 11.8 million t and total demersal organismal biomass for the northern Bering Sea was estimated at 2.8 million t. In the eastern Bering Sea, the proportion of fishes (78%; Table **8**) was higher than invertebrates (22%; Table **9**) and in the northern Bering Sea, the proportion of fishes (50%; Table **10**) was about the same as invertebrates (50%; Table **11**). The lower relative fish biomass in the northern Bering Sea than in the eastern Bering Sea is consistent with results of a broader analysis of all survey years presented by Stevenson and Lauth (2012), which showed decreasing fish biomass with increasing latitude on the eastern Bering Sea continental shelf.

Pleuronectidae (flatfishes) and Gadidae (cods) were the fish families with highest biomass in both the eastern Bering Sea (49.7% and 7.3% of the total fish biomass, respectively) and the northern Bering Sea (57.5% and 10.6% of the total fish biomass; Tables **8** and **10**). In the eastern Bering Sea, the family Gadidae, by biomass, was primarily comprised of walleye pollock (*Gadus chalcogrammus*, 34.5%) and Pacific cod (*Gadus macrocephalus*, 7.3%); and the family Pleuronectidae was primarily comprised of yellowfin sole (*Limanda aspera*, 15.2%) and northern rock sole (*Lepidopsetta polyxystra*, 15.1%). In the northern Bering Sea, the family Gadidae, by biomass, was primarily comprised of walleye pollock (*Gadus chalcogrammus*, 26.2%) and Pacific cod (*Gadus macrocephalus*, 7.8%); and the family Pleuronectidae was primarily comprised of yellowfin sole (*Limanda aspera*, 28.3%) and Alaska plaice (*Pleuronectes quadrituberculatus*, 22.2%).

Changes were observed in the eastern and northern Bering Sea benthic communities between 2022 and 2023. The total estimated biomass in the eastern Bering Sea decreased from 14.5 million t in 2022 to 11.8 million t in 2023. The total estimated biomass in the northern Bering Sea decreased from 3.3 million t in 2022 to 2.8 million t in 2023. While exhaustive efforts are made to standardize catch processing and data collection, variation in catchability may cause some differences in these results between years (Kotwicki and Ono, 2019).

The ten most abundant fish taxa in the eastern Bering Sea accounted for 16.2% (an average of 17,603.2 kg/km^2 per station) of total mean fish and invertebrate CPUE (an average of 108,646.5 kg/km^2 per station) and 22.1% of total mean fish CPUE (an average of 79,531.8 kg/km^2 per station). The ten most abundant fish taxa in the northern Bering Sea accounted for 9.9% (an average of 6,863.0 kg/km^2 per station) of total mean fish and invertebrate CPUE (an average of 69,033.9 kg/km^2 per station) and 22% of total mean fish CPUE (an average of 31,191.5 kg/km^2 per station).

Table 8. -- Total taxon biomass estimates (t), ± 95% confidence limits (CL), and biomass estimates by stratum for major fish taxa collected during the 2023 eastern Bering Sea shelf bottom trawl survey. The proportion of the taxon biomass is divided by the total fish estimated biomass (9,143,615 t) caught on the eastern Bering Sea bottom trawl survey.

Taxon		Estimated fish biomass across survey		Estimated fish biomass by stratum											
		Biomass ± 95% CL	Proportion	10	20	31	32	41	42	43	50	61	62	82	90
Agonidae (poachers)		14,902 ± 3,207	0.0016	4,457	1,651	3,313	2,076	271	2,410	17	561	141	0	1	5
Cottidae (sculpins)		120,764 ± 26,683	0.0132	25,306	6,970	13,395	9,325	12,244	18,713	5,787	1,361	18,460	2,211	3,544	3,447
Gadidae (cods)	Pacific cod	663,075 ± 74,732	0.0725	114,621	39,521	160,004	22,257	91,080	41,337	45,881	17,527	101,945	14,071	6,279	8,551
	walleye pollock	3,154,668 ± 550,956	0.3450	198,126	218,480	553,431	53,462	451,346	183,423	86,945	132,362	1,124,856	26,678	37,519	88,039
	other	4 ± 4	<0.0001	1	2	0	0	1	0	0	0	0	0	0	0
	total	663,079 ± 74,732	0.0725	114,622	39,523	160,004	22,257	91,081	41,337	45,881	17,527	101,945	14,071	6,279	8,551
Hexagrammidae (greenlings)		111 ± 94	<0.0001	99	0	0	0	0	12	0	0	0	0	0	0
Liparidae (snailfishes)		2,236 ± 967	0.0002	6	0	0	0	14	0	155	0	758	108	431	766
Osmeridae (smelts)		1,136 ± 683	0.0001	273	37	14	0	3	0	0	809	0	0	0	0
Pleuronectidae (flatfishes)	Alaska plaice	358,845 ± 85,613	0.0392	90,558	89,409	68,978	1,494	89,961	6,051	9,725	0	0	63	2,359	247
	Bering flounder	6,813 ± 2,416	0.0007	0	14	0	0	1,980	0	279	0	79	31	2,843	1,587
	Kamchatka flounder	24,875 ± 3,865	0.0027	60	0	2,693	700	2,686	1,514	1,563	3,729	8,671	1,165	59	2,034
	Pacific halibut	170,238 ± 52,949	0.0186	48,527	20,055	32,725	3,242	31,223	13,270	4,781	5,901	9,543	753	0	217
	arrowtooth flounder	462,575 ± 77,667	0.0506	4,515	0	197,649	20,645	15,754	35,641	1,803	102,448	80,225	2,727	0	1,168
	flathead sole	594,851 ± 195,036	0.0651	24,696	189	218,887	15,953	26,380	55,851	5,578	48,178	194,450	1,980	733	1,978
	northern rock sole	1,380,684 ± 275,226	0.1510	606,640	96,770	309,934	25,802	79,790	247,929	9,533	1,656	1,696	130	596	208
	yellowfin sole	1,393,379 ± 262,598	0.1524	717,577	176,632	374,218	907	113,279	9,056	1,366	0	0	0	326	18
	other	149,092 ± 44,458	0.0163	70,148	19,889	27,173	0	156	122	0	17,459	14,133	0	12	0
	total	4,547,209 ± 503,069	0.4973	1,562,721	402,959	1,232,600	68,742	361,217	369,433	34,862	179,371	311,456	7,636	7,452	8,761
Rajidae (skates)	Alaska skate	418,483 ± 67,034	0.0458	78,202	47,380	89,050	5,230	37,240	31,644	10,587	23,952	74,943	8,531	3,708	8,015
	other	81,682 ± 43,596	0.0089	13,164	0	39,819	1,511	461	377	91	12,391	13,623	77	0	167
	total	500,165 ± 81,292	0.0547	91,366	47,380	128,870	6,741	37,702	32,021	10,678	36,343	88,567	8,608	3,708	8,183
Scorpaenidae (rockfishes)	Pacific ocean perch	18,914 ± 18,914	0.0021	0	0	30	0	0	0	0	387	18,497	0	0	0
	other	783 ± 623	<0.0001	0	0	0	0	0	0	0	423	360	0	0	0
	total	19,697 ± 19,697	0.0022	0	0	30	0	0	0	0	810	18,856	0	0	0
Stichaeidae (prickleback)		41 ± 41	<0.0001	0	0	2	11	0	0	19	2	5	1	1	0
Zoarcidae (eelpouts)		55,297 ± 12,341	0.0060	21	0	3,618	98	4,612	972	4,355	130	31,422	3,324	790	5,956
Other fish		190,931 ± 34,777	0.0209	44,878	14,377	29,366	9,364	21,209	18,848	12,203	5,854	22,912	3,022	4,081	4,817
Total fish		**9,143,615 ± 842,142**	**1.0000**	**2,016,568**	**724,407**	**2,110,903**	**162,751**	**967,447**	**648,455**	**194,880**	**373,771**	**1,698,259**	**62,662**	**59,738**	**123,774**

Table 9. -- Total taxon biomass estimates (t), ± 95% confidence limits (CL), and biomass estimates by stratum for major invertebrate taxa collected during the 2023 eastern Bering Sea shelf bottom trawl survey. The proportion of the taxon biomass is divided by the total invertebrate estimated biomass (2,624,108 t) caught on the eastern Bering Sea bottom trawl survey.

Taxon		Estimated invertebrate biomass across survey		Estimated invertebrate biomass by stratum											
		Biomass ± 95% CL	Proportion	10	20	31	32	41	42	43	50	61	62	82	90
Ascidiacea		93,525 ± 39,882	0.0356	2,211	2,980	27,555	2,948	38,230	19,359	233	0	8	0	1	0
Coelenterata		237,788 ± 43,985	0.0906	9,250	790	77,112	10,333	11,165	35,081	5,217	17,729	33,158	6,463	15,135	16,355
Crustacea	shrimps	4,122 ± 1,320	0.0016	24	15	44	2	67	31	62	300	2,866	394	14	304
	other	577,298 ± 64,833	0.2200	32,486	13,881	212,316	21,428	87,337	82,122	16,919	20,653	65,271	5,658	12,393	6,834
	total	425,361 ± 59,300	0.1621	29,906	10,244	188,782	18,304	43,156	60,905	9,608	8,831	49,008	4,235	1,085	1,298
Echinodermata	Asteroidea (sea stars)	987,054 ± 138,090	0.3761	325,220	189,671	191,851	8,127	93,330	63,353	9,848	2,461	82,814	6,577	3,742	10,060
	Echinoidea (sea urchins)	33,650 ± 20,549	0.0128	49	1	7,232	1,994	307	5,481	765	12,386	5,155	189	0	89
	Holothuroidea (sea cucumbers)	10,300 ± 9,787	0.0039	238	0	3,412	4,462	0	1,674	484	14	15	0	0	0
	Ophiuroidea (brittle stars)	293,940 ± 89,540	0.1120	10,443	5,067	63,293	4,702	22,907	45,280	4,823	10,804	121,758	1,167	2,528	1,169
	total	1,324,944 ± 165,857	0.5049	335,951	194,739	265,788	19,286	116,543	115,788	15,921	25,665	209,742	7,933	6,270	11,319
Mollusca	Gastropoda (snails)	348,103 ± 57,656	0.1327	5,683	5,672	149,694	7,252	49,356	25,913	10,164	6,902	69,382	10,152	2,369	5,564
	Pelecypoda (bivalves)	13,076 ± 7,391	0.0050	1,054	395	7,474	354	1,117	1,684	55	128	750	39	16	11
	octopuses	2,557 ± 1,631	0.0010	0	0	687	348	1	139	21	0	1,349	12	0	0
	squids	90 ± 77	<0.0001	0	0	0	0	0	0	0	46	42	1	0	0
	total	363,826 ± 59,504	0.1386	6,736	6,067	157,855	7,953	50,474	27,736	10,241	7,077	71,523	10,204	2,385	5,575
Porifera (sponges)		16,031 ± 16,031	0.0061	241	443	13,894	627	46	35	78	371	246	50	0	0
Other invertebrates		6,573 ± 2,637	0.0025	95	6	1,143	40	480	731	32	606	3,277	86	21	58
Total invertebrates		**2,624,108 ± 208,060**	**1.0000**	**386,995**	**218,920**	**755,707**	**62,616**	**304,342**	**280,882**	**48,703**	**72,401**	**386,090**	**30,789**	**36,219**	**40,445**

Table 10. -- Total taxon biomass estimates (t), ± 95% confidence limits (CL), and biomass estimates by stratum for major fish taxa collected during the 2023 northern Bering Sea shelf bottom trawl survey. The proportion of the taxon biomass is divided by the total fish estimated biomass (1,387,868 t) caught on the northern Bering Sea bottom trawl survey.

Taxon		Estimated fish biomass across survey		Estimated fish biomass by stratum		
		Biomass ± 95% CL	Proportion	70	71	81
Agonidae (poachers)		439 ± 134	0.0003	264	173	3
Cottidae (sculpins)		17,171 ± 3,639	0.0124	7,235	9,817	119
Cyclopteridae (lumpsuckers)		8 ± 8	<0.0001	0	8	0
Gadidae (cods)	Pacific cod	108,346 ± 31,594	0.0781	76,708	19,130	12,508
	walleye pollock	363,839 ± 96,485	0.2622	193,123	81,494	89,222
	other	38,259 ± 16,311	0.0276	15,247	23,006	6
	total	146,605 ± 32,240	0.1056	91,955	42,136	12,514
Hexagrammidae (greenlings)		56 ± 39	<0.0001	25	30	0
Liparidae (snailfishes)		1,632 ± 726	0.0012	494	386	752
Osmeridae (smelts)		2,034 ± 866	0.0015	1,198	777	59
Pleuronectidae (flatfishes)	Alaska plaice	307,919 ± 110,171	0.2219	224,709	32,107	51,104
	Bering flounder	4,704 ± 1,691	0.0034	1,123	841	2,740
	Pacific halibut	19,076 ± 8,815	0.0137	15,890	3,119	67
	flathead sole	45 ± 45	<0.0001	2	0	42
	northern rock sole	29,225 ± 10,807	0.0211	23,480	2,515	3,230
	yellowfin sole	393,305 ± 78,358	0.2834	286,251	69,953	37,100
	other	43,531 ± 15,885	0.0314	11,715	31,254	562
	total	797,807 ± 157,394	0.5748	563,171	139,790	94,845
Rajidae (skates)	Alaska skate	51,728 ± 24,781	0.0373	42,362	5,578	3,789
	other	40 ± 30	<0.0001	19	19	2
	total	51,767 ± 24,782	0.0373	42,381	5,596	3,790
Stichaeidae (prickleback)		3,299 ± 1,635	0.0024	124	3,175	1
Zoarcidae (eelpouts)		958 ± 543	0.0007	134	645	179
Other fish		19,424 ± 3,900	0.0140	7,825	11,439	160
Total fish		**1,387,868 ± 221,335**	**1.0000**	**900,696**	**285,648**	**201,525**

Table 11. -- Total taxon biomass estimates (t), ± 95% confidence limits (CL), and biomass estimates by stratum for major invertebrate taxa collected during the 2023 northern Bering Sea shelf bottom trawl survey. The proportion of the taxon biomass is divided by the total invertebrate estimated biomass (1,403,227 t) caught on the northern Bering Sea bottom trawl survey.

Taxon		Estimated invertebrate biomass across survey		Estimated invertebrate biomass by stratum		
		Biomass ± 95% CL	**Proportion**	**70**	**71**	**81**
Ascidiacea		64,794 ± 39,191	0.0462	5,372	59,161	261
Coelenterata		80,056 ± 26,402	0.0571	14,054	47,701	18,302
Crustacea	shrimps	8,663 ± 3,677	0.0062	603	7,977	83
	other	298,166 ± 73,955	0.2125	97,713	163,167	37,286
	total	162,876 ± 34,554	0.1161	58,675	93,728	10,473
Echinodermata	Asteroidea (sea stars)	404,261 ± 84,265	0.2881	153,068	242,646	8,547
	Echinoidea (sea urchins)	191,398 ± 159,137	0.1364	273	191,122	4
	Holothuroidea (sea cucumbers)	4,496 ± 4,496	0.0032	0	4,496	0
	Ophiuroidea (brittle stars)	41,904 ± 19,123	0.0299	2,892	34,413	4,599
	total	642,059 ± 170,640	0.4576	156,233	472,677	13,149
Mollusca	Gastropoda (snails)	174,129 ± 59,816	0.1241	78,218	83,905	12,005
	Pelecypoda (bivalves)	3,494 ± 1,821	0.0025	563	2,892	39
	octopuses	7 ± 7	<0.0001	0	0	7
	total	177,629 ± 59,797	0.1266	78,781	86,797	12,052
Porifera (sponges)		11,711 ± 11,711	0.0083	0	11,703	8
Other invertebrates		120,148 ± 120,148	0.0856	1,992	118,100	57
Total invertebrates		**1,403,227 ± 270,562**	**1.0000**	**354,747**	**967,283**	**81,197**

Table 12. -- Total estimated biomass (t) and the percent change between the 2022 and 2023 eastern Bering Sea shelf bottom trawl surveys for predominant fish and invertebrate taxa. Taxa are listed in descending order of percent change from 2022 to 2023.

Common name	2019	2021	2022	2023	Change (2023, 2022)
Snailfishes	645	769	630	2,236	255.0%
Corals	873	943	1,328	3,839	189.0%
Smelts	1,961	766	561	1,136	102.7%
Prickleback	39	13	26	41	55.0%
Tanner crab	37,879	42,859	38,485	50,361	30.9%
Eelpouts	35,486	37,776	45,571	55,297	21.3%
Jellyfish	247,056	74,162	126,395	146,501	15.9%
Pacific halibut	114,266	131,864	149,064	170,238	14.2%
Bering flounder	8,251	9,511	6,237	6,813	9.2%
Northern rock sole	983,377	1,041,169	1,294,581	1,380,684	6.7%
Sea urchins	31,304	22,076	29,150	30,683	5.3%
Pacific cod	517,141	616,380	647,400	663,075	2.4%
Shorthorn sculpin	8,759	2,180	560	546	-2.5%
Red king crab	34,009	41,803	50,042	48,056	-4.0%
Basket sea stars	305,578	286,345	265,984	253,039	-4.9%
Alaska plaice	369,436	335,034	385,294	358,845	-6.9%
Clams	7,078	14,989	14,062	13,069	-7.1%
Alaska skate	490,420	468,113	463,017	418,483	-9.6%
Arrowtooth flounder	576,230	457,569	521,615	462,575	-11.3%
Starry flounder	66,436	83,295	92,652	81,383	-12.2%
Flathead sole	611,245	674,745	703,375	594,851	-15.4%
Snow crab	450,654	103,687	105,290	88,269	-16.2%
Kamchatka flounder	44,636	32,856	29,699	24,875	-16.2%
Hermit crabs	299,142	381,438	460,462	372,306	-19.1%
Purple-orange sea star	856,712	971,398	1,018,067	815,015	-19.9%
Worms	5,739	8,084	8,307	6,562	-21.0%
Walleye pollock	5,452,009	3,030,988	4,153,971	3,154,668	-24.1%
Greenland turbot	16,008	10,690	7,869	5,857	-25.6%
Yellowfin sole	2,017,620	1,633,968	2,039,968	1,393,379	-31.7%
Plain sculpin	50,636	37,180	39,123	26,716	-31.7%
Great sculpin	91,834	51,319	69,097	45,918	-33.5%
Blue king crab	5,282	3,849	4,419	2,753	-37.7%
Neptune whelks	83,272	138,193	150,232	79,184	-47.3%
Barnacles	408	223	3,068	1,487	-51.5%
Pacific herring	77,191	67,886	228,447	54,795	-76.0%
Saffron cod	1,383	3	21	3	-85.9%
Arctic cod	2	-	51	1	-98.0%

Table 13. -- Total estimated biomass (t) and the percent change between the 2022 and 2023 northern Bering Sea shelf bottom trawl surveys for predominant fish and invertebrate taxa. Taxa are listed in descending order of percent change from 2022 to 2023.

Common name	2019	2021	2022	2023	Change (2023, 2022)
Prickleback	2,015	757	617	3,299	434.7%
Snailfishes	777	329	630	1,632	159.1%
Eelpouts	1,707	425	417	958	129.5%
Jellyfish	88,795	21,959	28,510	58,257	104.3%
Smelts	4,891	1,950	1,439	2,034	41.3%
Red king crab	2,807	3,754	2,658	3,707	39.5%
Saffron cod	81,278	9,974	27,738	38,225	37.8%
Blue king crab	1,205	1,039	3,014	3,959	31.3%
Sea urchins	89,965	54,751	155,790	188,480	21.0%
Great sculpin	3,804	2,988	530	640	20.9%
Corals	2,823	5,776	5,032	5,756	14.4%
Alaska skate	95,104	80,207	48,920	51,728	5.7%
Worms	93,073	60,122	115,939	120,148	3.6%
Alaska plaice	321,575	344,581	299,028	307,919	3.0%
Purple-orange sea star	414,448	270,646	312,625	317,349	1.5%
Starry flounder	26,475	39,014	41,075	41,169	0.2%
Shorthorn sculpin	14,161	7,627	3,665	3,414	-6.8%
Walleye pollock	1,167,131	474,467	394,585	363,839	-7.8%
Hermit crabs	139,249	107,059	153,983	138,997	-9.7%
Pacific halibut	25,722	25,995	22,940	19,076	-16.8%
Basket sea stars	36,657	30,084	48,441	40,122	-17.2%
Neptune whelks	174,179	135,754	189,880	153,982	-18.9%
Bering flounder	18,526	8,384	5,913	4,704	-20.4%
Plain sculpin	41,639	20,652	15,392	11,990	-22.1%
Yellowfin sole	520,031	496,045	548,027	393,305	-28.2%
Pacific cod	365,005	227,582	153,735	108,346	-29.5%
Snow crab	165,964	72,482	158,704	111,482	-29.8%
Northern rock sole	99,040	76,631	46,443	29,225	-37.1%
Barnacles	2,965	750	14,473	8,165	-43.6%
Clams	6,662	2,417	6,348	3,494	-45.0%
Flathead sole	463	138	126	45	-64.6%
Tanner crab	0	34	95	29	-69.8%
Pacific herring	87,918	60,931	12,178	1,370	-88.7%
Arctic cod	47	83	387	35	-91.1%

Summary of Results for Selected Fish and Invertebrate Fauna of the Eastern and Northern Bering Sea

Plots, as appropriate, of the spatial distribution, abundance-at-length estimates, and tables of CPUE (kg/km^2 and no/km^2) for 37 major fish and two major invertebrate species caught during the eastern and northern Bering Sea continental shelf surveys are presented below. The spatial distribution maps illustrate where species were found during the surveys. The distributions are presented as inverse-distance-weighted interpolations of CPUE (kg/km^2) which assumes that data from stations that are closer to one another are more alike than those that are farther apart. Similar interactive maps of these highlighted species and others are available through the NOAA Distribution Mapping and Analysis Portal (https://apps-st.fisheries.noaa.gov/dismap/; NOAA Fisheries, 2023). More information on how to find, download, and interact with the data used to produce this report is available in the data sources. Differences in estimates and totals may be due to rounding. Species are presented in alphabetical order by common name.

Alaska Plaice (*Pleuronectes quadrituberculatus*)

Between 2022 and 2023, the Alaska plaice biomass estimate decreased by 7% in the eastern Bering Sea (Tables **14** and **15**; Fig. **11**) and the population was estimated at 617.8 million individuals (Tables **14** and **16**; Fig. **11**). The biomass estimate increased by 3% in the northern Bering Sea and the population was estimated at 578.1 million individuals.

Alaska plaice were present throughout the inner and middle domain of the survey area (Fig. **12**). In 2023, the highest concentration in the eastern Bering Sea was located on the northern edge of St. Matthew Island, while the highest densities of Alaska plaice in the northern Bering Sea occurred just south of St. Lawrence Island. Spatial distribution patterns in 2023 were similar to distributions in 2022. In the five most recent northern Bering Sea surveys (2017–2023), length modes were observed around 13 cm and 35 cm (Fig. **13**).

Overall, the size and sex composition of Alaska plaice varies by depth in the eastern Bering Sea. Males are more prevalent in the inner domain and females more prevalent in the middle and outer domains. In both sexes, average size increases with depth (Zhang et al., 1998).

Table 14. -- Summary of catch location environmental variables and biomass and population estimates for Alaska plaice (*Pleuronectes quadrituberculatus*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	242 of 376 (64.4%)	109 of 116 (94.0%)
Bottom Depth (m)	20 — 120	12 — 78
Bottom Temperature (°C)	-1.6 — 5.4	-1.6 — 11.1
Surface Temperature (°C)	1.7 — 11	4.5 — 15.1
Population	617.8 million	578.1 million
Biomass (t)	358,845	307,919
Biomass % Total	3.0%	11.0%
Biomass % Change	7% decrease from 2022	3% increase from 2022

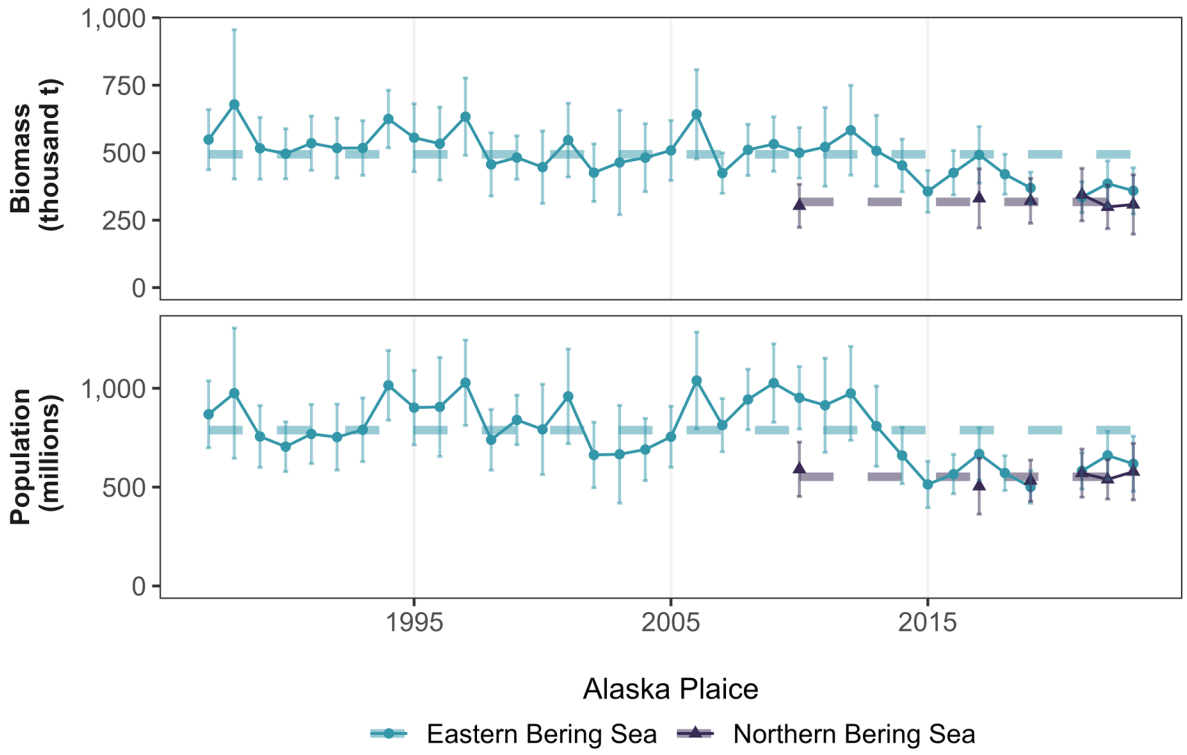

Figure 11. -- Time series of Alaska plaice (*Pleuronectes quadrituberculatus*) biomass (thousand t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

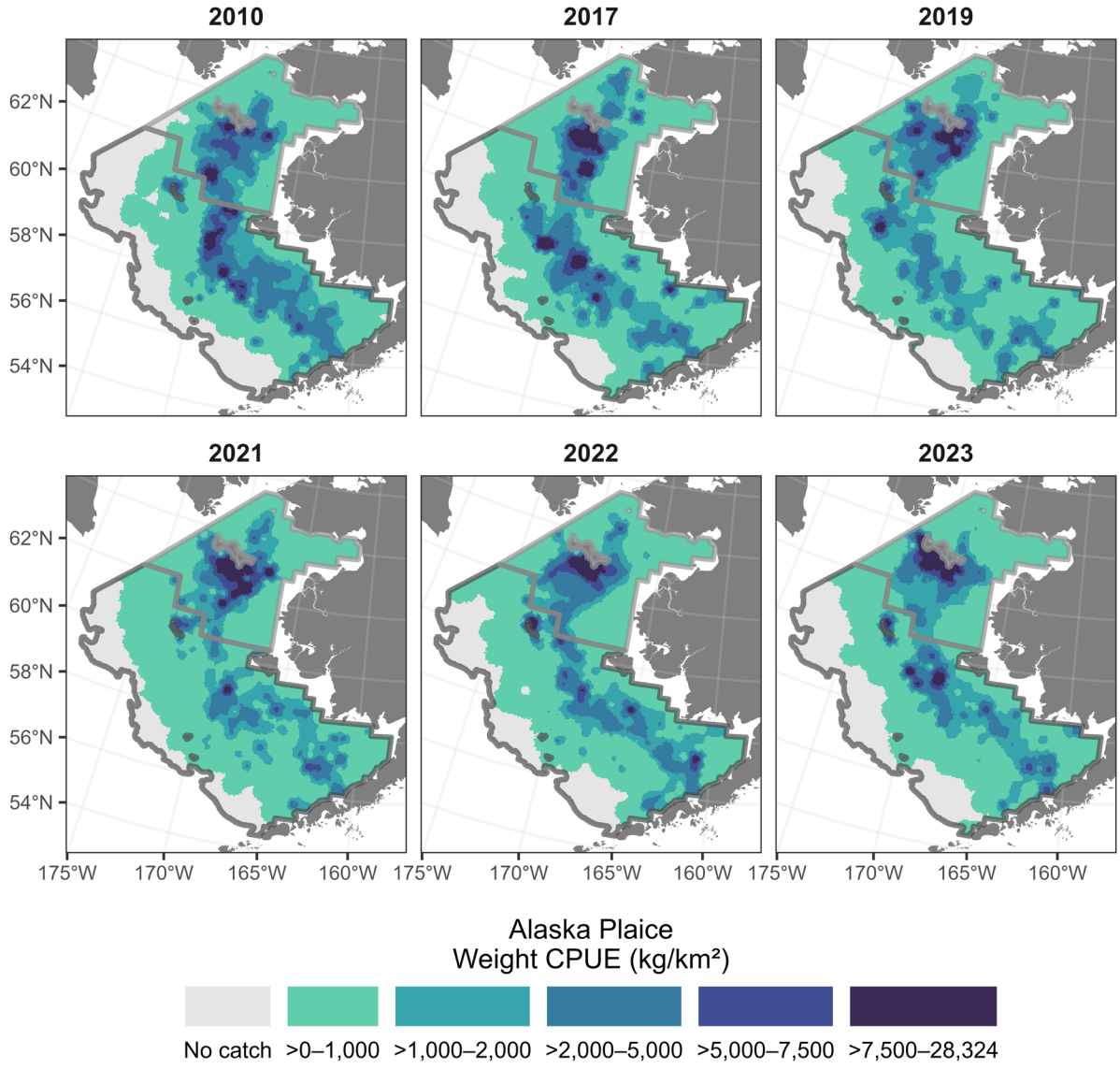

Figure 12. -- Weight CPUE (kg/km^2) distribution of Alaska plaice (*Pleuronectes quadrituberculatus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

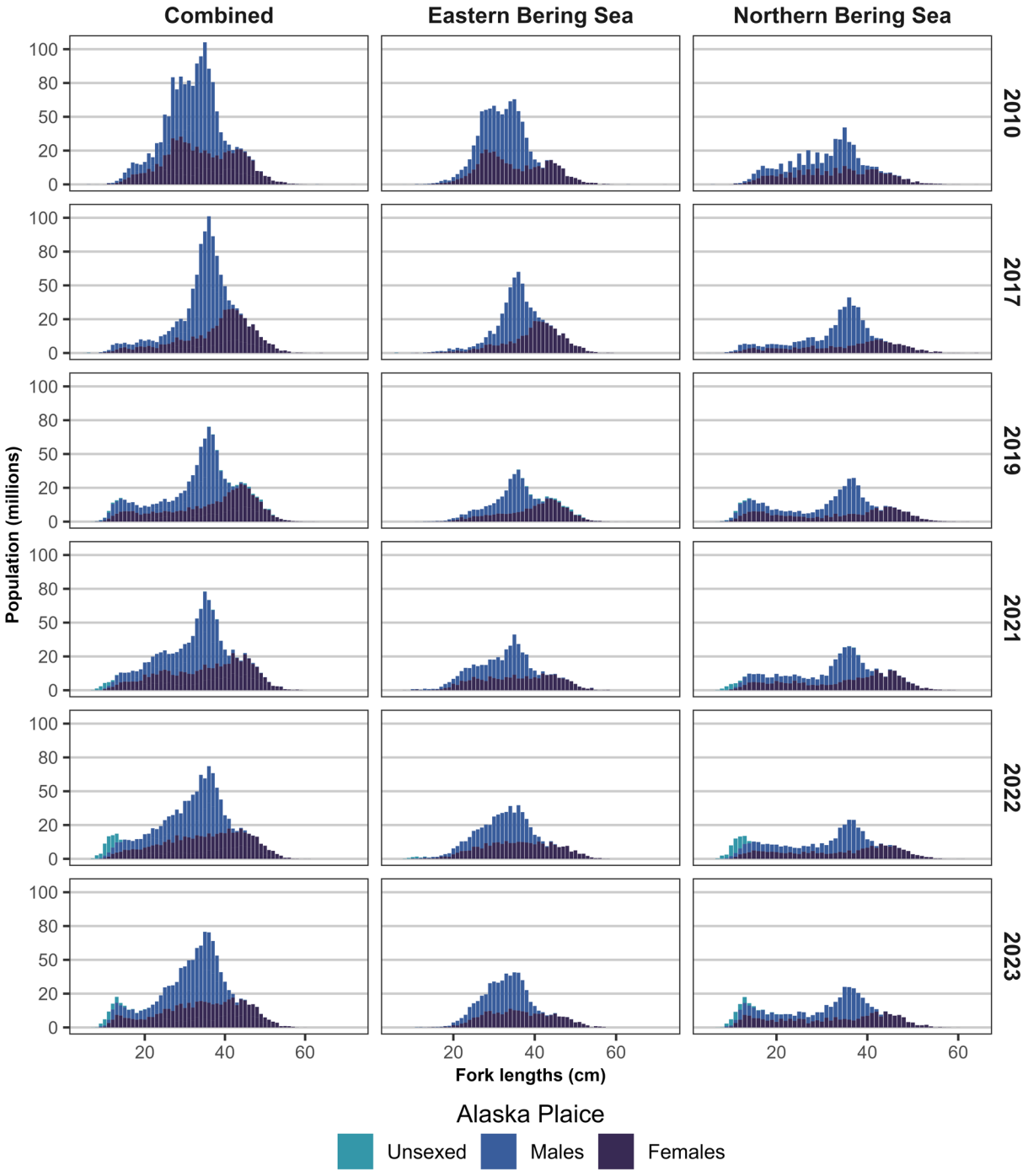

Figure 13. -- Total abundance-at-length estimates of Alaska plaice (*Pleuronectes quadrituberculatus*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 15. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for Alaska plaice (*Pleuronectes quadrituberculatus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	1,150.59	187.25	90,558	14,737	61,083	120,033	57
20	2,170.48	638.25	89,409	26,291	36,826	141,992	31
31	726.25	154.58	68,978	14,682	39,614	98,342	55
32	168.88	80.61	1,494	713	68	2,920	5
41	1,443.76	411.01	89,961	25,610	38,741	141,180	37
42	250.83	51.50	6,051	1,242	3,566	8,535	22
43	461.69	332.27	9,725	6,999	0	23,723	20
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	9.75	6.30	63	41	0	144	2
82	131.39	68.08	2,359	1,222	0	4,803	10
90	21.43	11.45	247	132	0	511	3
Total	**727.89**	**86.83**	**358,845**	**42,807**	**273,232**	**444,458**	**242**
Northern Bering Sea							
70	2,835.09	666.89	224,709	52,858	118,994	330,425	40
71	395.14	73.00	32,107	5,931	20,244	43,969	54
81	1,332.49	373.60	51,104	14,328	22,447	79,760	15
Total	**1,548.37**	**277.00**	**307,919**	**55,086**	**197,748**	**418,091**	**109**

Table 16. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for Alaska plaice (*Pleuronectes quadrituberculatus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	3,068.28	507.28	161,639.49	321,343.36	241,491.43	39,925.97	57
20	4,084.29	1,131.76	75,003.92	261,486.60	168,245.26	46,620.67	31
31	862.30	169.49	49,703.03	114,096.09	81,899.56	16,098.27	55
32	131.14	58.37	127.44	2,192.81	1,160.13	516.34	5
41	1,732.72	447.41	52,208.75	163,722.34	107,965.55	27,878.40	37
42	209.31	43.17	2,966.21	7,131.97	5,049.09	1,041.44	22
43	475.27	379.17	0.00	25,984.21	10,010.92	7,986.65	20
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	5.87	3.79	0.00	86.92	37.94	24.49	2
82	101.47	49.59	41.34	3,602.32	1,821.83	890.25	10
90	14.48	7.88	0.00	348.88	167.05	90.92	3
Total	**1,253.27**	**141.55**	**478,279.86**	**757,417.63**	**617,848.75**	**69,784.44**	**242**
Northern Bering Sea							
70	4,773.92	802.28	251,203.00	505,557.56	378,380.28	63,588.64	40
71	1,765.01	355.45	85,652.28	201,179.21	143,415.75	28,881.73	54
81	1,469.12	406.31	25,178.17	87,508.68	56,343.43	15,582.63	15
Total	**2,907.17**	**359.83**	**435,024.29**	**721,254.63**	**578,139.46**	**71,557.59**	**109**

Alaska Skate (*Arctoraja parmifera*)

Previous scientific name: *Bathyraja parmifera*

Between 2022 and 2023, the Alaska skate biomass estimate decreased by 10% in the eastern Bering Sea (Tables **17** and **18**; Fig. **14**) and the population was estimated at 98.3 million individuals (Tables **17** and **19**; Fig. **14**). The biomass estimate increased by 6% in the northern Bering Sea and the population was estimated at 12.2 million individuals.

Table 17. -- Summary of catch location environmental variables and biomass and population estimates for Alaska skate (*Arctoraja parmifera*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	351 of 376 (93.4%)	43 of 116 (37.1%)
Bottom Depth (m)	21 — 171	28 — 78
Bottom Temperature (°C)	-1.6 — 5.4	-1.6 — 8.7
Surface Temperature (°C)	1.7 — 11	6.3 — 10.1
Population	98.3 million	12.2 million
Biomass (t)	418,483	51,728
Biomass % Total	3.6%	1.9%
Biomass % Change	10% decrease from 2022	6% increase from 2022

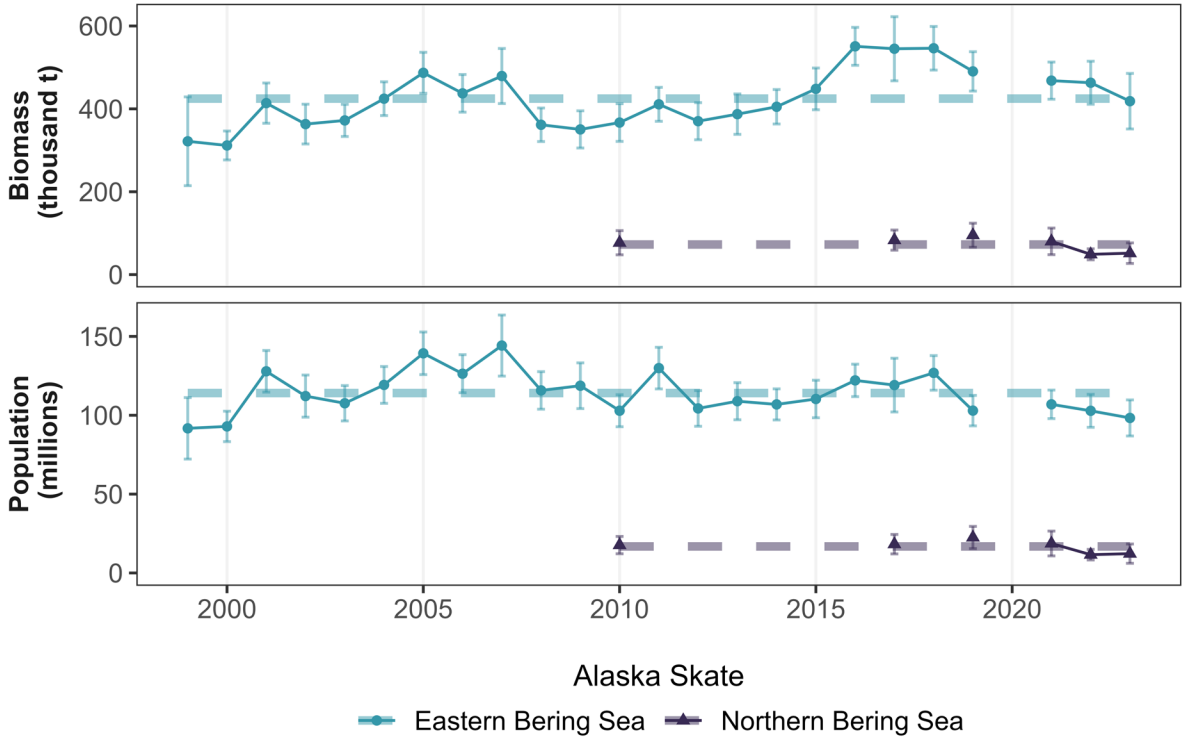

Figure 14. -- Time series of Alaska skate (*Arctoraja parmifera*) biomass (thousand t) and population (millions) from the 1999-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

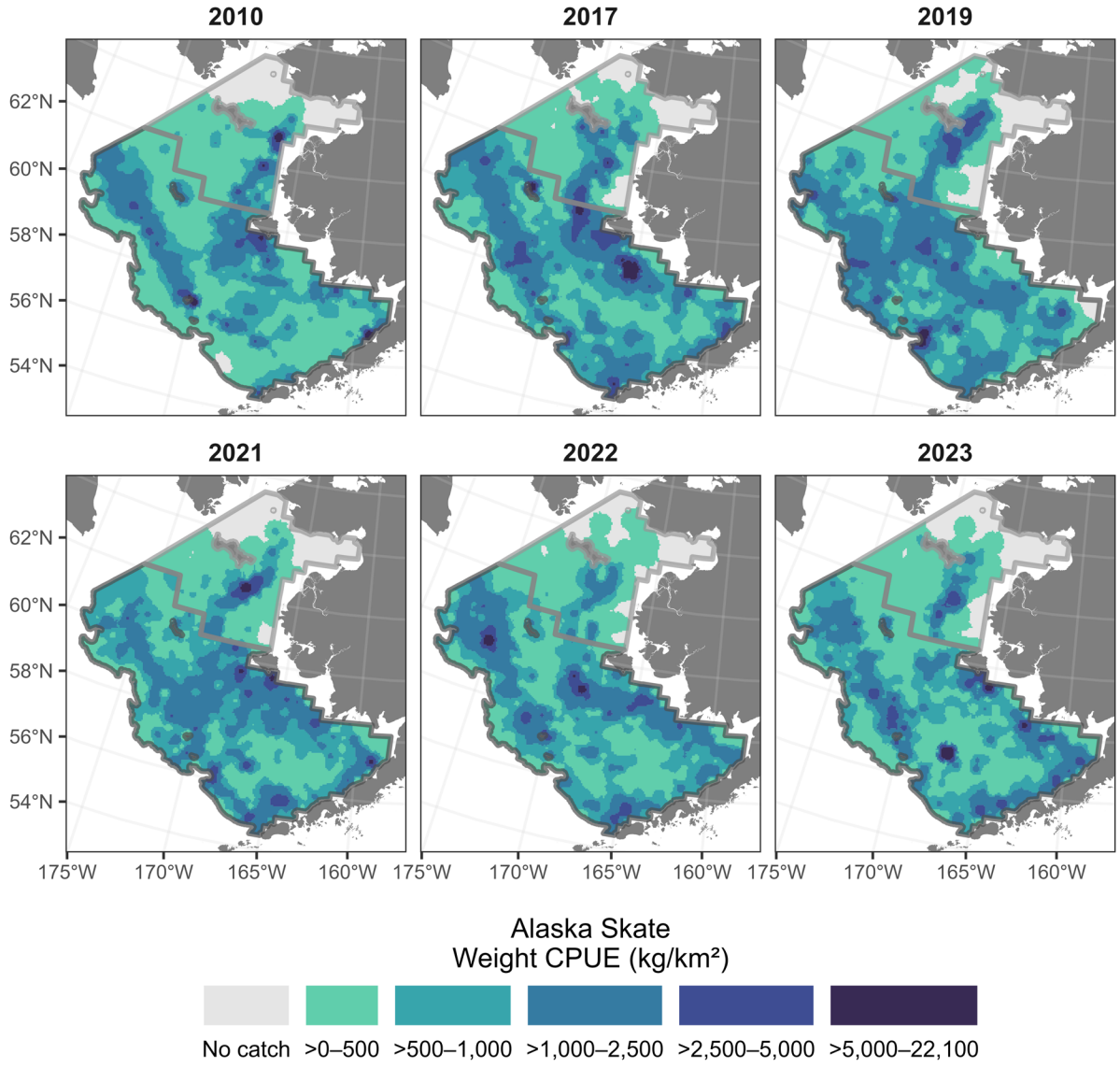

Figure 15. -- Weight CPUE (kg/km^2) distribution of Alaska skate (*Arctoraja parmifera*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

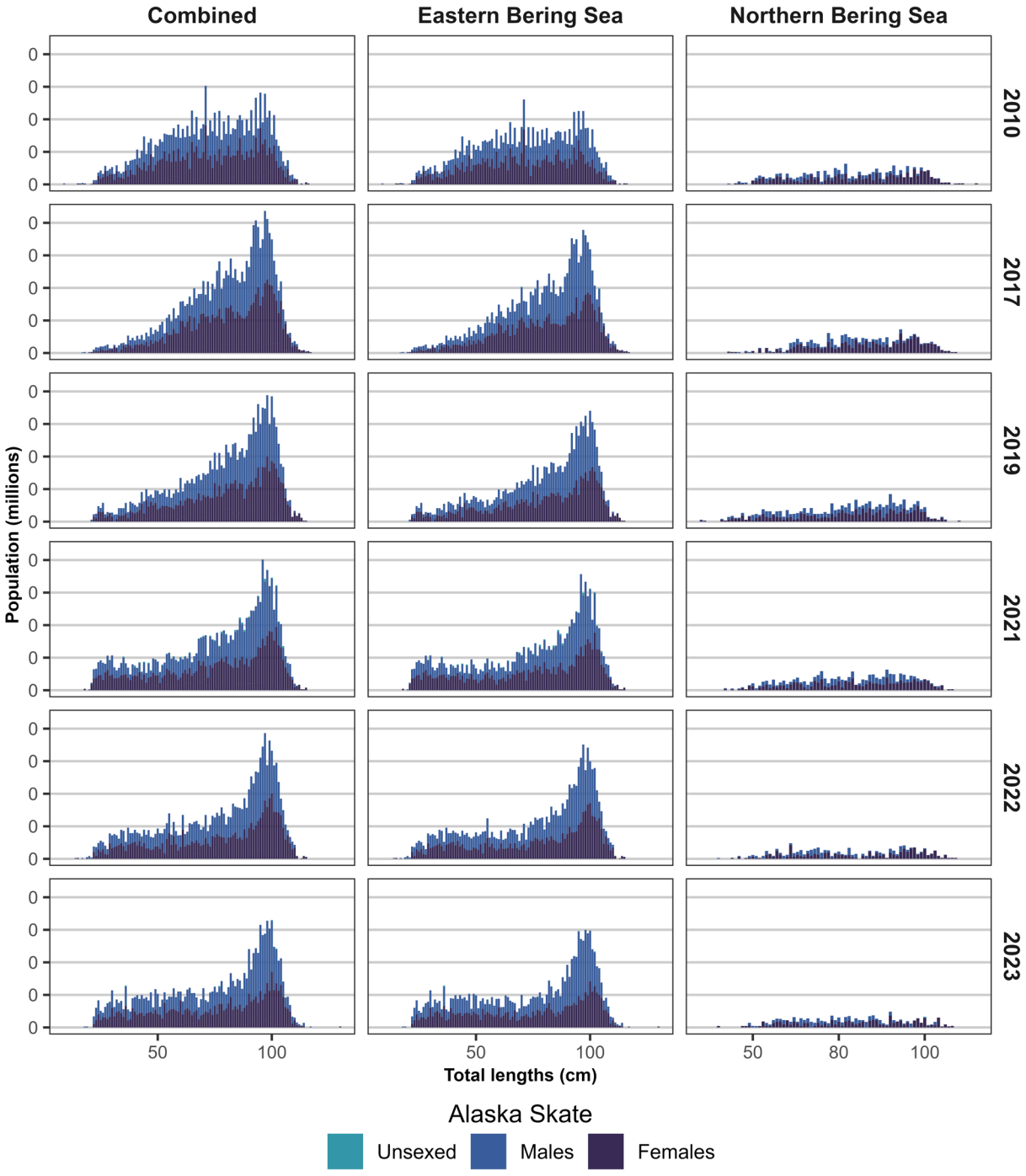

Figure 16. -- Total abundance-at-length estimates of Alaska skate (*Arctoraja parmifera*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 18. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (thousand t) with SD (thousand t), 95% lower (LCL; thousand t) and upper (UCL; thousand t) confidence limits, and number of hauls where species were weighed for Alaska skate (*Arctoraja parmifera*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (Kt)	Biomass SD (Kt)	95% LCL (Kt)	95% UCL (Kt)	Hauls w/weights
Eastern Bering Sea							
10	993.60	147.30	78.20	11.59	55.02	101.39	49
20	1,150.19	270.48	47.38	11.14	25.10	69.66	31
31	937.58	275.29	89.05	26.15	36.76	141.34	67
32	591.16	260.80	5.23	2.31	0.62	9.84	8
41	597.66	92.53	37.24	5.77	25.71	48.77	43
42	1,311.82	200.66	31.64	4.84	21.96	41.32	30
43	502.62	124.99	10.59	2.63	5.32	15.85	20
50	629.68	98.47	23.95	3.75	16.46	31.44	23
61	853.79	107.14	74.94	9.40	56.13	93.75	56
62	1,320.23	360.59	8.53	2.33	3.87	13.19	7
82	206.52	55.97	3.71	1.00	1.70	5.72	10
90	694.63	159.02	8.02	1.83	4.35	11.69	7
Total	**848.87**	**67.99**	**418.48**	**33.52**	**351.45**	**485.52**	**351**
Northern Bering Sea							
70	534.46	151.20	42.36	11.98	18.39	66.33	25
71	68.64	35.82	5.58	2.91	0.00	11.40	7
81	98.78	31.25	3.79	1.20	1.39	6.19	11
Total	**260.11**	**62.30**	**51.73**	**12.39**	**26.95**	**76.51**	**43**

Table 19. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for Alaska skate (*Arctoraja parmifera*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	187.33	25.04	10,801.55	18,686.10	14,743.82	1,971.14	49
20	234.54	42.91	6,126.16	13,197.15	9,661.66	1,767.75	31
31	239.09	42.14	14,704.74	30,712.60	22,708.67	4,001.97	67
32	179.47	46.63	762.68	2,412.79	1,587.73	412.53	8
41	164.36	25.14	7,108.05	13,374.92	10,241.49	1,566.72	43
42	265.13	33.45	4,782.03	8,009.12	6,395.58	806.77	30
43	166.59	33.31	2,105.55	4,912.29	3,508.92	701.69	20
50	97.78	16.99	2,427.09	5,011.76	3,719.43	646.17	23
61	221.65	24.82	15,097.87	23,813.07	19,455.47	2,178.80	56
62	395.61	83.68	1,474.82	3,637.62	2,556.22	540.70	7
82	57.61	12.41	588.55	1,479.93	1,034.24	222.84	10
90	231.93	52.45	1,465.94	3,886.63	2,676.29	605.17	7
Total	**199.37**	**11.59**	**86,858.50**	**109,720.53**	**98,289.51**	**5,715.51**	**351**
Northern Bering Sea							
70	124.97	37.79	3,915.34	15,895.20	9,905.27	2,994.96	25
71	8.75	4.53	0.00	1,446.46	710.84	367.81	7
81	42.40	12.20	690.07	2,562.09	1,626.08	468.01	11
Total	**61.56**	**15.35**	**6,135.11**	**18,349.28**	**12,242.19**	**3,053.54**	**43**

Antlered Sculpin (*Enophrys diceraus*)

Between 2022 and 2023, the antlered sculpin biomass estimate biomass estimate decreased by 15% in the northern Bering Sea (Tables **20** and **21**; Fig. **17**) and the population was estimated at 1.9 million individuals (Tables **20** and **22**; Fig. **17**). No antlered sculpin were observed in the eastern Bering Sea in 2023 (Fig. **18**).

Table 20. -- Summary of catch location environmental variables and biomass and population estimates for antlered sculpin (*Enophrys diceraus*) in the northern Bering Sea survey areas.

	Northern Bering Sea
Stations Present	14 of 116 (12.1%)
Bottom Depth (m)	16 — 45
Bottom Temperature (°C)	1.7 — 9.9
Surface Temperature (°C)	7.8 — 15.1
Population	1.9 million
Biomass (t)	104
Biomass % Total	<0.01%
Biomass % Change	15% decrease from 2022

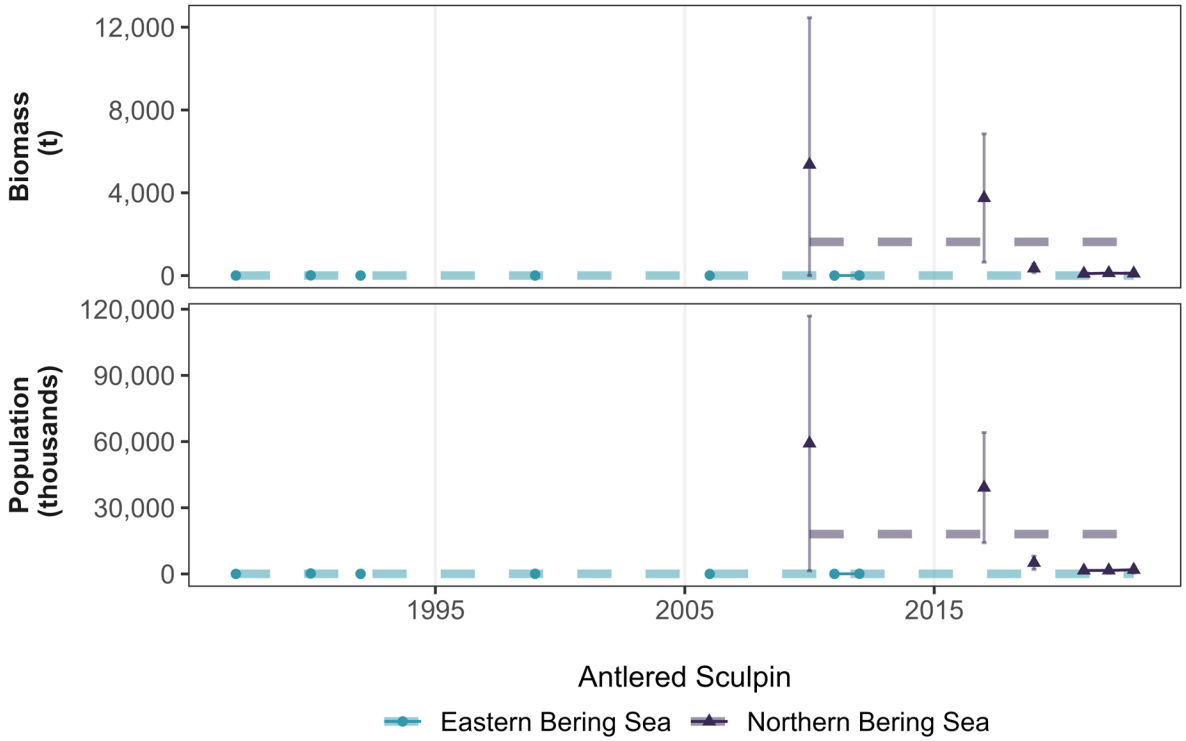

Figure 17. -- Time series of antlered sculpin (*Enophrys diceraus*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

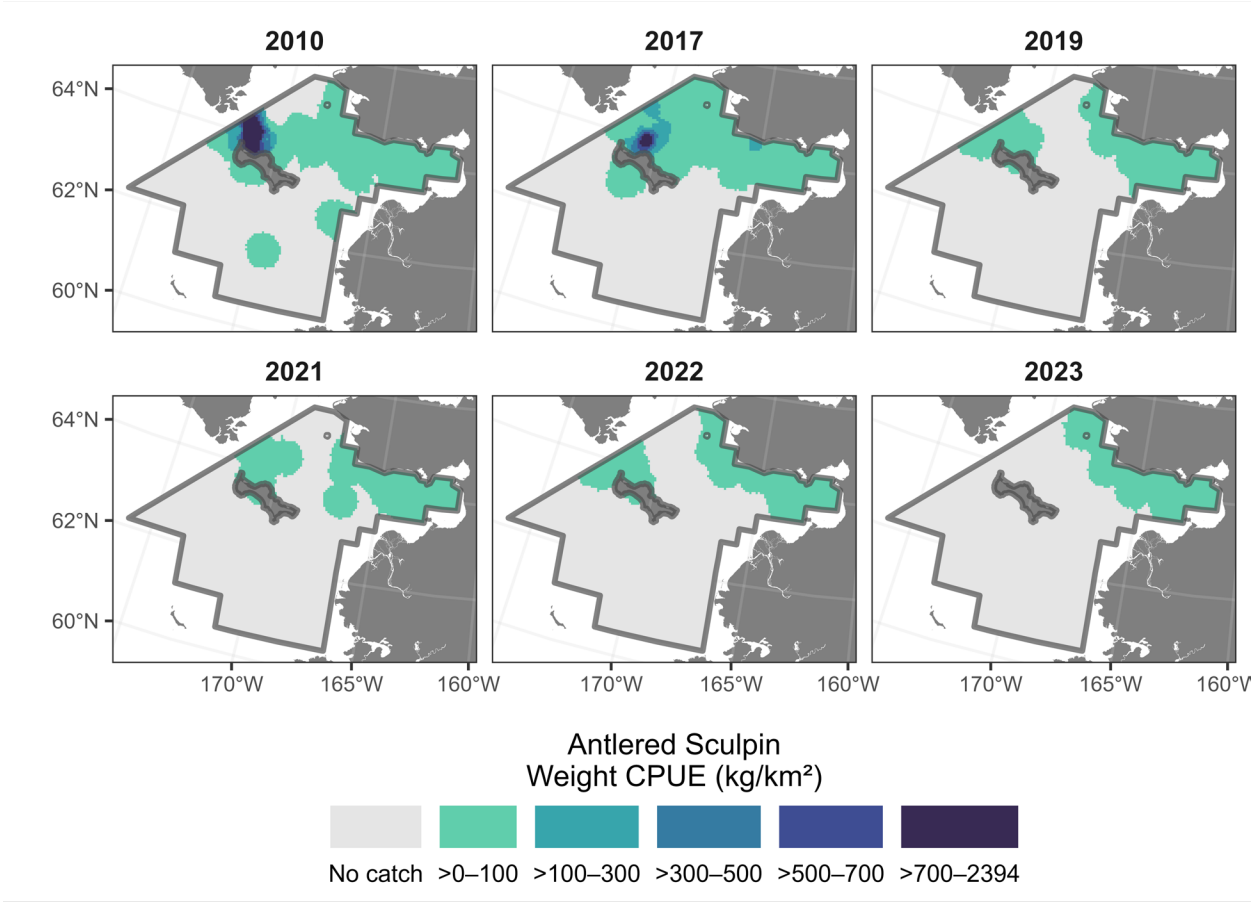

Figure 18. -- Weight CPUE (kg/km^2) distribution of antlered sculpin (*Enophrys diceraus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl survey. This species was not encountered in the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea shelf bottom trawl surveys.

Table 21. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for antlered sculpin (*Enophrys diceraus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 eastern Bering Sea shelf trawl survey.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Northern Bering Sea							
70	-	-	-	-	-	-	-
71	1.28	0.42	104	34	36	172	14
81	-	-	-	-	-	-	-
Total	**0.52**	**0.17**	**104**	**34**	**36**	**172**	**14**

Table 22. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (millions) with SD (thousands), 95% lower (LCL; millions) and upper (UCL; millions) confidence limits, and number of hauls where species were counted for antlered sculpin (*Enophrys diceraus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 eastern Bering Sea shelf trawl survey.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (M)	95% UCL (M)	Population (M)	Population SD (K)	Hauls w/counts
Northern Bering Sea							
70	-	-	-	-	-	-	-
71	23.32	9.30	0.38	3.41	1.90	755.89	14
81	-	-	-	-	-	-	-
Total	**9.53**	**3.80**	**0.38**	**3.41**	**1.90**	**755.89**	**14**

Arctic Cod (*Boreogadus saida*)

Between 2022 and 2023, the Arctic cod biomass estimate decreased by 98% in the eastern Bering Sea (Tables **23** and **24**; Fig. **19**) and the population was estimated at 43,501 individuals (Tables **23** and **25**; Fig. **19**). Similarly, the biomass estimate decreased by 91% in the northern Bering Sea and the population was estimated at 977,437 individuals.

Table 23. -- Summary of catch location environmental variables and biomass and population estimates for Arctic cod (*Boreogadus saida*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	1 of 376 (0.3%)	18 of 116 (15.5%)
Bottom Depth (m)	60	16 — 70
Bottom Temperature (°C)	-0.2	-1.3 — 9.9
Surface Temperature (°C)	8.1	5.4 — 15.1
Population	43,501	977,437
Biomass (t)	1	35
Biomass % Total	<0.01%	<0.01%
Biomass % Change	98% decrease from 2022	91% decrease from 2022

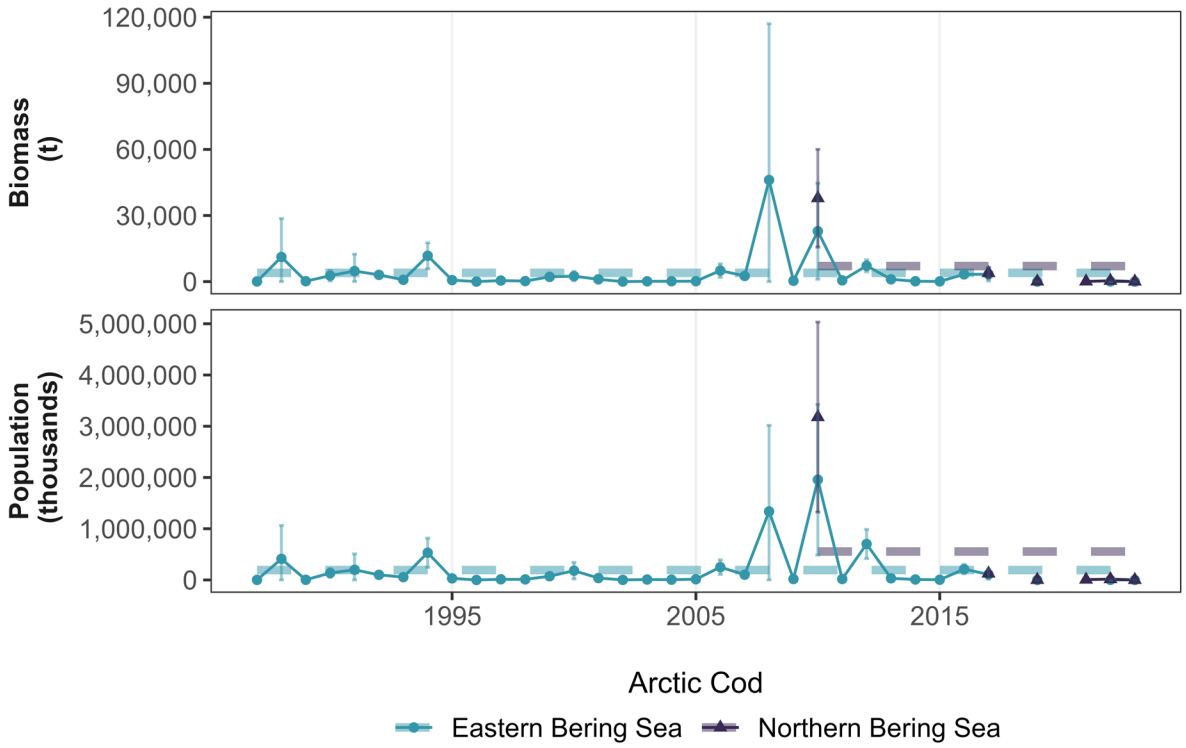

Figure 19. -- Time series of Arctic cod (*Boreogadus saida*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

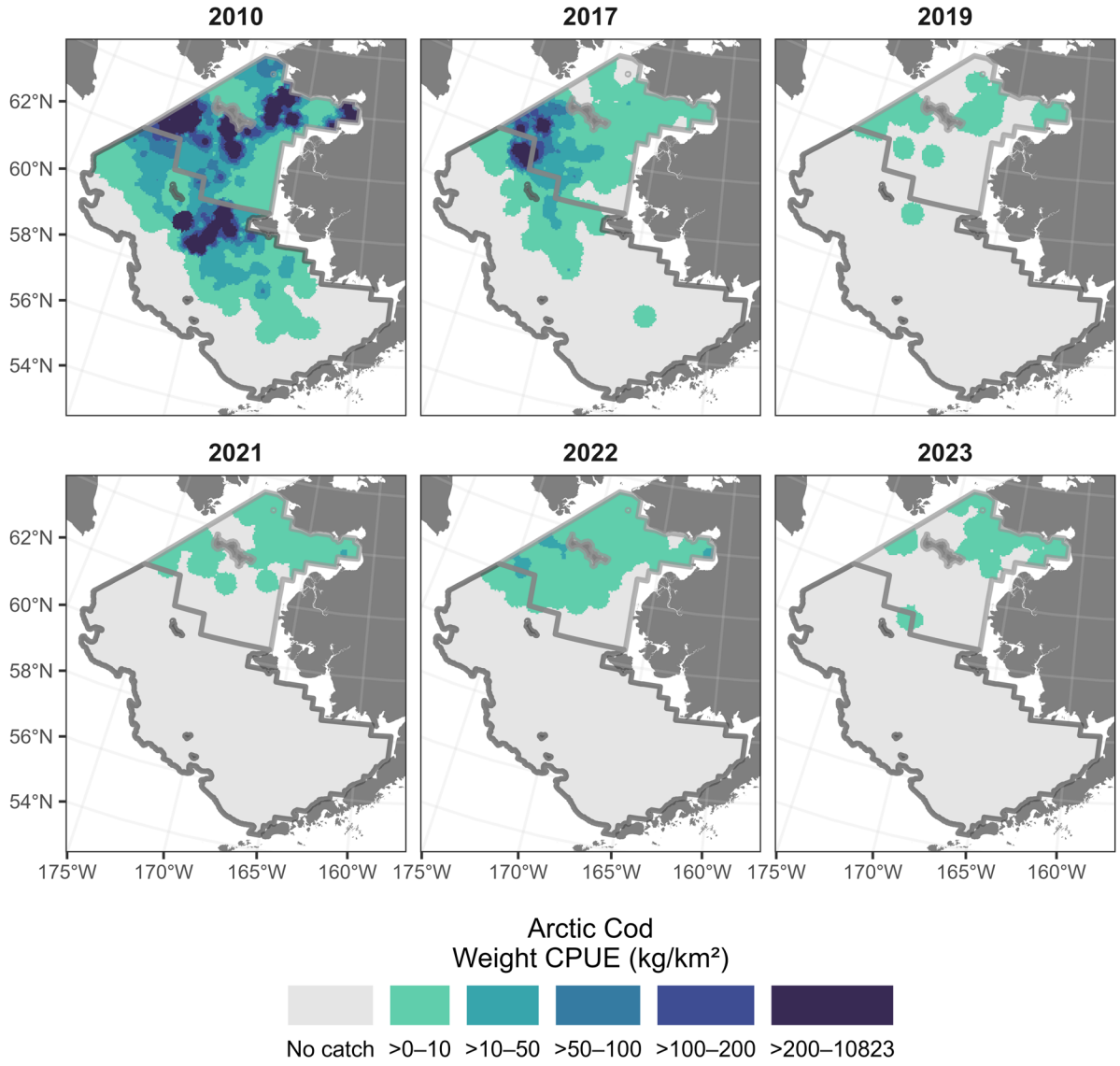

Figure 20. -- Weight CPUE (kg/km^2) distribution of Arctic cod (*Boreogadus saida*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 24. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for Arctic cod (*Boreogadus saida*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	0.02	0.02	1	1	0	3	1
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**0.00**	**0.00**	**1**	**1**	**0**	**3**	**1**
Northern Bering Sea							
70	-	-	-	-	-	-	-
71	0.35	0.10	28	8	13	44	17
81	0.17	0.17	6	6	0	19	1
Total	**0.17**	**0.05**	**35**	**10**	**14**	**55**	**18**

Table 25. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for Arctic cod (*Boreogadus saida*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	0.70	0.70	0.00	130.50	43.50	43.50	1
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**0.09**	**0.09**	**0.00**	**130.50**	**43.50**	**43.50**	**1**
Northern Bering Sea							
70	-	-	-	-	-	-	-
71	10.35	2.51	432.86	1,248.92	840.89	204.01	16
81	3.56	3.56	0.00	409.63	136.54	136.54	1
Total	**4.92**	**1.23**	**486.45**	**1,468.42**	**977.44**	**245.49**	**17**

Arctic Staghorn Sculpin (*Gymnocanthus tricuspis*)

Between 2022 and 2023, the Arctic staghorn sculpin biomass estimate biomass estimate decreased by 91% in the northern Bering Sea (Tables **26** and **27**; Fig. **21**) and the population was estimated at 1.2 million individuals (Tables **26** and **28**; Fig. **21**). No Arctic staghorn sculpin were observed in the eastern Bering Sea in 2023 (Fig. **22**).

Table 26. -- Summary of catch location environmental variables and biomass and population estimates for Arctic staghorn sculpin (*Gymnocanthus tricuspis*) in the northern Bering Sea survey areas.

	Northern Bering Sea
Stations Present	1 of 116 (0.9%)
Bottom Depth (m)	15
Bottom Temperature (°C)	8.5
Surface Temperature (°C)	14.2
Population	1.2 million
Biomass (t)	15
Biomass % Total	<0.01%
Biomass % Change	91% decrease from 2022

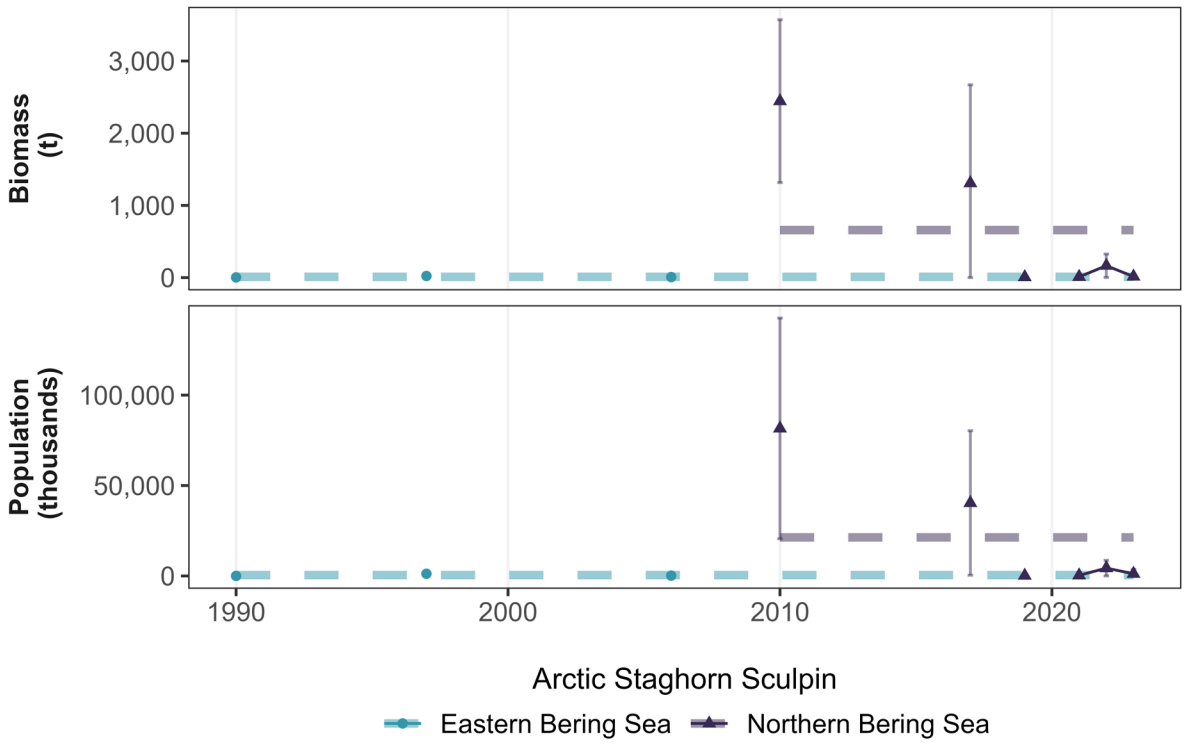

Figure 21. -- Time series of Arctic staghorn sculpin (*Gymnocanthus tricuspis*) biomass (t) and population (thousands) from the 1990-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

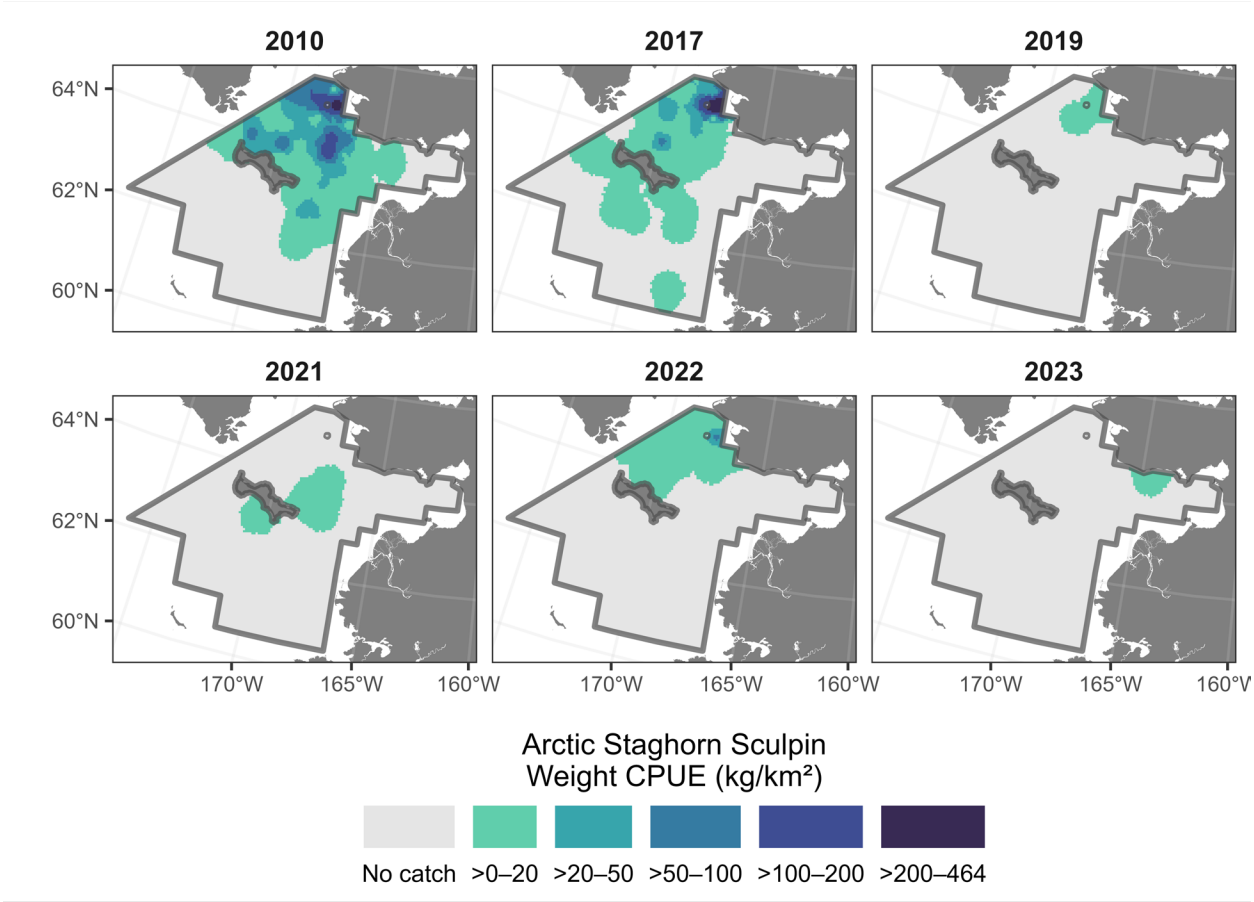

Figure 22. -- Weight CPUE (kg/km^2) distribution of Arctic staghorn sculpin (*Gymnocanthus tricuspis*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl survey. This species was not encountered in the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea shelf bottom trawl surveys.

Table 27. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for Arctic staghorn sculpin (*Gymnocanthus tricuspis*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 eastern Bering Sea shelf trawl survey.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Northern Bering Sea							
70	-	-	-	-	-	-	-
71	0.18	0.18	15	15	0	45	1
81	-	-	-	-	-	-	-
Total	**0.08**	**0.08**	**15**	**15**	**0**	**45**	**1**

Table 28. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (millions) with SD (millions), 95% lower (LCL; millions) and upper (UCL; millions) confidence limits, and number of hauls where species were counted for Arctic staghorn sculpin (*Gymnocanthus tricuspis*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 eastern Bering Sea shelf trawl survey.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (M)	95% UCL (M)	Population (M)	Population SD (M)	Hauls w/counts
Northern Bering Sea							
70	-	-	-	-	-	-	-
71	14.85	14.85	0.00	3.62	1.21	1.21	1
81	-	-	-	-	-	-	-
Total	**6.07**	**6.07**	**0.00**	**3.62**	**1.21**	**1.21**	**1**

Arrowtooth Flounder (*Atheresthes stomias*)

Between 2022 and 2023, the arrowtooth flounder biomass estimate decreased by 11% in the eastern Bering Sea (Tables **29** and **30**; Fig. **23**) and the population was estimated at 861.3 million individuals (Tables **29** and **31**; Fig. **23**). No arrowtooth flounder were observed in the northern Bering Sea in 2023 (Fig. **24**).

Arrowtooth flounder generally inhabit deeper waters as adults, but primarily occupy the shelf waters until age four. As individuals mature, they begin to recruit to the upper continental slope waters (Spies et al., 2018). Thus, the shelf survey estimates are not synoptically inclusive of the entire population. Arrowtooth flounder have been mostly absent from the northern Bering Sea because they prefer deeper waters, further indicated by their distributions in the eastern Bering Sea, where a large majority of the total estimated biomass occurs in the middle and outer domains (Fig. **24**). As with all previous years, females outnumbered males, at a rate of approximately 2:1, with females attaining larger average sizes (Fig. **25**). This disparity in sex ratio has been attributed to sex-specific differences in natural mortality rates, but the issue requires further research (Zimmermann and Goddard, 1996; Spies et al., 2018). The length mode for Arrowtooth flounder was approximately 38 cm in the eastern Bering Sea, with a relative decline in the number of individuals detected below 20 cm and above 40 cm, compared to 2022 (Fig. **25**).

Arrowtooth flounder are morphologically similar to the congeneric Kamchatka flounder (Yang, 1988), and methods to reliably distinguish between the two species were not adopted on AFSC bottom trawl surveys until 1994. Arrowtooth flounder and Kamchatka founder occupy similar areas, though in 2023, arrowtooth flounder were more abundant in the southern end of the eastern Bering Sea than Kamchatka flounder, for which abundance was greater in the northwestern edge (Fig. **24** and **49**). Arrowtooth flounder are much more abundant than Kamchatka flounder in the eastern Bering Sea.

Table 29. -- Summary of catch location environmental variables and biomass and population estimates for arrowtooth flounder (*Atheresthes stomias*) in the eastern Bering Sea survey areas.

	Eastern Bering Sea
Stations Present	227 of 376 (60.4%)
Bottom Depth (m)	37 — 171
Bottom Temperature (°C)	0 — 5.4
Surface Temperature (°C)	2.8 — 10.7
Population	861.3 million
Biomass (t)	462,575
Biomass % Total	3.9%
Biomass % Change	11% decrease from 2022

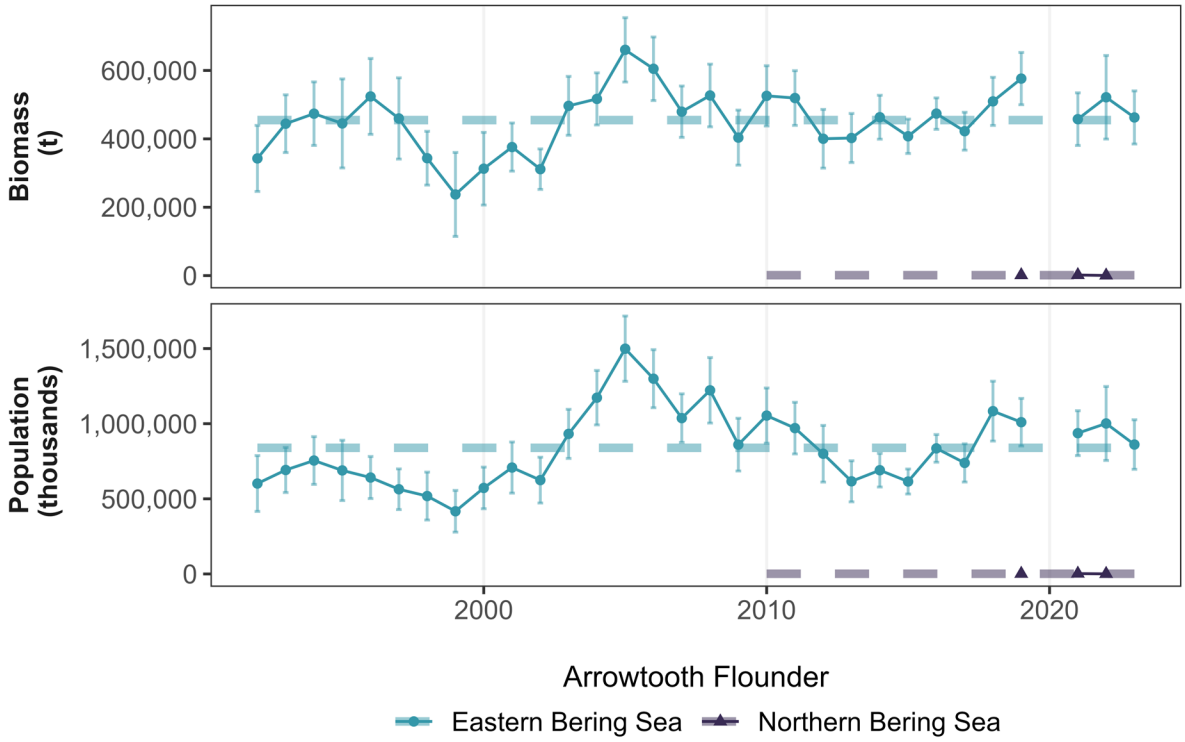

Figure 23. -- Time series of arrowtooth flounder (*Atheresthes stomias*) biomass (t) and population (thousands) from the 1992-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

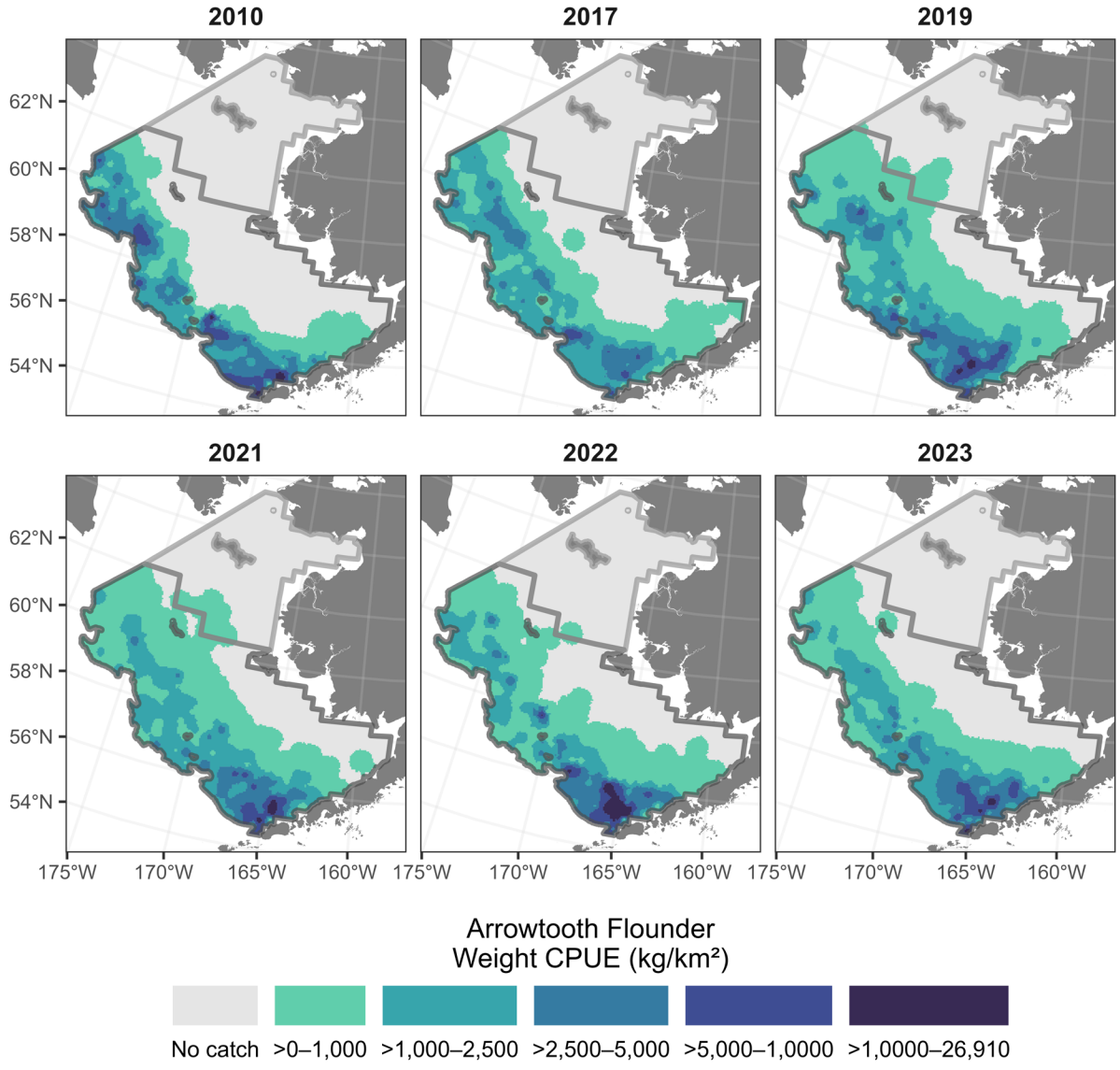

Figure 24. -- Weight CPUE (kg/km^2) distribution of arrowtooth flounder (*Atheresthes stomias*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

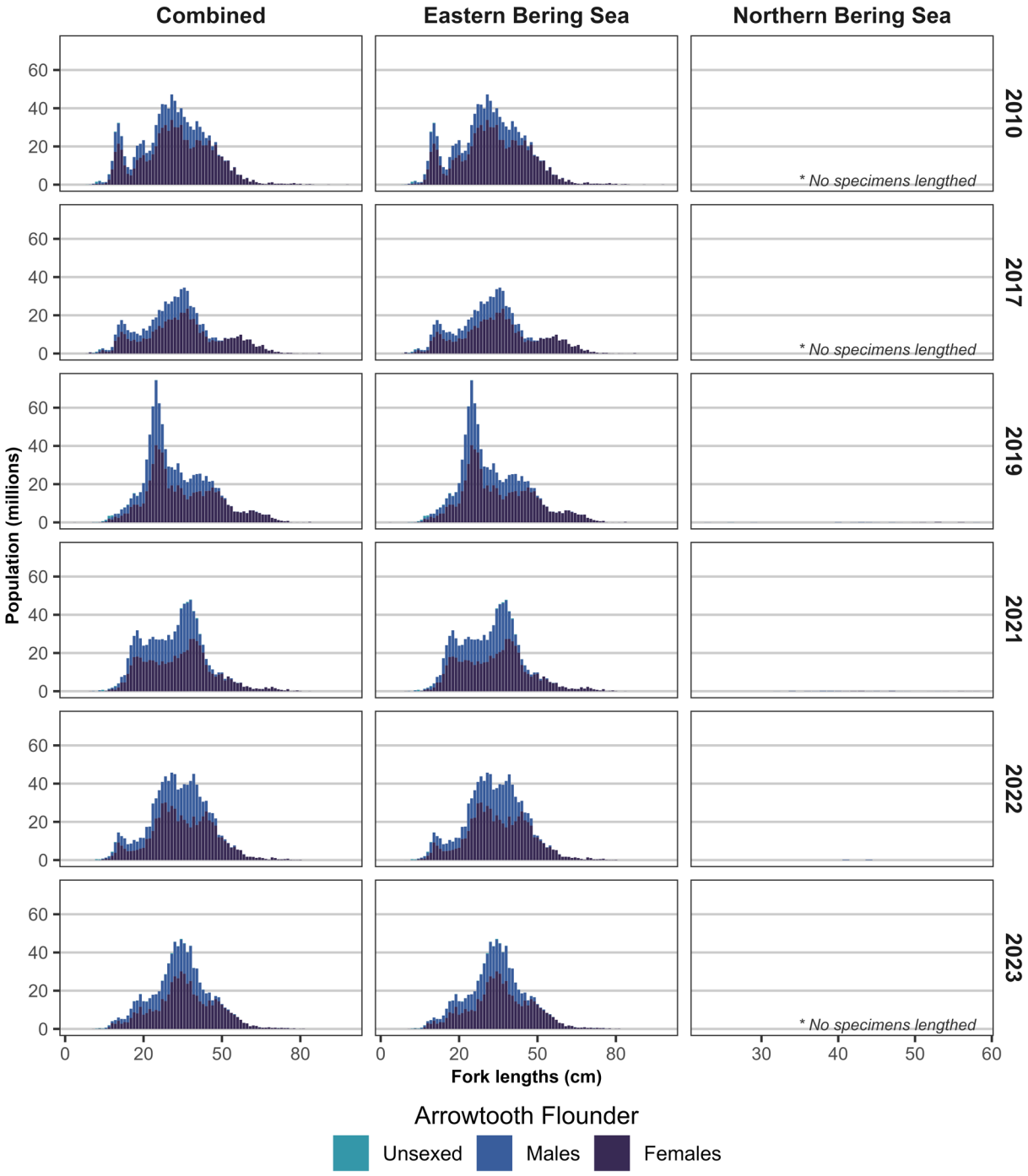

Figure 25. -- Total abundance-at-length estimates of arrowtooth flounder (*Atheresthes stomias*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 30. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (thousand t) with SD (t), 95% lower (LCL; thousand t) and upper (UCL; thousand t) confidence limits, and number of hauls where species were weighed for arrowtooth flounder (*Atheresthes stomias*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (Kt)	Biomass SD (t)	95% LCL (Kt)	95% UCL (Kt)	Hauls w/weights
Eastern Bering Sea							
10	57.36	30.98	4.51	2,438	0.00	9.39	7
20	-	-	-	-	-	-	-
31	2,080.98	363.70	197.65	34,544	128.56	266.74	61
32	2,333.67	337.88	20.65	2,989	14.67	26.62	8
41	252.83	90.78	15.75	5,657	4.44	27.07	14
42	1,477.51	247.40	35.64	5,968	23.71	47.58	30
43	85.58	38.58	1.80	813	0.18	3.43	8
50	2,693.25	343.75	102.45	13,076	76.30	128.60	26
61	913.97	86.83	80.23	7,622	64.98	95.47	60
62	422.08	220.94	2.73	1,428	0.00	5.58	6
82	-	-	-	-	-	-	-
90	101.26	61.38	1.17	708	0.00	2.59	7
Total	**938.31**	**78.77**	**462.58**	**38,833**	**384.91**	**540.24**	**227**

Table 31. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (millions) with SD (thousands), 95% lower (LCL; millions) and upper (UCL; millions) confidence limits, and number of hauls where species were counted for arrowtooth flounder (*Atheresthes stomias*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (M)	95% UCL (M)	Population (M)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	137.19	97.60	0.00	26.16	10.80	7,681.81	7
20	-	-	-	-	-	-	-
31	4,120.13	806.26	238.17	544.48	391.32	76,576.93	61
32	4,959.21	934.52	27.34	60.41	43.87	8,267.43	8
41	395.46	151.10	5.81	43.47	24.64	9,414.80	14
42	3,042.55	563.56	46.20	100.58	73.39	13,594.27	30
43	142.68	76.28	0.00	6.22	3.01	1,606.82	8
50	4,723.16	501.89	141.48	217.85	179.66	19,091.22	26
61	1,479.46	139.11	105.44	154.28	129.86	12,210.67	60
62	493.13	250.94	0.00	6.43	3.19	1,621.46	6
82	-	-	-	-	-	-	-
90	138.61	79.60	0.00	3.44	1.60	918.54	7
Total	**1,747.19**	**167.08**	**696.61**	**1,026.08**	**861.35**	**82,367.83**	**227**

Bering Flounder (*Hippoglossoides robustus*)

Between 2022 and 2023, the Bering flounder biomass estimate increased by 9% in the eastern Bering Sea (Tables **32** and **33**; Fig. **26**) and the population was estimated at 33.7 million individuals (Tables **32** and **34**; Fig. **26**). The biomass estimate decreased by 20% in the northern Bering Sea and the population was estimated at 107.1 million individuals.

In 2023, the distribution of Bering flounder contracted in the eastern Bering sea, compared to 2022, while their distribution in the northern Bering sea was largely consistent with 2022 (Fig. **27**). In the northern Bering Sea, Bering flounder were found north of 58°N, with highest densities found north west of St. Matthew Island (Fig. **27**).

A high proportion of juveniles in the northern Bering Sea was observed in the size distribution for 2023, with length modes at approximately 10 and 15 cm. There were fewer individuals above 30 cm observed in 2023 than in 2022 (Fig. **28**).

Table 32. -- Summary of catch location environmental variables and biomass and population estimates for Bering flounder (*Hippoglossoides robustus*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	60 of 376 (16.0%)	79 of 116 (68.1%)
Bottom Depth (m)	44 — 128	18 — 74
Bottom Temperature (°C)	-1.6 — 2.1	-1.6 — 9.3
Surface Temperature (°C)	2.2 — 11	4.5 — 14.6
Population	33.7 million	107.1 million
Biomass (t)	6,813	4,704
Biomass % Total	0.1%	0.2%
Biomass % Change	9% increase from 2022	20% decrease from 2022

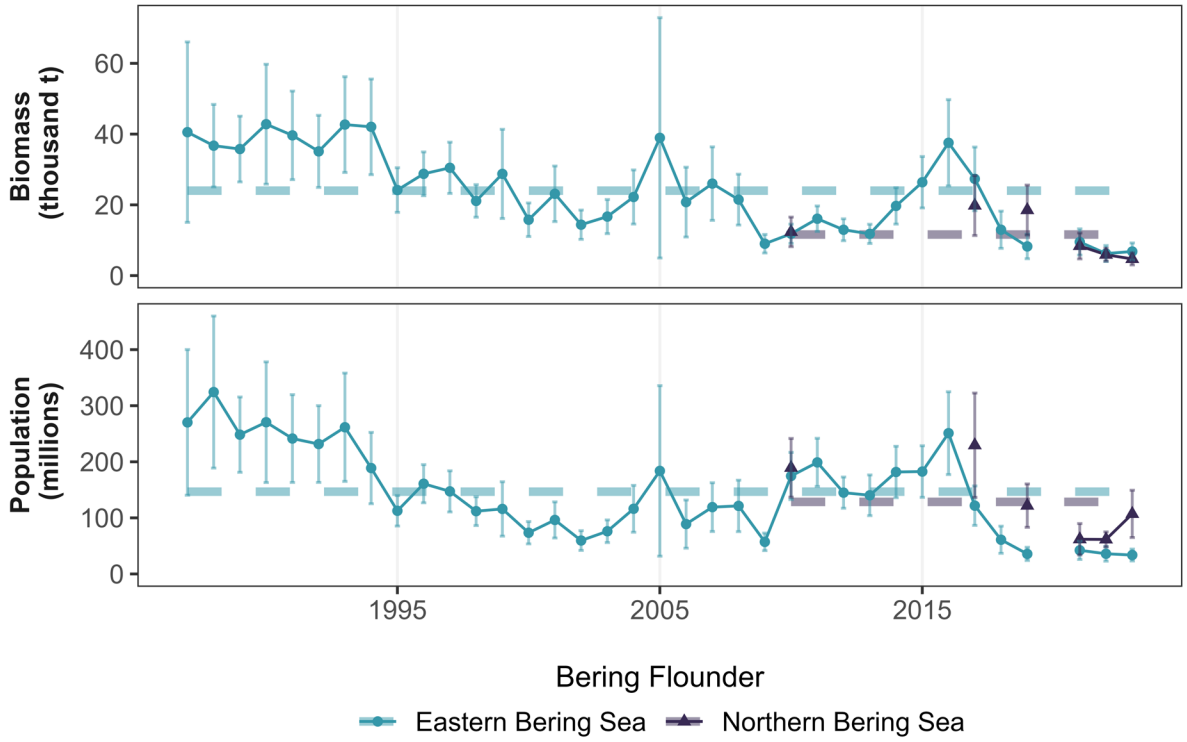

Figure 26. -- Time series of Bering flounder (*Hippoglossoides robustus*) biomass (thousand t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

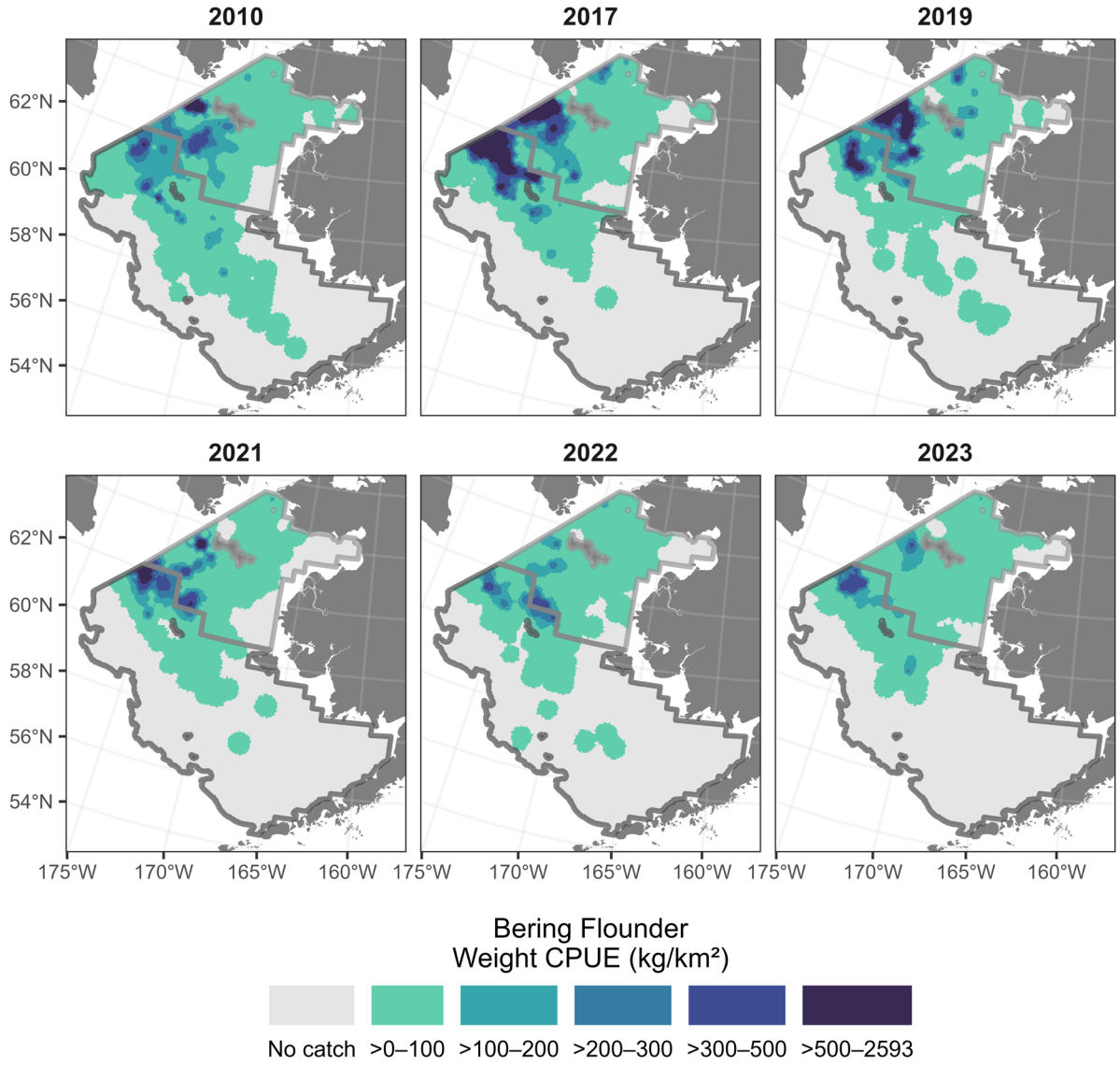

Figure 27. -- Weight CPUE (kg/km^2) distribution of Bering flounder (*Hippoglossoides robustus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

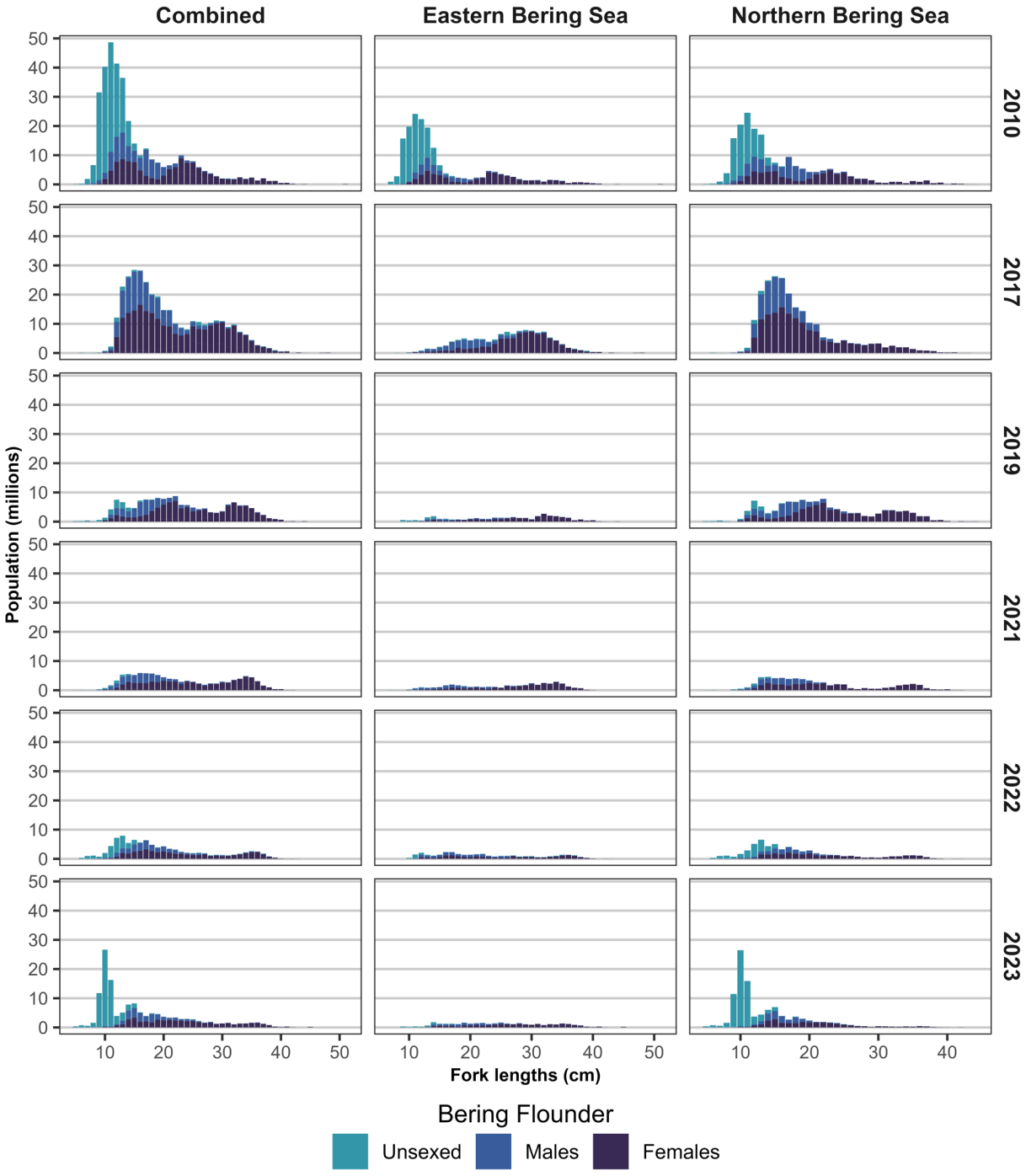

Figure 28. -- Total abundance-at-length estimates of Bering flounder (*Hippoglossoides robustus*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 33. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for Bering flounder (*Hippoglossoides robustus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	0.34	0.34	14	14	0	41	1
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	31.78	7.52	1,980	469	1,043	2,918	24
42	-	-	-	-	-	-	-
43	13.26	3.73	279	78	122	436	13
50	-	-	-	-	-	-	-
61	0.90	0.69	79	60	0	200	2
62	4.83	4.83	31	31	0	94	1
82	158.34	46.19	2,843	829	1,184	4,501	12
90	137.50	63.71	1,587	735	116	3,057	7
Total	**13.82**	**2.45**	**6,813**	**1,208**	**4,398**	**9,229**	**60**
Northern Bering Sea							
70	14.17	4.27	1,123	339	446	1,800	27
71	10.35	2.75	841	223	395	1,288	35
81	71.44	19.35	2,740	742	1,256	4,224	17
Total	**23.66**	**4.25**	**4,704**	**846**	**3,013**	**6,395**	**79**

Table 34. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for Bering flounder (*Hippoglossoides robustus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	5.91	5.91	0.00	729.86	243.29	243.29	1
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	206.45	42.08	7,619.96	18,108.21	12,864.08	2,622.06	24
42	-	-	-	-	-	-	-
43	77.81	23.10	666.11	2,612.02	1,639.07	486.48	13
50	-	-	-	-	-	-	-
61	4.05	3.00	0.00	881.09	355.06	263.02	2
62	35.33	35.33	0.00	684.89	228.29	228.30	1
82	619.81	178.31	4,725.37	17,530.38	11,127.88	3,201.25	12
90	630.79	282.40	761.43	13,796.00	7,278.71	3,258.64	7
Total	**68.43**	**10.76**	**23,123.34**	**44,349.41**	**33,736.38**	**5,306.52**	**60**
Northern Bering Sea							
70	523.83	167.15	15,021.52	68,015.67	41,518.60	13,248.54	26
71	482.37	180.39	9,879.24	68,510.15	39,194.69	14,657.73	34
81	687.47	190.44	11,758.56	40,973.27	26,365.91	7,303.68	17
Total	**538.45**	**105.92**	**64,950.05**	**149,208.36**	**107,079.20**	**21,064.58**	**77**

Bering Skate (*Bathyraja interrupta*)

Between 2022 and 2023, the Bering skate biomass estimate increased by 6% in the eastern Bering Sea (Tables **35** and **36**; Fig. **29**) and the population was estimated at 7.9 million individuals (Tables **35** and **37**; Fig. **29**). No Bering skate were observed in the northern Bering Sea in 2023 (Fig. **30**).

Table 35. -- Summary of catch location environmental variables and biomass and population estimates for Bering skate (*Bathyraja interrupta*) in the eastern Bering Sea survey areas.

	Eastern Bering Sea
Stations Present	103 of 376 (27.4%)
Bottom Depth (m)	70 — 171
Bottom Temperature (°C)	-1.3 — 5.4
Surface Temperature (°C)	4.9 — 10.3
Population	7.9 million
Biomass (t)	13,524
Biomass % Total	0.1%
Biomass % Change	6% increase from 2022

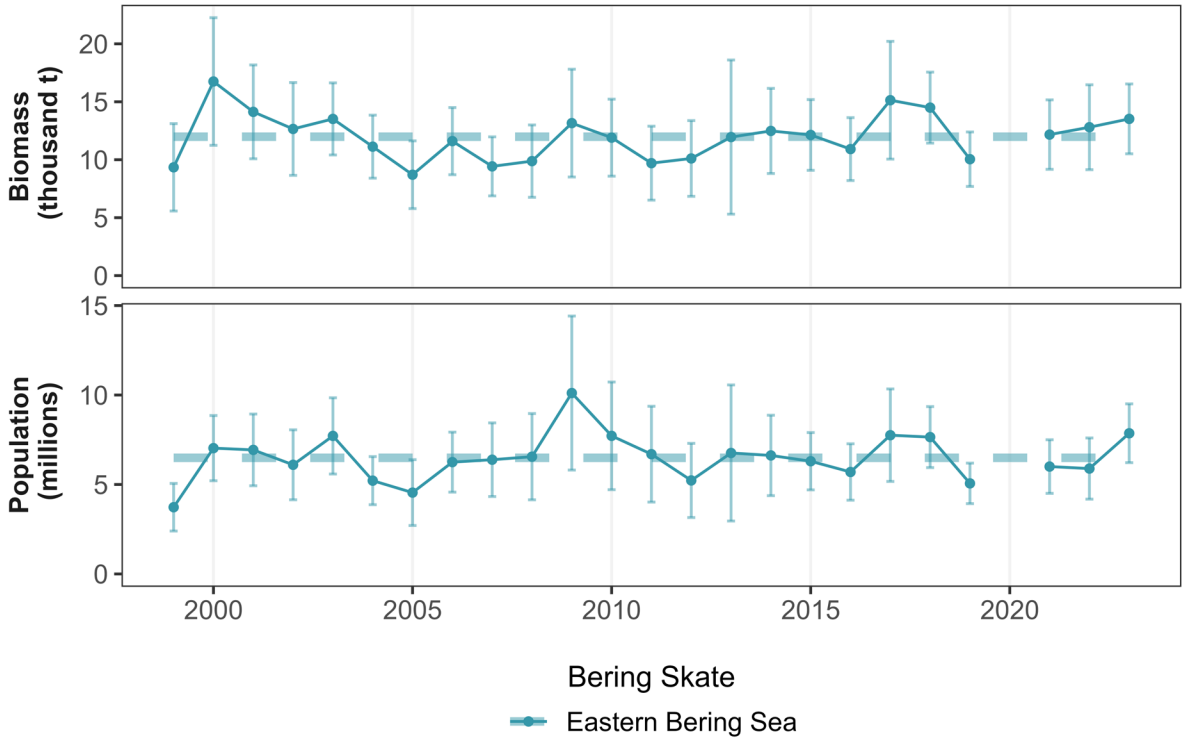

Figure 29. -- Time series of Bering skate (*Bathyraja interrupta*) biomass (thousand t) and population (millions) from the 1999-2023 eastern Bering Sea shelf bottom trawl survey. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

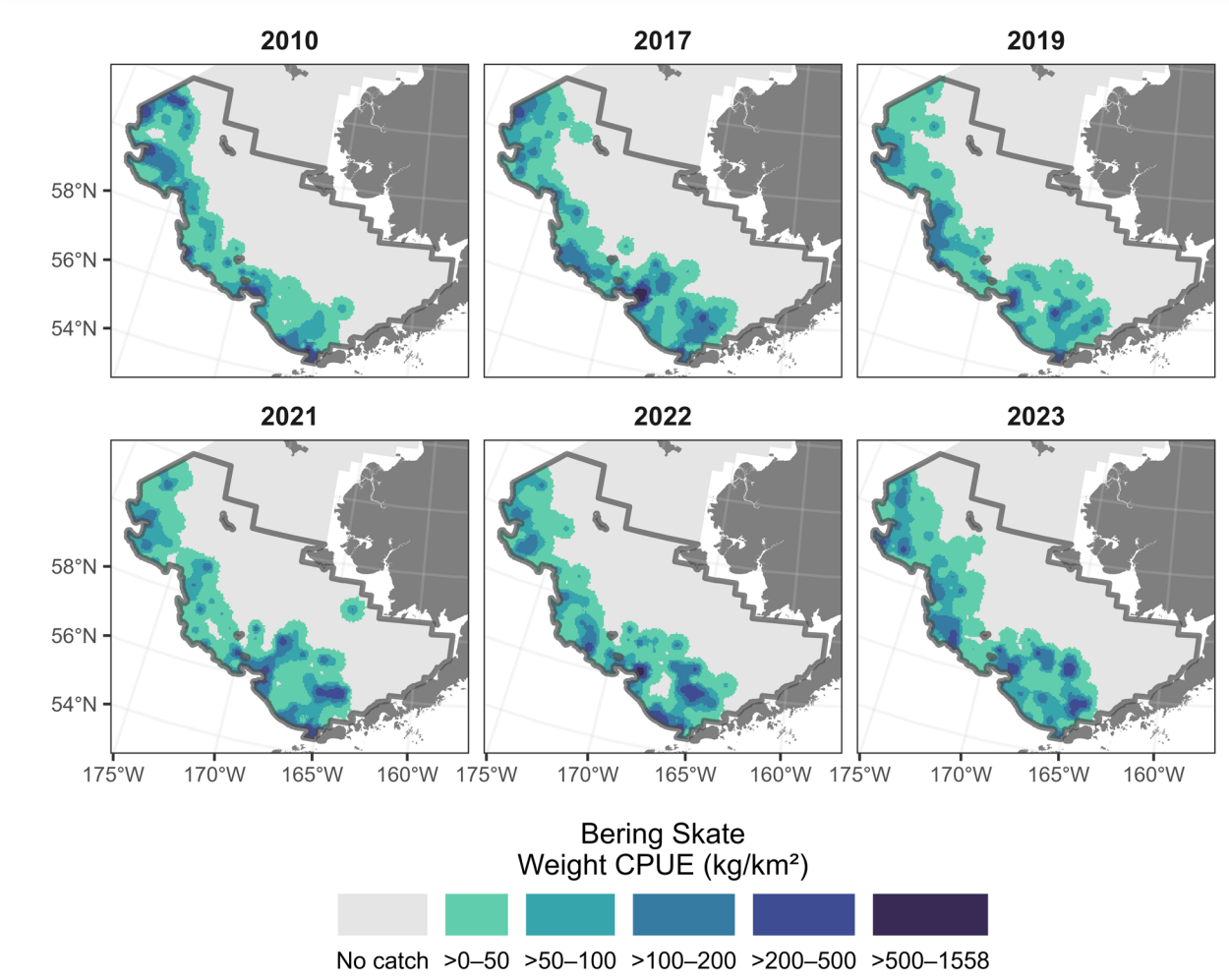

Figure 30. -- Weight CPUE (kg/km^2) distribution of Bering skate (*Bathyraja interrupta*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl survey. This species was not encountered in the 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys.

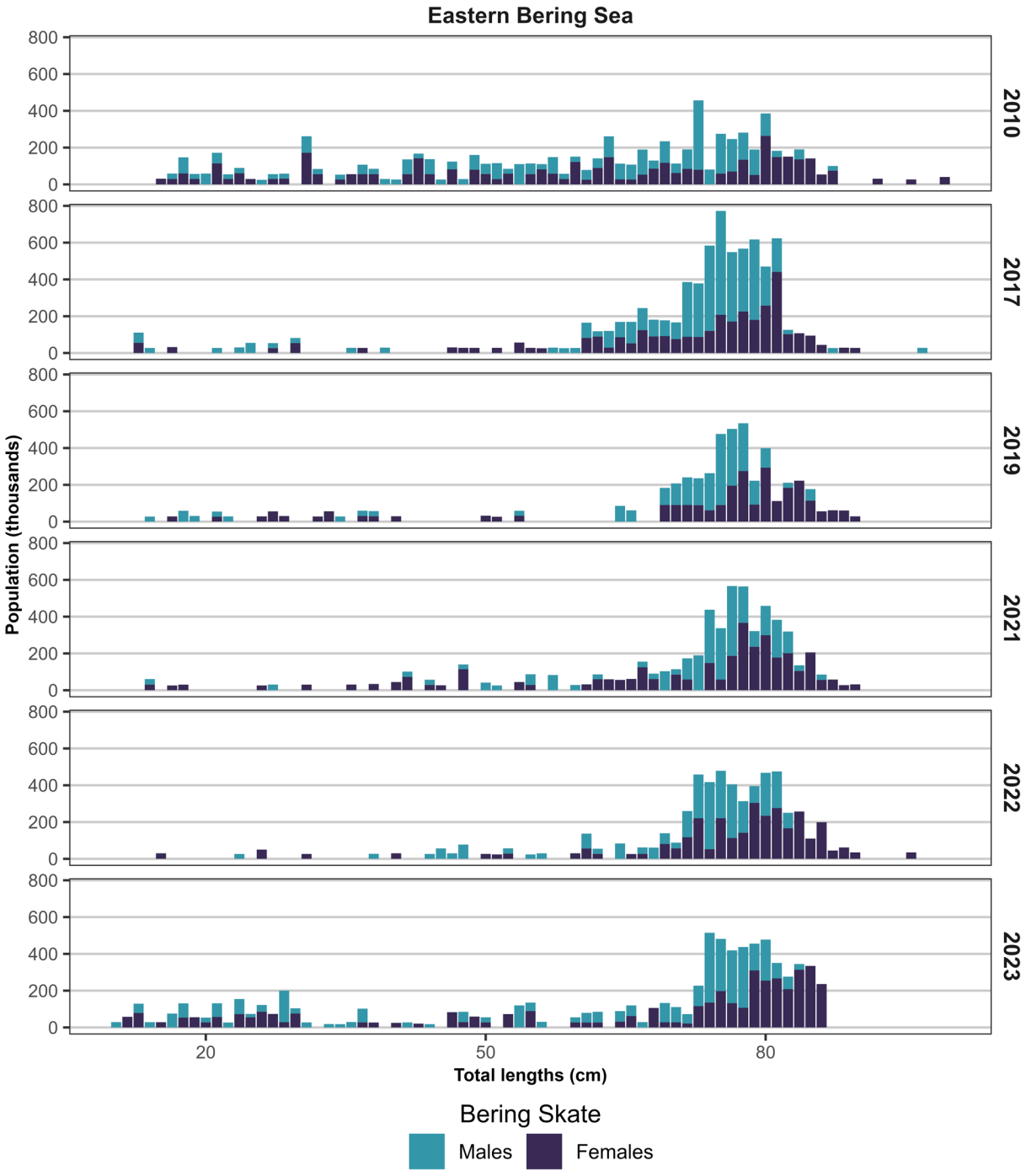

Figure 31. -- Total abundance-at-length estimates of Bering skate (*Bathyraja interrupta*) by sex (males and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea shelf bottom trawl surveys. There were no lengths collected for this species in the 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 36. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for Bering skate (*Bathyraja interrupta*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	38.46	10.77	3,653	1,023	1,606	5,699	20
32	61.16	36.44	541	322	0	1,186	4
41	1.04	0.63	65	39	0	143	3
42	3.47	2.08	84	50	0	184	3
43	4.32	2.24	91	47	0	185	4
50	76.92	15.46	2,926	588	1,750	4,102	22
61	67.44	9.78	5,920	858	4,203	7,637	44
62	11.99	7.75	77	50	0	178	2
82	-	-	-	-	-	-	-
90	14.48	14.48	167	167	0	501	1
Total	**27.43**	**3.06**	**13,524**	**1,507**	**10,510**	**16,537**	**103**

Table 37. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for Bering skate (*Bathyraja interrupta*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	17.06	4.37	789.54	2,451.06	1,620.30	415.38	20
32	31.60	15.08	12.71	546.47	279.59	133.44	4
41	1.35	0.76	0.00	179.15	84.19	47.48	3
42	1.86	1.04	0.00	95.08	44.93	25.07	3
43	11.35	6.59	0.00	516.85	239.05	138.90	4
50	45.77	9.84	992.73	2,489.54	1,741.14	374.20	22
61	42.78	6.43	2,626.47	4,884.45	3,755.46	564.50	44
62	5.73	3.70	0.00	84.87	37.03	23.92	2
82	-	-	-	-	-	-	-
90	5.27	5.27	0.00	182.33	60.78	60.78	1
Total	**15.95**	**1.67**	**6,218.73**	**9,506.21**	**7,862.47**	**821.87**	**103**

Bigmouth Sculpin (*Hemitripterus bolini*)

Between 2022 and 2023, the bigmouth sculpin biomass estimate increased by 23% in the eastern Bering Sea (Tables **38** and **39**; Fig. **32**) and the population was estimated at 4.6 million individuals (Tables **38** and **40**; Fig. **32**). No bigmouth sculpin were observed in the northern Bering Sea in 2023 (Fig. **33**).

Table 38. -- Summary of catch location environmental variables and biomass and population estimates for bigmouth sculpin (*Hemitripterus bolini*) in the eastern Bering Sea survey areas.

	Eastern Bering Sea
Stations Present	69 of 376 (18.4%)
Bottom Depth (m)	70 — 157
Bottom Temperature (°C)	0.2 — 4.3
Surface Temperature (°C)	5.9 — 10.3
Population	4.6 million
Biomass (t)	22,766
Biomass % Total	0.2%
Biomass % Change	23% increase from 2022

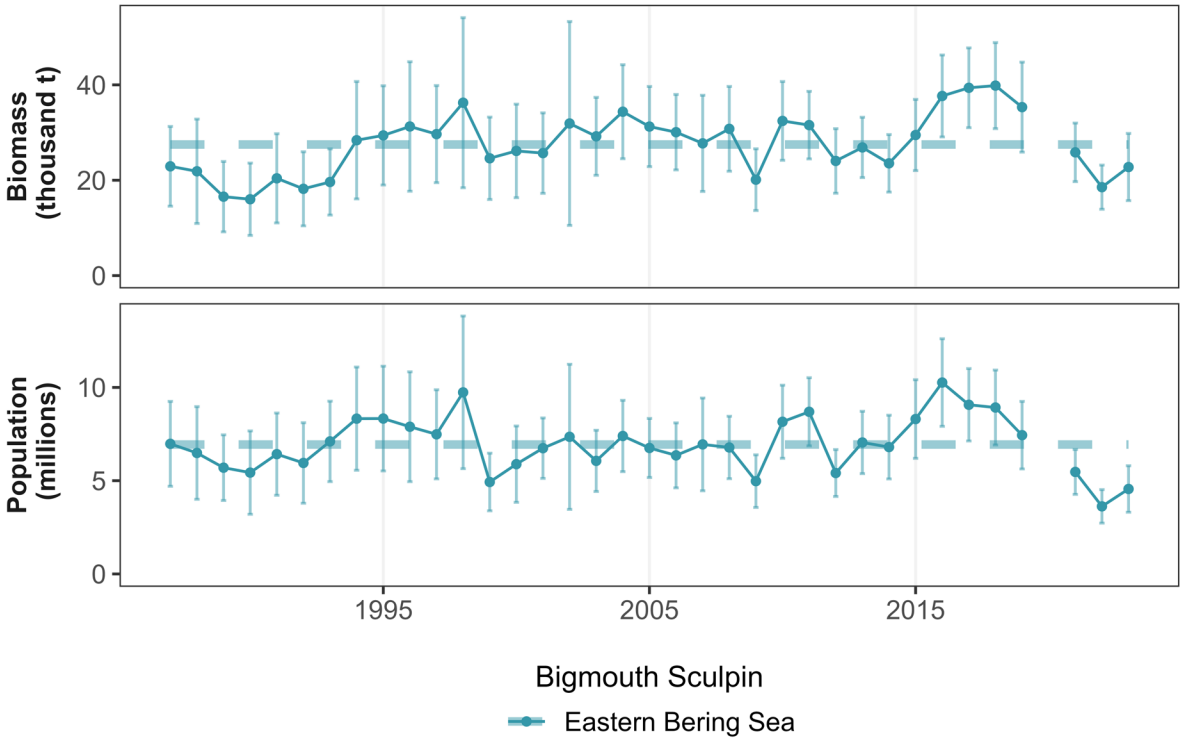

Figure 32. -- Time series of bigmouth sculpin (*Hemitripterus bolini*) biomass (thousand t) and population (millions) from the 1987-2023 eastern Bering Sea shelf bottom trawl survey. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

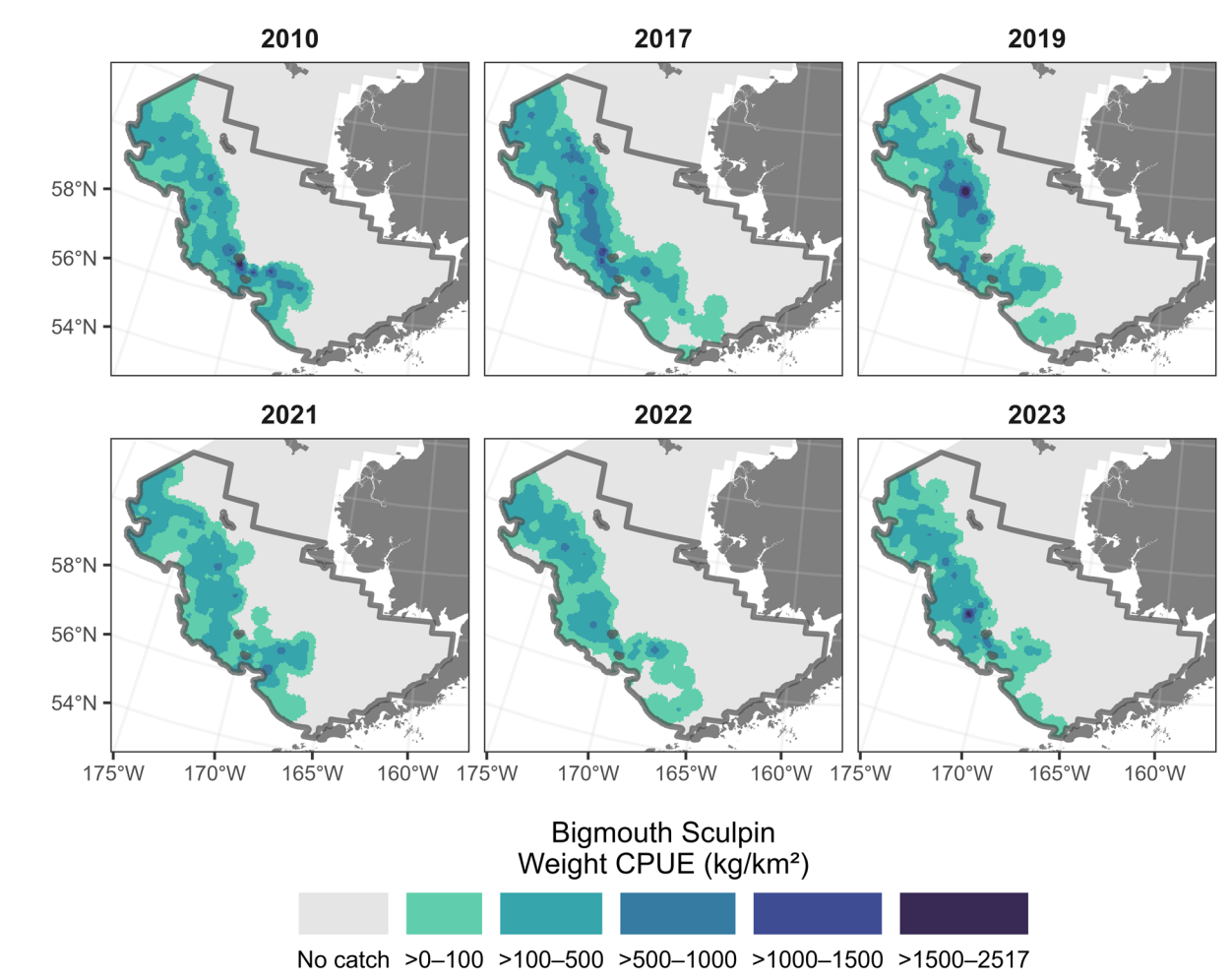

Figure 33. -- Weight CPUE (kg/km^2) distribution of bigmouth sculpin (*Hemitripterus bolini*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl survey. This species was not encountered in the 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys.

Table 39. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for bigmouth sculpin (*Hemitripterus bolini*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	5.18	3.07	492	292	0	1,076	3
32	87.82	37.42	777	331	115	1,439	4
41	61.02	41.07	3,802	2,559	0	8,920	4
42	111.49	45.48	2,689	1,097	495	4,883	7
43	11.78	8.23	248	173	0	595	2
50	12.71	6.02	484	229	26	941	6
61	148.36	23.36	13,022	2,050	8,921	17,123	36
62	131.47	49.46	849	320	210	1,489	5
82	-	-	-	-	-	-	-
90	34.81	23.74	402	274	0	949	2
Total	**46.18**	**7.15**	**22,766**	**3,523**	**15,720**	**29,811**	**69**

Table 40. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for bigmouth sculpin (*Hemitripterus bolini*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	0.88	0.50	0.00	177.92	83.22	47.35	3
32	14.46	5.95	22.69	233.22	127.95	52.63	4
41	9.71	6.39	0.00	1,401.58	604.78	398.40	4
42	18.19	7.64	70.51	807.27	438.89	184.19	7
43	1.78	1.23	0.00	89.16	37.46	25.85	2
50	5.23	2.01	46.02	352.13	199.07	76.53	6
61	30.91	4.58	1,909.03	3,517.11	2,713.07	402.02	36
62	30.97	13.24	29.00	371.24	200.12	85.56	5
82	-	-	-	-	-	-	-
90	13.14	10.48	0.00	393.64	151.68	120.98	2
Total	**9.24**	**1.26**	**3,310.83**	**5,801.64**	**4,556.23**	**622.70**	**69**

Butterfly Sculpin (*Hemilepidotus papilio*)

Between 2022 and 2023, the butterfly sculpin biomass estimate was 14 t in the eastern Bering Sea (Tables **41** and **42**; Fig. **34**) and the population was estimated at 56,125 individuals (Tables **41** and **43**; Fig. **34**). The biomass estimate increased by 97% in the northern Bering Sea and the population was estimated at 400,220 individuals.

Table 41. -- Summary of catch location environmental variables and biomass and population estimates for butterfly sculpin (*Hemilepidotus papilio*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	3 of 376 (0.8%)	4 of 116 (3.4%)
Bottom Depth (m)	59 — 61	28 — 48
Bottom Temperature (°C)	-1.1 — -0.8	1.2 — 3.2
Surface Temperature (°C)	7.5 — 9.3	5.9 — 9.8
Population	56,125	400,220
Biomass (t)	14	17
Biomass % Total	<0.01%	<0.01%
Biomass % Change	Not caught in 2022	97% increase from 2022

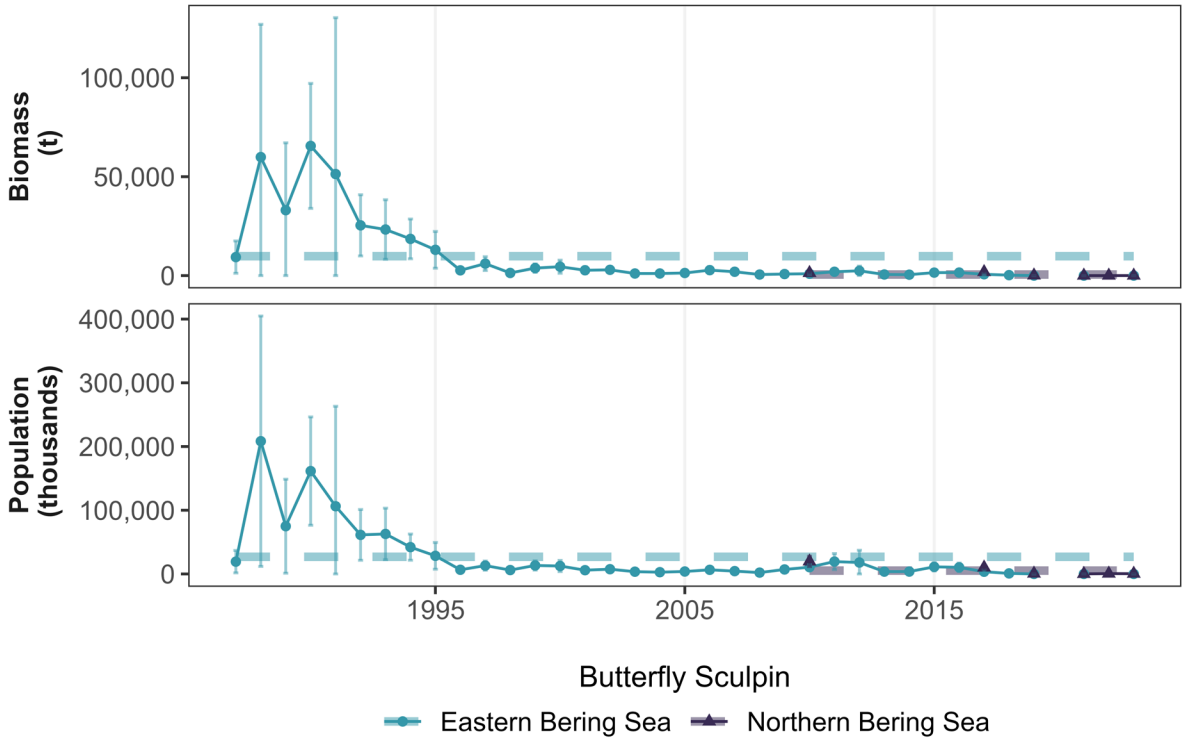

Figure 34. -- Time series of butterfly sculpin (*Hemilepidotus papilio*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

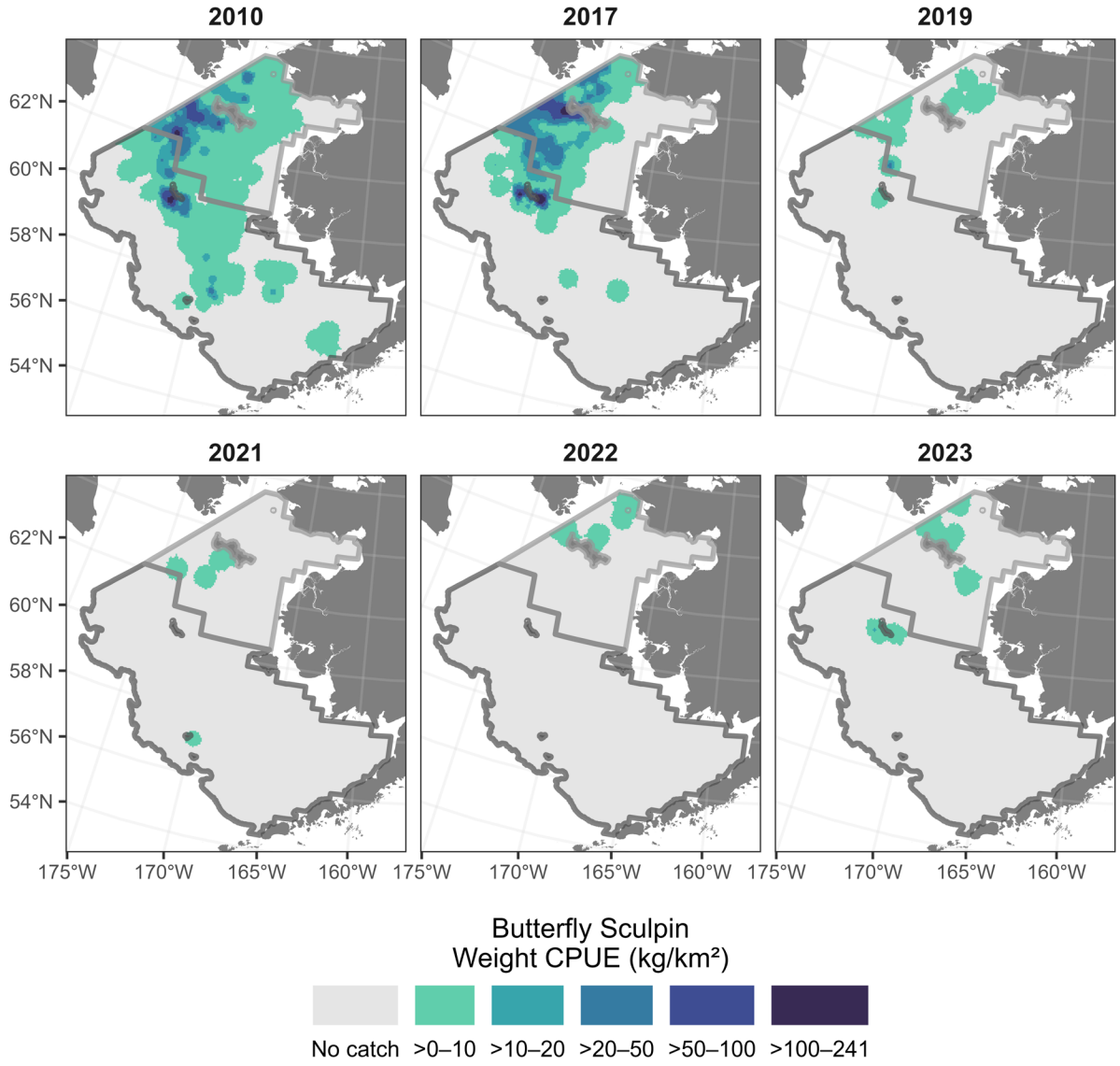

Figure 35. -- Weight CPUE (kg/km^2) distribution of butterfly sculpin (*Hemilepidotus papilio*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 42. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for butterfly sculpin (*Hemilepidotus papilio*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	0.67	0.51	14	11	0	36	3
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**0.03**	**0.02**	**14**	**11**	**0**	**36**	**3**
Northern Bering Sea							
70	0.06	0.06	5	5	0	14	1
71	0.15	0.10	12	8	0	29	3
81	-	-	-	-	-	-	-
Total	**0.08**	**0.05**	**17**	**10**	**0**	**36**	**4**

Table 43. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for butterfly sculpin (*Hemilepidotus papilio*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	2.66	1.46	0.00	117.80	56.12	30.84	3
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**0.11**	**0.06**	**0.00**	**117.80**	**56.12**	**30.84**	**3**
Northern Bering Sea							
70	0.76	0.76	0.00	181.64	60.55	60.55	1
71	4.18	2.52	0.00	749.23	339.67	204.78	3
81	-	-	-	-	-	-	-
Total	**2.01**	**1.07**	**0.00**	**827.31**	**400.22**	**213.54**	**4**

Capelin (*Mallotus villosus*)

Between 2022 and 2023, the capelin biomass estimate increased by 158% in the eastern Bering Sea (Tables **44** and **45**; Fig. **36**) and the population was estimated at 15.1 million individuals (Tables **44** and **46**; Fig. **36**). Similarly, the biomass estimate increased by 543% in the northern Bering Sea and the population was estimated at 53.9 million individuals.

Table 44. -- Summary of catch location environmental variables and biomass and population estimates for capelin (*Mallotus villosus*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	47 of 376 (12.5%)	44 of 116 (37.9%)
Bottom Depth (m)	20 — 129	20 — 78
Bottom Temperature (°C)	-1.6 — 4.8	-1.6 — 9.9
Surface Temperature (°C)	1.7 — 10.2	5 — 14.1
Population	15.1 million	53.9 million
Biomass (t)	304	465
Biomass % Total	<0.01%	<0.01%
Biomass % Change	158% increase from 2022	543% increase from 2022

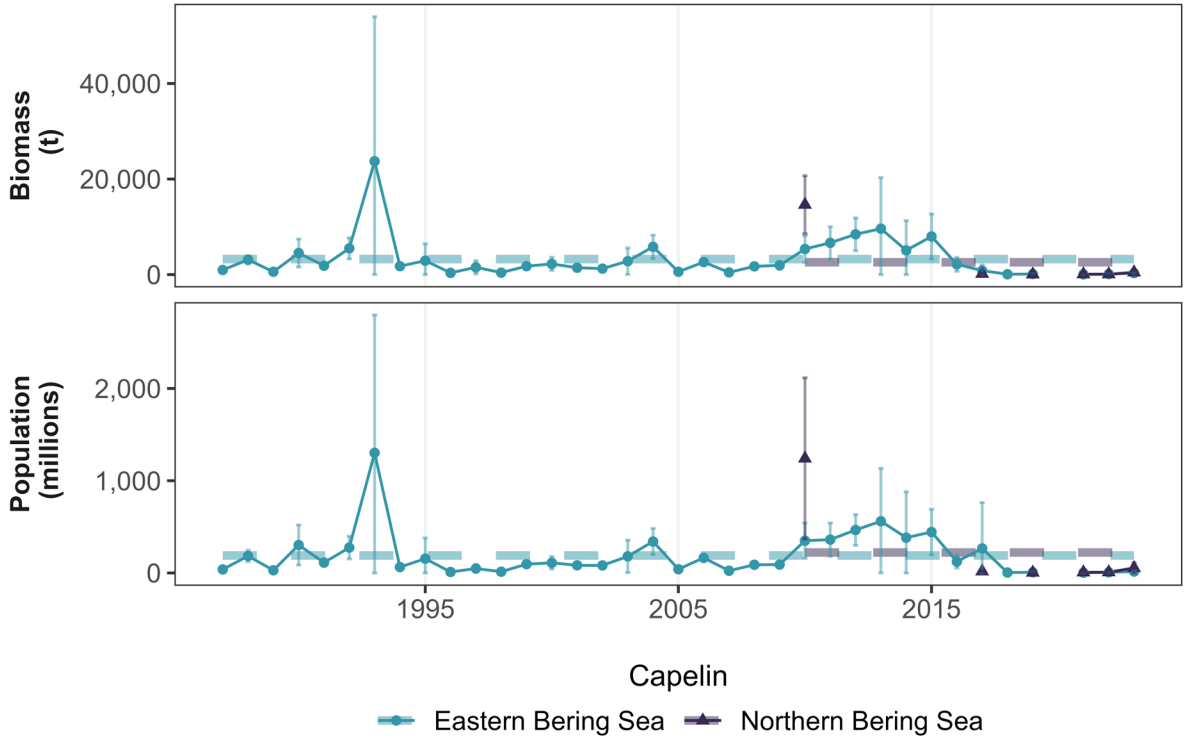

Figure 36. -- Time series of capelin (*Mallotus villosus*) biomass (t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

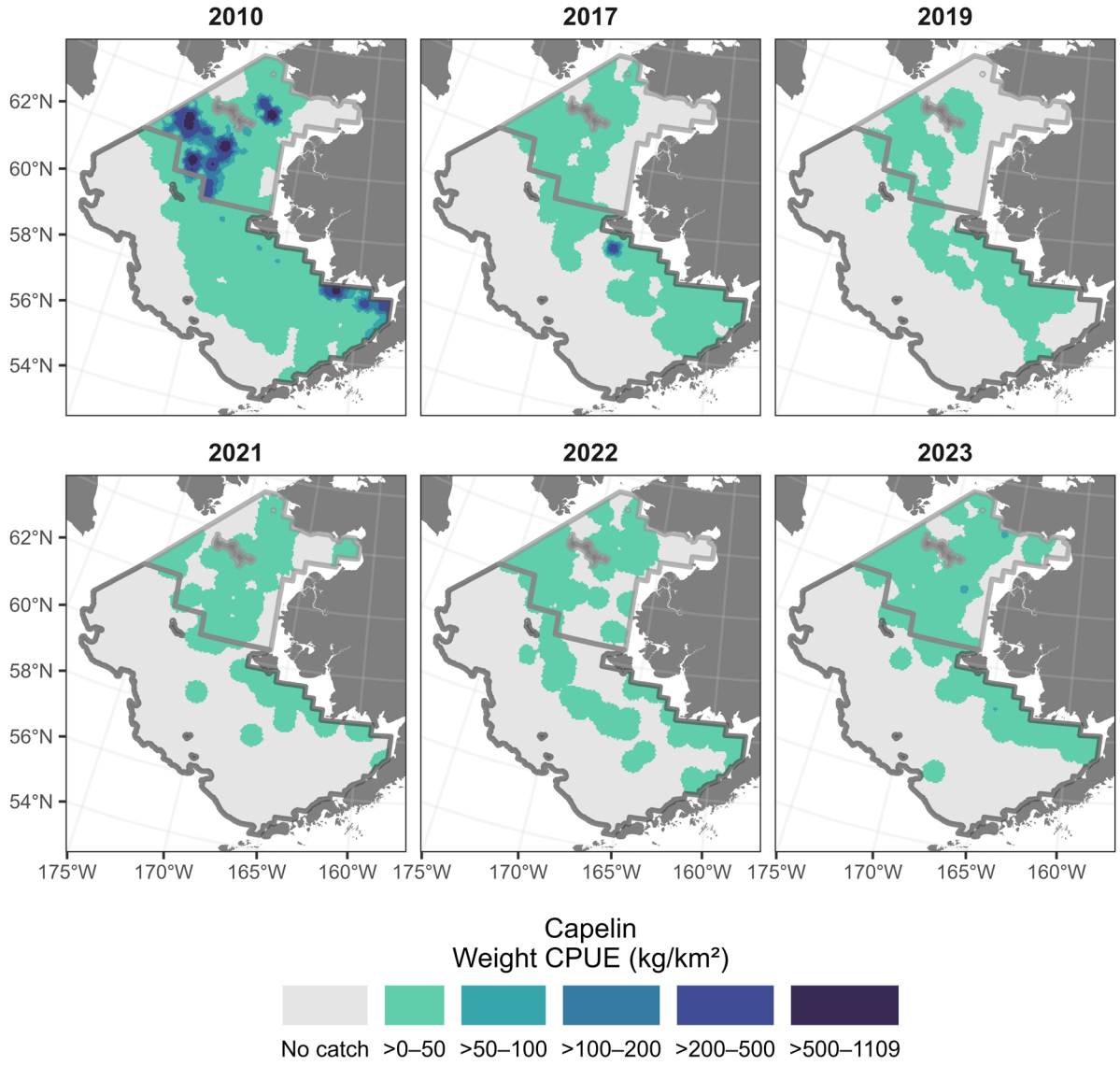

Figure 37. -- Weight CPUE (kg/km^2) distribution of capelin (*Mallotus villosus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 45. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for capelin (*Mallotus villosus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	3.36	1.08	264	85	95	434	27
20	0.90	0.28	37	11	14	60	14
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	0.04	0.02	3	2	0	6	4
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	0.00	0.00	0	0	0	0	1
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	0.02	0.02	0	0	0	1	1
90	-	-	-	-	-	-	-
Total	**0.62**	**0.17**	**304**	**86**	**133**	**476**	**47**
Northern Bering Sea							
70	2.97	1.87	236	148	0	532	18
71	2.09	1.32	170	108	0	385	18
81	1.54	1.09	59	42	0	143	8
Total	**2.34**	**0.94**	**465**	**188**	**89**	**840**	**44**

Table 46. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for capelin (*Mallotus villosus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	162.66	50.51	4,852.05	20,752.35	12,802.20	3,975.07	27
20	49.31	15.77	732.49	3,330.36	2,031.42	649.47	14
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	2.79	1.58	0.00	370.35	174.06	98.15	4
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	0.70	0.70	0.00	80.15	26.72	26.72	1
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	1.54	1.54	0.00	83.18	27.73	27.73	1
90	-	-	-	-	-	-	-
Total	**30.55**	**8.17**	**7,003.80**	**23,120.45**	**15,062.12**	**4,029.16**	**47**
Northern Bering Sea							
70	300.59	225.36	0.00	59,548.83	23,824.74	17,862.05	18
71	326.86	261.19	0.00	69,004.07	26,558.85	21,222.61	18
81	91.20	63.42	0.00	8,362.53	3,497.64	2,432.44	8
Total	**270.94**	**140.02**	**0.00**	**109,572.11**	**53,881.23**	**27,845.44**	**44**

Eulachon (*Thaleichthys pacificus*)

Between 2022 and 2023, the eulachon biomass estimate increased by 93% in the eastern Bering Sea (Tables **47** and **48**; Fig. **38**) and the population was estimated at 16.3 million individuals (Tables **47** and **49**; Fig. **38**). No eulachon were observed in the northern Bering Sea in 2023 (Fig. **39**).

Table 47. -- Summary of catch location environmental variables and biomass and population estimates for eulachon (*Thaleichthys pacificus*) in the eastern Bering Sea survey areas.

	Eastern Bering Sea
Stations Present	16 of 376 (4.3%)
Bottom Depth (m)	25 — 148
Bottom Temperature (°C)	2.7 — 4.6
Surface Temperature (°C)	3.3 — 8.3
Population	16.3 million
Biomass (t)	832
Biomass % Total	<0.01%
Biomass % Change	93% increase from 2022

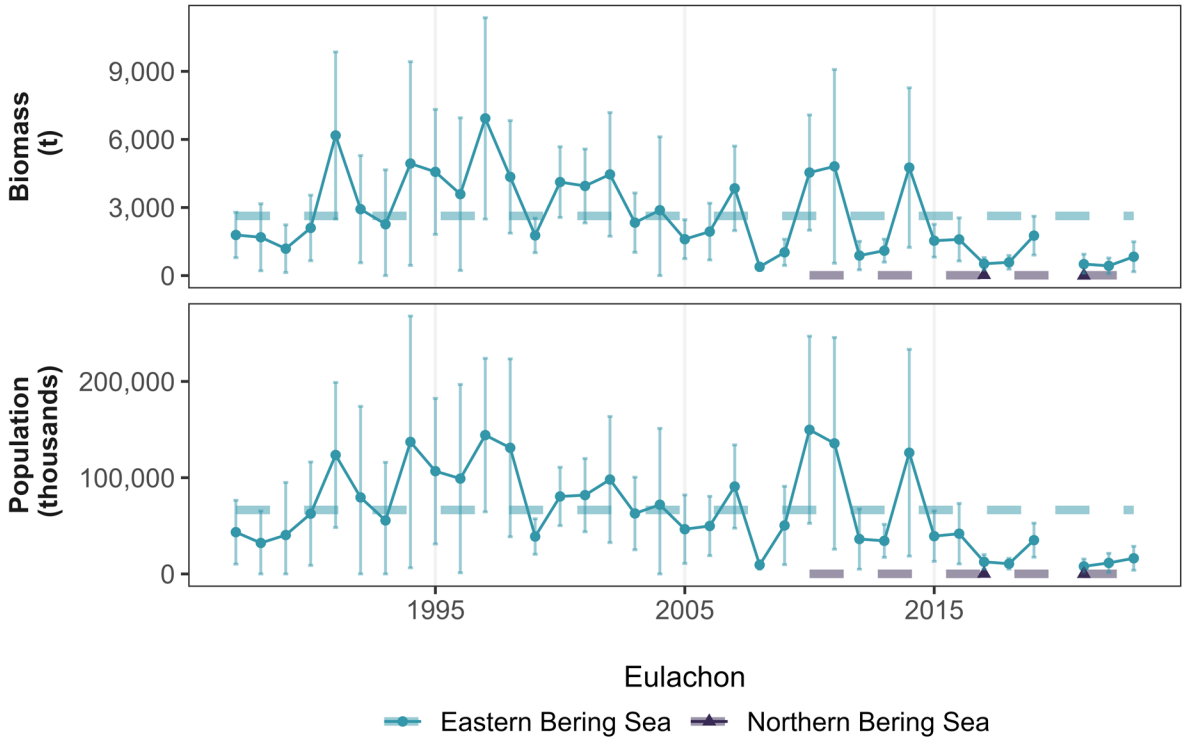

Figure 38. -- Time series of eulachon (*Thaleichthys pacificus*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

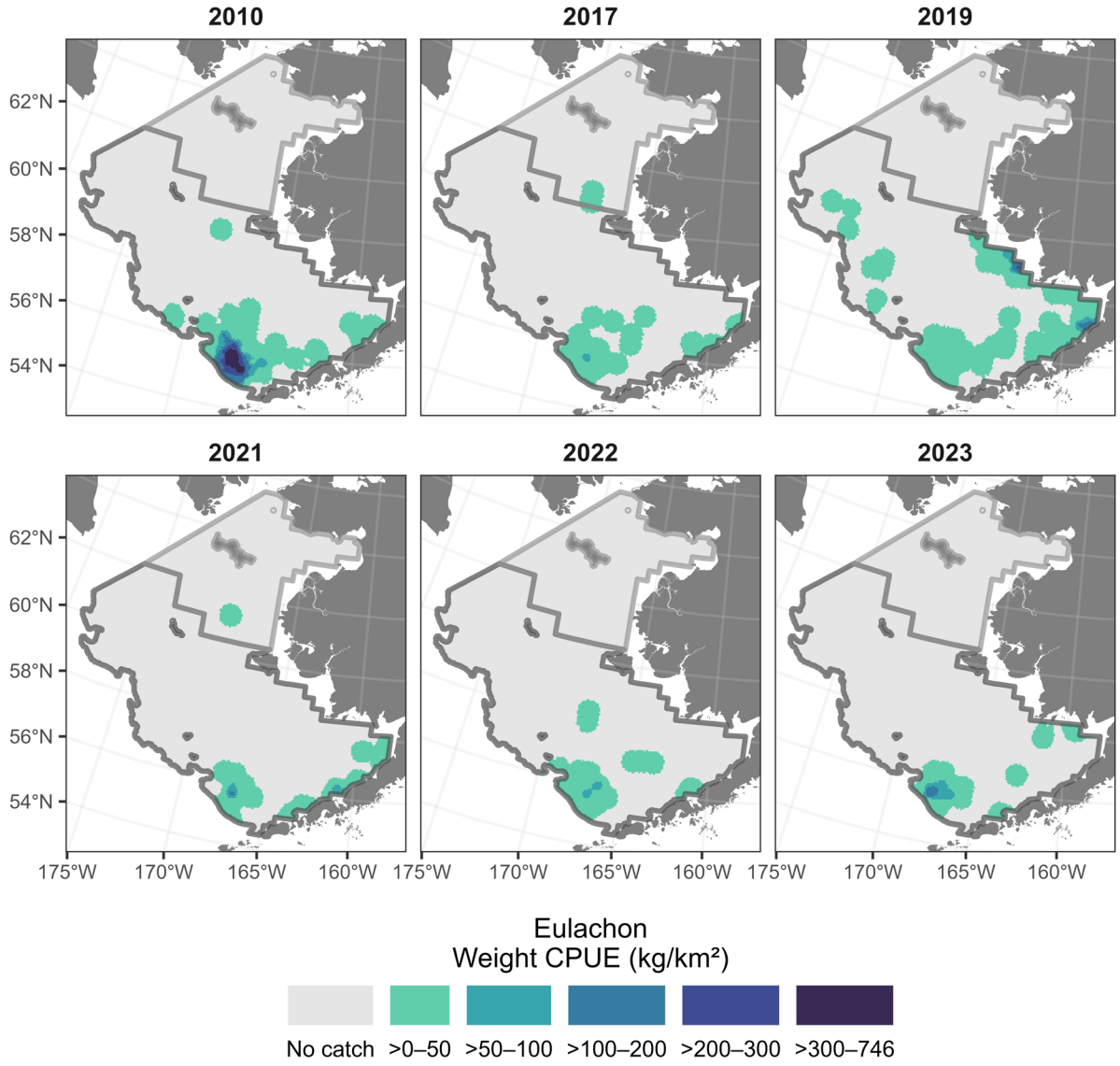

Figure 39. -- Weight CPUE (kg/km^2) distribution of eulachon (*Thaleichthys pacificus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 48. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for eulachon (*Thaleichthys pacificus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	0.11	0.10	9	8	0	25	2
20	-	-	-	-	-	-	-
31	0.14	0.09	14	9	0	32	3
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	21.28	8.68	809	330	149	1,470	11
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**1.69**	**0.67**	**832**	**331**	**171**	**1,493**	**16**

Table 49. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for eulachon (*Thaleichthys pacificus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	1.14	0.84	0.00	221.50	89.50	66.00	2
20	-	-	-	-	-	-	-
31	1.47	0.87	0.00	304.03	139.46	82.29	3
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	422.52	163.53	3,631.38	28,513.09	16,072.24	6,220.43	11
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**33.07**	**12.62**	**3,858.55**	**28,743.84**	**16,301.19**	**6,221.32**	**16**

Flathead Sole (*Hippoglossoides elassodon*)

Between 2022 and 2023, the flathead sole biomass estimate decreased by 15% in the eastern Bering Sea (Tables **50** and **51**; Fig. **40**) and the population was estimated at 2 billion individuals (Tables **50** and **52**; Fig. **40**). Similarly, the biomass estimate decreased by 65% in the northern Bering Sea and the population was estimated at 223,323 individuals.

In 2023, flathead sole were found in higher densities in the deeper water of the outer shelf with the highest concentration located east of St. Paul Island instead of west of St. Matthew Island, as in 2022. There was a greater density of flathead sole observed in the northern Bering Sea in 2023 than in 2021 or 2022 (Fig. **41**).

The size distribution was similar to 2022, with most individuals observed at approximately 30 cm. There was slight bimodality in the size distribution between 20 and 40 cm, though less than observed in 2019 and 2021 (Fig. **42**).

Table 50. -- Summary of catch location environmental variables and biomass and population estimates for flathead sole (*Hippoglossoides elassodon*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	308 of 376 (81.9%)	4 of 116 (3.4%)
Bottom Depth (m)	30 — 171	24 — 63
Bottom Temperature (°C)	-1.5 — 5.4	-0.8 — 9.2
Surface Temperature (°C)	1.8 — 10.7	8.6 — 9.2
Population	2 billion	223,323
Biomass (t)	594,851	45
Biomass % Total	5.1%	<0.01%
Biomass % Change	15% decrease from 2022	65% decrease from 2022

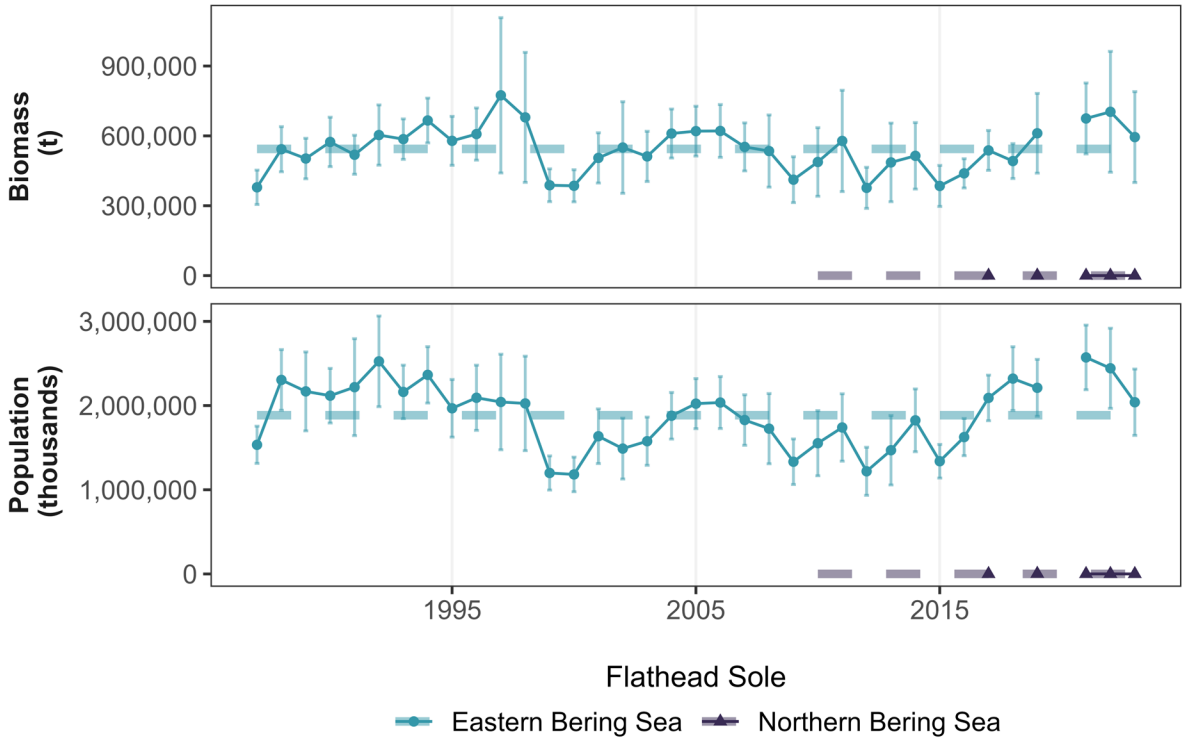

Figure 40. -- Time series of flathead sole (*Hippoglossoides elassodon*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

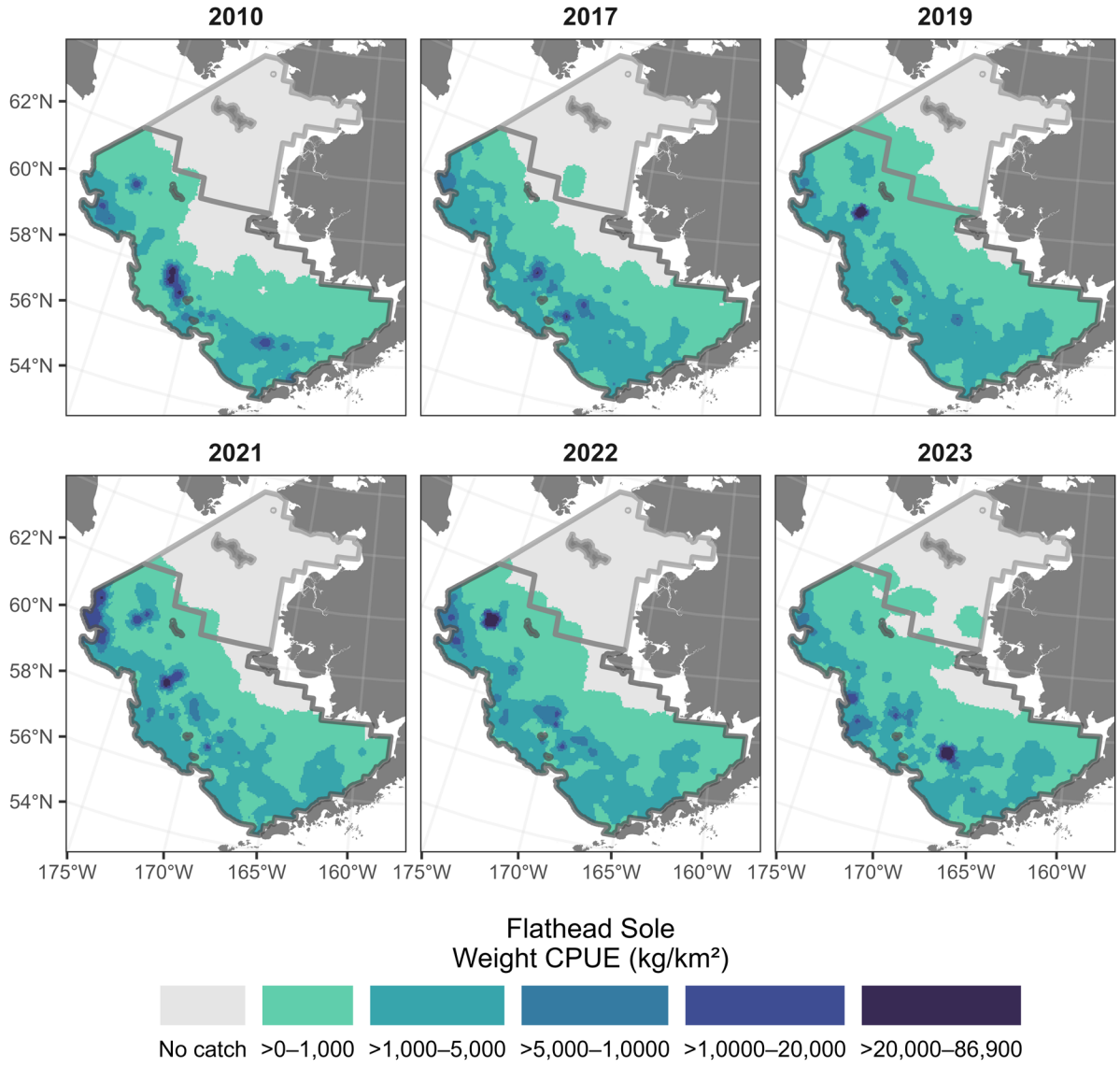

Figure 41. -- Weight CPUE (kg/km^2) distribution of flathead sole (*Hippoglossoides elassodon*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

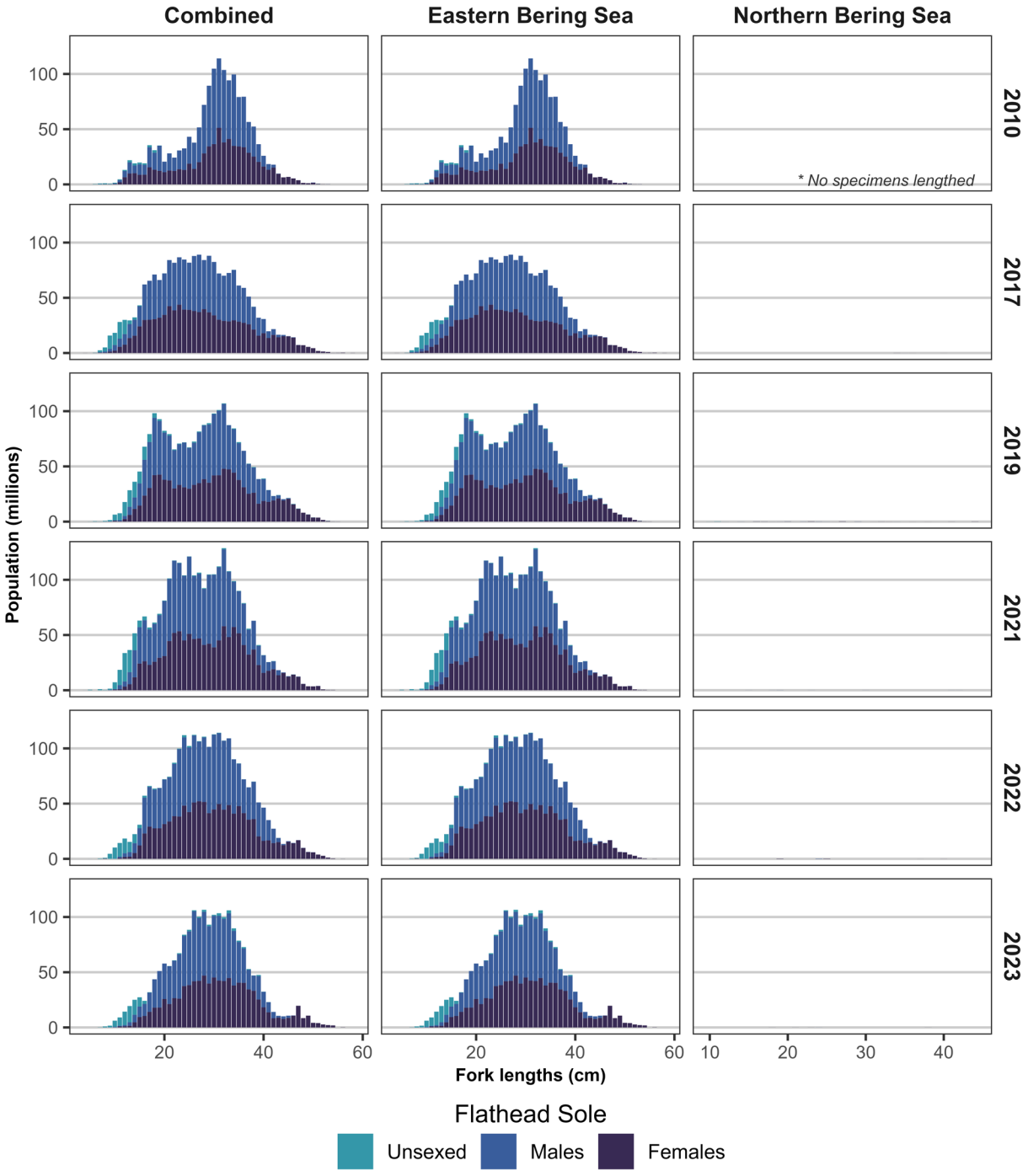

Figure 42. -- Total abundance-at-length estimates of flathead sole (*Hippoglossoides elassodon*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 51. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for flathead sole (*Hippoglossoides elassodon*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	313.77	63.94	24,696	5,032	14,631	34,760	41
20	4.58	2.35	189	97	0	382	5
31	2,304.59	925.38	218,887	87,891	43,104	394,669	69
32	1,803.23	633.58	15,953	5,605	4,743	27,163	8
41	423.37	123.51	26,380	7,696	10,988	41,772	34
42	2,315.32	533.16	55,851	12,861	30,129	81,572	27
43	264.81	150.83	5,578	3,177	0	11,932	18
50	1,266.55	172.40	48,178	6,558	35,062	61,294	26
61	2,215.28	433.52	194,450	38,053	118,344	270,557	60
62	306.46	225.47	1,980	1,457	0	4,894	7
82	40.81	22.05	733	396	0	1,524	5
90	171.38	29.88	1,978	345	1,288	2,667	8
Total	**1,206.62**	**197.81**	**594,851**	**97,518**	**399,815**	**789,888**	**308**
Northern Bering Sea							
70	0.03	0.03	2	2	0	7	1
71	-	-	-	-	-	-	-
81	1.10	0.72	42	28	0	98	3
Total	**0.22**	**0.14**	**45**	**28**	**0**	**100**	**4**

Table 52. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for flathead sole (*Hippoglossoides elassodon*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	636.79	133.86	29,047.56	71,189.79	50,118.67	10,535.56	41
20	16.40	8.12	7.10	1,344.38	675.74	334.32	5
31	6,176.83	1,415.40	317,801.20	855,529.88	586,665.54	134,432.17	69
32	6,062.65	2,364.27	11,802.45	95,466.83	53,634.64	20,916.09	8
41	843.22	203.33	27,201.77	77,880.29	52,541.03	12,669.63	34
42	5,484.41	1,165.72	76,056.61	188,534.73	132,295.67	28,119.53	27
43	669.74	337.41	0.00	28,321.19	14,107.16	7,107.02	18
50	8,738.74	1,310.27	232,729.35	432,094.74	332,412.05	49,841.35	26
61	9,124.17	1,470.45	542,748.86	1,059,033.84	800,891.35	129,071.25	60
62	998.84	709.18	0.00	15,618.82	6,454.03	4,582.39	7
82	113.91	58.33	0.00	4,139.49	2,045.14	1,047.17	5
90	674.40	101.92	5,429.71	10,134.11	7,781.91	1,176.10	8
Total	**4,137.25**	**399.50**	**1,645,722.62**	**2,433,523.24**	**2,039,622.93**	**196,950.15**	**308**
Northern Bering Sea							
70	0.59	0.59	0.00	139.79	46.60	46.60	1
71	-	-	-	-	-	-	-
81	4.61	2.62	0.00	377.78	176.73	100.53	3
Total	**1.12**	**0.56**	**1.72**	**444.93**	**223.32**	**110.80**	**4**

Great Sculpin (*Myoxocephalus polyacanthocephalus*)

Between 2022 and 2023, the great sculpin biomass estimate decreased by 34% in the eastern Bering Sea (Tables **53** and **54**; Fig. **43**) and the population was estimated at 15.5 million individuals (Tables **53** and **55**; Fig. **43**). The biomass estimate increased by 21% in the northern Bering Sea and the population was estimated at 5.9 million individuals.

Table 53. -- Summary of catch location environmental variables and biomass and population estimates for great sculpin (*Myoxocephalus polyacanthocephalus*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	179 of 376 (47.6%)	16 of 116 (13.8%)
Bottom Depth (m)	21 — 171	20 — 53
Bottom Temperature (°C)	-1.4 — 5.2	-0.1 — 9.9
Surface Temperature (°C)	1.7 — 11	4 — 12.8
Population	15.5 million	5.9 million
Biomass (t)	45,918	640
Biomass % Total	0.4%	<0.01%
Biomass % Change	34% decrease from 2022	21% increase from 2022

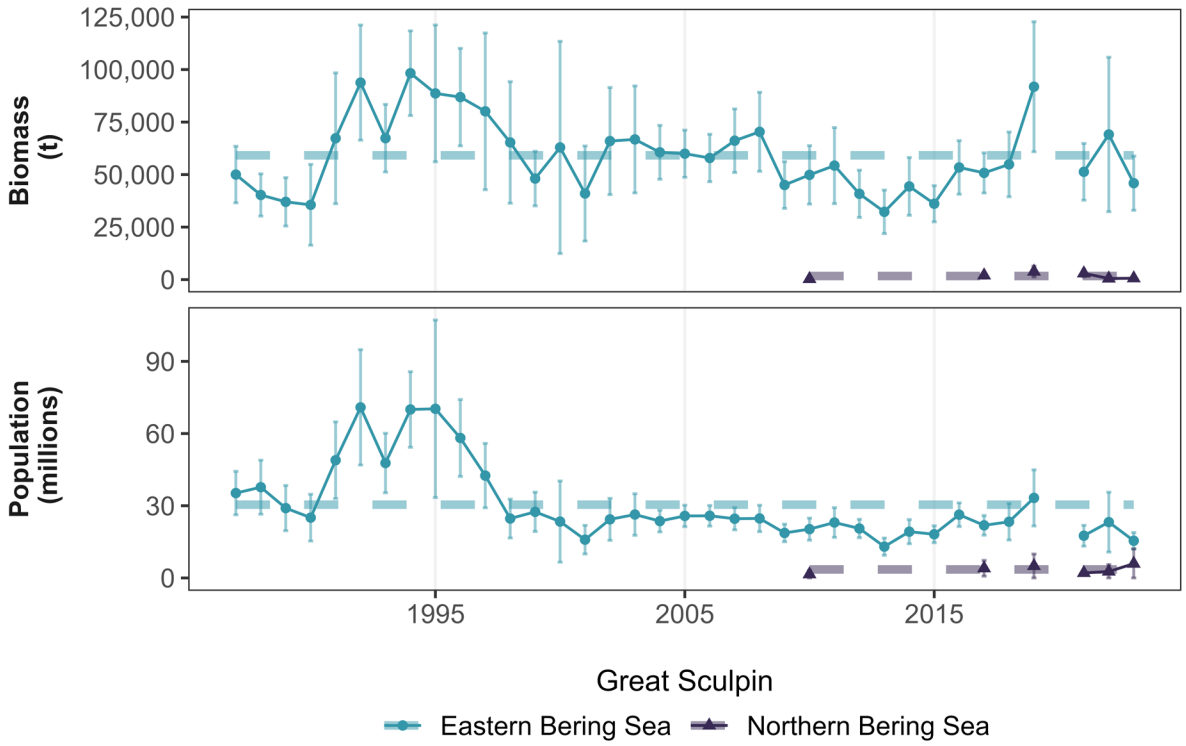

Figure 43. -- Time series of great sculpin (*Myoxocephalus polyacanthocephalus*) biomass (t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

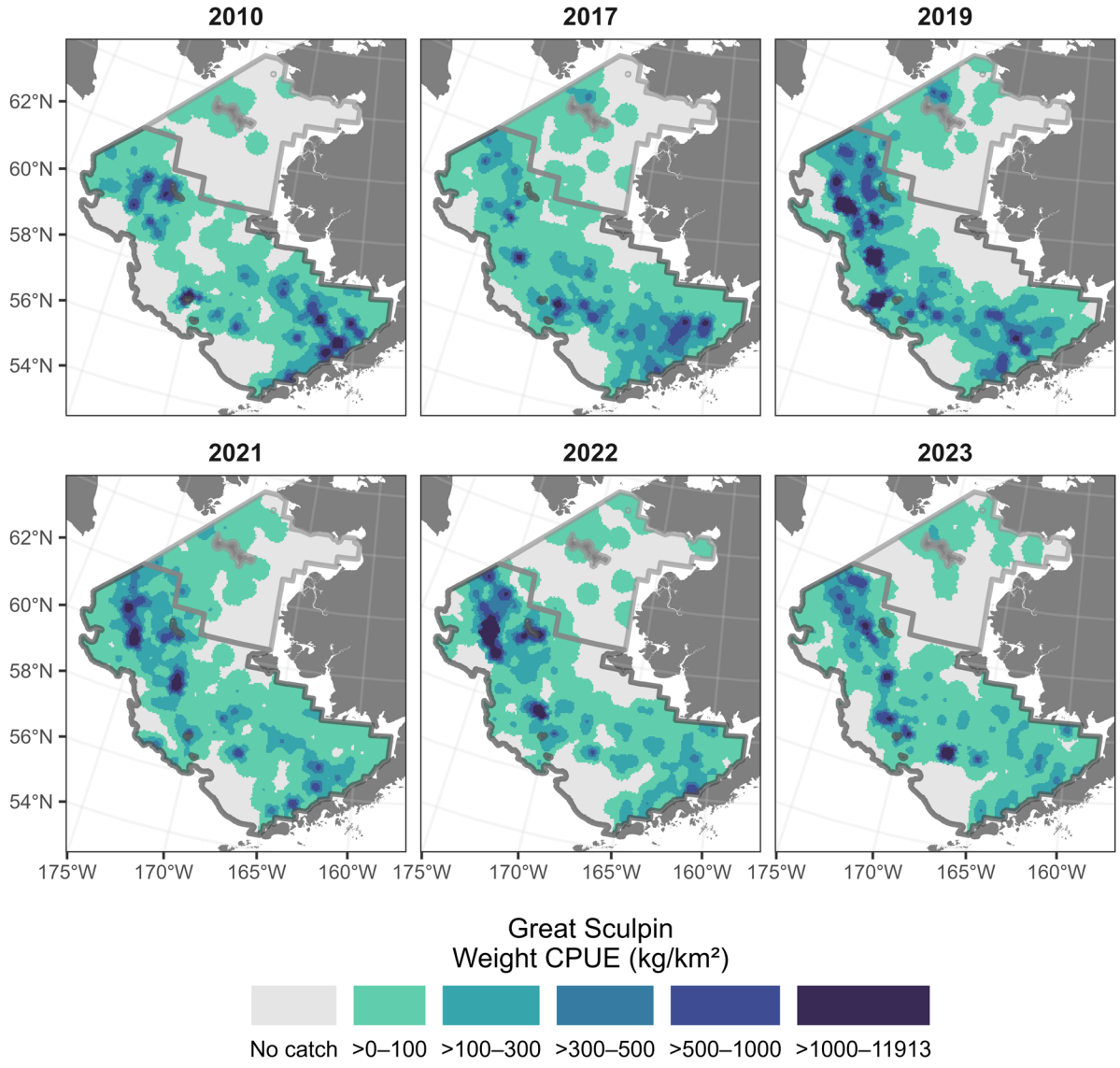

Figure 44. -- Weight CPUE (kg/km^2) distribution of great sculpin (*Myoxocephalus polyacanthocephalus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 54. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for great sculpin (*Myoxocephalus polyacanthocephalus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	68.30	11.66	5,375	918	3,540	7,211	39
20	17.28	7.44	712	306	99	1,325	9
31	121.46	50.63	11,536	4,809	1,918	21,154	37
32	59.72	28.67	528	254	21	1,036	5
41	113.30	42.58	7,060	2,653	1,754	12,366	20
42	178.10	60.89	4,296	1,469	1,359	7,234	18
43	240.00	86.07	5,055	1,813	1,429	8,681	14
50	-	-	-	-	-	-	-
61	41.19	14.36	3,616	1,261	1,094	6,137	17
62	198.18	43.75	1,281	283	715	1,846	7
82	195.26	96.09	3,506	1,725	55	6,956	6
90	255.97	64.32	2,954	742	1,469	4,438	7
Total	**93.14**	**13.12**	**45,918**	**6,466**	**32,987**	**58,850**	**179**
Northern Bering Sea							
70	1.04	0.65	82	52	0	186	3
71	6.87	3.85	558	313	0	1,184	13
81	-	-	-	-	-	-	-
Total	**3.22**	**1.60**	**640**	**317**	**6**	**1,275**	**16**

Table 55. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for great sculpin (*Myoxocephalus polyacanthocephalus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	36.09	7.61	1,643.63	4,037.90	2,840.76	598.57	39
20	10.16	3.91	96.55	740.36	418.45	160.95	9
31	33.89	9.27	1,457.43	4,979.57	3,218.50	880.53	37
32	22.18	8.80	40.49	351.93	196.21	77.86	5
41	36.02	13.55	555.41	3,933.71	2,244.56	844.58	20
42	47.34	15.69	384.94	1,899.18	1,142.06	378.56	18
43	76.55	27.95	434.91	2,789.77	1,612.34	588.71	14
50	-	-	-	-	-	-	-
61	13.51	4.78	347.41	2,024.70	1,186.06	419.32	17
62	55.21	10.54	220.51	492.92	356.71	68.10	7
82	61.10	26.27	153.53	2,040.38	1,096.96	471.71	6
90	99.43	30.00	454.99	1,839.68	1,147.34	346.17	7
Total	**31.36**	**3.45**	**12,059.00**	**18,860.89**	**15,459.94**	**1,700.47**	**179**
Northern Bering Sea							
70	2.79	1.83	0.00	510.96	221.46	144.75	3
71	70.34	37.77	0.00	11,853.89	5,715.55	3,069.17	13
81	-	-	-	-	-	-	-
Total	**29.85**	**15.45**	**0.00**	**12,082.17**	**5,937.01**	**3,072.58**	**16**

Greenland Turbot (*Reinhardtius hippoglossoides*)

Between 2022 and 2023, the Greenland turbot biomass estimate decreased by 26% in the eastern Bering Sea (Tables **56** and **57**; Fig. **45**) and the population was estimated at 3.7 million individuals (Tables **56** and **58**; Fig. **45**). The biomass estimate was 1 t in the northern Bering Sea and the population was estimated at 133,289 individuals.

In 2023, Greenland turbot were distributed primarily in the northwest portion of the middle and outer domains near the U.S.-Russia Maritime Boundary (Fig. **46**) and within the eastern Bering Sea survey area. Four juvenile Greenland turbot were found across the northern Bering Sea (Fig. **46**).

Greenland turbot are typically most abundant on the upper continental slope outside of the standard eastern Bering Sea survey area, although juveniles may spend several years on the continental shelf before moving to deeper water (Sohn et al., 2010; Vestfals et al., 2016). The order of magnitude decrease in estimated population since 2010 may be attributed to the ontogenetic movement of the strong 2010 year class out of the survey area and into the upper continental slope waters (Alton et al., 1998).

Table 56. -- Summary of catch location environmental variables and biomass and population estimates for Greenland turbot (*Reinhardtius hippoglossoides*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	40 of 376 (10.6%)	3 of 116 (2.6%)
Bottom Depth (m)	75 — 160	37 — 48
Bottom Temperature (°C)	-1.3 — 3.4	1.7 — 7.6
Surface Temperature (°C)	6.7 — 10.7	5 — 7.5
Population	3.7 million	133,289
Biomass (t)	5,857	1
Biomass % Total	<0.01%	<0.01%
Biomass % Change	26% decrease from 2022	Not caught in 2022

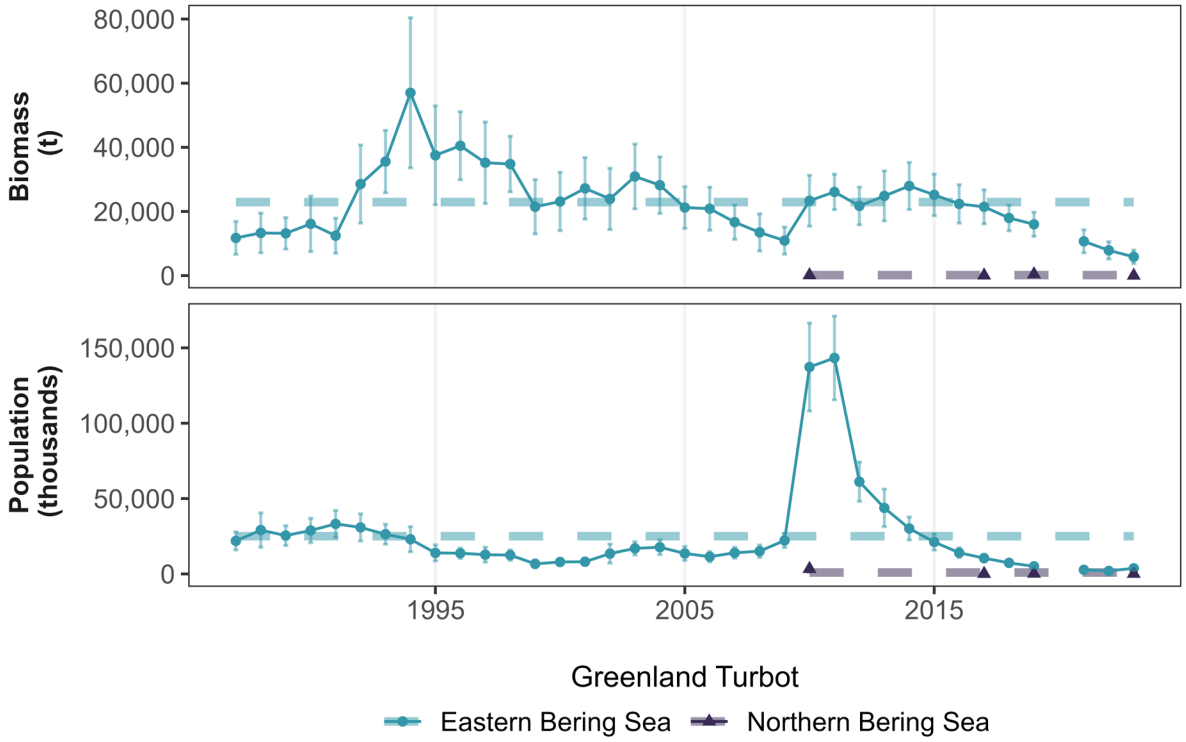

Figure 45. -- Time series of Greenland turbot (*Reinhardtius hippoglossoides*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

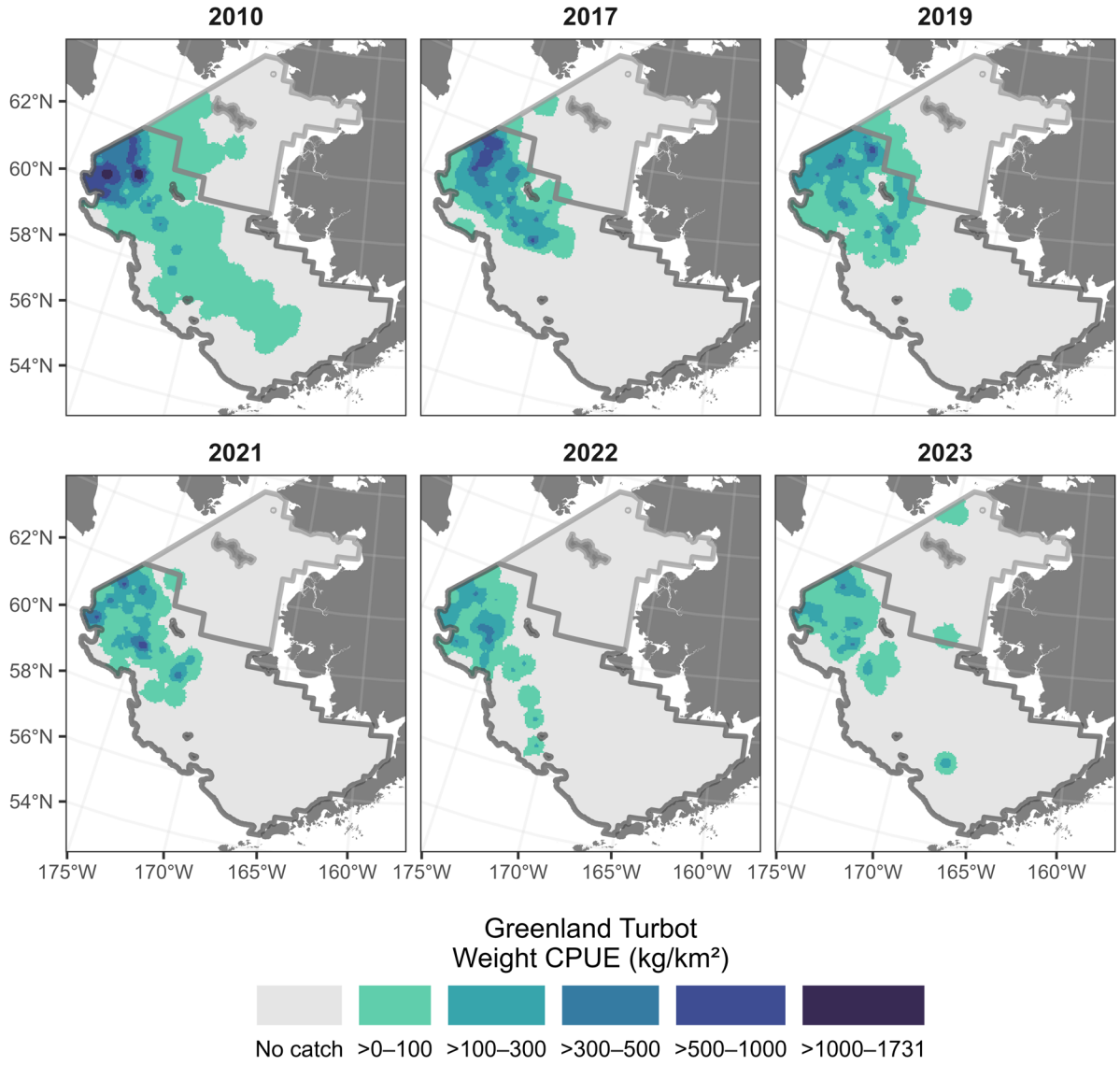

Figure 46. -- Weight CPUE (kg/km^2) distribution of Greenland turbot (*Reinhardtius hippoglossoides*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

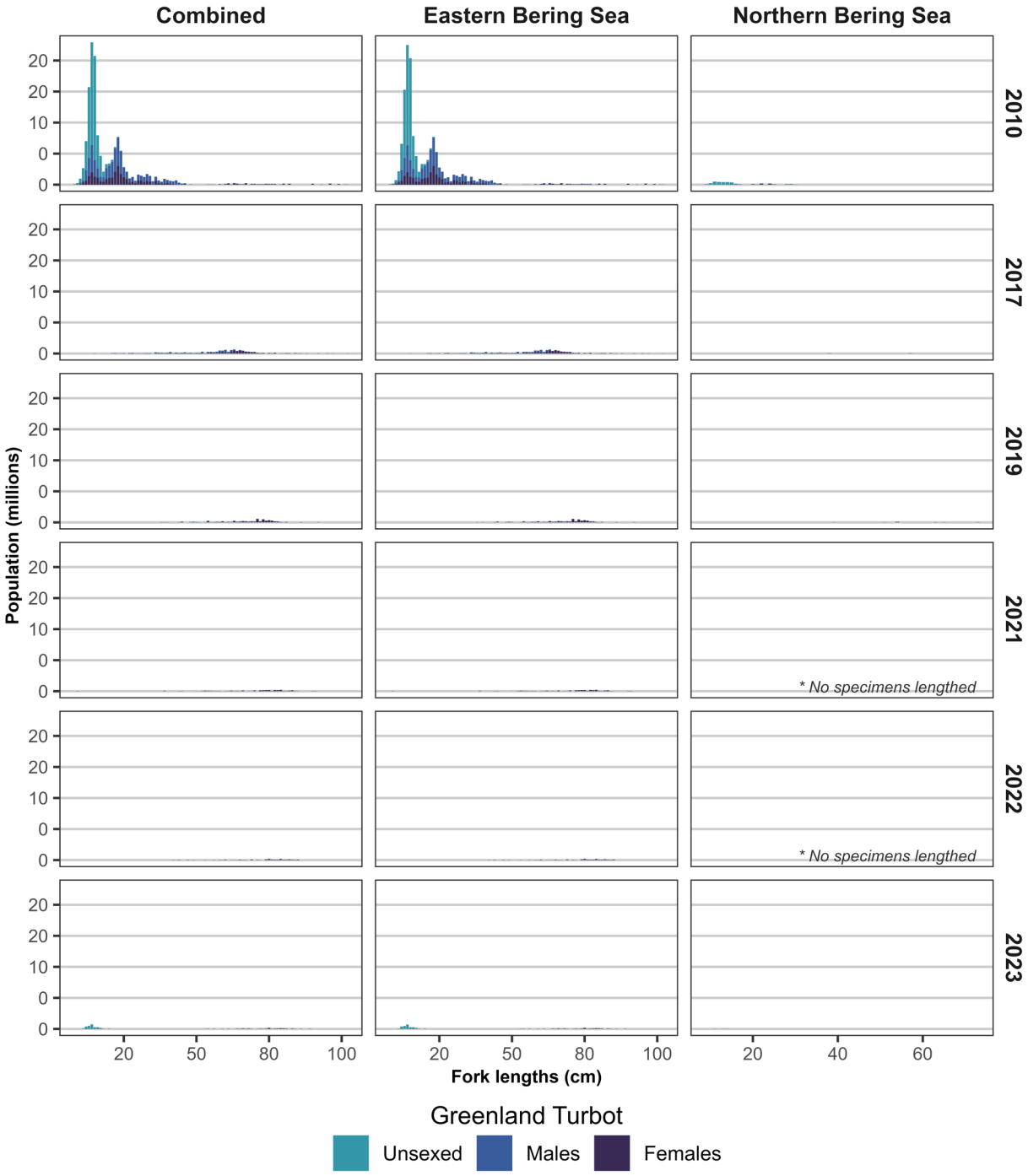

Figure 47. -- Total abundance-at-length estimates of Greenland turbot (*Reinhardtius hippoglossoides*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 57. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for Greenland turbot (*Reinhardtius hippoglossoides*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	3.62	3.62	344	344	0	1,031	1
32	-	-	-	-	-	-	-
41	0.11	0.07	7	4	0	15	3
42	-	-	-	-	-	-	-
43	11.12	6.36	234	134	0	502	6
50	-	-	-	-	-	-	-
61	30.29	7.68	2,659	674	1,310	4,007	17
62	121.71	60.90	786	394	0	1,574	3
82	29.19	20.17	524	362	0	1,248	3
90	112.97	40.97	1,304	473	358	2,249	7
Total	**11.88**	**2.13**	**5,857**	**1,049**	**3,760**	**7,955**	**40**
Northern Bering Sea							
70	0.00	0.00	0	0	0	0	1
71	0.01	0.01	1	1	0	3	2
81	-	-	-	-	-	-	-
Total	**0.01**	**0.00**	**1**	**1**	**0**	**3**	**3**

Table 58. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for Greenland turbot (*Reinhardtius hippoglossoides*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	0.58	0.58	0.00	164.67	54.89	54.89	1
32	-	-	-	-	-	-	-
41	7.87	4.99	0.00	1,112.39	490.54	310.92	3
42	-	-	-	-	-	-	-
43	7.61	3.31	20.77	299.65	160.21	69.72	6
50	-	-	-	-	-	-	-
61	7.03	1.71	317.38	916.87	617.13	149.87	17
62	30.04	14.36	8.48	379.75	194.12	92.82	3
82	37.75	22.51	0.00	1,485.86	677.67	404.10	3
90	134.15	42.95	556.81	2,539.19	1,548.00	495.59	7
Total	**7.59**	**1.50**	**2,266.71**	**5,218.41**	**3,742.56**	**737.92**	**40**
Northern Bering Sea							
70	0.54	0.54	0.00	128.34	42.78	42.78	1
71	1.11	0.83	0.00	225.98	90.51	67.73	2
81	-	-	-	-	-	-	-
Total	**0.67**	**0.40**	**0.00**	**293.51**	**133.29**	**80.11**	**3**

Kamchatka Flounder (*Atheresthes evermanni*)

Between 2022 and 2023, the Kamchatka flounder biomass estimate decreased by 16% in the eastern Bering Sea (Tables **59** and **60**; Fig. **48**) and the population was estimated at 40.1 million individuals (Tables **59** and **61**; Fig. **48**). No Kamchatka flounder were observed in the northern Bering Sea in 2023 (Fig. **49**).

Similar to arrowtooth flounder, Kamchatka flounder occupied areas in the middle and outer domain in 2023, although Kamchatka flounder were much less abundant than arrowtooth flounder in the Bering Sea and are distributed towards the northeast (Figs. **49** and **24**). The Kamchatka flounder sex ratio was roughly 1:1, with length nodes at approximately 18 and 38 cm (Fig. **50**). There were a greater number of small Kamchatka flounder (>20 cm) observed in the eastern Bering Sea than in previous years and relatively fewer individuals between 30 and 40 cm than in 2021 and 2022 (Fig. **50**).

Table 59. -- Summary of catch location environmental variables and biomass and population estimates for Kamchatka flounder (*Atheresthes evermanni*) in the eastern Bering Sea survey areas.

	Eastern Bering Sea
Stations Present	173 of 376 (46.0%)
Bottom Depth (m)	36 — 171
Bottom Temperature (°C)	-0.2 — 5.4
Surface Temperature (°C)	3.2 — 10.7
Population	40.1 million
Biomass (t)	24,875
Biomass % Total	0.2%
Biomass % Change	16% decrease from 2022

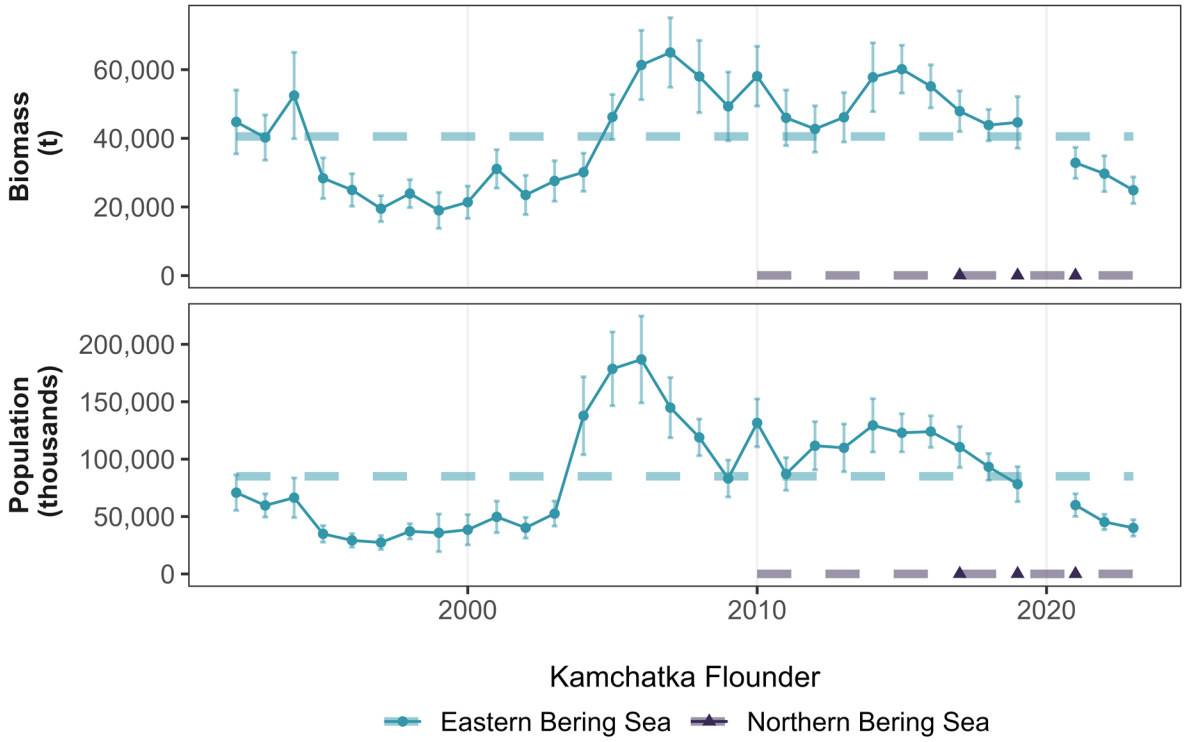

Figure 48. -- Time series of Kamchatka flounder (*Atheresthes evermanni*) biomass (t) and population (thousands) from the 1992-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

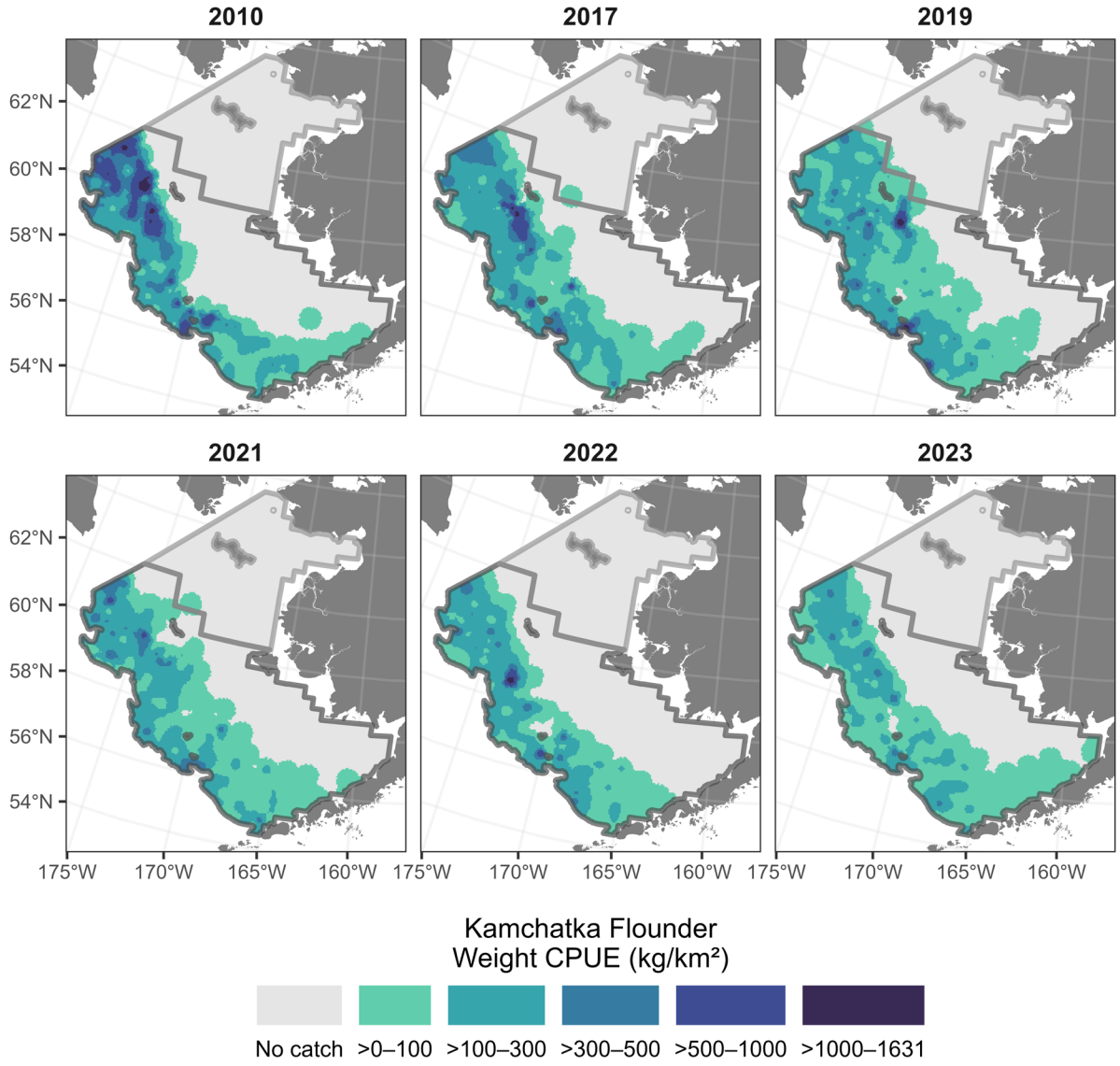

Figure 49. -- Weight CPUE (kg/km^2) distribution of Kamchatka flounder (*Atheresthes evermanni*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

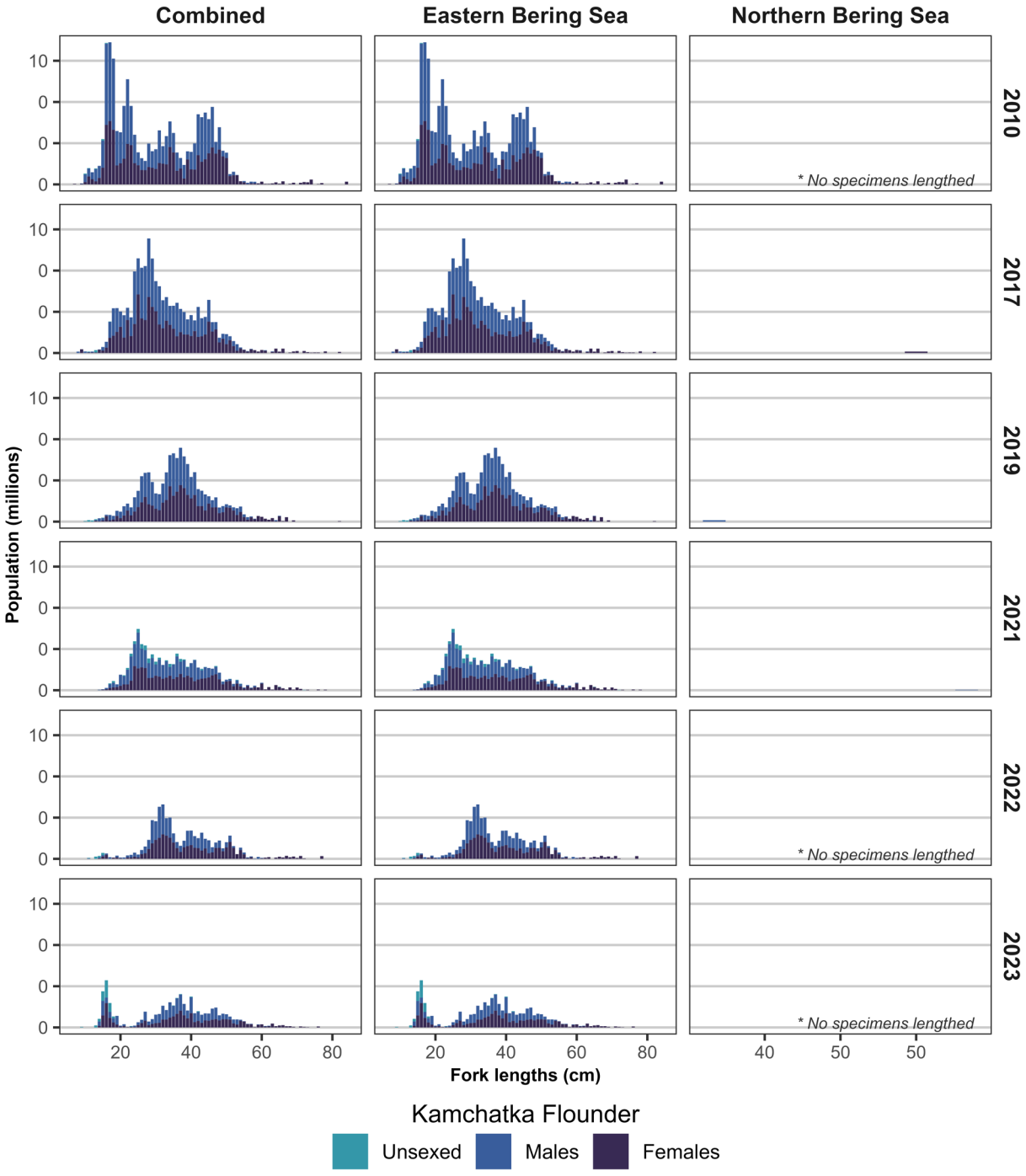

Figure 50. -- Total abundance-at-length estimates of Kamchatka flounder (*Atheresthes evermanni*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 60. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for Kamchatka flounder (*Atheresthes evermanni*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	0.77	0.45	60	36	0	132	5
20	-	-	-	-	-	-	-
31	28.35	5.87	2,693	557	1,578	3,808	36
32	79.10	30.54	700	270	159	1,240	7
41	43.11	15.94	2,686	993	700	4,673	9
42	62.76	17.94	1,514	433	648	2,380	18
43	74.20	26.43	1,563	557	449	2,677	8
50	98.04	16.84	3,729	641	2,448	5,011	23
61	98.78	12.07	8,671	1,060	6,551	10,790	52
62	180.31	52.13	1,165	337	491	1,839	6
82	3.30	3.30	59	59	0	178	1
90	176.27	40.24	2,034	464	1,105	2,962	8
Total	**50.46**	**3.92**	**24,875**	**1,933**	**21,010**	**28,740**	**173**

Table 61. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for Kamchatka flounder (*Atheresthes evermanni*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	30.35	19.90	0.00	5,521.97	2,388.86	1,566.56	5
20	-	-	-	-	-	-	-
31	93.48	19.84	5,110.60	12,646.97	8,878.79	1,884.09	36
32	175.44	53.86	599.09	2,504.97	1,552.03	476.47	7
41	48.43	18.82	671.81	5,363.02	3,017.41	1,172.80	9
42	96.28	23.02	1,211.98	3,432.78	2,322.38	555.20	18
43	52.92	19.36	299.15	1,930.41	1,114.78	407.81	8
50	158.65	40.96	2,918.55	9,151.14	6,034.84	1,558.15	22
61	134.82	15.90	9,043.30	14,625.12	11,834.21	1,395.45	52
62	167.85	48.07	463.36	1,705.74	1,084.55	310.59	6
82	2.29	2.29	0.00	123.36	41.12	41.12	1
90	161.15	43.23	861.76	2,857.21	1,859.49	498.86	8
Total	**81.40**	**7.26**	**32,972.18**	**47,284.74**	**40,128.46**	**3,578.14**	**172**

Longhead Dab (*Myzopsetta proboscidea*)

Previous scientific name: *Limanda proboscidea*

Between 2022 and 2023, the longhead dab biomass estimate decreased by 40% in the eastern Bering Sea (Tables **62** and **63**; Fig. **51**) and the population was estimated at 134.3 million individuals (Tables **62** and **64**; Fig. **51**). The biomass estimate increased by 7% in the northern Bering Sea and the population was estimated at 24.8 million individuals.

Table 62. -- Summary of catch location environmental variables and biomass and population estimates for longhead dab (*Myzopsetta proboscidea*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	44 of 376 (11.7%)	35 of 116 (30.2%)
Bottom Depth (m)	20 — 54	12 — 45
Bottom Temperature (°C)	-1.1 — 4.8	1.3 — 11.1
Surface Temperature (°C)	1.7 — 4.9	6.9 — 14.7
Population	134.3 million	24.8 million
Biomass (t)	12,216	1,314
Biomass % Total	0.1%	<0.01%
Biomass % Change	40% decrease from 2022	7% increase from 2022

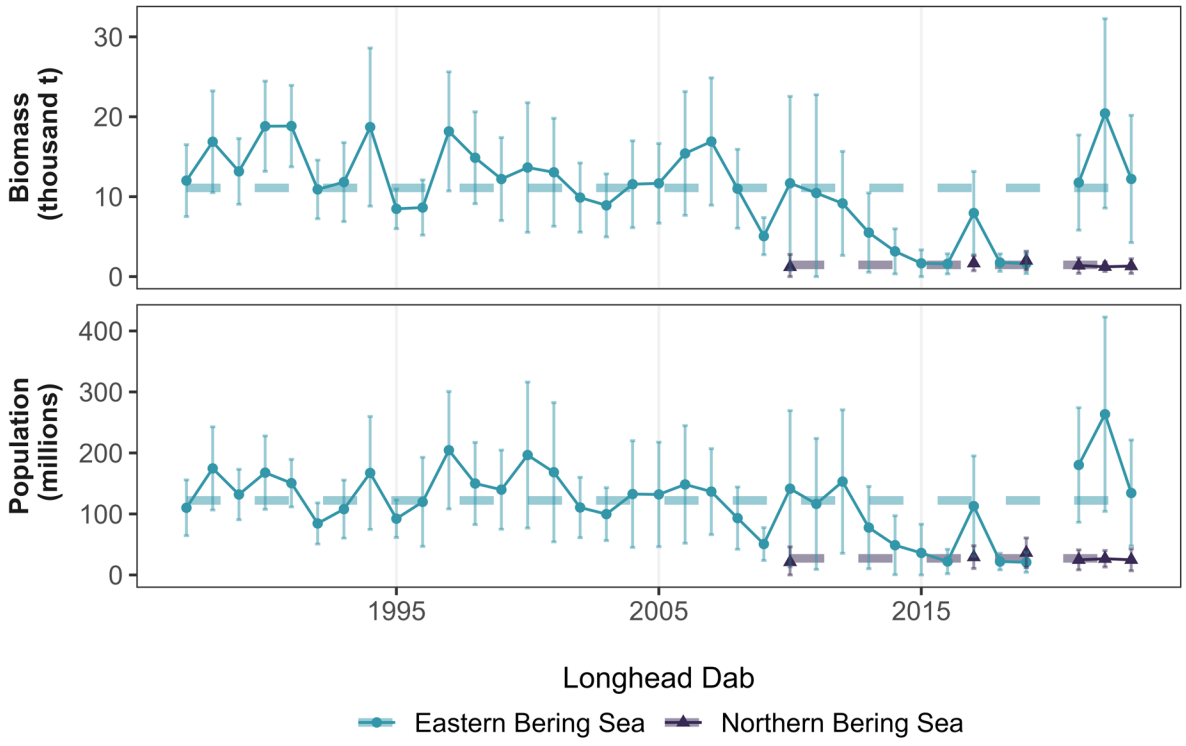

Figure 51. -- Time series of longhead dab (*Myzopsetta proboscidea*) biomass (thousand t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

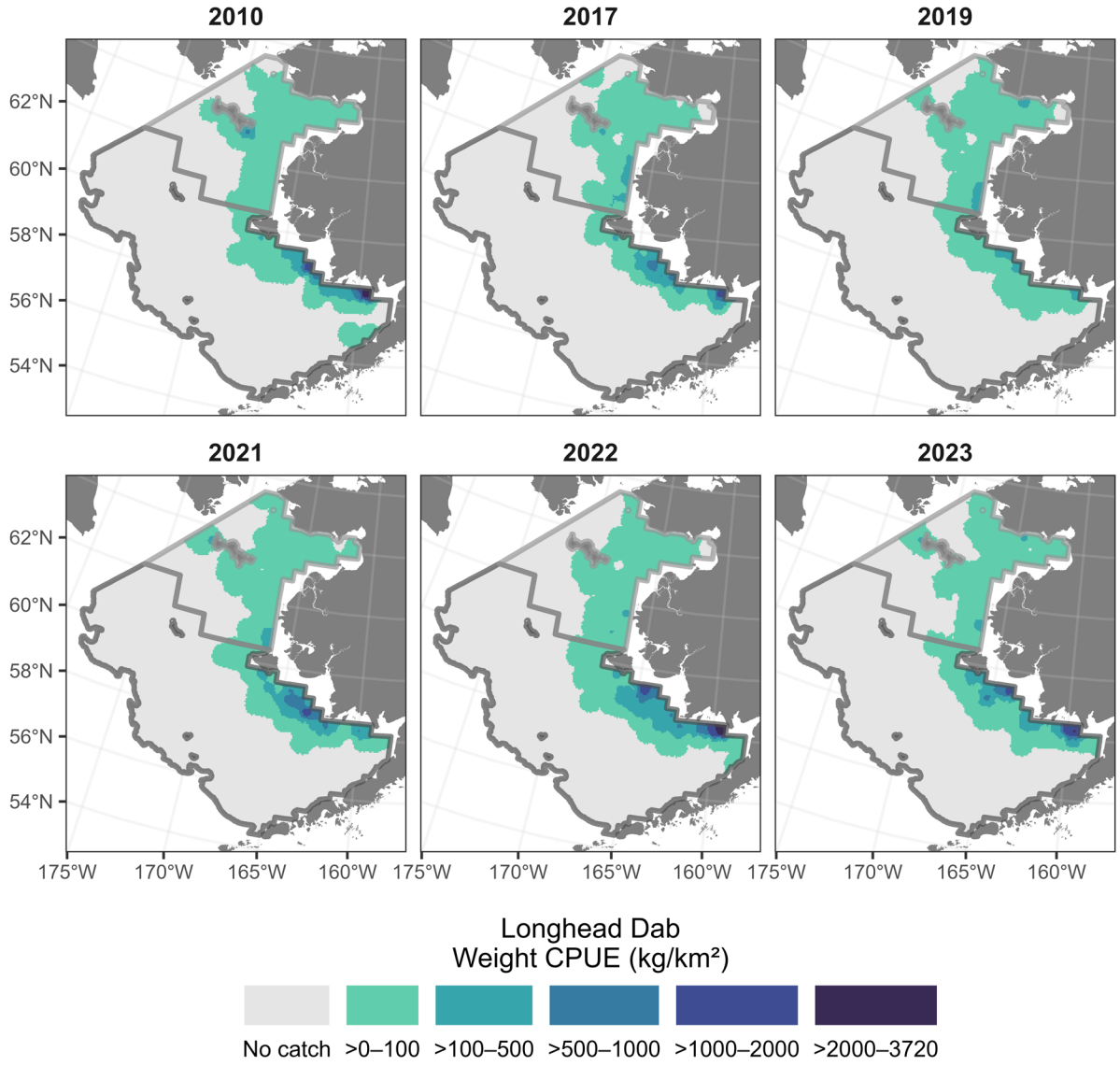

Figure 52. -- Weight CPUE (kg/km^2) distribution of longhead dab (*Myzopsetta proboscidea*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 63. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for longhead dab (*Myzopsetta proboscidea*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	138.24	50.03	10,880	3,938	3,005	18,755	30
20	32.44	14.03	1,336	578	180	2,493	14
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**24.78**	**8.07**	**12,216**	**3,980**	**4,257**	**20,176**	**44**
Northern Bering Sea							
70	12.46	5.28	987	419	150	1,824	16
71	4.02	2.37	327	192	0	711	19
81	-	-	-	-	-	-	-
Total	**6.61**	**2.32**	**1,314**	**461**	**393**	**2,235**	**35**

Table 64. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (millions) with SD (millions), 95% lower (LCL; millions) and upper (UCL; millions) confidence limits, and number of hauls where species were counted for longhead dab (*Myzopsetta proboscidea*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (M)	95% UCL (M)	Population (M)	Population SD (M)	Hauls w/counts
Eastern Bering Sea							
10	1,429.81	535.69	28.21	196.86	112.53	42.16	30
20	529.49	253.38	0.94	42.69	21.81	10.44	14
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**272.51**	**88.10**	**47.48**	**221.21**	**134.35**	**43.43**	**44**
Northern Bering Sea							
70	223.17	100.57	1.75	33.63	17.69	7.97	16
71	87.73	51.29	0.00	15.46	7.13	4.17	19
81	-	-	-	-	-	-	-
Total	**124.79**	**45.23**	**6.83**	**42.81**	**24.82**	**8.99**	**35**

Marbled Eelpout (*Lycodes raridens*)

Between 2022 and 2023, the marbled eelpout biomass estimate was 33 t in the eastern Bering Sea (Tables **65** and **63**; Fig. **53**) and the population was estimated at 49,688 individuals (Tables **65** and **64**; Fig. **53**). The biomass estimate increased by 2382% in the northern Bering Sea and the population was estimated at 663,158 individuals.

Table 65. -- Summary of catch location environmental variables and biomass and population estimates for marbled eelpout (*Lycodes raridens*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	1 of 376 (0.3%)	7 of 116 (6.0%)
Bottom Depth (m)	91	48 — 78
Bottom Temperature (°C)	-1.3	-1.6 — 2.2
Surface Temperature (°C)	9.7	6.9 — 10.1
Population	49,688	663,158
Biomass (t)	33	169
Biomass % Total	<0.01%	<0.01%
Biomass % Change	Not caught in 2022	2382% increase from 2022

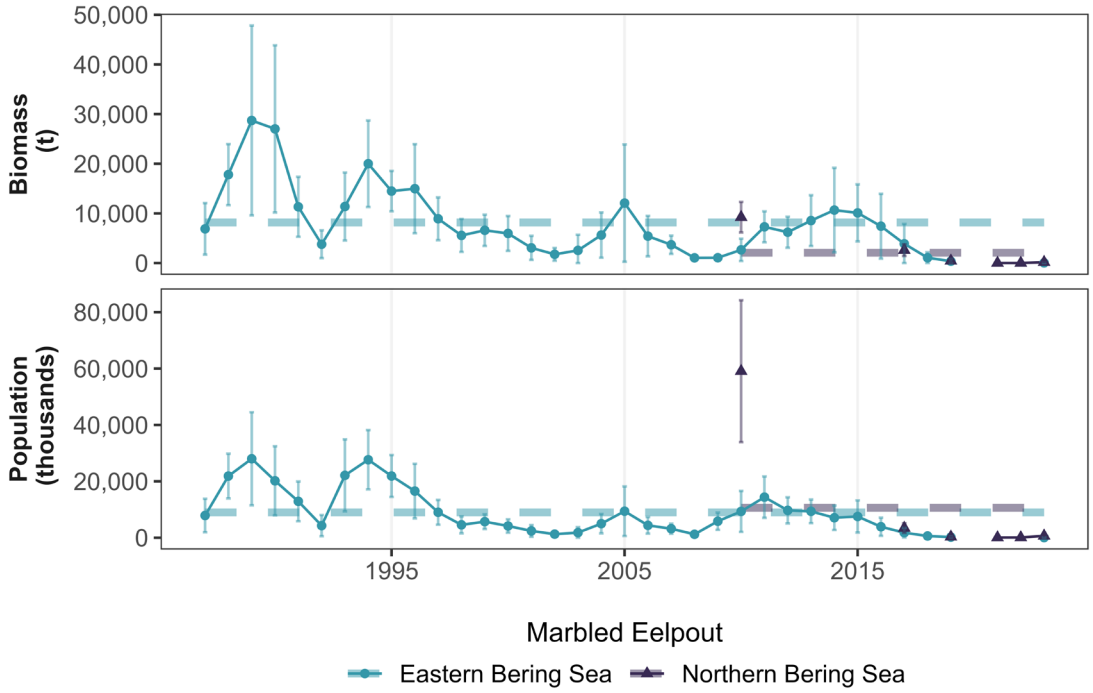

Figure 53. -- Time series of marbled eelpout (*Lycodes raridens*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

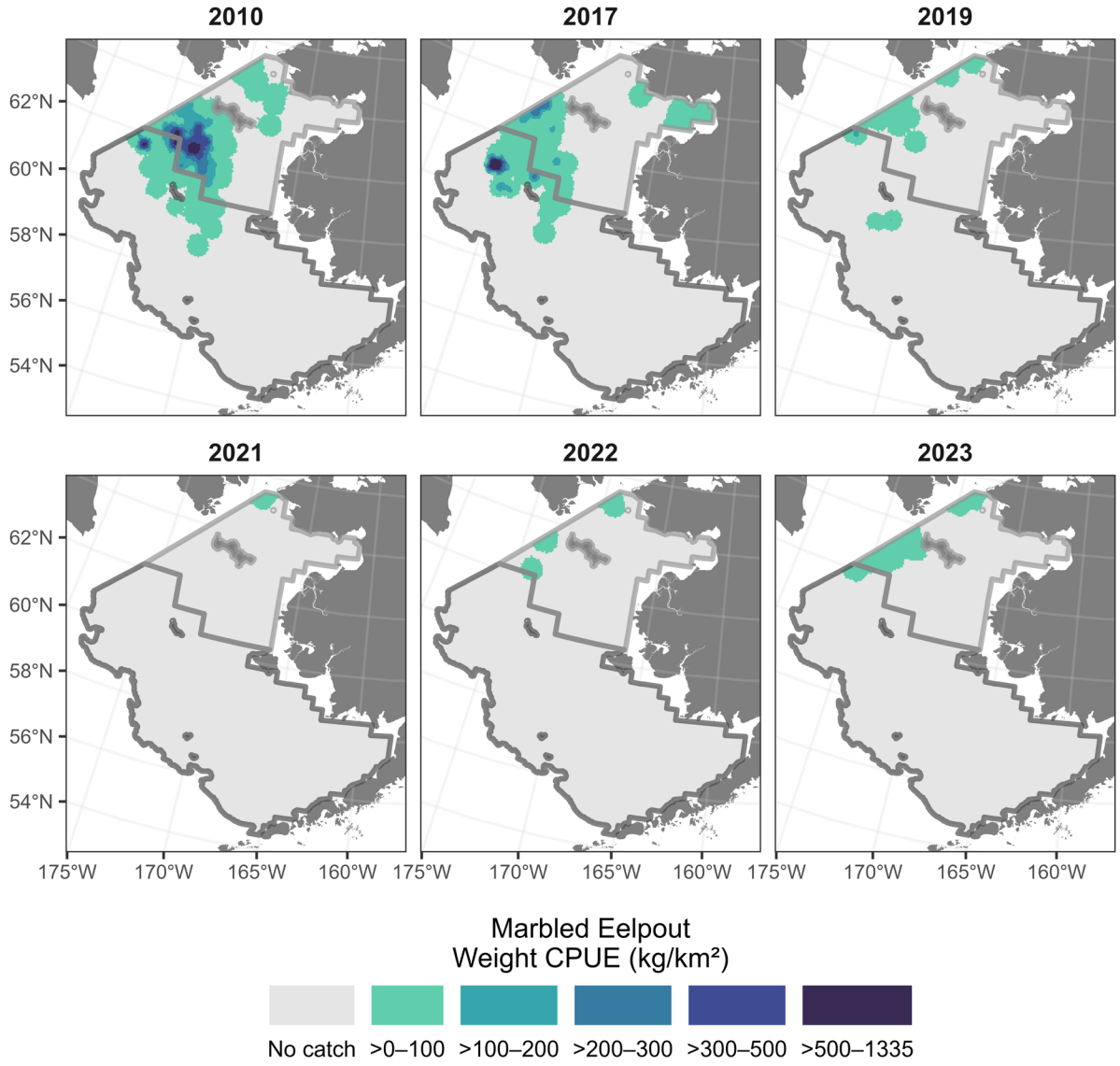

Figure 54. -- Weight CPUE (kg/km^2) distribution of marbled eelpout (*Lycodes raridens*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Neptune Whelks (*Neptunea heros* and *Neptunea ventricosa*)

Previous common name: Neptune snail, Northern Neptune snail

Between 2022 and 2023, the Neptune whelks biomass estimate decreased by 47% in the eastern Bering Sea (Tables **66** and **63**; Fig. **55**) and the population was estimated at 597.6 million individuals (Tables **66** and **64**; Fig. **55**). Similarly, the biomass estimate decreased by 19% in the northern Bering Sea and the population was estimated at 1.3 billion individuals.

Table 66. -- Summary of catch location environmental variables and biomass and population estimates for Neptune whelks (*Neptunea heros* and *Neptunea ventricosa*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	162 of 376 (43.1%)	86 of 116 (74.1%)
Bottom Depth (m)	21 — 126	15 — 70
Bottom Temperature (°C)	-1.6 — 4.6	-1.6 — 10.4
Surface Temperature (°C)	1.8 — 10.2	4 — 15.1
Population	597.6 million	1.3 billion
Biomass (t)	79,184	153,982
Biomass % Total	0.7%	5.5%
Biomass % Change	47% decrease from 2022	19% decrease from 2022

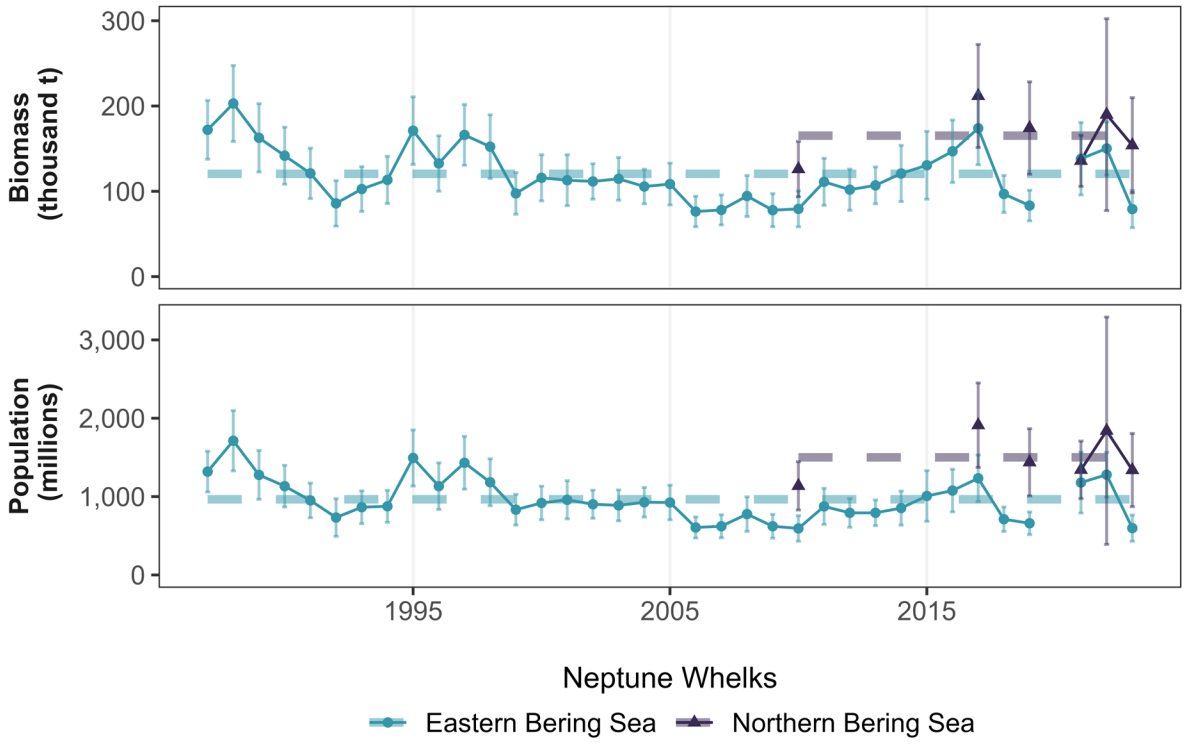

Figure 55. -- Time series of Neptune whelks (*Neptunea heros* and *Neptunea ventricosa*) biomass (thousand t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

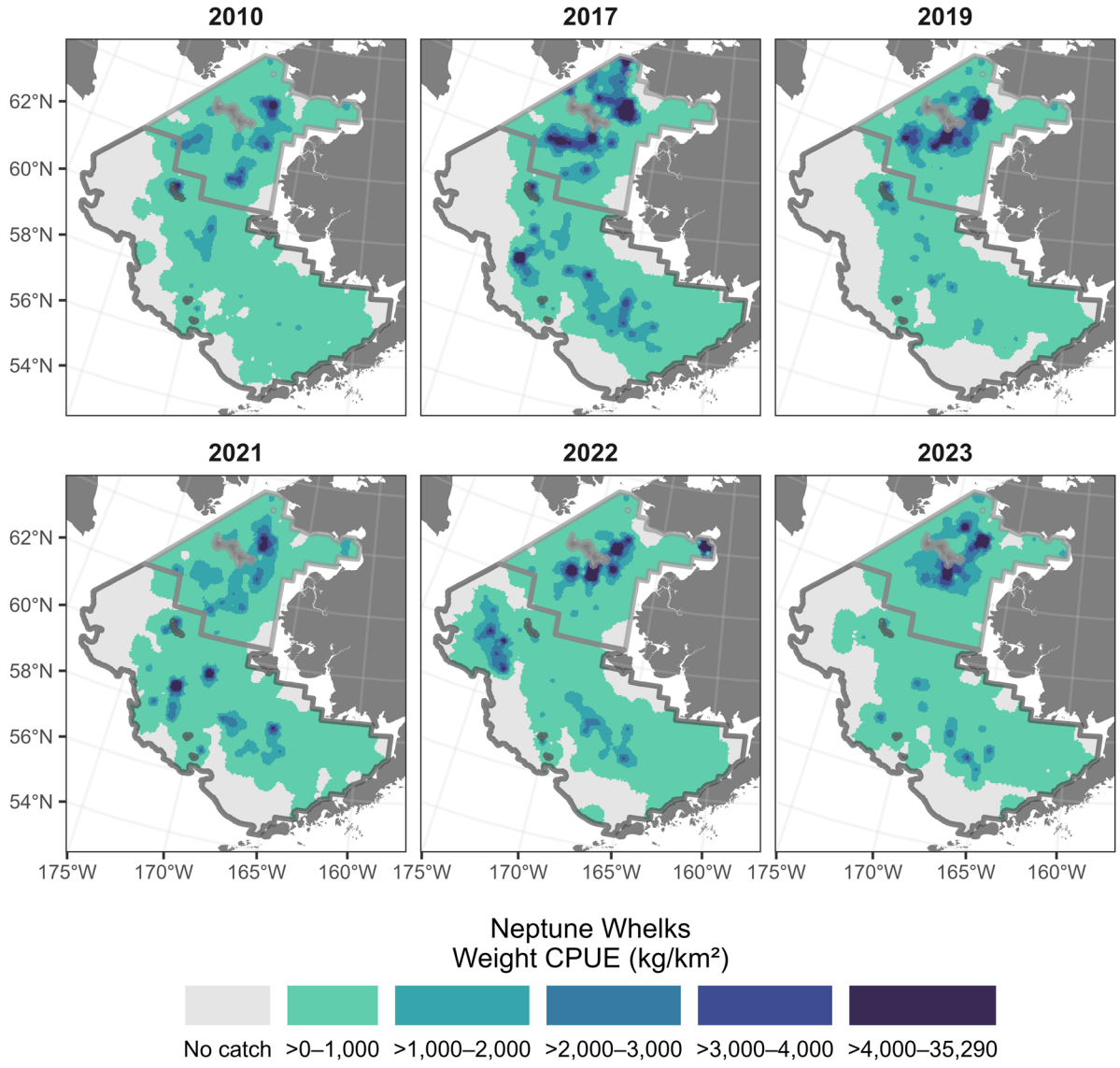

Figure 56. -- Weight CPUE (kg/km^2) distribution of Neptune whelks (*Neptunea heros* and *Neptunea ventricosa*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Northern Rock Sole (*Lepidopsetta polyxystra*)

Between 2022 and 2023, the northern rock sole biomass estimate increased by 7% in the eastern Bering Sea (Tables **67** and **68**; Fig. **57**) and the population was estimated at 6.7 billion individuals (Tables **67** and **69**; Fig. **57**). The biomass estimate decreased by 37% in the northern Bering Sea and the population was estimated at 88.9 million individuals.

The distribution of northern rock sole in 2023 was similar to the distribution in 2022. The highest densities in the eastern Bering Sea were observed in the southeast portion of the inner domain, in the vicinity of the Pribilof Islands and along the Alaska Peninsula (Fig. **58**). The distribution of northern rock sole appears mediated by the extent of the cold pool, as relatively low densities of northern rock sole were observed where bottom temperatures were < 1°C in the middle and outer domains (Fig. **58**; and Tables **68** and **69**). In colder years, such as 2010, when the cold pool was large and touched the western tip of Nunivak Island (Figs. **5** and **6**), the highest concentrations of rock sole were in the southwest part of the eastern Bering Sea shelf.

The length modes in the eastern Bering Sea were at approximately 15 and 30 cm, representing a slight increase in the size of northern rock sole compared to 2022, with fewer individuals below 20 cm and above 35 cm observed (Fig. **59**).

While spawning and feeding migrations for northern rock sole are poorly understood, they are believed to use active tidal stream transport during nighttime hours (Nichol and Somerton, 2009) to migrate from shallow summer feeding grounds to deep winter and spring spawning grounds (Shubnikov and Lisovenko, 1964; Fadeev, 1965).

Table 67. -- Summary of catch location environmental variables and biomass and population estimates for northern rock sole (*Lepidopsetta polyxystra*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	303 of 376 (80.6%)	67 of 116 (57.8%)
Bottom Depth (m)	20 — 171	14 — 70
Bottom Temperature (°C)	-1.6 — 5.4	-1.3 — 11
Surface Temperature (°C)	1.7 — 11	5.4 — 11.5
Population	6.7 billion	88.9 million
Biomass (t)	1.4 million	29,225
Biomass % Total	11.7%	1.0%
Biomass % Change	7% increase from 2022	37% decrease from 2022

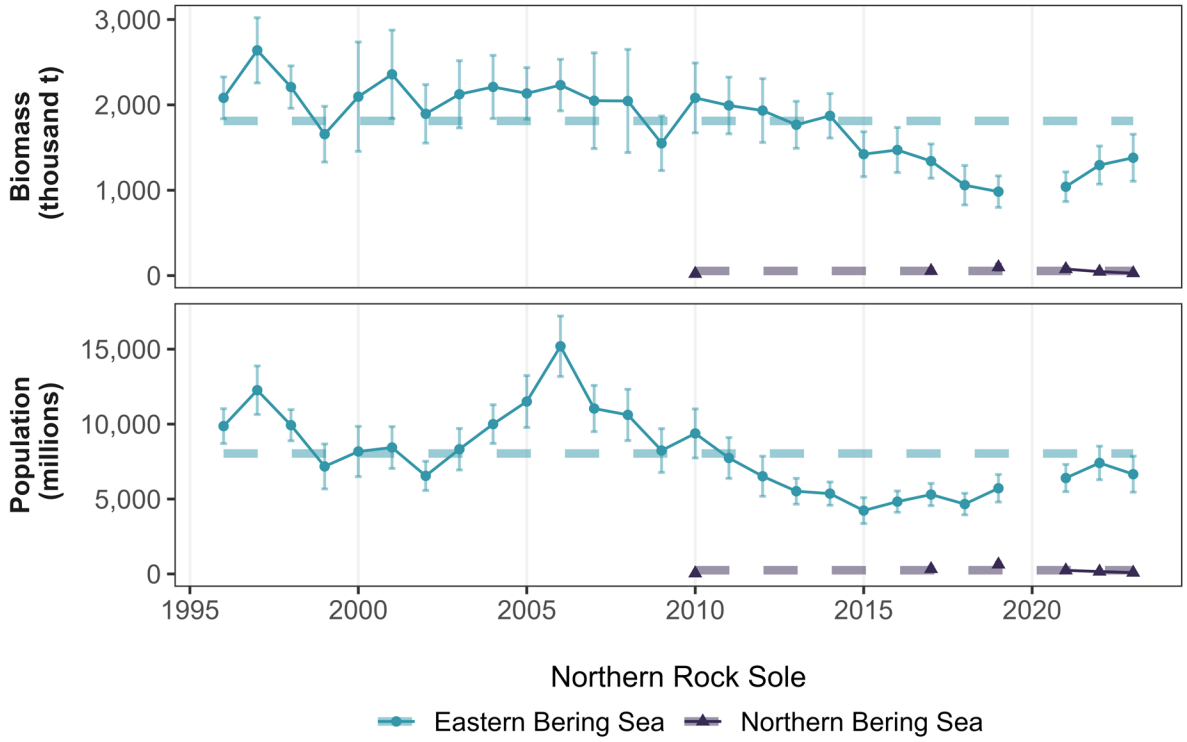

Figure 57. -- Time series of northern rock sole (*Lepidopsetta polyxystra*) biomass (thousand t) and population (millions) from the 1996-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

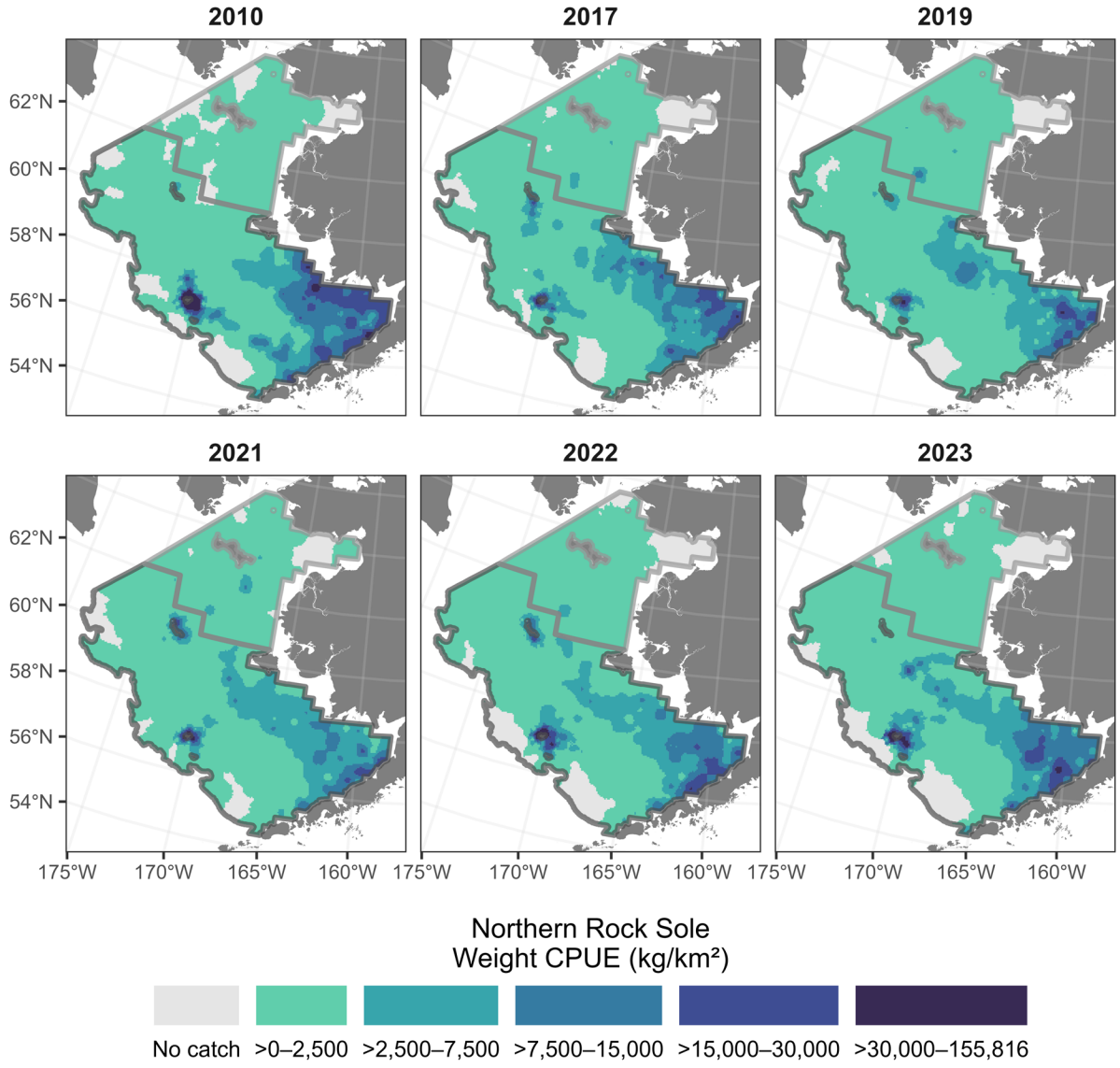

Figure 58. -- Weight CPUE (kg/km^2) distribution of northern rock sole (*Lepidopsetta polyxystra*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

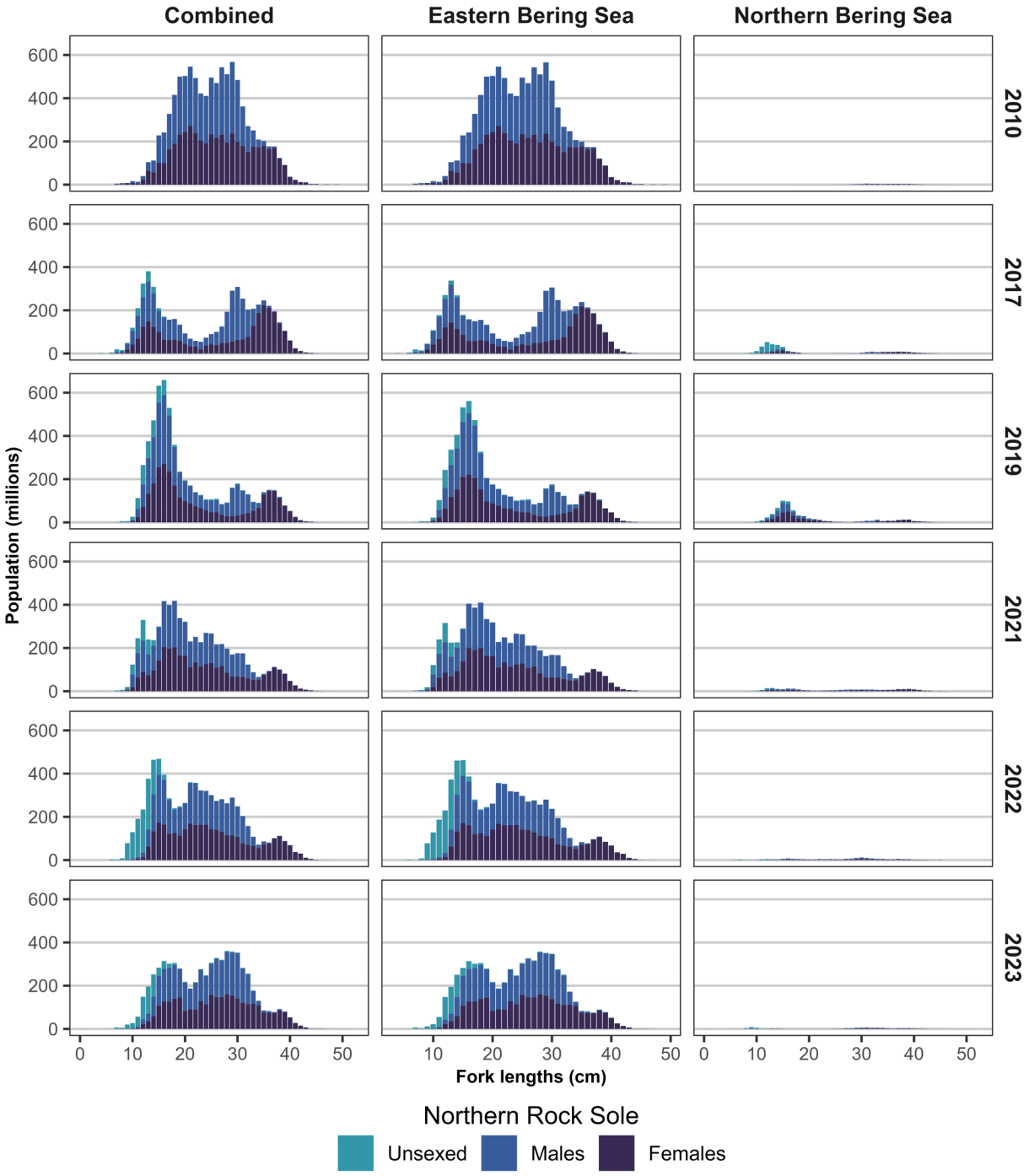

Figure 59. -- Total abundance-at-length estimates of northern rock sole (*Lepidopsetta polyxystra*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 68. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for northern rock sole (*Lepidopsetta polyxystra*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	7,707.70	753.09	606,640	59,273	488,095	725,185	58
20	2,349.18	369.41	96,770	15,217	66,336	127,205	30
31	3,263.20	788.51	309,934	74,892	160,150	459,718	63
32	2,916.51	1,178.98	25,802	10,430	4,941	46,662	7
41	1,280.54	461.30	79,790	28,744	22,303	137,278	42
42	10,278.08	3,850.65	247,929	92,886	62,157	433,701	28
43	452.57	205.15	9,533	4,321	890	18,175	22
50	43.53	37.98	1,656	1,445	0	4,545	2
61	19.32	4.80	1,696	422	853	2,539	28
62	20.11	4.69	130	30	69	191	6
82	33.19	11.42	596	205	186	1,006	10
90	18.07	4.74	208	55	99	318	7
Total	**2,800.63**	**279.14**	**1,380,684**	**137,613**	**1,105,458**	**1,655,910**	**303**
Northern Bering Sea							
70	296.24	64.27	23,480	5,094	13,292	33,669	36
71	30.95	12.95	2,515	1,052	410	4,619	19
81	84.23	38.12	3,230	1,462	306	6,155	12
Total	**146.96**	**27.17**	**29,225**	**5,403**	**18,419**	**40,032**	**67**

Table 69. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for northern rock sole (*Lepidopsetta polyxystra*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	46,265.69	4,795.73	2,886,469.45	4,396,275.29	3,641,372.37	377,451.46	58
20	11,020.12	1,889.84	298,257.17	609,651.19	453,954.18	77,848.51	30
31	15,549.05	3,903.31	735,364.32	2,218,285.57	1,476,824.95	370,730.31	63
32	11,505.92	4,698.61	18,655.13	184,924.43	101,789.78	41,567.32	7
41	3,552.41	1,180.00	74,298.59	368,402.79	221,350.69	73,526.05	42
42	30,177.83	10,861.68	203,939.95	1,251,966.64	727,953.29	262,006.67	28
43	1,133.76	475.48	3,850.42	43,911.86	23,881.14	10,015.36	22
50	111.86	99.21	0.00	11,803.09	4,255.17	3,773.96	2
61	47.62	11.29	2,197.55	6,162.87	4,180.21	991.33	28
62	60.92	13.79	215.50	571.79	393.65	89.07	6
82	61.20	21.16	338.78	1,858.72	1,098.75	379.99	9
90	43.67	11.98	227.47	780.25	503.86	138.19	7
Total	**13,504.45**	**1,220.22**	**5,454,448.59**	**7,860,667.48**	**6,657,558.03**	**601,554.72**	**302**
Northern Bering Sea							
70	972.64	154.57	52,588.04	101,594.07	77,091.06	12,251.51	35
71	50.61	18.47	1,111.04	7,114.39	4,112.71	1,500.84	19
81	200.96	87.35	1,006.80	14,407.63	7,707.21	3,350.21	12
Total	**447.09**	**64.31**	**63,331.63**	**114,490.34**	**88,910.98**	**12,789.68**	**66**

Pacific Cod (*Gadus macrocephalus*)

Between 2022 and 2023, the Pacific cod biomass estimate increased by 2% in the eastern Bering Sea (Tables **70** and **71**; Fig. **60**) and the population was estimated at 555.7 million individuals (Tables **70** and **72**; Fig. **60**). The biomass estimate decreased by 30% in the northern Bering Sea and the population was estimated at 52.2 million individuals.

In 2023, Pacific cod biomass was spread throughout both eastern and northern Bering Sea regions with several large concentrations located primarily in the eastern Bering Sea. Specifically, some of the highest concentrations of Pacific cod in the eastern Bering Sea were encountered both north and slightly south of St. Matthew Island, as well as just west of Nunivak. Pacific cod size composition in the eastern Bering Sea shows three distinct modes around 22 cm, 36 cm, and 51 cm (Fig. **62**) for males and 23 cm, 36 cm, and 53 cm for females.

In the northern Bering Sea, Pacific cod were mostly concentrated to the east of St. Lawrence Island (Fig. **61**). Pacific cod have been declining in the northern Bering Sea since abundance peaked in 2017 and 2019, while slightly increasing in the eastern Bering Sea. This pattern likely reflects interannual variability in the migration of Pacific cod between the eastern and northern Bering Sea survey areas. Satellite tagging shows high mobility between these regions, with fish moving from the northern Bering Sea to the Gulf of Alaska (Nielsen et al., 2023).

Pacific cod are highly mobile, semi-pelagic fish whose spatial distribution can vary with bottom temperature and abundance (Kotwicki and Lauth, 2013). During the previous warm stanza from 2002 to 2005, the highest densities of Pacific cod were observed in the northern part of the eastern Bering Sea surrounding the Pribilof Islands and St. Matthew Island and the lowest densities were in the southern part of the eastern Bering Sea. A similar pattern was observed from 2017 to 2021. However, 2017 was preceded by three warm years when Pacific cod abundance and biomass were relatively high and large aggregations were present in the middle and inner domains close to the northern border between the eastern Bering Sea and northern Bering Sea survey areas. During the recent warm stanza (2014 - 2021), higher-than-average bottom temperatures in the southeastern shelf created thermal corridors (between 1° and 6°C) for Pacific cod to move into the middle and inner domains, where they likely fed on capelin (Ciannelli and Bailey, 2005). Forage fish species such as capelin, Pacific herring, and smelt were found in high density in the inner domain. A change was observed in the estimates of survey biomass and abundance at length that accompanied the northerly shift in Pacific cod distribution in the 2017 survey. Pacific cod were generally absent from the northern middle domain during the cold stanza (2006 - 2013) and concentrated along the perimeter of the cold pool, where bottom temperatures were greater than 0°C.

From 2010 to 2016, the estimated biomass and abundance of Pacific cod in the eastern Bering Sea shelf continued to increase, reaching maximums of 1.1 million t (2014 - 2015) and 1.1 trillion cod (2014). However, in 2017, both biomass and abundance sharply declined to 0.64 million t and 364 billion cod. This sudden decline in the eastern Bering Sea biomass was accompanied by an order of magnitude increase in the northern Bering Sea survey biomass (0.3 million t) and abundance (133 million) compared to 2010. Moreover, unlike 2010, the northern Bering Sea population in 2017 had almost an identical size composition to that of the eastern Bering Sea. The decreased Pacific cod abundance in the eastern Bering Sea, along with the concomitant increase of the same-sized Pacific cod in the adjacent northern Bering Sea, was likely a result of migration from the eastern Bering Sea (Stevenson and Lauth, 2019). These migrations to the northern Bering Sea were potentially already taking place prior to 2017, as high densities

of Pacific cod were observed along the northern edge of the eastern Bering Sea survey area from 2014 to 2016 (Conner, Stevenson, et al., 2017; Conner, Nichol, et al., 2017; Conner and Lauth, 2017b).

Table 70. -- Summary of catch location environmental variables and biomass and population estimates for Pacific cod (*Gadus macrocephalus*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	361 of 376 (96.0%)	78 of 116 (67.2%)
Bottom Depth (m)	20 — 171	21 — 63
Bottom Temperature (°C)	-1.6 — 5.4	-1.1 — 9.9
Surface Temperature (°C)	1.7 — 11	4 — 12.8
Population	555.7 million	52.2 million
Biomass (t)	663,075	108,346
Biomass % Total	5.6%	3.9%
Biomass % Change	2% increase from 2022	30% decrease from 2022

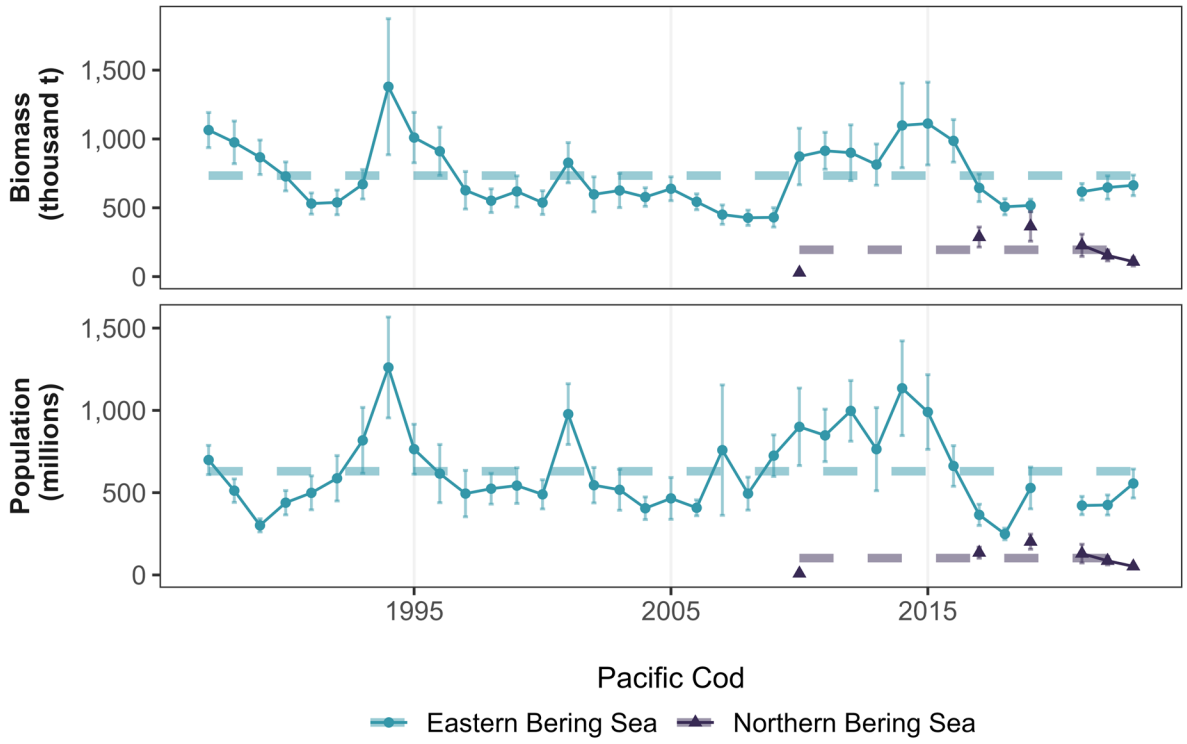

Figure 60. -- Time series of Pacific cod (*Gadus macrocephalus*) biomass (thousand t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

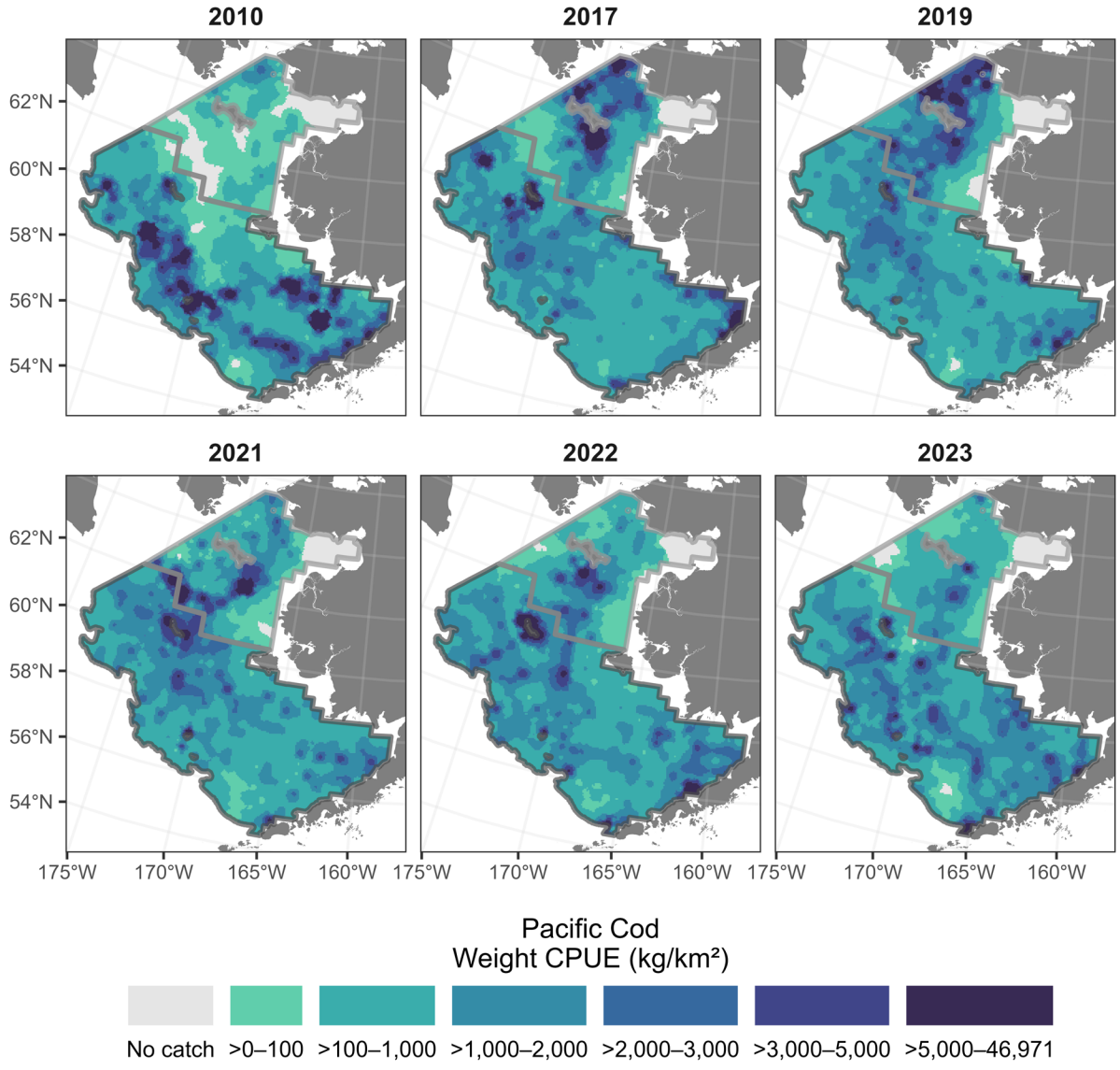

Figure 61. -- Weight CPUE (kg/km^2) distribution of Pacific cod (*Gadus macrocephalus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

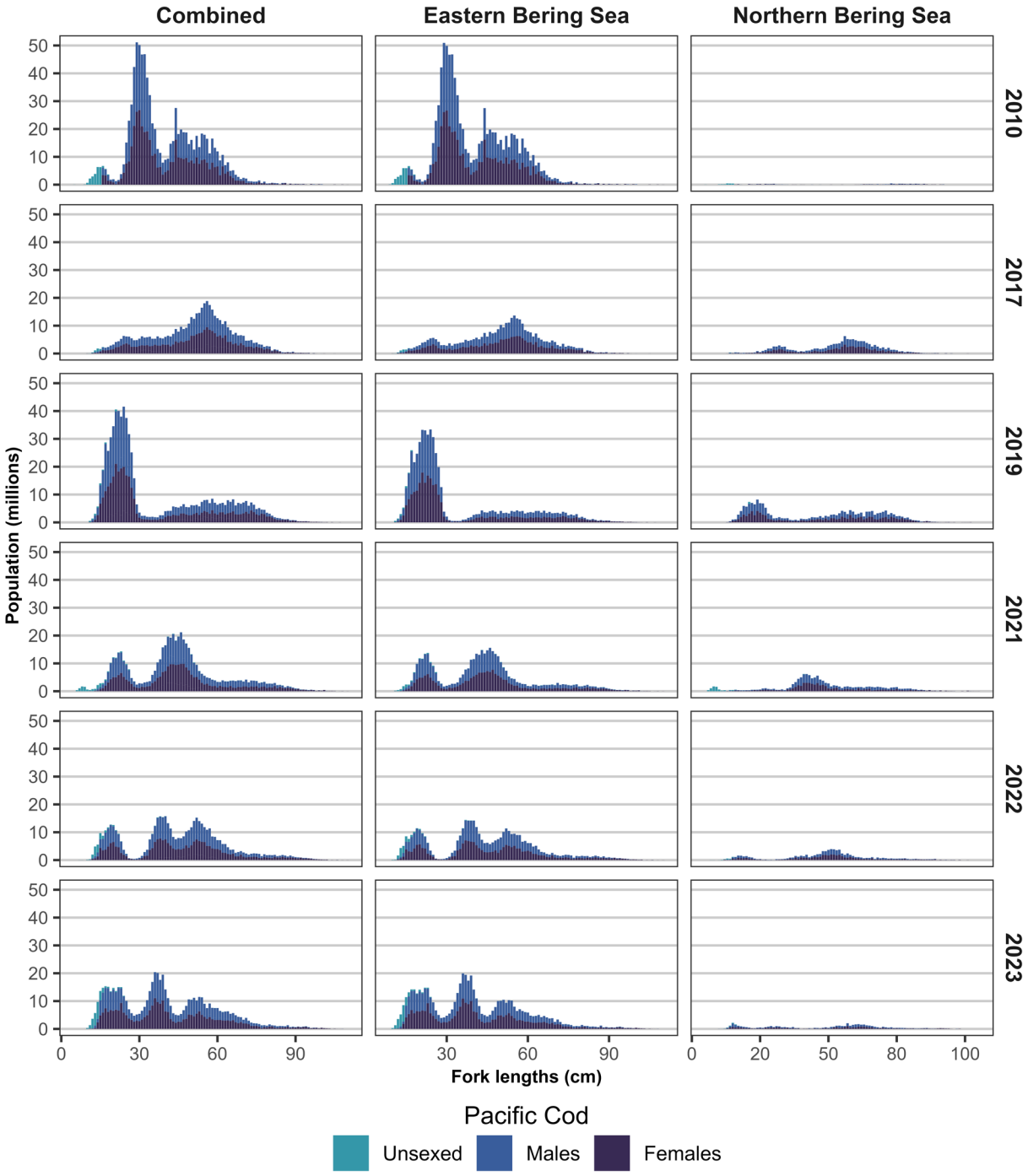

Figure 62. -- Total abundance-at-length estimates of Pacific cod (*Gadus macrocephalus*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 71. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (thousand t) with SD (thousand t), 95% lower (LCL; thousand t) and upper (UCL; thousand t) confidence limits, and number of hauls where species were weighed for Pacific cod (*Gadus macrocephalus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (Kt)	Biomass SD (Kt)	95% LCL (Kt)	95% UCL (Kt)	Hauls w/weights
Eastern Bering Sea							
10	1,456.32	147.74	114.62	11.63	91.37	137.88	58
20	959.40	124.64	39.52	5.13	29.25	49.79	30
31	1,684.63	287.84	160.00	27.34	105.33	214.68	69
32	2,515.88	823.99	22.26	7.29	7.68	36.84	8
41	1,461.72	230.68	91.08	14.37	62.33	119.83	41
42	1,713.67	237.06	41.34	5.72	29.90	52.77	31
43	2,178.22	355.98	45.88	7.50	30.88	60.88	22
50	460.77	139.78	17.53	5.32	6.89	28.16	17
61	1,161.41	110.02	101.94	9.66	82.63	121.26	60
62	2,177.73	408.71	14.07	2.64	8.79	19.35	7
82	349.74	145.81	6.28	2.62	1.04	11.51	10
90	741.08	155.31	8.55	1.79	4.97	12.14	8
Total	**1,345.01**	**75.79**	**663.07**	**37.37**	**588.34**	**737.81**	**361**
Northern Bering Sea							
70	967.81	182.65	76.71	14.48	47.75	105.66	34
71	235.43	59.89	19.13	4.87	9.40	28.86	33
81	326.13	105.23	12.51	4.04	4.44	20.58	11
Total	**544.82**	**79.44**	**108.35**	**15.80**	**76.75**	**139.94**	**78**

Table 72. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (millions) with SD (thousands), 95% lower (LCL; millions) and upper (UCL; millions) confidence limits, and number of hauls where species were counted for Pacific cod (*Gadus macrocephalus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (M)	95% UCL (M)	Population (M)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	2,455.38	395.86	130.94	255.57	193.25	31,156.57	58
20	713.40	104.89	20.75	38.03	29.39	4,320.77	30
31	1,609.42	249.14	105.53	200.19	152.86	23,662.79	69
32	1,510.18	591.68	2.89	23.83	13.36	5,234.47	8
41	982.23	271.03	27.43	94.98	61.20	16,888.19	41
42	1,030.37	166.23	16.84	32.87	24.85	4,009.81	31
43	1,528.96	313.98	18.98	45.43	32.21	6,613.58	22
50	208.95	69.62	2.65	13.24	7.95	2,648.11	17
61	335.58	30.04	24.18	34.73	29.46	2,637.00	60
62	770.72	130.31	3.30	6.66	4.98	842.00	7
82	166.05	62.79	0.73	5.24	2.98	1,127.25	10
90	281.74	44.42	2.23	4.28	3.25	512.52	8
Total	**1,127.28**	**89.30**	**467.69**	**643.78**	**555.74**	**44,022.34**	**361**
Northern Bering Sea							
70	499.70	89.97	25.34	53.87	39.61	7,130.90	33
71	104.11	21.80	4.92	12.00	8.46	1,771.20	33
81	107.64	32.97	1.60	6.66	4.13	1,264.39	11
Total	**262.46**	**37.49**	**37.28**	**67.10**	**52.19**	**7,455.58**	**77**

Pacific Halibut (*Hippoglossus stenolepis*)

Between 2022 and 2023, the Pacific halibut biomass estimate increased by 14% in the eastern Bering Sea (Tables **73** and **74**; Fig. **63**) and the population was estimated at 95.3 million individuals (Tables **73** and **75**; Fig. **63**). The biomass estimate decreased by 17% in the northern Bering Sea and the population was estimated at 7.4 million individuals.

The eastern Bering Sea bottom trawl survey provides annual estimates of biomass, population, and length composition for Pacific halibut on the eastern Bering Sea shelf (Stewart and Martell, 2015). Management of Pacific halibut stocks is the purview of the International Pacific Halibut Commission (IPHC), and their stock assessments include all available fisheries and scientific survey data from both the United States and Canada, in addition to data from an IPHC led longline survey.

To ensure a majority of the halibut caught at sea could be released alive, many of these animals were deliberately left unsexed and unweighed by survey teams. As a result, the abundance-at-length data are also categorized as unsexed. In instances when an IPHC secretariat was present on board the vessel or NOAA scientists collected specimen data on behalf of IPHC, subsampled halibut were lengthed, weighed, and sexed at minimum prior to otolith collection.

The distribution of Pacific halibut in the 2023 Bering Sea survey area was similar to that observed in 2022 and 2021, with the greatest densities around St. Matthew Island (Fig. **64**) and north of St. Paul Island. A length mode of about 56 cm was observed for unsexed Pacific halibut (Fig. **65**) in both the eastern and northern Bering Sea.

Table 73. -- Summary of catch location environmental variables and biomass and population estimates for Pacific halibut (*Hippoglossus stenolepis*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	278 of 376 (73.9%)	34 of 116 (29.3%)
Bottom Depth (m)	20 — 171	14 — 50
Bottom Temperature (°C)	-1.5 — 5.4	0.3 — 11
Surface Temperature (°C)	1.7 — 10.7	7.5 — 12.3
Population	95.3 million	7.4 million
Biomass (t)	170,238	19,076
Biomass % Total	1.4%	0.7%
Biomass % Change	14% increase from 2022	17% decrease from 2022

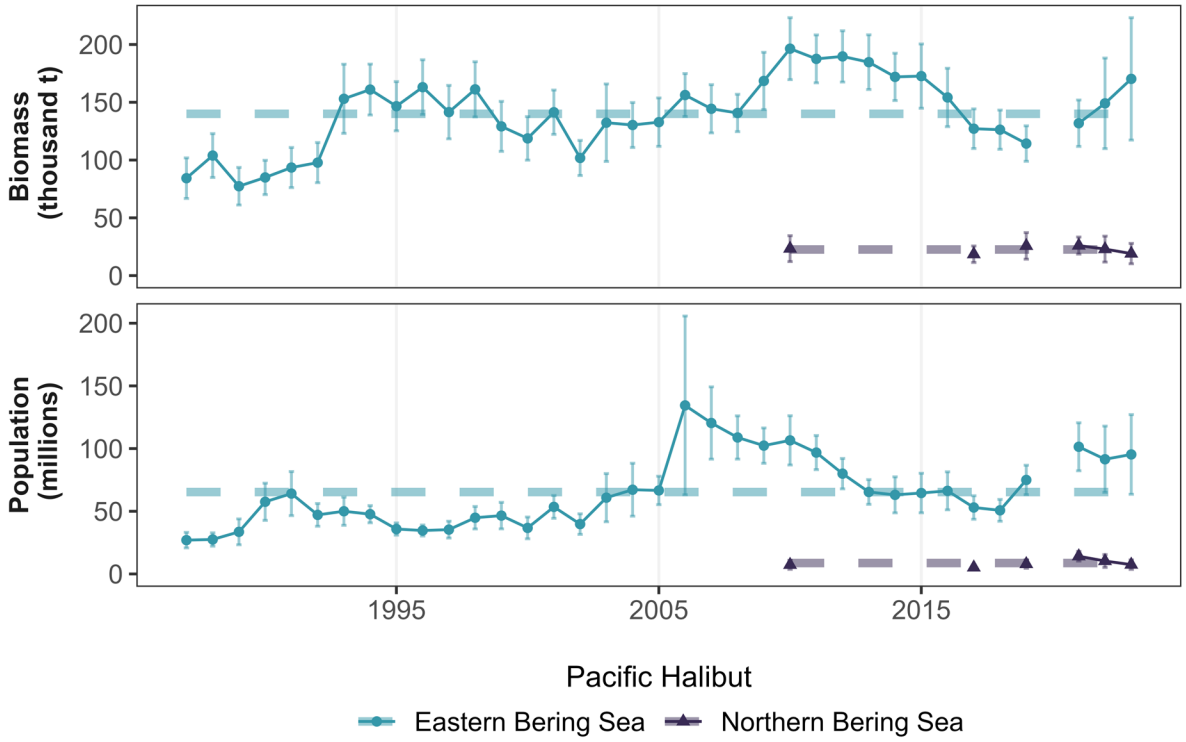

Figure 63. -- Time series of Pacific halibut (*Hippoglossus stenolepis*) biomass (thousand t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

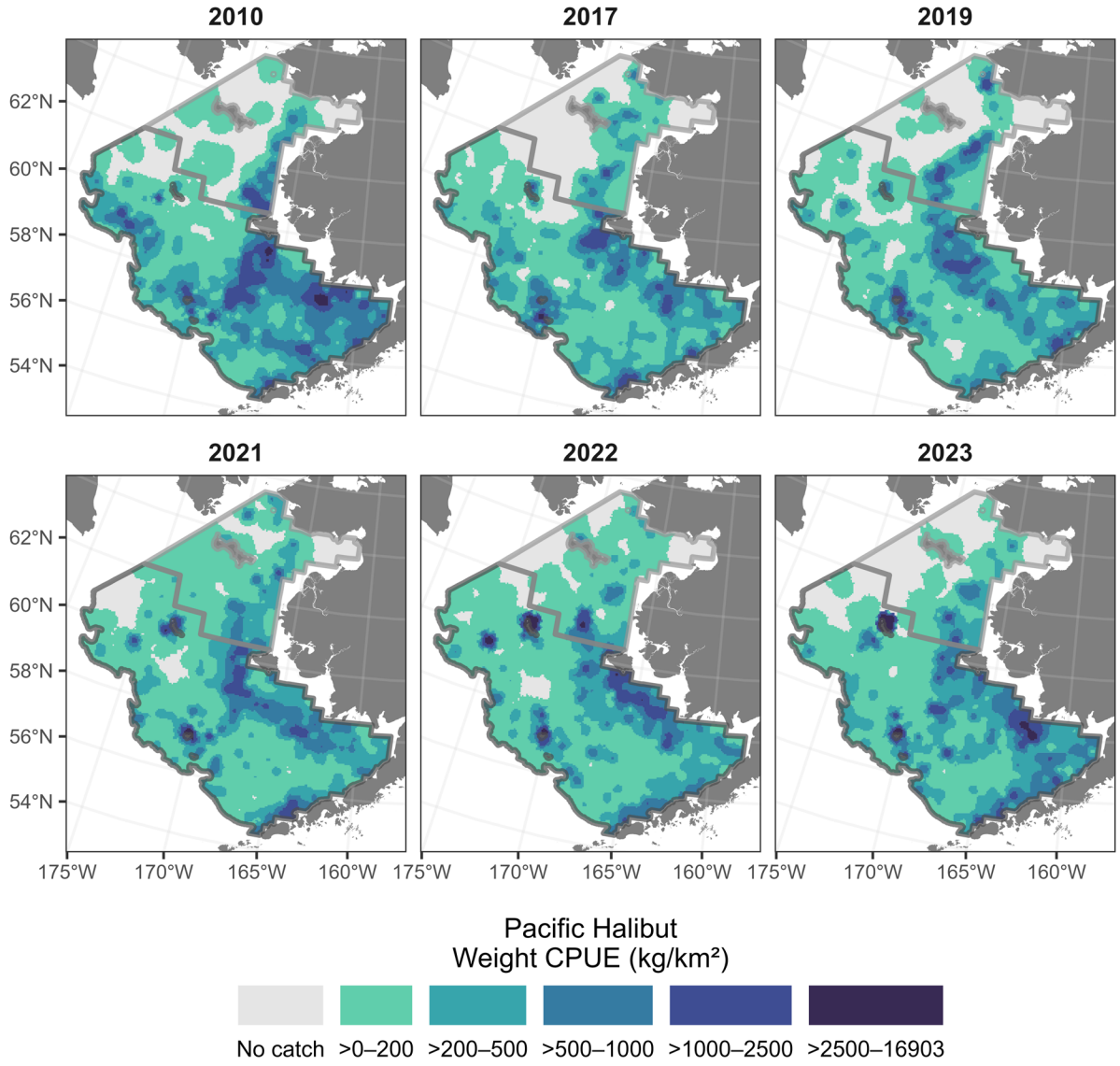

Figure 64. -- Weight CPUE (kg/km^2) distribution of Pacific halibut (*Hippoglossus stenolepis*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

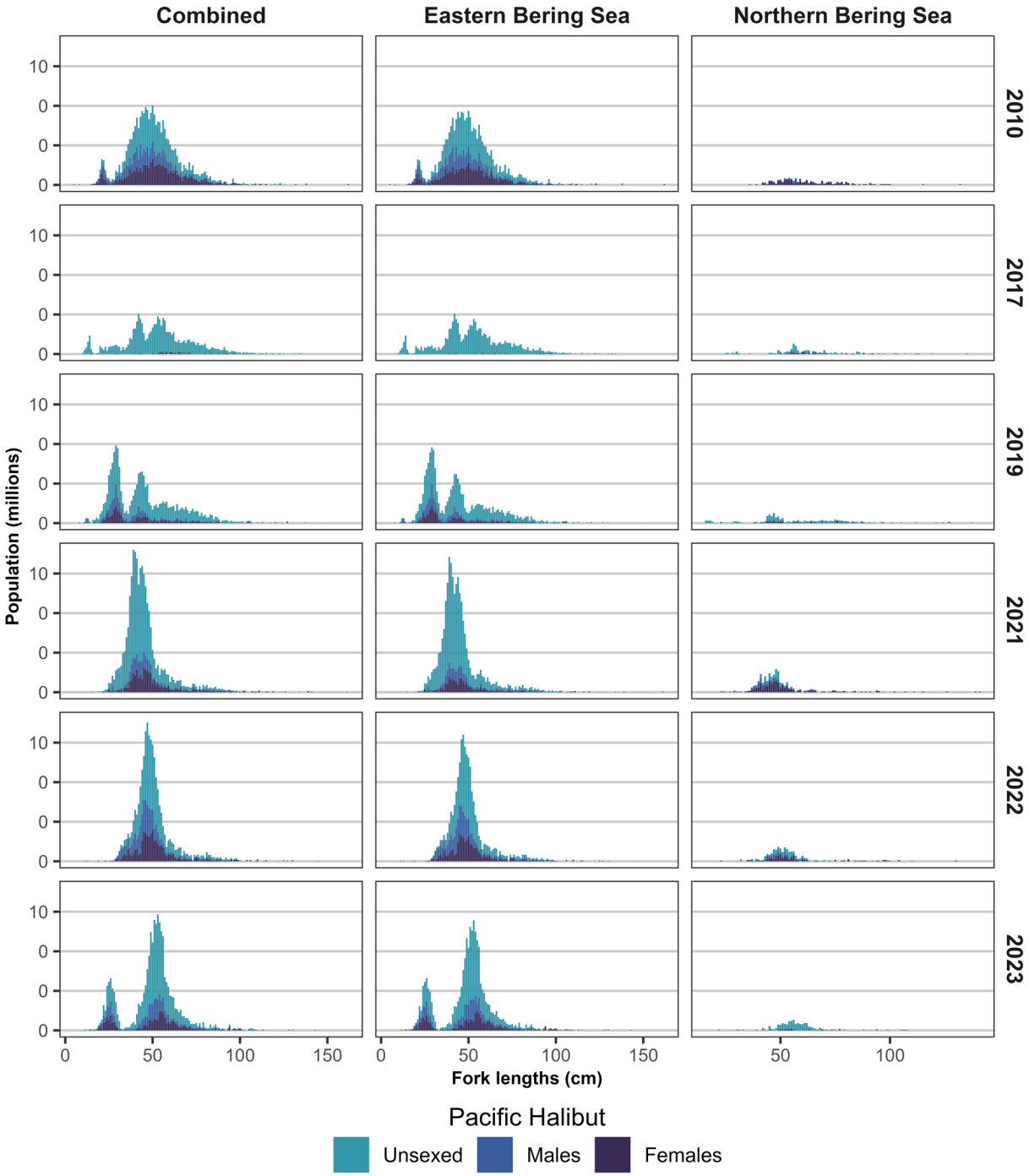

Figure 65. -- Total abundance-at-length estimates of Pacific halibut (*Hippoglossus stenolepis*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 74. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for Pacific halibut (*Hippoglossus stenolepis*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	616.57	97.46	48,527	7,671	33,186	63,869	54
20	486.86	66.19	20,055	2,727	14,602	25,508	27
31	344.56	48.56	32,725	4,612	23,502	41,949	59
32	366.42	154.78	3,242	1,369	503	5,980	8
41	501.09	384.51	31,223	23,959	0	79,141	25
42	550.14	225.60	13,270	5,442	2,386	24,155	29
43	226.97	71.09	4,781	1,497	1,786	7,776	19
50	155.13	43.43	5,901	1,652	2,597	9,205	15
61	108.72	17.93	9,543	1,574	6,395	12,691	39
62	116.59	90.26	753	583	0	1,920	2
82	-	-	-	-	-	-	-
90	18.79	18.79	217	217	0	650	1
Total	**345.32**	**53.70**	**170,238**	**26,474**	**117,289**	**223,187**	**278**
Northern Bering Sea							
70	200.48	53.48	15,890	4,239	7,412	24,368	22
71	38.39	14.84	3,119	1,205	708	5,530	11
81	1.75	1.75	67	67	0	201	1
Total	**95.92**	**22.16**	**19,076**	**4,408**	**10,261**	**27,891**	**34**

Table 75. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for Pacific halibut (*Hippoglossus stenolepis*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	515.16	111.58	22,981.83	58,109.86	40,545.85	8,782.01	54
20	252.02	38.23	7,231.48	13,531.45	10,381.47	1,574.99	27
31	143.15	22.52	9,318.34	17,874.65	13,596.50	2,139.08	59
32	168.25	71.11	230.34	2,746.65	1,488.49	629.08	8
41	261.88	204.35	0.00	41,783.92	16,317.96	12,732.98	25
42	234.31	85.65	1,519.89	9,784.32	5,652.10	2,066.11	29
43	96.52	32.22	675.52	3,390.51	2,033.01	678.75	19
50	48.18	18.95	391.20	3,274.03	1,832.61	720.71	15
61	38.60	6.67	2,217.11	4,558.71	3,387.91	585.40	39
62	8.76	6.07	0.00	135.08	56.58	39.25	2
82	-	-	-	-	-	-	-
90	2.45	2.45	0.00	84.67	28.23	28.22	1
Total	**193.35**	**32.22**	**63,552.90**	**127,088.51**	**95,320.71**	**15,883.90**	**278**
Northern Bering Sea							
70	84.30	23.75	2,917.45	10,446.10	6,681.78	1,882.16	22
71	8.57	2.80	241.29	1,150.68	695.99	227.35	11
81	1.23	1.23	0.00	141.43	47.14	47.14	1
Total	**37.34**	**9.54**	**3,632.05**	**11,217.77**	**7,424.91**	**1,896.43**	**34**

Pacific Herring (*Clupea pallasii*)

Between 2022 and 2023, the Pacific herring biomass estimate decreased by 76% in the eastern Bering Sea (Tables **76** and **77**; Fig. **66**) and the population was estimated at 282.8 million individuals (Tables **76** and **78**; Fig. **66**). Similarly, the biomass estimate decreased by 89% in the northern Bering Sea and the population was estimated at 19.3 million individuals.

Table 76. -- Summary of catch location environmental variables and biomass and population estimates for Pacific herring (*Clupea pallasii*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	124 of 376 (33.0%)	32 of 116 (27.6%)
Bottom Depth (m)	20 — 117	12 — 74
Bottom Temperature (°C)	-1.6 — 4.8	-1.6 — 11.1
Surface Temperature (°C)	1.7 — 10.5	7.8 — 14.9
Population	282.8 million	19.3 million
Biomass (t)	54,795	1,370
Biomass % Total	0.5%	<0.01%
Biomass % Change	76% decrease from 2022	89% decrease from 2022

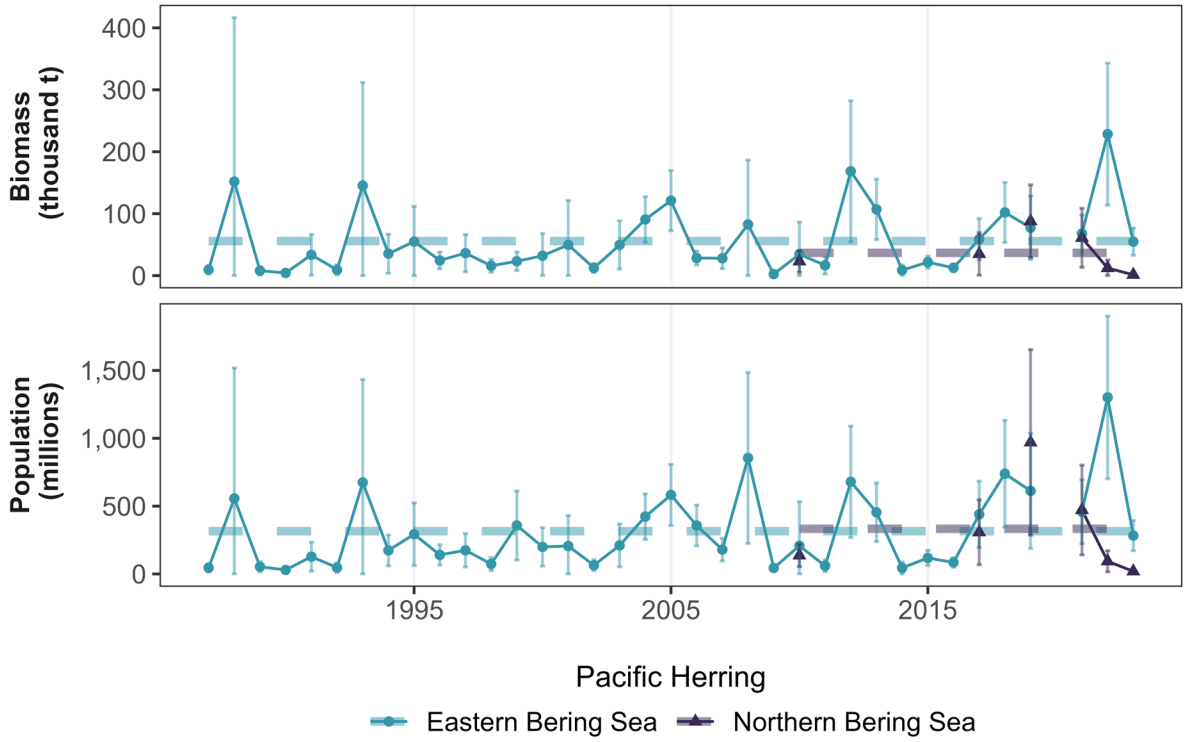

Figure 66. -- Time series of Pacific herring (*Clupea pallasii*) biomass (thousand t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

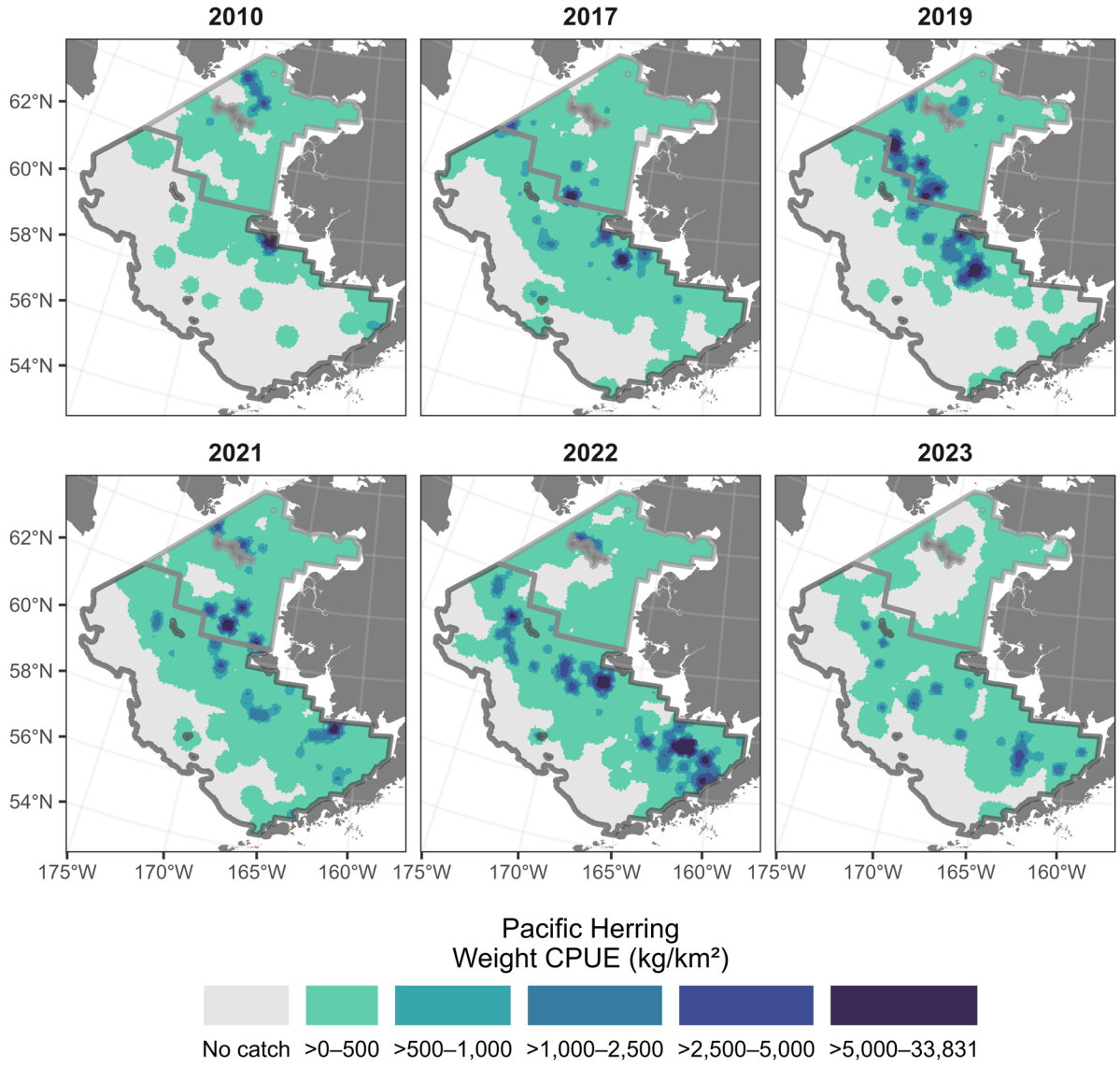

Figure 67. -- Weight CPUE (kg/km^2) distribution of Pacific herring (*Clupea pallasii*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 77. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for Pacific herring (*Clupea pallasii*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	241.30	89.48	18,992	7,043	4,906	33,078	32
20	157.30	80.32	6,479	3,309	0	13,097	18
31	139.01	59.56	13,203	5,657	1,889	24,516	26
32	-	-	-	-	-	-	-
41	142.34	68.75	8,869	4,284	302	17,437	21
42	5.49	4.08	132	98	0	329	3
43	293.20	146.34	6,176	3,083	11	12,341	12
50	-	-	-	-	-	-	-
61	9.73	6.60	854	580	0	2,013	6
62	1.53	1.53	10	10	0	30	1
82	0.73	0.50	13	9	0	31	2
90	5.81	4.35	67	50	0	167	3
Total	**111.15**	**22.29**	**54,795**	**10,989**	**32,818**	**76,773**	**124**
Northern Bering Sea							
70	3.95	2.18	313	173	0	658	11
71	12.52	5.42	1,017	440	137	1,897	17
81	1.06	0.53	40	20	0	81	4
Total	**6.89**	**2.38**	**1,370**	**473**	**424**	**2,316**	**32**

Table 78. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for Pacific herring (*Clupea pallasii*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	1,490.24	539.19	32,415.86	202,164.40	117,290.13	42,437.13	32
20	1,035.02	440.17	6,371.43	78,900.16	42,635.80	18,132.18	18
31	631.32	264.00	9,813.36	110,110.58	59,961.97	25,074.30	26
32	-	-	-	-	-	-	-
41	555.56	249.85	3,479.79	65,753.66	34,616.72	15,568.47	21
42	26.77	20.13	0.00	1,616.89	645.79	485.55	3
43	1,168.60	558.14	1,102.05	48,128.14	24,615.10	11,756.52	12
50	-	-	-	-	-	-	-
61	31.02	21.38	0.00	6,475.99	2,722.74	1,876.62	6
62	5.89	5.89	0.00	114.15	38.05	38.05	1
82	3.33	2.24	0.00	140.34	59.76	40.29	2
90	20.52	15.29	0.00	589.58	236.77	176.41	3
Total	**573.69**	**113.72**	**170,701.60**	**394,944.04**	**282,822.82**	**56,060.61**	**124**
Northern Bering Sea							
70	121.20	61.26	0.00	19,316.88	9,606.62	4,855.13	11
71	114.46	47.04	1,655.86	16,944.46	9,300.16	3,822.15	17
81	10.30	5.01	10.78	779.43	395.11	192.16	4
Total	**97.06**	**31.09**	**6,937.75**	**31,666.04**	**19,301.89**	**6,182.07**	**32**

Pacific Ocean Perch (*Sebastes alutus*)

Between 2022 and 2023, the Pacific ocean perch biomass estimate decreased by 85% in the eastern Bering Sea (Tables **79** and **80**; Fig. **68**) and the population was estimated at 23.6 million individuals (Tables **79** and **81**; Fig. **68**). No Pacific ocean perch were observed in the northern Bering Sea in 2023 (Fig. **69**).

Table 79. -- Summary of catch location environmental variables and biomass and population estimates for Pacific ocean perch (*Sebastes alutus*) in the eastern Bering Sea survey areas.

	Eastern Bering Sea
Stations Present	13 of 376 (3.5%)
Bottom Depth (m)	68 — 160
Bottom Temperature (°C)	3.2 — 4.3
Surface Temperature (°C)	3.4 — 9.1
Population	23.6 million
Biomass (t)	18,914
Biomass % Total	0.2%
Biomass % Change	85% decrease from 2022

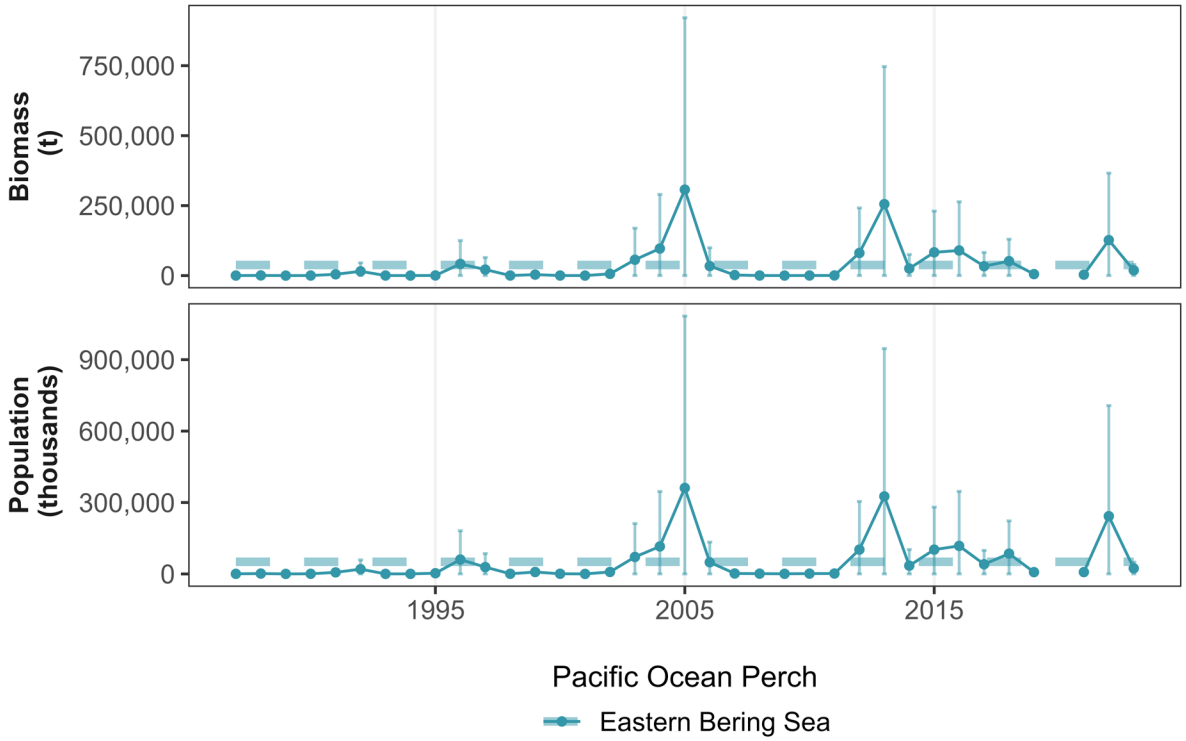

Figure 68. -- Time series of Pacific ocean perch (*Sebastes alutus*) biomass (t) and population (thousands) from the 1987-2023 eastern Bering Sea shelf bottom trawl survey. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

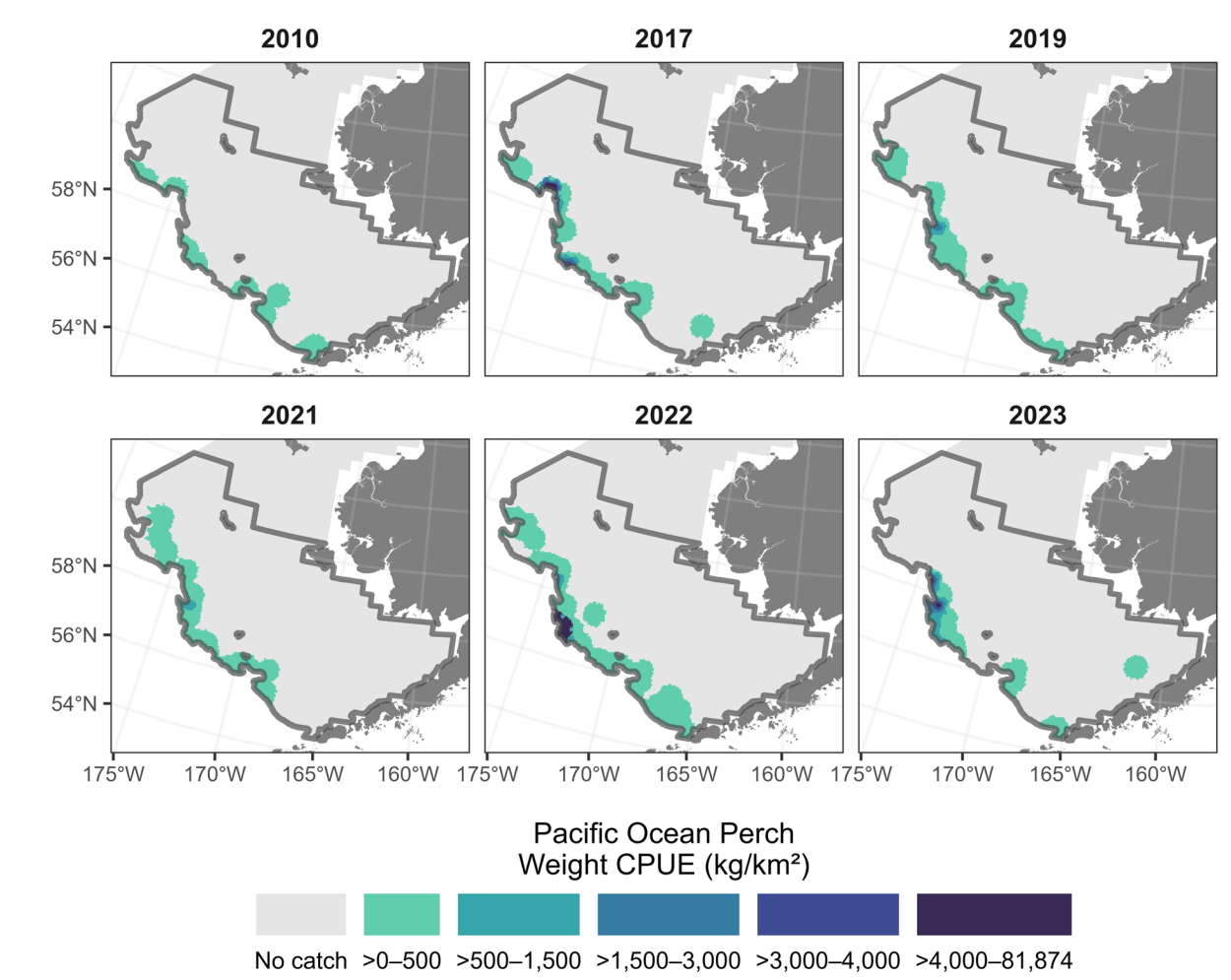

Figure 69. -- Weight CPUE (kg/km^2) distribution of Pacific ocean perch (*Sebastes alutus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl survey. This species was not encountered in the 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys.

Table 80. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with 7SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for Pacific ocean perch (*Sebastes alutus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	0.32	0.32	30	30	0	90	1
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	10.18	7.08	387	269	0	926	3
61	210.72	116.75	18,497	10,248	0	38,992	9
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**38.37**	**20.79**	**18,914**	**10,251**	**0**	**39,416**	**13**

Table 81. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for Pacific ocean perch (*Sebastes alutus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	0.32	0.32	0.00	91.10	30.37	30.37	1
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	9.82	6.37	0.00	858.34	373.62	242.36	3
61	263.81	149.10	0.00	49,330.61	23,156.31	13,087.15	9
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**47.79**	**26.55**	**0.00**	**49,739.15**	**23,560.30**	**13,089.43**	**13**

Plain Sculpin (*Myoxocephalus jaok*)

Between 2022 and 2023, the plain sculpin biomass estimate decreased by 32% in the eastern Bering Sea (Tables **82** and **83**; Fig. **70**) and the population was estimated at 33.2 million individuals (Tables **82** and **84**; Fig. **70**). Similarly, the biomass estimate decreased by 22% in the northern Bering Sea and the population was estimated at 51.9 million individuals.

Table 82. -- Summary of catch location environmental variables and biomass and population estimates for plain sculpin (*Myoxocephalus jaok*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	97 of 376 (25.8%)	62 of 116 (53.4%)
Bottom Depth (m)	20 — 74	12 — 54
Bottom Temperature (°C)	-1.6 — 4.8	-0.8 — 11.1
Surface Temperature (°C)	1.7 — 9.1	6.3 — 15.1
Population	33.2 million	51.9 million
Biomass (t)	26,716	11,990
Biomass % Total	0.2%	0.4%
Biomass % Change	32% decrease from 2022	22% decrease from 2022

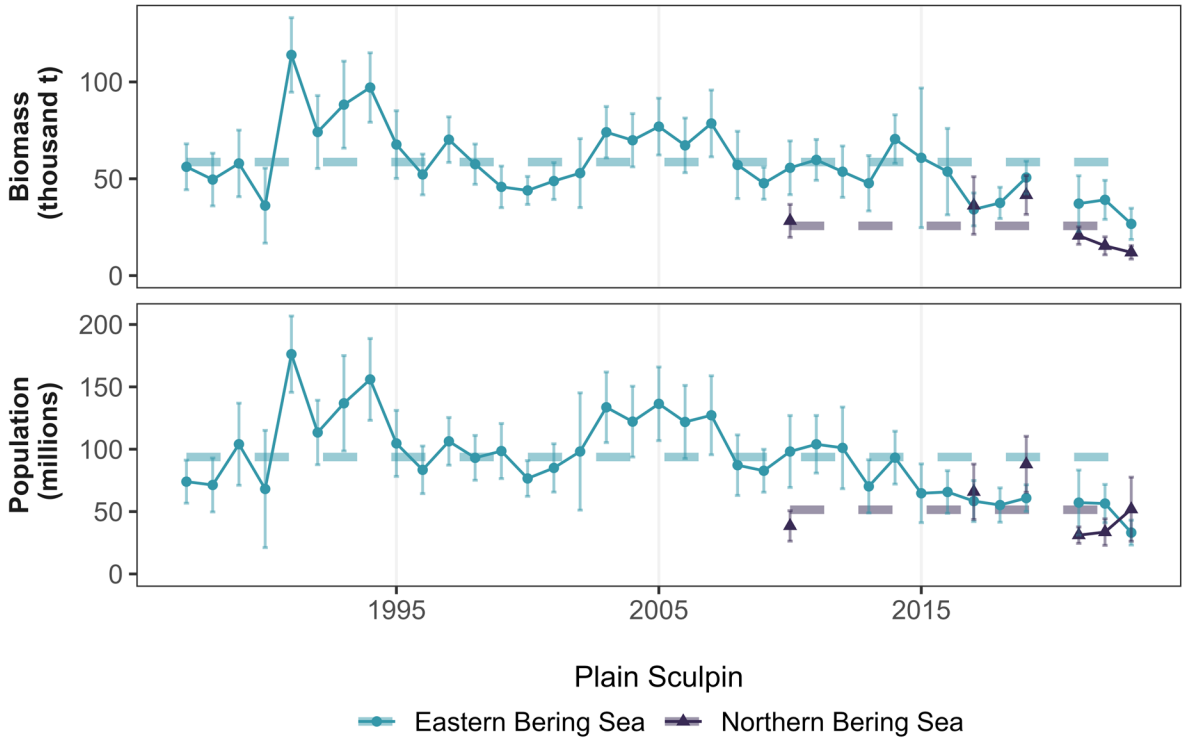

Figure 70. -- Time series of plain sculpin (*Myoxocephalus jaok*) biomass (thousand t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

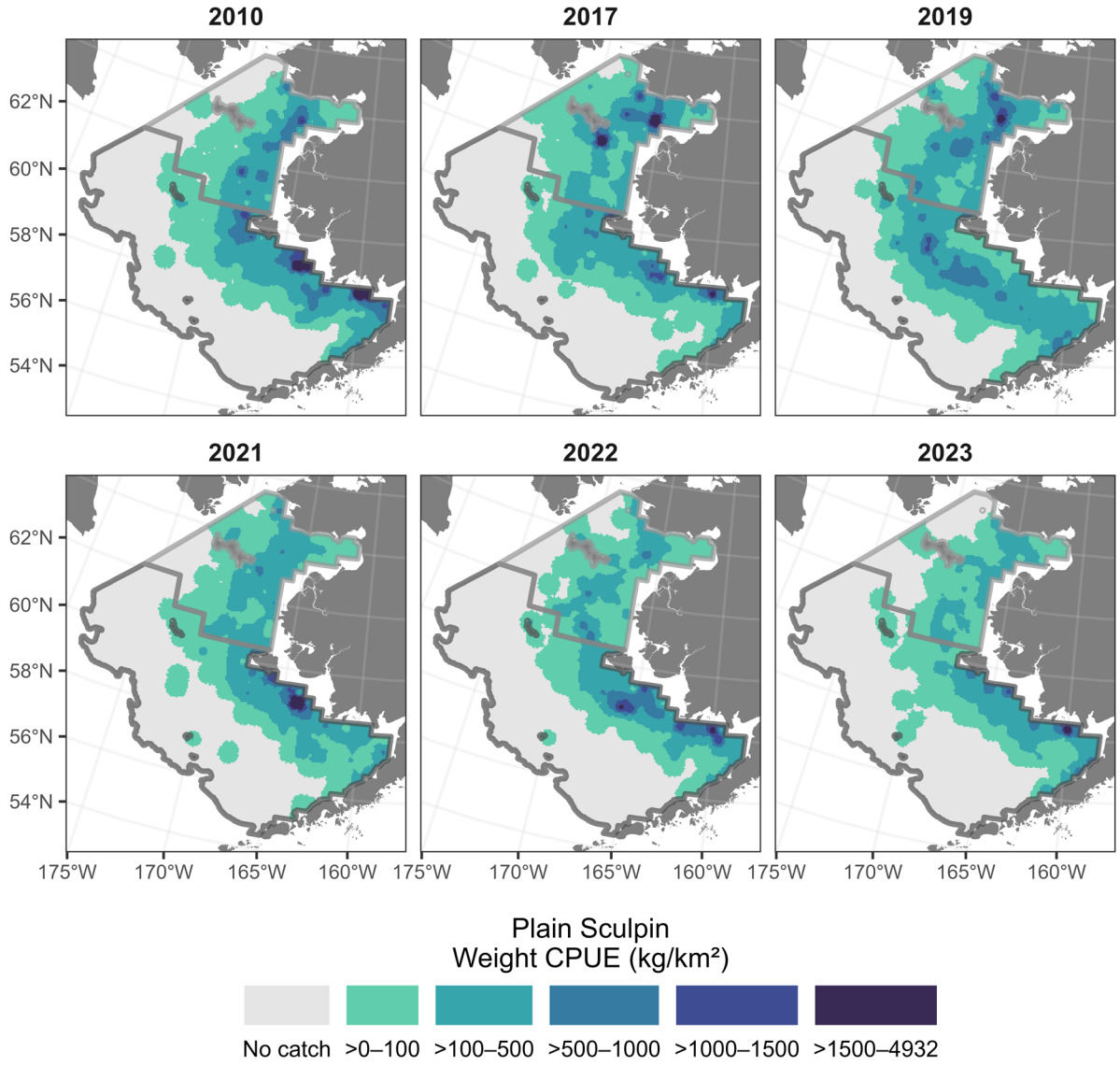

Figure 71. -- Weight CPUE (kg/km^2) distribution of plain sculpin (*Myoxocephalus jaok*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 83. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for plain sculpin (*Myoxocephalus jaok*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	246.31	47.01	19,386	3,700	11,986	26,786	49
20	150.76	38.02	6,210	1,566	3,078	9,343	29
31	4.54	2.44	431	232	0	894	5
32	-	-	-	-	-	-	-
41	7.25	2.67	452	166	119	784	8
42	6.75	3.77	163	91	0	345	4
43	1.72	1.72	36	36	0	109	1
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	2.14	2.14	38	38	0	115	1
90	-	-	-	-	-	-	-
Total	**54.19**	**8.17**	**26,716**	**4,029**	**18,657**	**34,775**	**97**
Northern Bering Sea							
70	87.31	16.33	6,920	1,294	4,332	9,509	31
71	61.50	14.03	4,997	1,140	2,717	7,277	30
81	1.91	1.91	73	73	0	220	1
Total	**60.29**	**8.68**	**11,990**	**1,726**	**8,538**	**15,443**	**62**

Table 84. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for plain sculpin (*Myoxocephalus jaok*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	288.02	53.85	14,192.59	31,145.68	22,669.13	4,238.27	49
20	232.82	63.61	4,349.80	14,831.08	9,590.44	2,620.32	29
31	3.09	1.47	13.79	573.57	293.68	139.94	5
32	-	-	-	-	-	-	-
41	6.62	2.62	86.08	738.61	412.34	163.13	8
42	5.88	3.53	0.00	312.20	141.81	85.20	4
43	1.03	1.03	0.00	65.10	21.70	21.70	1
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	1.68	1.68	0.00	90.71	30.24	30.24	1
90	-	-	-	-	-	-	-
Total	**67.26**	**10.12**	**23,182.59**	**43,136.09**	**33,159.34**	**4,988.37**	**97**
Northern Bering Sea							
70	168.83	38.63	7,257.64	19,505.37	13,381.50	3,061.93	30
71	473.33	153.55	13,506.64	63,413.45	38,460.04	12,476.70	30
81	1.24	1.24	0.00	142.54	47.51	47.51	1
Total	**260.92**	**64.60**	**26,195.04**	**77,583.09**	**51,889.06**	**12,847.01**	**61**

Purple-Orange Sea Star (*Asterias amurensis*)

Between 2022 and 2023, the purple-orange sea star biomass estimate decreased by 20% in the eastern Bering Sea (Tables **85** and **86**; Fig. **72**) and the population was estimated at 7.9 billion individuals (Tables **85** and **87**; Fig. **72**). The biomass estimate increased by 2% in the northern Bering Sea and the population was estimated at 3 billion individuals.

Table 85. -- Summary of catch location environmental variables and biomass and population estimates for purple-orange sea star (*Asterias amurensis*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	251 of 376 (66.8%)	71 of 116 (61.2%)
Bottom Depth (m)	20 — 150	12 — 54
Bottom Temperature (°C)	-1.6 — 5.4	-0.8 — 11.1
Surface Temperature (°C)	1.7 — 9.5	6.3 — 15.1
Population	7.9 billion	3 billion
Biomass (t)	815,015	317,349
Biomass % Total	6.9%	11.4%
Biomass % Change	20% decrease from 2022	2% increase from 2022

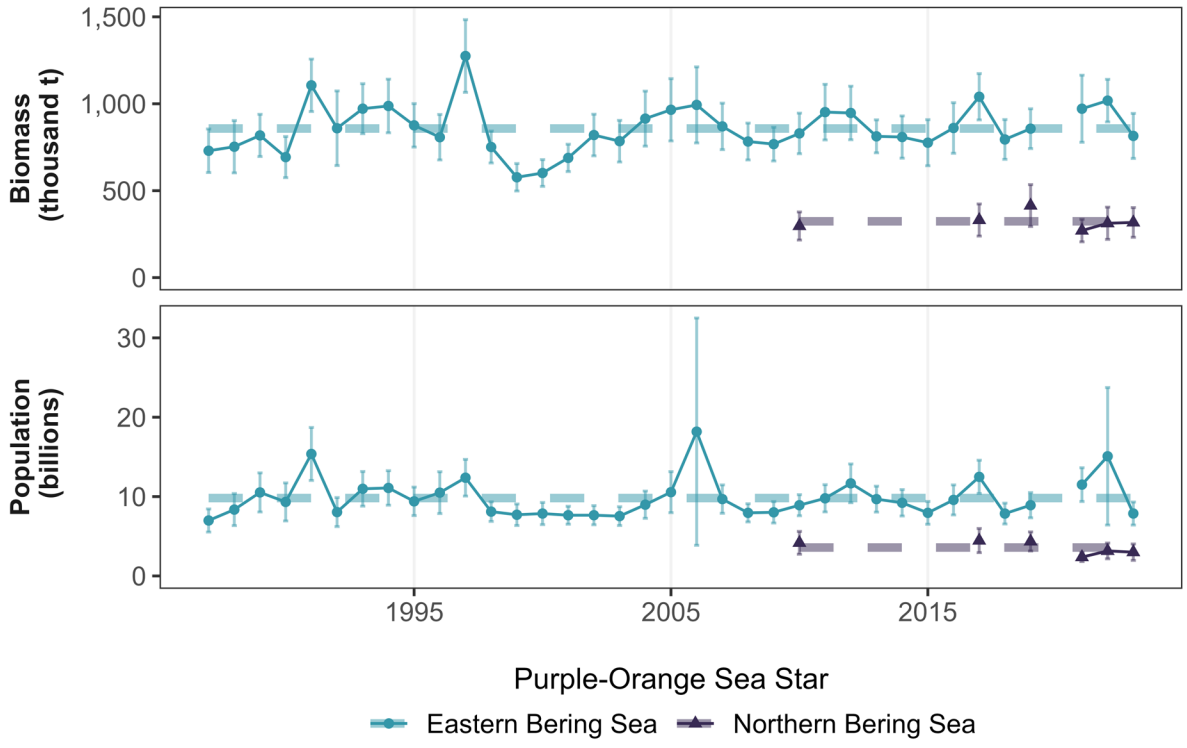

Figure 72. -- Time series of purple-orange sea star (*Asterias amurensis*) biomass (thousand t) and population (billions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

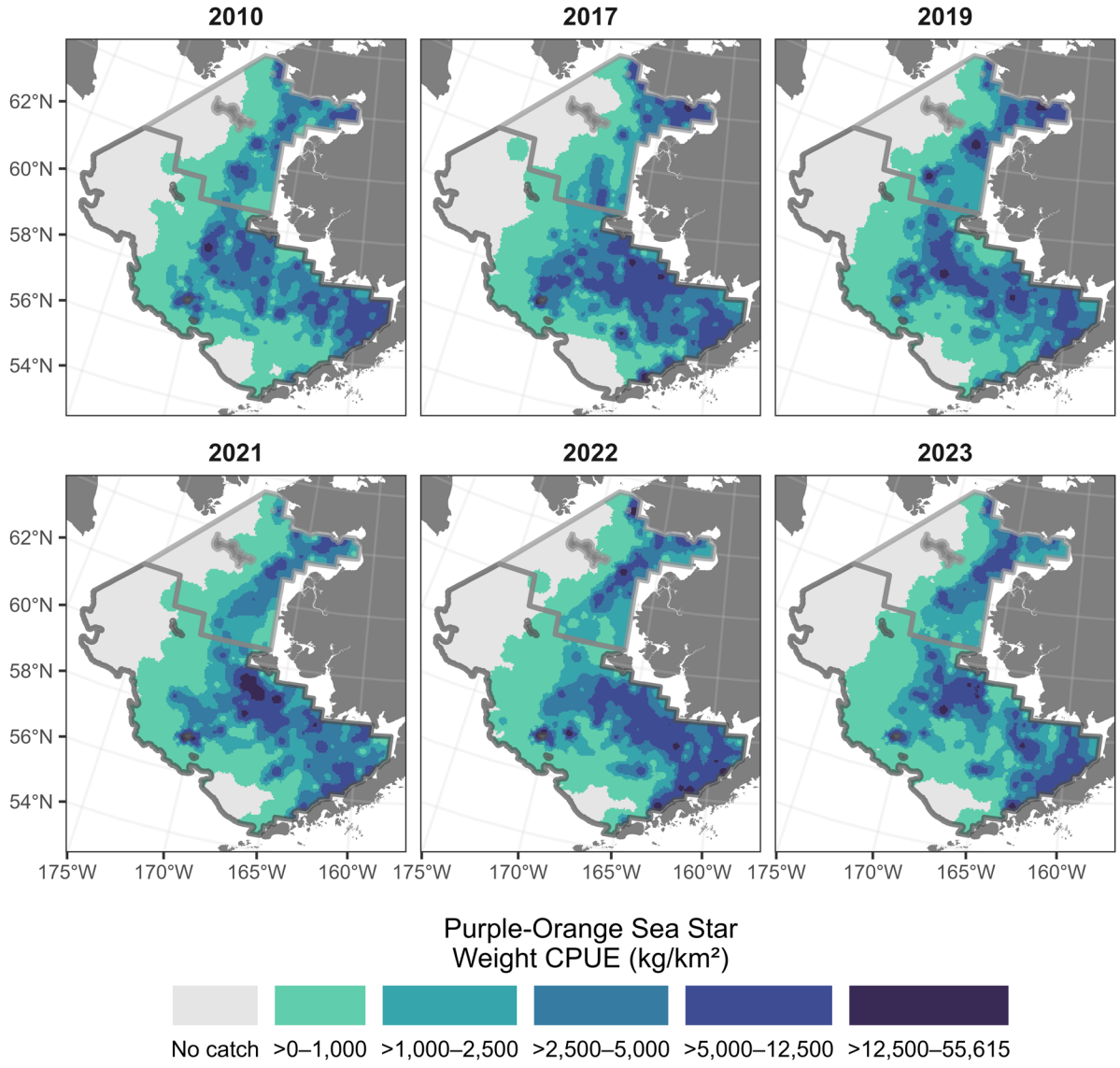

Figure 73. -- Weight CPUE (kg/km^2) distribution of purple-orange sea star (*Asterias amurensis*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 86. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for purple-orange sea star (*Asterias amurensis*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	4,077.98	493.52	320,960	38,843	243,275	398,646	58
20	4,604.06	706.95	189,656	29,121	131,413	247,899	31
31	1,652.08	269.16	156,912	25,564	105,784	208,041	58
32	622.95	218.45	5,511	1,933	1,646	9,376	8
41	1,305.52	498.92	81,347	31,088	19,171	143,522	36
42	2,401.07	613.87	57,919	14,808	28,303	87,534	31
43	13.32	7.96	281	168	0	616	8
50	21.43	12.02	815	457	0	1,729	7
61	18.38	8.95	1,614	786	42	3,185	14
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**1,653.21**	**131.47**	**815,015**	**64,812**	**685,390**	**944,640**	**251**
Northern Bering Sea							
70	1,829.90	371.11	145,038	29,414	86,210	203,865	31
71	2,104.24	380.66	170,980	30,930	109,119	232,841	38
81	34.73	34.45	1,332	1,321	0	3,974	2
Total	**1,595.79**	**214.74**	**317,349**	**42,704**	**231,942**	**402,757**	**71**

Table 87. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for purple-orange sea star (*Asterias amurensis*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	40,027.83	5,943.19	2,214,890.97	4,085,943.49	3,150,417.23	467,763.13	58
20	44,368.66	6,656.78	1,279,259.79	2,376,116.19	1,827,687.99	274,214.10	31
31	18,023.59	3,981.91	955,460.98	2,468,245.31	1,711,853.15	378,196.08	58
32	5,717.30	1,658.43	21,235.96	79,922.80	50,579.38	14,671.71	8
41	8,695.15	3,718.90	78,345.20	1,005,244.32	541,794.76	231,724.78	36
42	23,282.09	7,728.89	188,738.70	934,487.93	561,613.31	186,437.31	31
43	39.55	23.88	0.00	1,839.34	833.13	503.10	8
50	228.51	143.39	0.00	19,600.91	8,692.29	5,454.31	7
61	146.37	73.14	7.63	25,688.09	12,847.86	6,420.12	14
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**15,956.35**	**1,470.82**	**6,416,119.49**	**9,316,518.68**	**7,866,319.09**	**725,099.80**	**251**
Northern Bering Sea							
70	12,462.33	2,461.53	597,562.10	1,377,963.93	987,763.02	195,100.46	30
71	24,596.53	5,890.08	1,041,393.38	2,955,789.26	1,998,591.32	478,598.97	38
81	289.88	288.58	0.00	33,252.87	11,117.50	11,067.68	2
Total	**15,072.76**	**2,599.51**	**1,963,559.54**	**4,031,384.12**	**2,997,471.83**	**516,956.15**	**70**

Rainbow Smelt (*Osmerus mordax*)

Between 2022 and 2023, the rainbow smelt biomass estimate biomass estimate increased by 15% in the northern Bering Sea (Tables **88** and **89**; Fig. **74**) and the population was estimated at 50.5 million individuals (Tables **88** and **90**; Fig. **74**). No rainbow smelt were observed in the eastern Bering Sea in 2023 (Fig. **75**).

Table 88. -- Summary of catch location environmental variables and biomass and population estimates for rainbow smelt (*Osmerus mordax*) in the northern Bering Sea survey areas.

	Northern Bering Sea
Stations Present	32 of 116 (27.6%)
Bottom Depth (m)	12 — 38
Bottom Temperature (°C)	2.3 — 11.1
Surface Temperature (°C)	8.1 — 14.9
Population	50.5 million
Biomass (t)	1,570
Biomass % Total	0.1%
Biomass % Change	15% increase from 2022

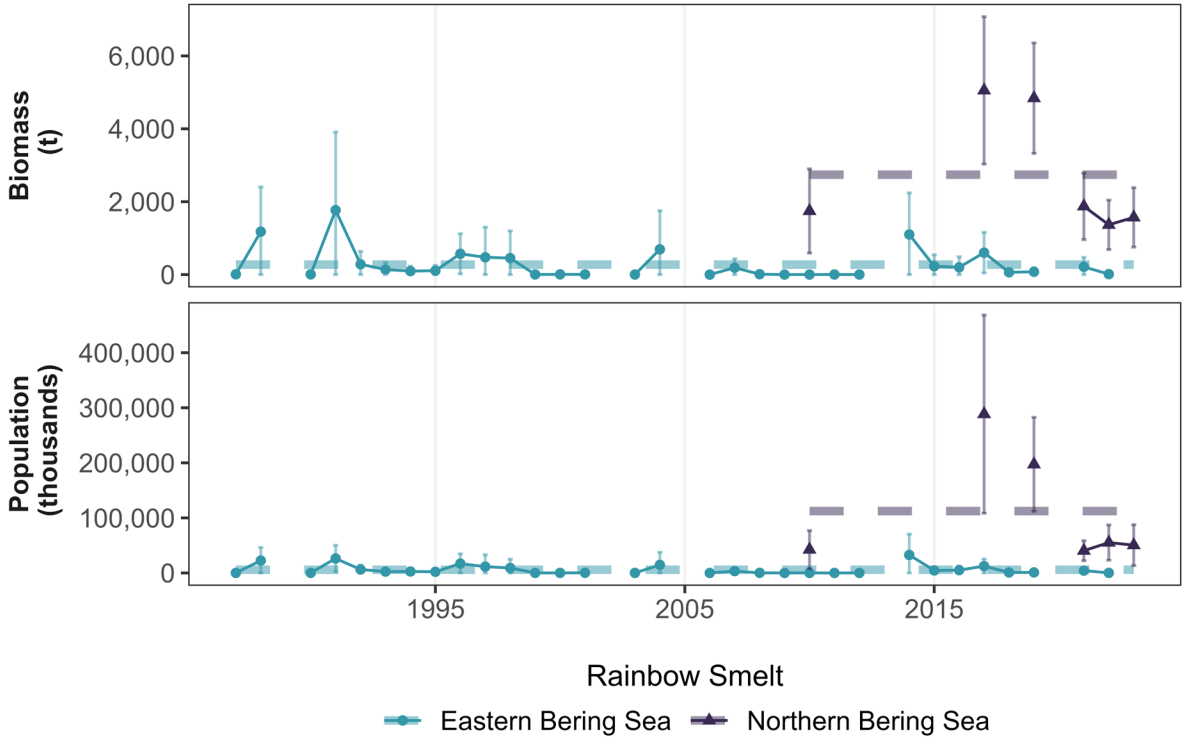

Figure 74. -- Time series of rainbow smelt (*Osmerus mordax*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

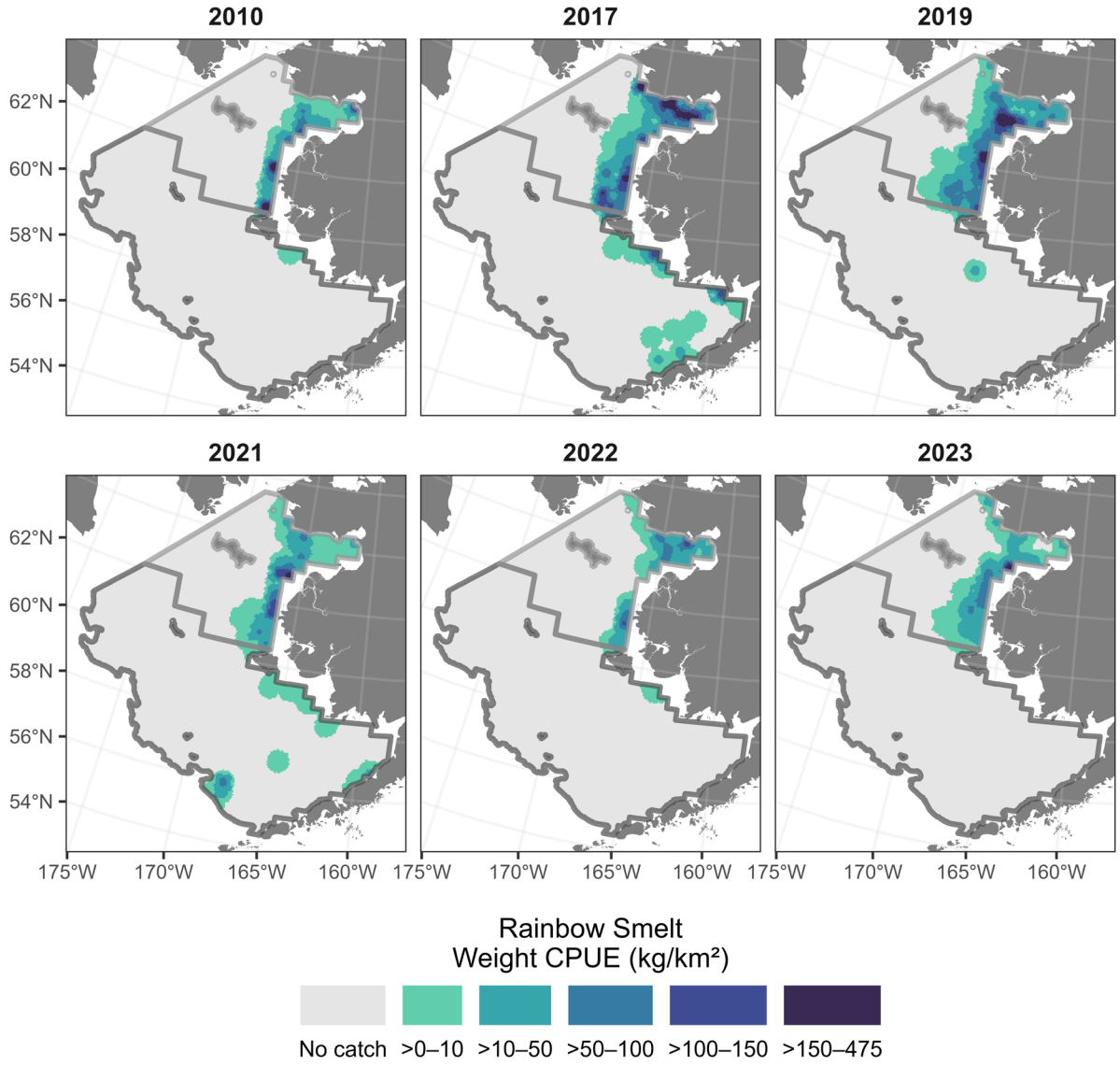

Figure 75. -- Weight CPUE (kg/km^2) distribution of rainbow smelt (*Osmerus mordax*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 89. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for rainbow smelt (*Osmerus mordax*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 eastern Bering Sea shelf trawl survey.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Northern Bering Sea							
70	12.14	3.79	962	301	361	1,564	16
71	7.47	3.38	607	275	58	1,157	16
81	-	-	-	-	-	-	-
Total	**7.89**	**2.05**	**1,570**	**407**	**755**	**2,384**	**32**

Table 90. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (millions) with SD (millions), 95% lower (LCL; millions) and upper (UCL; millions) confidence limits, and number of hauls where species were counted for rainbow smelt (*Osmerus mordax*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 eastern Bering Sea shelf trawl survey.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (M)	95% UCL (M)	Population (M)	Population SD (M)	Hauls w/counts
Northern Bering Sea							
70	304.04	105.69	7.34	40.85	24.10	8.38	16
71	324.65	203.83	0.00	59.50	26.38	16.56	16
81	-	-	-	-	-	-	-
Total	**253.83**	**93.33**	**13.36**	**87.60**	**50.48**	**18.56**	**32**

Rex Sole (*Glyptocephalus zachirus*)

Between 2022 and 2023, the rex sole biomass estimate decreased by 5% in the eastern Bering Sea (Tables **91** and **92**; Fig. **76**) and the population was estimated at 77.7 million individuals (Tables **91** and **93**; Fig. **76**). No rex sole were observed in the northern Bering Sea in 2023 (Fig. **77**).

Table 91. -- Summary of catch location environmental variables and biomass and population estimates for rex sole (*Glyptocephalus zachirus*) in the eastern Bering Sea survey areas.

	Eastern Bering Sea
Stations Present	88 of 376 (23.4%)
Bottom Depth (m)	54 — 171
Bottom Temperature (°C)	1.7 — 4.8
Surface Temperature (°C)	3.2 — 10
Population	77.7 million
Biomass (t)	39,164
Biomass % Total	0.3%
Biomass % Change	5% decrease from 2022

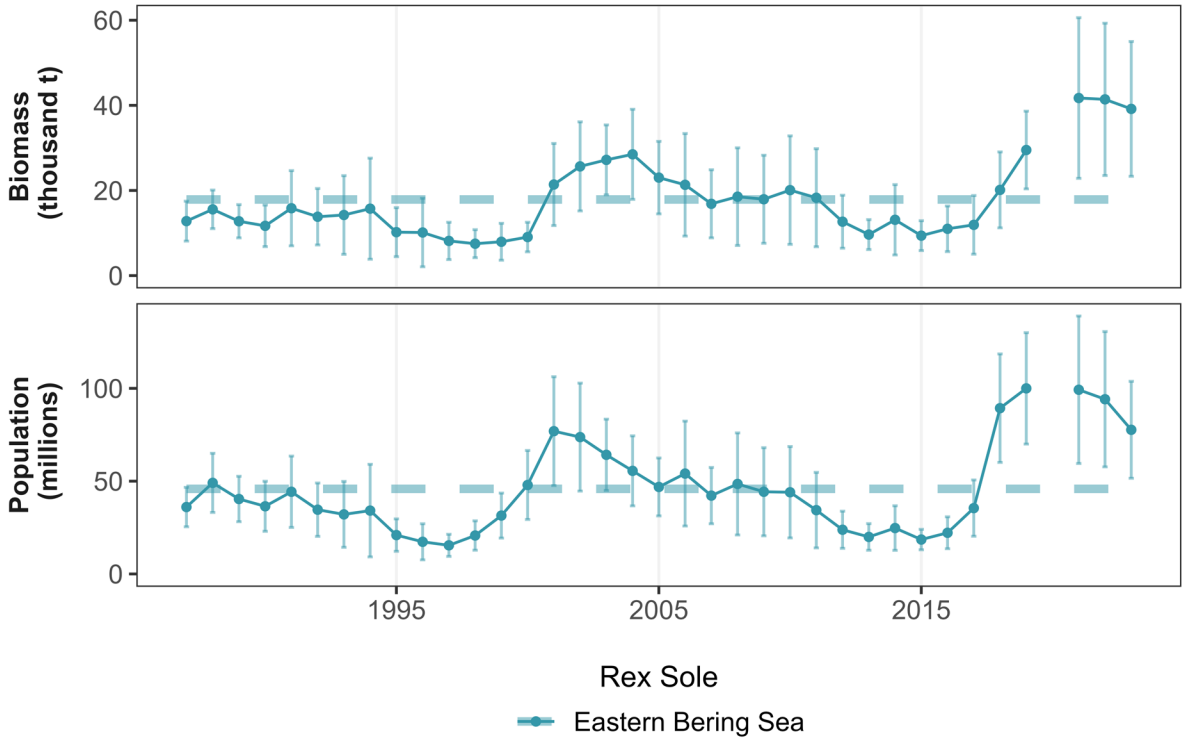

Figure 76. -- Time series of rex sole (*Glyptocephalus zachirus*) biomass (thousand t) and population (millions) from the 1987-2023 eastern Bering Sea shelf bottom trawl survey. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

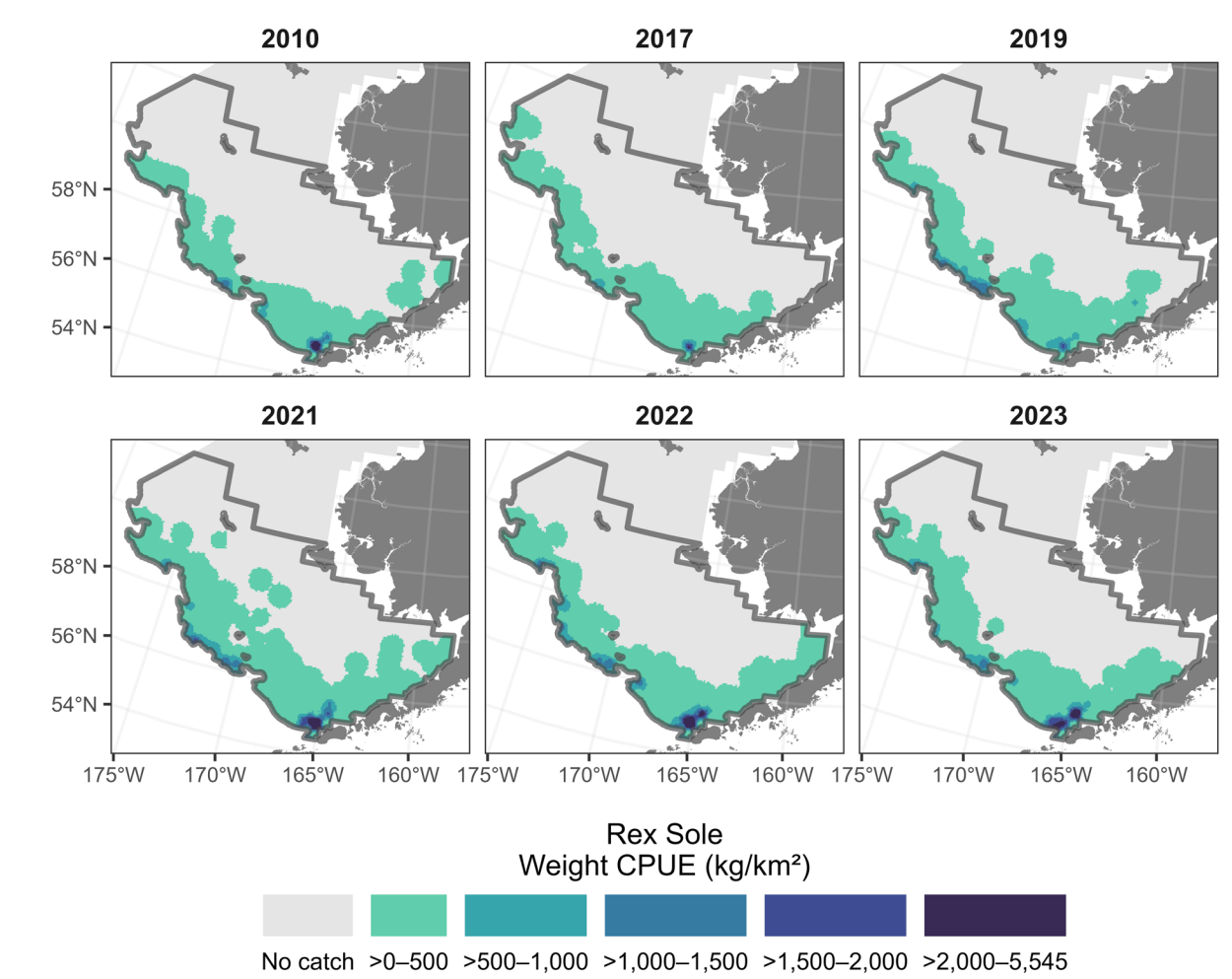

Figure 77. -- Weight CPUE (kg/km^2) distribution of rex sole (*Glyptocephalus zachirus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl survey. This species was not encountered in the 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys.

Table 92. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for rex sole (*Glyptocephalus zachirus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	3.73	2.40	293	189	0	671	3
20	-	-	-	-	-	-	-
31	99.20	55.26	9,422	5,249	0	19,919	22
32	-	-	-	-	-	-	-
41	2.39	2.27	149	142	0	432	2
42	4.07	3.22	98	78	0	254	2
43	-	-	-	-	-	-	-
50	455.29	135.67	17,319	5,161	6,997	27,640	26
61	135.37	33.14	11,882	2,909	6,064	17,701	33
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**79.44**	**16.06**	**39,164**	**7,919**	**23,326**	**55,001**	**88**

Table 93. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for rex sole (*Glyptocephalus zachirus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys. This species was not encountered in the 2023 northern Bering Sea shelf trawl survey.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	5.82	3.62	0.00	1,028.08	458.32	284.88	3
20	-	-	-	-	-	-	-
31	144.41	75.97	0.00	28,147.11	13,715.52	7,215.79	22
32	-	-	-	-	-	-	-
41	3.73	3.28	0.00	641.36	232.41	204.48	2
42	7.54	5.50	0.00	447.20	181.96	132.62	2
43	-	-	-	-	-	-	-
50	958.85	216.33	20,015.59	52,931.22	36,473.40	8,228.91	26
61	303.17	80.88	12,412.61	40,810.01	26,611.31	7,099.35	33
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**157.55**	**26.47**	**51,571.28**	**103,774.56**	**77,672.92**	**13,050.82**	**88**

Saffron Cod (*Eleginus gracilis*)

Previous common name: tomcod

Between 2022 and 2023, the saffron cod biomass estimate decreased by 86% in the eastern Bering Sea (Tables **94** and **95**; Fig. **78**) and the population was estimated at 111,167 individuals (Tables **94** and **96**; Fig. **78**). The biomass estimate increased by 38% in the northern Bering Sea and the population was estimated at 793.8 million individuals.

Table 94. -- Summary of catch location environmental variables and biomass and population estimates for saffron cod (*Eleginus gracilis*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	4 of 376 (1.1%)	54 of 116 (46.6%)
Bottom Depth (m)	26 — 31	12 — 53
Bottom Temperature (°C)	2.9 — 4.6	1.3 — 11.1
Surface Temperature (°C)	2.8 — 4.8	6.3 — 15.1
Population	111,167	793.8 million
Biomass (t)	3	38,225
Biomass % Total	<0.01%	1.4%
Biomass % Change	86% decrease from 2022	38% increase from 2022

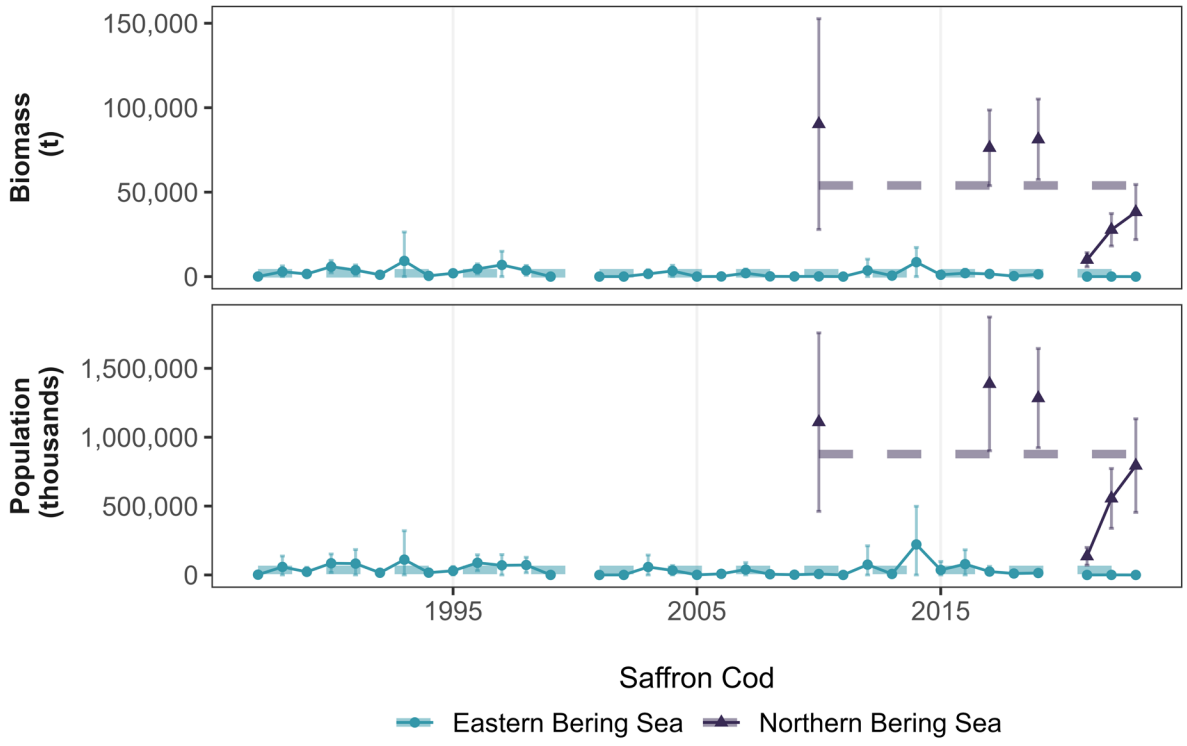

Figure 78. -- Time series of saffron cod (*Eleginus gracilis*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

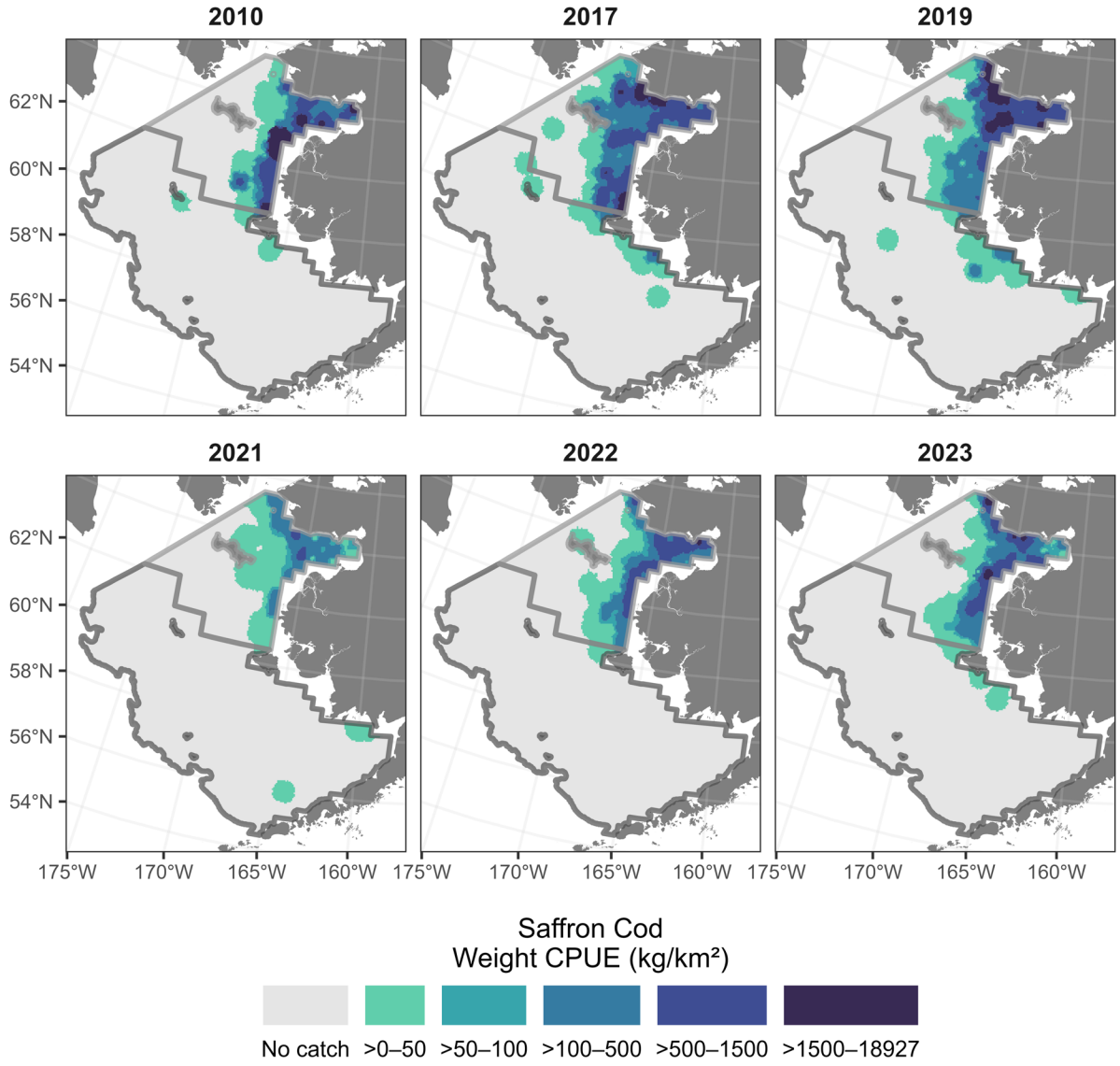

Figure 79. -- Weight CPUE (kg/km^2) distribution of saffron cod (*Eleginus gracilis*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 95. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for saffron cod (*Eleginus gracilis*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	0.01	0.01	1	1	0	2	1
20	0.05	0.03	2	1	0	5	3
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**0.01**	**0.00**	**3**	**1**	**0**	**6**	**4**
Northern Bering Sea							
70	192.37	71.49	15,247	5,666	3,915	26,579	19
71	282.78	72.16	22,978	5,863	11,251	34,704	35
81	-	-	-	-	-	-	-
Total	**192.21**	**41.00**	**38,225**	**8,154**	**21,917**	**54,532**	**54**

Table 96. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for saffron cod (*Eleginus gracilis*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	0.37	0.37	0.00	87.42	29.14	29.14	1
20	1.99	1.11	0.00	173.57	82.03	45.77	3
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**0.23**	**0.11**	**2.65**	**219.68**	**111.17**	**54.26**	**4**
Northern Bering Sea							
70	4,416.12	1,561.50	102,492.02	597,549.94	350,020.98	123,764.48	19
71	5,461.32	1,431.09	211,192.89	676,327.08	443,759.99	116,283.55	34
81	-	-	-	-	-	-	-
Total	**3,991.52**	**853.95**	**454,136.98**	**1,133,424.95**	**793,780.96**	**169,821.99**	**53**

Sakhalin Sole (*Limanda sakhalinensis*)

Between 2022 and 2023, the Sakhalin sole biomass estimate decreased by 88% in the eastern Bering Sea (Tables **97** and **98**; Fig. **80**) and the population was estimated at 522,877 individuals (Tables **97** and **99**; Fig. **80**). The biomass estimate did not notably change in the northern Bering Sea and the population was estimated at 28.5 million individuals.

Table 97. -- Summary of catch location environmental variables and biomass and population estimates for Sakhalin sole (*Limanda sakhalinensis*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	5 of 376 (1.3%)	55 of 116 (47.4%)
Bottom Depth (m)	44 — 65	23 — 74
Bottom Temperature (°C)	-1.4 — 1.1	-1.5 — 9.9
Surface Temperature (°C)	4.1 — 10.1	4.5 — 12.8
Population	522,877	28.5 million
Biomass (t)	21	1,028
Biomass % Total	<0.01%	<0.01%
Biomass % Change	88% decrease from 2022	no change

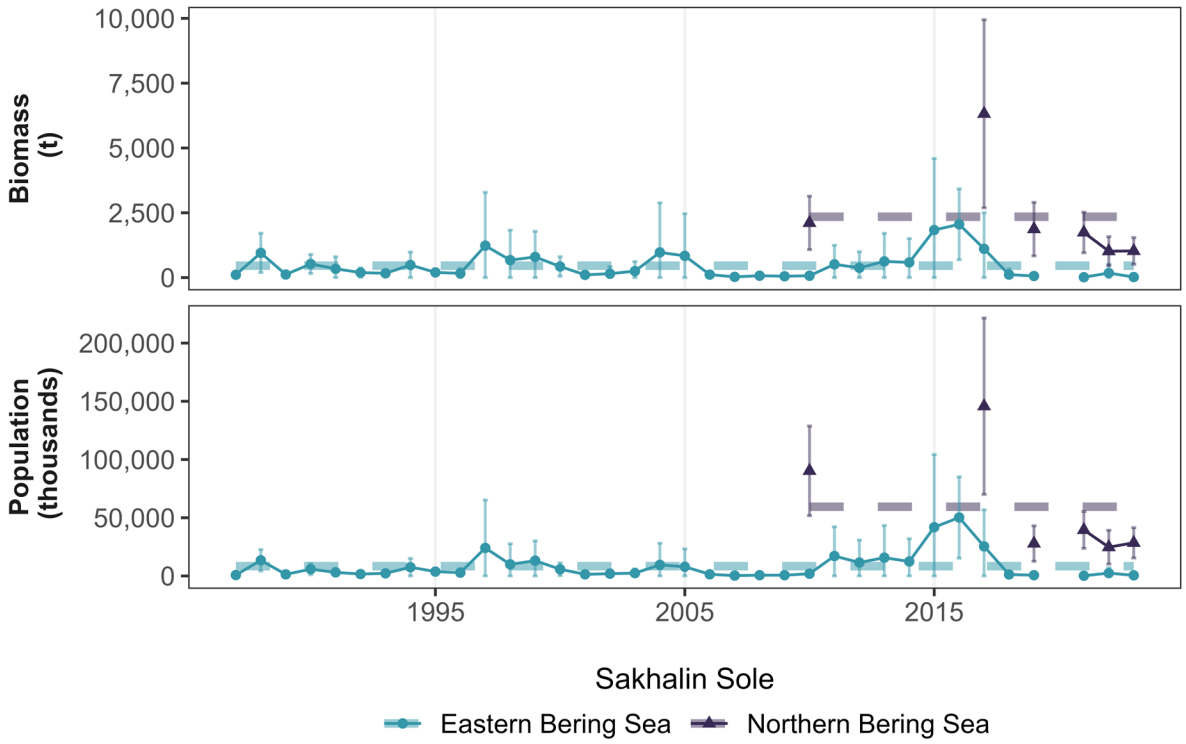

Figure 80. -- Time series of Sakhalin sole (*Limanda sakhalinensis*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

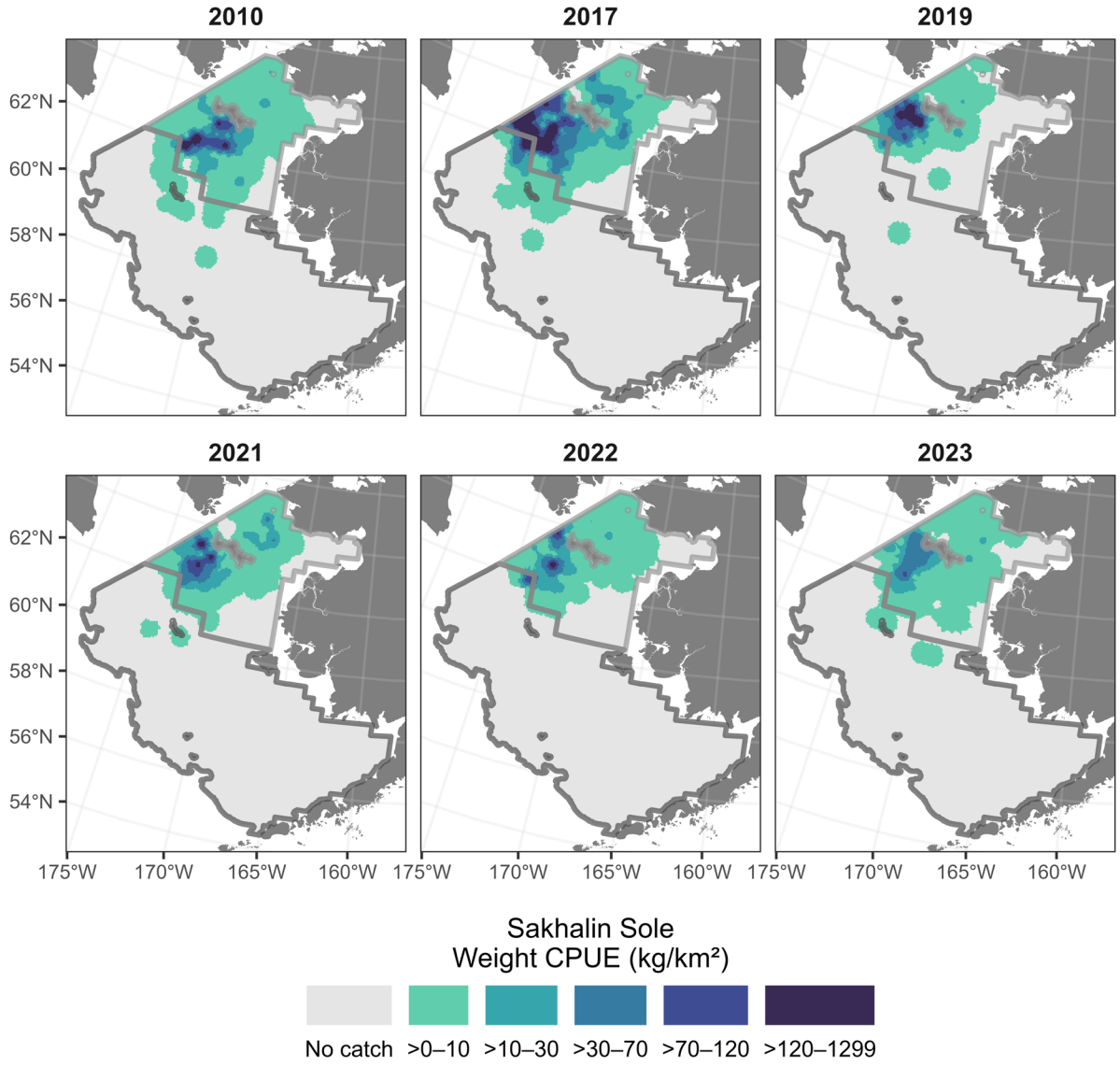

Figure 81. -- Weight CPUE (kg/km^2) distribution of Sakhalin sole (*Limanda sakhalinensis*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 98. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for Sakhalin sole (*Limanda sakhalinensis*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	0.03	0.03	1	1	0	4	1
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	0.11	0.09	7	6	0	18	3
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	0.69	0.69	12	12	0	37	1
90	-	-	-	-	-	-	-
Total	**0.04**	**0.03**	**21**	**14**	**0**	**48**	**5**
Northern Bering Sea							
70	4.33	1.95	343	155	34	652	17
71	1.51	0.41	123	34	56	190	24
81	14.66	5.32	562	204	154	970	14
Total	**5.17**	**1.30**	**1,028**	**258**	**512**	**1,545**	**55**

Table 99. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for Sakhalin sole (*Limanda sakhalinensis*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	1.97	1.97	0.00	243.29	81.09	81.10	1
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	3.75	2.87	0.00	591.47	233.74	178.86	3
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	11.59	11.59	0.00	624.12	208.04	208.04	1
90	-	-	-	-	-	-	-
Total	**1.06**	**0.58**	**0.00**	**1,095.06**	**522.88**	**286.09**	**5**
Northern Bering Sea							
70	166.01	69.15	2,196.37	24,119.03	13,157.70	5,480.66	17
71	76.66	20.07	2,966.56	9,491.22	6,228.89	1,631.16	24
81	236.35	81.71	2,796.84	15,331.87	9,064.36	3,133.76	14
Total	**143.07**	**32.79**	**15,409.66**	**41,492.24**	**28,450.95**	**6,520.64**	**55**

Shortfin Eelpout (*Lycodes brevipes*)

Between 2022 and 2023, the shortfin eelpout biomass estimate increased by 6% in the eastern Bering Sea (Tables **100** and **98**; Fig. **82**) and the population was estimated at 615.8 million individuals (Tables **100** and **99**; Fig. **82**). No shortfin eelpout were observed in the northern Bering Sea in 2023 (Fig. **83**).

Table 100. -- Summary of catch location environmental variables and biomass and population estimates for shortfin eelpout (*Lycodes brevipes*) in the eastern Bering Sea survey areas.

	Eastern Bering Sea
Stations Present	108 of 376 (28.7%)
Bottom Depth (m)	66 — 171
Bottom Temperature (°C)	-1.6 — 4.5
Surface Temperature (°C)	5.6 — 10.7
Population	615.8 million
Biomass (t)	38,205
Biomass % Total	0.3%
Biomass % Change	6% increase from 2022

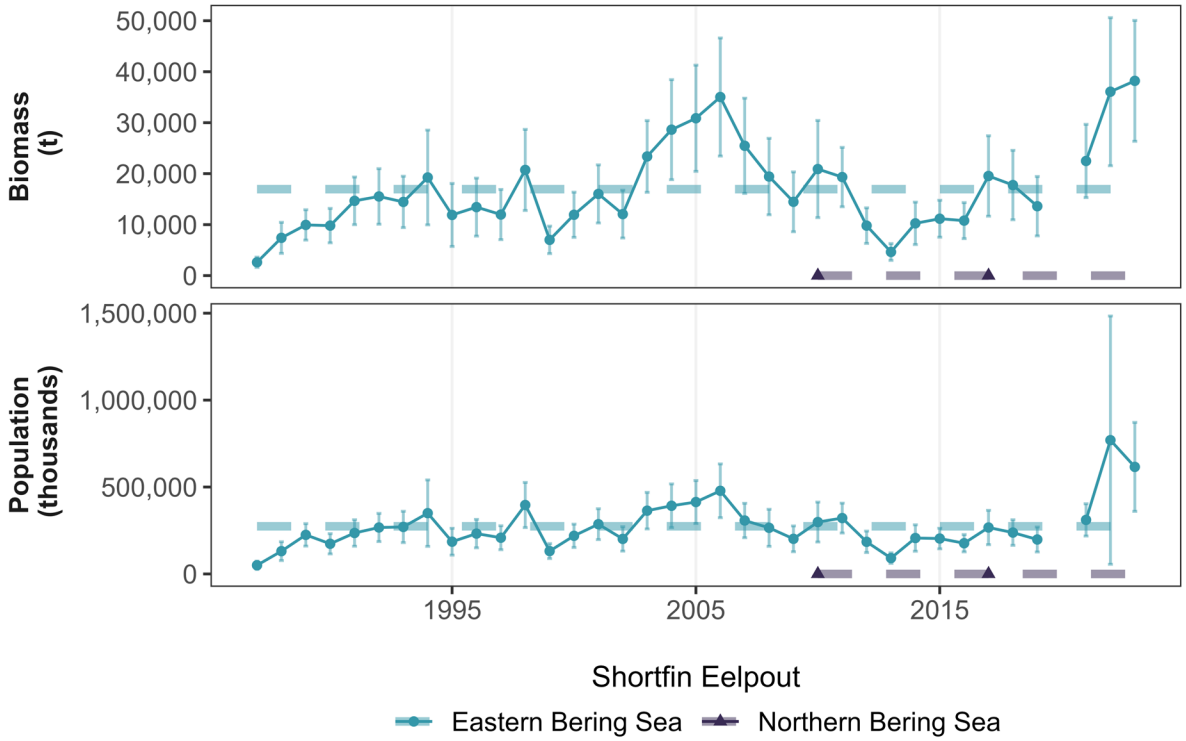

Figure 82. -- Time series of shortfin eelpout (*Lycodes brevipes*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

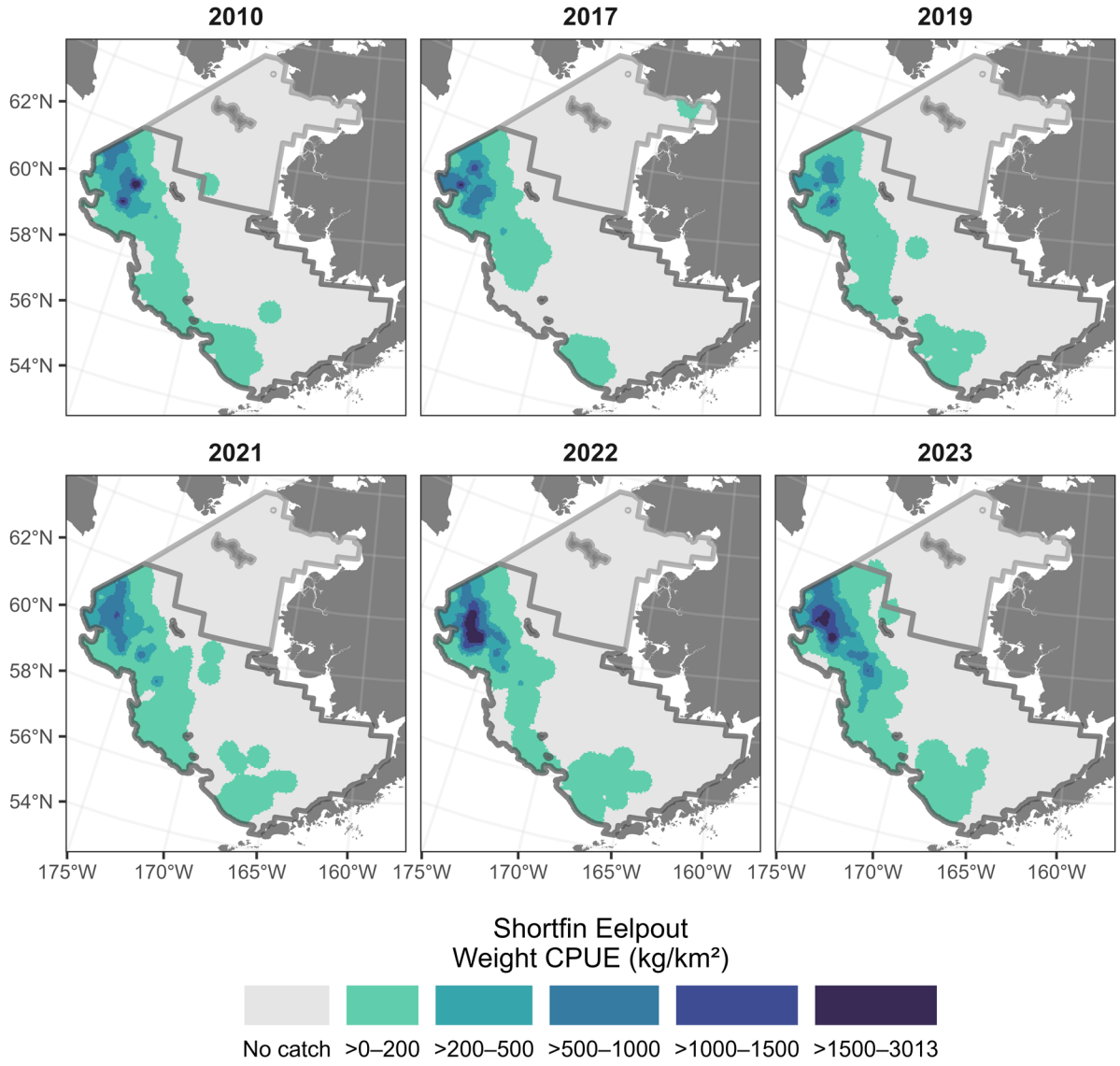

Figure 83. -- Weight CPUE (kg/km^2) distribution of shortfin eelpout (*Lycodes brevipes*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Shorthorn Sculpin (*Myoxocephalus scorpius*)

Previous scientific name: *Myoxocephalus verrucosus*
Previous common name: warty sculpin

Between 2022 and 2023, the shorthorn sculpin biomass estimate decreased by 2% in the eastern Bering Sea (Tables **101** and **102**; Fig. **84**) and the population was estimated at 358,610 individuals (Tables **101** and **103**; Fig. **84**). Similarly, the biomass estimate decreased by 7% in the northern Bering Sea and the population was estimated at 20.5 million individuals.

Table 101. -- Summary of catch location environmental variables and biomass and population estimates for shorthorn sculpin (*Myoxocephalus scorpius*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	12 of 376 (3.2%)	26 of 116 (22.4%)
Bottom Depth (m)	44 — 89	21 — 53
Bottom Temperature (°C)	-1.5 — 2.3	-0.1 — 8.7
Surface Temperature (°C)	2.2 — 9.5	4.5 — 9.8
Population	358,610	20.5 million
Biomass (t)	546	3,414
Biomass % Total	<0.01%	0.1%
Biomass % Change	2% decrease from 2022	7% decrease from 2022

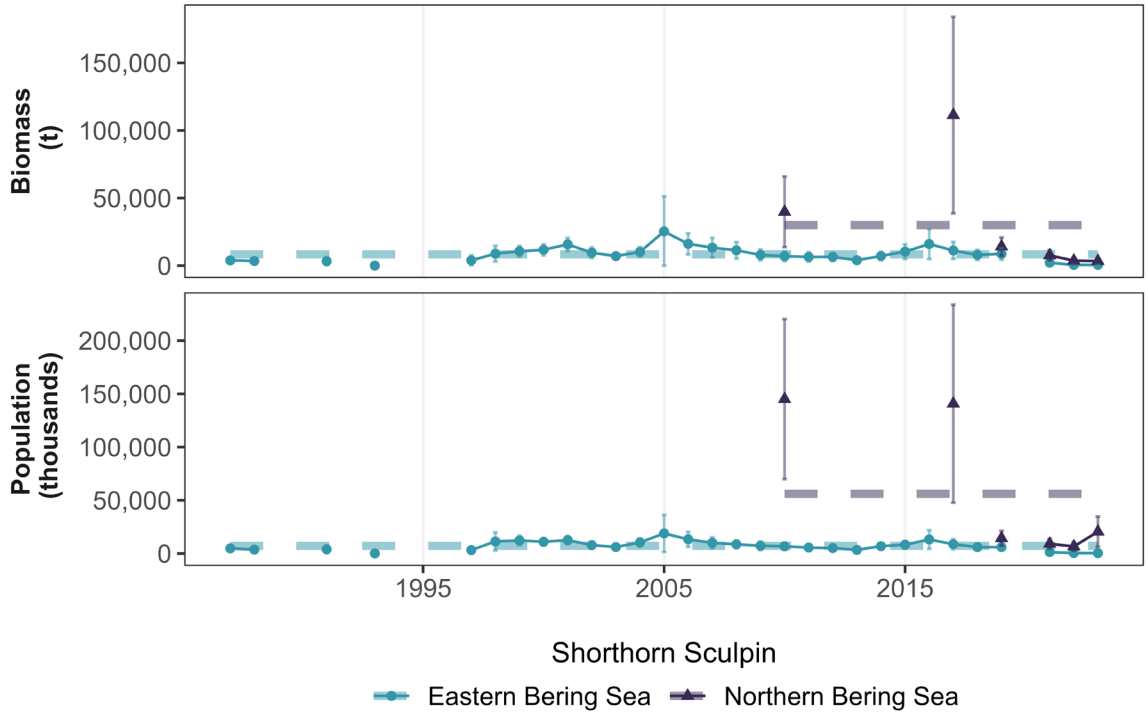

Figure 84. -- Time series of shorthorn sculpin (*Myoxocephalus scorpius*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

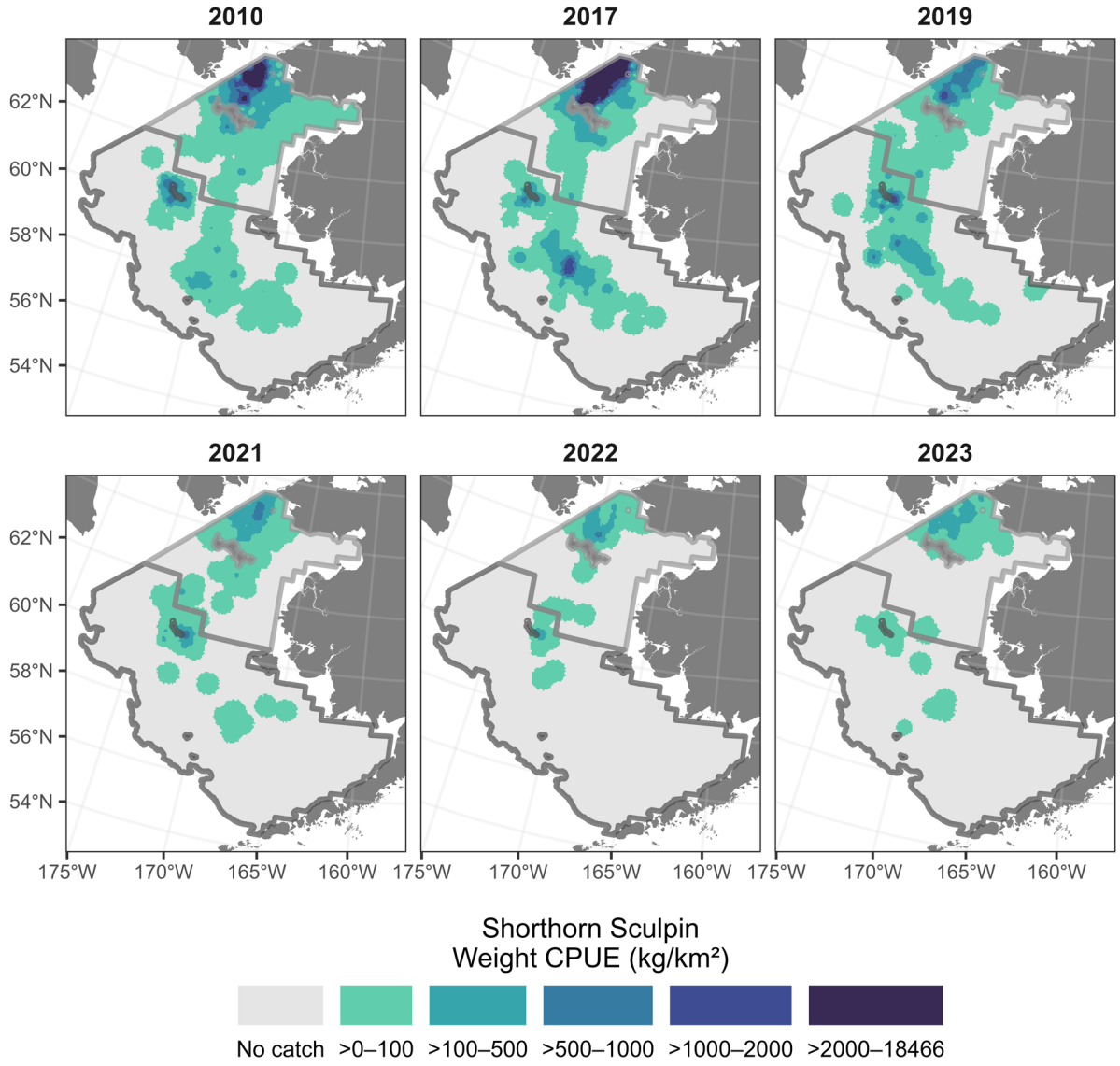

Figure 85. -- Weight CPUE (kg/km^2) distribution of shorthorn sculpin (*Myoxocephalus scorpius*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 102. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for shorthorn sculpin (*Myoxocephalus scorpius*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	0.29	0.29	12	12	0	36	1
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	3.63	2.18	226	136	0	498	4
42	1.87	1.87	45	45	0	135	1
43	12.47	4.84	263	102	59	467	6
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**1.11**	**0.36**	**546**	**176**	**194**	**898**	**12**
Northern Bering Sea							
70	0.63	0.63	50	50	0	149	1
71	41.41	10.66	3,364	866	1,632	5,097	25
81	-	-	-	-	-	-	-
Total	**17.17**	**4.36**	**3,414**	**868**	**1,678**	**5,150**	**26**

Table 103. --Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for shorthorn sculpin (*Myoxocephalus scorpius*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	0.66	0.66	0.00	81.82	27.27	27.27	1
31	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
41	2.29	1.18	0.00	290.31	142.68	73.82	4
42	0.66	0.66	0.00	47.45	15.82	15.82	1
43	8.21	3.33	32.37	313.33	172.85	70.24	6
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**0.73**	**0.22**	**145.29**	**571.93**	**358.61**	**106.66**	**12**
Northern Bering Sea							
70	0.55	0.55	0.00	131.24	43.75	43.75	1
71	251.90	87.71	6,214.89	34,721.14	20,468.01	7,126.56	25
81	-	-	-	-	-	-	-
Total	**103.14**	**35.84**	**6,258.37**	**34,765.15**	**20,511.76**	**7,126.70**	**26**

Starry Flounder (*Platichthys stellatus*)

Between 2022 and 2023, the starry flounder biomass estimate decreased by 12% in the eastern Bering Sea (Tables **104** and **105**; Fig. **86**) and the population was estimated at 53.8 million individuals (Tables **104** and **106**; Fig. **86**). The biomass estimate did not notably change in the northern Bering Sea and the population was estimated at 67.8 million individuals.

Table 104. -- Summary of catch location environmental variables and biomass and population estimates for starry flounder (*Platichthys stellatus*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	63 of 376 (16.8%)	72 of 116 (62.1%)
Bottom Depth (m)	20 — 74	12 — 53
Bottom Temperature (°C)	1.6 — 4.8	1.3 — 11.1
Surface Temperature (°C)	1.7 — 6.3	5.4 — 15.1
Population	53.8 million	67.8 million
Biomass (t)	81,383	41,169
Biomass % Total	0.7%	1.5%
Biomass % Change	12% decrease from 2022	no change

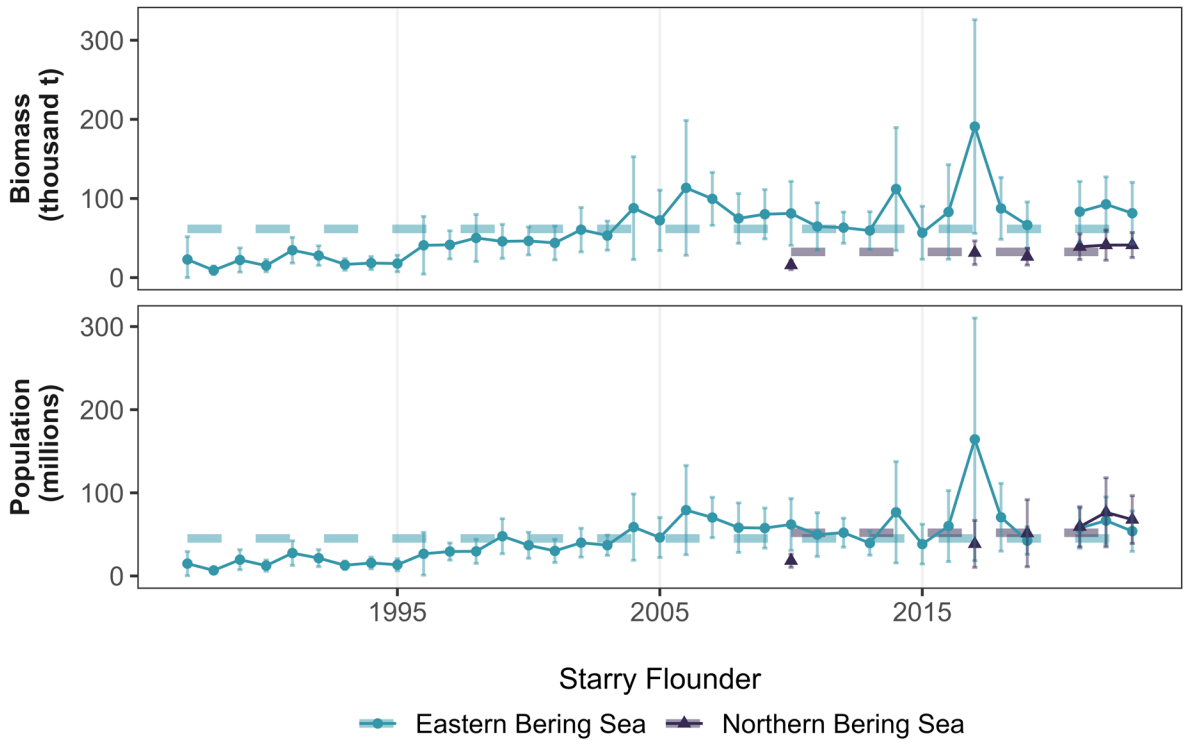

Figure 86. -- Time series of starry flounder (*Platichthys stellatus*) biomass (thousand t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

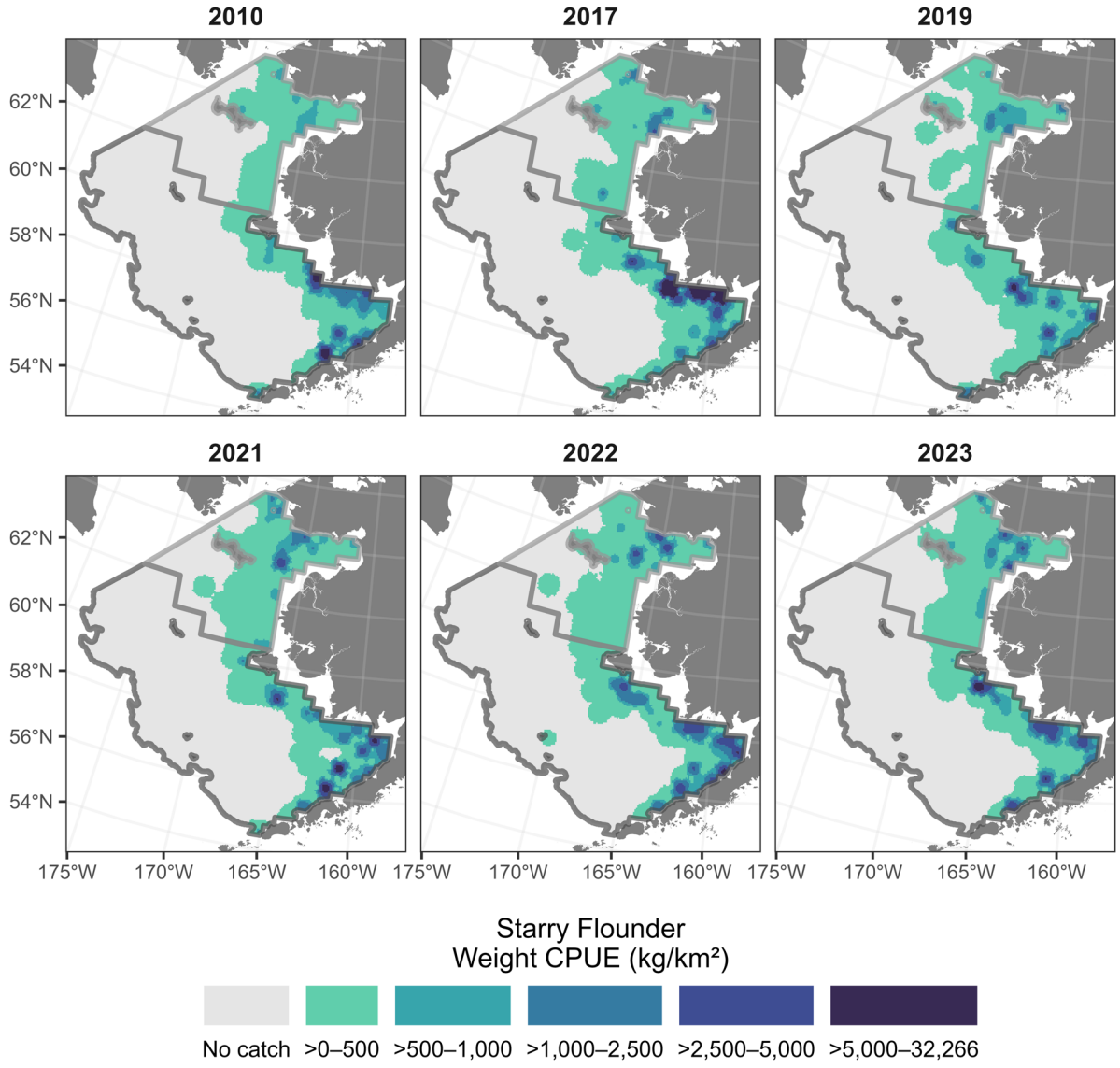

Figure 87. -- Weight CPUE (kg/km^2) distribution of starry flounder (*Platichthys stellatus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 105. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (thousand t) with SD (thousand t), 95% lower (LCL; thousand t) and upper (UCL; thousand t) confidence limits, and number of hauls where species were weighed for starry flounder (*Platichthys stellatus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (Kt)	Biomass SD (Kt)	95% LCL (Kt)	95% UCL (Kt)	Hauls w/weights
Eastern Bering Sea							
10	678.95	159.95	53.44	12.59	28.26	78.62	38
20	449.98	318.50	18.54	13.12	0.00	44.78	16
31	99.07	74.64	9.41	7.09	0.00	23.59	9
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**165.08**	**39.59**	**81.38**	**19.52**	**42.35**	**120.41**	**63**
Northern Bering Sea							
70	130.97	33.14	10.38	2.63	5.13	15.63	24
71	378.91	91.89	30.79	7.47	15.86	45.72	48
81	-	-	-	-	-	-	-
Total	**207.02**	**39.80**	**41.17**	**7.92**	**25.34**	**57.00**	**72**

Table 106. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (millions) with SD (millions), 95% lower (LCL; millions) and upper (UCL; millions) confidence limits, and number of hauls where species were counted for starry flounder (*Platichthys stellatus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (M)	95% UCL (M)	Population (M)	Population SD (M)	Hauls w/counts
Eastern Bering Sea							
10	478.07	107.52	20.70	54.55	37.63	8.46	38
20	270.73	191.74	0.00	26.95	11.15	7.90	16
31	53.35	38.71	0.00	12.42	5.07	3.68	8
32	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-
Total	**109.22**	**24.64**	**29.56**	**78.14**	**53.85**	**12.15**	**62**
Northern Bering Sea							
70	267.29	83.85	7.89	34.48	21.19	6.65	24
71	573.64	156.67	21.15	72.07	46.61	12.73	47
81	-	-	-	-	-	-	-
Total	**340.92**	**72.21**	**39.08**	**96.52**	**67.80**	**14.36**	**71**

Sturgeon Poacher (*Podothecus accipenserinus*)

Between 2022 and 2023, the sturgeon poacher biomass estimate decreased by 18% in the eastern Bering Sea (Tables **107** and **105**; Fig. **88**) and the population was estimated at 211.2 million individuals (Tables **107** and **106**; Fig. **88**). Similarly, the biomass estimate decreased by 39% in the northern Bering Sea and the population was estimated at 8.9 million individuals.

Table 107. -- Summary of catch location environmental variables and biomass and population estimates for sturgeon poacher (*Podothecus accipenserinus*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	211 of 376 (56.1%)	26 of 116 (22.4%)
Bottom Depth (m)	20 — 160	14 — 50
Bottom Temperature (°C)	-1.6 — 5.2	0.1 — 11
Surface Temperature (°C)	1.7 — 9.5	7.2 — 12.3
Population	211.2 million	8.9 million
Biomass (t)	14,219	194
Biomass % Total	0.1%	<0.01%
Biomass % Change	18% decrease from 2022	39% decrease from 2022

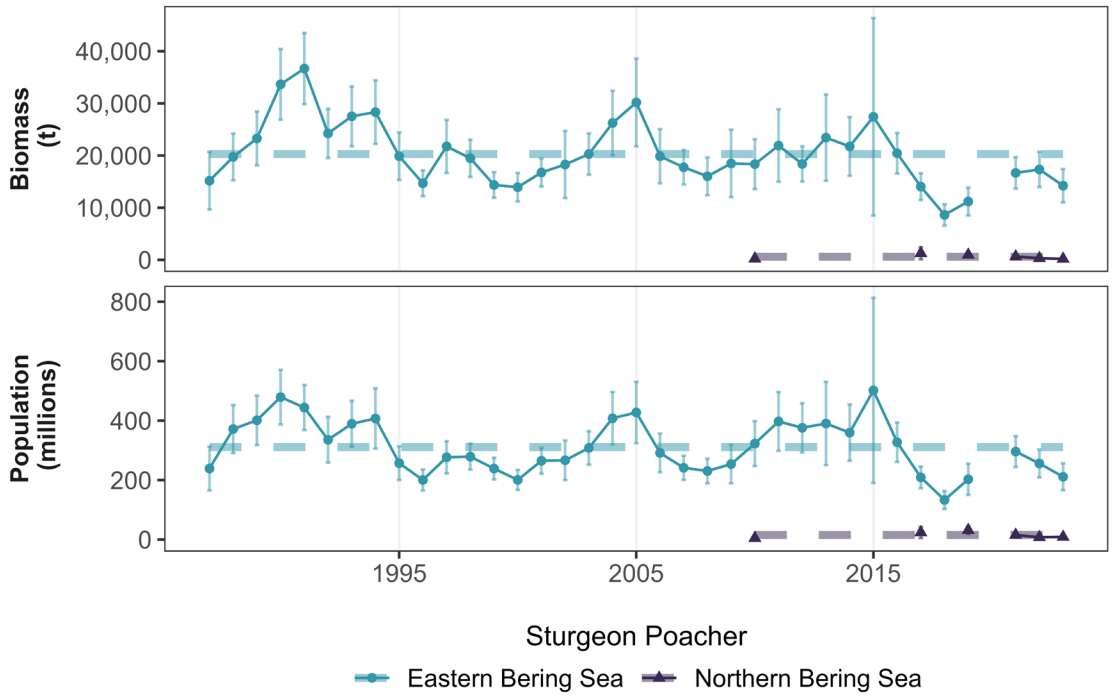

Figure 88. -- Time series of sturgeon poacher (*Podothecus accipenserinus*) biomass (t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

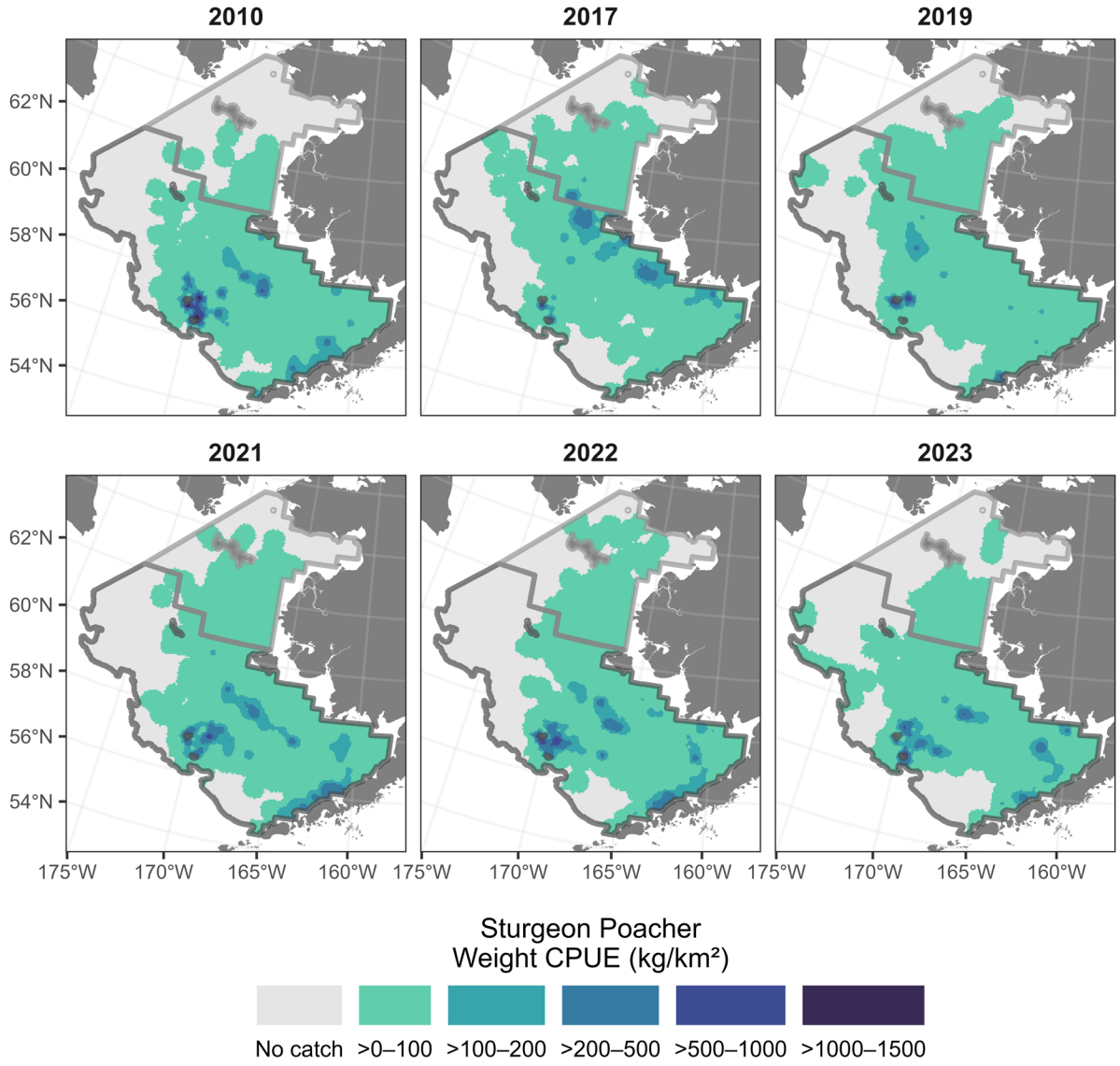

Figure 89. -- Weight CPUE (kg/km^2) distribution of sturgeon poacher (*Podothecus accipenserinus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Variegated Snailfish (*Liparis gibbus*)

Between 2022 and 2023, the variegated snailfish biomass estimate increased by 396% in the eastern Bering Sea (Tables **108** and **105**; Fig. **90**) and the population was estimated at 1.9 million individuals (Tables **108** and **106**; Fig. **90**). Similarly, the biomass estimate increased by 165% in the northern Bering Sea and the population was estimated at 8.8 million individuals.

Table 108. -- Summary of catch location environmental variables and biomass and population estimates for variegated snailfish (*Liparis gibbus*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	25 of 376 (6.6%)	52 of 116 (44.8%)
Bottom Depth (m)	36 — 147	29 — 78
Bottom Temperature (°C)	-1.6 — 4.4	-1.6 — 8.7
Surface Temperature (°C)	3.9 — 10.7	4.5 — 10.1
Population	1.9 million	8.8 million
Biomass (t)	1,162	1,585
Biomass % Total	<0.01%	0.1%
Biomass % Change	396% increase from 2022	165% increase from 2022

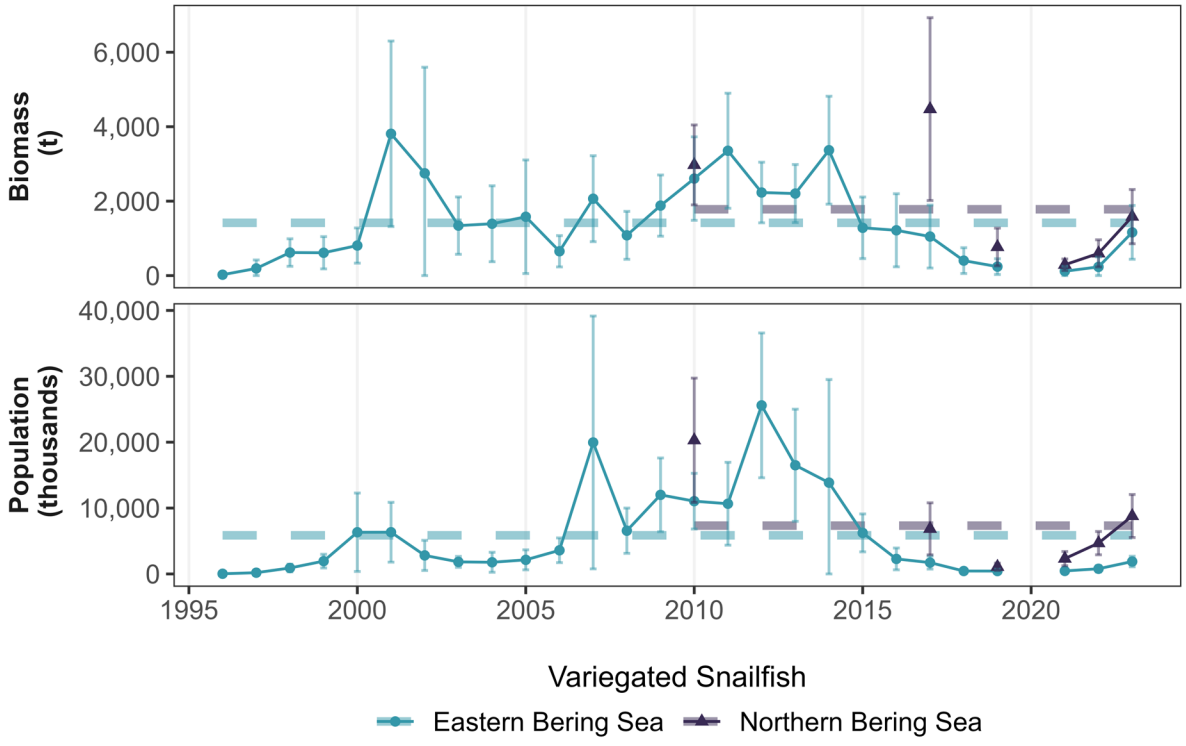

Figure 90. -- Time series of variegated snailfish (*Liparis gibbus*) biomass (t) and population (thousands) from the 1996-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

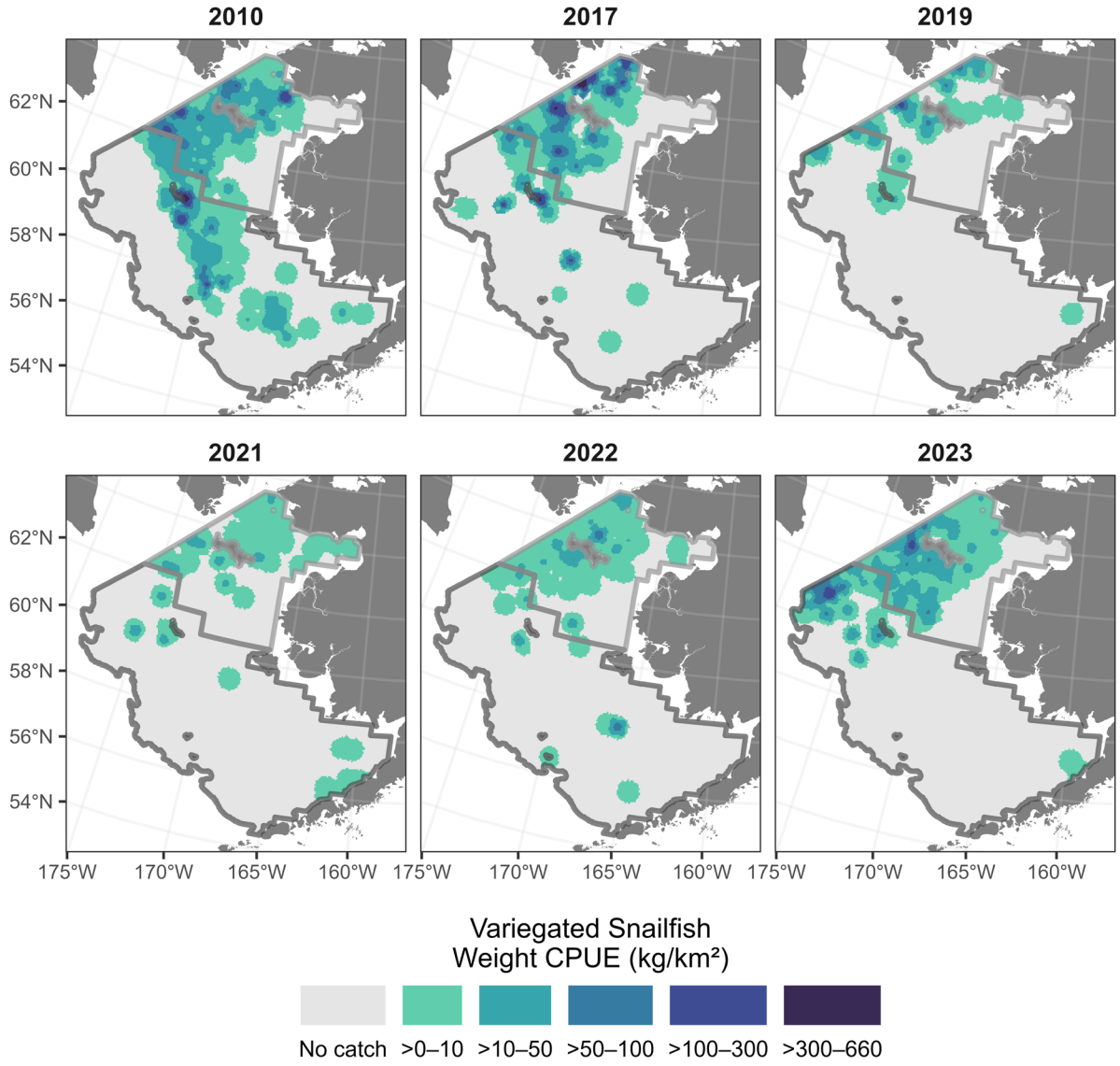

Figure 91. -- Weight CPUE (kg/km^2) distribution of variegated snailfish (*Liparis gibbus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Walleye Pollock (*Gadus chalcogrammus*)

Between 2022 and 2023, the walleye pollock biomass estimate decreased by 24% in the eastern Bering Sea (Tables **109** and **110**; Fig. **92**) and the population was estimated at 5.7 billion individuals (Tables **109** and **111**; Fig. **92**). Similarly, the biomass estimate decreased by 8% in the northern Bering Sea and the population was estimated at 915.2 million individuals.

The distribution of pollock was relatively consistent with previous years. In the eastern Bering Sea, there was an increase in the outer shelf to the northwest. In the northern Bering Sea, there was a small area of higher density in the Chirikov Basin just south of the Bering Strait, similar to distributions in 2021 and 2022 (Fig. **93**).

During colder years (2006 to 2013), the highest densities of pollock were along the outer half of the eastern Bering Sea shelf (> 70 m) and the lowest densities of pollock were along the inner shelf. Low densities were also observed throughout the northern Bering Sea when it was first surveyed in 2010. During the recent warm stanza (2014 to present), pollock were more spread out across the shelf compared to cold years. In these instances, high catch densities sometimes reached into the inner domain close to Nunivak Island and up against the northern edge of the standard eastern Bering Sea shelf survey area. These distribution patterns are consistent with shoreward and northward feeding migrations typical of pollock during the spring and summer (Kotwicki et al., 2005).

Size distributions of walleye pollock in 2023 were similar to 2022 and had two distinct modes (Fig. **94**). The total abundance of adult fish >40 cm was much lower in 2023 than in 2022. However, the total abundance of juvenile fish (<20 cm) was much higher in 2023 than in 2022. Pollock in the 20-35 cm size range (representing 2-3 year-olds) were generally absent or rare in survey catch samples in the eastern Bering Sea (Fig. **94**) because they typically occupy a position high above the seafloor where they are unavailable to the survey trawl (Kotwicki et al., 2015). Their vertical availability depends on environmental factors and can be affected by bottom depth, light conditions, and fish density (Kotwicki et al., 2014, 2015).

Table 109. -- Summary of catch location environmental variables and biomass and population estimates for walleye pollock (*Gadus chalcogrammus*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	374 of 376 (99.5%)	106 of 116 (91.4%)
Bottom Depth (m)	20 — 171	12 — 78
Bottom Temperature (°C)	-1.6 — 5.4	-1.6 — 11.1
Surface Temperature (°C)	1.7 — 11	4 — 14.9
Population	5.7 billion	915.2 million
Biomass (t)	3.2 million	363,839
Biomass % Total	26.8%	13.0%
Biomass % Change	24% decrease from 2022	8% decrease from 2022

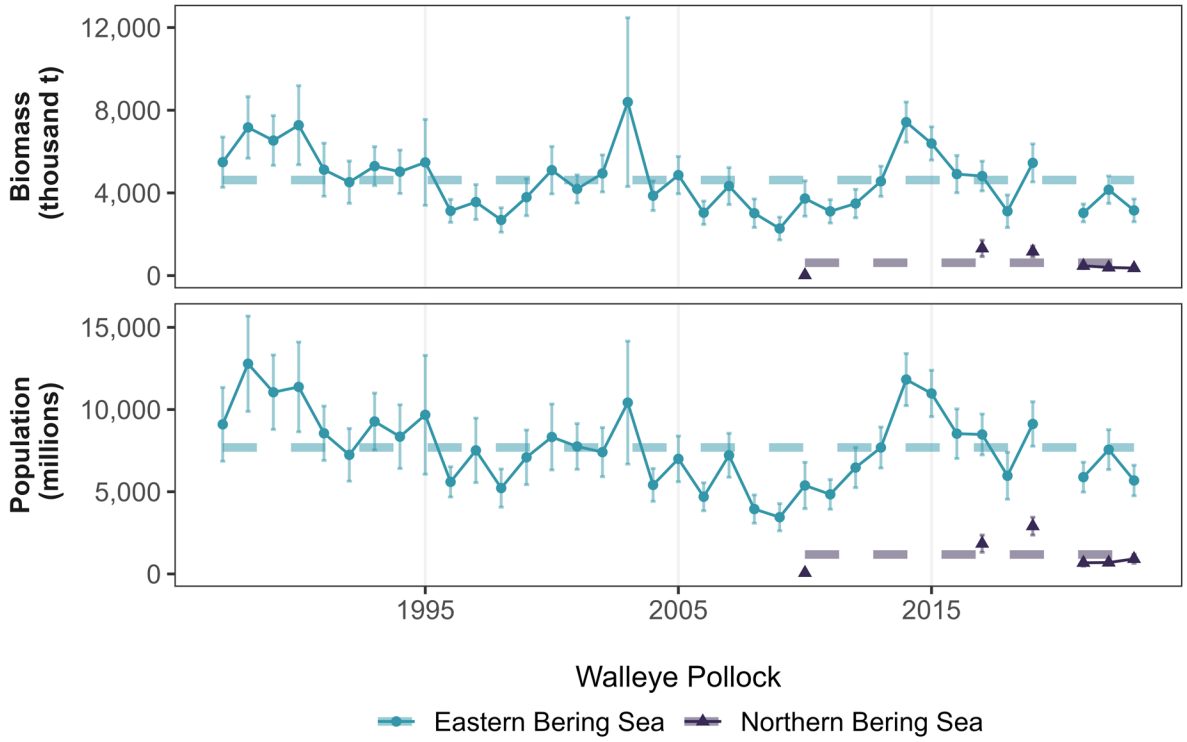

Figure 92. -- Time series of walleye pollock (*Gadus chalcogrammus*) biomass (thousand t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

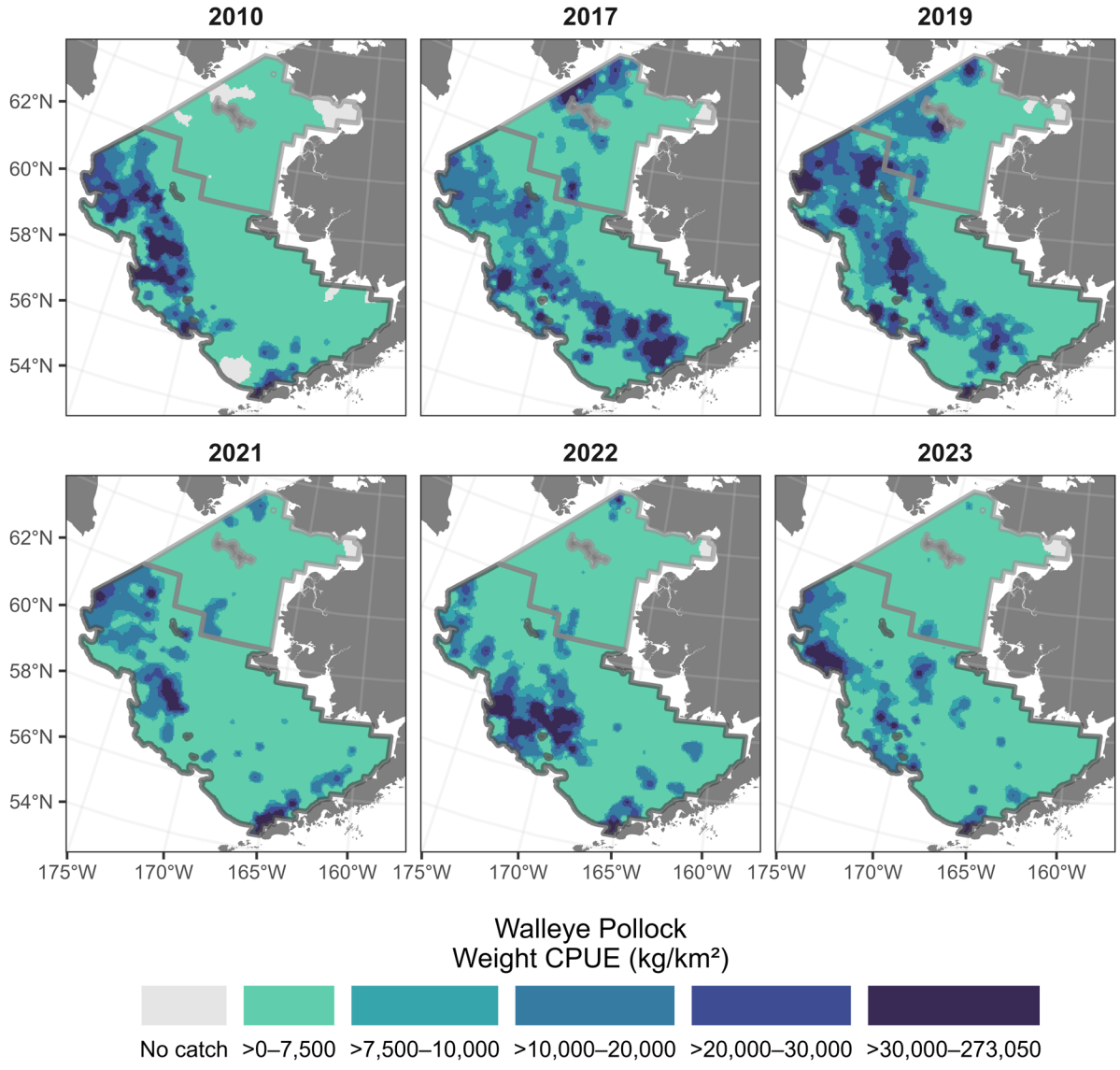

Figure 93. -- Weight CPUE (kg/km^2) distribution of walleye pollock (*Gadus chalcogrammus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

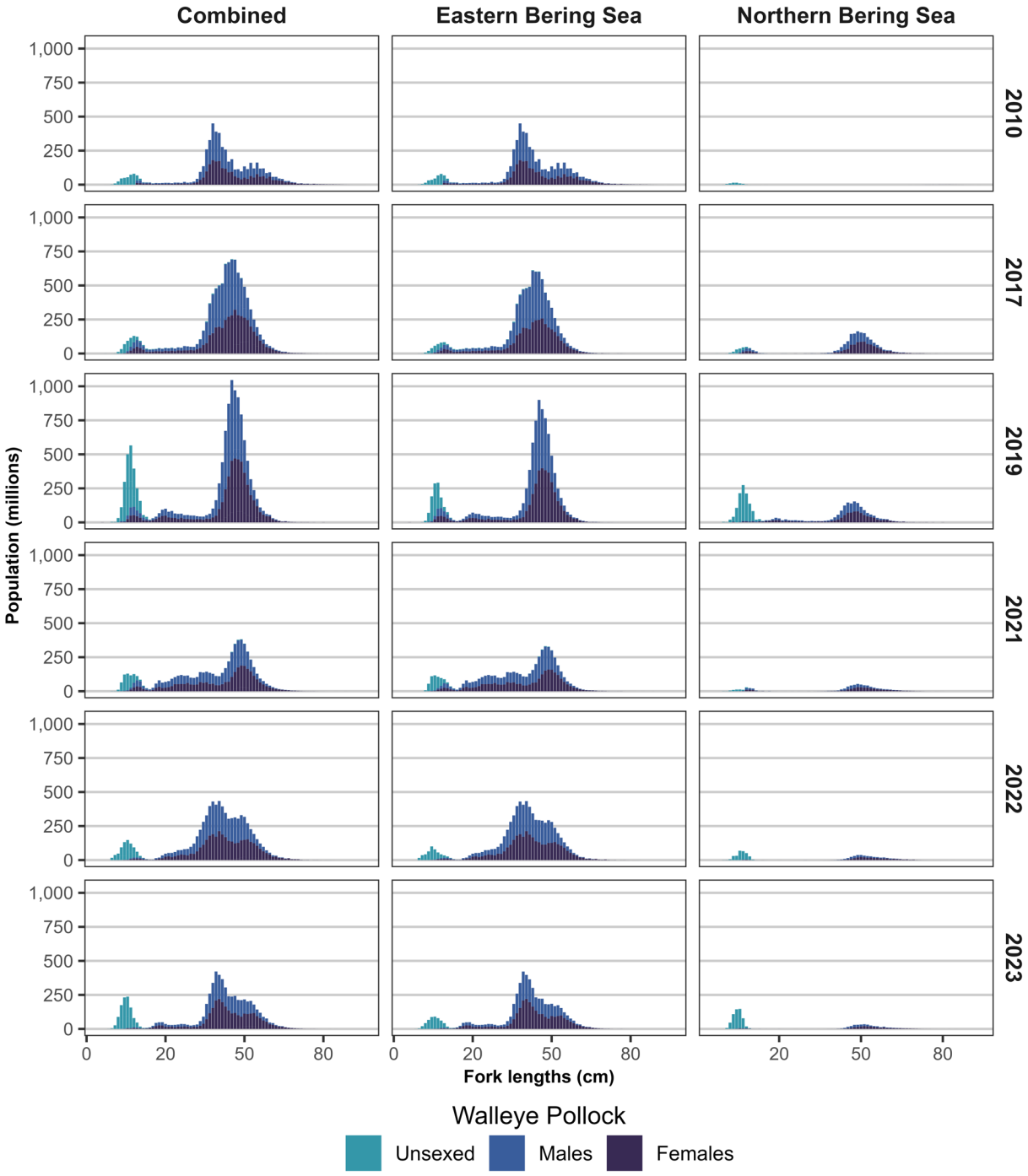

Figure 94. -- Total abundance-at-length estimates of walleye pollock (*Gadus chalcogrammus*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 110. -- Mean weight CPUE (thousand kg/km²) with standard deviation (SD; kg/km²), estimated biomass (thousand t) with SD (thousand t), 95% lower (LCL; thousand t) and upper (UCL; thousand t) confidence limits, and number of hauls where species were weighed for walleye pollock (*Gadus chalcogrammus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (Kkg/km²)	CPUE SD (kg/km²)	Biomass (Kt)	Biomass SD (Kt)	95% LCL (Kt)	95% UCL (Kt)	Hauls w/weights
Eastern Bering Sea							
10	2.52	327.09	198.13	25.74	146.64	249.61	58
20	5.30	870.59	218.48	35.86	146.76	290.21	31
31	5.83	2,183.49	553.43	207.39	138.66	968.20	69
32	6.04	1,385.21	53.46	12.25	28.95	77.97	8
41	7.24	1,294.00	451.35	80.63	290.09	612.60	44
42	7.60	1,778.37	183.42	42.90	97.63	269.22	31
43	4.13	574.00	86.95	12.09	62.76	111.13	22
50	3.48	1,448.20	132.36	55.09	22.19	242.54	24
61	12.81	1,557.80	1,124.86	136.74	851.38	1,398.33	60
62	4.13	594.15	26.68	3.84	19.00	34.36	7
82	2.09	635.70	37.52	11.41	14.69	60.35	12
90	7.63	1,767.16	88.04	20.39	47.26	128.82	8
Total	**6.40**	**558.79**	**3,154.67**	**275.48**	**2,603.71**	**3,705.62**	**374**
Northern Bering Sea							
70	2.44	507.60	193.12	40.23	112.66	273.59	40
71	1.00	243.19	81.49	19.76	41.97	121.01	48
81	2.33	465.13	89.22	17.84	53.54	124.90	18
Total	**1.83**	**242.59**	**363.84**	**48.24**	**267.35**	**460.32**	**106**

Table 111. -- Mean number CPUE (thousand no/km²) with standard deviation (SD; no/km²), estimated population (millions) with SD (millions), 95% lower (LCL; millions) and upper (UCL; millions) confidence limits, and number of hauls where species were counted for walleye pollock (*Gadus chalcogrammus*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (Kno/km²)	CPUE SD (no/km²)	95% LCL (M)	95% UCL (M)	Population (M)	Population SD (M)	Hauls w/counts
Eastern Bering Sea							
10	4.05	732.09	203.33	433.81	318.57	57.62	58
20	7.28	1,237.37	198.11	401.99	300.05	50.97	31
31	9.02	2,974.68	291.66	1,421.78	856.72	282.53	69
32	11.90	3,655.30	40.59	169.94	105.27	32.34	8
41	12.81	2,180.22	526.47	1,069.87	798.17	135.85	43
42	14.82	3,389.81	194.04	521.12	357.58	81.77	31
43	10.72	1,645.25	156.42	295.04	225.73	34.66	22
50	5.22	2,481.42	9.74	387.30	198.52	94.39	24
61	23.98	3,229.18	1,537.99	2,671.78	2,104.89	283.45	60
62	10.39	2,010.57	41.17	93.14	67.15	12.99	7
82	4.96	1,320.29	41.57	136.38	88.98	23.70	12
90	22.87	9,686.29	40.33	487.41	263.87	111.77	8
Total	**11.53**	**941.87**	**4,756.83**	**6,614.16**	**5,685.50**	**464.33**	**373**
Northern Bering Sea							
70	5.68	1,329.71	239.52	661.09	450.31	105.39	39
71	3.90	1,011.38	152.79	481.51	317.15	82.18	47
81	3.85	614.86	100.56	194.88	147.72	23.58	18
Total	**4.60**	**682.42**	**643.76**	**1,186.60**	**915.18**	**135.71**	**104**

Wattled Eelpout (*Lycodes palearis*)

Between 2022 and 2023, the wattled eelpout biomass estimate increased by 80% in the eastern Bering Sea (Tables **112** and **110**; Fig. **95**) and the population was estimated at 105.2 million individuals (Tables **112** and **111**; Fig. **95**). The biomass estimate decreased by 2% in the northern Bering Sea and the population was estimated at 3.7 million individuals.

Table 112. -- Summary of catch location environmental variables and biomass and population estimates for wattled eelpout (*Lycodes palearis*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	141 of 376 (37.5%)	12 of 116 (10.3%)
Bottom Depth (m)	51 — 160	16 — 78
Bottom Temperature (°C)	-1.6 — 4.3	-1.6 — 8.4
Surface Temperature (°C)	3.3 — 11	8.9 — 15.1
Population	105.2 million	3.7 million
Biomass (t)	17,060	219
Biomass % Total	0.1%	<0.01%
Biomass % Change	80% increase from 2022	2% decrease from 2022

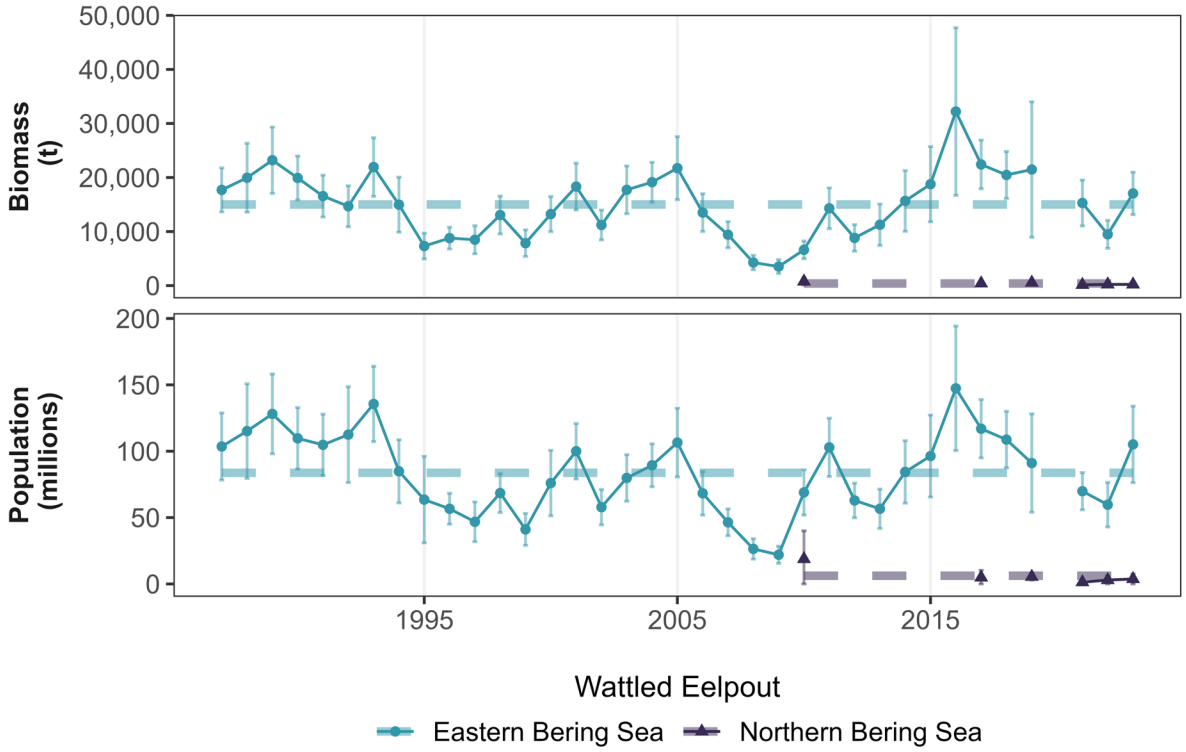

Figure 95. -- Time series of wattled eelpout (*Lycodes palearis*) biomass (t) and population (millions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

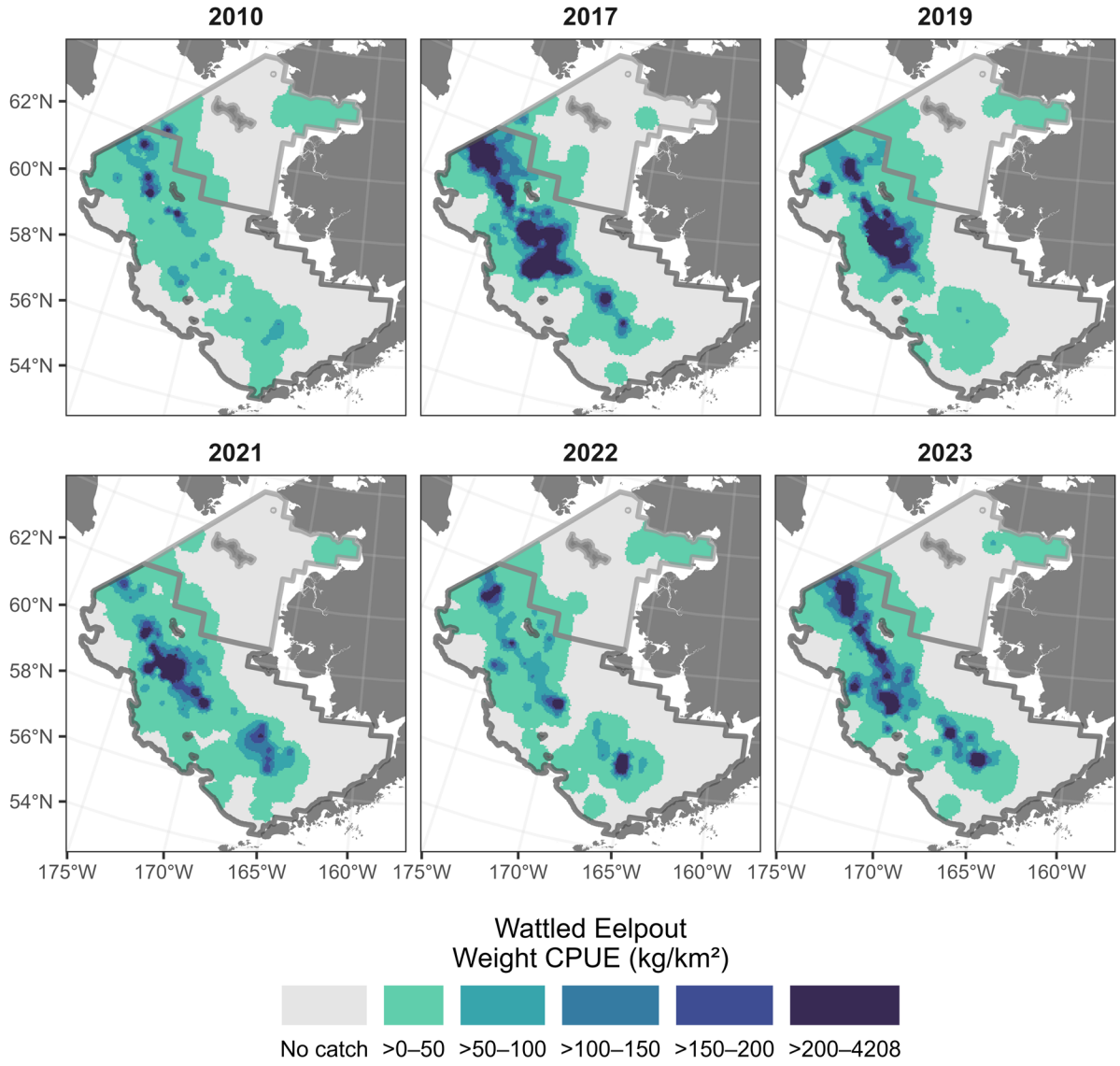

Figure 96. -- Weight CPUE (kg/km^2) distribution of wattled eelpout (*Lycodes palearis*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Yellow Irish Lord (*Hemilepidotus jordani*)

Between 2022 and 2023, the yellow Irish lord biomass estimate decreased by 19% in the eastern Bering Sea (Tables **113** and **114**; Fig. **97**) and the population was estimated at 29.4 million individuals (Tables **113** and **115**; Fig. **97**). The biomass estimate increased by 43% in the northern Bering Sea and the population was estimated at 46,609 individuals.

Table 113. -- Summary of catch location environmental variables and biomass and population estimates for yellow Irish lord (*Hemilepidotus jordani*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	61 of 376 (16.2%)	1 of 116 (0.9%)
Bottom Depth (m)	49 — 171	55
Bottom Temperature (°C)	-0.9 — 5.2	-0.1
Surface Temperature (°C)	4.2 — 10.3	9.2
Population	29.4 million	46,609
Biomass (t)	21,044	40
Biomass % Total	0.2%	<0.01%
Biomass % Change	19% decrease from 2022	43% increase from 2022

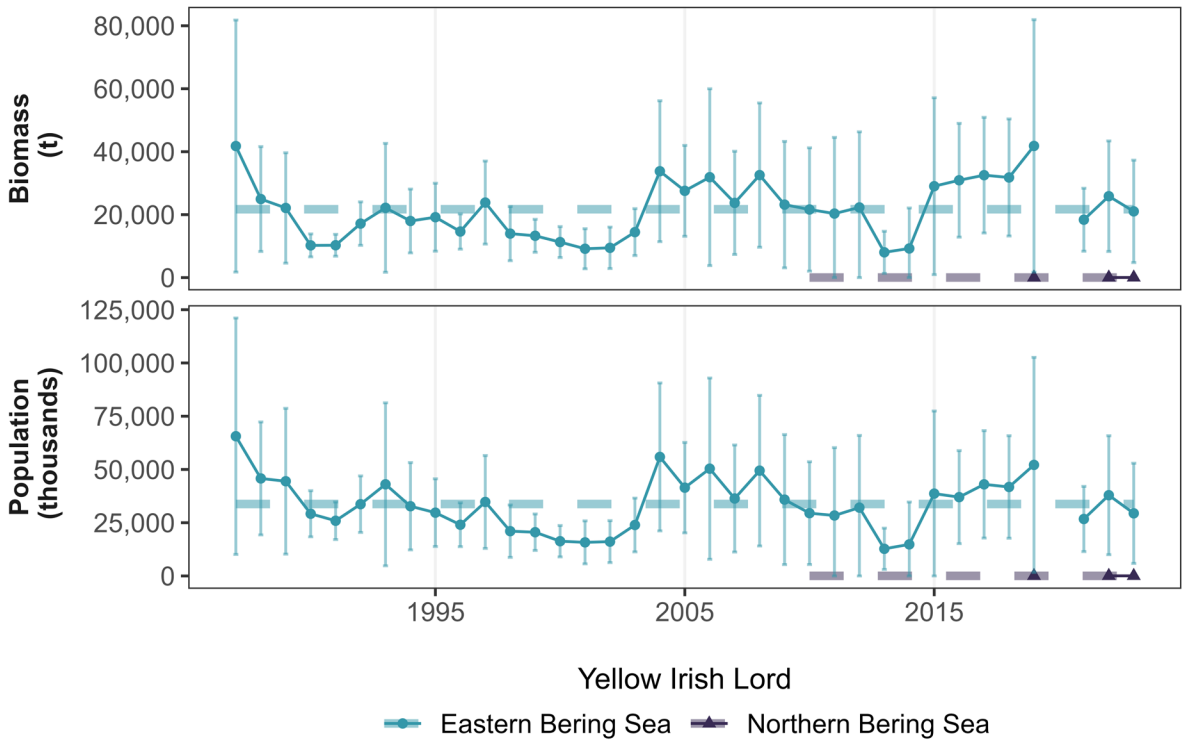

Figure 97. -- Time series of yellow Irish lord (*Hemilepidotus jordani*) biomass (t) and population (thousands) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

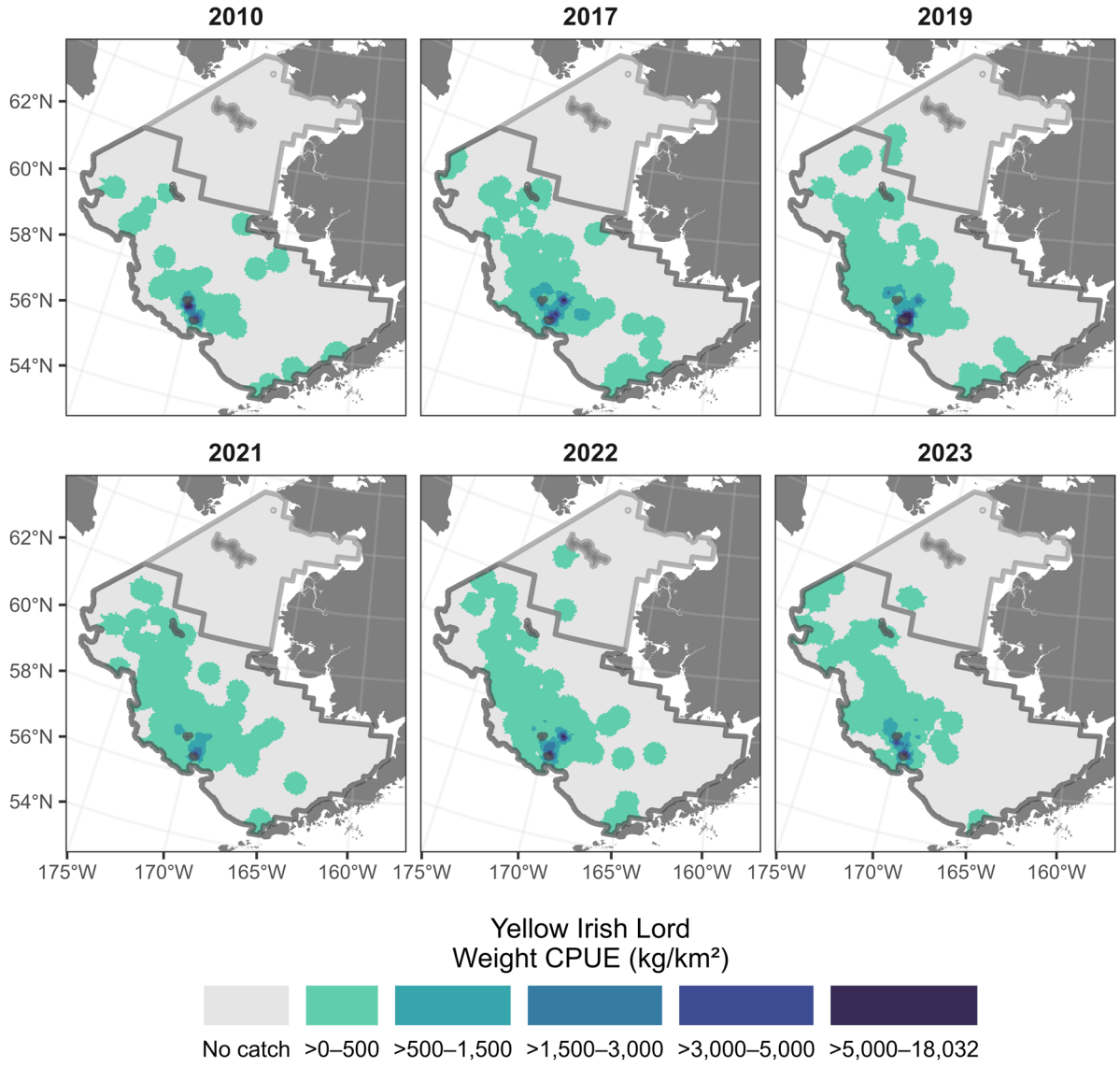

Figure 98. -- Weight CPUE (kg/km^2) distribution of yellow Irish lord (*Hemilepidotus jordani*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Table 114. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for yellow Irish lord (*Hemilepidotus jordani*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	8.09	7.03	768	668	0	2,105	4
32	820.59	791.60	7,260	7,003	0	21,266	3
41	9.52	7.30	593	455	0	1,504	8
42	470.51	166.93	11,350	4,027	3,297	19,403	20
43	5.74	2.75	121	58	5	237	9
50	5.80	5.80	221	221	0	662	1
61	8.00	3.97	702	349	5	1,400	13
62	1.99	1.30	13	8	0	30	2
82	-	-	-	-	-	-	-
90	1.40	1.40	16	16	0	48	1
Total	**42.69**	**16.49**	**21,044**	**8,129**	**4,786**	**37,303**	**61**
Northern Bering Sea							
70	-	-	-	-	-	-	-
71	-	-	-	-	-	-	-
81	1.03	1.03	40	40	0	119	1
Total	**0.20**	**0.20**	**40**	**40**	**0**	**119**	**1**

Table 115. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for yellow Irish lord (*Hemilepidotus jordani*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
31	8.72	7.30	0.00	2,215.81	828.65	693.58	4
32	1,240.52	1,202.52	0.00	32,251.25	10,974.52	10,638.36	3
41	17.11	12.18	0.00	2,584.43	1,065.95	759.24	8
42	613.95	202.18	5,056.04	24,563.72	14,809.88	4,876.92	20
43	20.93	7.54	123.32	758.26	440.79	158.73	9
50	6.70	6.70	0.00	765.01	255.00	255.00	1
61	10.82	4.55	151.04	1,748.43	949.74	399.35	13
62	7.54	5.10	0.00	114.57	48.72	32.93	2
82	-	-	-	-	-	-	-
90	2.55	2.55	0.00	88.37	29.46	29.46	1
Total	**59.64**	**23.85**	**5,885.21**	**52,920.23**	**29,402.72**	**11,758.75**	**61**
Northern Bering Sea							
70	-	-	-	-	-	-	-
71	-	-	-	-	-	-	-
81	1.22	1.22	0.00	139.83	46.61	46.61	1
Total	**0.23**	**0.23**	**0.00**	**139.83**	**46.61**	**46.61**	**1**

Yellowfin Sole (*Limanda aspera*)

Between 2022 and 2023, the yellowfin sole biomass estimate decreased by 32% in the eastern Bering Sea (Tables **116** and **117**; Fig. **99**) and the population was estimated at 5.6 billion individuals (Tables **116** and **118**; Fig. **99**). Similarly, the biomass estimate decreased by 28% in the northern Bering Sea and the population was estimated at 2.1 billion individuals.

In 2023, the yellowfin sole population in the eastern Bering Sea was distributed along the inner and middle domain between Norton Sound and the Alaska Peninsula, similar to previous years. The highest densities were observed along the Alaska coast south of Nunivak Island and along the Alaska Peninsula (Fig. **100**). High densities continue to be observed near Togiak Bay and the spawning grounds in Kuskokwim Bay and Bristol Bay. In the northern Bering Sea, the spatial distribution of yellowfin sole was similar to 2010 and 2017, with the densest aggregations east of St. Matthew Island, and to the east and south of St. Lawrence Island (Fig. **100**).

In 2023, the abundance-at-length in the eastern Bering Sea was more uniform than in previous years, with the size length mode at approximately 28 cm. In the northern Bering Sea, size length modes were observed around 11 cm, 17 cm, and 32 cm (Fig. **101**).

Yellowfin sole is a target of the largest commercial flatfish fishery in the world (Wilderbuer et al., 2018) and is the most abundant flatfish species in the eastern Bering Sea (Table **8**) and northern Bering Sea (Table **10**). The cross-shelf distribution of yellowfin sole, and the availability of sexually mature males and females to the summer bottom trawl survey, varies from year to year because of temperature-mediated differences in the timing of their spring-summer spawning migration into shallow waters (Nichol et al., 2019).

Most spawning activity occurs at bottom depths less than 30 m (Nichol, 1995). Size segregation among spawning and non-spawning portions of the population can also affect the spatial distribution of yellowfin sole (Nichol et al., 2019). This segregation occurs because length or age at sexual maturity differs for males and females (Nichol, 1998) and sexually immature individuals undergo a gradual (multi-year) ontogenetic migration away from the nearshore that differs from the annual spawning migrations of mature individuals (Nichol, 1997). Interannual differences in the proportion of the yellowfin sole population that is available to the eastern Bering Sea survey, as well as the sex and size composition of this available population, may bias survey estimates. The bottom temperature and the survey start date are both used in the stock assessment model to adjust the catchability (q) parameter (Wilderbuer et al., 2018; Nichol et al., 2019).

Table 116. -- Summary of catch location environmental variables and biomass and population estimates for yellowfin sole (*Limanda aspera*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	233 of 376 (62.0%)	108 of 116 (93.1%)
Bottom Depth (m)	20 — 102	12 — 70
Bottom Temperature (°C)	-1.6 — 5.4	-1.6 — 11.1
Surface Temperature (°C)	1.7 — 11	4.5 — 15.1
Population	5.6 billion	2.1 billion
Biomass (t)	1.4 million	393,305
Biomass % Total	11.8%	14.1%
Biomass % Change	32% decrease from 2022	28% decrease from 2022

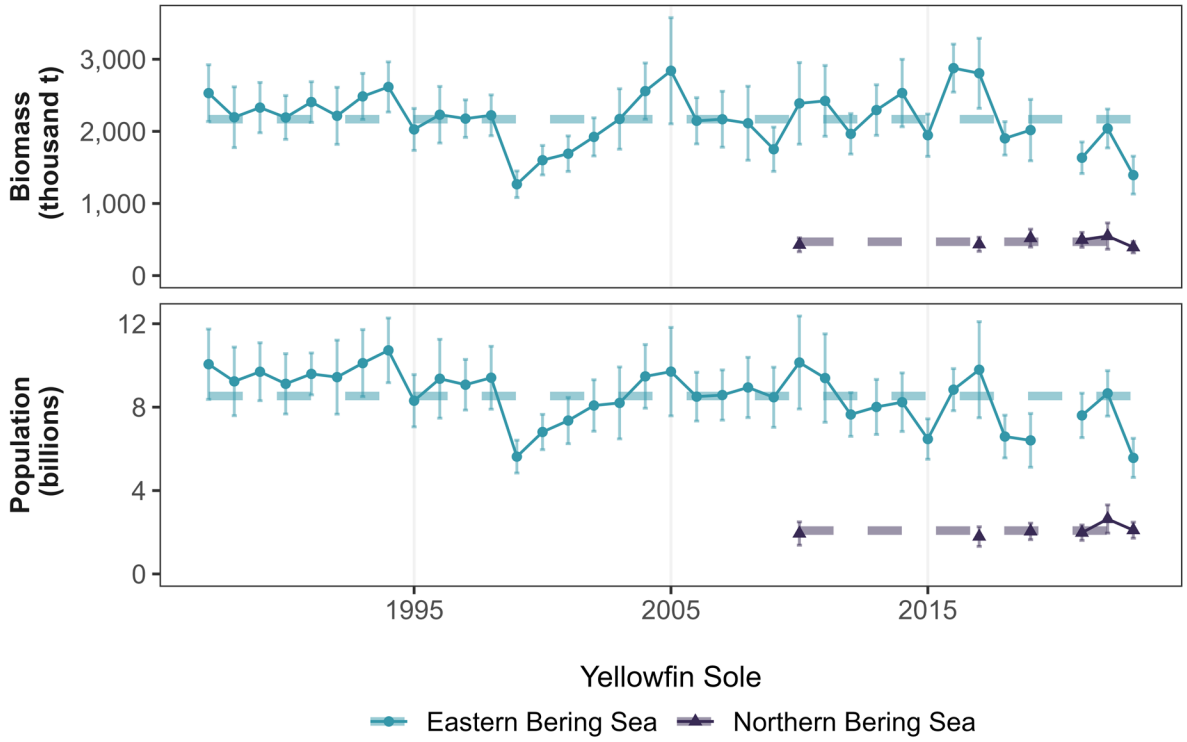

Figure 99. -- Time series of yellowfin sole (*Limanda aspera*) biomass (thousand t) and population (billions) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys. Dashed lines represent time series average and error bars represent estimated 95% confidence intervals.

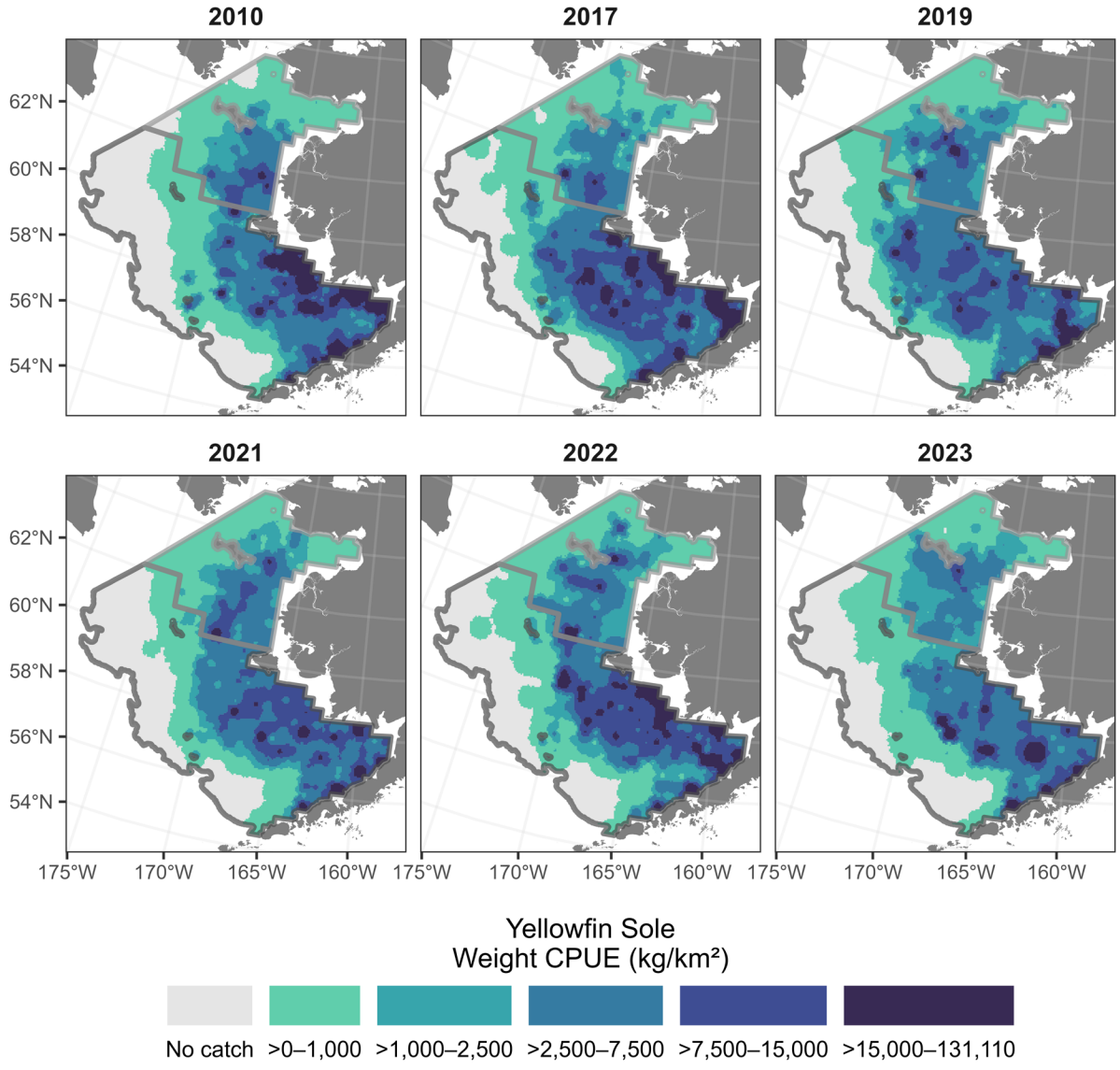

Figure 100. -- Weight CPUE (kg/km^2) distribution of yellowfin sole (*Limanda aspera*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

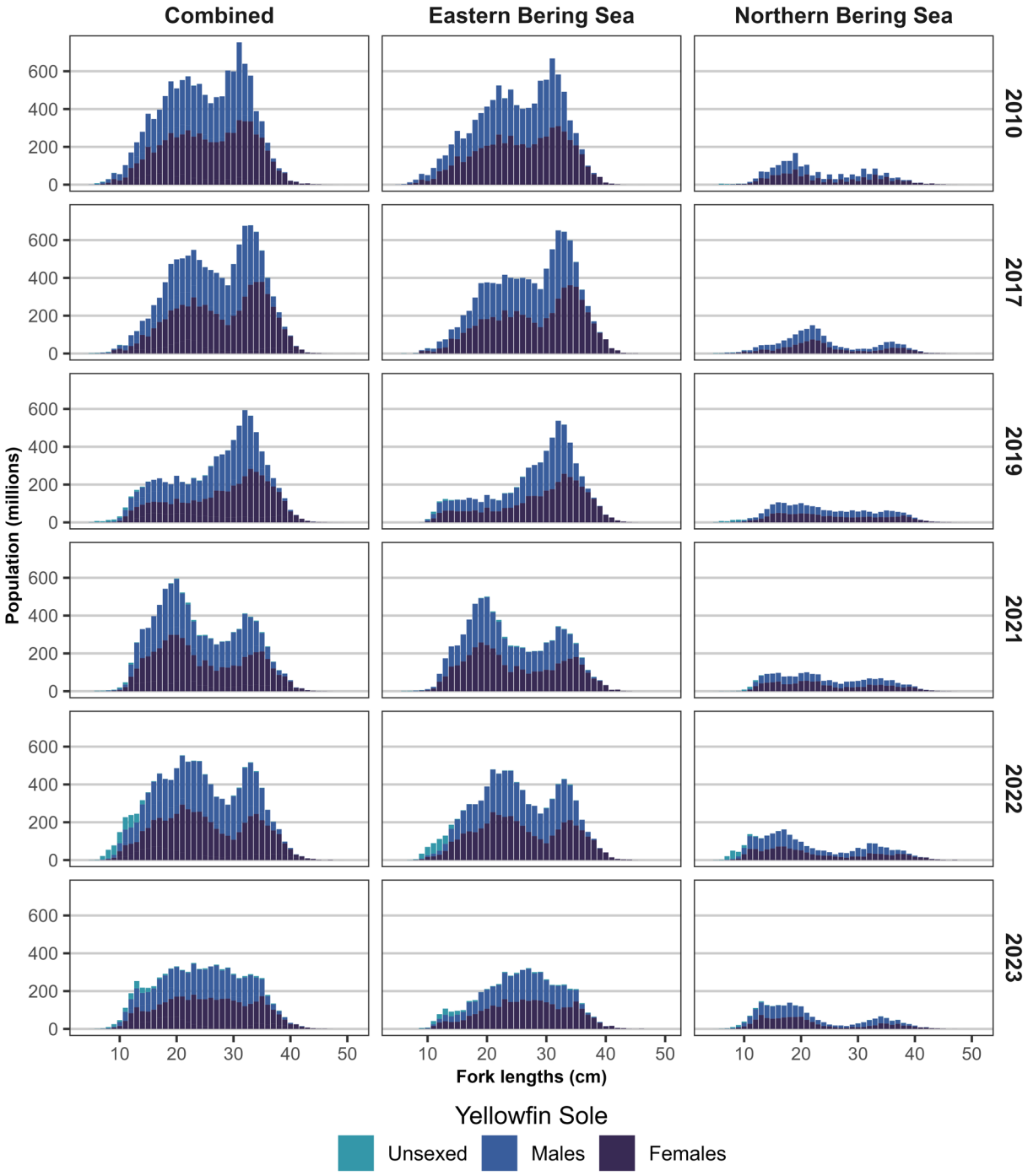

Figure 101. -- Total abundance-at-length estimates of yellowfin sole (*Limanda aspera*) by sex (unsexed, males, and females) in centimeters (cm) encountered during the 2010, 2017, 2019, and 2021-2023 eastern Bering Sea, northern Bering Sea, and combined eastern and northern Bering Sea shelf bottom trawl surveys. Length distributions are scaled up to the total estimated population size.

Table 117. -- Mean weight CPUE (kg/km²) with standard deviation (SD; kg/km²), estimated biomass (t) with SD (t), 95% lower (LCL; t) and upper (UCL; t) confidence limits, and number of hauls where species were weighed for yellowfin sole (*Limanda aspera*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (kg/km²)	CPUE SD (kg/km²)	Biomass (t)	Biomass SD (t)	95% LCL (t)	95% UCL (t)	Hauls w/weights
Eastern Bering Sea							
10	9,117.22	1,150.08	717,577	90,518	536,541	898,613	58
20	4,287.90	530.01	176,632	21,833	132,967	220,298	31
31	3,940.03	838.86	374,218	79,673	214,871	533,565	52
32	102.58	33.72	907	298	311	1,504	6
41	1,817.99	755.44	113,279	47,072	19,136	207,422	37
42	375.40	89.26	9,056	2,153	4,749	13,362	25
43	64.86	44.94	1,366	947	0	3,259	16
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	18.14	8.28	326	149	28	623	7
90	1.55	1.55	18	18	0	54	1
Total	**2,826.38**	**266.33**	**1,393,379**	**131,299**	**1,130,781**	**1,655,977**	**233**
Northern Bering Sea							
70	3,611.55	442.93	286,251	35,106	216,039	356,464	40
71	860.91	157.24	69,953	12,776	44,401	95,506	54
81	967.36	307.75	37,100	11,803	13,495	60,706	14
Total	**1,977.73**	**197.01**	**393,305**	**39,179**	**314,947**	**471,662**	**108**

Table 118. -- Mean number CPUE (no/km²) with standard deviation (SD; no/km²), estimated population (thousands) with SD (thousands), 95% lower (LCL; thousands) and upper (UCL; thousands) confidence limits, and number of hauls where species were counted for yellowfin sole (*Limanda aspera*) by stratum encountered during the 2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Stratum	CPUE mean (no/km²)	CPUE SD (no/km²)	95% LCL (K)	95% UCL (K)	Population (K)	Population SD (K)	Hauls w/counts
Eastern Bering Sea							
10	41,176.68	4,781.96	2,488,103.35	3,993,572.62	3,240,837.99	376,367.32	58
20	21,636.53	2,942.58	648,849.18	1,133,707.32	891,278.25	121,214.54	31
31	11,982.34	2,440.51	674,472.96	1,601,656.63	1,138,064.80	231,795.92	52
32	145.24	46.97	453.86	2,115.95	1,284.91	415.52	6
41	4,283.01	1,597.78	67,758.61	465,989.84	266,874.22	99,557.81	37
42	1,012.68	248.30	12,448.91	36,407.18	24,428.05	5,989.57	25
43	198.84	148.54	0.00	10,445.88	4,188.27	3,128.80	16
50	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-
82	32.27	14.33	64.88	1,093.83	579.36	257.24	7
90	5.22	5.22	0.00	180.73	60.24	60.24	1
Total	**11,293.53**	**951.49**	**4,629,444.00**	**6,505,748.17**	**5,567,596.08**	**469,076.04**	**233**
Northern Bering Sea							
70	16,068.94	1,785.62	990,565.73	1,556,679.10	1,273,622.42	141,528.34	40
71	8,738.95	1,498.77	466,518.79	953,648.82	710,083.80	121,782.51	54
81	3,012.16	1,113.57	30,107.24	200,937.07	115,522.16	42,707.46	14
Total	**10,555.95**	**963.13**	**1,716,160.88**	**2,482,295.87**	**2,099,228.38**	**191,533.75**	**108**

Data Sources

Groundfish Assessment Program's Bering Sea team and the Shellfish Assessment Program conduct the eastern Bering Sea bottom trawl survey each summer. The haul-level data collected from the survey are extrapolated to catch-per-unit-effort (CPUE), population-level abundance, population-level abundance by size class, and population-level biomass estimates. Those estimates are presented in this document, which was generated using R and R Markdown. R is a programming language and environment for statistical computing and graphics. R Markdown provides a framework for reproducible, transparent, and documentable report writing.

Many of the data sources and tools used to develop the figures and content of this document have been developed by members across the AFSC's Groundfish Assessment Program. These tools and public-serving data products aim to provide transparency and accessibility to Bering Sea ecosystem data. The *akgfmaps* R package (https://github.com/afsc-gap-products/akgfmaps), developed by Sean Rohan, was used for producing the species distribution plots and other maps in this document. The *coldpool* R package (https://github.com/afsc-gap-products/coldpool), developed by Sean Rohan and Lewis Barnett, uses reproducible interpolation techniques to better understand changes in surface temperature, bottom temperature, and the cold pool in the Bering Sea (Rohan et al., 2022). The *gapindex* R package (https://github.com/afsc-gap-products/gapindex), developed by Zack Oyafuso and Margaret Siple, calculates design-based indices of abundance and composition for all AFSC Groundfish Assessment Program bottom trawl surveys.

The catch, environmental, and location data collected and calculated from the survey can be directly accessed and downloaded from the Fisheries One Stop Shop data platform (FOSS; https://www.fisheries.noaa.gov/foss; NOAA Fisheries Alaska Fisheries Science Center (2024)). The FOSS web-based data portal allows users to select, view, and download data from the eastern Bering Sea shelf survey, northern Bering Sea survey, and other surveys conducted by AFSC's Resource Assessment and Conservation Engineering Division. The catch, environmental, location data and biomass, population, size composition, and age composition estimates collected and calculated from the survey can be accessed and downloaded from the Alaska Fisheries Information Network (AKFIN; https://www.psmfc.org/program/alaska-fisheries-information-network-akfin; Alaska Fisheries Information Network (AKFIN), 2024) with a user log in provided by AKFIN. Data from NOAA surveys are used in the NOAA Fisheries Distribution Mapping and Analysis Portal (DisMAP; https://apps-st.fisheries.noaa.gov/dismap) that provides public access to maps and other information about the distributions of marine species in U.S. Marine Ecosystems.

For results previous surveys, please refer to the AFSC technical memoranda listed on the NOAA (https://repository.library.noaa.gov/) and AFSC websites (https://www.fisheries.noaa.gov/resource/publication-database/alaska-fisheries-science-center-technical-memorandums and https://www.fisheries.noaa.gov/alaska/science-data/groundfish-assessment-program-bottom-trawl-surveys).

To learn more about the sustained participation of fishing communities that are substantially dependent on or engaged in North Pacific groundfish and crab fisheries, please review the AFSC's Annual Community Engagement and Participation Overview (ACEPO) for Federal Groundfish and Crab Fisheries of the North Pacific (https://shinyfin.psmfc.org/acepo/). Additionally, the AFSC's Human Dimensions of Fisheries Data Explorer (https://reports.psmfc.org/akfin) provides access to data, data visualizations, and other tools for understanding the economic and socio-cultural dimensions of Alaska fisheries.

Acknowledgments

Recognition and appreciation are extended to the captains and crew of the FV *Alaska Knight* and FV *Northwest Explorer*. Without their expertise, goodwill, and sacrifice, this survey would not be possible. Thank you to United States Seafoods and B&N Fisheries Company for making the vessels available and always maintaining safety as a top priority. Great appreciation is also extended to all the scientists, researchers, contractors, interns, and volunteers who worked tirelessly aboard each vessel to complete the survey in a safe and successful manner. Thanks also to Norton Sound Economic Development Corporation and Kawerak, Inc. The survey would not have been possible without the major contributions from other AFSC groups including the net shed, the research survey support team, the data management group, and the administrative team. A huge thank you is given to Zack Oyafuso and Margaret Siple for the creation of the gapindex R package and to Zack Oyafuso, specifically, for helping to write and edit the data changes section of the appendix. This section is critical for data users to know how data has been changed and updated in a transparent and documentable format. Finally, appreciation is extended to Thaddaeus Buser, Rebecca Haehn, and Emily Ryznar for reviewing this document. Their excellent comments and suggestions greatly improved this work.

We would like to thank the many communities of the Bering Strait region and their members who have helped contribute to this document. The knowledge, experiences, and insights of the people of the Bering Strait region have been instrumental in expanding the scope of our science and knowledge to encompass the many issues that face this important ecosystem. We appreciate feedback from those residing in the region who are willing to share their insights, including identifying species of interest or concern that should be included in this document and participating in an open dialog about how we can improve our collective knowledge of the ecosystem and the region.

NOAA Fisheries Alaska Fisheries Science Center's work is conducted in the waters and along the coastlines of Alaska, which include the traditional homelands and waters of the Inupiat, Yupiit, Siberian Yupiit, Unangax, Alutiiq/Sugpiaq, Eyak, Dena'ina Athabascan, Tlingit, Haida, and Tsimshian who have stewarded their lands and waters since time immemorial. We are indebted to these peoples for their wisdom and knowledge of their lands and waters.

This document was prepared in the greater Seattle area, which is located on the traditional lands of the Coast Salish people, including the Duwamish people, past and present. We are grateful for their continued sharing of vision, wisdom, values, and leadership.

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Appendix A: List of taxa encountered in the eastern Bering Sea

Appendix A lists all fish and invertebrate taxa taken during the AFSC's eastern Bering Sea bottom trawl survey.

List of Tables

- Appendix **A 119**: Fish taxa encountered during the 2023 eastern Bering Sea bottom trawl survey listed alphabetically by family.
- Appendix **A 120**: Invertebrate taxa encountered during the 2023 eastern Bering Sea bottom trawl survey listed alphabetically by phylum.

Appendix Table A 119.-- Fish taxa encountered during the 2023 eastern Bering Sea bottom trawl survey listed alphabetically by family.

Family	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
Agonidae	Agonidae	poacher unid.	2	93	108	100.5	59.3	59.8
	Aspidophoroides monopterygius	Aleutian alligatorfish	40	49	118	72.2	56.3	60.2
	Aspidophoroides olrikii	Arctic alligatorfish	1	59	59	59.0	60.3	60.3
	Bathyagonus alascanus	gray starsnout	1	85	85	85.0	56.3	56.3
	Bathyagonus infraspinatus	spinycheek starsnout	2	100	105	102.5	56.0	56.7
	Occella dodecaedron	Bering poacher	25	19	84	39.5	56.3	60.3
	Pallasina barbata	tubenose poacher	1	20	20	20.0	59.3	59.3
	Percis japonica	dragon poacher	3	119	145	135.7	60.3	61.0
	Podothecus accipenserinus	sturgeon poacher	211	19	158	59.6	55.0	60.3
	Podothecus veternus	veteran poacher	3	52	89	69.7	56.3	61.0
	Sarritor frenatus	sawback poacher	50	65	153	99.9	54.8	62.0
Ammodytidae	*Ammodytes* sp.	sand lance unid.	9	20	45	33.8	57.6	60.0
Anarhichadidae	*Anarhichas orientalis*	Bering wolffish	6	23	34	28.8	58.3	60.3
Anoplopomatidae	*Anoplopoma fimbria*	sablefish	29	28	155	90.9	54.8	57.4
Arhynchobatidae	*Bathyraja aleutica*	Aleutian skate	25	90	158	125.6	54.8	59.3
	Bathyraja aleutica egg case	Aleutian skate egg case	3	52	100	71.7	56.3	58.3
	Bathyraja interrupta	Bering skate	103	68	169	113.6	54.7	61.0
	Bathyraja interrupta egg case	Bering skate egg case	11	85	158	128.2	54.8	58.7
	Bathyraja maculata	whiteblotched skate	1	134	134	134.0	55.7	55.7
	Bathyraja taranetzi	mud skate	2	134	158	146.0	59.0	60.7
Bathymasteridae	*Bathymaster signatus*	searcher	34	77	169	125.4	54.7	60.7
Clupeidae	*Clupea pallasii*	Pacific herring	124	20	114	59.7	55.3	62.0
Cottidae	*Artediellus miacanthus*	bride sculpin	1	125	125	125.0	58.7	58.7
	Artediellus pacificus	hookhorn sculpin	5	68	71	69.4	56.7	57.7
	Artediellus sp.		2	68	107	87.5	56.3	57.5
	Gymnocanthus galeatus	armorhead sculpin	4	77	119	93.5	56.3	56.8
	Gymnocanthus pistilliger	threaded sculpin	32	19	117	34.3	55.0	60.7
	Hemilepidotus jordani	yellow Irish lord	61	47	169	86.0	55.0	61.3
	Hemilepidotus papilio	butterfly sculpin	3	57	59	57.7	60.2	60.4
	Icelinus sp.		2	68	105	86.5	57.3	57.7
	Icelus sp.		3	67	148	95.0	56.3	58.0

Family	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Icelus spatula	spatulate sculpin	37	57	158	78.8	57.0	60.3
	Icelus spiniger	thorny sculpin	60	79	169	119.0	54.8	61.7
	Myoxocephalus jaok	plain sculpin	97	19	72	40.9	56.3	61.3
	Myoxocephalus polyacanthocephalus	great sculpin	179	19	169	71.8	55.0	61.7
	Myoxocephalus scorpius	shorthorn (=warty) sculpin	12	42	87	60.2	57.5	60.7
	Triglops macellus	roughspine sculpin	12	59	148	105.8	55.0	60.3
	Triglops pingelii	ribbed sculpin	23	33	146	65.9	55.0	60.2
	Triglops scepticus	spectacled sculpin	6	140	158	149.2	54.8	58.7
Cryptacanthodidae	*Cryptacanthodes aleutensis*	dwarf wrymouth	2	125	133	129.0	55.7	55.7
Gadidae	*Boreogadus saida*	Arctic cod	1	58	58	58.0	61.0	61.0
	Eleginus gracilis	saffron cod	4	24	30	26.5	59.0	60.3
	Gadus chalcogrammus	walleye pollock	374	19	169	78.4	54.7	62.0
	Gadus macrocephalus	Pacific cod	361	19	169	77.7	54.7	62.0
Hemitripteridae	*Hemitripterus bolini*	bigmouth sculpin	69	68	155	111.2	54.8	61.0
Hexagrammidae	*Hexagrammos stelleri*	whitespotted greenling	9	20	45	31.0	56.7	59.3
	Pleurogrammus monopterygius	Atka mackerel	1	51	51	51.0	57.3	57.3
Liparidae	*Careproctus phasma*	monster snailfish	27	67	145	110.7	58.7	62.0
	Careproctus scottae	peachskin snailfish	33	71	145	109.1	59.0	62.0
	Careproctus sp.		1	106	106	106.0	58.3	58.3
	Liparis bathyarcticus	nebulous snailfish	1	78	78	78.0	59.8	59.8
	Liparis gibbus	variegated snailfish	25	33	145	89.7	57.0	62.0
	Liparis sp.		4	42	57	51.0	56.3	60.4
Osmeridae	*Mallotus villosus*	Pacific capelin	47	19	127	39.3	56.3	62.0
	Thaleichthys pacificus	eulachon	16	23	146	107.3	55.3	58.3
Pleuronectidae	*Atheresthes evermanni*	Kamchatka flounder	173	34	169	101.5	54.7	61.7
	Atheresthes sp.		1	102	102	102.0	58.0	58.0
	Atheresthes stomias	arrowtooth flounder	227	35	169	96.3	54.7	61.7
	Glyptocephalus zachirus	rex sole	88	52	169	111.6	54.8	59.7
	Hippoglossoides elassodon	flathead sole	308	28	169	86.3	54.7	62.0
	Hippoglossoides robustus	Bering flounder	60	42	126	78.2	58.7	62.0

Family	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Hippoglossus stenolepis	Pacific halibut	278	19	169	72.9	54.7	61.3
	Isopsetta isolepis	butter sole	23	34	80	57.2	54.7	58.0
	Lepidopsetta bilineata	southern rock sole	6	51	80	66.7	54.7	55.7
	Lepidopsetta polyxystra	northern rock sole	303	19	169	69.1	54.7	62.0
	Limanda aspera	yellowfin sole	233	19	100	57.3	54.7	62.0
	Limanda sakhalinensis	Sakhalin sole	5	42	63	52.2	60.0	62.0
	Microstomus pacificus	Dover sole	11	52	153	93.0	54.8	57.3
	Myzopsetta proboscidea	longhead dab	44	19	52	32.2	57.7	60.3
	Parophrys vetulus	English sole	1	51	51	51.0	55.7	55.7
	Platichthys stellatus	starry flounder	63	19	74	38.7	55.4	60.3
	Platichthys stellatus X Pleuronectes quadrituberculatus hybrid	hybrid starry flounder X Alaska plaice	1	26	26	26.0	59.3	59.3
	Pleuronectes quadrituberculatus	Alaska plaice	242	19	118	59.5	54.7	62.0
	Psettichthys melanostictus	sand sole	1	51	51	51.0	55.7	55.7
	Reinhardtius hippoglossoides	Greenland turbot	40	72	158	108.0	56.7	61.7
Psychrolutidae	*Dasycottus setiger*	spinyhead sculpin	64	52	155	114.1	55.0	60.3
	Eurymen gyrinus	smoothcheek sculpin	1	72	72	72.0	60.0	60.0
	Malacocottus zonurus	darkfin sculpin	2	138	139	138.5	60.0	60.0
	Psychrolutes sp.		1	97	97	97.0	56.7	56.7
Rajidae	*Arctoraja parmifera*	Alaska skate	351	19	169	79.0	54.7	62.0
	Arctoraja parmifera egg case	Alaska skate egg case	37	38	155	106.1	54.8	60.3
	Beringraja binoculata	big skate	15	48	94	71.1	54.7	57.1
	Beringraja rhina	longnose skate	2	105	128	116.5	55.0	56.0
	Raja sp.	Raja sp. egg case	1	153	153	153.0	54.8	54.8
Salmonidae	*Oncorhynchus gorbuscha*	pink salmon	1	119	119	119.0	56.3	56.3
	Oncorhynchus tshawytscha	chinook salmon	1	130	130	130.0	55.3	55.3
Sebastidae	*Sebastes aleutianus*	rougheye rockfish	3	127	155	140.0	55.0	56.3
	Sebastes alutus	Pacific ocean perch	13	66	158	129.7	54.8	58.3
	Sebastes melanostictus	blackspotted rockfish	1	128	128	128.0	55.0	55.0

Family	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Sebastes polyspinis	northern rockfish	5	100	140	124.4	55.0	57.3
	Sebastes sp.	white spotted red rockfish unid.	1	117	117	117.0	57.7	57.7
	Sebastes variabilis	dusky rockfish	1	153	153	153.0	54.8	54.8
Somniosidae	*Somniosus pacificus*	Pacific sleeper shark	1	107	107	107.0	55.7	55.7
Stichaeidae	*Anisarchus medius*	stout eelblenny	1	79	79	79.0	62.0	62.0
	Leptoclinus maculatus	daubed shanny	11	72	118	92.9	56.3	60.7
	Lumpenus fabricii	slender eelblenny	3	28	105	72.7	56.3	59.0
	Lumpenus sagitta	snake prickleback	1	52	52	52.0	55.4	55.4
	Poroclinus rothrocki	whitebarred prickleback	10	105	146	127.3	55.3	58.7
Trichodontidae	*Trichodon trichodon*	Pacific sandfish	4	23	36	32.0	56.7	58.3
Zaproridae	*Zaprora silenus*	prowfish	4	95	155	120.8	55.0	60.3
Zoarcidae	*Lycodes brevipes*	shortfin eelpout	108	64	169	109.3	55.0	62.0
	Lycodes palearis	wattled eelpout	141	49	158	87.3	55.3	62.0
	Lycodes raridens	marbled eelpout	1	90	90	90.0	62.0	62.0
Other	*Rajiformes* egg case	skate egg case unid.	4	52	141	97.8	55.0	57.3

Appendix Table A 120.-- Invertebrate taxa encountered during the 2023 eastern Bering Sea bottom trawl survey listed alphabetically by phylum.

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
Annelida	*Aphrodita negligens*		2	96	105	100.5	56.7	59.0
	Aphroditidae	sea mouse unid.	33	93	169	129.0	55.0	61.0
	Chaetopterus sp.	parchment tubeworms	1	127	127	127.0	59.0	59.0
	Eunoe depressa	depressed scale worm	78	34	158	80.9	56.3	61.7
	Eunoe nodosa	giant scale worm	94	28	169	83.0	56.0	62.0
	Eunoe sp.		8	64	130	84.5	55.3	57.3
	Hirudinea	leech unid.	1	64	64	64.0	61.0	61.0
	Nothria conchylega	gravel tube worm	3	61	67	64.7	58.0	59.3
	Notostomum cyclostomum	striped sea leech	8	53	134	81.9	57.8	60.2
	Polychaeta	polychaete worm unid.	3	35	74	60.3	56.7	61.3
	Polychaeta tubes		3	120	146	133.7	55.3	57.0
	Serpula columbiana	red trumpet calcareous tubeworm	5	133	155	143.8	55.0	56.3
	Sipuncula	peanut worm unid.	7	35	131	87.7	57.3	62.0
Arthropoda	Amphipoda	amphipod unid.	3	57	72	63.3	57.0	60.2
	Argis sp.		65	20	153	98.5	54.8	62.0
	Chionoecetes bairdi	Tanner crab	249	28	169	90.7	54.8	61.0
	Chionoecetes hybrid	hybrid Tanner crab	106	45	169	87.9	56.3	61.3
	Chionoecetes opilio	snow crab	239	41	169	89.2	55.3	62.0
	Chirona evermanni	giant barnacle	6	52	118	92.5	55.3	60.3
	Cirripedia		4	69	149	104.8	56.0	57.5
	Crangon sp.		118	20	155	84.5	55.0	62.0
	Elassochirus cavimanus	purple hermit	21	59	158	115.6	54.8	59.0
	Elassochirus tenuimanus	widehand hermit crab	4	51	77	60.2	55.0	57.3
	Erimacrus isenbeckii	horsehair crab	58	34	74	53.1	56.7	61.7
	Eualus barbatus	barbed eualid	1	146	146	146.0	55.3	55.3
	Eualus gaimardii	circumpolar eualid	1	79	79	79.0	62.0	62.0
	Eualus macilentus	Greenland shrimp	1	79	79	79.0	62.0	62.0
	Eualus sp.		2	61	64	62.5	61.0	61.0
	Gammaridae	gammarid amphipod unid.	1	85	85	85.0	61.3	61.3
	Glebocarcinus oregonensis	Oregon rock crab	14	53	99	74.6	55.3	57.7

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Heptacarpus flexus	slenderbeak coastal shrimp	2	61	72	66.5	60.0	61.0
	Hyas coarctatus	circumboreal toad crab	78	32	114	56.6	57.3	62.0
	Hyas lyratus	Pacific lyre crab	105	35	158	82.2	54.8	60.7
	Isopoda	isopod unid.	7	52	155	91.7	55.0	59.3
	Labidochirus splendescens	splendid hermit	146	34	169	79.5	54.8	62.0
	Lebbeus groenlandicus	spiny lebbeid	2	57	59	58.0	60.2	60.3
	Metacarcinus magister	Dungeness crab	1	52	52	52.0	55.4	55.4
	Oregonia gracilis	graceful decorator crab	35	31	118	57.0	55.0	59.0
	Pagurus aleuticus	Aleutian hermit	145	52	169	97.3	54.8	60.0
	Pagurus brandti	sponge hermit	1	67	67	67.0	58.3	58.3
	Pagurus capillatus	hairy hermit crab	175	23	152	77.6	55.0	60.3
	Pagurus confragosus	knobbyhand hermit	93	61	158	102.4	54.8	59.3
	Pagurus ochotensis	Alaskan hermit	114	19	99	46.1	54.7	60.3
	Pagurus rathbuni	longfinger hermit	102	58	169	98.0	57.0	62.0
	Pagurus sp.		1	64	64	64.0	57.8	57.8
	Pagurus trigonocheirus	fuzzy hermit crab	161	36	169	82.3	54.8	62.0
	Pandalidae	pandalid shrimp unid.	2	84	89	86.5	57.7	61.0
	Pandalus eous	Alaskan pink shrimp	97	73	169	117.7	54.8	61.7
	Pandalus goniurus	humpy shrimp	12	28	133	66.3	55.7	62.0
	Pandalus jordani	ocean shrimp	2	79	128	103.5	55.0	62.0
	Pandalus sp.		1	38	38	38.0	58.2	58.2
	Paralithodes camtschaticus	red king crab	111	23	135	51.2	55.4	60.3
	Paralithodes platypus	blue king crab	17	42	93	70.4	56.8	60.7
	Spirontocaris lamellicornis	Dana blade shrimp	2	133	146	139.5	55.3	55.7
	Spirontocaris sp.		1	90	90	90.0	62.0	62.0
	Telmessus cheiragonus	helmet crab	18	19	35	27.3	57.0	60.3
	Thoracica	barnacle unid.	14	24	158	86.7	57.0	60.4
Brachiopoda	Brachiopoda	lampshell unid.	2	58	96	77.0	60.7	60.7
Bryozoa	*Alcyonidium disciforme*	disc bryozoan	1	55	55	55.0	60.2	60.2
	Bryozoa	bryozoan unid.	41	20	141	69.9	55.0	61.7
	Dendrobeania sp.		4	53	81	68.5	56.6	58.3

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Flustrellidra corniculata		1	68	68	68.0	57.3	57.3
	Rhamphostomella costata	ribbed bryozoan	5	66	149	86.2	56.0	58.0
	Serratiflustra serrulata	leafy bryozoan	6	46	100	66.0	56.4	60.0
Chordata	*Aplidium* sp.		10	44	139	63.0	57.0	60.4
	Ascidiacea	tunicate unid.	3	42	67	50.7	57.7	58.7
	Boltenia ovifera	sea onion	62	23	94	55.6	56.7	60.4
	Boltenia sp.		1	58	58	58.0	59.3	59.3
	Halocynthia aurantium	sea peach	21	45	134	69.1	57.0	61.7
	Halocynthia sp.	sea peach unid.	16	52	72	65.1	57.2	60.7
	Styela rustica	sea potato	74	37	83	61.2	57.0	61.0
Cnidaria	Actiniaria	sea anemone unid.	73	28	158	96.7	55.0	62.0
	Aequorea sp.		3	134	146	139.3	55.3	55.7
	Aurelia limbata	brown rimmed jelly	26	37	99	64.1	58.0	60.7
	Aurelia sp.		1	131	131	131.0	56.0	56.0
	Balticina willemoesi		9	47	140	103.2	56.7	57.7
	Chrysaora melanaster		291	28	169	83.6	55.0	62.0
	Chrysaora sp.	chrysaora jelly	4	93	105	98.8	57.7	58.3
	Cyanea capillata	lion's mane jelly	3	132	138	134.3	55.3	56.0
	Gersemia rubiformis		9	24	71	57.7	57.0	60.0
	Gersemia sp.	sea raspberry	54	34	99	62.7	56.3	62.0
	Hydroidolina	hydroid unid.	33	23	138	64.5	55.0	60.7
	Hydrozoa		3	52	69	58.0	57.5	59.0
	Liponema brevicorne	tentacle-shedding anemone	36	70	169	124.7	55.0	60.7
	Metridium farcimen	gigantic anemone	29	35	143	71.3	55.3	58.3
	Metridium sp.		64	28	155	69.3	55.0	60.3
	Pennatuloidea	sea whip or sea pen unid.	15	94	155	110.9	55.0	57.0
	Phacellophora camtschatica	egg yolk jelly	2	118	127	122.5	55.3	56.3
	Scyphozoa	jellyfish unid.	27	23	143	66.3	55.7	60.3
	Stomphia coccinea	swimming anemone	3	65	76	70.7	57.0	62.0
	Stomphia sp.		20	66	158	108.2	58.3	60.3
	Urticina crassicornis	mottled anemone	11	28	99	64.4	55.3	57.4
	Urticina sp.		47	29	169	97.6	55.0	60.7
Echinodermata	*Asterias amurensis*	purple-orange sea star	251	19	148	62.7	54.7	61.0
	Ceramaster japonicus	red bat star	1	155	155	155.0	55.0	55.0
	Ceramaster sp.		3	116	153	129.0	54.8	55.7
	Crossaster papposus	rose sea star	25	55	153	80.0	54.8	61.0

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Crossaster sp.		1	67	67	67.0	60.0	60.0
	Ctenodiscus crispatus	common mud star	74	74	169	113.9	55.3	61.7
	Ctenodiscus sp.		1	107	107	107.0	56.3	56.3
	Cucumaria fallax	sea football	10	35	82	60.0	56.3	58.0
	Cucumaria sp.		7	59	76	67.1	56.3	57.3
	Diplopteraster multipes	pincushion sea star	4	135	158	145.5	56.0	58.3
	Dipsacaster borealis	northern sea star	2	120	135	127.5	56.7	57.0
	Dipsacaster sp.		2	118	153	135.5	54.8	55.3
	Echinacea	sea urchin unid.	1	119	119	119.0	57.3	57.3
	Echinarachnius parma	parma sand dollar	9	28	127	75.2	55.0	61.0
	Evasterias echinosoma	giant sea star	26	33	93	62.6	55.7	59.8
	Evasterias troschelii	mottled sea star	1	68	68	68.0	57.5	57.5
	Gorgonocephalus eucnemis	basketstar	238	28	158	79.4	55.0	62.0
	Henricia sp.		28	41	158	103.7	54.8	60.7
	Holothuroidea	sea cucumber unid.	4	67	143	104.0	56.0	58.0
	Leptasterias arctica		94	37	143	74.8	56.6	62.0
	Leptasterias groenlandica		2	71	80	75.5	58.7	58.7
	Leptasterias polaris		144	38	158	90.1	56.4	62.0
	Leptasterias sp.		1	134	134	134.0	59.7	59.7
	Leptychaster anomalus		21	85	152	118.0	55.0	59.7
	Leptychaster sp.		1	149	149	149.0	56.0	56.0
	Lethasterias nanimensis	blackspined sea star	89	47	152	83.5	56.0	60.7
	Mediaster aequalis	vermilion sea star	4	133	158	144.2	58.3	59.0
	Odontohenricia sp.		2	79	158	118.5	57.0	58.3
	Ophiopholis japonica		1	67	67	67.0	57.7	57.7
	Ophiophthalmus cataleimmoidus		2	67	114	90.5	57.7	58.3
	Ophiura sarsii	notched brittlestar	94	58	138	84.3	55.3	62.0
	Ophiura sp.		4	58	74	66.0	56.7	57.7
	Ophiuroidea	brittlestar unid.	13	55	100	66.1	56.7	59.7
	Pedicellaster magister	majestic sea star	1	118	118	118.0	55.3	55.3
	Pseudarchaster parelii	scarlet sea star	4	118	149	135.5	55.3	56.3
	Pseudarchaster sp.		3	116	140	130.3	55.7	57.0
	Psolus fabricii	brownscaled sea cucumber	1	72	72	72.0	60.0	60.0
	Pteraster obscurus	obscure sea star	39	62	158	102.1	57.0	62.0

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Pteraster tesselatus		3	127	153	143.0	54.8	56.3
	Pycnopodia helianthoides	sunflower sea star	2	52	77	64.5	55.3	55.4
	Solaster endeca	northern sun sea star	1	77	77	77.0	56.7	56.7
	Solaster sp.		4	57	153	81.5	54.8	60.4
	Stephanasterias albula		1	131	131	131.0	59.0	59.0
	Strongylocentrotus droebachiensis	green sea urchin	48	34	158	107.4	55.0	61.0
	Strongylocentrotus fragilis	orange-pink sea urchin	1	134	134	134.0	55.7	55.7
	Strongylocentrotus pallidus		4	127	149	139.5	55.7	56.3
	Strongylocentrotus sp.		14	33	153	77.9	54.8	58.3
Mollusca	*Aforia circinata*	keeled Aforia	33	82	158	118.3	55.0	61.3
	Aforia sp.		2	105	115	110.0	57.0	60.7
	Arctomelon sp.		2	118	153	135.5	54.8	55.3
	Astarte sp.		2	127	149	138.0	56.0	56.3
	Aulacofusus brevicauda	thick-ribbed whelk	1	93	93	93.0	56.7	56.7
	Aulacofusus herendeeni	thin-ribbed whelk	2	118	124	121.0	59.0	59.3
	Bathypolypus sp.		3	100	143	120.7	56.7	57.7
	Beringius behringii	Bering beringius	49	53	169	105.2	55.0	61.3
	Beringius sp.		18	43	133	89.1	55.3	60.2
	Beringius stimpsoni		3	49	85	66.0	57.7	60.1
	Berryteuthis magister	magistrate armhook squid	1	153	153	153.0	54.8	54.8
	Bivalvia	bivalve unid.	5	37	90	72.6	56.7	62.0
	Boreotrophon alaskanus	Alaskan trophon	1	110	110	110.0	60.3	60.3
	Boreotrophon beringi	Bering trophon	1	158	158	158.0	60.7	60.7
	Boreotrophon sp.		1	100	100	100.0	59.5	59.5
	Buccinidae		1	62	62	62.0	57.3	57.3
	Buccinum angulosum	angular whelk	72	58	145	94.6	57.0	62.0
	Buccinum angulosum transliratum	transect whelk	1	81	81	81.0	58.3	58.3
	Buccinum oedematum	swollen whelk	9	66	124	87.7	57.8	60.7
	Buccinum plectrum	sinuous whelk	39	28	158	95.1	54.8	61.0
	Buccinum polare	polar whelk	60	52	143	75.9	56.7	62.0
	Buccinum scalariforme	ladder whelk	129	42	169	97.7	54.8	62.0
	Buccinum sp.		17	38	120	76.9	54.7	61.7
	Capulidae		2	68	96	82.0	58.0	59.0

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Chlamys sp.		3	59	86	75.0	55.7	60.3
	Ciliatocardium ciliatum	hairy cockle	11	36	105	77.4	57.7	62.0
	Clinocardium sp.		12	43	99	76.6	56.7	61.7
	Clinopegma magnum	helmet whelk	43	61	138	94.1	57.3	62.0
	Colus sp.		24	58	125	95.6	55.7	62.0
	Crepidula sp.	slipper shell	1	72	72	72.0	57.3	57.3
	Cryptonatica aleutica	Aleutian moonsnail	11	49	133	85.7	55.7	61.3
	Cryptonatica russa	rusty moonsnail	25	61	138	90.4	57.7	62.0
	Cryptonatica sp.		2	65	75	70.0	58.7	59.7
	Cyclocardia sp.		3	19	57	41.7	57.7	60.4
	Dendronotus sp.		4	64	81	72.8	58.3	59.7
	Enteroctopus dofleini	giant octopus	18	61	140	114.0	55.0	60.0
	Euspira pallida	pale moonsnail	11	58	93	78.4	60.1	62.0
	Fusitriton oregonensis	Oregon triton	105	61	169	108.4	54.8	61.0
	Gastropoda	snail unid.	2	99	104	101.5	59.3	59.8
	Gastropoda egg	snail egg	147	24	158	78.4	55.0	62.0
	Grandicrepidula grandis	great slippersnail	3	59	82	71.0	56.7	58.0
	Hiatella arctica	Arctic Hiatella	8	59	78	68.8	57.0	58.0
	Hiatella sp.		1	59	59	59.0	60.3	60.3
	Latisipho hallii	shrew whelk	1	61	61	61.0	61.0	61.0
	Latisipho hypolispus		4	85	113	99.8	59.7	60.2
	Limneria prolongata	conical lamellaria	1	53	53	53.0	58.0	58.0
	Macoma nasuta	bent-nose Macoma	11	20	52	34.1	57.6	59.3
	Macoma sp.		4	34	46	40.2	58.3	60.3
	Mactromeris polynyma	Arctic surfclam	61	20	139	50.0	56.0	61.0
	Megangulus luteus	Alaska great-tellin	22	20	54	36.4	56.7	59.4
	Musculus discors	discordant mussel	16	24	117	61.9	56.7	61.0
	Muusoctopus leioderma	smoothskin octopus	2	135	140	137.5	56.7	57.0
	Muusoctopus oregonensis		5	96	134	111.4	55.7	60.7
	Mytilidae	mussel unid.	4	44	61	55.5	57.0	60.0
	Mytilus sp.		4	37	65	54.2	57.6	59.3
	Mytilus trossulus	foolish mussel	1	52	52	52.0	55.4	55.4
	gastropod egg	moonsnail egg unid.	13	61	103	86.2	59.5	62.0
	Neoberingius frielei		3	134	155	142.3	55.0	60.0
	Neptunea borealis		49	35	145	68.4	56.7	62.0
	Neptunea heros		110	23	90	58.5	56.3	62.0

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Neptunea lyrata	lyre whelk	97	35	169	96.7	55.0	60.7
	Neptunea pribiloffensis	Pribilof whelk	133	58	169	107.8	55.0	61.7
	Neptunea sp.		8	36	84	61.5	57.0	59.7
	Neptunea ventricosa	fat whelk	118	19	124	59.2	55.7	60.7
	Nuculana pernula	stout nutclam	1	123	123	123.0	56.0	56.0
	Nudibranchia	nudibranch unid.	26	55	138	85.0	58.0	61.0
	Octopodidae	octopus unid.	5	100	139	114.0	59.3	60.0
	Onchidiopsis clarki	warty blobsnail	5	61	68	65.2	57.4	59.7
	Patinopecten caurinus	weathervane scallop	17	61	120	97.9	55.0	57.3
	Pectinidae	scallop unid.	1	94	94	94.0	56.0	56.0
	Plicifusus kroyeri		41	57	148	102.3	56.3	61.0
	Plicifusus sp.		2	106	117	111.5	57.3	57.7
	Pododesmus macrochisma	abalone jingle	1	75	75	75.0	57.0	57.0
	Pyrulofusus deformis	warped whelk	32	49	158	87.7	55.7	60.4
	Pyrulofusus melonis		26	36	149	90.8	55.0	59.3
	Pyrulofusus sp.		2	68	105	86.5	56.0	57.0
	Retifusus roseus	rosy whelk	2	132	133	132.5	55.7	56.0
	Rossia pacifica	eastern Pacific bobtail	14	107	158	138.1	55.0	60.0
	Serripes groenlandicus	Greenland cockle	4	48	158	112.2	59.3	61.0
	Serripes notabilis	oblique smoothcockle	43	26	169	69.2	56.3	61.7
	Serripes sp.		4	23	104	68.0	58.3	59.8
	Siliqua alta	Alaska razor	19	20	70	35.2	57.2	60.3
	Tachyrhynchus erosus	eroded turretsnail	2	36	42	39.0	58.3	58.7
	Tritonia festiva	festive Tritonia	4	71	79	75.0	61.3	62.0
	Velutina plicatilis	oblique lamellaria	3	66	67	66.7	57.7	58.3
	Volutomitra sp.		1	100	100	100.0	56.4	56.4
	Volutopsius fragilis	fragile whelk	18	49	107	67.9	55.7	60.2
	Volutopsius simplex	simple whelk	2	107	115	111.0	57.0	57.0
	Volutopsius sp.		42	57	158	113.8	56.7	61.3
	Volutopsius stefanssoni	shouldered whelk	2	76	120	98.0	56.6	57.0
	Yoldia aeolica	crisscrossed Yoldia	1	72	72	72.0	60.0	60.0
	Yoldia hyperborea	northern Yoldia	1	66	66	66.0	59.3	59.3
	Yoldia sp.		1	63	63	63.0	60.7	60.7
Platyhelminthes	Platyhelminthes	flatworm unid.	1	138	138	138.0	60.0	60.0
Porifera	*Echinoclathria beringensis*	hat sponge	2	69	74	71.5	57.2	57.5

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Porifera	sponge unid.	63	34	153	83.3	54.8	60.7
	Suberites montalbidus	stinky sponge	4	84	94	90.0	55.7	56.4
Other		compound ascidian unid.	39	28	78	58.1	56.7	60.4
		empty barnacle shells	4	36	149	102.2	56.0	60.7
		empty bivalve shells	239	19	158	72.6	55.0	62.0
		empty gastropod shells	285	19	169	79.3	54.8	62.0
		invertebrate unid.	1	145	145	145.0	60.3	60.3
		limpet unid.	1	68	68	68.0	57.0	57.0
		sand dollar unid.	7	23	84	66.4	54.7	61.0
		tube worm unid.	3	63	127	91.7	59.0	60.7
		unsorted catch and debris	21	45	158	103.1	55.0	61.0
		unsorted shab	2	69	78	73.5	59.0	59.8

Appendix B: List of taxa encountered in the northern Bering Sea

Appendix B lists all fish and invertebrate taxa taken during the AFSC's northern Bering Sea bottom trawl survey.

List of Tables

- Appendix **B 121**: Fish taxa encountered during the 2023 northern Bering Sea bottom trawl survey listed alphabetically by family.
- Appendix **B 122**: Invertebrate taxa encountered during the 2023 northern Bering Sea bottom trawl survey listed alphabetically by phylum.

Appendix Table B 121.-- Fish taxa encountered during the 2023 northern Bering Sea bottom trawl survey listed alphabetically by family.

Family	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
Agonidae	*Aspidophoroides monopterygius*	Aleutian alligatorfish	1	35	35	35.0	60.7	60.7
	Aspidophoroides olrikii	Arctic alligatorfish	10	28	72	45.8	63.0	65.3
	Occella dodecaedron	Bering poacher	28	10	34	19.1	61.0	64.3
	Pallasina barbata	tubenose poacher	7	13	35	18.4	63.7	65.3
	Podothecus accipenserinus	sturgeon poacher	26	12	47	30.7	60.7	64.3
	Podothecus veternus	veteran poacher	34	13	50	29.3	62.0	65.3
	Sarritor frenatus	sawback poacher	2	21	22	21.5	64.0	64.3
Ammodytidae	*Ammodytes* sp.	sand lance unid.	2	19	31	25.0	64.2	65.0
Anarhichadidae	*Anarhichas orientalis*	Bering wolffish	4	16	35	23.2	60.7	64.7
Clupeidae	*Clupea pallasii*	Pacific herring	32	10	72	29.3	60.7	65.3
Cottidae	*Artediellus pacificus*	hookhorn sculpin	2	32	37	34.5	64.0	64.3
	Artediellus sp.		2	27	28	27.5	64.3	64.3
	Enophrys diceraus	antlered sculpin	14	14	42	21.9	64.0	65.3
	Enophrys sp.		2	18	27	22.5	63.7	64.0
	Gymnocanthus detrisus	purplegray sculpin	3	49	66	55.7	62.0	62.7
	Gymnocanthus pistilliger	threaded sculpin	52	12	50	27.6	60.7	65.3
	Gymnocanthus sp.		1	16	16	16.0	64.3	64.3
	Gymnocanthus tricuspis	Arctic staghorn sculpin	1	13	13	13.0	64.3	64.3
	Hemilepidotus jordani	yellow Irish lord	1	52	52	52.0	61.6	61.6
	Hemilepidotus papilio	butterfly sculpin	4	26	46	34.0	62.7	65.0
	Icelus spatula	spatulate sculpin	2	37	41	39.0	64.3	64.7
	Megalocottus platycephalus	belligerent sculpin	1	16	16	16.0	64.3	64.3
	Microcottus sellaris	brightbelly sculpin	1	17	17	17.0	63.7	63.7
	Myoxocephalus jaok	plain sculpin	62	10	51	26.1	60.7	64.7
	Myoxocephalus polyacanthocephalus	great sculpin	16	17	50	31.2	62.3	65.0
	Myoxocephalus quadricornis	fourhorn sculpin	2	13	13	13.0	63.7	63.7
	Myoxocephalus scorpius	shorthorn (=warty) sculpin	26	18	50	37.0	60.7	65.3
	Myoxocephalus sp.		2	21	21	21.0	63.3	64.7
	Rastrinus scutiger	roughskin sculpin	1	28	28	28.0	64.3	64.3
	Triglops pingelii	ribbed sculpin	9	16	68	38.3	63.0	65.2
Cyclopteridae	*Eumicrotremus andriashevi*	pimpled lumpsucker	1	38	38	38.0	64.3	64.3

Family	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
Gadidae	*Boreogadus saida*	Arctic cod	18	13	68	30.1	63.3	65.3
	Eleginus gracilis	saffron cod	54	10	50	23.5	60.7	65.3
	Gadus chalcogrammus	walleye pollock	106	10	76	35.9	60.7	65.3
	Gadus macrocephalus	Pacific cod	78	18	61	36.4	60.7	65.3
Gasterosteidae	*Pungitius pungitius*	ninespine stickleback	1	16	16	16.0	64.0	64.0
Hemitripteridae	*Nautichthys pribiloviu*	eyeshade sculpin	7	14	38	22.7	64.0	64.3
Hexagrammidae	*Hexagrammos stelleri*	whitespotted greenling	14	12	26	18.3	60.7	64.3
Liparidae	*Careproctus phasma*	monster snailfish	2	66	68	67.0	61.3	62.3
	Careproctus scottae	peachskin snailfish	2	72	76	74.0	62.3	63.0
	Liparis bathyarcticus	nebulous snailfish	3	16	21	18.0	64.0	64.0
	Liparis gibbus	variegated snailfish	52	27	76	44.4	61.0	65.3
	Liparis marmoratus	festive snailfish	2	27	32	29.5	62.7	63.7
	Liparis pulchellus	showy snailfish	3	17	25	20.3	63.7	64.2
	Liparis sp.		2	17	32	24.5	64.0	64.0
	Liparis tunicatus	kelp snailfish	7	26	34	29.6	62.3	63.7
Osmeridae	*Mallotus villosus*	Pacific capelin	44	17	76	38.5	60.7	65.3
	Osmerus mordax	rainbow smelt	32	10	35	20.8	60.7	65.3
Petromyzontidae	Petromyzontidae	lamprey unid.	1	17	17	17.0	64.3	64.3
Pleuronectidae	*Hippoglossoides elassodon*	flathead sole	4	21	61	45.2	61.3	61.7
	Hippoglossoides robustus	Bering flounder	79	16	72	39.5	60.7	65.3
	Hippoglossus stenolepis	Pacific halibut	34	12	47	27.1	60.7	65.0
	Lepidopsetta polyxystra	northern rock sole	67	12	68	36.8	60.7	65.0
	Limanda aspera	yellowfin sole	108	10	68	33.3	60.7	65.3
	Limanda sakhalinensis	Sakhalin sole	55	21	72	40.7	61.3	65.3
	Liopsetta glacialis	Arctic flounder	6	10	14	12.7	61.3	64.3
	Myzopsetta proboscidea	longhead dab	35	10	42	24.3	60.7	65.3
	Platichthys stellatus	starry flounder	72	10	50	26.5	60.7	65.3
	Pleuronectes quadrituberculatus	Alaska plaice	109	10	76	33.5	60.7	65.3
	Reinhardtius hippoglossoides	Greenland turbot	3	35	45	41.7	60.7	64.7
Psychrolutidae	*Eurymen gyrinus*	smoothcheek sculpin	3	13	16	14.7	64.0	64.3
Rajidae	*Arctoraja parmifera*	Alaska skate	43	26	76	41.7	60.7	64.3

Family	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Arctoraja parmifera egg case	Alaska skate egg case	13	26	60	33.5	61.3	65.0
Salmonidae	*Oncorhynchus keta*	chum salmon	2	35	46	40.5	63.5	65.0
	Oncorhynchus nerka	sockeye salmon	2	19	45	32.0	62.3	64.7
Stichaeidae	*Acantholumpenus mackayi*	pighead prickleback	26	10	25	17.5	61.7	64.3
	Anisarchus medius	stout eelblenny	1	76	76	76.0	62.3	62.3
	Chirolophis snyderi	bearded warbonnet	1	17	17	17.0	64.3	64.3
	Eumesogrammus praecisus	fourline snakeblenny	3	21	45	33.7	64.3	64.7
	Lumpenus fabricii	slender eelblenny	45	13	50	26.7	62.3	65.3
	Stichaeidae	prickleback unid.	2	18	21	19.5	63.7	64.7
	Stichaeus punctatus	Arctic shanny	5	14	27	19.6	64.2	64.3
Zoarcidae	*Lycodes mucosus*	saddled eelpout	2	17	35	26.0	64.0	65.3
	Lycodes palearis	wattled eelpout	12	13	76	29.5	61.0	64.3
	Lycodes raridens	marbled eelpout	7	46	76	62.6	62.3	65.2
	Lycodes turneri	polar eelpout	19	13	50	22.3	63.3	65.3
Other		fish egg unid.	2	24	40	32.0	62.0	62.3
		fish unid.	1	50	50	50.0	64.0	64.0

Appendix Table B 122.-- Invertebrate taxa encountered during the 2023 northern Bering Sea bottom trawl survey listed alphabetically by phylum.

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
Annelida	Annelida	worm unid.	1	19	19	19.0	64.0	64.0
	Eunoe depressa	depressed scale worm	27	14	53	35.9	61.0	65.3
	Eunoe nodosa	giant scale worm	9	17	76	54.3	61.0	64.7
	Eunoe sp.		2	13	21	17.0	63.7	64.0
	Hirudinea	leech unid.	1	60	60	60.0	63.3	63.3
	Notostomum cyclostomum	striped sea leech	2	44	52	48.0	61.3	62.7
	Polychaeta	polychaete worm unid.	10	14	68	37.9	62.0	65.0
	Polychaeta tubes		8	16	52	29.8	62.0	65.3
	Sipuncula	peanut worm unid.	11	14	76	52.1	62.3	65.0
Arthropoda	Amphipoda	amphipod unid.	4	17	51	35.2	62.3	64.3
	Argis sp.		73	12	76	33.4	60.7	65.3
	Chionoecetes bairdi	Tanner crab	5	21	60	35.2	63.3	64.3
	Chionoecetes hybrid	hybrid Tanner crab	1	21	21	21.0	64.3	64.3
	Chionoecetes opilio	snow crab	85	16	76	39.7	60.7	65.3
	Chirona evermanni	giant barnacle	5	21	50	35.0	63.7	65.0
	Cirripedia		2	28	28	28.0	61.3	63.3
	Crangon sp.		53	10	76	26.9	60.7	65.3
	Cumacea	cumacean unid.	1	17	17	17.0	64.3	64.3
	Erimacrus isenbeckii	horsehair crab	10	21	46	36.5	60.7	64.3
	Eualus gaimardii	circumpolar eualid	8	28	72	58.2	62.3	65.0
	Eualus macilentus	Greenland shrimp	5	45	72	59.4	62.7	65.0
	Eualus suckleyi	shortscale eualid	2	41	42	41.5	64.7	65.0
	Gammaridae	gammarid amphipod unid.	7	27	68	47.7	61.3	64.7
	Hyas coarctatus	circumboreal toad crab	62	18	76	36.7	60.7	65.3
	Isopoda	isopod unid.	5	10	36	21.6	63.0	64.3
	Labidochirus splendescens	splendid hermit	63	13	76	34.8	60.7	65.3
	Lebbeus groenlandicus	spiny lebbeid	1	31	31	31.0	65.0	65.0
	Pagurus capillatus	hairy hermit crab	44	13	44	26.4	60.7	64.3
	Pagurus ochotensis	Alaskan hermit	35	12	40	22.9	60.7	65.3
	Pagurus rathbuni	longfinger hermit	22	37	76	55.4	61.0	65.0
	Pagurus sp.		3	28	34	31.3	62.7	63.3
	Pagurus trigonocheirus	fuzzy hermit crab	74	15	68	37.6	60.7	65.3

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Pandalus goniurus	humpy shrimp	25	16	76	37.8	61.3	65.3
	Paralithodes camtschaticus	red king crab	24	13	49	23.0	62.0	65.3
	Paralithodes platypus	blue king crab	23	18	60	36.5	63.3	65.3
	Sclerocrangon boreas	sculptured shrimp	8	15	35	25.2	64.0	65.3
	Telmessus cheiragonus	helmet crab	29	10	35	19.4	60.7	65.3
	Thoracica	barnacle unid.	11	13	46	27.3	62.7	65.0
Bryozoa	*Alcyonidium disciforme*	disc bryozoan	10	10	31	16.8	63.7	64.3
	Alcyonidium enteromorpha	noodle bryozoan	14	21	50	38.0	62.9	65.3
	Bryozoa	bryozoan unid.	11	13	50	32.1	62.9	65.0
	Crisularia pacifica		1	19	19	19.0	64.2	64.2
	Dendrobeania sp.		1	14	14	14.0	64.3	64.3
	Rhamphostomella costata	ribbed bryozoan	4	21	32	28.2	62.3	64.0
Chordata	*Aplidium* sp.		16	16	32	24.5	60.7	64.3
	Ascidiacea	tunicate unid.	14	12	50	36.4	61.3	65.3
	Boltenia ovifera	sea onion	13	19	50	37.2	61.3	65.0
	Halocynthia aurantium	sea peach	7	21	52	36.3	62.7	64.7
	Halocynthia sp.	sea peach unid.	1	46	46	46.0	65.0	65.0
	Molgula retortiformis	sea clod	2	24	24	24.0	61.7	62.3
	Styela rustica	sea potato	58	18	55	35.7	60.7	65.0
	Thaliacea	salp unid.	8	28	50	35.0	63.5	65.2
Cnidaria	Actiniaria	sea anemone unid.	34	21	76	44.3	62.0	65.3
	Anthozoa		1	17	17	17.0	63.7	63.7
	Chrysaora melanaster		90	16	76	39.0	60.7	65.3
	Cribrinopsis fernaldi	chevron-tentacled anemone	1	17	17	17.0	64.3	64.3
	Cyanea capillata	lion's mane jelly	9	12	23	16.8	60.7	64.3
	Gersemia sp.	sea raspberry	59	10	76	35.4	60.7	65.3
	Hydroidolina	hydroid unid.	17	10	72	41.3	61.4	65.0
	Hydrozoa		3	12	28	20.3	61.0	61.3
	Metridium sp.		27	13	50	25.1	60.7	65.3
	Scyphozoa	jellyfish unid.	14	10	53	24.8	61.3	64.3
	Sertulariidae	Sertulariid hydroid	2	16	19	17.5	64.0	64.0
	Staurostoma mertensii	whitecross jelly	2	17	19	18.0	64.0	64.0
	Urticina crassicornis	mottled anemone	2	16	19	17.5	64.0	64.0
	Urticina sp.		9	10	32	23.6	63.3	64.3
Ctenophora	Ctenophora	comb jelly unid.	1	17	17	17.0	64.0	64.0

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
Echinodermata	*Asterias amurensis*	purple-orange sea star	71	10	51	27.4	60.7	65.3
	Crossaster papposus	rose sea star	12	14	50	33.2	64.0	65.3
	Echinarachnius parma	parma sand dollar	5	31	37	33.2	62.7	64.0
	Evasterias echinosoma	giant sea star	27	13	50	23.6	63.3	65.3
	Gorgonocephalus eucnemis	basketstar	75	16	76	38.1	60.7	65.3
	Henricia sp.		14	13	41	26.4	63.0	65.0
	Holothuroidea	sea cucumber unid.	5	36	50	43.8	64.3	65.3
	Leptasterias arctica		43	18	76	42.5	61.3	65.3
	Leptasterias polaris		73	16	76	40.3	61.0	65.3
	Leptasterias sp.		27	13	66	28.3	61.3	64.3
	Lethasterias nanimensis	blackspined sea star	31	13	50	26.3	63.3	65.3
	Lethasterias sp.		1	21	21	21.0	64.0	64.0
	Ophiura sarsii	notched brittlestar	19	17	76	54.7	61.3	64.3
	Ophiuroidea	brittlestar unid.	2	10	50	30.0	63.7	64.0
	Psolus fabricii	brownscaled sea cucumber	6	21	35	28.3	64.0	64.7
	Pteraster obscurus	obscure sea star	3	31	76	55.7	62.3	65.0
	Solaster sp.		1	50	50	50.0	64.0	64.0
	Strongylocentrotus droebachiensis	green sea urchin	19	10	50	22.1	63.3	64.3
	Strongylocentrotus sp.		16	21	66	40.7	61.3	65.3
Mollusca	*Beringius behringii*	Bering beringius	4	14	19	16.0	64.0	64.3
	Beringius sp.		2	31	50	40.5	65.0	65.3
	Bivalvia	bivalve unid.	3	21	52	38.3	61.0	65.0
	Buccinidae		1	49	49	49.0	62.0	62.0
	Buccinum angulosum	angular whelk	9	32	66	42.4	61.3	64.7
	Buccinum angulosum transliratum	transect whelk	1	24	24	24.0	61.7	61.7
	Buccinum plectrum	sinuous whelk	6	21	66	42.3	62.0	64.7
	Buccinum polare	polar whelk	41	24	76	47.5	61.0	65.2
	Buccinum scalariforme	ladder whelk	28	24	76	46.2	61.0	65.0
	Buccinum sp.		9	26	66	43.0	62.0	65.2
	Chlamylla sp.		1	32	32	32.0	64.0	64.0
	Chlamys sp.		1	50	50	50.0	64.0	64.0
	Ciliatocardium ciliatum	hairy cockle	1	53	53	53.0	61.3	61.3
	Clinocardium sp.		5	10	41	25.4	63.7	64.7
	Colus sp.		4	34	50	42.8	62.7	65.2

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Cryptonatica aleutica	Aleutian moonsnail	4	28	34	32.0	62.3	63.3
	Cryptonatica russa	rusty moonsnail	15	26	76	55.2	61.3	64.0
	Cyclocardia sp.		2	16	28	22.0	64.0	64.3
	Euspira pallida	pale moonsnail	10	33	76	57.4	62.0	64.0
	Gastropoda	snail unid.	1	36	36	36.0	64.3	64.3
	Gastropoda egg	snail egg	78	12	76	39.1	60.7	65.3
	Grandicrepidula grandis	great slippersnail	4	27	50	35.0	64.0	65.2
	Hiatella arctica	Arctic Hiatella	8	18	35	26.9	60.7	64.0
	Hiatella sp.		1	24	24	24.0	62.3	62.3
	Lamellariinae	lamellarid unid.	5	13	21	17.6	63.7	64.3
	Macoma sp.		4	14	68	34.5	60.7	63.3
	Mactromeris polynyma	Arctic surfclam	6	23	66	38.2	60.7	64.7
	Musculus discors	discordant mussel	10	21	66	37.9	61.3	64.0
	Muusoctopus leioderma	smoothskin octopus	1	68	68	68.0	63.3	63.3
	Mytilus trossulus	foolish mussel	2	15	19	17.0	64.0	64.0
	gastropod egg	moonsnail egg unid.	12	30	72	52.0	62.0	65.0
	Neptunea borealis		24	33	76	48.5	61.3	65.2
	Neptunea heros		76	13	68	37.3	60.7	65.3
	Neptunea sp.		4	27	32	29.0	62.3	63.3
	Neptunea ventricosa	fat whelk	55	14	68	33.3	60.7	65.3
	Nudibranchia	nudibranch unid.	4	37	46	42.2	64.3	65.0
	Pyrulofusus deformis	warped whelk	1	27	27	27.0	64.3	64.3
	Saxidomus gigantea	butter clam	2	41	46	43.5	64.7	65.0
	Serripes notabilis	oblique smoothcockle	19	14	66	37.1	60.7	65.2
	Serripes sp.		4	28	50	36.8	61.3	65.2
	Siliqua alta	Alaska razor	3	12	23	18.7	60.7	61.4
	Tachyrhynchus erosus	eroded turretsnail	1	17	17	17.0	64.3	64.3
	Tellina sp.		1	22	22	22.0	64.3	64.3
	Trichotropis bicarinata	two-keel hairysnail	1	32	32	32.0	64.0	64.0
	Tritonia festiva	festive Tritonia	6	60	76	67.3	62.3	63.3
	Tritonia sp.		1	50	50	50.0	65.3	65.3
	Trochidae	trochid unid.	1	34	34	34.0	62.7	62.7
	Velutina sp.		2	31	33	32.0	64.0	65.0
	Volutopsius sp.		1	35	35	35.0	65.3	65.3
	Yoldia aeolica	crisscrossed Yoldia	1	19	19	19.0	62.0	62.0

Phylum	Scientific name	Common name	#Hauls	Bottom depth (m)			Latitude	
				Min.	Max.	Avg.	N	S
	Yoldia hyperborea	northern Yoldia	2	14	21	17.5	63.3	64.3
	Yoldia sp.		3	44	66	52.3	62.0	63.0
Nemertea	Nemertea	nemertean worm unid.	3	52	72	62.0	62.0	63.0
Porifera	Porifera	sponge unid.	13	13	50	30.3	62.3	65.3
Other		compound ascidian unid.	20	18	42	32.0	60.7	65.3
		empty barnacle shells	3	19	34	24.0	62.7	64.2
		empty bivalve shells	84	12	66	31.3	60.7	65.3
		empty gastropod shells	99	10	76	35.1	60.7	65.3
		sand dollar unid.	1	28	28	28.0	64.3	64.3
		shrimp unid.	2	22	27	24.5	64.3	64.3
		unsorted catch and debris	10	13	50	29.3	63.7	65.3

Appendix C: List of population estimates by sex and size group for principal fish species in the eastern Bering Sea

Appendix C presents population estimates by sex and size group from the 2023 eastern Bering Sea bottom trawl survey for principal fish species.

List of Tables

Appendix Table C 123.-- Population estimates by sex and size by size for Alaska plaice (*Pleuronectes quadrituberculatus*) from the 2023 eastern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
110	169,728	0	56,467	226,195	0.0004	0.0004
120	175,454	69,452	28,233	273,139	0.0004	0.0008
130	87,381	28,324	0	115,705	0.0002	0.0010
140	56,558	113,024	0	169,582	0.0003	0.0013
150	92,470	223,786	0	316,256	0.0005	0.0018
160	280,435	97,685	0	378,120	0.0006	0.0024
170	281,780	208,085	0	489,865	0.0008	0.0032
180	360,012	668,138	0	1,028,150	0.0017	0.0049
190	772,790	466,735	0	1,239,525	0.0020	0.0069
200	1,962,322	1,685,577	0	3,647,899	0.0059	0.0128
210	3,520,850	1,413,254	0	4,934,104	0.0080	0.0207
220	4,154,614	2,809,108	0	6,963,722	0.0113	0.0320
230	5,839,515	3,525,476	0	9,364,991	0.0152	0.0472
240	9,519,857	5,603,079	0	15,122,936	0.0245	0.0717
250	10,578,519	7,303,757	0	17,882,276	0.0289	0.1006
260	11,947,617	7,569,669	0	19,517,286	0.0316	0.1322
270	14,291,895	9,195,044	0	23,486,939	0.0380	0.1702
280	12,705,177	11,822,416	0	24,527,593	0.0397	0.2099
290	20,506,165	12,218,819	0	32,724,984	0.0530	0.2629
300	23,849,260	10,086,735	0	33,935,995	0.0549	0.3178
310	22,115,123	10,982,931	0	33,098,054	0.0536	0.3714
320	25,001,760	9,674,264	0	34,676,024	0.0561	0.4275
330	28,358,964	11,452,827	50,874	39,862,665	0.0645	0.4920
340	24,529,812	13,776,339	0	38,306,151	0.0620	0.5540
350	27,962,076	12,727,165	50,874	40,740,115	0.0659	0.6199
360	27,992,370	12,488,082	0	40,480,452	0.0655	0.6855
370	23,060,030	11,921,723	0	34,981,753	0.0566	0.7421
380	16,297,698	11,331,419	0	27,629,117	0.0447	0.7868
390	10,249,878	8,643,217	50,874	18,943,969	0.0307	0.8175
400	5,634,081	10,266,205	0	15,900,286	0.0257	0.8432
410	2,378,107	9,988,035	50,874	12,417,016	0.0201	0.8633
420	914,301	10,393,482	0	11,307,783	0.0183	0.8816
430	589,290	8,382,629	0	8,971,919	0.0145	0.8961
440	392,899	9,040,201	0	9,433,100	0.0153	0.9114
450	333,870	10,217,464	101,749	10,653,083	0.0172	0.9286
460	0	8,091,102	0	8,091,102	0.0131	0.9417
470	0	7,947,736	0	7,947,736	0.0129	0.9546
480	0	7,631,240	50,874	7,682,114	0.0124	0.9670
490	65,462	5,982,453	50,874	6,098,789	0.0099	0.9769
500	0	3,769,931	50,874	3,820,805	0.0062	0.9831
510	0	4,067,797	0	4,067,797	0.0066	0.9897
520	0	2,688,859	0	2,688,859	0.0044	0.9940
530	0	1,546,821	0	1,546,821	0.0025	0.9965
540	0	200,738	0	200,738	0.0003	0.9968
550	0	954,331	0	954,331	0.0015	0.9984
560	0	664,825	0	664,825	0.0011	0.9995

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
570	0	338,086	0	338,086	0.0005	1.0000
Total	**337,028,120**	**280,278,065**	**542,567**	**617,848,752**	**1.0000**	**1.0000**

Appendix Table C 124.-- Population estimates by sex and size by size for arrowtooth flounder (*Atheresthes stomias*) from the 2023 eastern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
90	0	49,155	0	49,155	0.0001	0.0001
100	39,944	0	163,404	203,348	0.0002	0.0003
110	0	165,987	222,573	388,560	0.0005	0.0007
120	57,746	0	171,095	228,841	0.0003	0.0010
130	467,853	28,859	190,810	687,522	0.0008	0.0018
140	915,771	831,099	180,414	1,927,284	0.0022	0.0040
150	1,013,449	3,012,468	52,034	4,077,951	0.0047	0.0088
160	1,936,209	2,654,839	58,685	4,649,733	0.0054	0.0142
170	1,726,658	4,250,415	0	5,977,073	0.0069	0.0211
180	2,504,291	2,717,670	26,017	5,247,978	0.0061	0.0272
190	1,642,851	3,540,145	0	5,182,996	0.0060	0.0332
200	3,641,620	3,394,405	0	7,036,025	0.0082	0.0414
210	4,855,741	5,723,441	0	10,579,182	0.0123	0.0537
220	5,747,635	8,671,246	106,898	14,525,779	0.0169	0.0705
230	6,693,147	8,121,284	84,512	14,898,943	0.0173	0.0878
240	6,629,856	11,523,351	106,898	18,260,105	0.0212	0.1090
250	7,092,263	7,419,153	0	14,511,416	0.0168	0.1259
260	5,911,739	8,297,292	161,762	14,370,793	0.0167	0.1426
270	5,610,765	10,411,690	80,881	16,103,336	0.0187	0.1613
280	8,726,239	9,162,919	0	17,889,158	0.0208	0.1820
290	8,215,539	9,914,649	0	18,130,188	0.0210	0.2031
300	10,337,952	9,371,366	0	19,709,318	0.0229	0.2260
310	9,486,612	15,604,005	161,762	25,252,379	0.0293	0.2553
320	13,847,922	14,594,120	213,796	28,655,838	0.0333	0.2886
330	16,137,403	18,041,176	152,952	34,331,531	0.0399	0.3284
340	14,677,884	24,494,380	450,780	39,623,044	0.0460	0.3744
350	17,991,589	27,529,444	132,915	45,653,948	0.0530	0.4274
360	16,669,711	26,476,547	158,932	43,305,190	0.0503	0.4777
370	16,594,128	30,097,720	401,576	47,093,424	0.0547	0.5324
380	15,741,805	28,870,354	239,813	44,851,972	0.0521	0.5844
390	16,418,326	23,640,787	106,898	40,166,011	0.0466	0.6311
400	18,342,261	25,066,001	126,935	43,535,197	0.0505	0.6816
410	13,802,577	18,044,940	72,071	31,919,588	0.0371	0.7187
420	14,202,761	17,399,602	0	31,602,363	0.0367	0.7554
430	9,837,601	14,393,190	52,034	24,282,825	0.0282	0.7836
440	7,444,619	13,029,449	126,935	20,601,003	0.0239	0.8075
450	6,669,692	11,910,016	26,017	18,605,725	0.0216	0.8291
460	4,174,506	14,838,155	26,017	19,038,678	0.0221	0.8512
470	2,659,228	12,316,150	26,017	15,001,395	0.0174	0.8686
480	1,646,423	15,552,267	52,034	17,250,724	0.0200	0.8886
490	2,105,058	14,428,599	52,034	16,585,691	0.0193	0.9079
500	376,537	12,642,057	26,017	13,044,611	0.0151	0.9230
510	306,536	10,876,627	0	11,183,163	0.0130	0.9360
520	529,637	9,633,414	26,017	10,189,068	0.0118	0.9478
530	0	8,405,375	0	8,405,375	0.0098	0.9576
540	242,565	7,386,420	106,898	7,735,883	0.0090	0.9666

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
550	29,291	6,164,106	80,881	6,274,278	0.0073	0.9739
560	0	4,769,134	0	4,769,134	0.0055	0.9794
570	29,826	3,165,057	0	3,194,883	0.0037	0.9831
580	0	2,887,661	0	2,887,661	0.0034	0.9865
590	0	1,429,632	0	1,429,632	0.0017	0.9881
600	0	1,820,401	0	1,820,401	0.0021	0.9902
610	0	1,567,192	0	1,567,192	0.0018	0.9920
620	0	839,962	80,881	920,843	0.0011	0.9931
630	0	641,311	0	641,311	0.0007	0.9939
640	0	684,529	0	684,529	0.0008	0.9947
650	0	865,395	26,017	891,412	0.0010	0.9957
660	0	516,111	0	516,111	0.0006	0.9963
670	0	639,278	0	639,278	0.0007	0.9970
680	0	373,813	80,881	454,694	0.0005	0.9976
690	0	563,661	0	563,661	0.0007	0.9982
700	0	417,813	0	417,813	0.0005	0.9987
710	88,740	400,739	0	489,479	0.0006	0.9993
720	0	124,677	0	124,677	0.0001	0.9994
730	0	271,424	0	271,424	0.0003	0.9997
740	0	26,837	0	26,837	0.0000	0.9998
750	0	86,041	0	86,041	0.0001	0.9999
760	0	124,677	0	124,677	0.0001	1.0000
Total	**303,820,506**	**552,911,679**	**4,613,093**	**861,345,278**	**1.0000**	**1.0000**

Appendix Table C 125.-- Population estimates by sex and size by size for Bering flounder (*Hippoglossoides robustus*) from the 2023 eastern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
90	0	0	305,438	305,438	0.0091	0.0091
100	20,076	0	136,304	156,380	0.0046	0.0137
110	0	0	343,521	343,521	0.0102	0.0239
120	28,617	45,236	150,192	224,045	0.0066	0.0305
130	136,329	18,647	527,635	682,611	0.0202	0.0507
140	573,585	415,735	808,188	1,797,508	0.0533	0.1040
150	470,673	583,529	229,490	1,283,692	0.0381	0.1421
160	580,058	476,157	206,707	1,262,922	0.0374	0.1795
170	528,742	556,979	186,601	1,272,322	0.0377	0.2172
180	830,724	256,041	62,263	1,149,028	0.0341	0.2513
190	827,678	738,951	62,263	1,628,892	0.0483	0.2996
200	538,950	728,045	31,132	1,298,127	0.0385	0.3380
210	522,739	897,624	0	1,420,363	0.0421	0.3801
220	846,025	680,552	0	1,526,577	0.0453	0.4254
230	393,944	792,229	0	1,186,173	0.0352	0.4606
240	479,237	905,098	0	1,384,335	0.0410	0.5016
250	467,501	1,186,193	0	1,653,694	0.0490	0.5506
260	258,827	1,065,144	0	1,323,971	0.0392	0.5899
270	103,477	1,036,612	0	1,140,089	0.0338	0.6236
280	242,843	1,212,213	0	1,455,056	0.0431	0.6668
290	112,546	975,611	0	1,088,157	0.0323	0.6990
300	19,025	917,789	0	936,814	0.0278	0.7268
310	49,688	1,161,590	0	1,211,278	0.0359	0.7627
320	76,277	757,442	0	833,719	0.0247	0.7874
330	19,025	1,105,202	0	1,124,227	0.0333	0.8207
340	24,844	1,010,388	0	1,035,232	0.0307	0.8514
350	24,844	1,332,689	0	1,357,533	0.0402	0.8917
360	77,913	1,132,330	0	1,210,243	0.0359	0.9275
370	53,171	847,229	0	900,400	0.0267	0.9542
380	24,844	671,184	0	696,028	0.0206	0.9749
390	0	229,152	21,701	250,853	0.0074	0.9823
400	0	111,379	0	111,379	0.0033	0.9856
410	24,844	261,033	0	285,877	0.0085	0.9941
420	0	29,799	0	29,799	0.0009	0.9950
450	0	170,100	0	170,100	0.0050	1.0000
Total	**8,357,046**	**22,307,902**	**3,071,435**	**33,736,383**	**1.0000**	**1.0000**

Appendix Table C 126.-- Population estimates by sex and size by size for flathead sole (*Hippoglossoides elassodon*) from the 2023 eastern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
70	0	0	164,094	164,094	0.0001	0.0001
80	0	0	898,037	898,037	0.0004	0.0005
90	54,621	0	1,567,804	1,622,425	0.0008	0.0013
100	591,649	18,475	5,523,481	6,133,605	0.0030	0.0043
110	647,462	879,175	7,539,074	9,065,711	0.0044	0.0088
120	1,191,876	959,492	12,177,716	14,329,084	0.0070	0.0158
130	3,288,158	1,443,651	14,655,583	19,387,392	0.0095	0.0253
140	6,813,445	4,625,589	13,608,956	25,047,990	0.0123	0.0376
150	9,515,991	9,405,015	8,383,198	27,304,204	0.0134	0.0510
160	10,878,642	10,386,612	2,835,010	24,100,264	0.0118	0.0628
170	17,377,187	14,121,615	380,444	31,879,246	0.0156	0.0784
180	25,716,891	17,865,280	0	43,582,171	0.0214	0.0998
190	33,100,180	17,993,602	27,268	51,121,050	0.0251	0.1248
200	32,103,774	25,759,119	0	57,862,893	0.0284	0.1532
210	34,211,881	21,154,274	213,958	55,580,113	0.0273	0.1805
220	33,892,302	26,502,885	400,647	60,795,834	0.0298	0.2103
230	40,304,524	26,014,601	878,911	67,198,036	0.0329	0.2432
240	45,472,062	37,388,347	1,082,766	83,943,175	0.0412	0.2844
250	48,697,225	38,285,852	1,451,956	88,435,033	0.0434	0.3277
260	63,430,810	41,783,449	906,179	106,120,438	0.0520	0.3798
270	56,975,759	42,187,182	1,065,600	100,228,541	0.0491	0.4289
280	57,722,641	46,952,708	1,859,669	106,535,018	0.0522	0.4811
290	51,901,795	39,731,805	1,435,942	93,069,542	0.0456	0.5268
300	55,855,322	45,190,355	923,345	101,969,022	0.0500	0.5768
310	58,688,146	42,378,852	2,344,997	103,411,995	0.0507	0.6275
320	56,357,350	41,987,554	1,581,073	99,925,977	0.0490	0.6765
330	58,561,623	44,733,938	2,748,520	106,044,081	0.0520	0.7284
340	49,477,336	37,979,798	2,253,091	89,710,225	0.0440	0.7724
350	36,863,387	40,503,889	1,262,231	78,629,507	0.0386	0.8110
360	31,188,230	40,344,268	1,242,028	72,774,526	0.0357	0.8467
370	17,746,911	34,404,580	746,597	52,898,088	0.0259	0.8726
380	13,794,334	33,096,654	149,319	47,040,307	0.0231	0.8957
390	21,199,286	25,264,064	1,082,606	47,545,956	0.0233	0.9190
400	14,037,517	18,198,019	149,319	32,384,855	0.0159	0.9348
410	9,105,979	13,724,999	149,319	22,980,297	0.0113	0.9461
420	5,728,588	8,319,869	0	14,048,457	0.0069	0.9530
430	1,664,377	8,883,113	0	10,547,490	0.0052	0.9582
440	2,377,495	7,681,394	0	10,058,889	0.0049	0.9631
450	2,048,578	8,621,878	0	10,670,456	0.0052	0.9683
460	238,584	10,603,049	0	10,841,633	0.0053	0.9737
470	0	19,610,681	0	19,610,681	0.0096	0.9833
480	17,983	8,442,810	0	8,460,793	0.0041	0.9874
490	0	10,697,532	0	10,697,532	0.0052	0.9927
500	0	4,182,997	0	4,182,997	0.0021	0.9947
510	0	3,954,955	0	3,954,955	0.0019	0.9967
520	0	2,705,702	0	2,705,702	0.0013	0.9980

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
530	0	2,135,041	0	2,135,041	0.0010	0.9990
540	0	1,824,254	0	1,824,254	0.0009	0.9999
560	0	165,333	0	165,333	0.0001	1.0000
Total	**1,008,839,901**	**939,094,306**	**91,688,738**	**2,039,622,945**	**1.0000**	**1.0000**

Appendix Table C 127.-- Population estimates by sex and size by size for Greenland turbot (*Reinhardtius hippoglossoides*) from the 2023 eastern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
110	0	0	41,119	41,119	0.0110	0.0110
120	0	47,250	330,377	377,627	0.1009	0.1119
130	0	0	466,270	466,270	0.1246	0.2365
140	27,063	28,225	655,670	710,958	0.1900	0.4264
150	0	28,225	242,386	270,611	0.0723	0.4987
160	54,125	28,225	196,054	278,404	0.0744	0.5731
170	0	0	183,681	183,681	0.0491	0.6222
180	0	29,458	0	29,458	0.0079	0.6301
200	0	27,624	0	27,624	0.0074	0.6375
530	28,114	0	0	28,114	0.0075	0.6450
540	0	29,826	0	29,826	0.0080	0.6529
560	0	29,826	0	29,826	0.0080	0.6609
590	29,458	0	0	29,458	0.0079	0.6688
610	0	28,514	0	28,514	0.0076	0.6764
640	28,581	29,494	0	58,075	0.0155	0.6919
650	0	30,121	0	30,121	0.0080	0.7000
660	28,225	58,298	0	86,523	0.0231	0.7231
670	0	29,240	0	29,240	0.0078	0.7309
680	19,002	56,541	0	75,543	0.0202	0.7511
690	0	27,624	0	27,624	0.0074	0.7585
710	0	20,340	0	20,340	0.0054	0.7639
720	29,635	28,523	0	58,158	0.0155	0.7794
730	0	28,455	0	28,455	0.0076	0.7870
740	0	58,329	0	58,329	0.0156	0.8026
750	0	174,194	0	174,194	0.0465	0.8492
760	0	30,626	0	30,626	0.0082	0.8574
770	0	58,854	0	58,854	0.0157	0.8731
780	0	74,413	0	74,413	0.0199	0.8930
790	0	105,406	0	105,406	0.0282	0.9211
800	0	92,189	0	92,189	0.0246	0.9458
810	0	55,400	0	55,400	0.0148	0.9606
830	0	61,069	0	61,069	0.0163	0.9769
840	0	28,225	0	28,225	0.0075	0.9844
860	0	28,225	0	28,225	0.0075	0.9920
890	0	30,073	0	30,073	0.0080	1.0000
Total	**244,203**	**1,382,812**	**2,115,557**	**3,742,572**	**1.0000**	**1.0000**

Appendix Table C 128.-- Population estimates by sex and size by size for Kamchatka flounder (*Atheresthes evermanni*) from the 2023 eastern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
90	0	0	29,472	29,472	0.0007	0.0007
130	0	0	123,250	123,250	0.0031	0.0038
140	265,047	98,073	158,879	521,999	0.0130	0.0168
150	882,106	726,181	584,395	2,192,682	0.0546	0.0715
160	331,607	1,477,286	1,052,889	2,861,782	0.0713	0.1428
170	363,544	577,417	541,715	1,482,676	0.0369	0.1797
180	259,805	301,082	105,365	666,252	0.0166	0.1963
190	528,099	172,953	0	701,052	0.0175	0.2138
200	54,614	54,243	0	108,857	0.0027	0.2165
210	107,485	86,361	0	193,846	0.0048	0.2213
220	0	28,532	0	28,532	0.0007	0.2220
230	29,068	26,523	27,268	82,859	0.0021	0.2241
240	84,258	27,737	0	111,995	0.0028	0.2269
250	171,190	144,480	0	315,670	0.0079	0.2348
260	204,884	261,949	0	466,833	0.0116	0.2464
270	548,658	408,362	0	957,020	0.0238	0.2703
280	220,461	138,285	0	358,746	0.0089	0.2792
290	293,680	212,613	0	506,293	0.0126	0.2918
300	511,785	264,928	0	776,713	0.0194	0.3112
310	535,690	280,735	0	816,425	0.0203	0.3315
320	838,543	477,852	0	1,316,395	0.0328	0.3643
330	578,004	477,218	0	1,055,222	0.0263	0.3906
340	931,394	595,904	0	1,527,298	0.0381	0.4287
350	636,021	668,030	27,268	1,331,319	0.0332	0.4618
360	941,495	821,846	27,268	1,790,609	0.0446	0.5065
370	980,294	1,013,729	27,268	2,021,291	0.0504	0.5568
380	694,289	732,757	0	1,427,046	0.0356	0.5924
390	478,178	550,456	0	1,028,634	0.0256	0.6180
400	965,439	861,716	46,790	1,873,945	0.0467	0.6647
410	540,917	322,206	0	863,123	0.0215	0.6862
420	542,392	397,427	46,790	986,609	0.0246	0.7108
430	496,195	274,721	0	770,916	0.0192	0.7300
440	427,521	425,031	0	852,552	0.0212	0.7513
450	439,397	405,180	0	844,577	0.0210	0.7723
460	677,344	464,861	0	1,142,205	0.0285	0.8008
470	703,858	501,435	0	1,205,293	0.0300	0.8308
480	313,129	424,481	0	737,610	0.0184	0.8492
490	338,768	495,597	0	834,365	0.0208	0.8700
500	310,493	490,921	0	801,414	0.0200	0.8900
510	187,129	469,964	0	657,093	0.0164	0.9064
520	240,471	243,862	0	484,333	0.0121	0.9184
530	309,691	175,411	0	485,102	0.0121	0.9305
540	65,903	403,641	0	469,544	0.0117	0.9422
550	18,456	359,677	0	378,133	0.0094	0.9516
560	18,890	198,816	0	217,706	0.0054	0.9571
570	29,875	189,597	0	219,472	0.0055	0.9625

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
580	0	27,737	0	27,737	0.0007	0.9632
590	30,538	153,670	0	184,208	0.0046	0.9678
600	0	189,205	0	189,205	0.0047	0.9725
610	28,225	58,125	0	86,350	0.0022	0.9747
620	28,232	75,055	0	103,287	0.0026	0.9773
630	0	233,823	0	233,823	0.0058	0.9831
640	0	76,054	0	76,054	0.0019	0.9850
650	0	119,908	0	119,908	0.0030	0.9880
660	0	139,001	0	139,001	0.0035	0.9914
670	0	72,017	0	72,017	0.0018	0.9932
680	0	75,961	0	75,961	0.0019	0.9951
690	0	34,635	0	34,635	0.0009	0.9960
710	0	59,948	0	59,948	0.0015	0.9975
720	0	29,704	0	29,704	0.0007	0.9982
730	0	14,836	0	14,836	0.0004	0.9986
760	0	57,028	0	57,028	0.0014	1.0000
Total	**18,183,062**	**19,146,783**	**2,798,617**	**40,128,462**	**1.0000**	**1.0000**

Appendix Table C 129.-- Population estimates by sex and size by size for northern rock sole (*Lepidopsetta polyxystra*) from the 2023 eastern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
60	0	0	206,018	206,018	0.0000	0.0000
70	0	188,462	6,476,164	6,664,626	0.0010	0.0010
80	0	0	2,816,201	2,816,201	0.0004	0.0015
90	0	16,177	11,621,225	11,637,402	0.0017	0.0032
100	908,031	1,615,222	19,363,931	21,887,184	0.0033	0.0065
110	5,986,483	3,704,743	45,569,680	55,260,906	0.0083	0.0148
120	21,073,724	22,329,359	104,235,856	147,638,939	0.0222	0.0370
130	34,467,309	35,132,334	124,775,781	194,375,424	0.0292	0.0662
140	89,027,933	58,794,123	103,006,353	250,828,409	0.0377	0.1038
150	138,079,079	106,854,719	37,292,103	282,225,901	0.0424	0.1462
160	149,372,542	127,531,083	36,866,793	313,770,418	0.0471	0.1934
170	155,114,051	126,317,659	19,880,911	301,312,621	0.0453	0.2386
180	155,671,554	139,138,854	9,711,519	304,521,927	0.0457	0.2844
190	131,691,260	144,510,357	2,903,836	279,105,453	0.0419	0.3263
200	130,875,903	82,763,647	3,347,078	216,986,628	0.0326	0.3589
210	94,887,429	90,976,902	1,060,667	186,924,998	0.0281	0.3870
220	124,209,401	89,204,787	2,533,002	215,947,190	0.0324	0.4194
230	145,427,007	128,280,396	2,903,836	276,611,239	0.0415	0.4609
240	131,466,968	113,801,347	2,121,334	247,389,649	0.0372	0.4981
250	143,583,055	157,324,523	4,208,591	305,116,169	0.0458	0.5439
260	178,170,128	146,338,627	2,399,498	326,908,253	0.0491	0.5930
270	166,724,647	145,949,627	4,129,580	316,803,854	0.0476	0.6406
280	193,629,766	159,149,194	4,932,500	357,711,460	0.0537	0.6943
290	195,850,884	152,394,646	3,738,329	351,983,859	0.0529	0.7472
300	207,953,874	137,434,864	2,162,168	347,550,906	0.0522	0.7994
310	154,218,503	117,079,339	4,839,830	276,137,672	0.0415	0.8409
320	136,532,500	110,706,006	3,686,338	250,924,844	0.0377	0.8786
330	58,989,822	112,261,576	1,338,831	172,590,229	0.0259	0.9045
340	18,810,989	105,754,493	1,338,831	125,904,313	0.0189	0.9234
350	8,896,287	73,093,028	1,359,248	83,348,563	0.0125	0.9359
360	5,666,318	73,480,341	2,677,663	81,824,322	0.0123	0.9482
370	2,012,179	72,611,091	669,416	75,292,686	0.0113	0.9595
380	4,857,759	83,649,506	1,060,667	89,567,932	0.0135	0.9730
390	2,856,188	74,639,401	391,251	77,886,840	0.0117	0.9847
400	260,468	51,222,388	391,251	51,874,107	0.0078	0.9925
410	692,403	25,415,337	0	26,107,740	0.0039	0.9964
420	528,163	13,461,705	0	13,989,868	0.0021	0.9985
430	732,569	6,054,780	0	6,787,349	0.0010	0.9995
440	0	695,550	0	695,550	0.0001	0.9996
450	0	816,359	0	816,359	0.0001	0.9998
460	0	266,735	948,674	1,215,409	0.0002	0.9999
470	0	408,610	0	408,610	0.0001	1.0000
Total	**2,989,225,176**	**3,091,367,897**	**576,964,954**	**6,657,558,027**	**1.0000**	**1.0000**

Appendix Table C 130.-- Population estimates by sex and size by size for Pacific cod (*Gadus macrocephalus*) from the 2023 eastern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
100	0	0	295,351	295,351	0.0005	0.0005
110	29,626	79,688	1,212,827	1,322,141	0.0024	0.0029
120	29,626	112,738	3,402,925	3,545,289	0.0064	0.0093
130	716,203	173,820	4,319,414	5,209,437	0.0094	0.0187
140	812,486	1,823,580	5,911,023	8,547,089	0.0154	0.0340
150	4,249,188	4,126,101	3,039,149	11,414,438	0.0205	0.0546
160	6,319,771	5,319,426	1,509,793	13,148,990	0.0237	0.0782
170	6,903,475	6,745,356	544,660	14,193,491	0.0255	0.1038
180	8,082,234	5,616,664	494,364	14,193,262	0.0255	0.1293
190	6,113,131	6,384,498	255,872	12,753,501	0.0229	0.1523
200	7,203,384	6,219,371	672,134	14,094,889	0.0254	0.1776
210	6,137,923	6,613,082	388,985	13,139,990	0.0236	0.2013
220	8,073,233	6,420,107	319,880	14,813,220	0.0267	0.2279
230	5,199,221	9,217,357	394,499	14,811,077	0.0267	0.2546
240	5,635,795	5,609,452	251,665	11,496,912	0.0207	0.2753
250	4,840,760	4,690,453	27,801	9,559,014	0.0172	0.2925
260	3,110,439	3,562,881	0	6,673,320	0.0120	0.3045
270	2,274,328	2,735,865	0	5,010,193	0.0090	0.3135
280	1,744,937	2,184,788	0	3,929,725	0.0071	0.3206
290	1,698,648	2,443,332	0	4,141,980	0.0075	0.3280
300	2,382,360	2,360,314	0	4,742,674	0.0085	0.3366
310	2,710,316	2,792,741	27,801	5,530,858	0.0100	0.3465
320	3,323,759	3,683,607	0	7,007,366	0.0126	0.3591
330	5,089,087	4,629,530	0	9,718,617	0.0175	0.3766
340	6,523,350	6,349,380	55,601	12,928,331	0.0233	0.3999
350	8,320,912	7,983,051	55,601	16,359,564	0.0294	0.4293
360	9,039,461	10,904,745	27,801	19,972,007	0.0359	0.4652
370	10,049,669	9,366,119	27,801	19,443,589	0.0350	0.5002
380	8,444,596	8,888,210	27,801	17,360,607	0.0312	0.5315
390	9,177,389	10,005,404	0	19,182,793	0.0345	0.5660
400	7,899,679	6,244,167	0	14,143,846	0.0255	0.5914
410	4,968,596	5,955,652	55,601	10,979,849	0.0198	0.6112
420	4,776,730	3,448,864	0	8,225,594	0.0148	0.6260
430	2,812,946	2,591,619	0	5,404,565	0.0097	0.6357
440	2,811,692	2,147,158	0	4,958,850	0.0089	0.6446
450	2,073,434	2,421,727	28,514	4,523,675	0.0081	0.6528
460	2,645,874	2,398,633	28,514	5,073,021	0.0091	0.6619
470	3,176,911	3,330,260	27,801	6,534,972	0.0118	0.6737
480	4,461,931	3,392,407	27,801	7,882,139	0.0142	0.6879
490	5,202,276	4,814,849	28,514	10,045,639	0.0181	0.7059
500	5,174,292	4,880,041	84,829	10,139,162	0.0182	0.7242
510	6,128,657	4,318,208	27,801	10,474,666	0.0188	0.7430
520	4,426,663	4,948,922	56,315	9,431,900	0.0170	0.7600
530	4,679,755	5,653,330	0	10,333,085	0.0186	0.7786
540	5,478,914	4,666,169	55,601	10,200,684	0.0184	0.7969
550	4,118,811	3,832,360	56,315	8,007,486	0.0144	0.8113

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
560	3,505,117	2,959,910	0	6,465,027	0.0116	0.8230
570	3,837,088	3,229,117	28,514	7,094,719	0.0128	0.8357
580	3,463,653	2,975,346	0	6,438,999	0.0116	0.8473
590	3,376,060	2,601,975	85,542	6,063,577	0.0109	0.8582
600	3,215,643	2,646,256	28,514	5,890,413	0.0106	0.8688
610	2,350,958	2,404,244	28,514	4,783,716	0.0086	0.8775
620	2,288,987	2,210,037	84,829	4,583,853	0.0082	0.8857
630	2,482,644	2,181,005	28,514	4,692,163	0.0084	0.8941
640	2,676,258	2,345,232	28,514	5,050,004	0.0091	0.9032
650	1,943,260	2,293,974	0	4,237,234	0.0076	0.9109
660	2,129,394	2,513,729	0	4,643,123	0.0084	0.9192
670	1,986,319	2,165,336	0	4,151,655	0.0075	0.9267
680	1,936,769	1,808,393	0	3,745,162	0.0067	0.9334
690	1,690,177	2,153,522	0	3,843,699	0.0069	0.9403
700	985,898	1,541,803	0	2,527,701	0.0045	0.9449
710	1,668,121	1,697,868	28,514	3,394,503	0.0061	0.9510
720	940,388	1,546,692	27,801	2,514,881	0.0045	0.9555
730	761,115	901,514	28,514	1,691,143	0.0030	0.9586
740	830,373	881,214	28,514	1,740,101	0.0031	0.9617
750	705,891	847,971	57,028	1,610,890	0.0029	0.9646
760	672,087	687,026	28,514	1,387,627	0.0025	0.9671
770	650,719	270,016	28,514	949,249	0.0017	0.9688
780	499,360	528,881	28,514	1,056,755	0.0019	0.9707
790	522,265	440,801	0	963,066	0.0017	0.9724
800	699,240	716,806	0	1,416,046	0.0025	0.9750
810	321,122	740,831	0	1,061,953	0.0019	0.9769
820	623,397	438,754	0	1,062,151	0.0019	0.9788
830	498,364	286,902	28,514	813,780	0.0015	0.9803
840	473,847	405,410	0	879,257	0.0016	0.9818
850	416,055	367,366	0	783,421	0.0014	0.9833
860	295,350	327,588	28,514	651,452	0.0012	0.9844
870	542,245	647,149	0	1,189,394	0.0021	0.9866
880	269,899	277,368	27,801	575,068	0.0010	0.9876
890	239,938	451,766	0	691,704	0.0012	0.9888
900	200,088	283,190	28,514	511,792	0.0009	0.9898
910	115,746	467,703	0	583,449	0.0010	0.9908
920	194,304	294,685	0	488,989	0.0009	0.9917
930	162,573	536,922	0	699,495	0.0013	0.9930
940	159,002	625,410	57,028	841,440	0.0015	0.9945
950	238,577	378,127	0	616,704	0.0011	0.9956
960	60,898	240,009	0	300,907	0.0005	0.9961
970	97,006	291,932	0	388,938	0.0007	0.9968
980	89,723	273,827	0	363,550	0.0007	0.9975
990	59,419	172,472	0	231,891	0.0004	0.9979
1000	0	407,670	0	407,670	0.0007	0.9986
1010	28,276	229,431	0	257,707	0.0005	0.9991
1020	0	171,593	0	171,593	0.0003	0.9994
1030	0	127,881	0	127,881	0.0002	0.9996
1040	0	30,928	0	30,928	0.0001	0.9997

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
1050	0	77,787	0	77,787	0.0001	0.9998
1060	0	28,172	0	28,172	0.0001	0.9999
1070	0	23,269	0	23,269	0.0000	0.9999
1080	29,654	15,011	0	44,665	0.0001	1.0000
Total	**266,005,735**	**265,253,847**	**24,479,579**	**555,739,161**	**1.0000**	**1.0000**

Appendix Table C 131.-- Population estimates by sex and size by size for Pacific halibut (*Hippoglossus stenolepis*) from the 2023 eastern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
110	0	0	28,562	28,562	0.0003	0.0003
120	0	0	29,527	29,527	0.0003	0.0006
140	28,611	0	35,595	64,206	0.0007	0.0013
150	0	0	31,479	31,479	0.0003	0.0016
160	28,611	0	0	28,611	0.0003	0.0019
170	26,864	0	28,324	55,188	0.0006	0.0025
180	58,138	0	31,479	89,617	0.0009	0.0034
190	122,906	86,748	30,363	240,017	0.0025	0.0060
200	114,444	220,714	57,222	392,380	0.0041	0.0101
210	262,077	58,138	234,142	554,357	0.0058	0.0159
220	380,618	387,248	459,527	1,227,393	0.0129	0.0288
230	204,504	417,934	379,100	1,001,538	0.0105	0.0393
240	558,193	678,916	1,021,206	2,258,315	0.0237	0.0630
250	655,520	508,868	1,292,886	2,457,274	0.0258	0.0887
260	711,100	745,789	1,184,279	2,641,168	0.0277	0.1164
270	437,964	413,890	1,272,130	2,123,984	0.0223	0.1387
280	324,589	403,491	1,230,806	1,958,886	0.0206	0.1593
290	206,041	226,161	991,741	1,423,943	0.0149	0.1742
300	29,175	123,743	622,036	774,954	0.0081	0.1823
310	29,527	29,175	374,099	432,801	0.0045	0.1869
320	0	27,325	63,797	91,122	0.0010	0.1878
340	0	27,210	90,955	118,165	0.0012	0.1891
350	29,111	29,358	105,101	163,570	0.0017	0.1908
360	0	27,210	108,353	135,563	0.0014	0.1922
370	30,135	0	151,595	181,730	0.0019	0.1941
380	59,493	26,864	235,841	322,198	0.0034	0.1975
390	0	29,527	355,960	385,487	0.0040	0.2016
400	75,065	17,158	207,791	300,014	0.0031	0.2047
410	61,838	74,026	694,659	830,523	0.0087	0.2134
420	285,522	109,259	828,707	1,223,488	0.0128	0.2262
430	253,576	56,819	884,168	1,194,563	0.0125	0.2388
440	396,993	121,285	939,247	1,457,525	0.0153	0.2541
450	285,370	267,431	1,132,360	1,685,161	0.0177	0.2717
460	426,737	268,469	1,495,444	2,190,650	0.0230	0.2947
470	493,558	175,729	2,378,580	3,047,867	0.0320	0.3267
480	821,237	484,154	2,353,106	3,658,497	0.0384	0.3651
490	759,102	549,766	3,361,978	4,670,846	0.0490	0.4141
500	881,240	399,511	2,881,863	4,162,614	0.0437	0.4578
510	979,115	545,907	3,699,786	5,224,808	0.0548	0.5126
520	1,051,600	520,287	3,478,984	5,050,871	0.0530	0.5656
530	1,049,249	461,761	4,058,725	5,569,735	0.0584	0.6240
540	866,071	867,129	3,259,780	4,992,980	0.0524	0.6764
550	426,127	949,820	3,173,957	4,549,904	0.0477	0.7241
560	802,270	853,096	2,570,006	4,225,372	0.0443	0.7684
570	350,978	635,371	1,388,213	2,374,562	0.0249	0.7933
580	456,674	342,449	1,273,477	2,072,600	0.0217	0.8151

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
590	379,440	413,249	1,097,104	1,889,793	0.0198	0.8349
600	174,282	317,718	956,472	1,448,472	0.0152	0.8501
610	65,210	463,076	813,237	1,341,523	0.0141	0.8642
620	141,373	460,061	691,903	1,293,337	0.0136	0.8778
630	85,755	302,094	530,460	918,309	0.0096	0.8874
640	164,263	296,651	441,360	902,274	0.0095	0.8968
650	104,716	154,434	532,367	791,517	0.0083	0.9052
660	168,524	140,058	670,159	978,741	0.0103	0.9154
670	99,962	165,531	411,880	677,373	0.0071	0.9225
680	112,969	225,469	242,987	581,425	0.0061	0.9286
690	112,601	143,262	287,280	543,143	0.0057	0.9343
700	57,653	94,501	436,429	588,583	0.0062	0.9405
710	57,217	177,498	209,688	444,403	0.0047	0.9452
720	146,238	62,405	120,958	329,601	0.0035	0.9486
730	54,191	82,938	149,793	286,922	0.0030	0.9516
740	27,671	65,749	184,932	278,352	0.0029	0.9546
750	54,712	99,035	172,812	326,559	0.0034	0.9580
760	58,238	21,999	110,865	191,102	0.0020	0.9600
770	75,002	77,877	125,877	278,756	0.0029	0.9629
780	0	45,510	107,146	152,656	0.0016	0.9645
790	58,606	85,217	240,239	384,062	0.0040	0.9685
800	0	28,172	129,872	158,044	0.0017	0.9702
810	0	28,886	82,356	111,242	0.0012	0.9714
820	26,061	29,111	56,053	111,225	0.0012	0.9725
830	0	0	294,386	294,386	0.0031	0.9756
840	0	79,147	55,663	134,810	0.0014	0.9770
850	28,380	0	159,350	187,730	0.0020	0.9790
860	18,847	111,091	170,500	300,438	0.0032	0.9822
870	0	0	148,092	148,092	0.0016	0.9837
880	28,553	62,138	0	90,691	0.0010	0.9847
890	29,393	18,475	0	47,868	0.0005	0.9852
900	0	46,755	58,749	105,504	0.0011	0.9863
910	0	0	76,494	76,494	0.0008	0.9871
930	0	46,704	55,594	102,298	0.0011	0.9881
940	28,468	156,053	43,688	228,209	0.0024	0.9905
950	0	0	15,918	15,918	0.0002	0.9907
960	46,848	18,475	17,797	83,120	0.0009	0.9916
970	0	87,943	29,255	117,198	0.0012	0.9928
980	0	45,980	0	45,980	0.0005	0.9933
990	0	57,789	16,115	73,904	0.0008	0.9941
1000	0	87,139	28,563	115,702	0.0012	0.9953
1010	31,063	15,491	0	46,554	0.0005	0.9958
1020	0	0	28,958	28,958	0.0003	0.9961
1030	0	15,491	0	15,491	0.0002	0.9962
1050	0	29,358	0	29,358	0.0003	0.9965
1060	17,158	0	55,323	72,481	0.0008	0.9973
1070	0	18,456	29,568	48,024	0.0005	0.9978
1080	0	0	27,587	27,587	0.0003	0.9981
1090	0	27,592	0	27,592	0.0003	0.9984

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
1100	0	0	16,177	16,177	0.0002	0.9986
1130	0	29,255	0	29,255	0.0003	0.9989
1150	0	0	17,797	17,797	0.0002	0.9990
1280	0	26,128	0	26,128	0.0003	0.9993
1300	0	0	46,029	46,029	0.0005	0.9998
1430	0	18,890	0	18,890	0.0002	1.0000
Total	**17,473,337**	**17,146,587**	**60,700,768**	**95,320,692**	**1.0000**	**1.0000**

Appendix Table C 132.-- Population estimates by sex and size by size for walleye pollock (*Gadus chalcogrammus*) from the 2023 eastern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
70	0	0	497,800	497,800	0.0001	0.0001
80	57,680	0	2,969,397	3,027,077	0.0005	0.0006
90	115,360	0	19,926,478	20,041,838	0.0035	0.0041
100	259,560	0	42,314,374	42,573,934	0.0075	0.0116
110	593,269	114,571	65,567,760	66,275,600	0.0117	0.0233
120	430,966	0	87,247,186	87,678,152	0.0154	0.0387
130	457,139	1,089,750	88,789,767	90,336,656	0.0159	0.0546
140	1,475,828	1,321,145	76,278,570	79,075,543	0.0139	0.0685
150	3,302,316	3,590,353	54,384,266	61,276,935	0.0108	0.0793
160	5,053,404	3,131,947	34,167,487	42,352,838	0.0074	0.0867
170	2,132,401	3,361,689	11,221,006	16,715,096	0.0029	0.0897
180	1,491,776	1,783,532	3,105,454	6,380,762	0.0011	0.0908
190	2,021,366	2,853,065	2,353,335	7,227,766	0.0013	0.0921
200	4,270,857	5,735,261	1,342,757	11,348,875	0.0020	0.0941
210	9,171,568	12,174,858	1,427,766	22,774,192	0.0040	0.0981
220	22,677,822	20,788,559	1,176,085	44,642,466	0.0079	0.1059
230	21,861,235	26,222,607	799,334	48,883,176	0.0086	0.1145
240	24,150,790	24,913,289	596,356	49,660,435	0.0087	0.1233
250	19,671,377	16,126,611	268,316	36,066,304	0.0063	0.1296
260	14,112,925	15,460,086	146,410	29,719,421	0.0052	0.1348
270	11,924,204	16,763,851	58,744	28,746,799	0.0051	0.1399
280	17,373,016	12,315,272	469,953	30,158,241	0.0053	0.1452
290	15,435,450	16,941,408	0	32,376,858	0.0057	0.1509
300	20,867,423	15,374,192	0	36,241,615	0.0064	0.1573
310	17,194,671	18,044,297	0	35,238,968	0.0062	0.1635
320	13,677,572	16,781,058	146,410	30,605,040	0.0054	0.1688
330	12,899,920	11,808,506	0	24,708,426	0.0043	0.1732
340	11,679,922	16,557,763	0	28,237,685	0.0050	0.1781
350	18,355,778	14,151,261	41,682	32,548,721	0.0057	0.1839
360	34,899,480	22,797,314	0	57,696,794	0.0101	0.1940
370	52,529,266	37,675,533	0	90,204,799	0.0159	0.2099
380	113,308,201	70,646,215	0	183,954,416	0.0324	0.2422
390	144,631,341	115,053,358	0	259,684,699	0.0457	0.2879
400	184,011,331	154,257,936	27,712	338,296,979	0.0595	0.3474
410	213,150,540	208,268,821	392,365	421,811,726	0.0742	0.4216
420	177,495,959	219,579,965	0	397,075,924	0.0698	0.4915
430	168,456,693	195,765,374	0	364,222,067	0.0641	0.5555
440	137,967,217	163,620,716	0	301,587,933	0.0530	0.6086
450	98,297,736	133,894,056	0	232,191,792	0.0408	0.6494
460	114,192,508	108,370,619	0	222,563,127	0.0391	0.6885
470	112,615,509	109,505,628	0	222,121,137	0.0391	0.7276
480	94,438,958	88,380,137	0	182,819,095	0.0322	0.7598
490	105,585,568	75,273,044	0	180,858,612	0.0318	0.7916
500	90,226,928	94,458,104	0	184,685,032	0.0325	0.8241
510	78,408,356	88,961,327	0	167,369,683	0.0294	0.8535
520	79,800,111	94,521,790	0	174,321,901	0.0307	0.8842

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
530	54,670,416	99,079,064	0	153,749,480	0.0270	0.9112
540	42,385,389	79,757,257	0	122,142,646	0.0215	0.9327
550	32,780,258	66,623,005	0	99,403,263	0.0175	0.9502
560	23,312,658	52,932,524	0	76,245,182	0.0134	0.9636
570	19,221,040	41,426,733	0	60,647,773	0.0107	0.9742
580	9,472,172	27,570,066	0	37,042,238	0.0065	0.9808
590	8,419,266	24,727,467	0	33,146,733	0.0058	0.9866
600	4,838,496	16,352,621	0	21,191,117	0.0037	0.9903
610	3,025,415	12,231,149	0	15,256,564	0.0027	0.9930
620	3,200,444	11,041,627	0	14,242,071	0.0025	0.9955
630	1,403,155	7,477,334	0	8,880,489	0.0016	0.9971
640	1,228,736	4,620,120	0	5,848,856	0.0010	0.9981
650	671,152	3,009,698	0	3,680,850	0.0006	0.9987
660	319,931	2,032,091	0	2,352,022	0.0004	0.9992
670	383,773	982,249	0	1,366,022	0.0002	0.9994
680	534,984	923,430	0	1,458,414	0.0003	0.9997
690	30,140	502,185	0	532,325	0.0001	0.9997
700	112,576	87,490	0	200,066	0.0000	0.9998
710	90,309	242,511	0	332,820	0.0001	0.9998
720	0	494,160	0	494,160	0.0001	0.9999
730	147,703	60,446	0	208,149	0.0000	1.0000
740	29,472	85,076	0	114,548	0.0000	1.0000
750	0	30,933	0	30,933	0.0000	1.0000
760	0	50,149	0	50,149	0.0000	1.0000
Total	**2,479,008,782**	**2,710,774,253**	**495,716,770**	**5,685,499,805**	**1.0000**	**1.0000**

Appendix Table C 133.-- Population estimates by sex and size by size for yellowfin sole (*Limanda aspera*) from the 2023 eastern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
90	155,465	766,467	3,810,748	4,732,680	0.0009	0.0009
100	2,729,237	1,781,824	2,751,350	7,262,411	0.0013	0.0022
110	9,061,577	15,696,216	17,027,087	41,784,880	0.0075	0.0097
120	18,928,781	34,167,993	24,881,605	77,978,379	0.0140	0.0237
130	33,821,467	40,787,065	32,700,681	107,309,213	0.0193	0.0429
140	30,195,574	36,379,233	25,055,895	91,630,702	0.0165	0.0594
150	37,775,273	37,662,529	20,592,349	96,030,151	0.0172	0.0766
160	44,128,899	45,757,718	9,641,948	99,528,565	0.0179	0.0945
170	71,686,212	69,196,827	6,972,649	147,855,688	0.0266	0.1211
180	66,396,036	78,105,614	8,169,440	152,671,090	0.0274	0.1485
190	98,236,629	95,647,529	1,195,130	195,079,288	0.0350	0.1835
200	101,414,971	106,569,782	3,255,296	211,240,049	0.0379	0.2215
210	100,187,394	123,531,619	2,948,486	226,667,499	0.0407	0.2622
220	116,106,239	116,545,447	4,914,144	237,565,830	0.0427	0.3049
230	139,661,760	157,078,747	4,914,144	301,654,651	0.0542	0.3590
240	136,463,765	142,239,417	3,160,787	281,863,969	0.0506	0.4097
250	147,483,238	143,015,721	6,321,574	296,820,533	0.0533	0.4630
260	156,589,073	155,412,301	212,301	312,213,675	0.0561	0.5191
270	169,163,816	148,184,787	4,355,917	321,704,520	0.0578	0.5768
280	140,764,456	152,778,400	7,092,102	300,634,958	0.0540	0.6308
290	148,424,057	150,129,765	3,585,389	302,139,211	0.0543	0.6851
300	116,357,261	140,805,422	4,992,819	262,155,502	0.0471	0.7322
310	99,269,978	130,563,601	3,451,763	233,285,342	0.0419	0.7741
320	122,664,437	104,394,755	5,126,445	232,185,637	0.0417	0.8158
330	115,811,110	113,724,271	5,496,095	235,031,476	0.0422	0.8580
340	91,786,065	114,719,671	6,321,574	212,827,310	0.0382	0.8962
350	60,825,316	144,945,817	4,992,819	210,763,952	0.0379	0.9341
360	24,250,537	106,648,336	5,338,746	136,237,619	0.0245	0.9586
370	8,368,127	74,558,364	3,373,088	86,299,579	0.0155	0.9741
380	3,653,368	59,095,662	2,177,958	64,926,988	0.0117	0.9857
390	4,005,689	32,103,185	982,829	37,091,703	0.0067	0.9924
400	1,055,654	13,639,722	0	14,695,376	0.0026	0.9950
410	503,630	16,029,271	0	16,532,901	0.0030	0.9980
420	428,677	4,971,033	0	5,399,710	0.0010	0.9990
430	0	3,749,732	0	3,749,732	0.0007	0.9996
440	0	645,180	0	645,180	0.0001	0.9997
450	0	295,430	0	295,430	0.0001	0.9998
460	0	1,104,704	0	1,104,704	0.0002	1.0000
Total	**2,418,353,768**	**2,913,429,157**	**235,813,158**	**5,567,596,083**	**1.0000**	**1.0000**

Appendix D: List of population estimates by sex and size group for principal fish species in the northern Bering Sea

Appendix D presents population estimates by sex and length from the 2023 northern Bering Sea bottom trawl survey for principal fish species.

List of Tables

Appendix Table D 134.-- Population estimates by sex and size by size for Alaska plaice (*Pleuronectes quadrituberculatus*) from the 2023 northern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
70	0	0	66,838	66,838	0.0001	0.0001
80	0	0	162,029	162,029	0.0003	0.0004
90	681,877	182,661	1,997,329	2,861,867	0.0050	0.0053
100	959,790	578,466	4,487,660	6,025,916	0.0104	0.0158
110	2,289,178	3,290,020	5,966,051	11,545,249	0.0200	0.0357
120	7,360,527	5,706,084	4,258,713	17,325,324	0.0300	0.0657
130	8,862,131	9,264,024	4,374,260	22,500,415	0.0389	0.1046
140	7,483,389	8,678,211	1,786,034	17,947,634	0.0310	0.1357
150	7,757,892	6,923,009	1,056,245	15,737,146	0.0272	0.1629
160	5,668,657	6,830,594	280,932	12,780,183	0.0221	0.1850
170	6,814,918	6,020,371	309,347	13,144,636	0.0227	0.2077
180	4,450,453	5,016,698	247,478	9,714,629	0.0168	0.2245
190	5,397,144	5,641,171	247,478	11,285,793	0.0195	0.2441
200	5,399,130	4,125,076	309,347	9,833,553	0.0170	0.2611
210	3,155,376	6,392,257	123,739	9,671,372	0.0167	0.2778
220	4,956,752	4,891,925	61,869	9,910,546	0.0171	0.2949
230	3,416,003	6,404,827	61,869	9,882,699	0.0171	0.3120
240	3,781,199	4,889,004	0	8,670,203	0.0150	0.3270
250	5,327,122	6,423,607	0	11,750,729	0.0203	0.3474
260	5,100,281	6,153,242	0	11,253,523	0.0195	0.3668
270	4,667,748	3,000,410	0	7,668,158	0.0133	0.3801
280	4,539,727	4,568,519	0	9,108,246	0.0158	0.3958
290	5,939,343	5,314,228	0	11,253,571	0.0195	0.4153
300	6,856,178	4,315,536	0	11,171,714	0.0193	0.4346
310	9,355,775	7,225,591	0	16,581,366	0.0287	0.4633
320	10,176,743	5,064,994	0	15,241,737	0.0264	0.4897
330	11,292,718	7,645,047	0	18,937,765	0.0328	0.5224
340	16,425,664	5,785,107	0	22,210,771	0.0384	0.5608
350	23,744,895	6,272,347	0	30,017,242	0.0519	0.6128
360	24,062,188	5,783,258	0	29,845,446	0.0516	0.6644
370	23,819,065	5,144,210	0	28,963,275	0.0501	0.7145
380	19,096,989	6,407,229	0	25,504,218	0.0441	0.7586
390	13,751,659	8,218,358	0	21,970,017	0.0380	0.7966
400	9,312,458	8,601,839	0	17,914,297	0.0310	0.8276
410	4,504,070	10,726,944	0	15,231,014	0.0263	0.8539
420	1,824,162	11,686,411	0	13,510,573	0.0234	0.8773
430	1,348,255	8,127,782	0	9,476,037	0.0164	0.8937
440	158,021	11,749,428	0	11,907,449	0.0206	0.9143
450	77,897	9,788,680	0	9,866,577	0.0171	0.9313
460	0	8,732,410	0	8,732,410	0.0151	0.9465
470	0	9,235,088	0	9,235,088	0.0160	0.9624
480	0	7,542,938	0	7,542,938	0.0130	0.9755
490	0	3,970,631	0	3,970,631	0.0069	0.9823
500	0	3,651,687	0	3,651,687	0.0063	0.9887
510	0	1,660,983	0	1,660,983	0.0029	0.9915
520	0	1,610,695	0	1,610,695	0.0028	0.9943

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
530	0	1,950,901	0	1,950,901	0.0034	0.9977
540	0	770,678	0	770,678	0.0013	0.9990
550	0	91,967	0	91,967	0.0002	0.9992
560	0	279,141	0	279,141	0.0005	0.9997
570	0	93,559	0	93,559	0.0002	0.9998
580	0	66,539	0	66,539	0.0001	0.9999
600	0	32,484	0	32,484	0.0001	1.0000
Total	**279,815,374**	**272,526,866**	**25,797,218**	**578,139,458**	**1.0000**	**1.0000**

Appendix Table D 135.-- Population estimates by sex and size by size for Bering flounder (*Hippoglossoides robustus*) from the 2023 northern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
50	0	0	387,856	387,856	0.0036	0.0036
60	0	0	750,817	750,817	0.0070	0.0106
70	0	0	572,444	572,444	0.0053	0.0160
80	33,054	0	1,551,269	1,584,323	0.0148	0.0308
90	35,699	0	11,415,643	11,451,342	0.1069	0.1377
100	266,914	136,250	26,058,651	26,461,815	0.2471	0.3848
110	245,586	85,108	15,584,129	15,914,823	0.1486	0.5335
120	404,438	646,908	2,664,290	3,715,636	0.0347	0.5682
130	1,084,757	1,034,345	2,280,421	4,399,523	0.0411	0.6093
140	2,421,710	2,325,288	1,291,826	6,038,824	0.0564	0.6657
150	2,860,511	2,768,112	1,327,185	6,955,808	0.0650	0.7306
160	2,428,920	1,482,763	0	3,911,683	0.0365	0.7671
170	1,180,826	1,501,521	0	2,682,347	0.0251	0.7922
180	2,054,875	1,434,272	216,967	3,706,114	0.0346	0.8268
190	1,051,916	1,895,430	46,609	2,993,955	0.0280	0.8548
200	670,961	1,665,854	46,609	2,383,424	0.0223	0.8770
210	223,363	1,675,831	0	1,899,194	0.0177	0.8948
220	179,823	1,700,065	0	1,879,888	0.0176	0.9123
230	181,343	1,483,586	46,609	1,711,538	0.0160	0.9283
240	230,811	1,233,243	93,218	1,557,272	0.0145	0.9428
250	44,689	980,714	93,218	1,118,621	0.0104	0.9533
260	88,048	729,037	46,609	863,694	0.0081	0.9614
270	42,313	480,445	0	522,758	0.0049	0.9662
280	0	398,777	46,609	445,386	0.0042	0.9704
290	0	166,443	0	166,443	0.0016	0.9719
300	44,505	400,948	0	445,453	0.0042	0.9761
310	42,477	339,774	0	382,251	0.0036	0.9797
320	0	254,572	0	254,572	0.0024	0.9821
330	0	220,180	0	220,180	0.0021	0.9841
340	0	340,187	0	340,187	0.0032	0.9873
350	0	253,321	0	253,321	0.0024	0.9897
360	0	439,771	46,609	486,380	0.0045	0.9942
370	0	354,648	0	354,648	0.0033	0.9975
380	0	129,873	0	129,873	0.0012	0.9987
390	0	45,515	0	45,515	0.0004	0.9991
400	0	0	46,609	46,609	0.0004	0.9996
420	0	44,689	0	44,689	0.0004	1.0000
Total	**15,817,539**	**26,647,470**	**64,614,197**	**107,079,206**	**1.0000**	**1.0000**

Appendix Table D 136.-- Population estimates by sex and size by size for flathead sole (*Hippoglossoides elassodon*) from the 2023 northern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
180	0	46,597	0	46,597	0.2087	0.2087
210	0	41,487	0	41,487	0.1858	0.3944
230	0	41,487	0	41,487	0.1858	0.5802
240	47,143	0	0	47,143	0.2111	0.7913
380	0	46,609	0	46,609	0.2087	1.0000
Total	**47,143**	**176,180**	**0**	**223,323**	**1.0000**	**1.0000**

Appendix Table D 137.-- Population estimates by sex and size by size for Greenland turbot (*Reinhardtius hippoglossoides*) from the 2023 northern Bering Sea bottom trawl survey.

Length (cm)	Unsexed	Males	Females	Total	Proportion	Cumulative proportion
110	30,950	0	0	30,950	0.3420	0.3420
130	30,950	0	0	30,950	0.3420	0.6839
140	28,610	0	0	28,610	0.3161	1.0000
Total	**90,510**	**0**	**0**	**90,510**	**1.0000**	**1.0000**

Appendix Table D 138.-- Population estimates by sex and size by size for northern rock sole (*Lepidopsetta polyxystra*) from the 2023 northern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
10	49,531	0	0	49,531	0.0006	0.0006
60	0	0	242,374	242,374	0.0027	0.0033
70	0	0	184,961	184,961	0.0021	0.0054
80	0	262,069	2,429,405	2,691,474	0.0303	0.0356
90	188,858	645,190	7,724,638	8,558,686	0.0963	0.1319
100	451,889	584,452	4,027,901	5,064,242	0.0570	0.1889
110	233,168	250,162	1,032,200	1,515,530	0.0170	0.2059
120	385,731	565,750	376,340	1,327,821	0.0149	0.2208
130	769,146	729,609	467,788	1,966,543	0.0221	0.2430
140	641,102	808,490	281,938	1,731,530	0.0195	0.2624
150	473,655	538,905	91,085	1,103,645	0.0124	0.2748
160	195,405	177,560	0	372,965	0.0042	0.2790
170	143,747	164,663	0	308,410	0.0035	0.2825
180	177,156	247,028	0	424,184	0.0048	0.2873
190	221,642	533,855	0	755,497	0.0085	0.2958
200	273,693	227,050	0	500,743	0.0056	0.3014
210	107,924	92,713	0	200,637	0.0023	0.3037
220	258,312	269,814	0	528,126	0.0059	0.3096
230	101,367	154,577	0	255,944	0.0029	0.3125
240	235,021	346,954	0	581,975	0.0065	0.3190
250	566,628	468,418	0	1,035,046	0.0116	0.3307
260	661,215	724,063	0	1,385,278	0.0156	0.3462
270	1,347,987	1,556,244	0	2,904,231	0.0327	0.3789
280	1,812,909	1,268,924	0	3,081,833	0.0347	0.4136
290	3,779,800	1,771,547	0	5,551,347	0.0624	0.4760
300	3,247,056	2,616,462	0	5,863,518	0.0659	0.5420
310	3,105,391	3,650,052	0	6,755,443	0.0760	0.6179
320	1,674,857	3,440,458	0	5,115,315	0.0575	0.6755
330	848,278	4,287,778	0	5,136,056	0.0578	0.7332
340	1,082,350	3,536,582	0	4,618,932	0.0520	0.7852
350	454,237	2,218,676	0	2,672,913	0.0301	0.8153
360	175,284	1,445,725	0	1,621,009	0.0182	0.8335
370	173,425	2,618,131	0	2,791,556	0.0314	0.8649
380	129,494	2,456,976	0	2,586,470	0.0291	0.8940
390	35,635	2,975,271	0	3,010,906	0.0339	0.9278
400	0	2,129,506	0	2,129,506	0.0240	0.9518
410	0	1,529,380	0	1,529,380	0.0172	0.9690
420	171,258	1,095,674	0	1,266,932	0.0142	0.9832
430	0	478,927	0	478,927	0.0054	0.9886
440	0	398,253	0	398,253	0.0045	0.9931
450	0	254,939	0	254,939	0.0029	0.9960
460	0	242,529	0	242,529	0.0027	0.9987
470	0	30,160	0	30,160	0.0003	0.9990
490	54,234	0	0	54,234	0.0006	0.9996
510	0	31,455	0	31,455	0.0004	1.0000

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
Total	**24,227,385**	**47,824,971**	**16,858,630**	**88,910,986**	**1.0000**	**1.0000**

Appendix Table D 139.-- Population estimates by sex and size by size for Pacific cod (*Gadus macrocephalus*) from the 2023 northern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
100	31,107	0	0	31,107	0.0006	0.0006
110	0	0	34,366	34,366	0.0007	0.0013
120	43,678	0	60,840	104,518	0.0020	0.0033
130	190,965	144,111	162,108	497,184	0.0095	0.0128
140	396,138	525,461	248,748	1,170,347	0.0224	0.0352
150	1,191,663	693,996	321,663	2,207,322	0.0423	0.0775
160	850,910	527,377	242,117	1,620,404	0.0310	0.1085
170	427,617	644,550	60,529	1,132,696	0.0217	0.1302
180	441,680	472,413	30,265	944,358	0.0181	0.1483
190	395,076	354,530	0	749,606	0.0144	0.1627
200	380,408	262,249	0	642,657	0.0123	0.1750
210	222,926	258,652	0	481,578	0.0092	0.1842
220	43,876	174,981	0	218,857	0.0042	0.1884
230	113,414	90,959	0	204,373	0.0039	0.1923
240	213,661	209,292	0	422,953	0.0081	0.2005
250	288,753	235,483	0	524,236	0.0100	0.2105
260	239,671	135,780	0	375,451	0.0072	0.2177
270	179,822	459,221	0	639,043	0.0122	0.2299
280	423,540	383,494	0	807,034	0.0155	0.2454
290	529,470	502,441	0	1,031,911	0.0198	0.2652
300	245,166	423,660	0	668,826	0.0128	0.2780
310	447,551	552,736	0	1,000,287	0.0192	0.2971
320	358,781	562,699	0	921,480	0.0177	0.3148
330	345,642	258,837	0	604,479	0.0116	0.3264
340	351,389	321,214	0	672,603	0.0129	0.3393
350	136,515	408,987	0	545,502	0.0105	0.3497
360	302,890	128,057	0	430,947	0.0083	0.3580
370	413,367	272,540	0	685,907	0.0131	0.3711
380	136,298	134,417	0	270,715	0.0052	0.3763
390	111,468	187,312	0	298,780	0.0057	0.3820
400	0	44,256	0	44,256	0.0008	0.3829
410	0	92,318	0	92,318	0.0018	0.3846
420	0	89,738	0	89,738	0.0017	0.3864
430	132,591	88,394	0	220,985	0.0042	0.3906
440	48,061	48,061	0	96,122	0.0018	0.3924
450	194,676	178,132	0	372,808	0.0071	0.3996
460	236,387	83,734	0	320,121	0.0061	0.4057
470	89,178	102,295	0	191,473	0.0037	0.4094
480	193,304	220,585	0	413,889	0.0079	0.4173
490	268,786	313,731	0	582,517	0.0112	0.4285
500	222,310	144,002	0	366,312	0.0070	0.4355
510	550,169	169,752	0	719,921	0.0138	0.4493

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
520	274,164	516,014	0	790,178	0.0151	0.4644
530	505,528	637,920	0	1,143,448	0.0219	0.4863
540	799,244	366,926	0	1,166,170	0.0223	0.5087
550	563,507	482,137	0	1,045,644	0.0200	0.5287
560	363,989	651,646	0	1,015,635	0.0195	0.5482
570	1,036,087	1,010,892	0	2,046,979	0.0392	0.5874
580	654,351	475,823	0	1,130,174	0.0217	0.6090
590	881,617	578,013	0	1,459,630	0.0280	0.6370
600	1,061,610	569,854	0	1,631,464	0.0313	0.6683
610	898,526	806,404	0	1,704,930	0.0327	0.7009
620	697,041	829,065	0	1,526,106	0.0292	0.7302
630	764,864	802,853	0	1,567,717	0.0300	0.7602
640	585,684	705,295	0	1,290,979	0.0247	0.7849
650	650,616	539,219	0	1,189,835	0.0228	0.8077
660	455,784	588,385	0	1,044,169	0.0200	0.8277
670	545,221	227,783	0	773,004	0.0148	0.8426
680	365,367	243,486	0	608,853	0.0117	0.8542
690	86,727	292,599	0	379,326	0.0073	0.8615
700	369,033	406,409	0	775,442	0.0149	0.8763
710	340,456	254,680	0	595,136	0.0114	0.8877
720	279,924	162,536	0	442,460	0.0085	0.8962
730	408,422	176,557	0	584,979	0.0112	0.9074
740	153,787	152,524	0	306,311	0.0059	0.9133
750	157,193	213,168	0	370,361	0.0071	0.9204
760	246,240	131,547	0	377,787	0.0072	0.9276
770	305,871	42,418	0	348,289	0.0067	0.9343
780	166,535	135,027	0	301,562	0.0058	0.9401
790	76,158	124,973	0	201,131	0.0039	0.9439
800	90,821	128,041	0	218,862	0.0042	0.9481
810	78,092	152,922	0	231,014	0.0044	0.9526
820	110,060	32,141	0	142,201	0.0027	0.9553
830	102,085	47,143	0	149,228	0.0029	0.9581
840	75,889	109,034	0	184,923	0.0035	0.9617
850	108,542	139,222	0	247,764	0.0047	0.9664
860	135,752	172,260	0	308,012	0.0059	0.9723
870	45,571	94,888	0	140,459	0.0027	0.9750
880	69,026	44,256	0	113,282	0.0022	0.9772
890	50,821	75,381	0	126,202	0.0024	0.9796
900	0	167,417	0	167,417	0.0032	0.9828
910	0	251,651	0	251,651	0.0048	0.9876
920	0	196,789	0	196,789	0.0038	0.9914
930	32,172	118,509	0	150,681	0.0029	0.9943
940	0	120,566	0	120,566	0.0023	0.9966
950	0	35,205	0	35,205	0.0007	0.9973
970	62,130	0	0	62,130	0.0012	0.9985
980	0	79,627	0	79,627	0.0015	1.0000
Total	**26,043,411**	**24,989,652**	**1,160,636**	**52,193,699**	**1.0000**	**1.0000**

Appendix Table D 140.-- Population estimates by sex and size by size for Pacific halibut (*Hippoglossus stenolepis*) from the 2023 northern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
220	0	0	47,224	47,224	0.0064	0.0064
300	0	0	40,459	40,459	0.0054	0.0118
310	0	0	40,459	40,459	0.0054	0.0173
330	0	0	40,459	40,459	0.0054	0.0227
390	0	0	40,459	40,459	0.0054	0.0282
420	0	0	127,105	127,105	0.0171	0.0453
430	0	0	38,189	38,189	0.0051	0.0504
450	49,550	0	166,161	215,711	0.0291	0.0795
460	0	0	80,919	80,919	0.0109	0.0904
470	0	0	47,224	47,224	0.0064	0.0967
480	0	0	119,108	119,108	0.0160	0.1128
490	46,135	0	251,983	298,118	0.0402	0.1529
500	0	43,747	240,486	284,233	0.0383	0.1912
510	0	46,135	318,236	364,371	0.0491	0.2403
520	0	43,150	291,640	334,790	0.0451	0.2854
530	0	46,135	255,914	302,049	0.0407	0.3260
540	46,135	47,143	373,484	466,762	0.0629	0.3889
550	46,135	46,860	380,284	473,279	0.0637	0.4527
560	0	31,107	500,114	531,221	0.0715	0.5242
570	0	0	323,837	323,837	0.0436	0.5678
580	0	0	370,781	370,781	0.0499	0.6178
590	0	0	321,053	321,053	0.0432	0.6610
600	0	0	310,214	310,214	0.0418	0.7028
610	46,135	0	331,765	377,900	0.0509	0.7537
620	0	0	367,619	367,619	0.0495	0.8032
630	0	43,150	148,100	191,250	0.0258	0.8289
640	0	0	173,035	173,035	0.0233	0.8522
650	0	0	127,679	127,679	0.0172	0.8694
660	0	0	81,207	81,207	0.0109	0.8804
670	0	0	42,463	42,463	0.0057	0.8861
680	0	0	129,130	129,130	0.0174	0.9035
690	0	35,222	46,186	81,408	0.0110	0.9145
700	0	0	28,442	28,442	0.0038	0.9183
710	0	0	42,463	42,463	0.0057	0.9240
730	0	0	48,530	48,530	0.0065	0.9305
740	0	0	48,530	48,530	0.0065	0.9371
750	0	0	40,459	40,459	0.0054	0.9425
770	82,051	0	0	82,051	0.0111	0.9536
790	0	0	42,586	42,586	0.0057	0.9593
880	0	0	38,102	38,102	0.0051	0.9644
940	0	0	66,908	66,908	0.0090	0.9735
990	0	0	44,103	44,103	0.0059	0.9794
1050	0	0	38,189	38,189	0.0051	0.9845
1060	0	0	40,459	40,459	0.0054	0.9900
1070	0	0	44,103	44,103	0.0059	0.9959
1080	0	0	30,265	30,265	0.0041	1.0000

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
Total	316,141	382,649	6,726,115	7,424,905	1.0000	1.0000

Appendix Table D 141.-- Population estimates by sex and size by size for walleye pollock (*Gadus chalcogrammus*) from the 2023 northern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
70	0	0	41,497	41,497	0.0000	0.0000
80	0	0	99,800	99,800	0.0001	0.0002
90	0	0	6,528,727	6,528,727	0.0071	0.0073
100	130,821	0	45,955,810	46,086,631	0.0504	0.0576
110	98,116	0	108,387,997	108,486,113	0.1185	0.1762
120	425,908	1,099,837	142,485,618	144,011,363	0.1574	0.3335
130	1,080,728	3,039,876	142,774,395	146,894,999	0.1605	0.4941
140	932,565	2,505,960	74,716,296	78,154,821	0.0854	0.5795
150	2,020,418	2,822,712	13,487,519	18,330,649	0.0200	0.5995
160	1,069,201	1,115,248	2,212,143	4,396,592	0.0048	0.6043
170	218,441	96,123	175,205	489,769	0.0005	0.6048
180	32,705	126,479	77,875	237,059	0.0003	0.6051
190	262,415	96,153	188,585	547,153	0.0006	0.6057
200	35,699	0	0	35,699	0.0000	0.6057
210	32,737	78,450	44,666	155,853	0.0002	0.6059
220	31,653	0	0	31,653	0.0000	0.6059
230	41,487	32,705	0	74,192	0.0001	0.6060
250	90,026	144,184	0	234,210	0.0003	0.6063
260	43,974	0	0	43,974	0.0000	0.6063
300	0	45,713	0	45,713	0.0000	0.6064
350	37,743	0	0	37,743	0.0000	0.6064
370	0	93,855	0	93,855	0.0001	0.6065
390	85,807	0	0	85,807	0.0001	0.6066
400	89,355	157,966	0	247,321	0.0003	0.6069
410	175,354	233,934	0	409,288	0.0004	0.6073
420	164,819	176,103	0	340,922	0.0004	0.6077
430	896,946	653,227	0	1,550,173	0.0017	0.6094
440	2,204,442	806,289	0	3,010,731	0.0033	0.6127
450	5,965,922	1,675,729	0	7,641,651	0.0083	0.6210
460	10,273,683	5,139,572	0	15,413,255	0.0168	0.6379
470	12,750,001	7,930,265	0	20,680,266	0.0226	0.6605
480	17,463,143	12,622,659	0	30,085,802	0.0329	0.6933
490	16,011,534	14,788,485	0	30,800,019	0.0337	0.7270
500	14,532,164	17,743,061	0	32,275,225	0.0353	0.7623
510	14,140,157	20,257,116	0	34,397,273	0.0376	0.7998
520	13,164,704	18,480,002	0	31,644,706	0.0346	0.8344
530	7,928,574	17,301,358	0	25,229,932	0.0276	0.8620
540	6,395,021	14,165,908	0	20,560,929	0.0225	0.8845
550	7,604,873	11,808,563	0	19,413,436	0.0212	0.9057
560	3,945,602	8,742,974	0	12,688,576	0.0139	0.9195
570	5,084,540	11,115,150	0	16,199,690	0.0177	0.9372
580	3,153,872	7,028,994	0	10,182,866	0.0111	0.9484
590	4,055,356	5,889,564	0	9,944,920	0.0109	0.9592
600	2,419,319	5,414,373	0	7,833,692	0.0086	0.9678
610	2,170,689	4,141,019	0	6,311,708	0.0069	0.9747
620	1,258,507	4,534,852	0	5,793,359	0.0063	0.9810

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
630	881,645	3,078,370	0	3,960,015	0.0043	0.9853
640	595,611	2,996,552	0	3,592,163	0.0039	0.9893
650	349,651	2,725,923	0	3,075,574	0.0034	0.9926
660	325,817	1,902,131	0	2,227,948	0.0024	0.9951
670	183,362	1,403,926	0	1,587,288	0.0017	0.9968
680	286,384	806,730	0	1,093,114	0.0012	0.9980
690	31,446	473,874	0	505,320	0.0006	0.9985
700	32,737	396,925	0	429,662	0.0005	0.9990
710	0	380,559	0	380,559	0.0004	0.9994
720	0	131,798	0	131,798	0.0001	0.9996
730	0	142,012	0	142,012	0.0002	0.9997
740	0	32,737	0	32,737	0.0000	0.9998
750	29,880	32,775	0	62,655	0.0001	0.9998
770	0	122,962	0	122,962	0.0001	1.0000
790	0	33,109	0	33,109	0.0000	1.0000
Total	**161,235,554**	**216,764,841**	**537,176,133**	**915,176,528**	**1.0000**	**1.0000**

Appendix Table D 142.-- Population estimates by sex and size by size for yellowfin sole (*Limanda aspera*) from the 2023 northern Bering Sea bottom trawl survey.

Length (cm)	Males	Females	Unsexed	Total	Proportion	Cumulative proportion
50	0	0	226,504	226,504	0.0001	0.0001
60	0	203,825	990,514	1,194,339	0.0006	0.0007
70	874,826	204,982	1,659,929	2,739,737	0.0013	0.0020
80	2,393,413	1,184,738	6,264,353	9,842,504	0.0047	0.0067
90	4,435,424	6,544,234	9,496,444	20,476,102	0.0098	0.0164
100	18,575,588	13,377,745	7,061,127	39,014,460	0.0186	0.0350
110	38,897,638	26,762,405	4,326,083	69,986,126	0.0333	0.0683
120	55,500,862	48,895,820	6,280,369	110,677,051	0.0527	0.1211
130	66,077,724	73,568,220	6,303,639	145,949,583	0.0695	0.1906
140	66,177,836	57,488,747	3,127,093	126,793,676	0.0604	0.2510
150	65,265,800	53,958,940	1,932,793	121,157,533	0.0577	0.3087
160	68,787,717	56,028,141	1,526,687	126,342,545	0.0602	0.3689
170	62,698,165	60,492,535	1,086,221	124,276,921	0.0592	0.4281
180	75,906,785	62,556,454	430,503	138,893,742	0.0662	0.4943
190	60,304,977	62,809,963	1,746,921	124,861,861	0.0595	0.5537
200	54,944,397	64,110,683	660,700	119,715,780	0.0570	0.6108
210	36,815,450	48,038,986	655,718	85,510,154	0.0407	0.6515
220	27,191,730	36,900,599	220,233	64,312,562	0.0306	0.6821
230	23,276,525	24,037,150	0	47,313,675	0.0225	0.7047
240	20,276,977	15,281,784	0	35,558,761	0.0169	0.7216
250	9,312,596	13,947,445	215,251	23,475,292	0.0112	0.7328
260	9,481,392	8,884,731	220,233	18,586,356	0.0089	0.7417
270	12,584,453	5,813,357	0	18,397,810	0.0088	0.7504
280	8,897,015	6,421,421	0	15,318,436	0.0073	0.7577
290	12,478,902	10,290,337	0	22,769,239	0.0108	0.7686
300	19,746,581	8,992,507	870,969	29,610,057	0.0141	0.7827
310	25,093,675	10,244,403	440,467	35,778,545	0.0170	0.7997
320	30,230,899	15,706,956	1,531,669	47,469,524	0.0226	0.8223
330	35,770,857	18,849,327	0	54,620,184	0.0260	0.8483
340	36,115,354	29,617,338	1,091,203	66,823,895	0.0318	0.8802
350	28,927,456	28,093,387	1,301,472	58,322,315	0.0278	0.9080
360	21,175,104	21,373,892	1,301,472	43,850,468	0.0209	0.9288
370	20,218,881	26,856,007	1,096,185	48,171,073	0.0229	0.9518
380	13,406,961	17,365,982	1,296,490	32,069,433	0.0153	0.9671
390	8,310,822	16,817,991	655,718	25,784,531	0.0123	0.9794
400	5,540,753	12,060,767	215,251	17,816,771	0.0085	0.9878
410	532,630	8,003,871	0	8,536,501	0.0041	0.9919
420	1,637,414	7,455,643	440,467	9,533,524	0.0045	0.9965
430	75,707	3,579,804	0	3,655,511	0.0017	0.9982
440	0	2,364,025	0	2,364,025	0.0011	0.9993
450	0	1,033,486	0	1,033,486	0.0005	0.9998
460	0	93,034	0	93,034	0.0000	0.9999
470	0	273,847	0	273,847	0.0001	1.0000
490	0	30,904	0	30,904	0.0000	1.0000
Total	**1,047,939,286**	**986,616,413**	**64,672,678**	**2,099,228,377**	**1.0000**	**1.0000**

Appendix E: Data Changes

The AFSC Groundfish Assessment Program (GAP) team recently developed and deployed new bottom trawl survey data products (e.g., CPUE, biomass, abundance, age composition, and size composition) in simplified, standardized formats that are consistent with data management best practices. These data products are stored and served from the newly established, production-level Oracle schema, GAP_PRODUCTS, for easy access by stock assessment authors and other internal partners, and are in ready-to-serve form for external data requests. The team has also prepared transparent documentation, metadata, and user examples (https://afsc-gap-products.github.io/gap_products/) to accompany these data products. Data and estimates from each survey were consolidated into single-themed (e.g., biomass) tables where estimates identified by survey region coexist in the same table location. The 2023 production-run data product tables are produced by the gapindex R package v2.1.3 (https://github.com/afsc-gap-products/gapindex/tree/v2.1.3/) and distributed through the GAP_PRODUCTS Oracle schema. These are data products, and as such, the data have been processed and only include standard and successful deployment survey data. GAP produced both the new and historical tables for the 2023 post-survey stock assessment season. For the 2024 post-survey stock assessment season, GAP will discontinue the historical tables and replace them with the new GAP_PRODUCTS tables.

Improving our production data design, content, and delivery are major steps toward NOAA's commitment to open data science and dedication to providing partners and stakeholders with the best available science. The design and production of the original historical tables were established decades ago and updates to these tables were long overdue. These changes have also instituted consistent logic behind internal processes, streamlined onboarding and offboarding, and revolutionized access to these data.

Highlights of these new tables include:

1. Consolidated production tables include all standard data products for all surveys. Data are provided in the same format, with the same units, and created using the same methodology. This consolidation should limit data pulls, reduce complexity for data access, and reduce secondary data wrangling.

2. Publicly accessible tables are filtered to include only data from hauls in which survey standard conditions were met, and do not include data from hauls with unacceptable performance and non-standard survey designs.

3. Consistent naming conventions are applied to schemata, tables, and column metadata. Columns across all tables use the same naming conventions, units, and data types.

4. The content of standard data product tables are restricted to necessary columns. Previously redundant data columns that were acquired by joining reference and other data tables were removed. This change is key for providing consistent and up-to-date data while limiting the size of data tables.

5. Previously used Oracle schemata are in the process of being consolidated and repurposed. This consolidation will help the GAP team limit unnecessary access to unprocessed or problematic data by outside users.

6. All code and data inclusion decisions and wrangling are documented in the *gapindex* R package (https://github.com/afsc-gap-products/gapindex). Improved and consolidated data creation and

documentation provide data creators and users with greater confidence in the data products and enhanced ability to share these data.

Estimates for all species in all years of each survey were recalculated with the most up-to-date data. Generally speaking, changes in these data can occur for many reasons. These reasons can be unique and uncommon, such as data corrections (e.g., mistakes in data collection realized after data finalization), or due to regular improvements to the data, such as updates to species identifications and improved area estimates (e.g., recalculations of stratum and station areas to better account for land, sea, and untrawlable habitat). It is important to recognize that these data sets are living documents that are subject to changes and improvements between versions.

Species time-series cutoffs

As species identification guides improve and species taxonomy is better defined, the survey team has established guidelines for when the time series of some species should begin. The species listed below were not identified confidently in the past (e.g., have previously been inconsistently distinguished from congeners and appear synonymized in the data) before improved identification efforts. To avoid misinterpretation of the data and to identify when data were consistently collected, these 18 species' timelines have been intentionally truncated to years in which identifications of these species were confidently made. Those species and minimum years are summarized in Appendix Table E **143**. More information on historical identification confidence for these and other species can be found in Stevenson and Hoff (2009) and Stevenson et al. (2016) and is further discussed in Laman et al. (2022).

Appendix Table E 143.-- Established species time-series cutoff guidelines for when the time series of some species should begin. These cutoffs were formally established in 2023.

Common Name	Species Name	First Year
Alaska skate	*Arctoraja parmifera*	1999
Alaska skate egg case	*Arctoraja parmifera* egg case	1999
Aleutian skate	*Bathyraja aleutica*	1999
Aleutian skate egg case	*Bathyraja aleutica* egg case	1999
Arrowtooth flounder	*Atheresthes stomias*	1992
Bering skate	*Bathyraja interrupta*	1999
Bering skate egg case	*Bathyraja interrupta* egg case	1999
Blackspotted rockfish	*Sebastes melanostictus*	2006
Dusky rockfish	*Sebastes variabilis*	1996
Kamchatka flounder	*Atheresthes evermanni*	1992
Mud skate	*Bathyraja taranetzi*	1999
Mud skate egg case	*Bathyraja taranetzi* egg case	1999
Northern rock sole	*Lepidopsetta polyxystra*	1996
Rougheye rockfish	*Sebastes aleutianus*	2006
Sakhalin sole	*Limanda sakhalinensis*	1984
Southern rock sole	*Lepidopsetta bilineata*	1996
Whiteblotched skate	*Bathyraja maculata*	1988
Whiteblotched skate egg case	*Bathyraja maculata* egg case	1988

Species taxonomy

In an effort to clear a backlog in updates and improvements to the GAP species registry, 345 scientific species names were updated from 2022 to 2023. Updates were made by comparing the 2022 GAP catalog of species taxonomy with the World Register of Marine Species (WoRMS; https://www.marinespecies.org/) and Integrated Taxonomic Information System (ITIS; https://www.itis.gov/) databases. A summary of these changes is available upon request.

Updates to individual historical records in data tables

In 2023, length-weight parameters used in the regression for Pacific halibut weight calculations in the eastern and northern Bering Sea surveys were updated to reflect new guidance from the International Pacific Halibut Commission (IPHC). The new parameters are those specified for area 4CDE (α = 5.925x10^{-6}, β = 3.161; Webster and Stewart (2023)). While there is no attempt to recalculate historical biomass estimates at this time, we estimate that the new parameters have increased the 2023 and future biomass estimates by approximately 3%. These updated parameters will be used for all future Bering Sea surveys until further notice.

There were several erroneous length measurements corrected in the length collection data that will result in minor to changes taxon counts, CPUE, biomass, and size composition estimates for the taxon and year they represent. Arctic cod (*Boreogadus saida*; individuals 33 cm or larger) in the 2010 northern Bering sea survey data were reassigned as to "Gadidae" because these records are longer than the known maximum length for this species and are therefore very unlikely to have been identified correctly. Similarly, one 94 cm male plain sculpin (*Myoxocephalus jaok*) in the 2017 northern Bering Sea survey data was reassigned as "*Myoxocephalus* sp.". Two Bering skate (*Bathyraja interrupta*; 130 and 103 cm) from the 2010 in the eastern Bering Sea survey length data were incorrectly identified and have been removed from the production tables. Some Northern rock sole (*Lepidopsetta polyxystra*) observations in the 2017 northern Bering Sea survey data had been previously excluded from resultant data products because they had been incorrectly assigned using the juvenile northern rock sole species code.

Crab taxa records (for blue king crab (*Paralithodes platypus*), red king crab (*Paralithodes camtschaticus*), snow crab (*Chionoecetes opilio*), tanner crab (*Chionoecetes bairdi*), and *Chionoecetes* hybrid Tanner crab (*Chionoecetes* hybrid)) were removed from the new production table until estimates prepared by the shellfish assessment program (as they are responsible for preparing those estimates) can be formally integrated. Four records were removed where, in the historical tables, abundance was incorrectly assumed to be zero with zero variance or NA with zero variance.

There were 118 instances where the number of hauls with weight data did not equal the number of hauls with count data and had to be modified. This occurred because NA values are handled differently when using the *gapindex* R package to calculate variances. Historically, there were some hauls in the Bering Sea where a positive catch weight was recorded for a taxon without an associated count. Those hauls without count data are not included in the sample variance calculation, but they are included in the total sample size when calculating the variance associated with the mean numerical CPUE. This leads to a slight negative bias in the variance calculation for both the mean numerical CPUE and stratum abundance.

Age composition records of total age-aggregated abundance by sex (flag code -9) with age (flag code -99) were added to in the 2023 age composition dataset. The *gapindex* R package reports these values by default if otoliths were not collected for a given species or year and were not part of the historical dataset.

The 2023 age composition table only includes data from hauls with positive performance codes, but negative performance codes were included in the 2022 calculation of the age composition.

All new records in the 2023 data tables for CPUE, biomass and abundance, size composition, and age composition were missing from the historical Bering Sea production tables because the historical tables only included a subset of taxa. The new production tables provide estimates for all species present in the catch data for a given survey region. Records present in previous data tables, but removed from the 2023 data tables were eliminated primarily as a result of the species time-series cutoffs (Appendix Table E **143**), as well as other cases in which presence-absence or "zero-filled" records may be misleading. Specific information about individual records, or sets of records, is available upon request.

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