Northern Bering Sea Groundfish and Crab Trawl Survey Highlights

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Alaska Fisheries Science Center

Resource Assessment and Conservation Engineering

Cover Photos

Upper left: Stack of tanner crabs (Chionoecetes bairdi) *ready for measuring. Photo Credit: Cody Szuwalski/NOAA Fisheries*

Lower right: A researcher poses with a large starry flounder (Platichthys stellatus) *from catch. Photo Credit: Rebecca Haehn/NOAA Fisheries*

Find photos from our survey in our photo gallery: https://www.fisheries.noaa.gov/gallery/alaska-research-surveys-photo-gallery

Introduction

In 2023, NOAA Fisheries' Alaska Fisheries Science Center conducted two surveys within U.S. territorial waters of the Bering Sea: the eastern Bering Sea shelf bottom trawl survey and the northern Bering Sea bottom trawl survey. This is the 41st year of the eastern Bering Sea shelf survey and the sixth year of the northern Bering Sea survey using consistent sampling methods and protocols. A rapid response survey for the northern Bering Sea region was also conducted in 2018 and will not be covered here. The northern Bering Sea survey region contains 144 stations in an area bounded by the Bering Strait, Norton Sound, and the U.S.–Russia Maritime Boundary (Fig. **1**). While the northern Bering Sea region has been surveyed occasionally in the past, 2010 is considered the start of the modern series because it was the first year the region was sampled using the same standardized sampling methods as the eastern Bering Sea shelf survey.

NOAA has identified the northern Bering Sea area as a region of critical importance for increased scientific monitoring because this marine ecosystem may be rapidly altered by climate change. This survey represents one part of an extensive research plan to design a long-term time series that identifies and tracks the environmental and ecological change throughout the Bering Sea. Beyond the potential impacts of climate change, the scale and extent of fish and crab movements may also vary from year to year in response to many biological or environmental processes. These movements cause changes in distribution and abundance that extend beyond the traditional survey boundaries (e.g., eastern Bering Sea) and ultimately create an additional need for survey data that provide comprehensive coverage of the entire Bering Sea.

In this document, we provide some of the results of the 2023 northern Bering Sea survey and compare these to observations from the 2010, 2017, 2019, 2021, and 2022 surveys. The results of the 2022 survey can be found in the 2022 Data Report (Markowitz et al., 2023). Detailed information on bottom trawl survey results for commercial crab species are discussed and analyzed in the AFSC Shellfish Assessment Program's annual data report (Zacher et al., 2023). In the future, continuation of this survey effort in the form of a combined eastern Bering Sea and northern Bering Sea bottom trawl survey will provide more comprehensive information to investigate how fishes, crabs, and other bottom dwellers respond to biological and environmental changes on a large spatial scale over a multi-year time period.

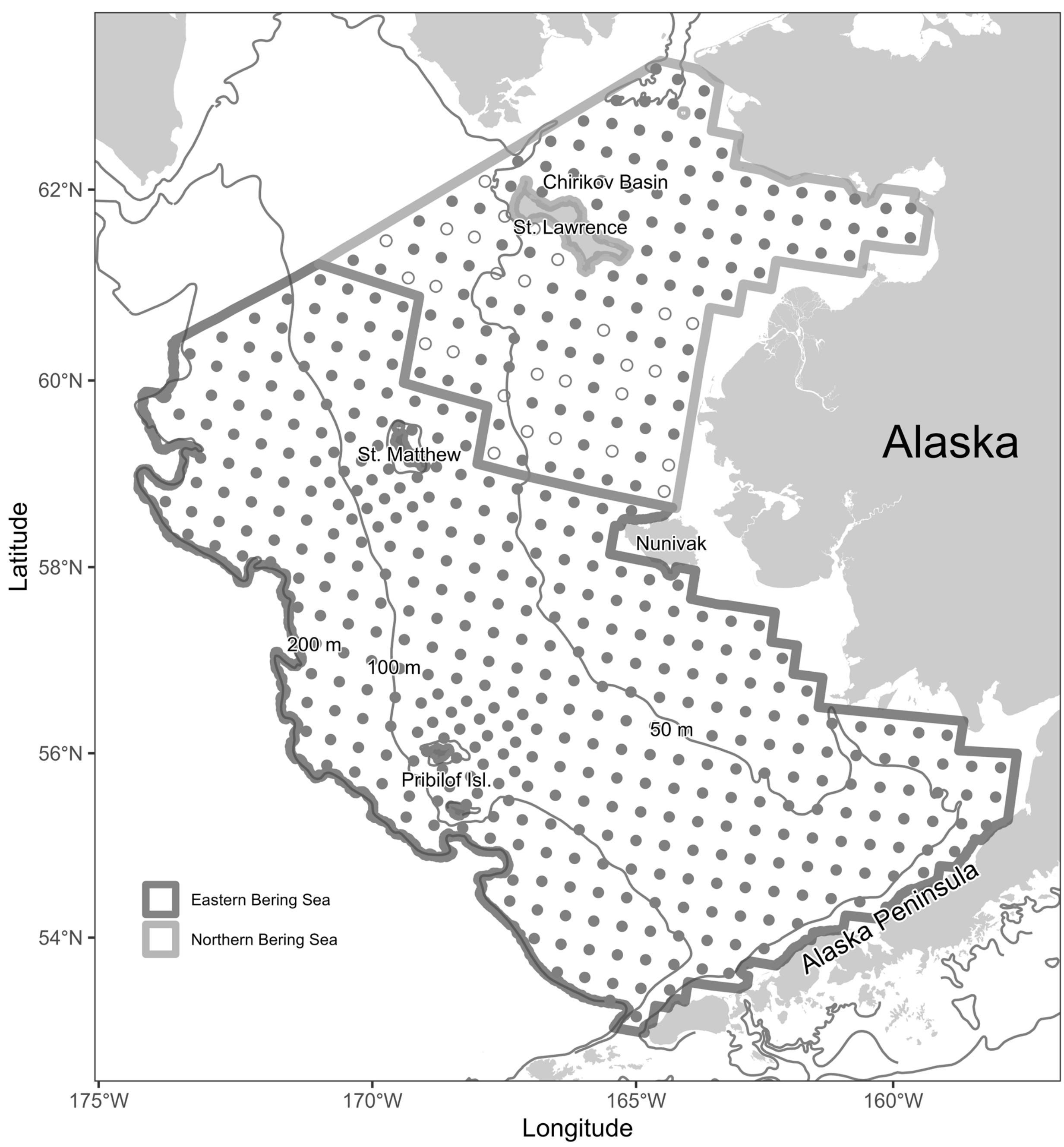


Figure 1. -- Map of 2023 eastern and northern Bering Sea survey sampling stations. The areas enclosed within the dark and light gray lines contain the eastern and northern Bering Sea shelf stations, respectively. The dots within each area indicate station locations. Filled dots are completed stations; unfilled dots represent planned stations that were not sampled in 2023.

Survey Design, Execution, and Analysis

The 2023 eastern Bering Sea shelf and northern Bering Sea bottom trawl surveys were conducted aboard the chartered commercial stern-trawlers FV *Northwest Explorer* and FV *Alaska Knight* (Fig. **2**). Sampling for the eastern Bering Sea shelf survey started for both vessels May 28, 2023 and ended July 25, 2023 for the FV *Northwest Explorer* and August 03, 2023 for the FV *Alaska Knight*. Sampling for the northern Bering Sea shelf survey started for the FV *Northwest Explorer* July 29, 2023 and ended August 18, 2023, while sampling started for the FV *Alaska Knight* August 03, 2023 and ended August 20, 2023.

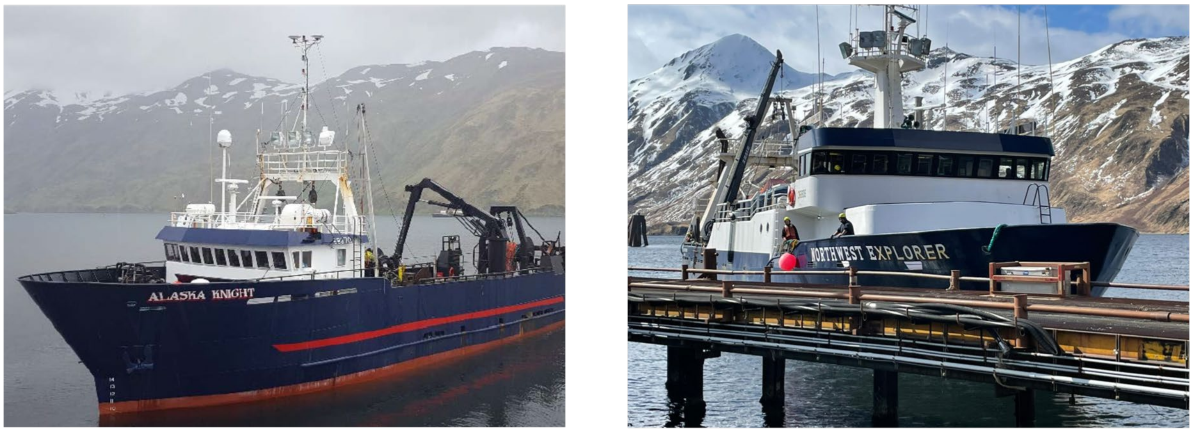


Figure 2. -- Fishing vessels FV *Alaska Knight* (left) and FV *Northwest Explorer* (right) contracted to conduct the 2023 eastern and northern Bering Sea bottom trawl survey.

Scientists from the Alaska Fisheries Science Center, Alaska Department of Fish and Game, International Pacific Halibut Commission, Bigelow Laboratory for Ocean Sciences, Oregon State University, Southeast Fisheries Science Center and volunteers from Washington College, University of Alaska Fairbanks, and Stanford University participated in the survey.

The northern Bering Sea survey was designed as an extension of the systematic 20 × 20 nautical mile (nmi) sampling grid for the annual eastern Bering Sea shelf survey. The eastern Bering Sea shelf survey area contains 376 stations distributed over 143,733 nmi^2 (492,990 km^2). The northern Bering Sea shelf survey area contains 144 stations distributed over 57,980 nmi^2 (198,867 km^2). The addition of the northern Bering Sea survey expanded the overall survey coverage in the Bering Sea to 201,713 nmi^2 (691,857 km^2). Bottom depths in the northern Bering Sea survey area range from 39.4 ft (12 m) to 255.9 ft (78 m).

Both vessels sampled using an 83-112 Eastern otter trawl that has been historically used for eastern Bering Sea shelf, Chukchi Sea, and Beaufort Sea surveys (Fig. **3**). This trawl is significantly smaller and weighs less than trawls typically used for commercial fishing in Alaska. Each trawl tow was conducted for 30 minutes at a speed of 2.8–3.2 knots.

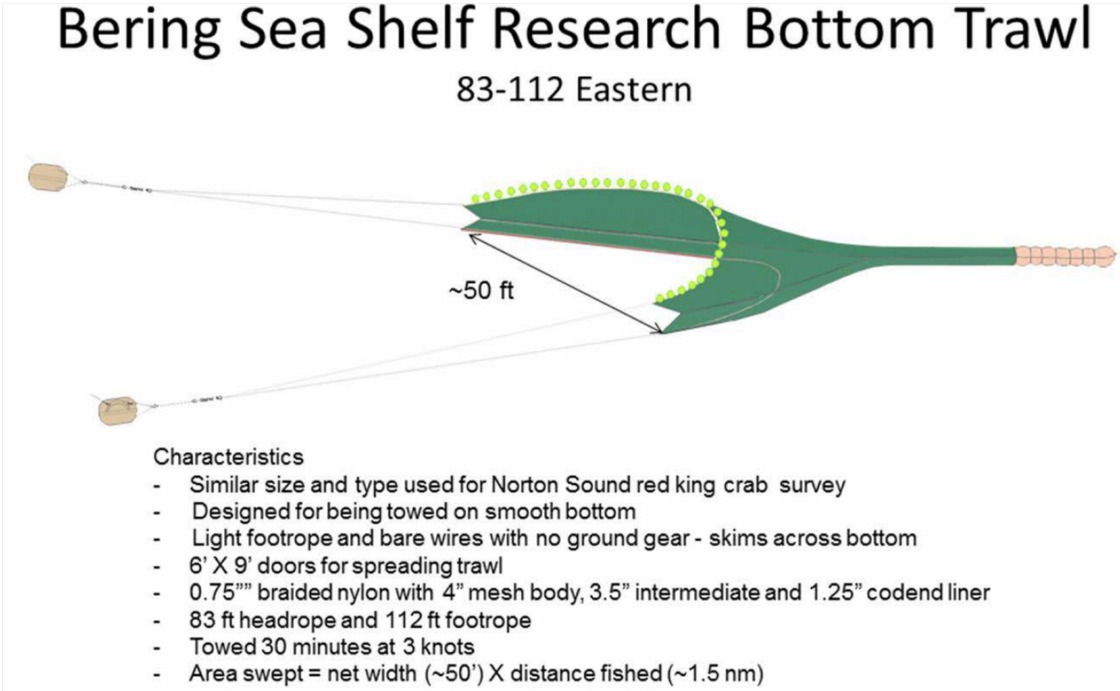


Figure 3. -- Diagram of the 83-112 Eastern trawl net.

Fishes, crabs, and other invertebrates were identified and sorted by species and weighed. A subsample of fishes were sorted by sex and measured to the nearest centimeter (cm). For the predominant crab species, carapace width (snow crab) or length (king crabs) was measured to the nearest millimeter (mm). Samples of some species of fishes, crabs, and other invertebrates were also retained to gather additional information on size, weight, sex, age, reproductive state, genetics, body condition, and stomach content/diet.

Trawl survey catch data were used to estimate catch-per-unit-effort (CPUE), biomass, abundance, and demographic structure (size and age distribution). CPUE is the estimated catch of organisms caught (in kilograms (kg) or number of individuals) per amount of effort (generally, a combination of gear type, gear size, and tow duration), and can be used as a measure of the density of a species. Effort was estimated as the area swept (area sampled in km^2). Mean CPUE values were calculated for larger survey areas. Biomass and abundance were estimated for each survey area by multiplying the mean CPUE by the total survey area.

Environmental data, including water temperature in degrees Celsius (°C), depth in meters (m), salinity (parts per thousand), and underwater downwelling light level were also recorded at each sampling station. Water column profiles of temperature and salinity at each trawl location were measured using a trawl-mounted conductivity, temperature, and depth profiler (CTD).

2023 Survey Results in Comparisons to 2022

Bottom and Surface Temperatures

Bottom temperature can influence the distribution of fishes, crabs, and other invertebrates on the Bering Sea shelf. The highly variable annual bottom temperatures determine the extent of the summer cold pool, defined as the bottom temperatures below 2°C (35.6°F) across the area of the eastern Bering Sea shelf. The size of the cold pool each summer depends on the extent of sea ice cover during the preceding winter and the timing of its retreat during the spring and early summer. During the coldest years, the cold pool has extended across the middle shelf from the northern edge of the eastern Bering Sea survey area and into Bristol Bay and near the Alaska Peninsula.

Subarctic fish and invertebrate species tend to avoid areas with cold bottom temperatures (below 0°C (32°C) or 1°C (33.8°C), depending on the species). Therefore, the size and location of the cold pool can affect the migration of species across the eastern Bering Sea shelf and between the eastern and northern Bering Sea shelf. Cold temperatures may also provide a unique habitat for cold-adapted Arctic species. During warm years, Arctic species may be forced to adapt to unfavorable conditions or migrate to find cold temperatures. Temperature data from the northern Bering Sea surveys helps improve understanding of how changes in bottom temperature affect the distribution and migration of fishes, crabs, and other invertebrates.

Bottom (Figs. **4** and **5**) and surface (Figs. **6** and **7**) water temperatures varied over space and among years due to variation in atmospheric and ocean conditions. The 2023 average bottom temperature on the eastern Bering Sea shelf was 2.3°C (36.1°F), which is near the 2.5°C (36.5°F) time-series average from 1982 to 2023 (Fig. **8**). The near-average bottom temperatures observed during the 2022 and 2023 surveys represent a departure from recent years (2016–2021), which have included four of the five warmest years in the 41-year time series. The 2023 average surface temperature (6.3°C; 43.3°F) on the eastern Bering Sea shelf was slightly colder than the average surface temperature (6.8°C; 44.2°F; Fig. **8**). Over the 41-year survey time series, annual average summer bottom temperatures have ranged from 0.7°C (33.3°F) to 4.4°C (39.9°F; Fig. **8**). During the last 16 years, bottom temperatures from 2006-2013 were colder than average ("cold stanza"), while 2014-2019 and 2021 were warmer than average ("warm stanza"; Fig. **8**).

The size of the cold pool in the eastern Bering Sea has varied greatly, from 6,150 km^2 (1,793 nmi^2) in 2018 to 385,975 km^2 (112,532 nmi^2) in 1999 (Fig. **9**). The extent of bottom temperatures below 0°C and 1°C in 2023 were near their time series averages.

The average bottom temperature in the northern Bering Sea was 3.7°C (38.7°F) in 2023, which was 0.2°C cooler than the mean bottom temperature in 2022 (Fig. **8**). The average surface temperature in the northern Bering Sea in 2023 was 9.1°C (48.4°F), which was 1°C warmer than the average surface temperature in 2022 (Fig. **8**). In 2022, surface temperatures above 10°C were recorded in only 3% of the northern Bering Sea survey area, which was less than in past years, when temperatures above 10°C were recorded in 5-39% of the northern Bering Sea area (Fig. **7**).

The geographic range of the 2023 cold pool was similar to the most recent near-average year in 2022. The cold pool covered nearly the entire middle shelf between 50 m and 100 m bottom depths north of 57 °N (Fig. **5**). Extremely cold bottom temperatures (<-1°C) were observed south of St. Matthew Island for the first time since 2015. These cold temperatures may have posed a temperature barrier to the northward migration of mobile species such as walleye pollock and Pacific cod from the eastern Bering Sea shelf to the northern Bering Sea.

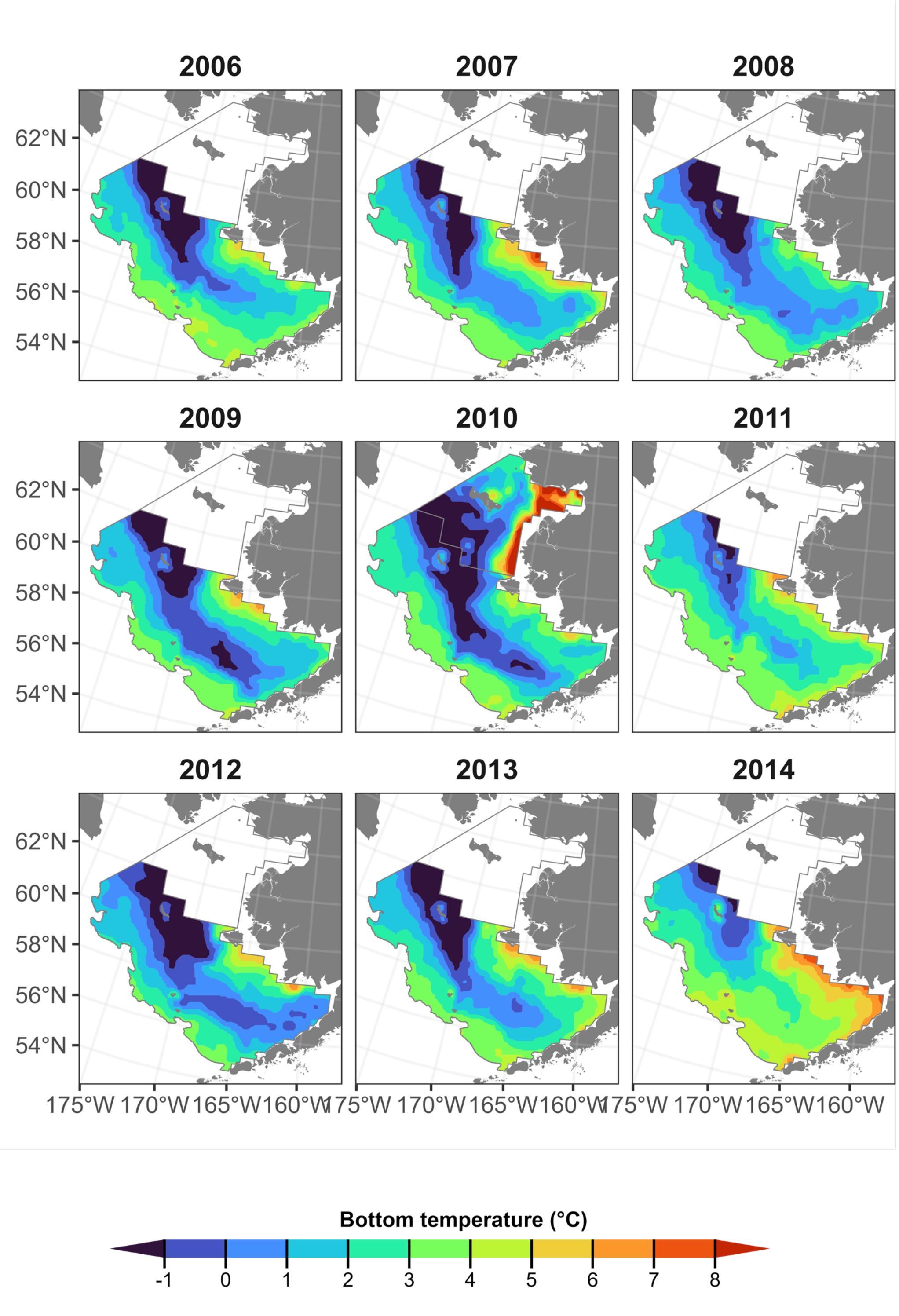


Figure 4. -- Bottom temperatures (°C) during the 2006-2014 eastern and northern Bering Sea shelf bottom trawl surveys.

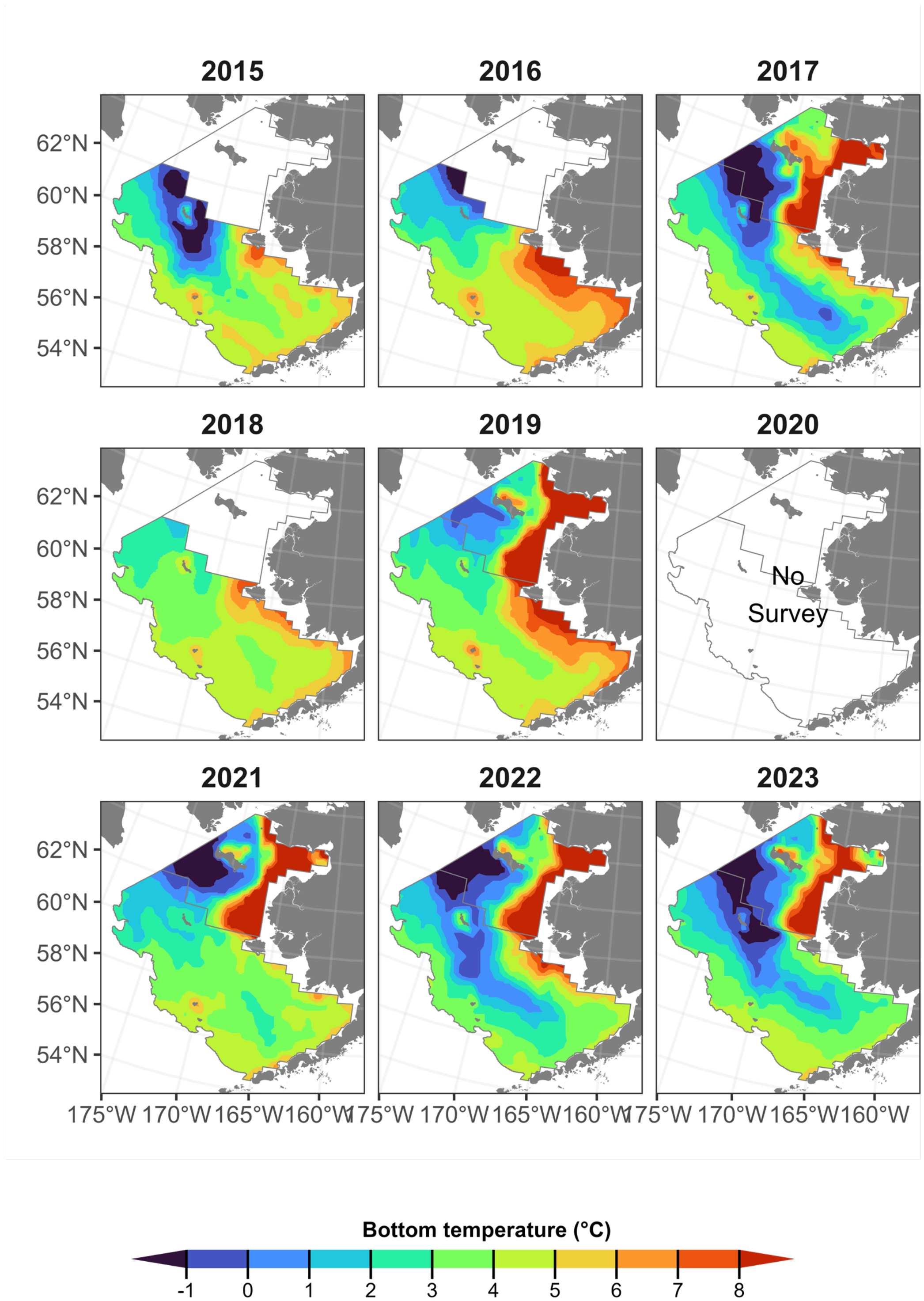


Figure 5. -- Bottom temperatures (°C) during the 2015-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

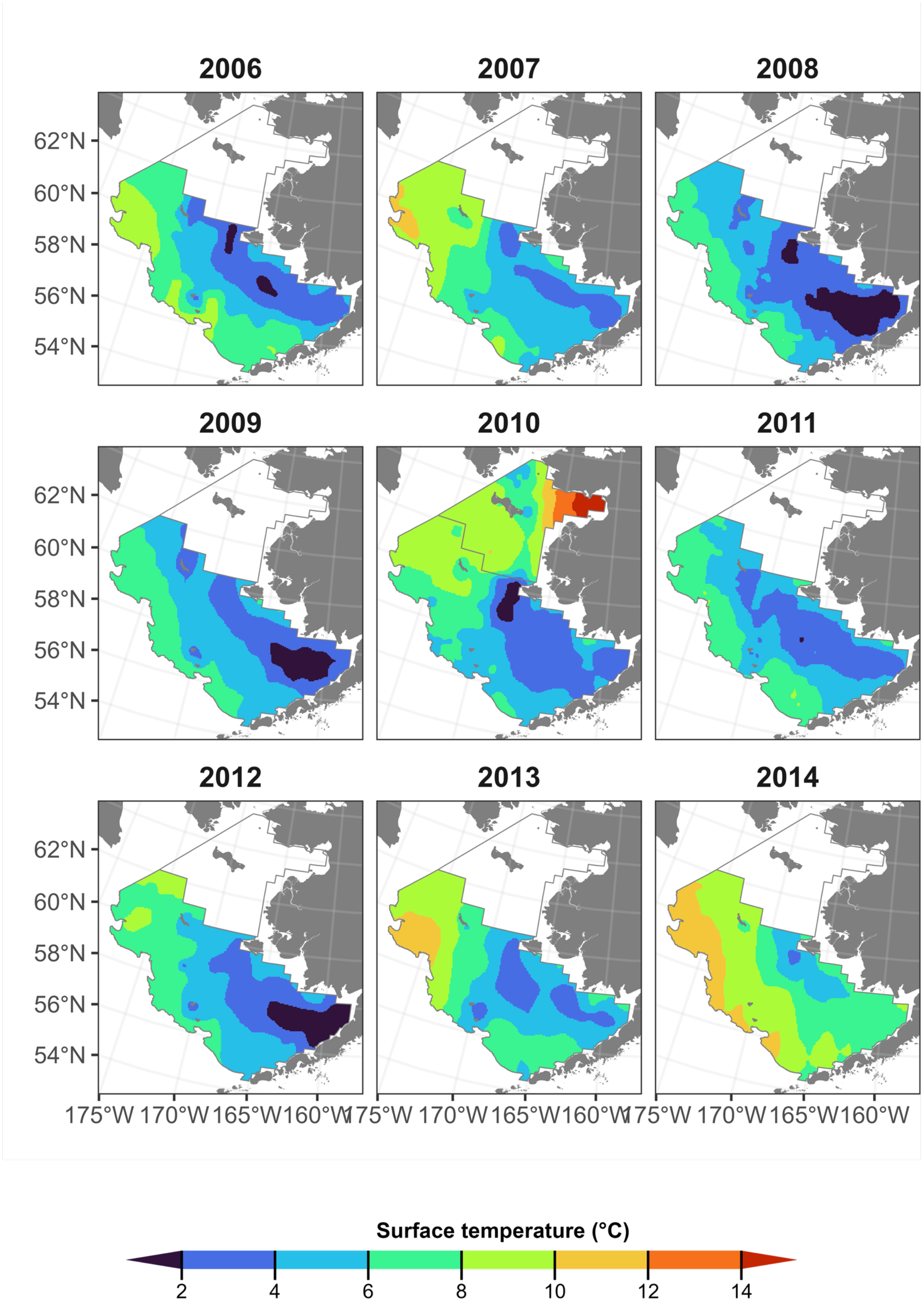


Figure 6. -- Surface temperatures (°C) during the 2006-2014 eastern and northern Bering Sea shelf bottom trawl surveys.

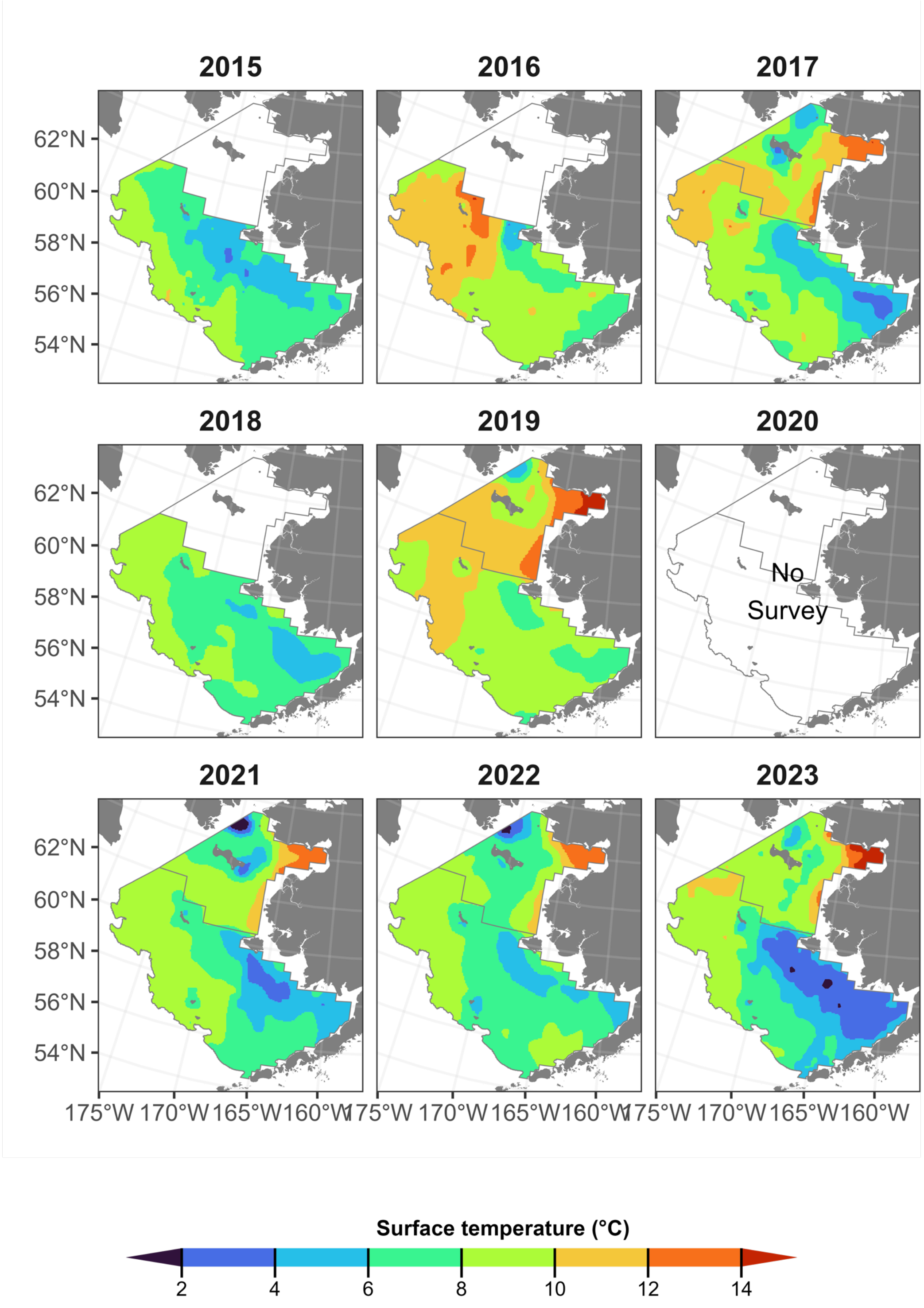


Figure 7. -- Surface temperatures (°C) during the 2015-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

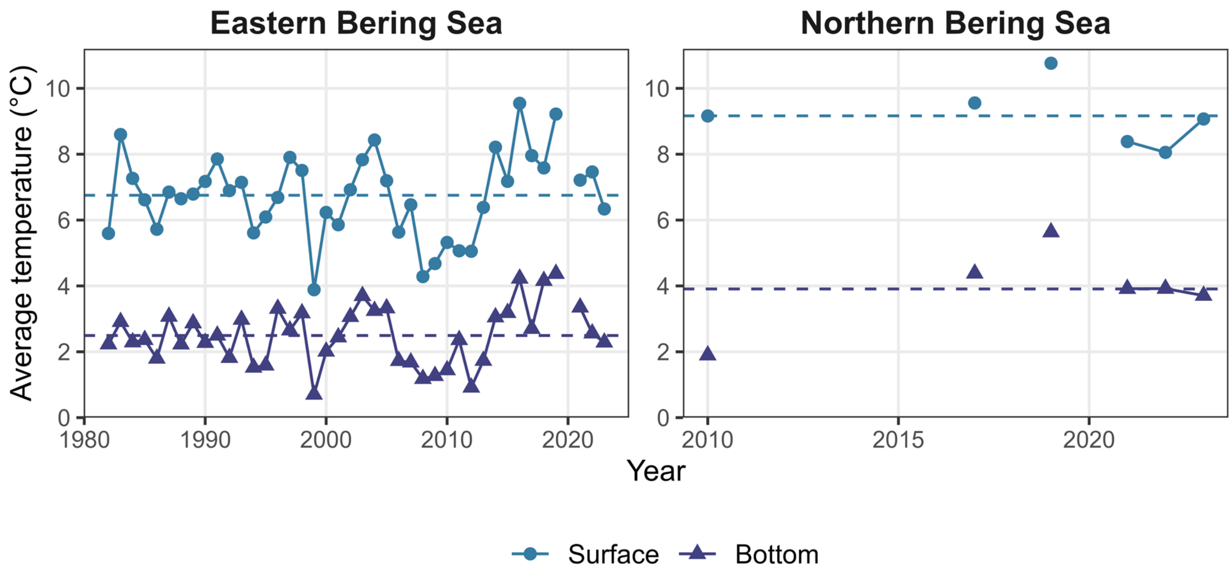


Figure 8. -- Average summer surface and bottom, and time-series average surface and bottom (dashed lines) temperatures (°C) on the eastern Bering Sea shelf, based on data collected during standardized summer bottom trawl surveys from 1982–2023 (left), and northern Bering Sea shelf based on data collected during standardized summer bottom trawl surveys (right).

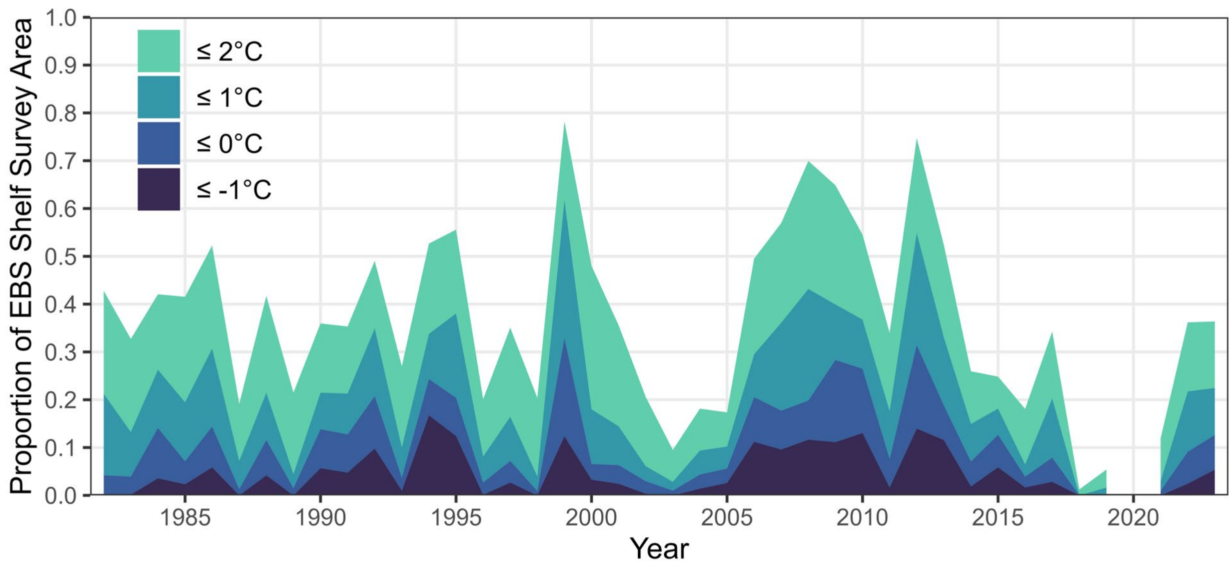


Figure 9. -- Annual extent of the summer cold pool on the eastern Bering Sea shelf, based on observations from the eastern Bering Sea bottom trawl survey. The extent of the cold pool is shown as a percentage of the total eastern Bering Sea shelf survey area. Shading denotes near-bottom temperatures ≤ 2°C, ≤ 1°C, ≤ 0°C, and ≤ -1°C.

Survey Data and Specimen Collections

In 2023, the total area sampled by trawls at the 116 completed stations was approximately 1.49 nmi^2 (5.1 km^2), covering 0.0026% of the total area of the northern Bering Sea. In 2022, the total area sampled by trawls at the 144 completed stations was approximately 1.86 nmi^2 (6.39 km^2), covering 0.0032% of the total area of the northern Bering Sea.

From the eastern and northern Bering Sea shelf trawl surveys, length measurements were collected from 174,680 individual fish representing 50 fish taxa. Additionally, 7,831 otolith age structure samples were collected from 10 taxa; 6,409 stomach samples were collected from six taxa; 222 fat-meter condition samples were collected from Pacific cod and walleye pollock; 162 genetic fin clip samples were collected from four taxa, and three genetic samples were collected from Pacific sleeper sharks.

Estimates of Fishes and Invertebrates

In 2023, the total bottom-dwelling animal biomass of the eastern Bering Sea shelf was estimated at 12 million metric tons (t) and the northern Bering Sea shelf was estimated at 2.9 million t. Previously, the total bottom-dwelling animal biomass of the 2022 eastern Bering Sea shelf was estimated at 14.7 million t and 2022 northern Bering Sea shelf was estimated at 3.4 million t.

In the northern Bering Sea between 2022 and 2023, eight fishes and six invertebrates experienced decreasing biomass, four fishes and four invertebrates experienced increasing biomass, and 13 fishes and seven invertebrates experienced no notable change in biomass. The biomasses of predominant species are listed in Table **1** in order of largest increase to largest decrease.

Survey catches in the northern Bering Sea were generally smaller than in the eastern Bering Sea. Many predominant species were distributed throughout both survey regions. Several key species were found in the northern Bering Sea in greater biomass than the eastern Bering Sea, including Arctic cod, Neptune whelks, Pacific capelin, blue king crab, saffron cod, sea urchins, shorthorn sculpin, smelts, snow crab, and variegated snailfish.

In 2023, 50% of the total estimated biomass in the northern Bering Sea was comprised of yellowfin sole (14%), walleye pollock (13%), purple-orange sea star (11%), Alaska plaice (11%), and Neptune whelks (5%). Previously in 2022, 50% of the estimated biomass was comprised of yellowfin sole (16%), walleye pollock (11%), purple-orange sea star (9%), Alaska plaice (9%), and Neptune whelks (6%).

Saffron cod and Arctic cod accounted for 1.3% of the total biomass in 2023 and 0.8% of the total biomass in 2022. Invertebrates (i.e., shrimps, sea squirts, sea stars, jellyfish, crabs, and urchins) made up 43% of the biomass in 2023 and 44% of the biomass in 2022.

Table 1. -- Total estimated biomass in metric tons (t) and the percent change between the 2022 and 2023 northern Bering Sea shelf bottom trawl surveys for predominant fish and invertebrate taxa.

Common name	2010	2017	2019	2021	2022	2023	Change (2023, 2022)
other worms	205	278	253	54	312	1,851	492.5%
snailfishes	3,305	4,864	777	329	630	1,632	159.1%
eelpouts	10,666	9,760	1,707	425	417	958	129.5%
jellyfish	12,862	66,295	88,795	21,959	28,510	58,257	104.3%
smelts	16,378	5,260	4,891	1,950	1,439	2,034	41.3%
red king crab	2,430	2,173	2,807	3,754	2,658	3,707	39.5%
saffron cod	90,301	76,244	81,278	9,974	27,738	38,225	37.8%
blue king crab	2,163	5,790	1,205	1,039	3,014	3,959	31.3%
great sculpin	293	2,014	3,804	2,988	530	640	20.9%
corals	12,627	8,520	2,823	5,776	5,032	5,756	14.4%
other sculpins	984	1,509	587	628	870	954	9.6%
Alaska skate	76,942	83,255	95,104	80,207	48,920	51,728	5.7%
Alaska plaice	302,979	330,733	321,575	344,581	299,028	307,919	3.0%
purple-orange sea star	296,864	331,287	414,448	270,646	312,625	317,349	1.5%
starry flounder	15,804	31,434	26,475	39,014	41,075	41,169	0.2%
shorthorn sculpin	39,828	111,363	14,161	7,627	3,665	3,411	-6.9%
walleye pollock	21,142	1,319,140	1,167,131	474,467	394,585	363,839	-7.8%
hermit crabs	133,111	162,378	139,249	107,059	153,983	138,997	-9.7%
other snails	27,371	40,335	19,685	22,902	23,191	20,147	-13.1%
Pacific halibut	23,333	18,508	25,722	25,995	22,940	19,076	-16.8%
basket sea stars	70,649	40,459	36,657	30,084	48,441	40,122	-17.2%
Neptune whelks	126,022	211,797	174,179	135,754	189,880	153,982	-18.9%
other sea stars	106,616	103,126	84,669	79,318	107,545	86,912	-19.2%
Bering flounder	12,355	19,804	18,526	8,384	5,913	4,704	-20.4%
plain sculpin	28,275	36,208	41,639	20,652	15,392	11,990	-22.1%
yellowfin sole	427,374	434,088	520,031	496,045	548,027	393,305	-28.2%
Pacific cod	29,126	287,551	365,005	227,582	153,735	108,346	-29.5%
snow crab	332,141	221,678	165,964	72,482	158,704	111,482	-29.8%
all shrimps	3,802	4,118	2,437	4,562	12,576	8,663	-31.1%
northern rock sole	21,256	55,467	99,040	76,631	46,443	29,225	-37.1%
other tunicates	339,431	88,465	23,684	66,867	93,540	58,007	-38.0%
other poachers	193	767	379	157	454	245	-46.0%
flathead sole	-	79	463	138	126	45	-64.6%
other crabs	62,763	33,861	27,911	54,166	85,003	29,700	-65.1%
tanner crab	6	7	0	34	95	29	-69.8%
all sea anemones	9,439	20,922	10,378	8,711	67,867	15,576	-77.0%
other flatfishes	37	401	1,266	134	136	20	-85.5%
Pacific herring	23,013	34,914	87,918	60,931	12,178	1,370	-88.7%
Arctic cod	37,862	3,906	47	83	387	35	-91.1%

Summary Results for Select Major Taxa

Survey results for select taxa are presented with a photograph of the taxon, a summary of results, maps of geographic distribution of CPUE (kg/km^2), and plots showing total population estimates by sex and size. Maps of species distributions include both the eastern and northern Bering Sea survey regions to better illustrate patterns and trends in fish distribution and movement. For comparison among years, distribution maps and abundance-at-size plots show survey data from the 2010, 2017, 2019, 2021, 2022, and 2023 surveys.

You can help us with this document by providing names in local language(s) and cultural or traditional uses for each fish and invertebrate species reviewed in this report by reaching out to afsc.gap.metadata@noaa.gov.

Sunrise on the FV Northwest Explorer *before for another day of the 2023 Bering Sea bottom trawl groundfish survey. Credit: Rebecca Haehn/NOAA Fisheries; https://www.fisheries.noaa.gov/gallery/alaska-research-surveys-photo-gallery*

Alaska Plaice (*Pleuronectes quadrituberculatus*)

Russian: желтобрюхая камбала

In 2023, biomass increased by 3% for Alaska plaice in the northern Bering Sea (Table **2**; Figure **10**). The highest density of Alaska plaice in the northern Bering Sea was south of St. Lawrence Island (Figure **11**). Spatial distribution patterns in 2023 were similar to distributions in 2017. In the five most recent northern Bering Sea surveys (2017–2023), length modes were observed around 13 cm and 35 cm (Figure **12**).

Table 2. -- Summary of catch location environmental variables, as well as 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%	10.6%
Biomass % Change	7% decrease from 2022	3% increase from 2022

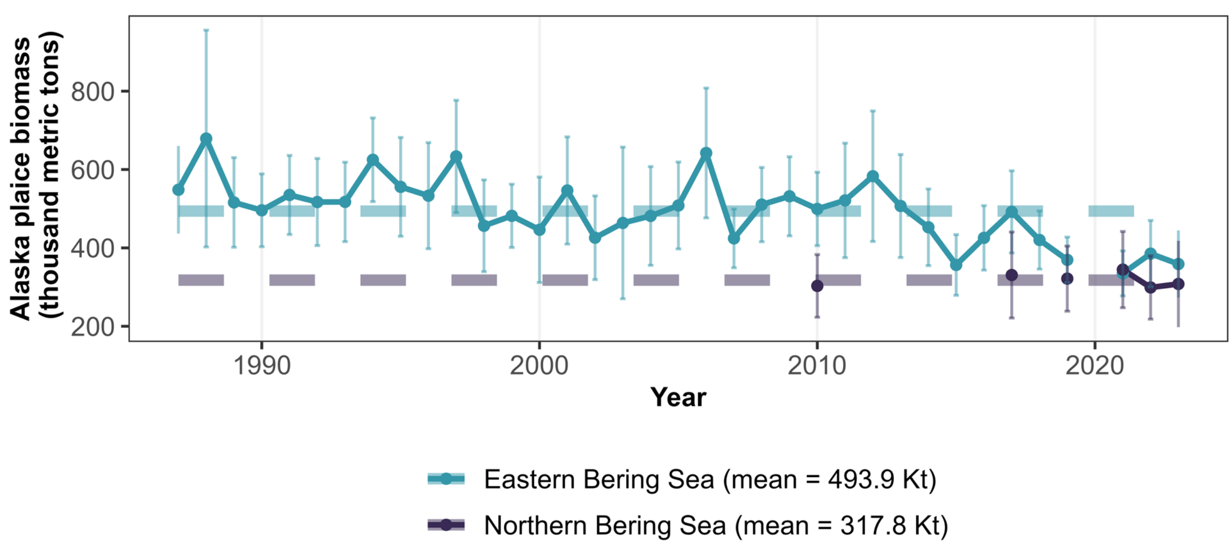


Figure 10. -- Estimates of Alaska plaice (*Pleuronectes quadrituberculatus*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

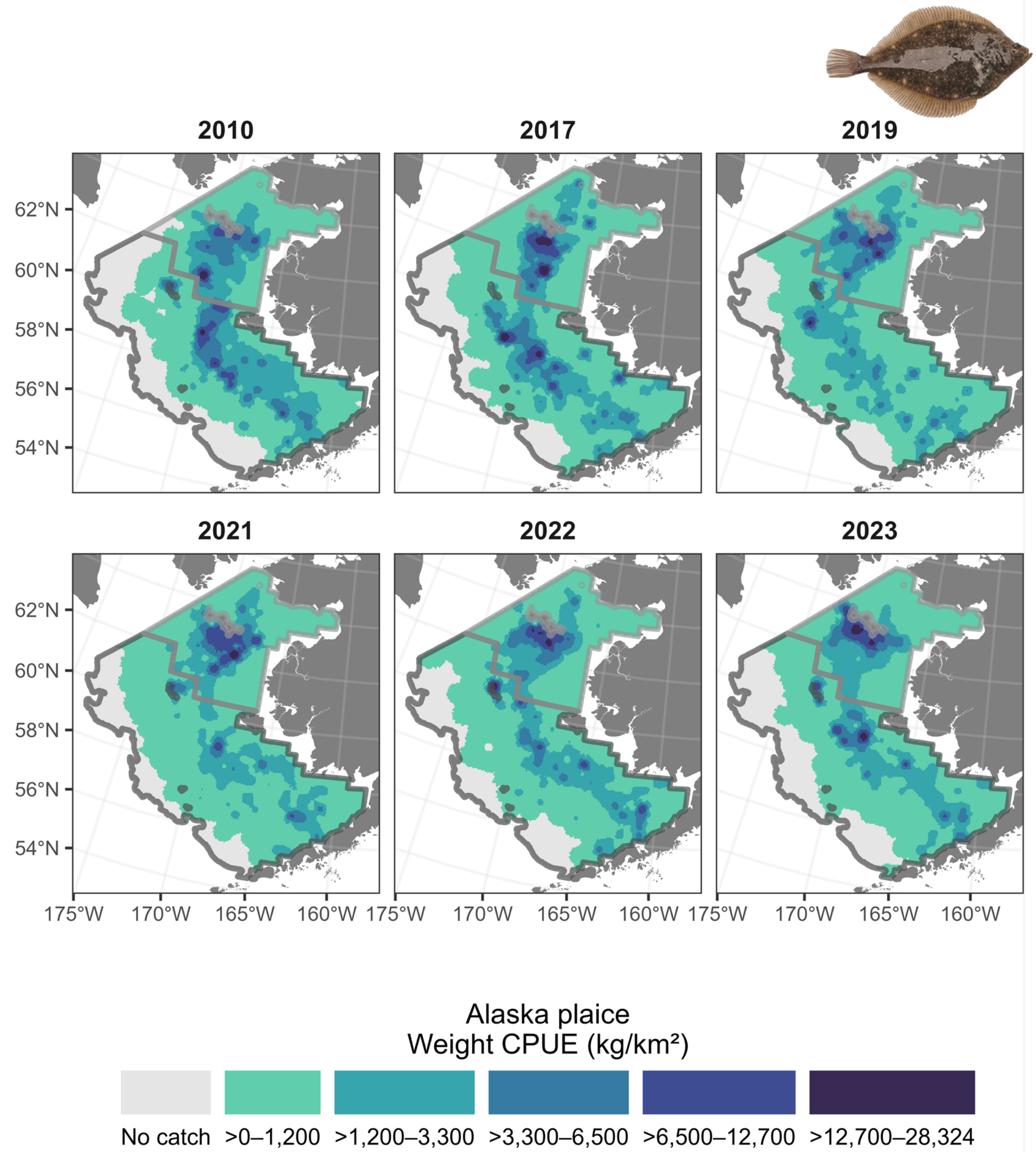


Figure 11. -- Distribution (Weight CPUE (kg/km^2)) of Alaska plaice (*Pleuronectes quadrituberculatus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

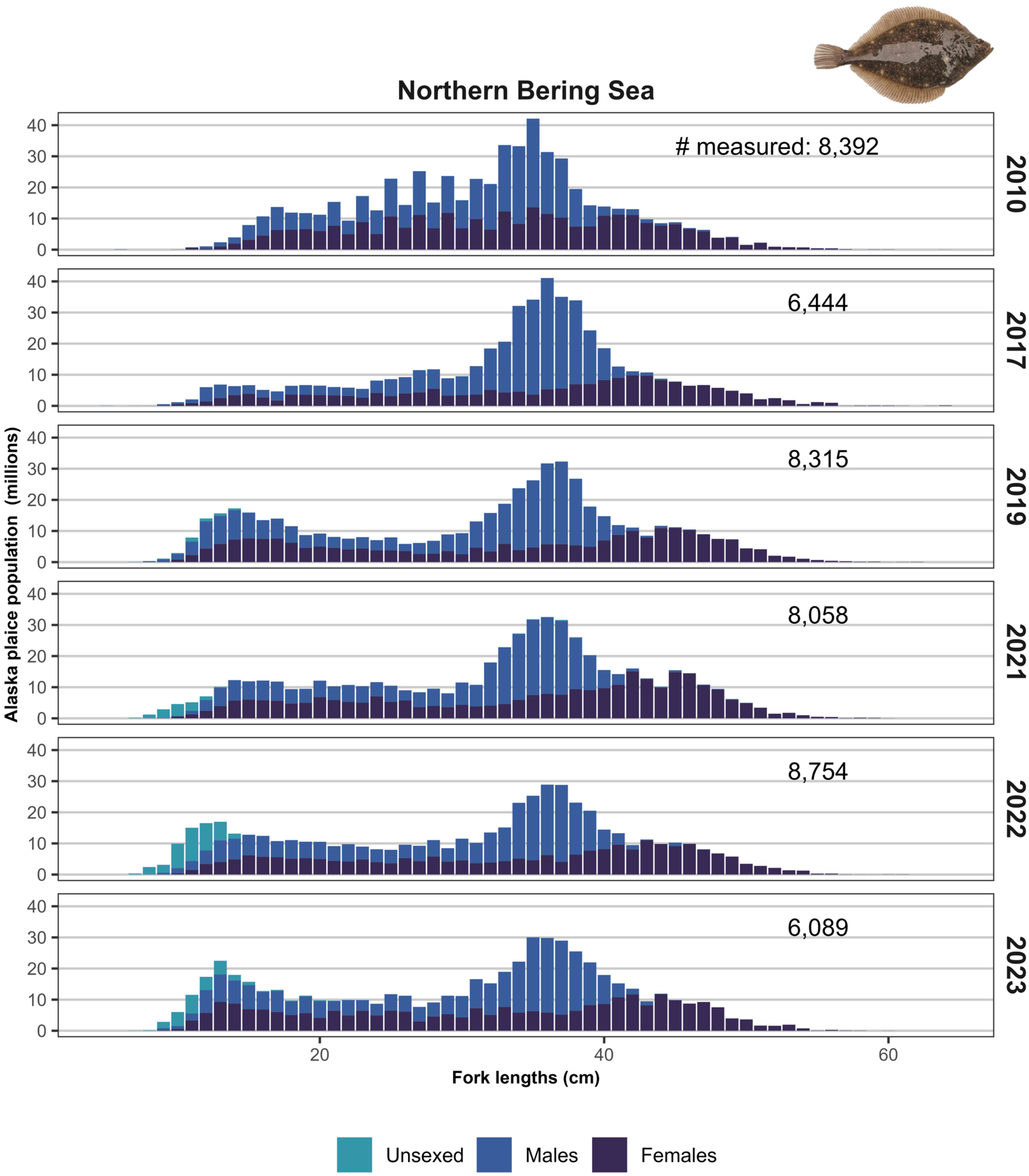


Figure 12. -- Total population estimates at length for Alaska plaice (*Pleuronectes quadrituberculatus*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Yellowfin Sole (*Limanda aspera*)

Russian: желтопёрая камбала

In 2023, biomass decreased by 28% for yellowfin sole in the northern Bering Sea (Table **3**; Figure **13**). The highest densities of yellowfin sole in the northern Bering Sea survey area were southeast of St. Lawrence Island in 2023 (Figure **14**). Size length modes were observed around 11 cm, 17 cm, and 32 cm (Figure **15**).

Table 3. -- Summary of catch location environmental variables, as well as 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	11.6%	13.5%
Biomass % Change	32% decrease from 2022	28% decrease from 2022

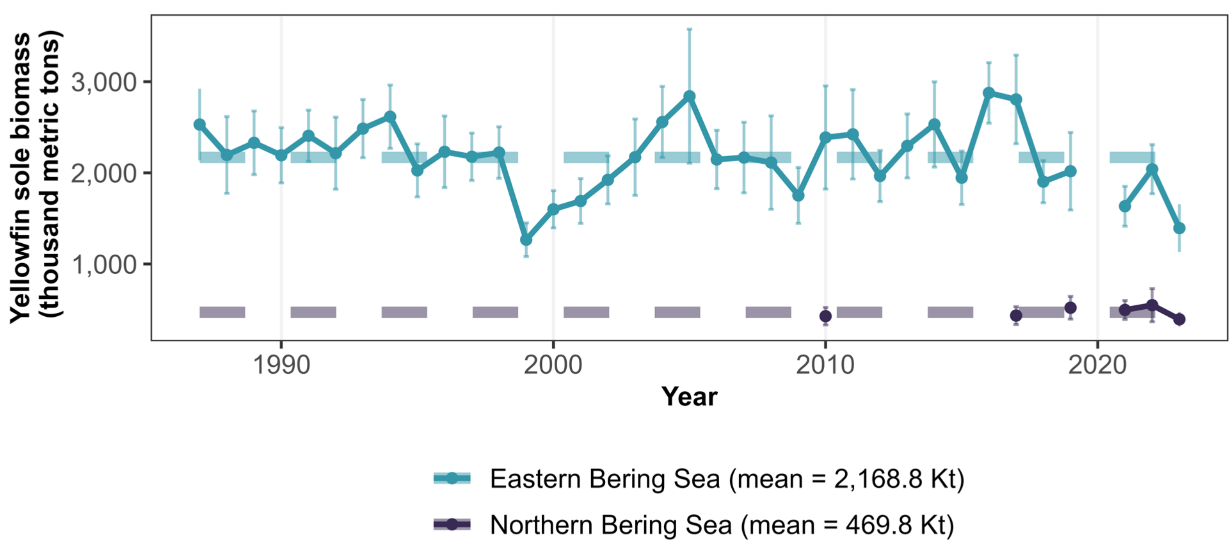


Figure 13. -- Estimates of yellowfin sole (*Limanda aspera*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

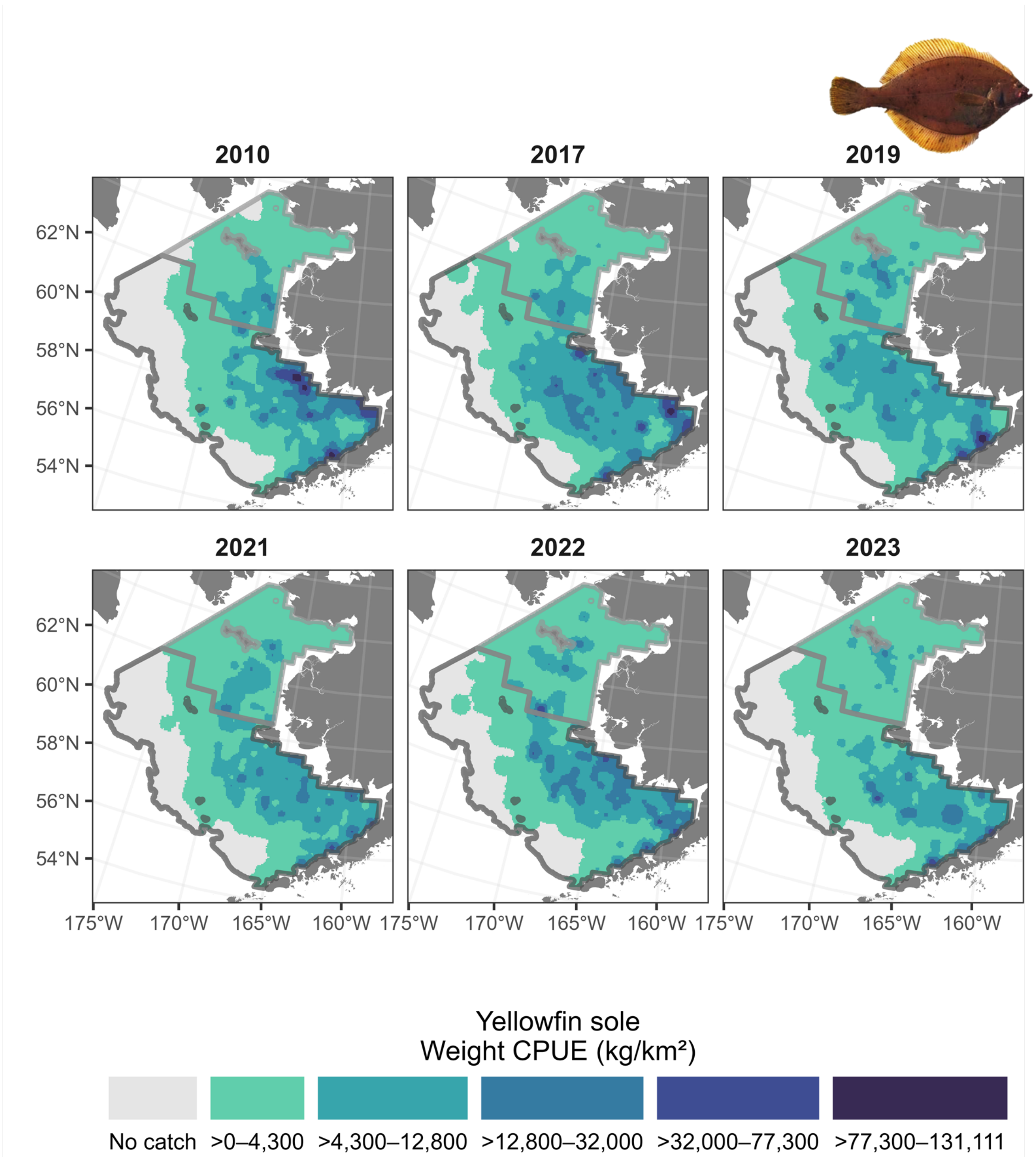


Figure 14. -- Distribution (Weight CPUE (kg/km^2)) of yellowfin sole (*Limanda aspera*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

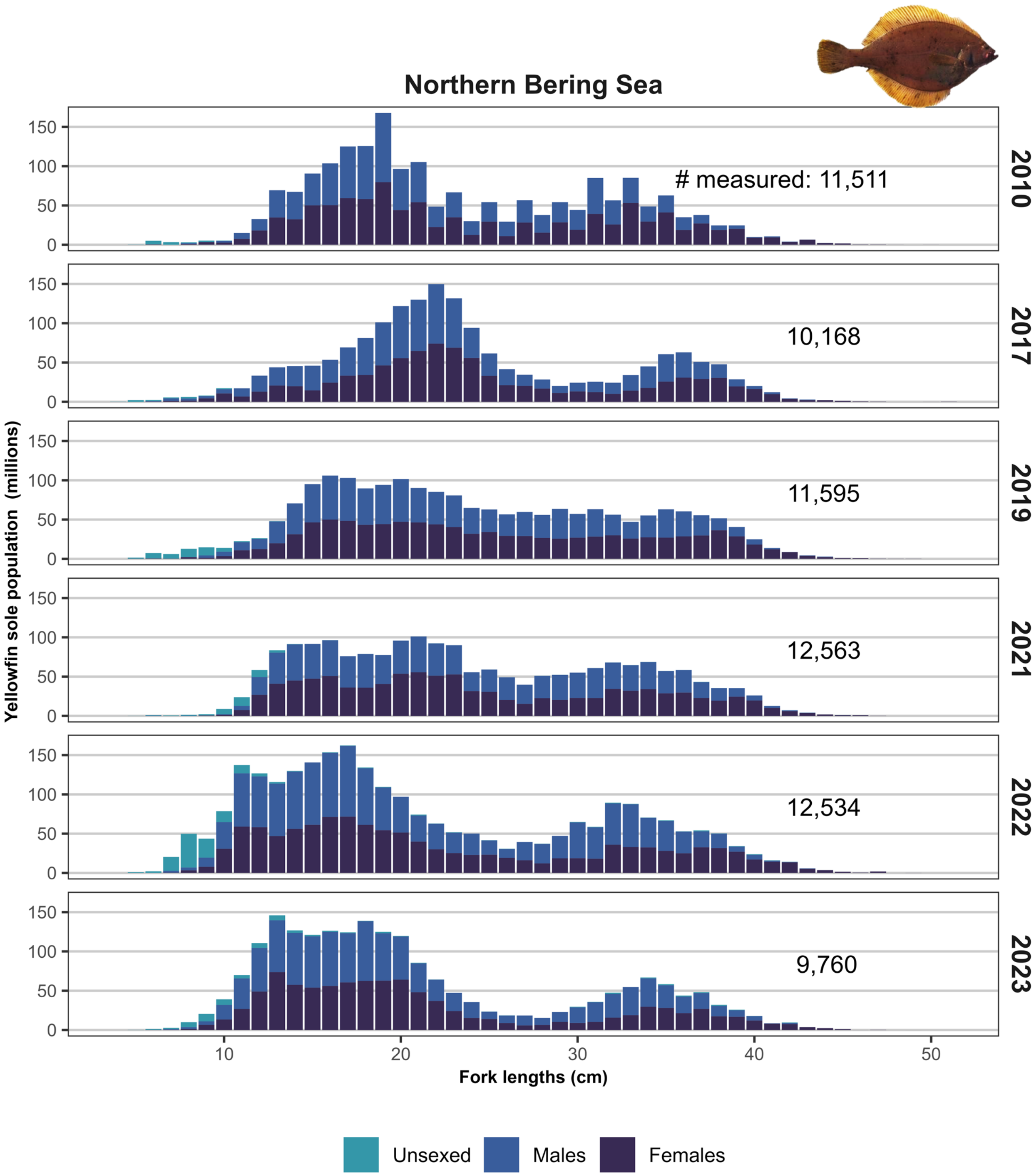


Figure 15. -- Total population estimates at length for yellowfin sole (*Limanda aspera*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Pacific Halibut
(*Hippoglossus stenolepis*)

Russian:
тихоокеанский белокорый палтус

St. Lawrence Island Yup'ik:
cagiq, naternarpak

In 2023, Pacific halibut biomass decreased by 17% in the northern Bering Sea (Table **4**; Figure **16**). Distribution of Pacific halibut in the 2023 northern Bering Sea survey area was similar to that observed in 2022 and 2021, with the greatest densities around St. Matthew Island (Figure **17**). A length mode was observed for Pacific halibut around 56 cm, and lengths ranged between 22 and 108 cm (Figure **18**).

Table 4. -- Summary of catch location environmental variables, as well as 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

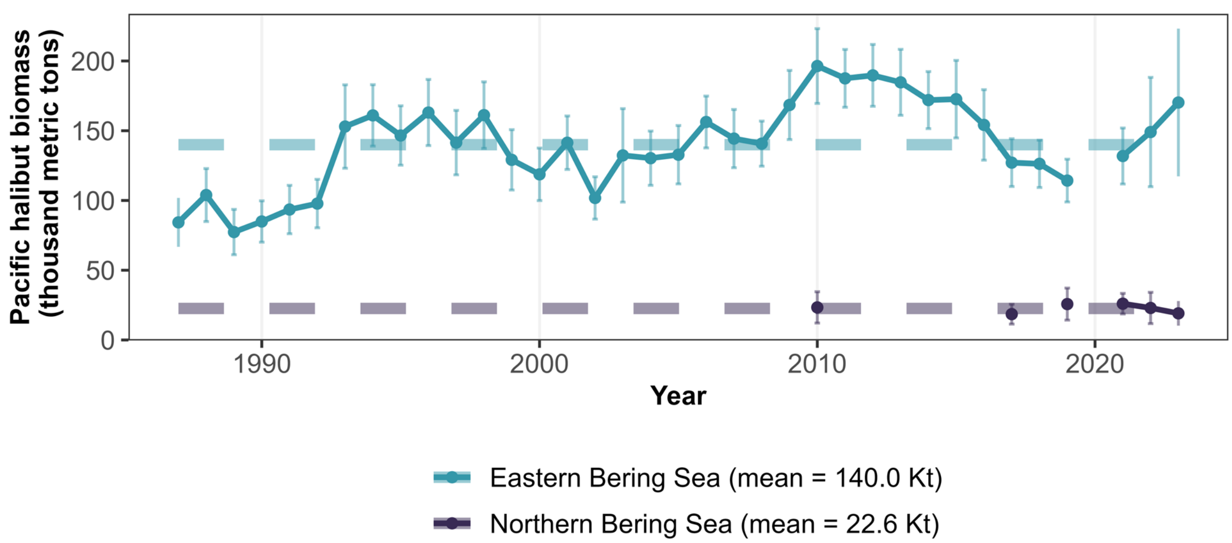


Figure 16. -- Estimates of Pacific halibut (*Hippoglossus stenolepis*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

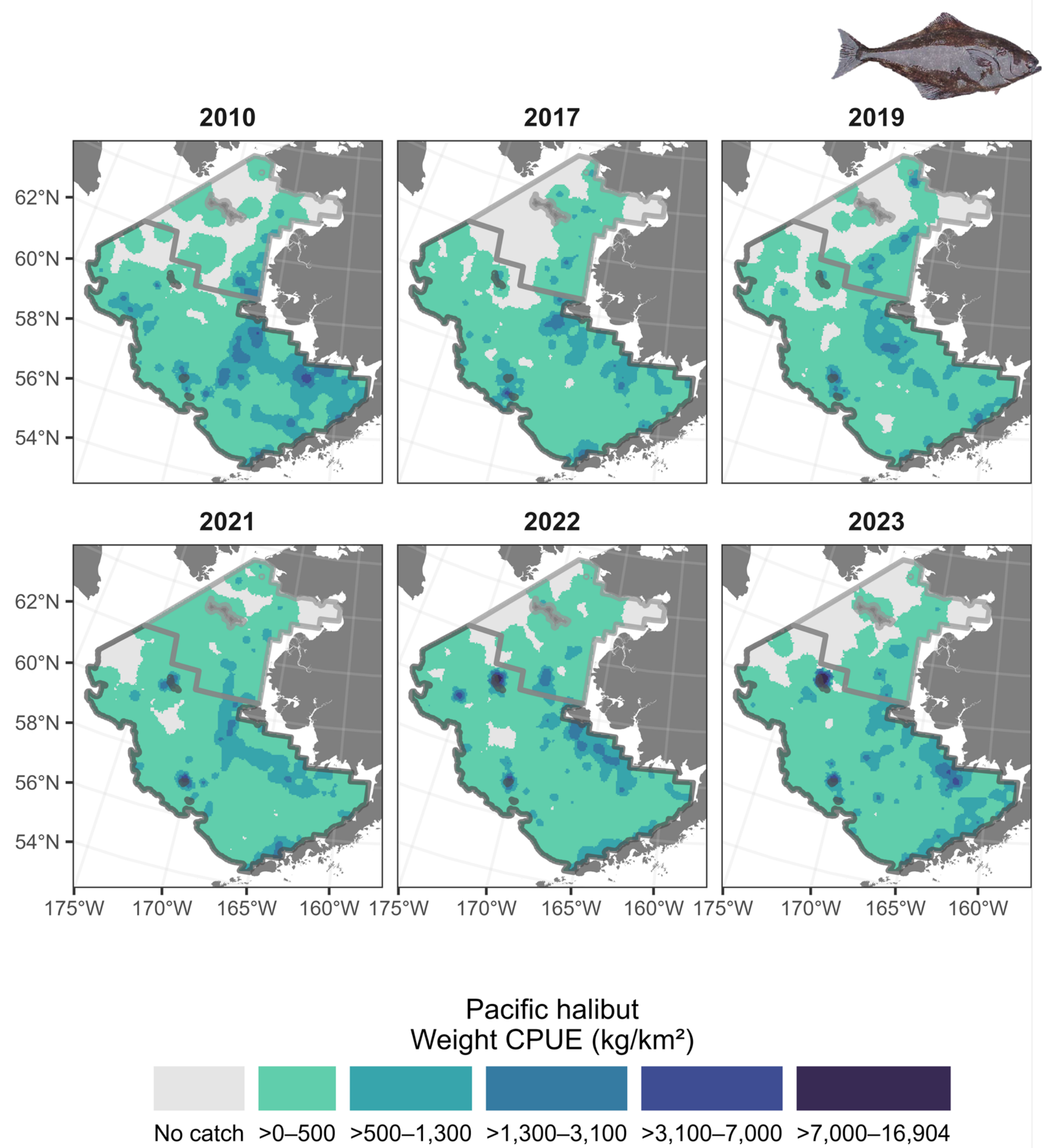


Figure 17. -- Distribution (Weight CPUE (kg/km^2)) of Pacific halibut (*Hippoglossus stenolepis*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

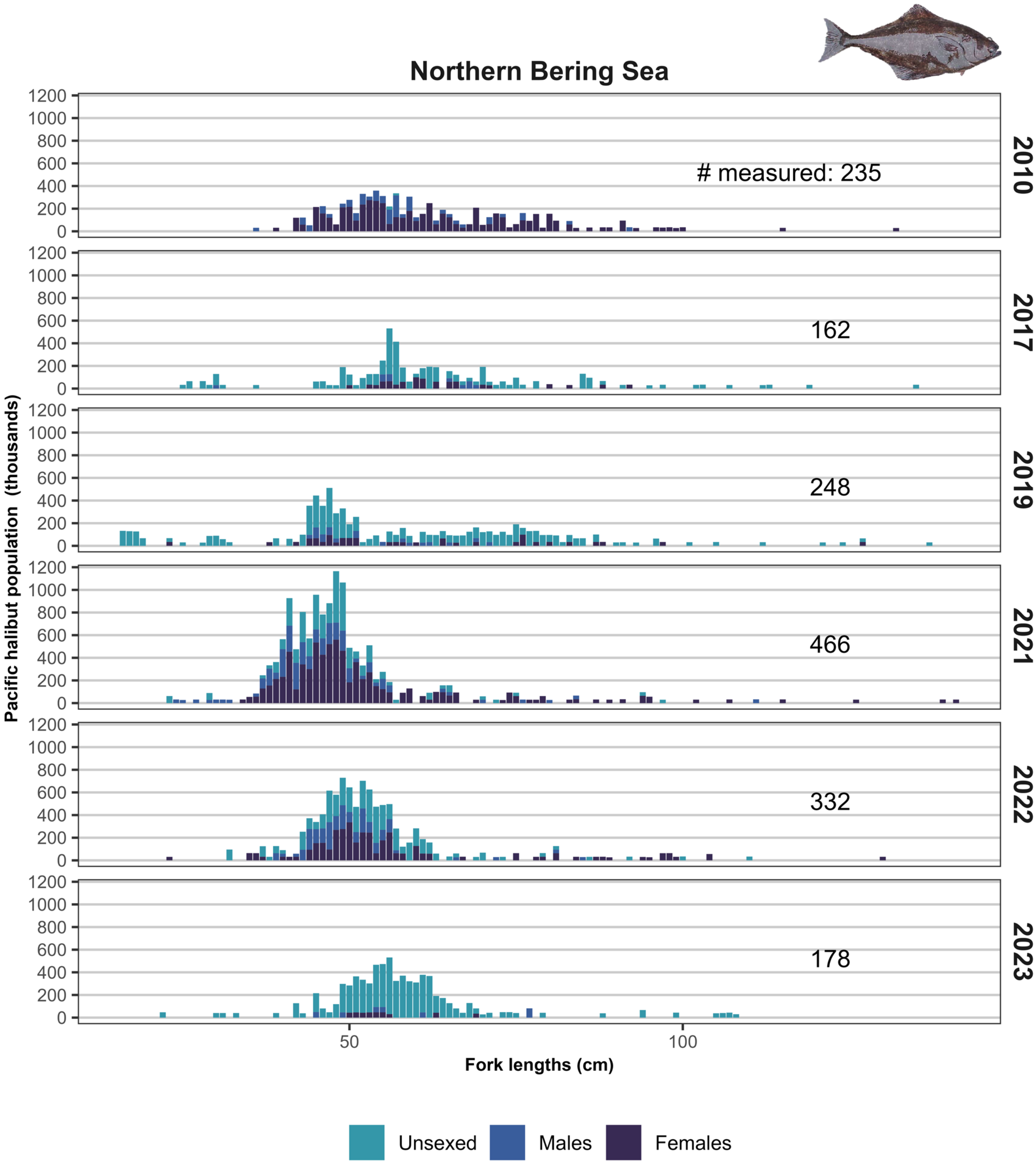


Figure 18. -- Total population estimates at length for Pacific halibut (*Hippoglossus stenolepis*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Bering Flounder (*Hippoglossoides robustus*)

Russian:
северная палтусовидная камбала

St. Lawrence Island Yup'ik:
cagiq, sagiq

In 2023, Bering flounder biomass decreased by 20% in the northern Bering Sea (Table **5**; Figure **19**). In the northern Bering Sea, Bering flounder were found north of 58°N, with highest densities found north west of St. Matthew Island (Figure **20**). A length mode was observed for Bering flounder around 10 cm (Figure **21**).

Table 5. -- Summary of catch location environmental variables, as well as 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

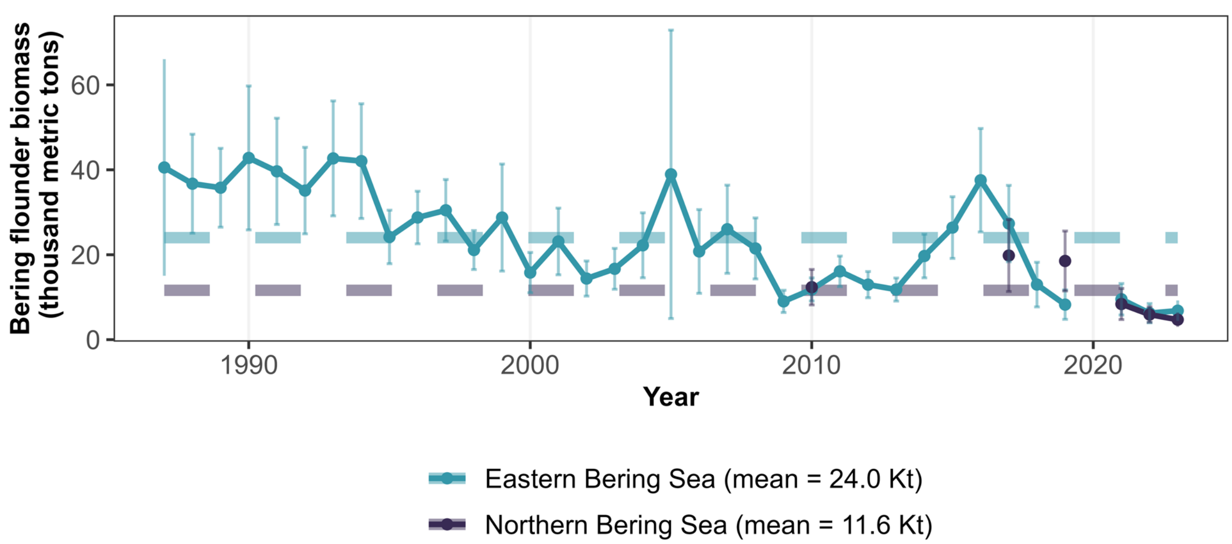


Figure 19. -- Estimates of Bering flounder (*Hippoglossoides robustus*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

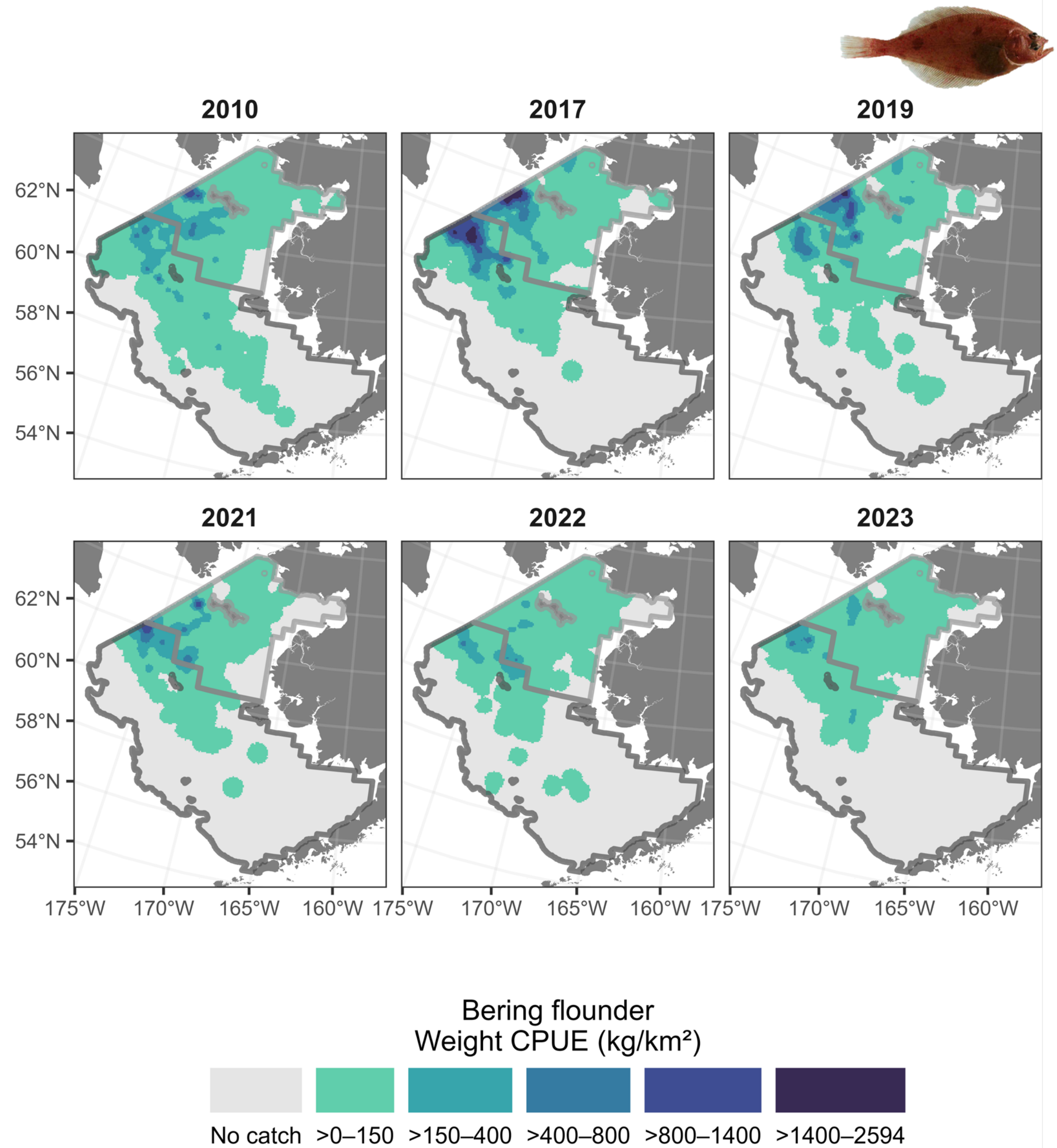


Figure 20. -- Distribution (Weight CPUE (kg/km^2)) of Bering flounder (*Hippoglossoides robustus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

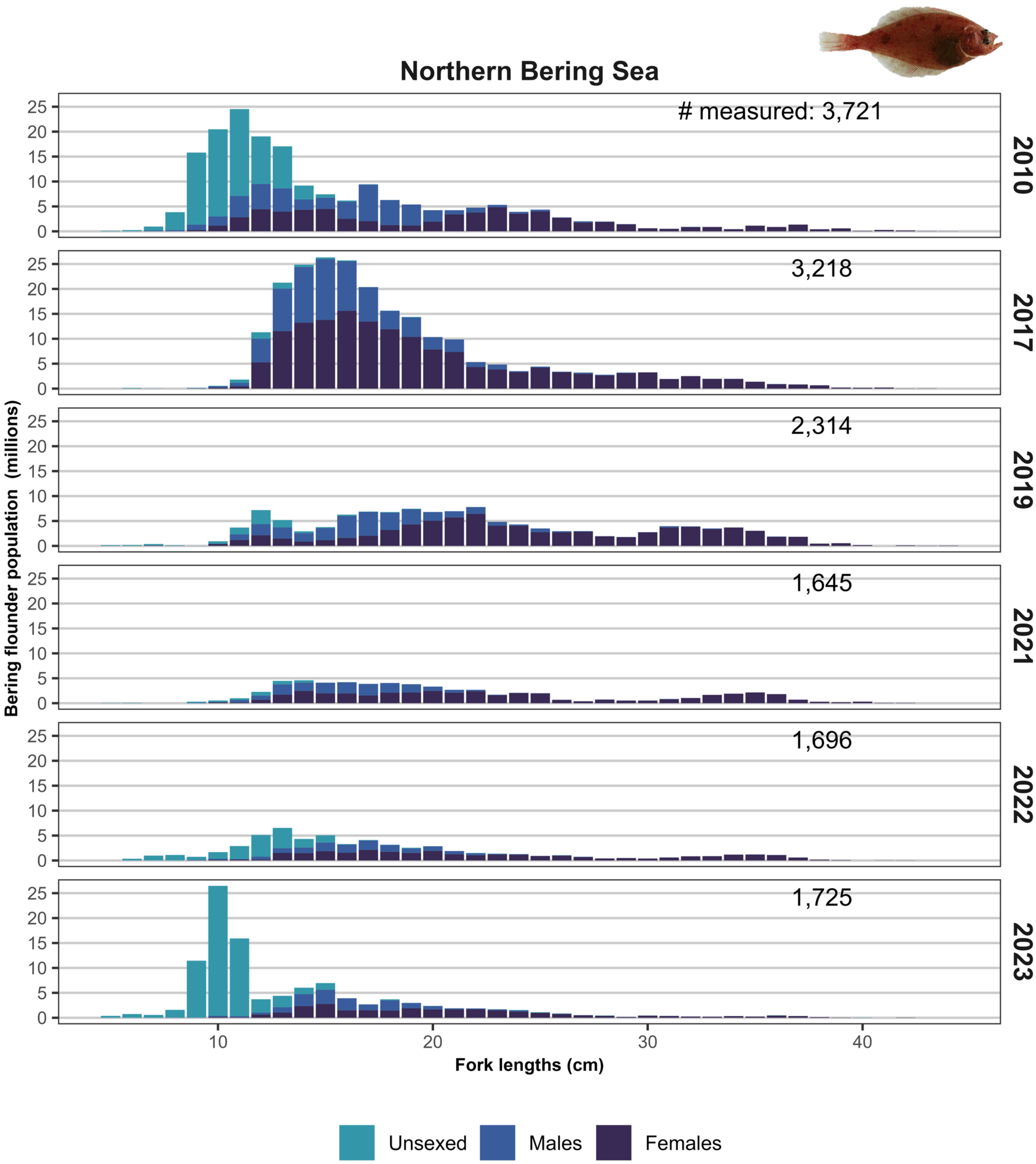


Figure 21. -- Total population estimates at length for Bering flounder (*Hippoglossoides robustus*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Northern Rock Sole (*Lepidopsetta polyxystra*)

Russian: северная двухлинейная камбала

St. Lawrence Island Yup'ik: cagiq, sagiq

In 2023, northern rock sole biomass decreased by 37% in the northern Bering Sea (Table **6**; Figure **22**). The highest densities of northern rock sole in the northern Bering Sea were observed north of the Pribilof Islands and in Bristol Bay in 2023 (Figure **23**). Measured fork lengths of northern rock sole were between 1 and 51 cm, with modes at 9 cm and 31 cm (Figure **24**).

Table 6. -- Summary of catch location environmental variables, as well as 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	11.5%	1.0%
Biomass % Change	7% increase from 2022	37% decrease from 2022

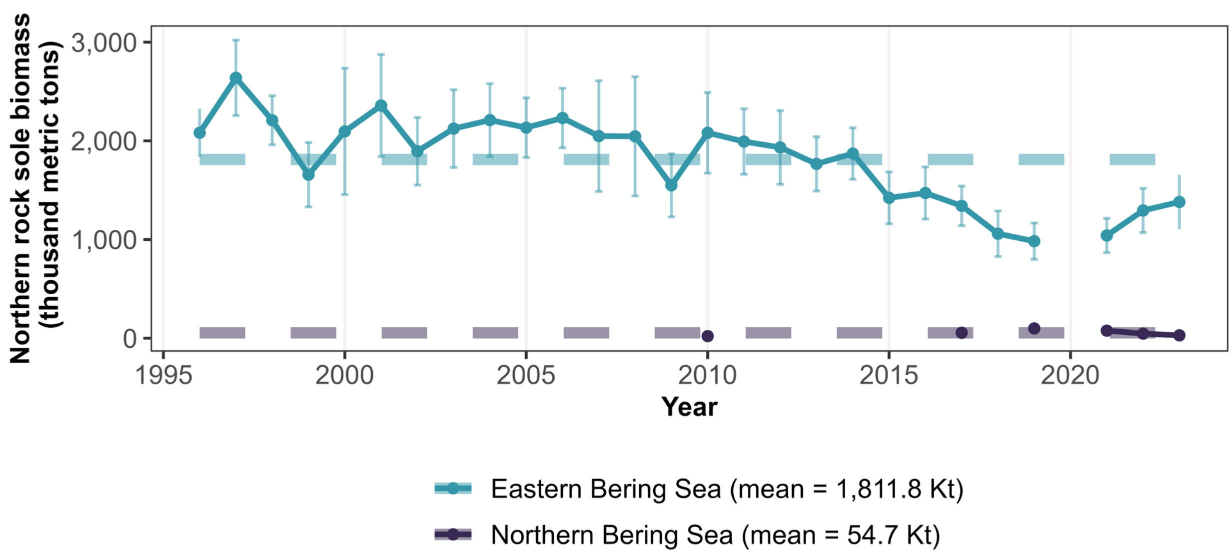


Figure 22. -- Estimates of northern rock sole (*Lepidopsetta polyxystra*) biomass (t) from the 1996-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

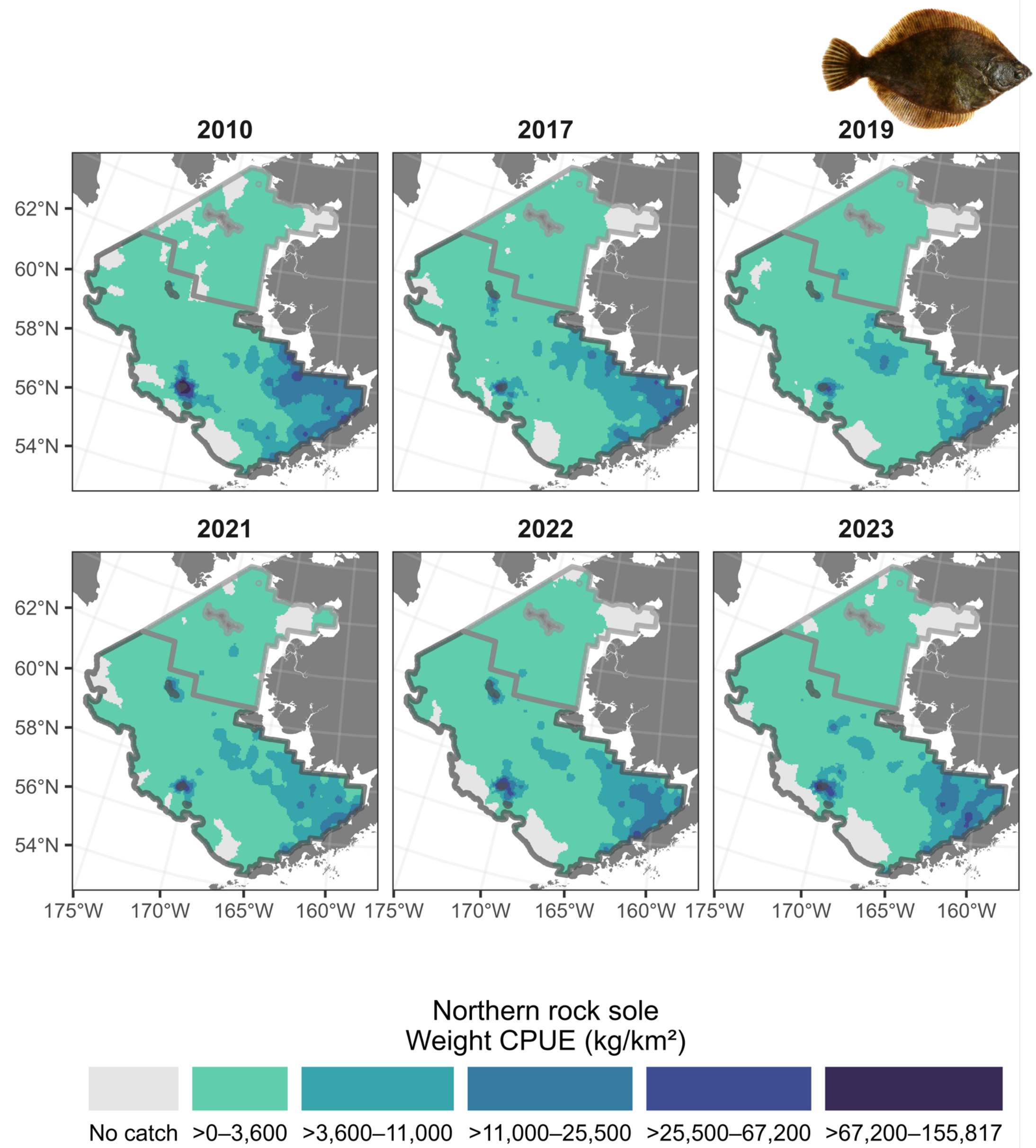


Figure 23. -- Distribution (Weight CPUE (kg/km^2)) of northern rock sole (*Lepidopsetta polyxystra*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

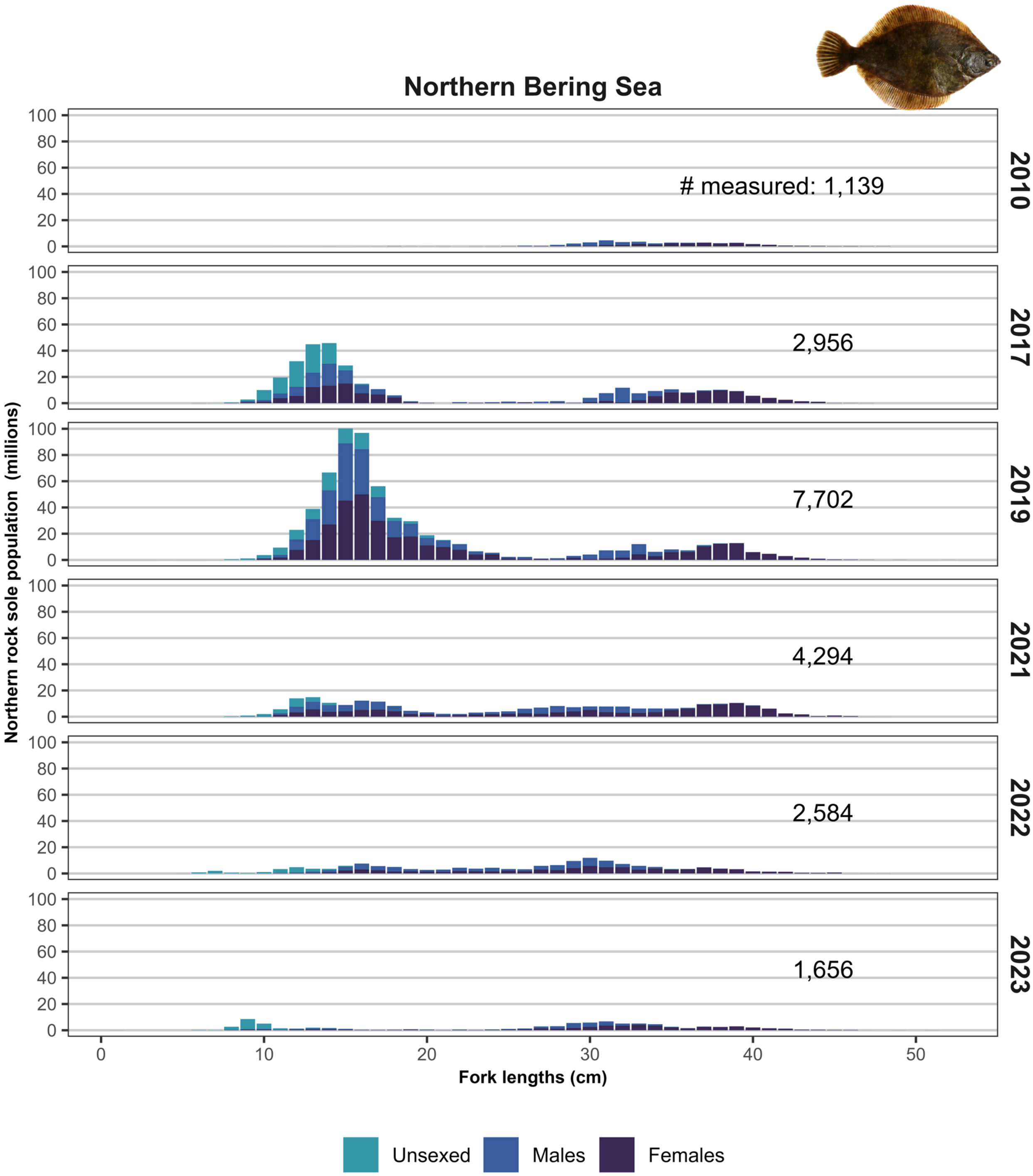


Figure 24. -- Total population estimates at length for northern rock sole (*Lepidopsetta polyxystra*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Walleye Pollock
(*Gadus chalcogrammus*)

Russian: тихоокеанский минтай

In 2023, walleye pollock biomass decreased by 8% in the northern Bering Sea (Table **7**; Figure **25**). The spatial distribution of walleye pollock was relatively uniform throughout the northern Bering Sea survey area, with a small area of higher density in the Chirikov Basin just south of the Bering Strait (Figure **26**).

Size distributions of walleye pollock in 2023 were similar to 2022 and had two distinct modes (Figure **27**). 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) is much higher in 2023 than in 2022. Pollock in the 20-35 cm size range (representing 2-3 year-olds) are generally absent or rare in survey catch samples in the eastern Bering Sea (Figure **27**) because they typically occupy a position high above the seafloor where they are unavailable to the survey trawl (Kotwicki et al., 2015).

Table 7. -- Summary of catch location environmental variables, as well as 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	26.3%	12.5%
Biomass % Change	24% decrease from 2022	8% decrease from 2022

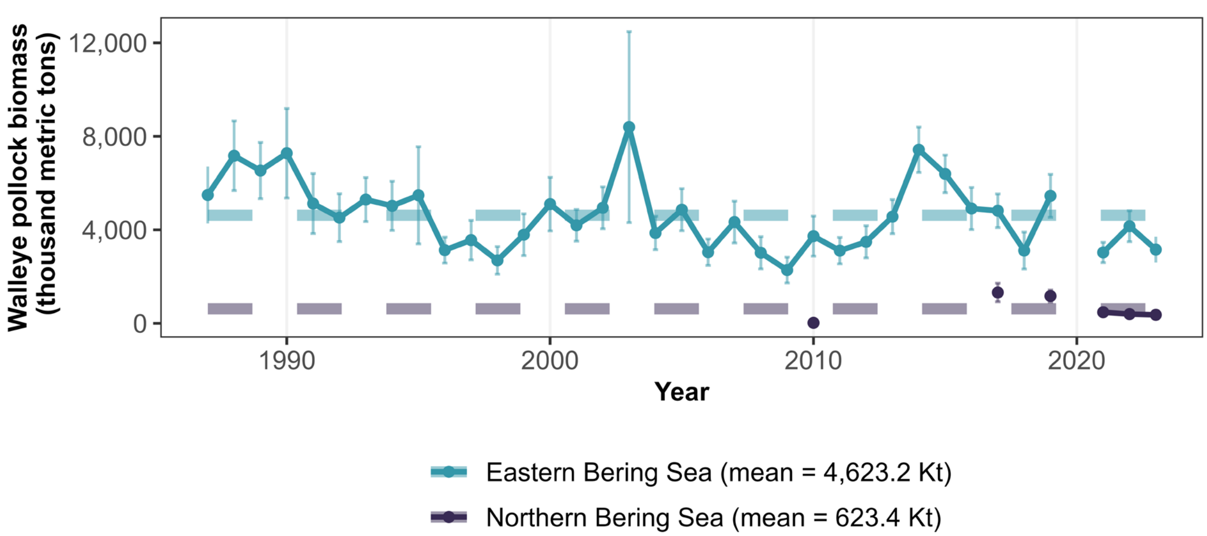


Figure 25. -- Estimates of walleye pollock (*Gadus chalcogrammus*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

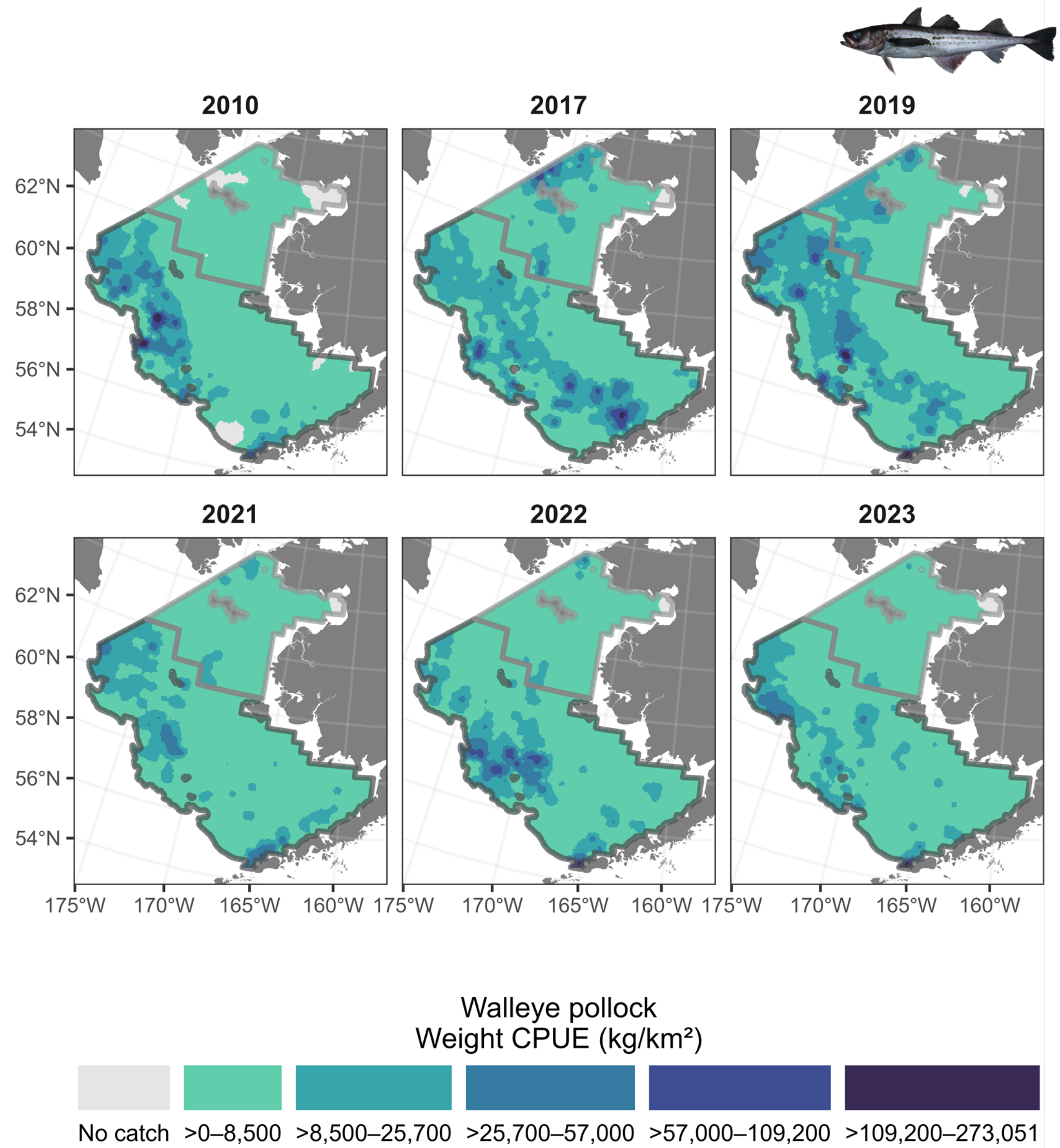


Figure 26. -- Distribution (Weight CPUE (kg/km^2)) of walleye pollock (*Gadus chalcogrammus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

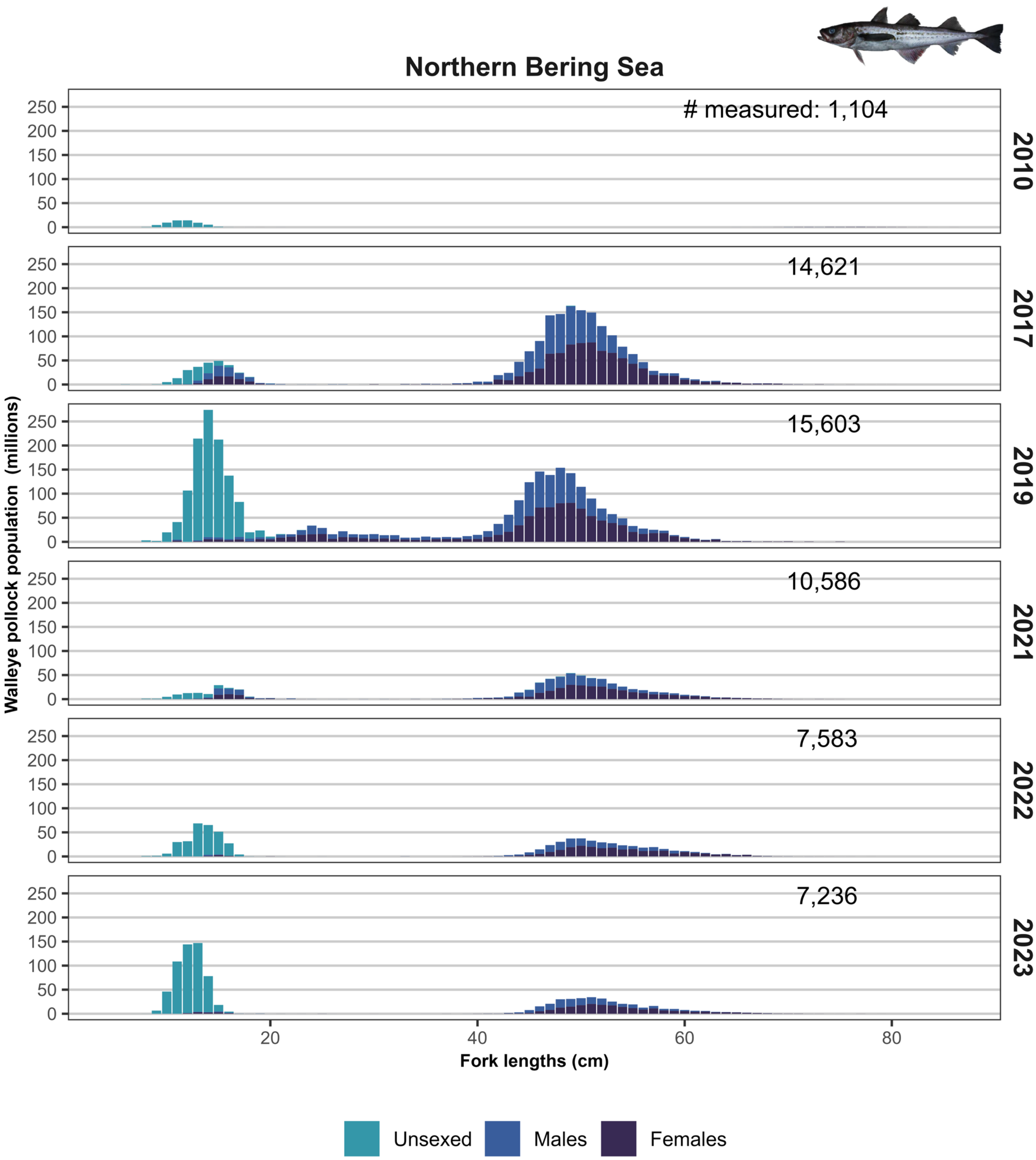
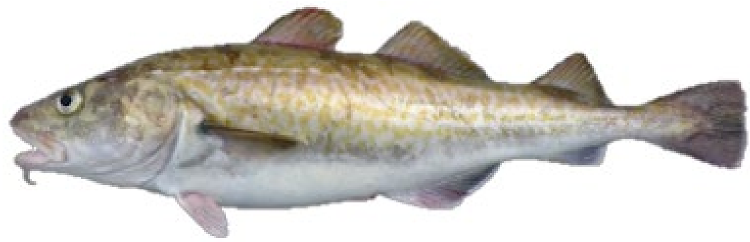


Figure 27. -- Total population estimates at length for walleye pollock (*Gadus chalcogrammus*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Pacific Cod (*Gadus macrocephalus*)



Russian: тихоокеанская треска

Bristol Bay Yup`ik: atigiaq

Nunivak Island Yup`ik: atgiiyaq

Central Yup`ik: centurrnaq

Yukon, Hooper Bay, Chevak, Nunivak Island Yup'ik: iqalluaq

In 2023, Pacific cod biomass decreased by 30% in the northern Bering Sea (Table **8**; Figure **28**). The highest densities Pacific Cod in the northern Bering Sea were just north of St. Lawrence Island (Figure **29**). Pacific cod size composition in 2023 shows three distinct modes around 15 cm, 31 cm, and 61 cm (Figure **30**).

Table 8. -- Summary of catch location environmental variables, as well as 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	5.5%	3.7%
Biomass % Change	2% increase from 2022	30% decrease from 2022

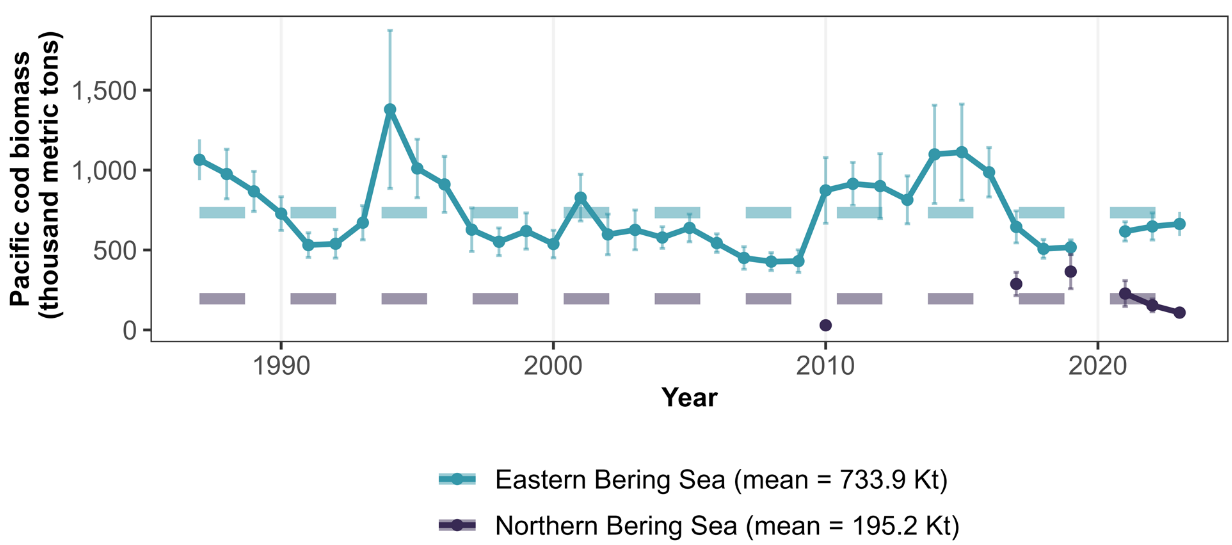


Figure 28. -- Estimates of Pacific cod (*Gadus macrocephalus*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

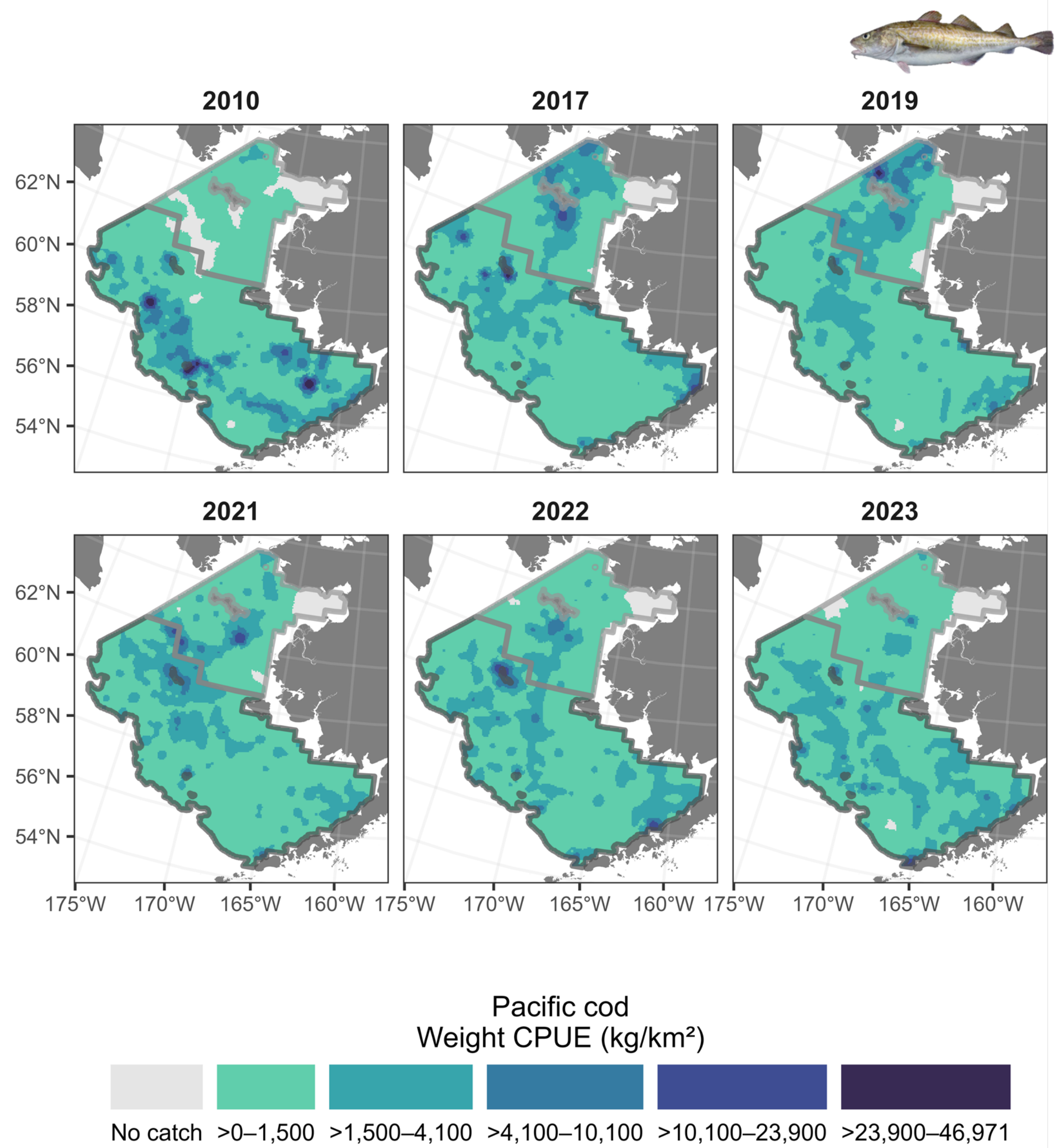


Figure 29. -- Distribution (Weight CPUE (kg/km^2)) of Pacific cod (*Gadus macrocephalus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

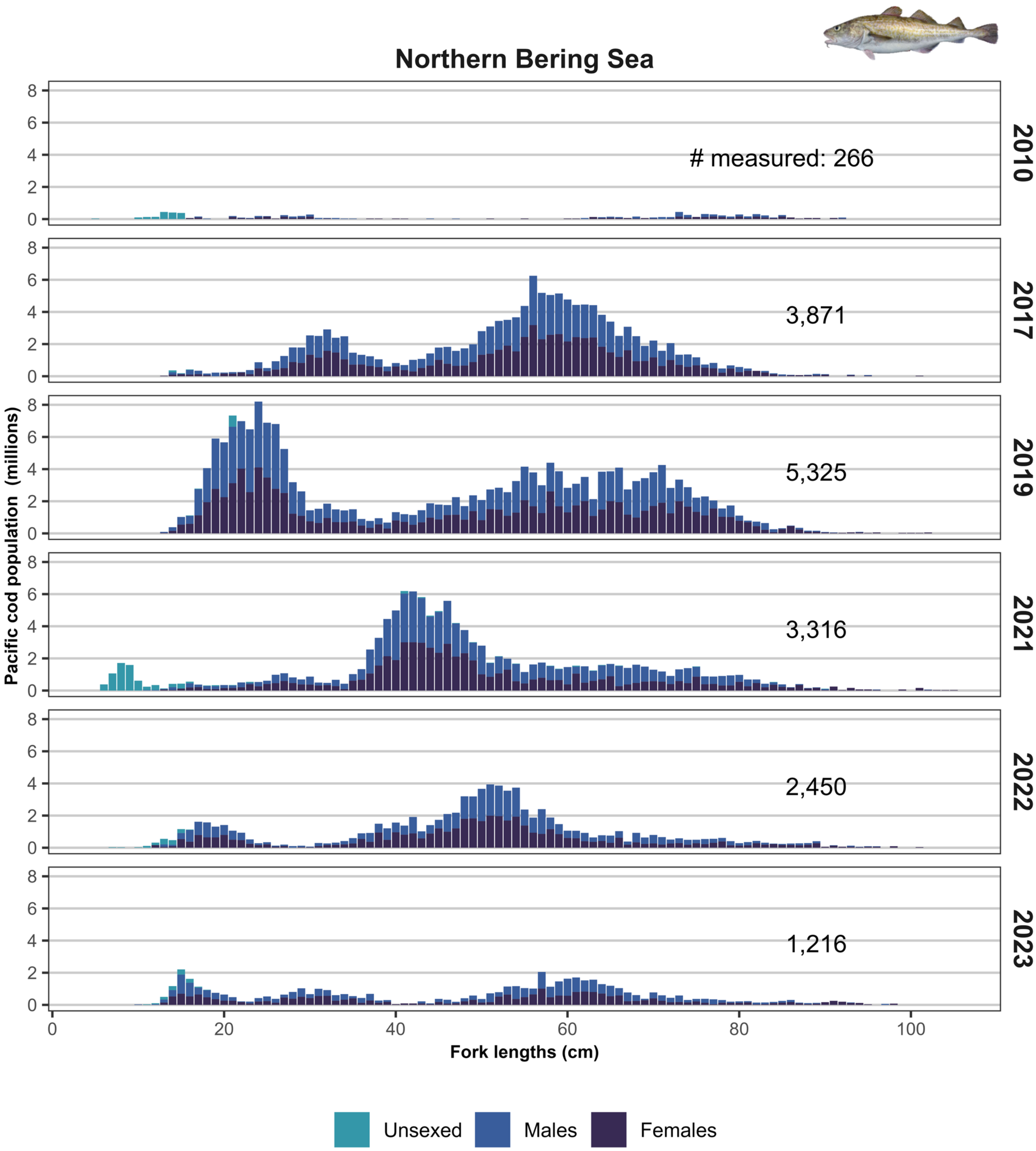


Figure 30. -- Total population estimates at length for Pacific cod (*Gadus macrocephalus*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Saffron Cod (*Eleginus gracilis*)

Previous common name: tomcod

Russian: тихоокеанская навага

Inupiaq: Uugaq

In 2023, saffron cod biomass increased by 38% in the northern Bering Sea (Table **9**; Figure **31**). The highest density of saffron cod in the northern Bering Sea survey area was just north of Nunivak Island, with lower densities in the waters off the coast of western Alaska, and into Norton Sound (Figure **32**). The lengths of saffron cod measured in 2023 were between 6 and 42 cm (Figure **33**).

Table 9. -- Summary of catch location environmental variables, as well as 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%	1.3%
Biomass % Change	86% decrease from 2022	38% increase from 2022

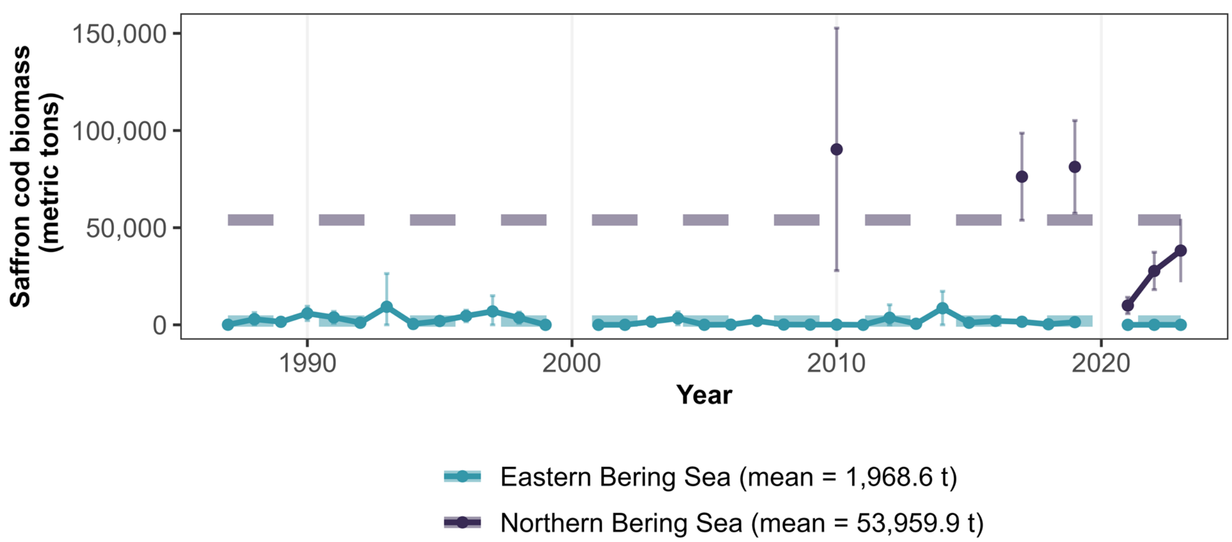


Figure 31. -- Estimates of saffron cod (*Eleginus gracilis*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

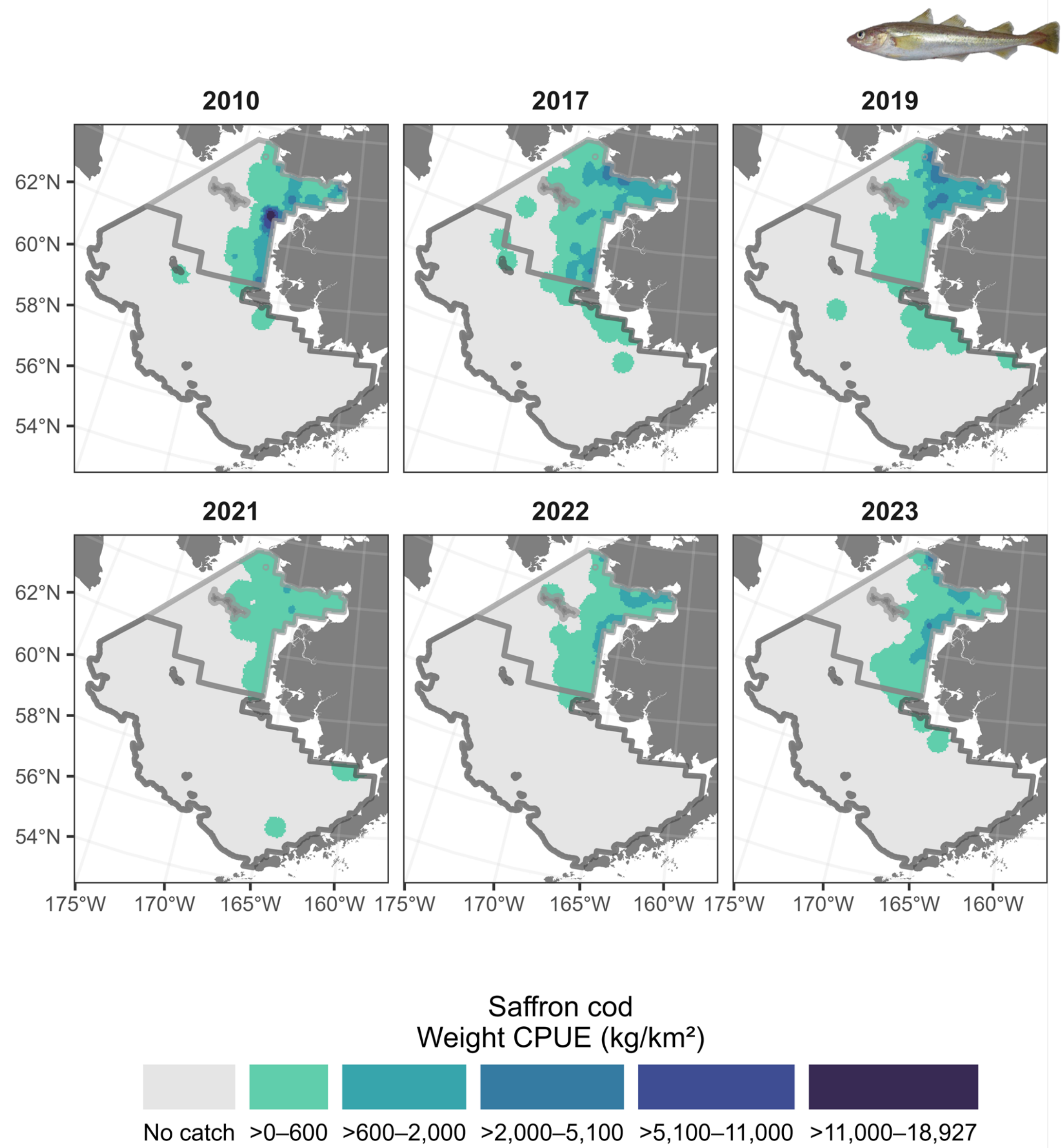


Figure 32. -- Distribution (Weight CPUE (kg/km^2)) of saffron cod (*Eleginus gracilis*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

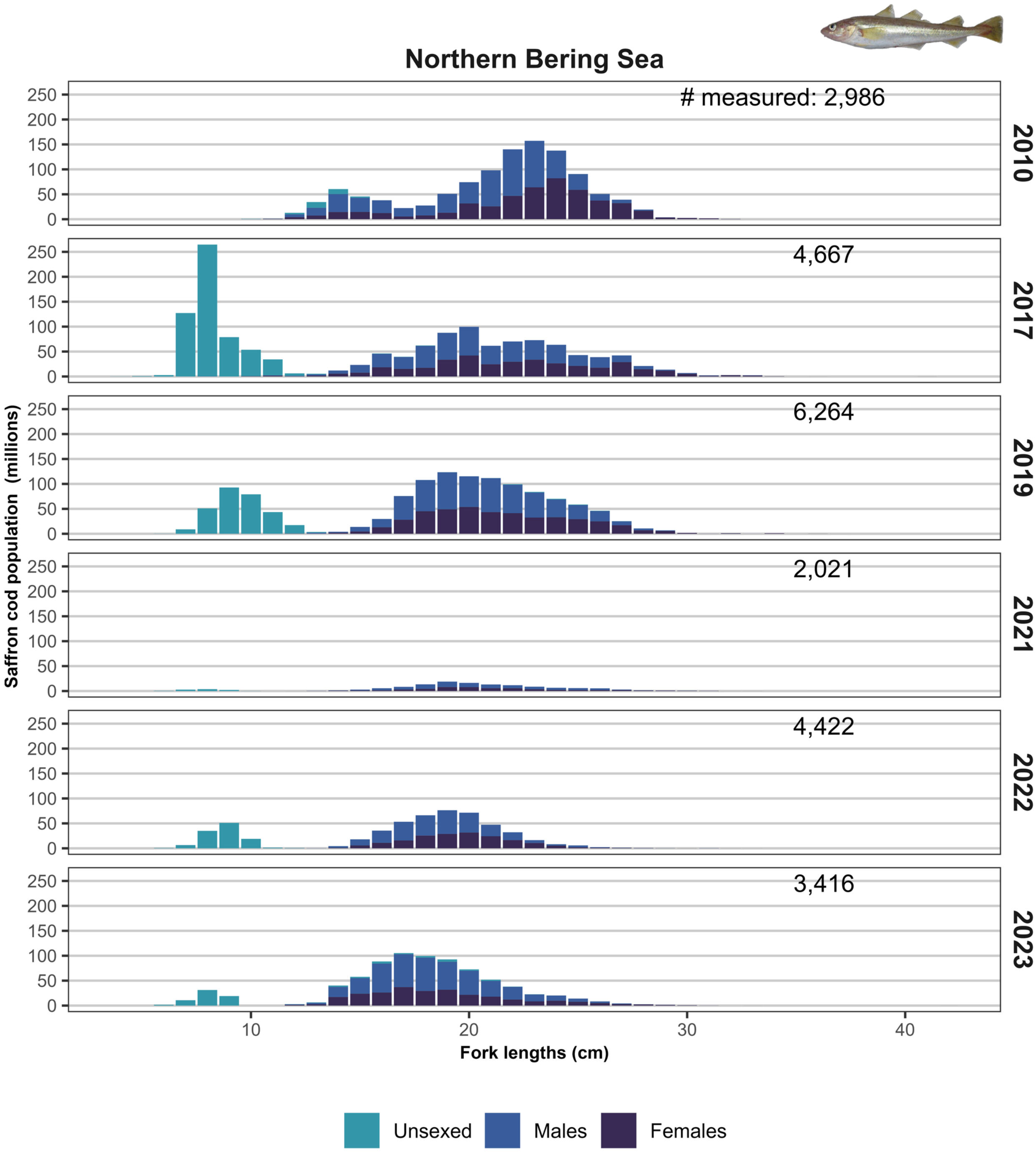


Figure 33. -- Total population estimates at length for saffron cod (*Eleginus gracilis*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Arctic Cod (*Boreogadus saida*)

Russian: ледовая (чёрная) треска

Inupiaq: Iqalugaq

Arctic cod are an important forage fish species of the Bering Sea region. In 2023, Arctic cod biomass decreased by 91% in the northern Bering Sea (Table **10**; Figure **34**). The highest densities of Arctic cod in the northern Bering Sea were observed in Norton Sound, and in a small area northeast of St. Matthew Island in 2023 (Figure **35**). The fork lengths of Arctic cod measured were between 10 and 24 cm, while during the 2022 northern Bering Sea survey Arctic cod were between 9 and 24 cm (Figure **36**).

Table 10. -- Summary of catch location environmental variables, as well as 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

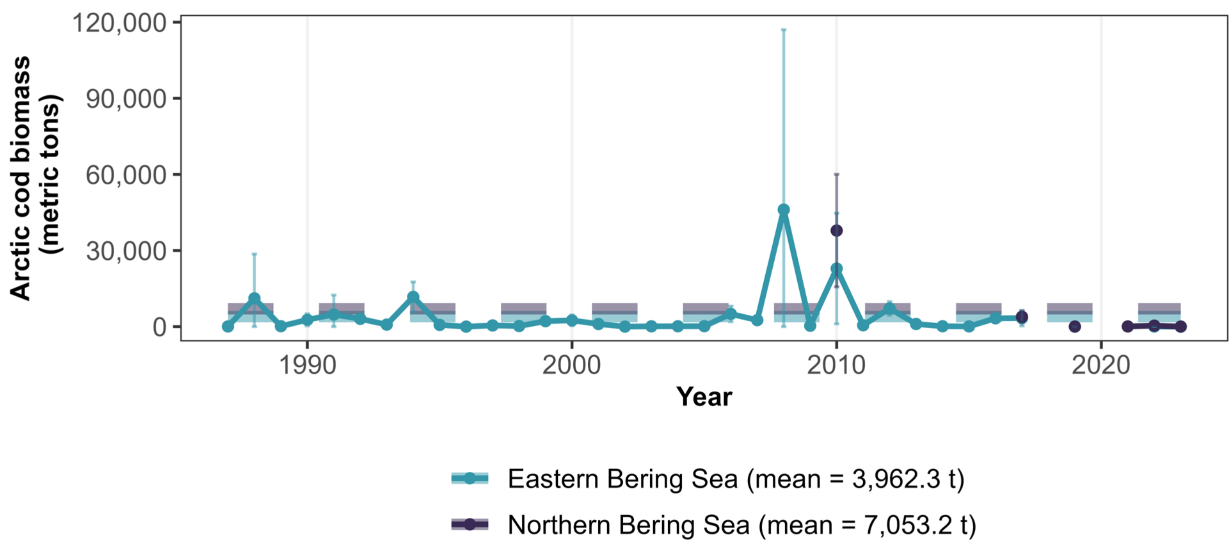


Figure 34. -- Estimates of Arctic cod (*Boreogadus saida*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

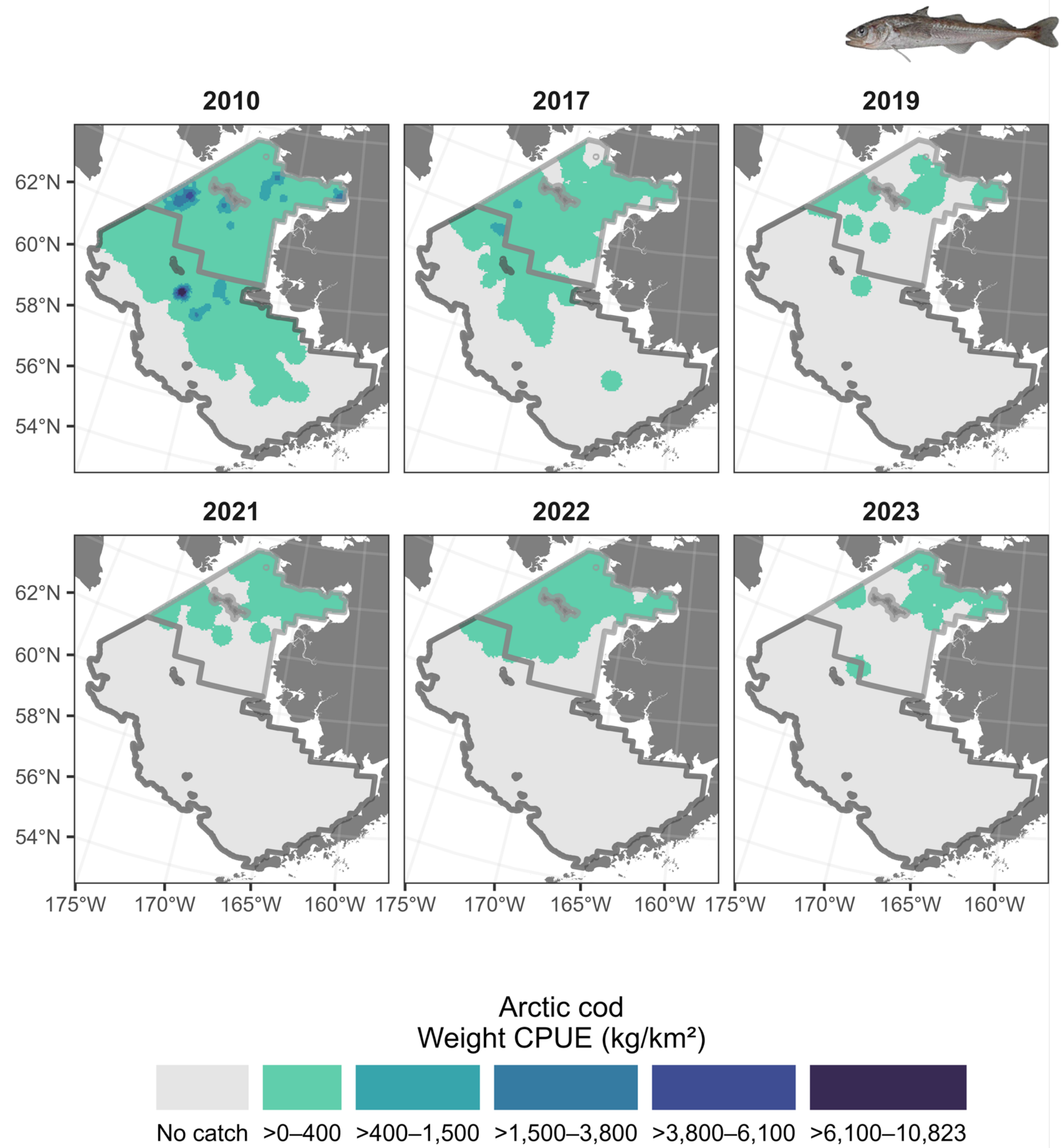


Figure 35. -- Distribution (Weight CPUE (kg/km^2)) of Arctic cod (*Boreogadus saida*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

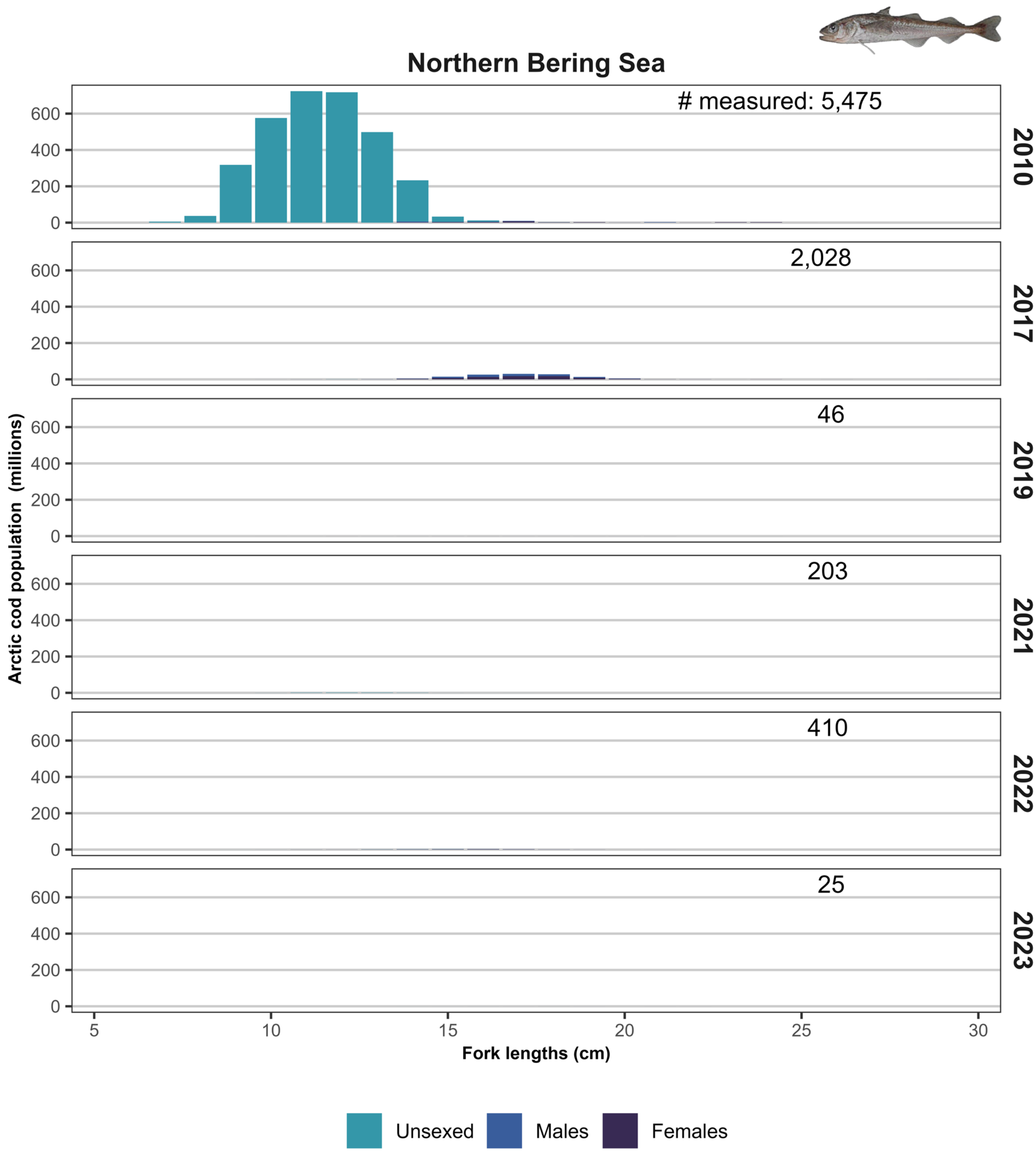


Figure 36. -- Total population estimates at length for Arctic cod (*Boreogadus saida*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Red King Crab (*Paralithodes camtschaticus*)

Russian: Амурская морская звезда

In 2023, red king crab biomass increased by 39% in the northern Bering Sea (Table **11**; Figure **37**). Within the 2023 northern Bering Sea survey area, red king crab were found predominantly in Norton Sound (Figure **38**). The carapace lengths of red king crab measured were between 14.8 mm and 148.1 mm (Figure **39**). Detailed information on bottom trawl survey results for commercial crab species are discussed and analyzed in the AFSC Shellfish Assessment Program's annual data report (Zacher et al., 2023).

Table 11. -- Summary of catch location environmental variables, as well as biomass and population estimates, for red king crab (*Paralithodes camtschaticus*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	111 of 376 (29.5%)	24 of 116 (20.7%)
Bottom Depth (m)	25 — 137	16 — 52
Bottom Temperature (°C)	-1 — 4.6	-0.2 — 9.9
Surface Temperature (°C)	1.8 — 8.4	7.8 — 15.1
Population	30.7 million	5.2 million
Biomass (t)	48,056	3,707
Biomass % Total	0.4%	0.1%
Biomass % Change	4% decrease from 2022	39% increase from 2022

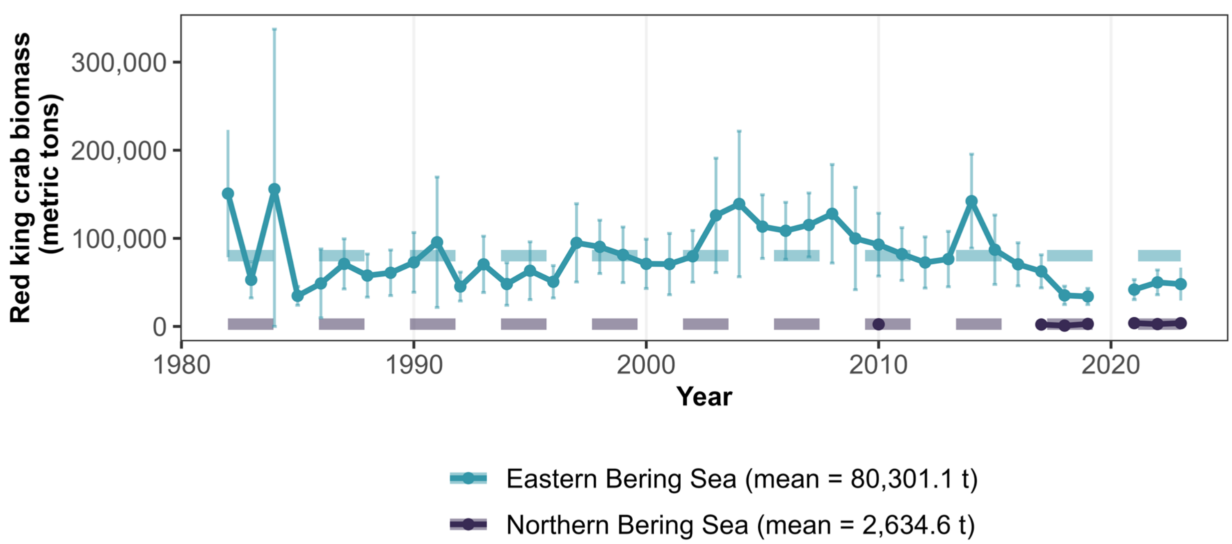


Figure 37. -- Estimates of red king crab (*Paralithodes camtschaticus*) biomass (t) from the 1982-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

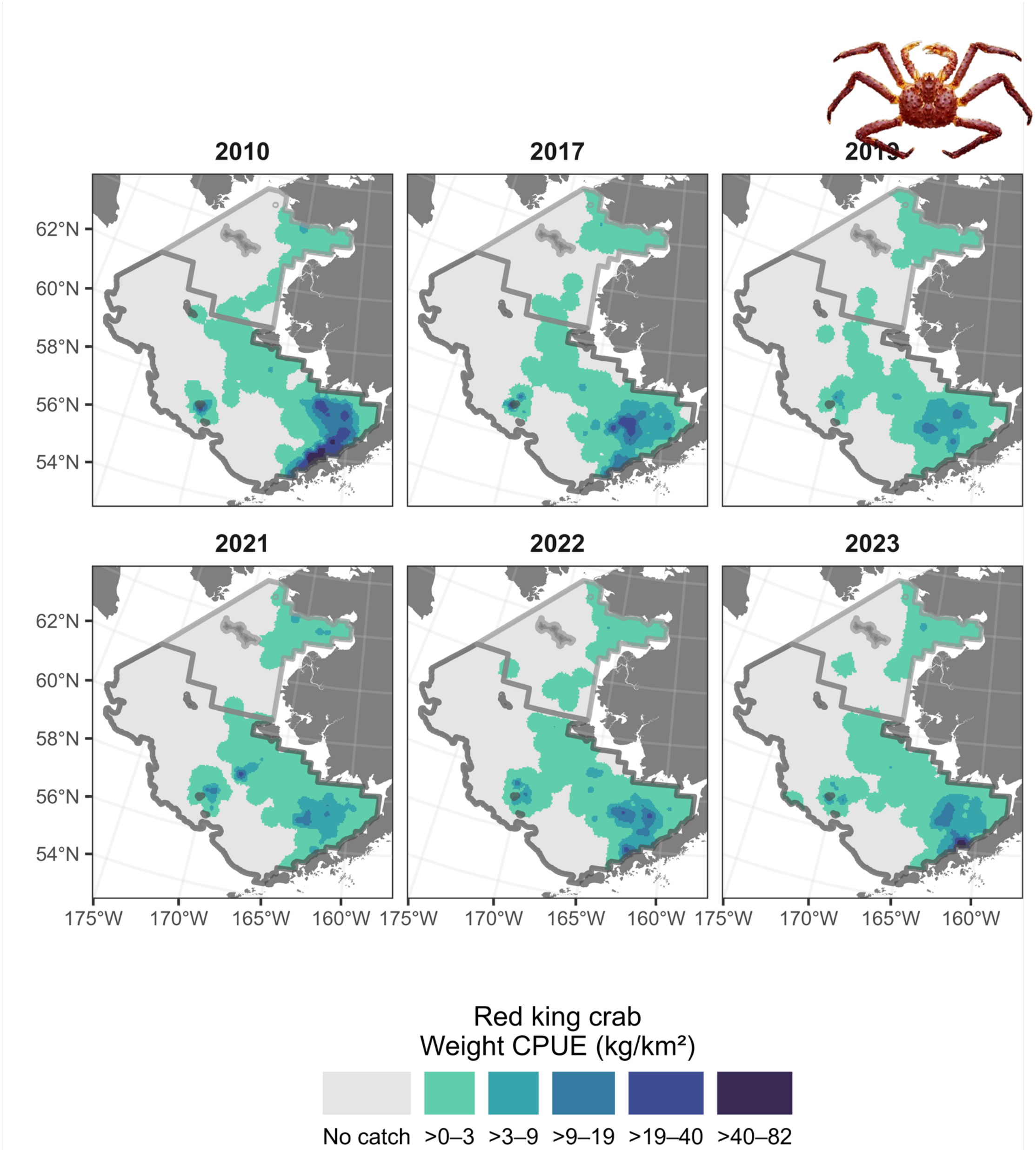


Figure 38. -- Distribution (Weight CPUE (kg/km^2)) of red king crab (*Paralithodes camtschaticus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

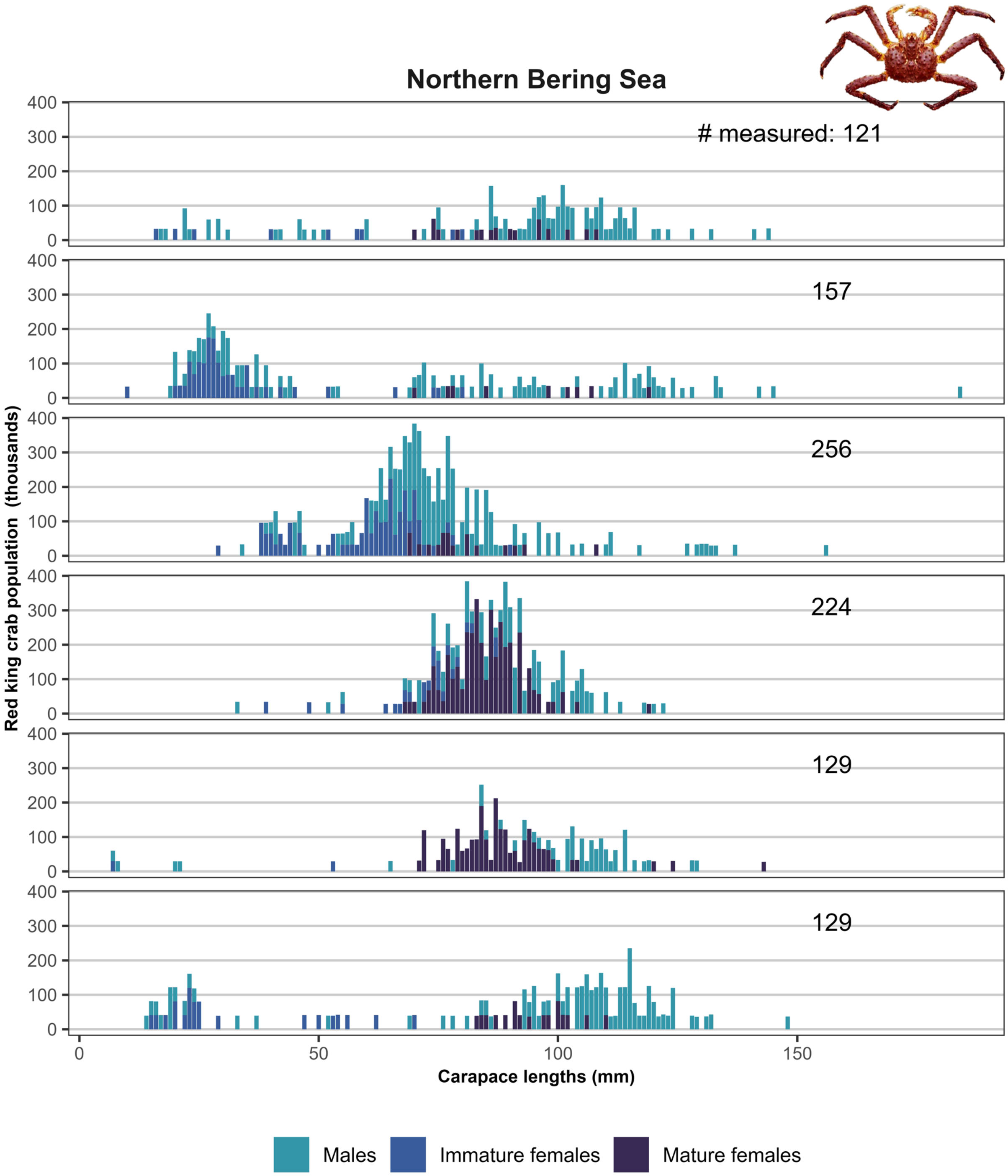


Figure 39. -- Total population estimates at length for red king crab (*Paralithodes camtschaticus*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Blue King Crab
(*Paralithodes platypus*)

Russian: Синий краб

In 2023, blue king crab biomass increased by 31% in the northern Bering Sea (Table **12**; Figure **40**). In recent years, the highest density of blue king crab in the Bering Sea survey area were encountered around St. Matthew Island, the Pribilof Islands, and north of St. Lawrence Island (Figure **41**). In 2023, the carapace lengths of blue king crab measured were between 40.7 and 129.4 mm (Figure **42**). Detailed information on bottom trawl survey results for commercial crab species are discussed and analyzed in the AFSC Shellfish Assessment Program's annual data report (Zacher et al., 2023).

Table 12. -- Summary of catch location environmental variables, as well as biomass and population estimates, for blue king crab (*Paralithodes platypus*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	**Northern Bering Sea**
Stations Present	17 of 376 (4.5%)	23 of 116 (19.8%)
Bottom Depth (m)	44 — 95	21 — 63
Bottom Temperature (°C)	-1.5 — 3.8	-0.1 — 8.7
Surface Temperature (°C)	4.2 — 9.5	4 — 9.8
Population	2.8 million	7.2 million
Biomass (t)	2,753	3,959
Biomass % Total	<0.01%	0.1%
Biomass % Change	38% decrease from 2022	31% increase from 2022

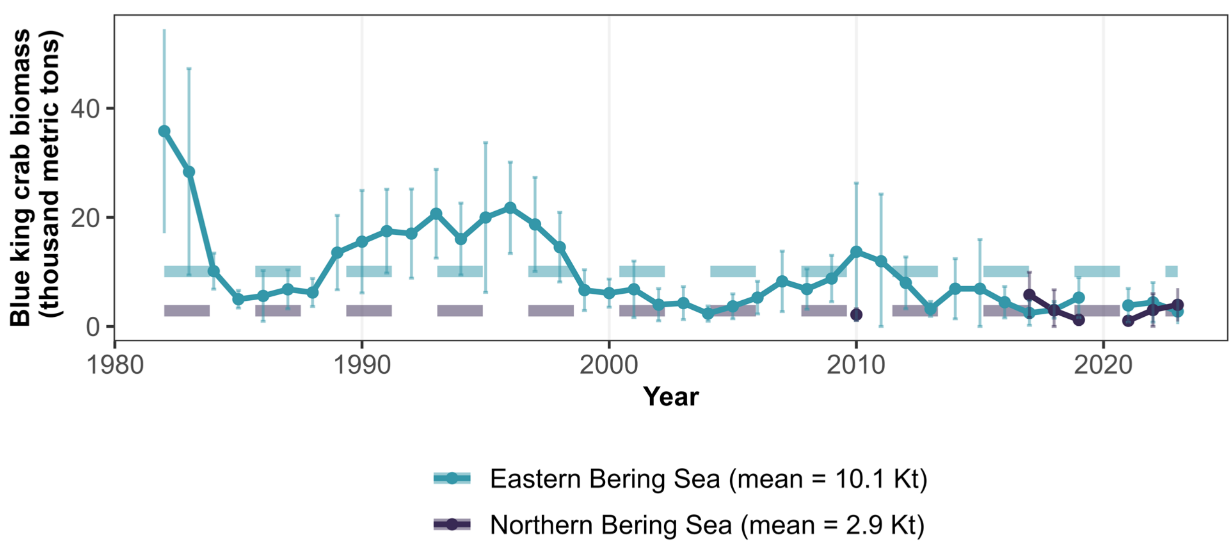


Figure 40. -- Estimates of blue king crab (*Paralithodes platypus*) biomass (t) from the 1982-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

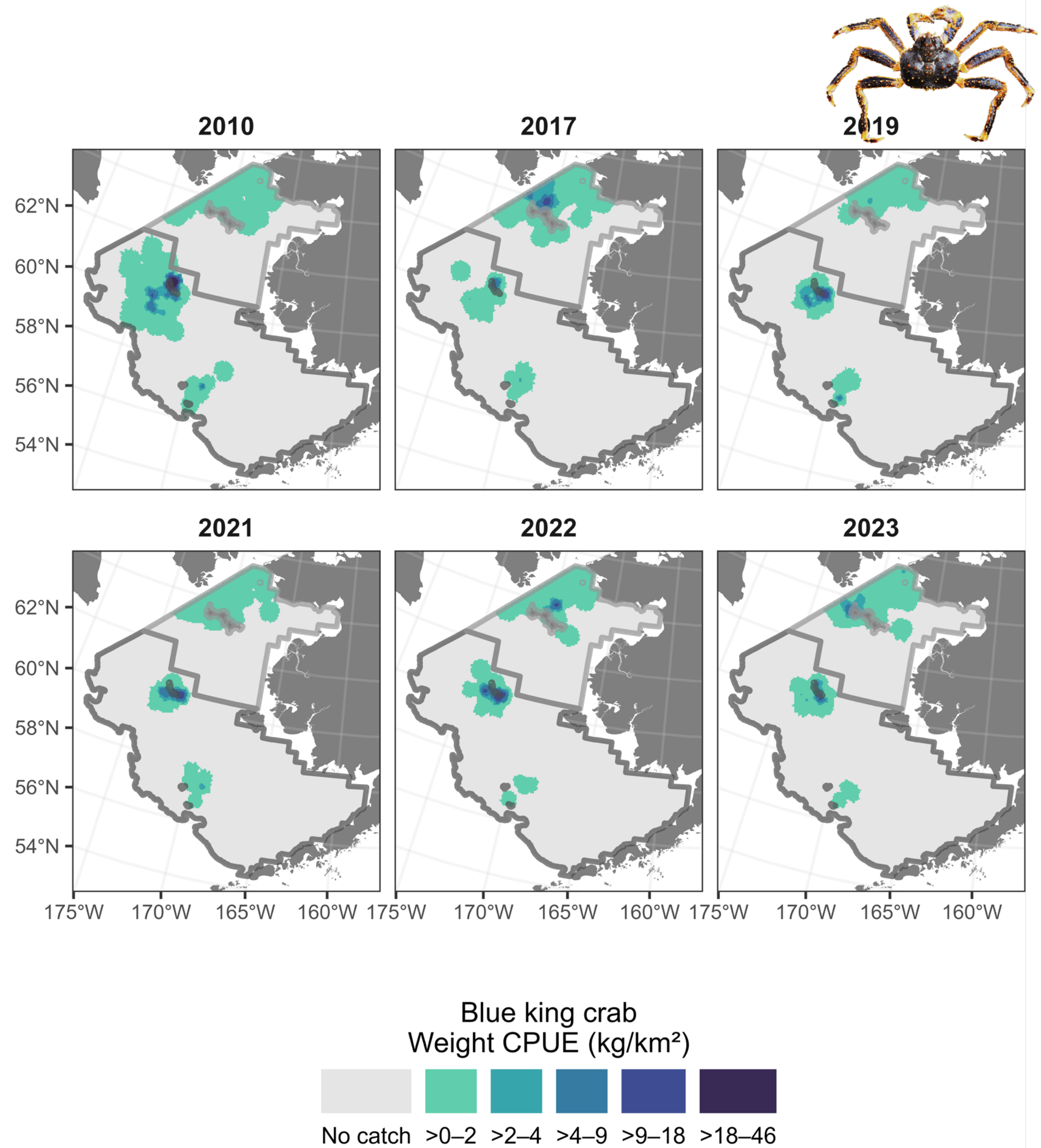


Figure 41. -- Distribution (Weight CPUE (kg/km^2)) of blue king crab (*Paralithodes platypus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

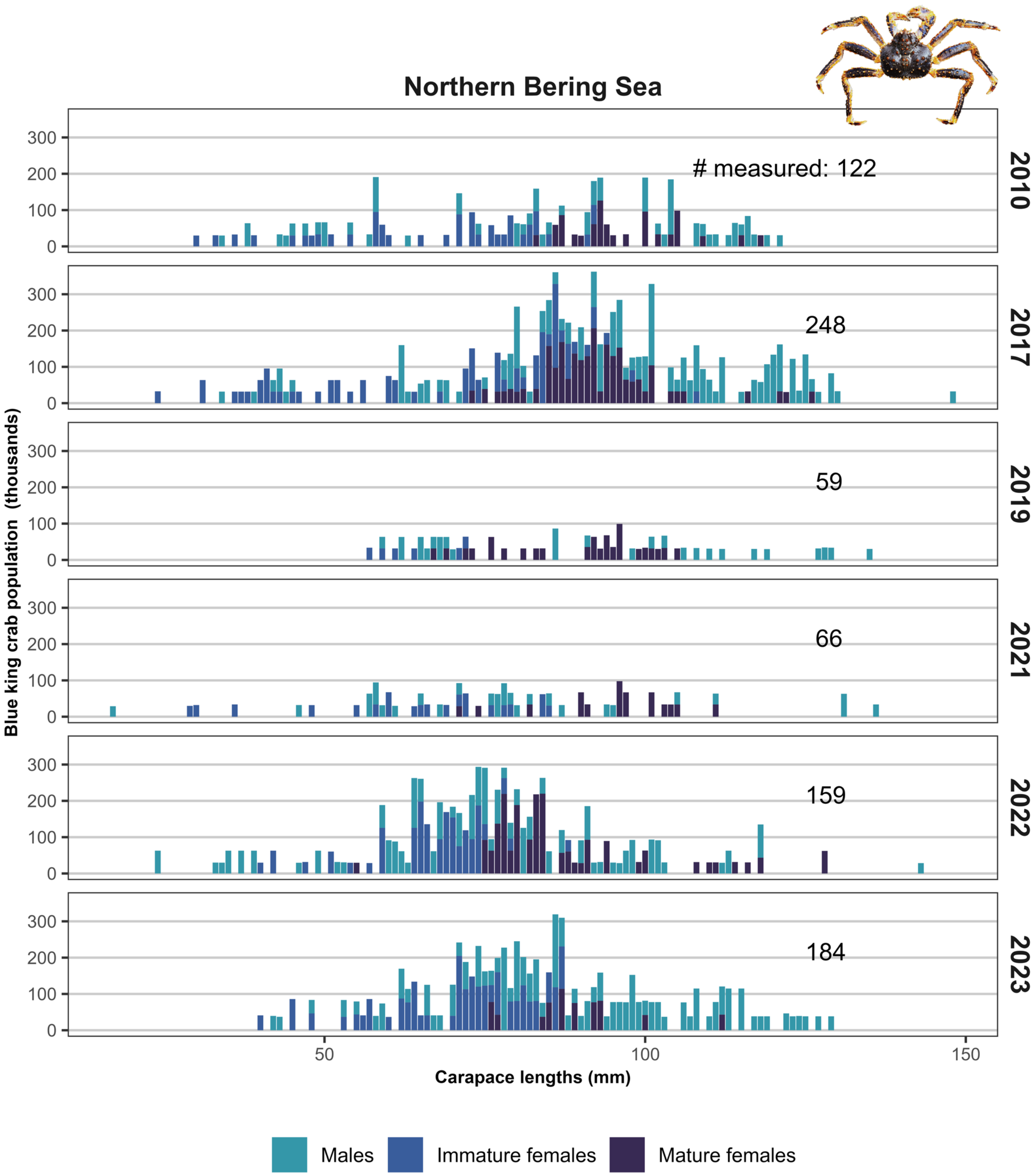


Figure 42. -- Total population estimates at length for blue king crab (*Paralithodes platypus*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Snow Crab
(*Chionoecetes opilio*)

Russian: снежный краб

In 2023, snow crab biomass decreased by 30% in the northern Bering Sea (Table **13**; Figure **43**). The highest densities of snow crab in the 2023 northern Bering Sea survey area were observed to the north and south of St. Matthew Island (Figure **44**). The carapace widths of snow crab measured were between 7.5 mm and 126.7 mm (Figure **45**). Detailed information on bottom trawl survey results for commercial crab species are discussed and analyzed in the AFSC Shellfish Assessment Program's annual data report (Zacher et al., 2023).

Table 13. -- Summary of catch location environmental variables, as well as biomass and population estimates, for snow crab (*Chionoecetes opilio*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	239 of 376 (63.6%)	85 of 116 (73.3%)
Bottom Depth (m)	43 — 171	18 — 78
Bottom Temperature (°C)	-1.6 — 4.6	-1.6 — 9.9
Surface Temperature (°C)	2.2 — 11	4 — 12.8
Population	2.1 billion	5.8 billion
Biomass (t)	88,269	111,482
Biomass % Total	0.7%	3.8%
Biomass % Change	16% decrease from 2022	30% decrease from 2022

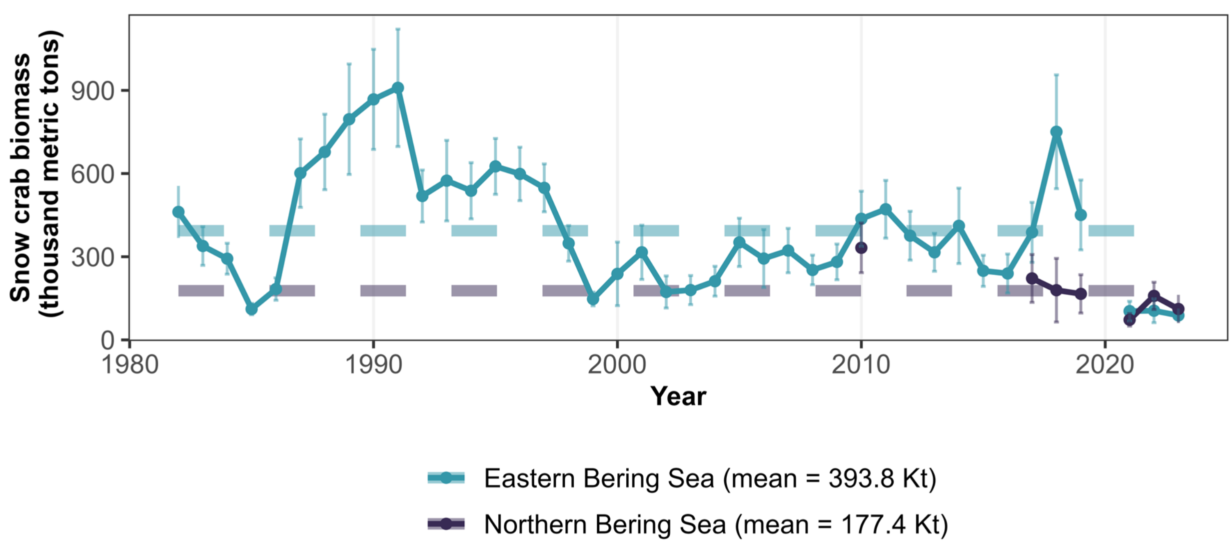


Figure 43. -- Estimates of snow crab (*Chionoecetes opilio*) biomass (t) from the 1982-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

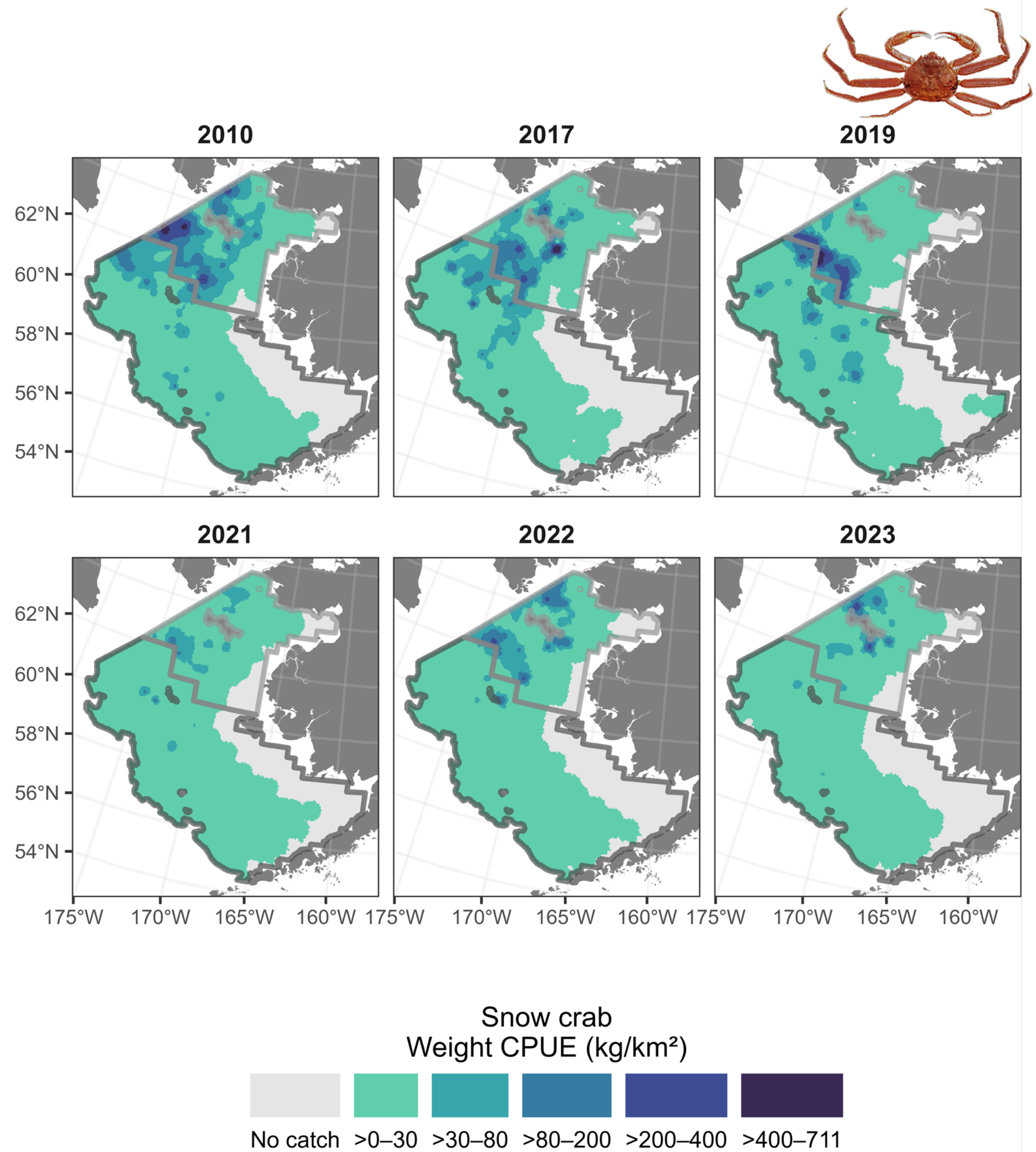


Figure 44. -- Distribution (Weight CPUE (kg/km^2)) of snow crab (*Chionoecetes opilio*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

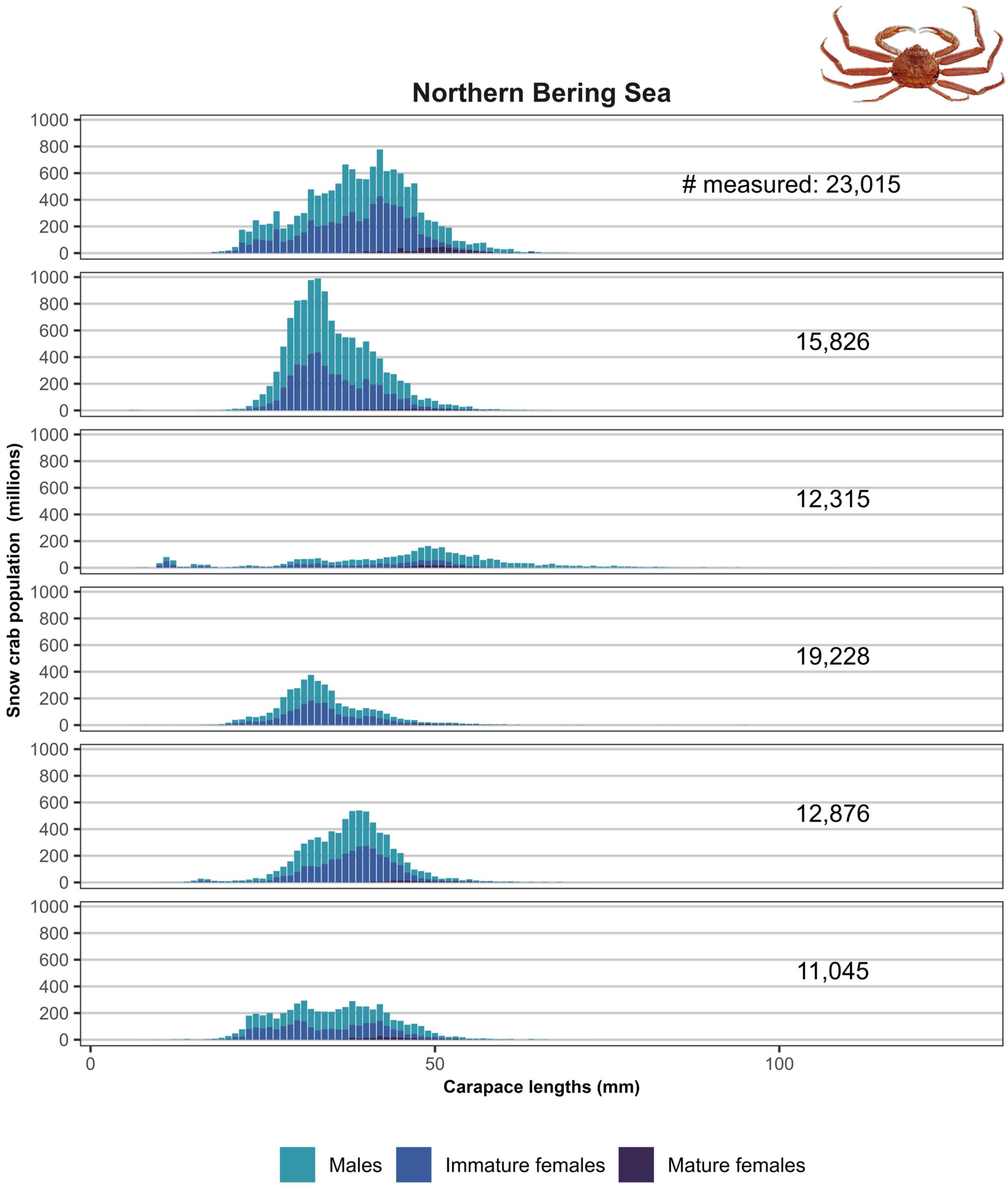


Figure 45. -- Total population estimates at length for snow crab (*Chionoecetes opilio*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Alaska Skate (*Arctoraja parmifera*)

Previous scientific name: *Bathyraja parmifera*

Russian: щитоносный скат

In 2023, biomass increased by 6% for Alaska skate in the northern Bering Sea (Table **14**; Figure **46**). The highest density of Alaska skates in the 2023 northern Bering Sea survey area were north of St. Lawrence Island north to the Bering Strait. No Alaska skates were encountered in Norton Sound (Figure **47**). The Alaska skate is the most abundant skate on the continental shelf of the Bering Sea. A similar size composition of Alaska skates has been observed for all years of the northern Bering Sea survey (Figure **48**).

Table 14. -- Summary of catch location environmental variables, as well as 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	3.5%	1.8%
Biomass % Change	10% decrease from 2022	6% increase from 2022

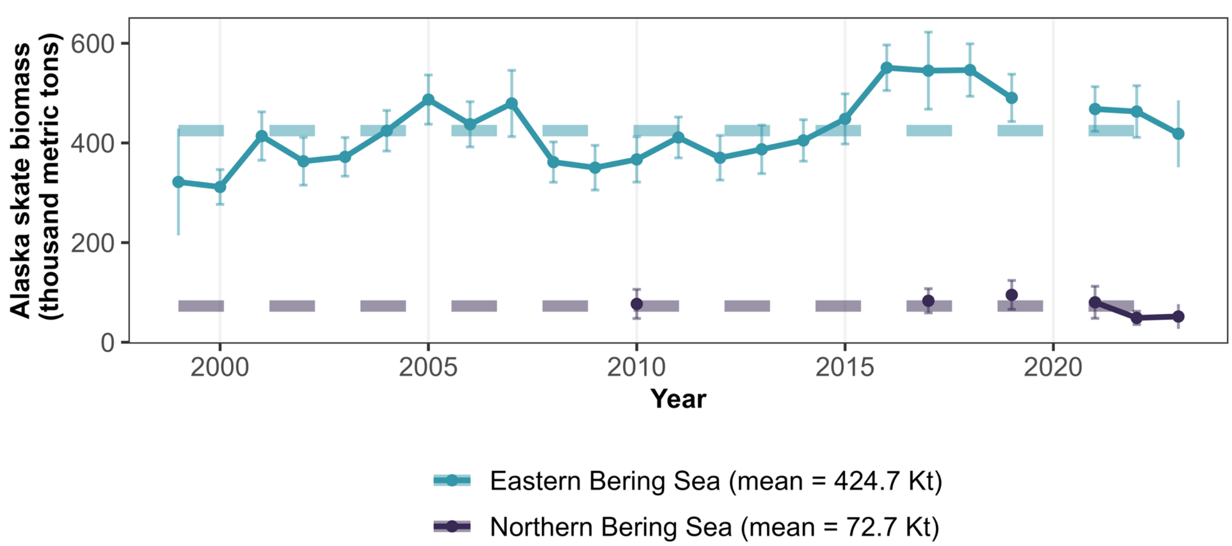


Figure 46. -- Estimates of Alaska skate (*Arctoraja parmifera*) biomass (t) from the 1999-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

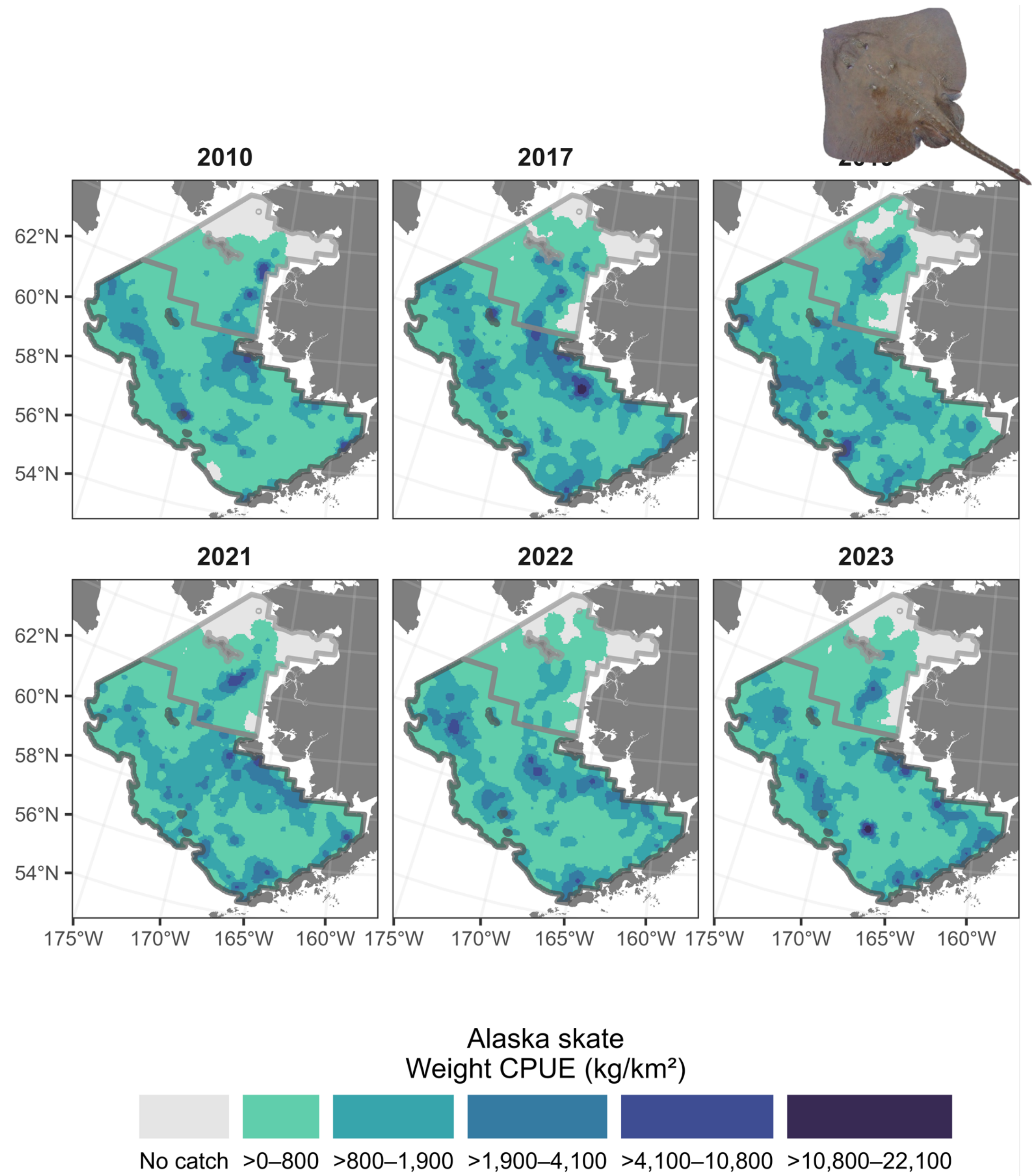


Figure 47. -- Distribution (Weight CPUE (kg/km^2)) of Alaska skate (*Arctoraja parmifera*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

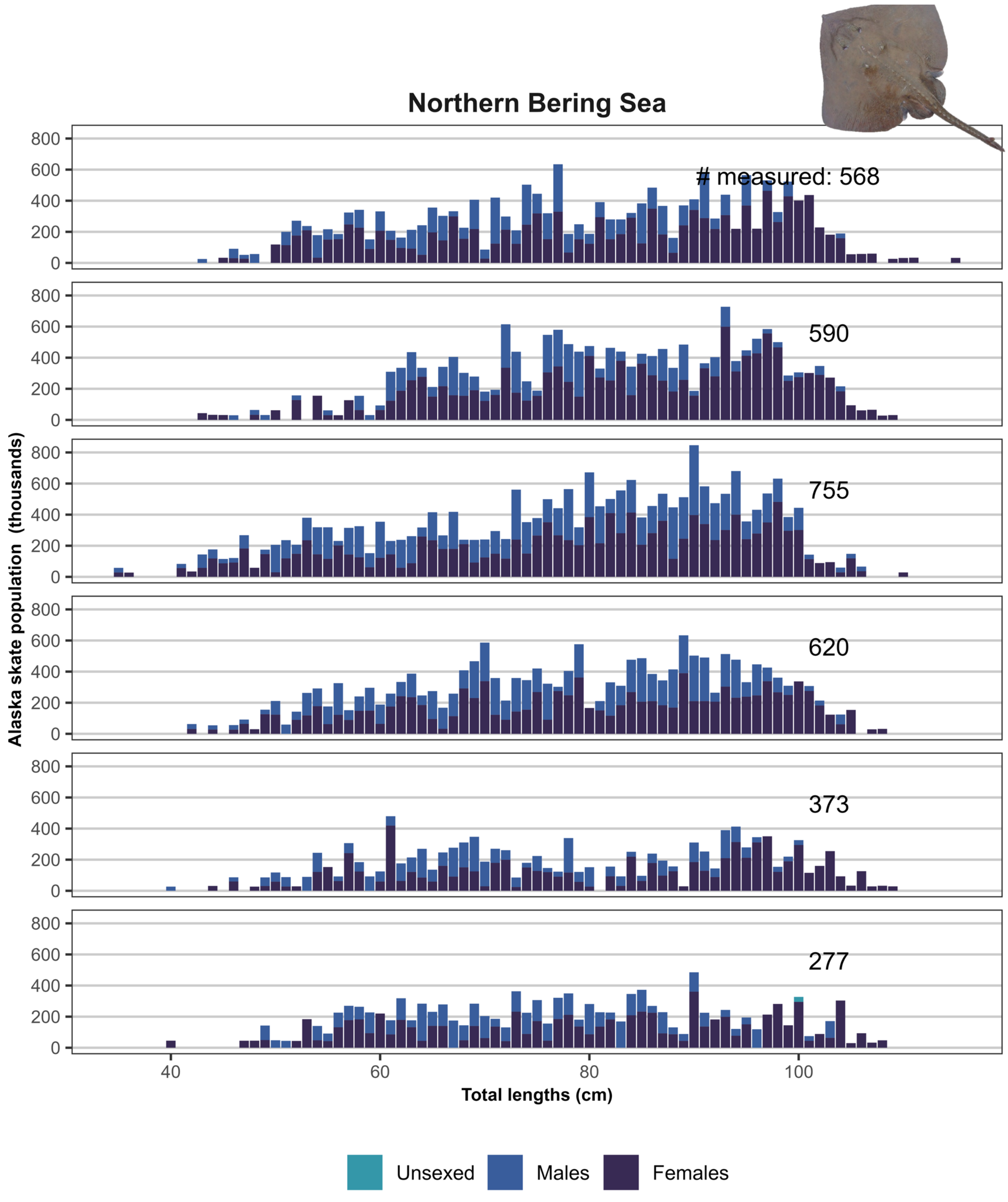


Figure 48. -- Total population estimates at length for Alaska skate (*Arctoraja parmifera*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Shorthorn Sculpin (*Myoxocephalus scorpius*)

Previous scientific name:
Myoxocephalus verrucosus

Previous common name: warty sculpin

Russian: европейский керчак

St. Lawrence Island Yup'ik: nertuli

Inupiaq: kanayuq

In 2023, biomass decreased by 7% for shorthorn sculpin in the northern Bering Sea (Table **15**; Figure **49**). The highest densities of shorthorn sculpin in the 2023 northern Bering Sea survey area were north of St. Lawrence Island and north of St. Matthew Island (Figure **50**). The size distribution of shorthorn sculpin ranged from 6 cm to 54 cm length, with modes at 8 cm and 20 cm (Figure **51**).

Table 15. -- Summary of catch location environmental variables, as well as 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	20.4 million
Biomass (t)	546	3,411
Biomass % Total	<0.01%	0.1%
Biomass % Change	2% decrease from 2022	7% decrease from 2022

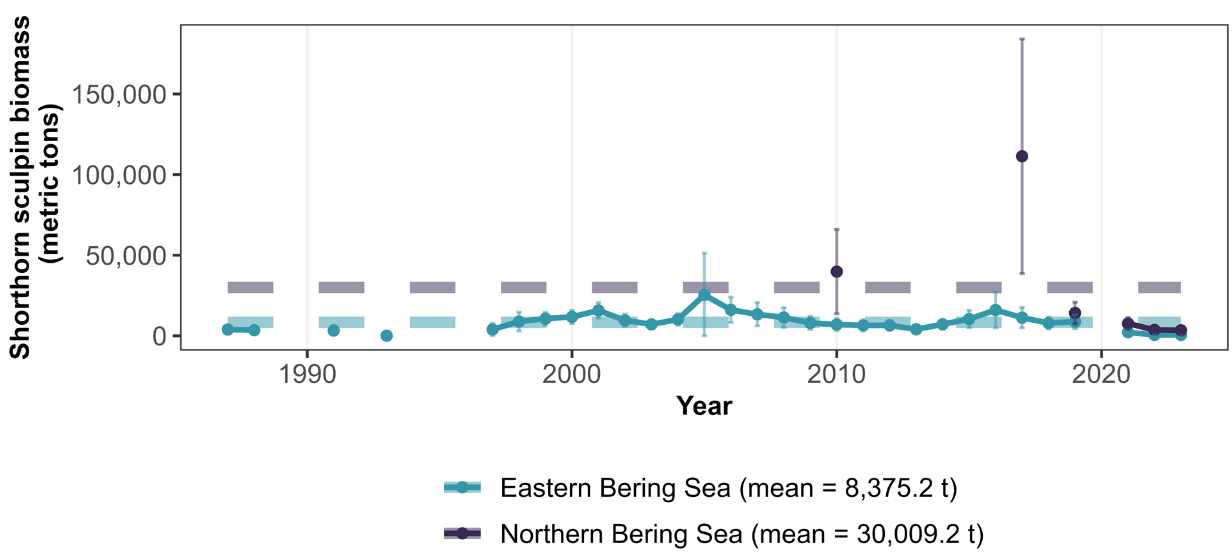


Figure 49. -- Estimates of shorthorn sculpin (*Myoxocephalus scorpius*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

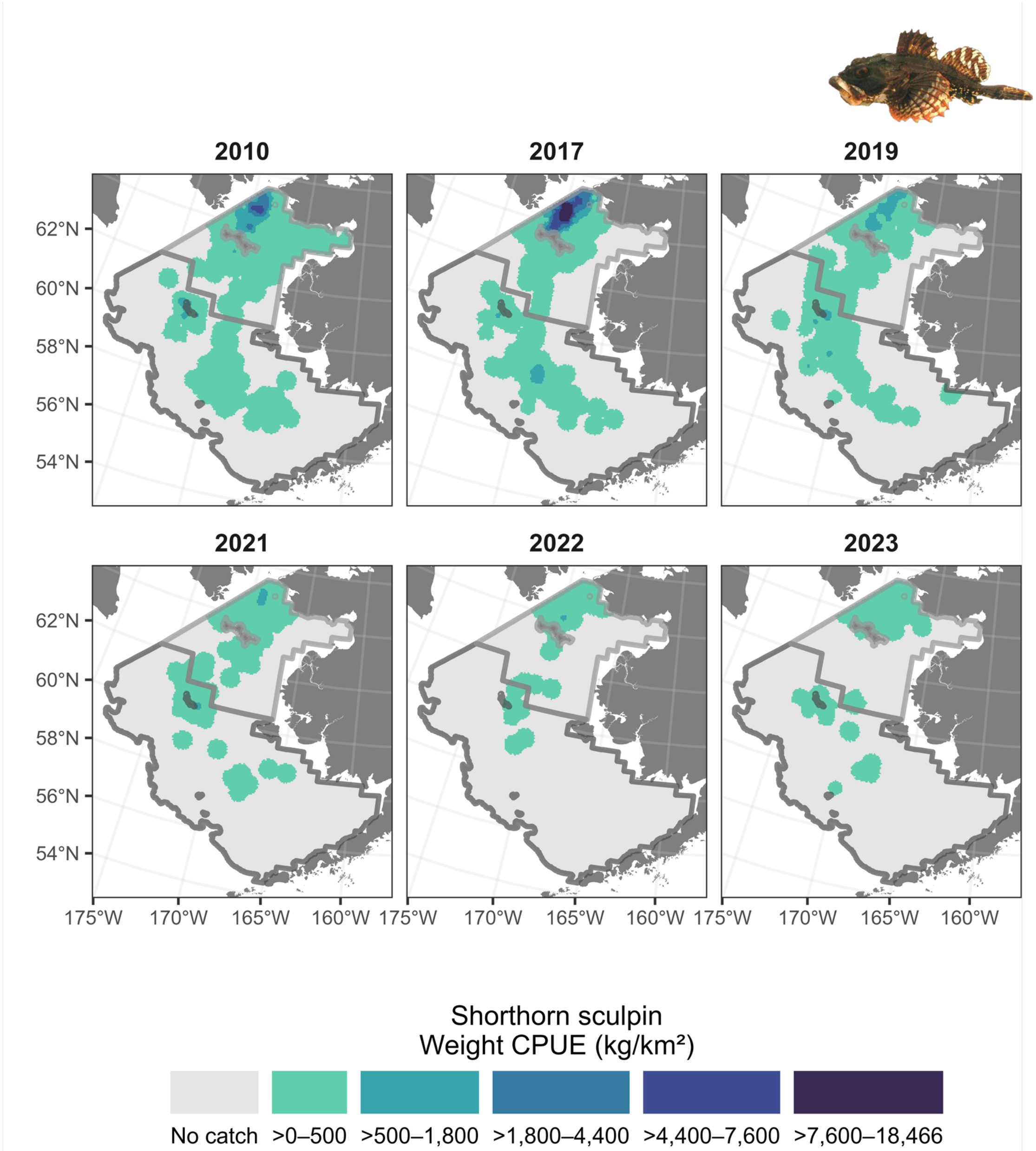


Figure 50. -- Distribution (Weight CPUE (kg/km^2)) of shorthorn sculpin (*Myoxocephalus scorpius*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

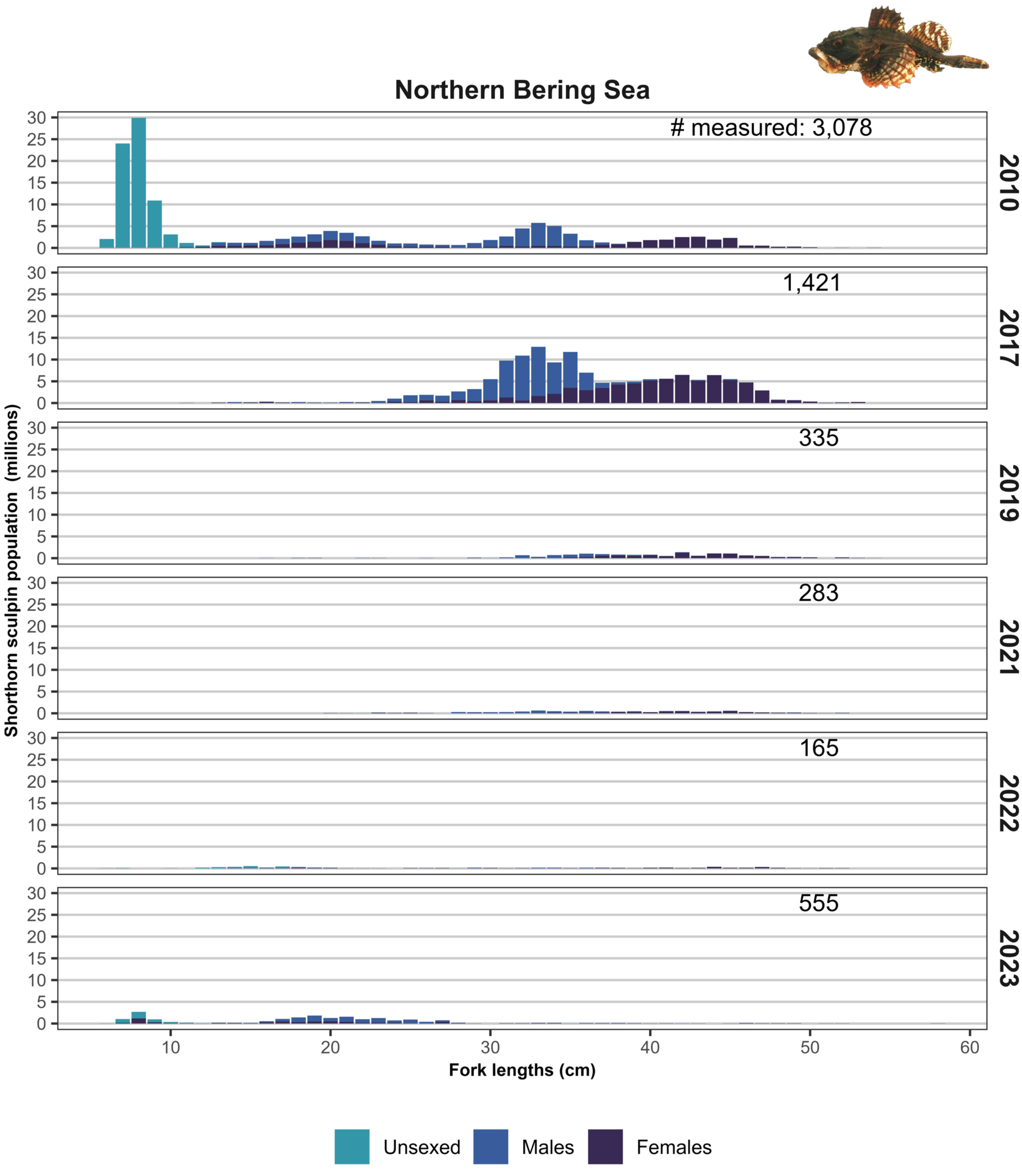
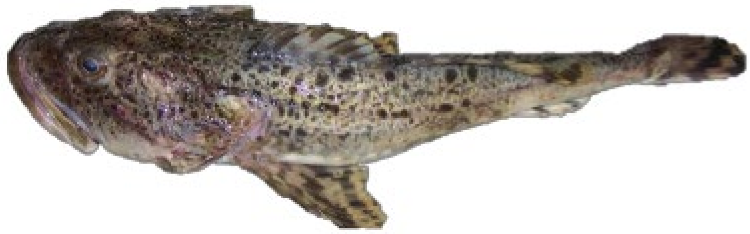


Figure 51. -- Total population estimates at length for shorthorn sculpin (*Myoxocephalus scorpius*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Plain Sculpin
(*Myoxocephalus jaok*)



Russian: керчак-яок

St. Lawrence Island Yup'ik: nertuli

In 2023, biomass decreased by 22% for plain sculpin in the northern Bering Sea (Table **16**; Figure **52**). In the northern Bering Sea, plain sculpin were primarily encountered along the coast of the Alaska mainland, from Nunivak Island to just south of Port Clarence Bay (Figure **53**). The length composition of this species was similar to previous years, with a mode around 18 cm (Figure **54**).

Table 16. -- Summary of catch location environmental variables, as well as 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

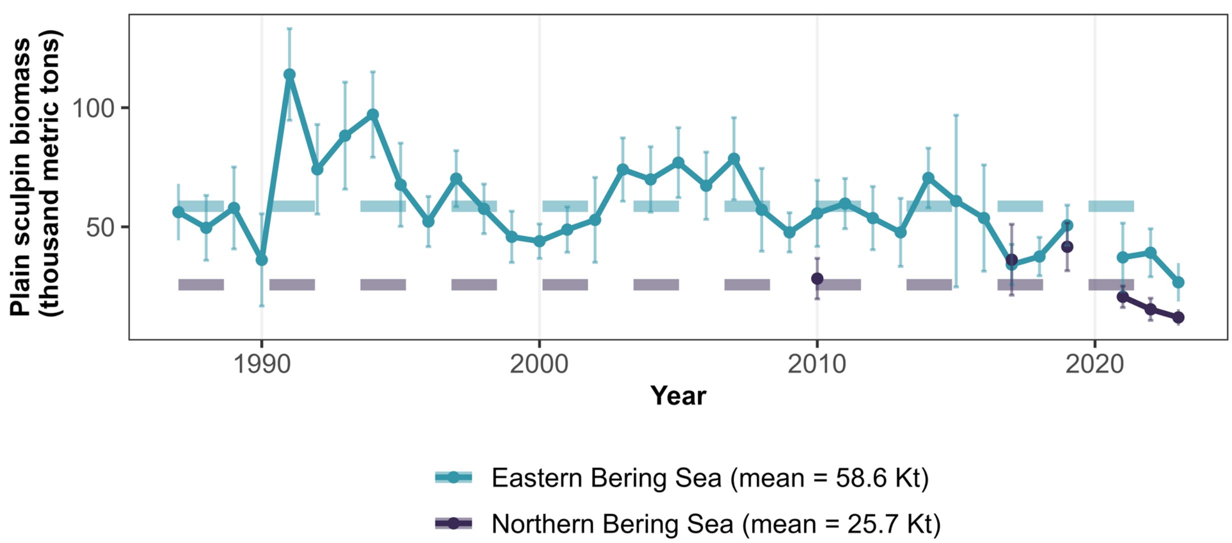


Figure 52. -- Estimates of plain sculpin (*Myoxocephalus jaok*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

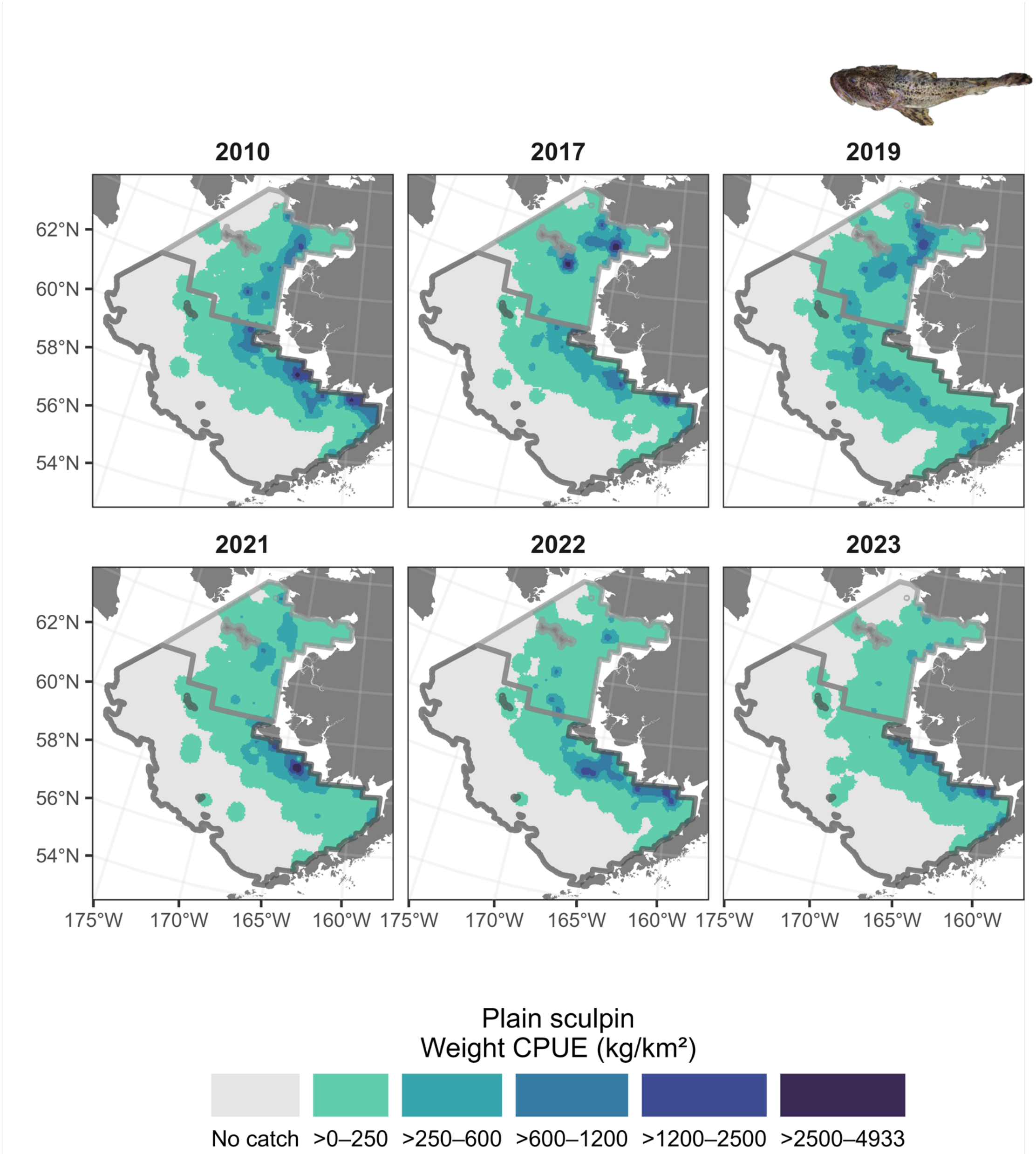


Figure 53. -- Distribution (Weight CPUE (kg/km^2)) of plain sculpin (*Myoxocephalus jaok*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

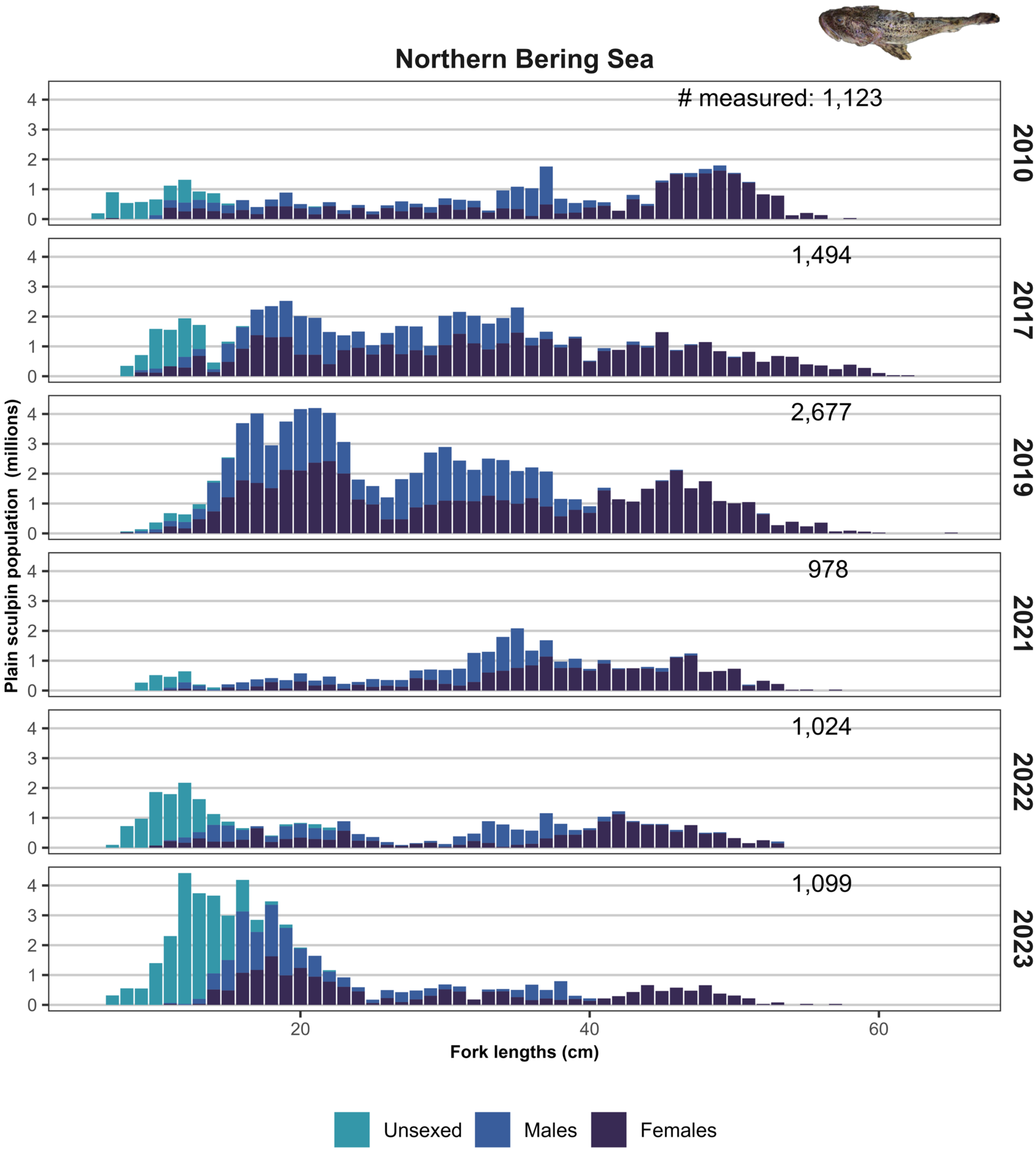


Figure 54. -- Total population estimates at length for plain sculpin (*Myoxocephalus jaok*) calculated from 2010, 2017, 2019, and 2021-2023 northern Bering Sea shelf bottom trawl surveys. Total number of individuals measured during the survey is indicated in the upper right corner of each plot.

Purple-Orange Sea Star (*Asterias amurensis*)

Russian: Амурская морская звезда

In 2023, biomass increased by 2% for purple-orange sea stars in the northern Bering Sea (Table **17**; Figure **55**). The highest densities of purple-orange sea star, also known as the northern Pacific sea star, in the 2023 northern Bering Sea survey area were observed east of St. Lawrence Island and in outer Norton Sound (Figure **56**).

Table 17. -- Summary of catch location environmental variables, as well as 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	6.8%	10.9%
Biomass % Change	20% decrease from 2022	2% increase from 2022

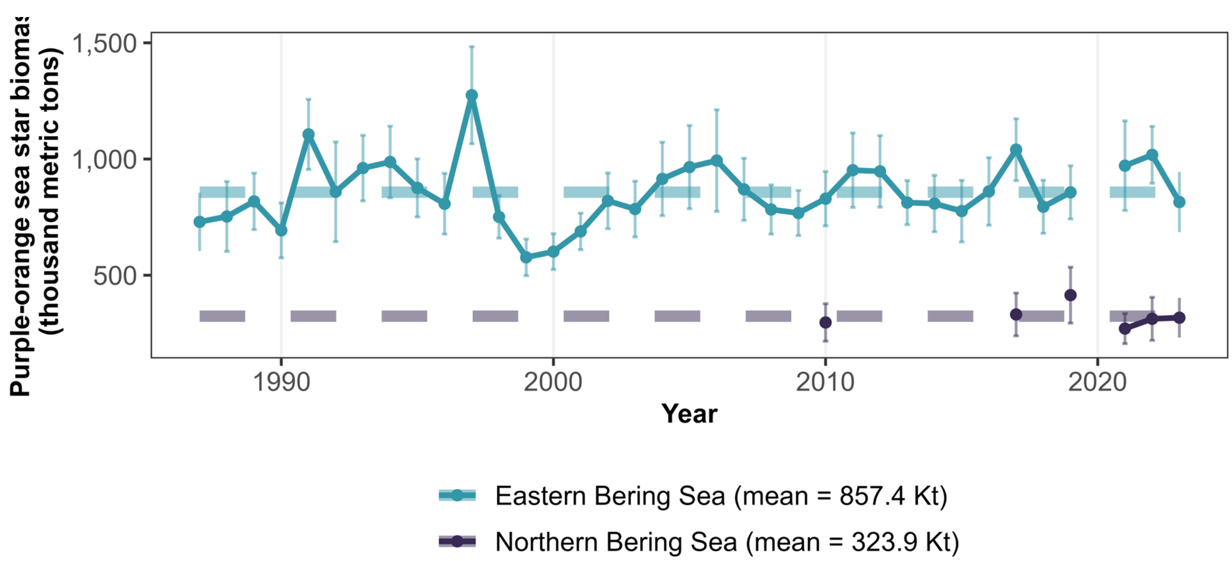


Figure 55. -- Estimates of purple-orange sea star (*Asterias amurensis*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

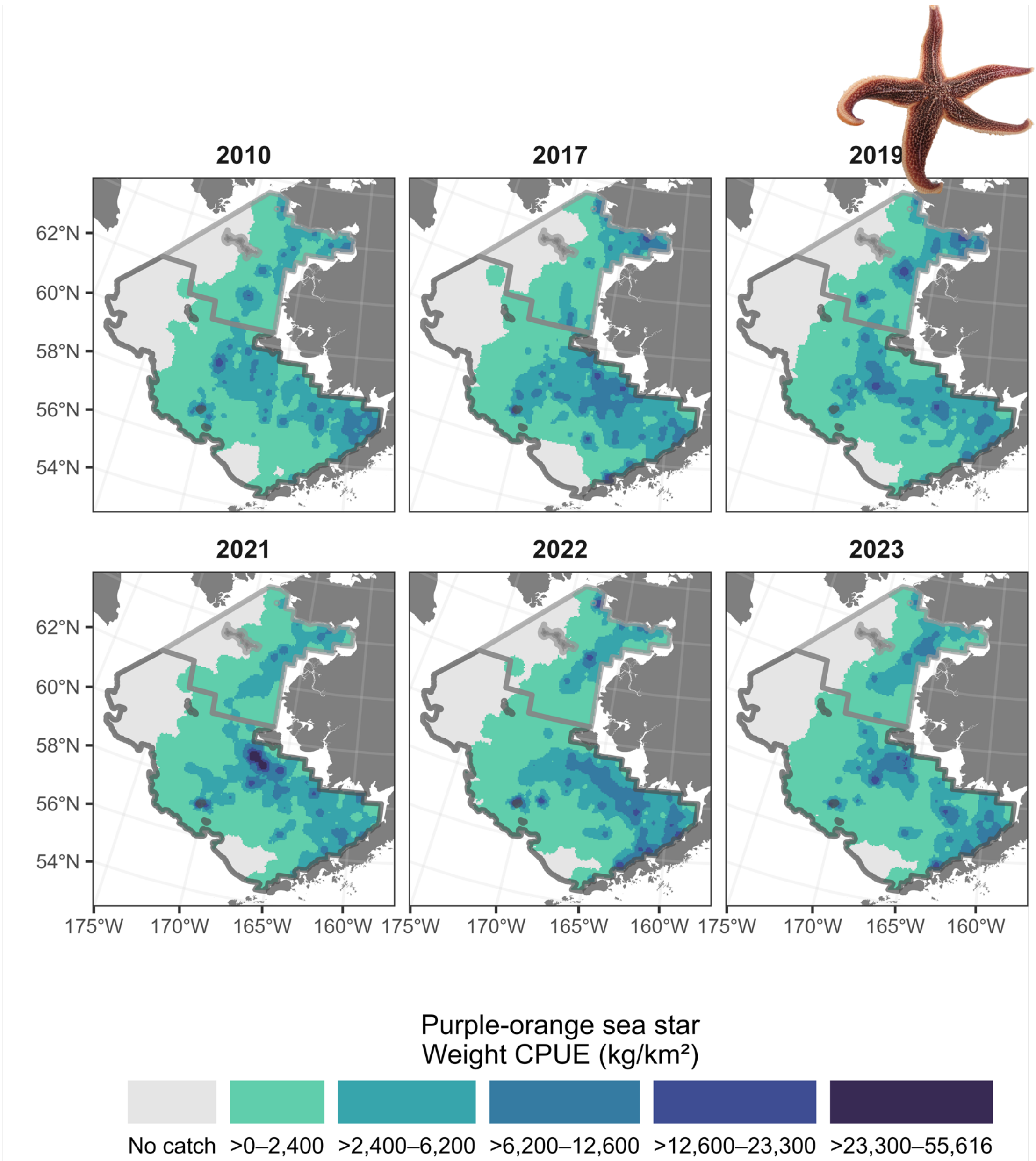


Figure 56. -- Distribution (Weight CPUE (kg/km^2)) of purple-orange sea star (*Asterias amurensis*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Sea Urchins (*Strongylocentrotus* spp.)

Russian: еж

St. Lawrence Island Yup'ik: kemagnaq, uutuk

Central Yup`ik: kemagnaq, uutuk

In 2023, biomass increased by 21% for sea urchins of the genus *Strongylocentrotus* in the northern Bering Sea (Table **18**; Figure **57**). In 2023, the highest densities of sea urchins were observed just north of St. Lawrence Island (Figure **58**).

Table 18. -- Summary of catch location environmental variables, as well as biomass and population estimates, for sea urchins (*Strongylocentrotus* spp.) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	62 of 376 (16.5%)	35 of 116 (30.2%)
Bottom Depth (m)	36 — 160	12 — 69
Bottom Temperature (°C)	-1.3 — 5.2	-1 — 11.1
Surface Temperature (°C)	2.3 — 10.5	4 — 15.1
Population	513.1 million	4.2 billion
Biomass (t)	30,683	188,480
Biomass % Total	0.3%	6.5%
Biomass % Change	5% increase from 2022	21% increase from 2022

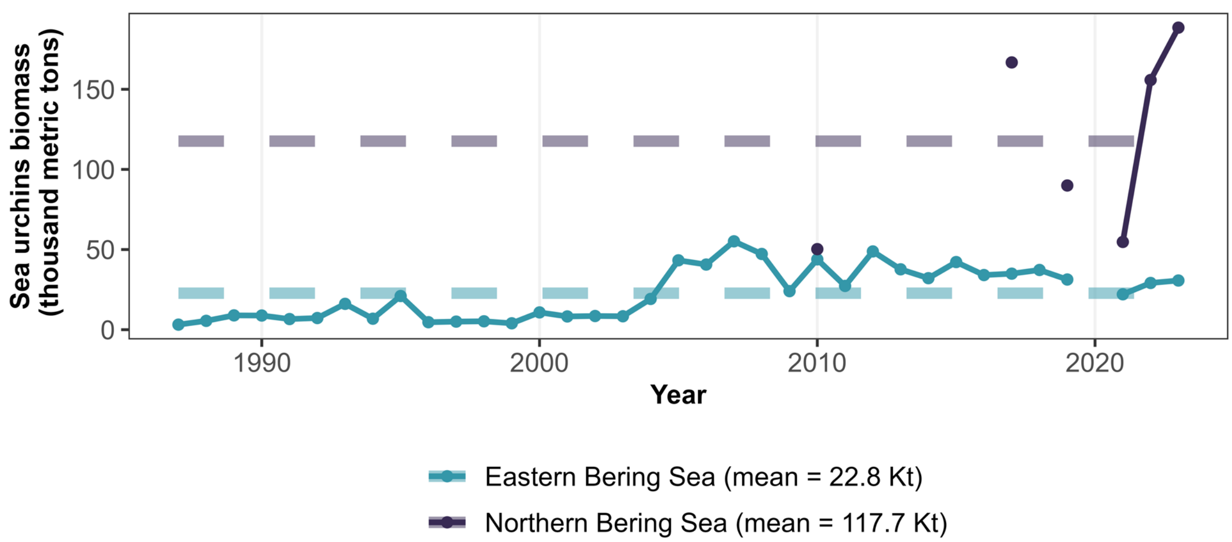


Figure 57. -- Estimates of sea urchins (*Strongylocentrotus* spp.) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

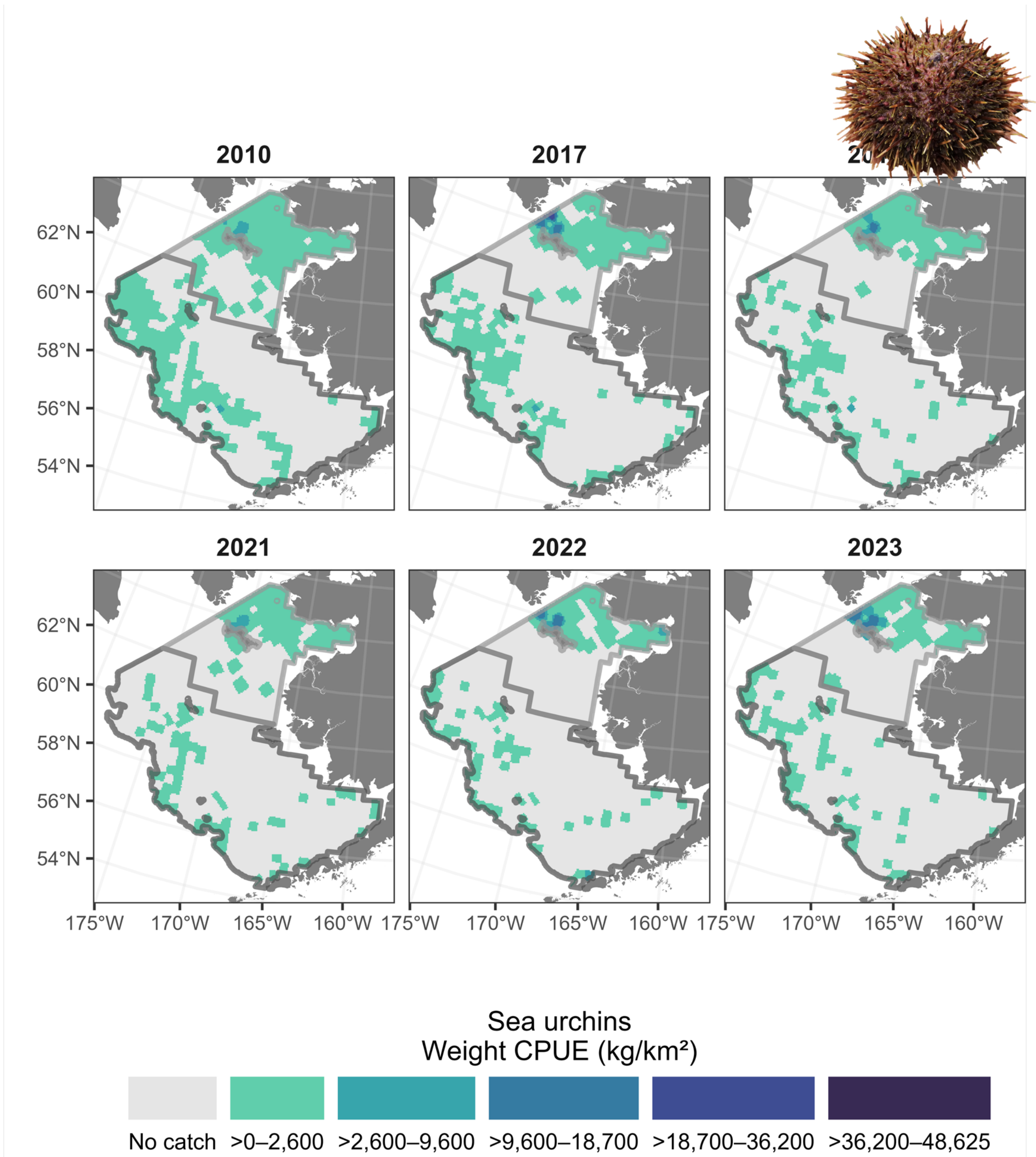


Figure 58. -- Distribution (Weight CPUE (kg/km^2)) of sea urchins (*Strongylocentrotus* spp.) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Jellyfish (Scyphozoa)

Russian: медуза

In 2023, biomass increased by 104% for jellyfish in the northern Bering Sea (Table **19**; Figure **59**). Jellyfishes play important roles as both predator and prey within the Bering Sea ecosystem. Large jellyfish blooms can have a significant effect on the survival of larval and juvenile forage fishes, juvenile walleye pollock, salmon, and the larval stages of many invertebrates, including crabs (Ruzicka et al., 2020). Jellyfishes had a relatively even distribution throughout the northern Bering Sea in 2023, with the highest density found east of St. Lawrence Island (Figure **60**).

Table 19. -- Summary of catch location environmental variables, as well as biomass and population estimates, for jellyfish (Scyphozoa) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	321 of 376 (85.4%)	108 of 116 (93.1%)
Bottom Depth (m)	25 — 171	12 — 78
Bottom Temperature (°C)	-1.6 — 5.2	-1.6 — 11.1
Surface Temperature (°C)	1.8 — 11	4 — 15.1
Population	397.3 million	169.5 million
Biomass (t)	146,501	58,257
Biomass % Total	1.2%	2.0%
Biomass % Change	16% increase from 2022	104% increase from 2022

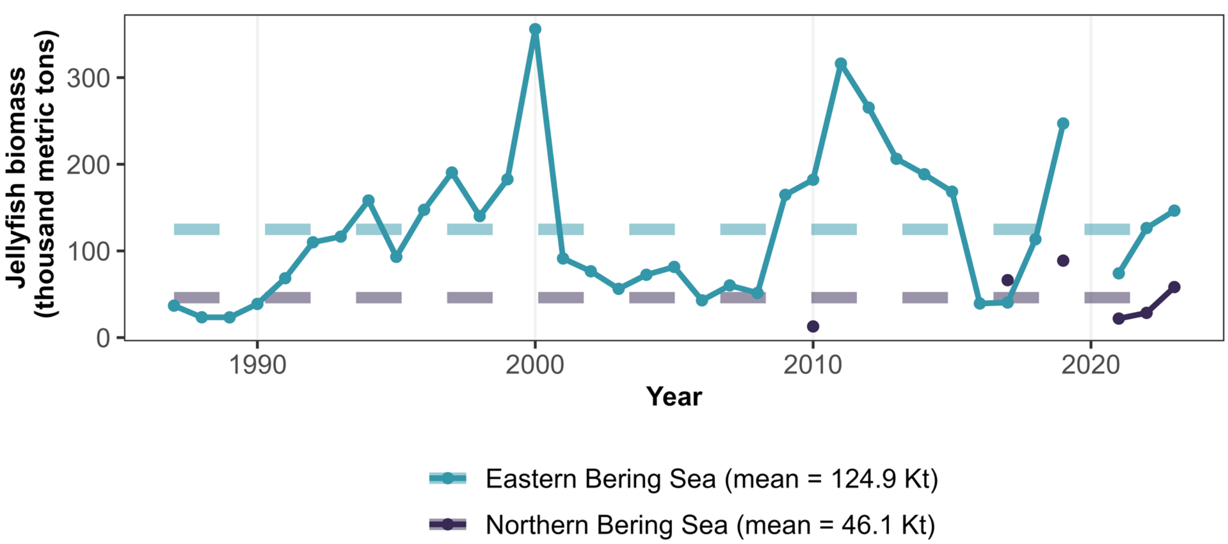


Figure 59. -- Estimates of jellyfish (Scyphozoa) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

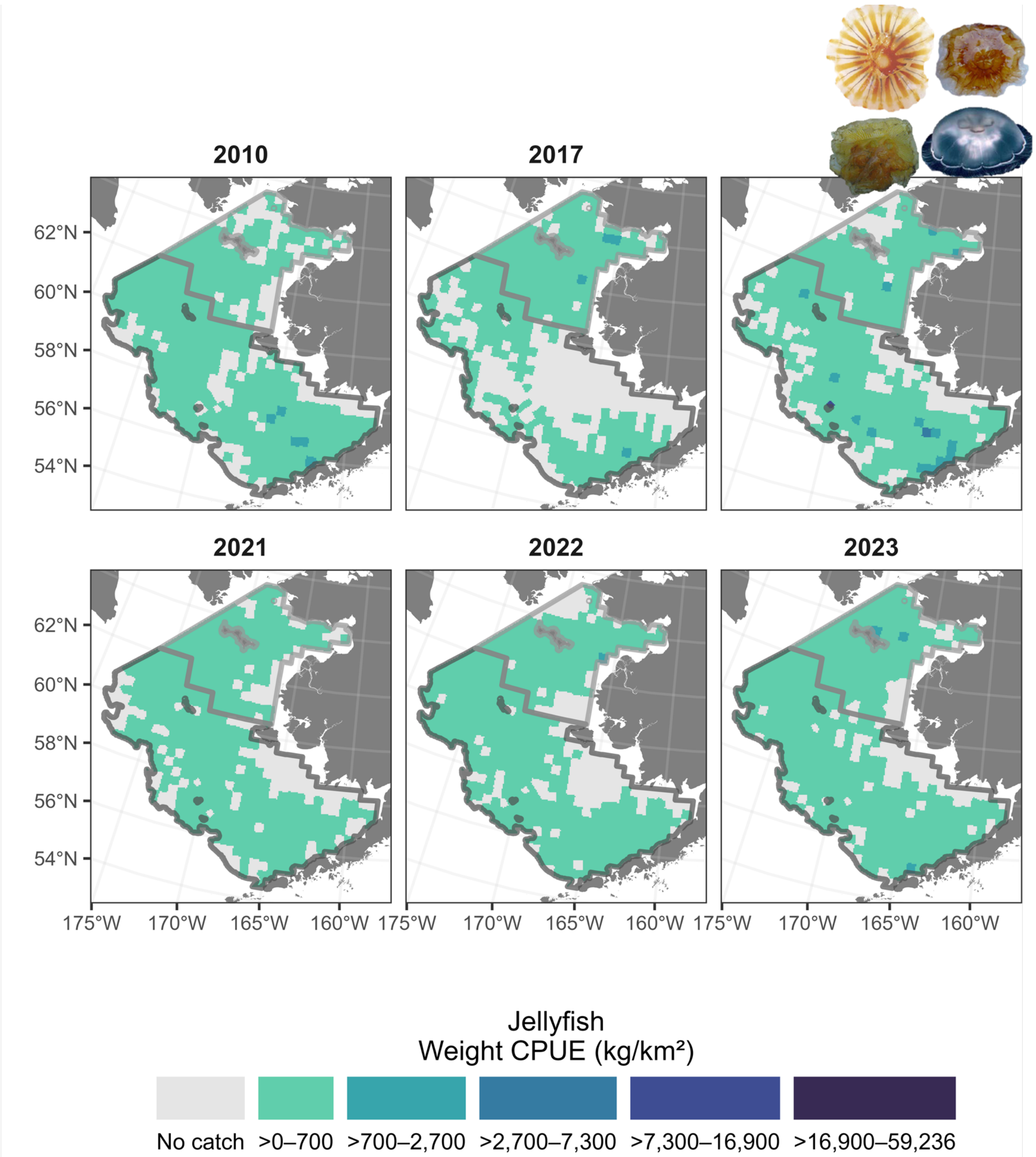


Figure 60. -- Distribution (Weight CPUE (kg/km^2)) of jellyfish (Scyphozoa) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

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

Previous common name: Neptune snail, Northern Neptune snail

Russian: северный трубач Нептуна

In 2023, biomass decreased by 19% for Neptune whelks in the northern Bering Sea (Table **20**; Figure **61**). The highest densities of northern Neptune whelk in the 2023 northern Bering Sea survey were to the northeast and south of St. Lawrence Island (Figure **62**).

Table 20. -- Summary of catch location environmental variables, as well as 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%	5.3%
Biomass % Change	47% decrease from 2022	19% decrease from 2022

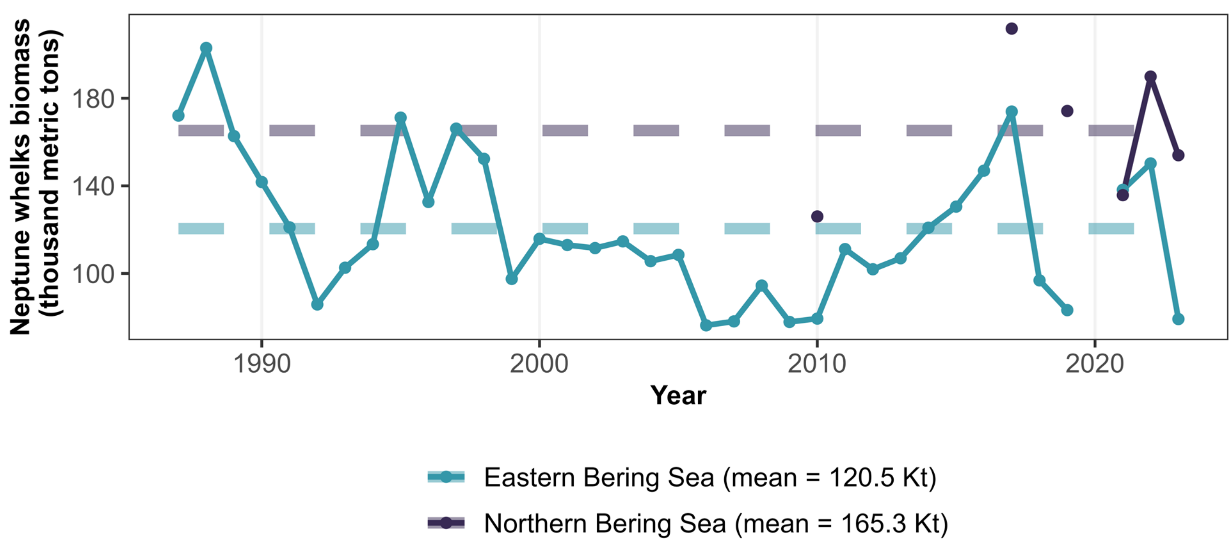


Figure 61. -- Estimates of Neptune whelks (*Neptunea heros* and *Neptunea ventricosa*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

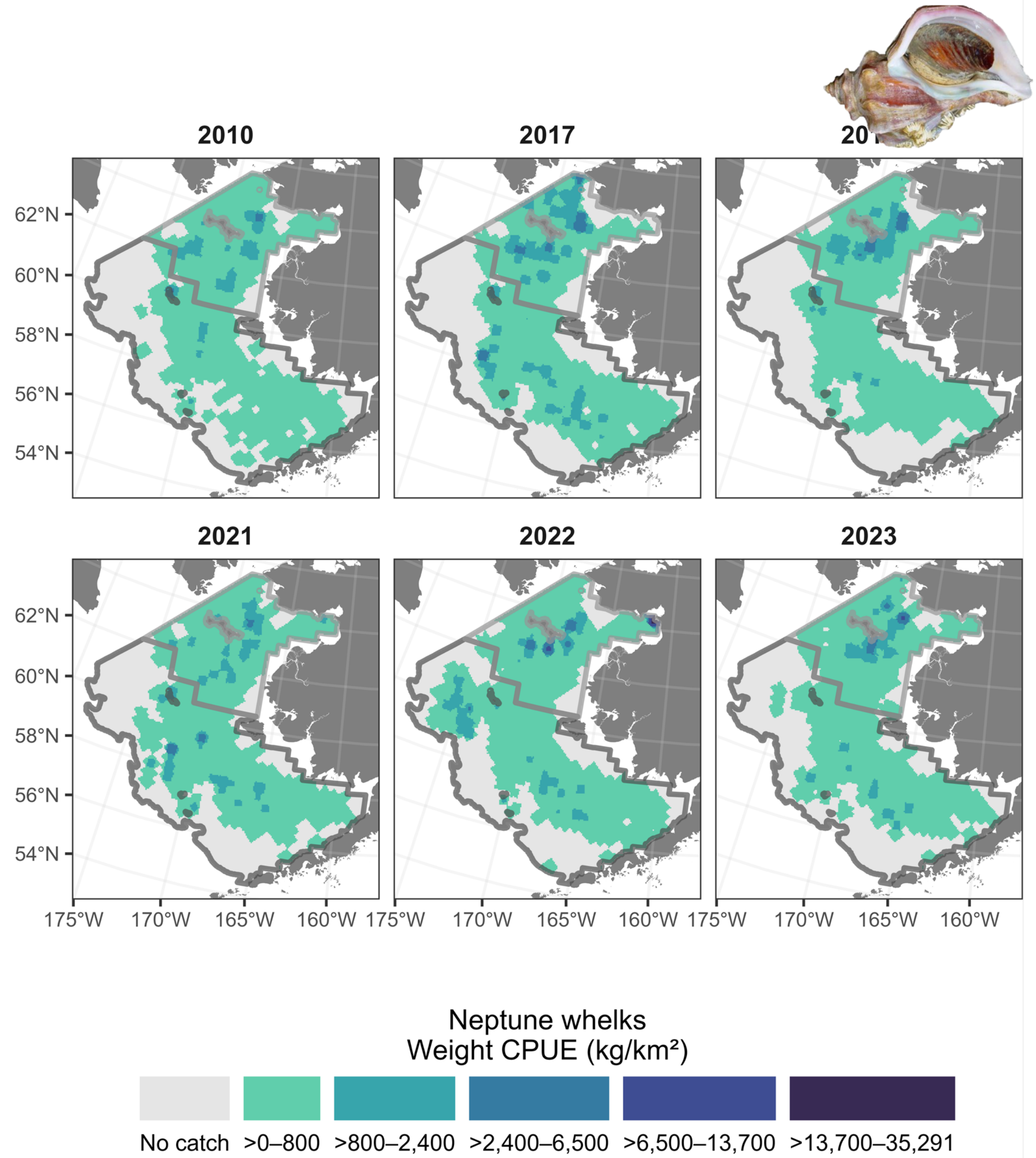


Figure 62. -- Distribution (Weight CPUE (kg/km^2)) of Neptune whelks (*Neptunea heros* and *Neptunea ventricosa*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Sea Onion (*Boltenia ovifera*)

In 2023, biomass decreased by 72% for sea onions in the northern Bering Sea (Table **21**; Figure **63**). Sea onions are stalked, solitary ascidians that are widely distributed in the Arctic, North Atlantic, North Pacific, and Bering Sea. The highest densities of sea onions in the 2023 northern Bering Sea survey area were found around St. Lawrence Island and north of Nunivak Island. (Figure **64**).

Table 21. -- Summary of catch location environmental variables, as well as biomass and population estimates, for sea onion (*Boltenia ovifera*) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	62 of 376 (16.5%)	13 of 116 (11.2%)
Bottom Depth (m)	25 — 96	21 — 53
Bottom Temperature (°C)	-1.6 — 3.7	-0.1 — 10.9
Surface Temperature (°C)	1.8 — 9.7	5 — 12.3
Population		232,986
Biomass (t)	6,041	854
Biomass % Total	0.1%	<0.01%
Biomass % Change	12% decrease from 2022	72% decrease from 2022

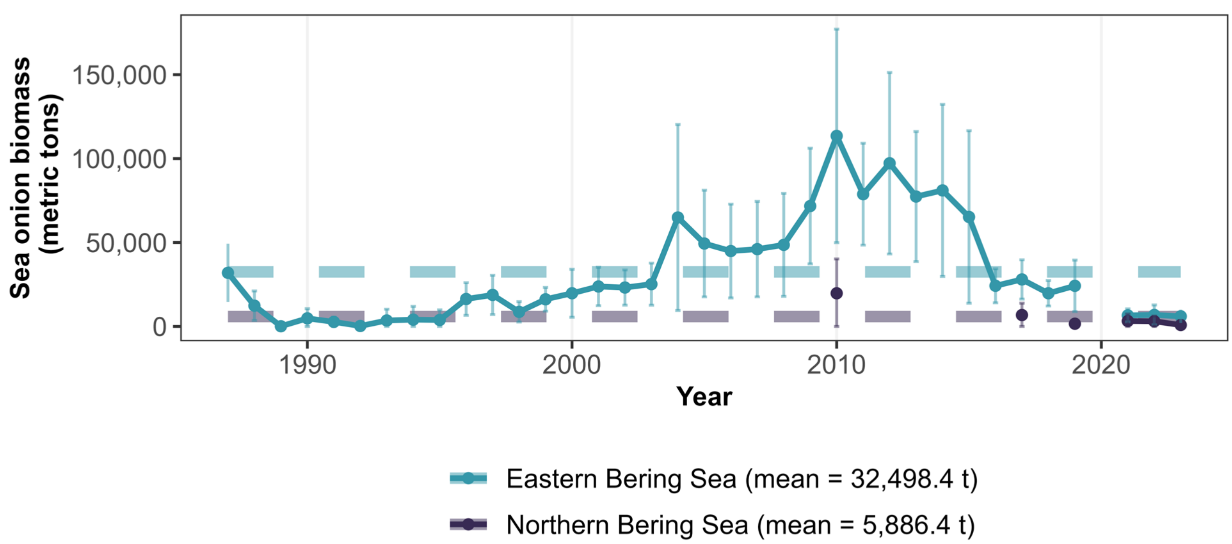


Figure 63. -- Estimates of sea onion (*Boltenia ovifera*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

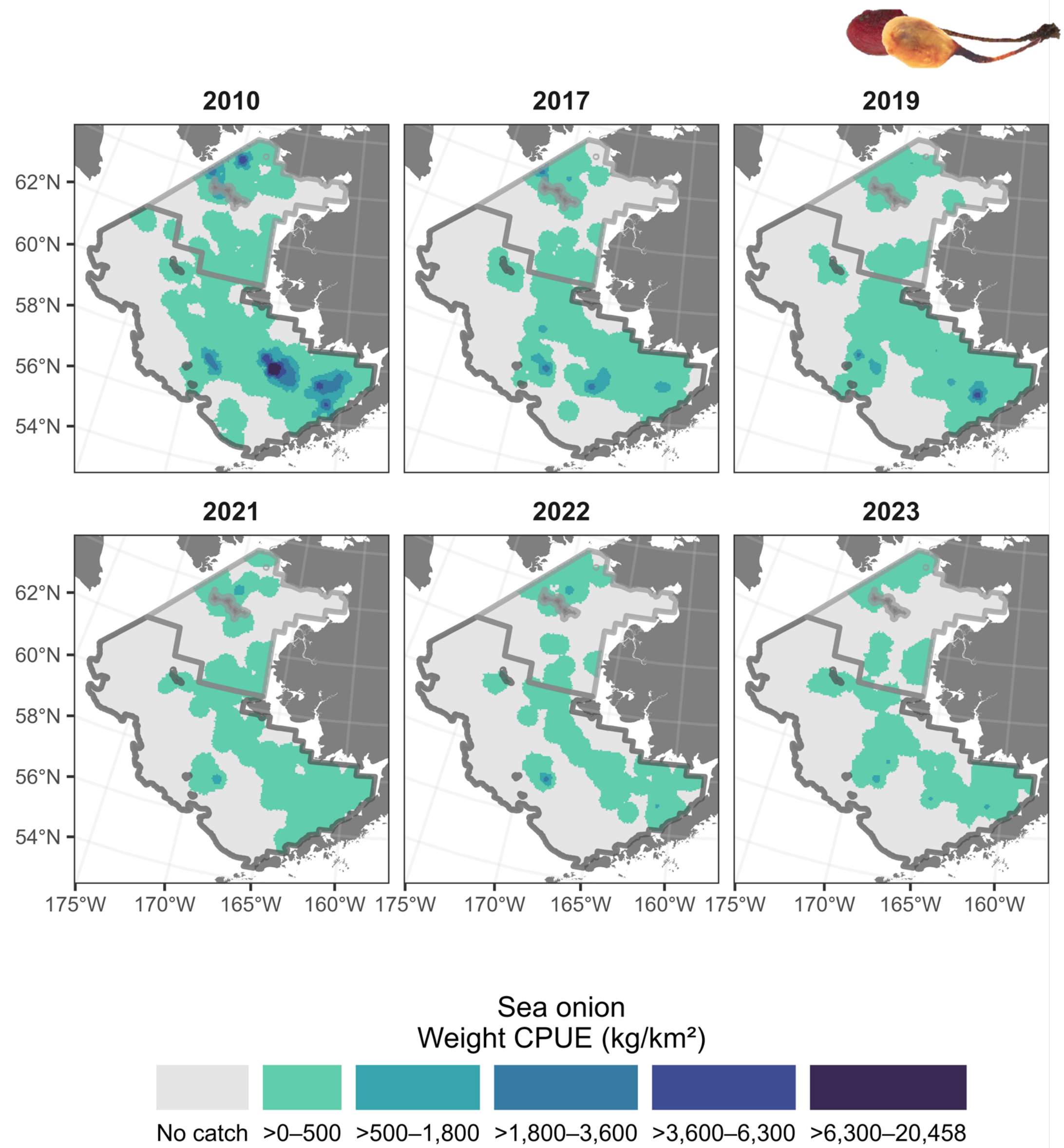


Figure 64. -- Distribution (Weight CPUE (kg/km^2)) of sea onion (*Boltenia ovifera*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Sea Peach (*Halocynthia* sp.)

In 2023, biomass decreased by 1,030% for sea peach in the northern Bering Sea (Table **22**; Figure **65**). Sea peaches are large, solitary ascidians that are often found in clusters. In 2023, they were found only in a few small sections of the northern Bering Sea survey area.

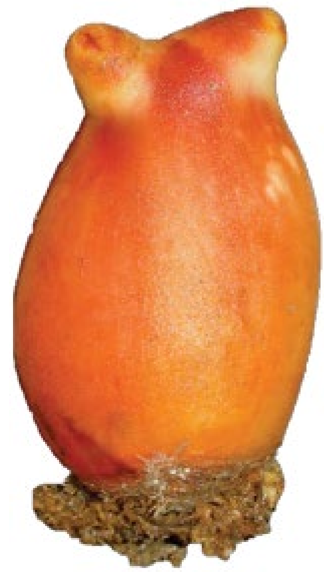


Table 22. -- Summary of catch location environmental variables, as well as biomass and population estimates, for sea peach (*Halocynthia* sp.) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	37 of 376 (9.8%)	8 of 116 (6.9%)
Bottom Depth (m)	47 — 136	24 — 54
Bottom Temperature (°C)	-1.6 — 3.3	-1.1 — 9.9
Surface Temperature (°C)	3.3 — 10.5	5.4 — 12.8
Population		
Biomass (t)	57,423	5,933
Biomass % Total	0.5%	0.2%
Biomass % Change	40% decrease from 2022	1030% increase from 2022

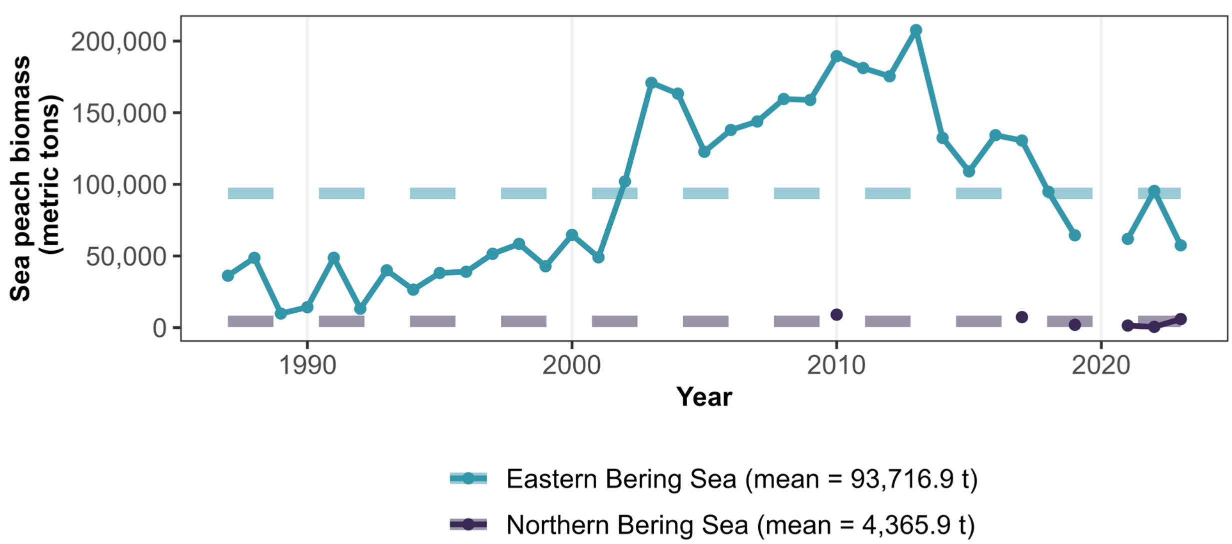


Figure 65. -- Estimates of sea peach (*Halocynthia* sp.) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

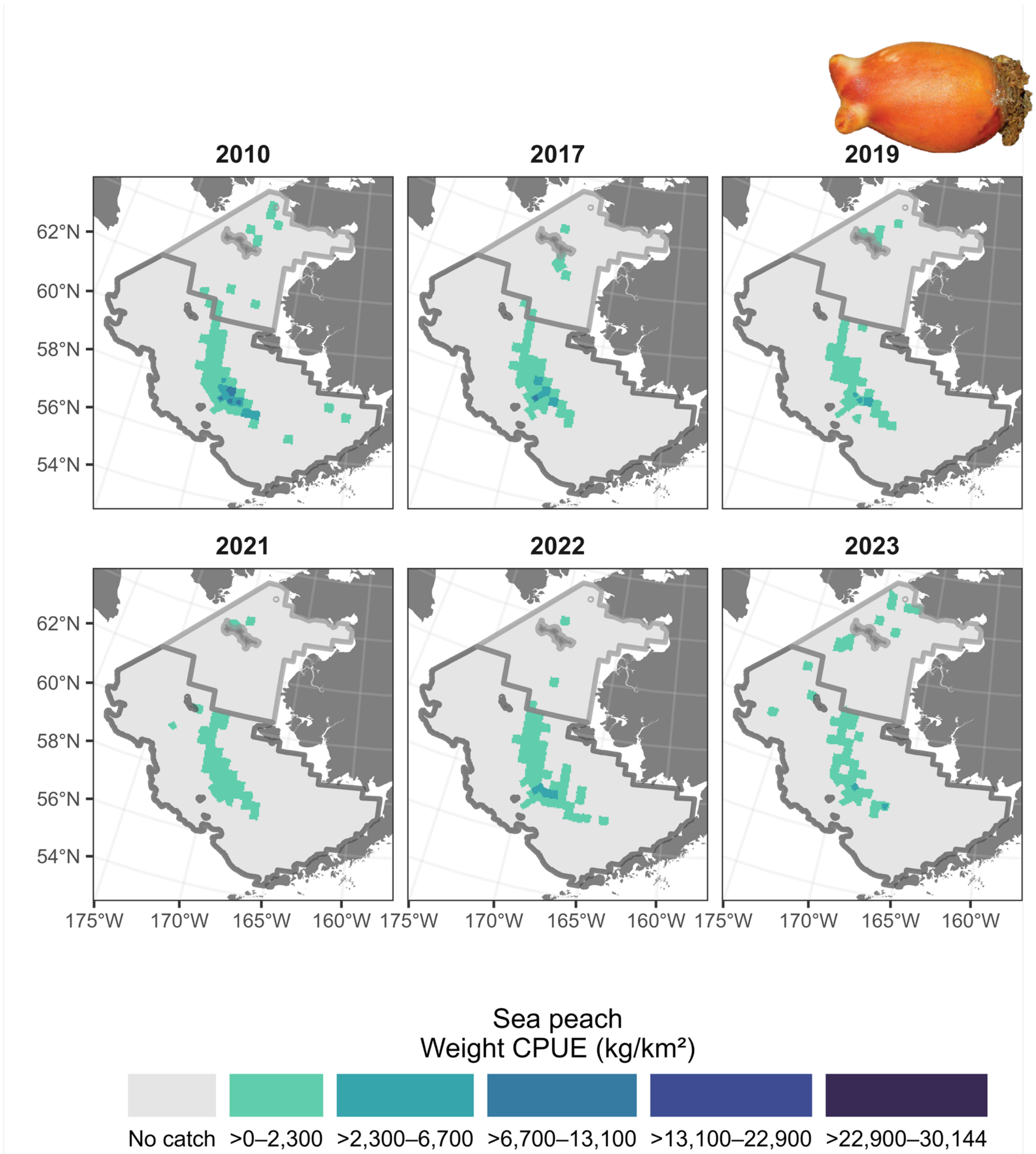


Figure 66. -- Distribution (Weight CPUE (kg/km^2)) of sea peach (*Halocynthia* sp.) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Pacific Herring (*Clupea pallasii*)

Russian: тихоокеанская сельдь

Inupiaq: Uqsruqtuuq

Central Yup`ik: neqalluarpak

St. Lawrence Island Yup'ik: iqalluarpak, iqallugpak

In 2023, biomass decreased by 89% for Alaska plaice in the northern Bering Sea (Table **23**; Figure **67**). The highest densities of Pacific herring in the 2023 northern Bering Sea survey area were located north of St. Lawrence Island, along the Alaska coast, and in Norton Sound, as well as along the U.S.-Russia Maritime Boundary to the west and southwest of St. Lawrence Island (Figure **68**). Lengths of Pacific herring have not historically been recorded during the eastern and northern Bering Sea surveys because they are consistently caught in a small size range.

Table 23. -- Summary of catch location environmental variables, as well as 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

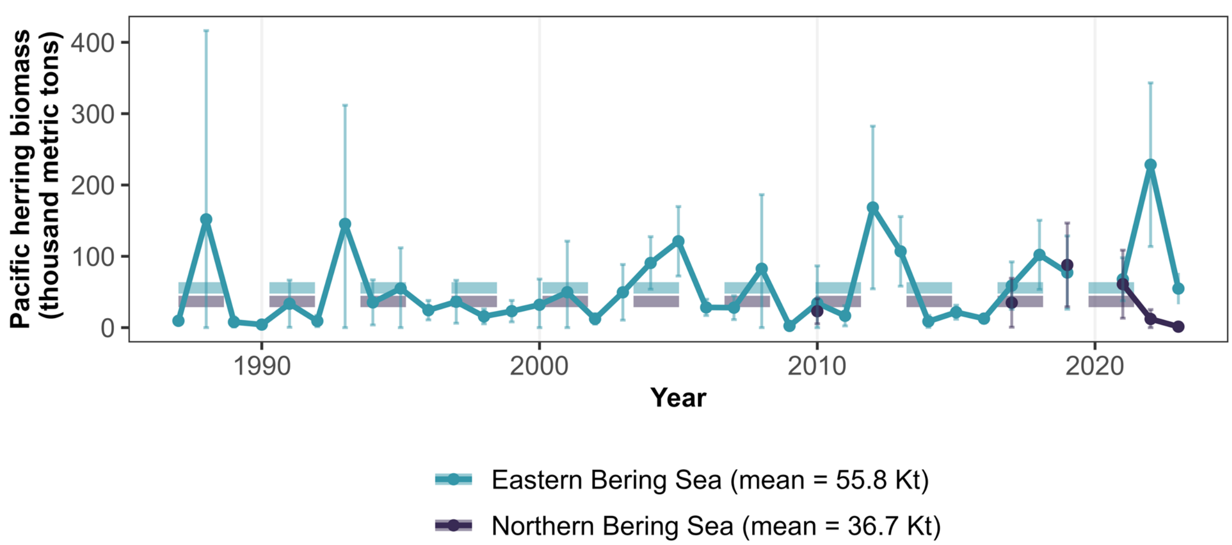


Figure 67. -- Estimates of Pacific herring (*Clupea pallasii*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

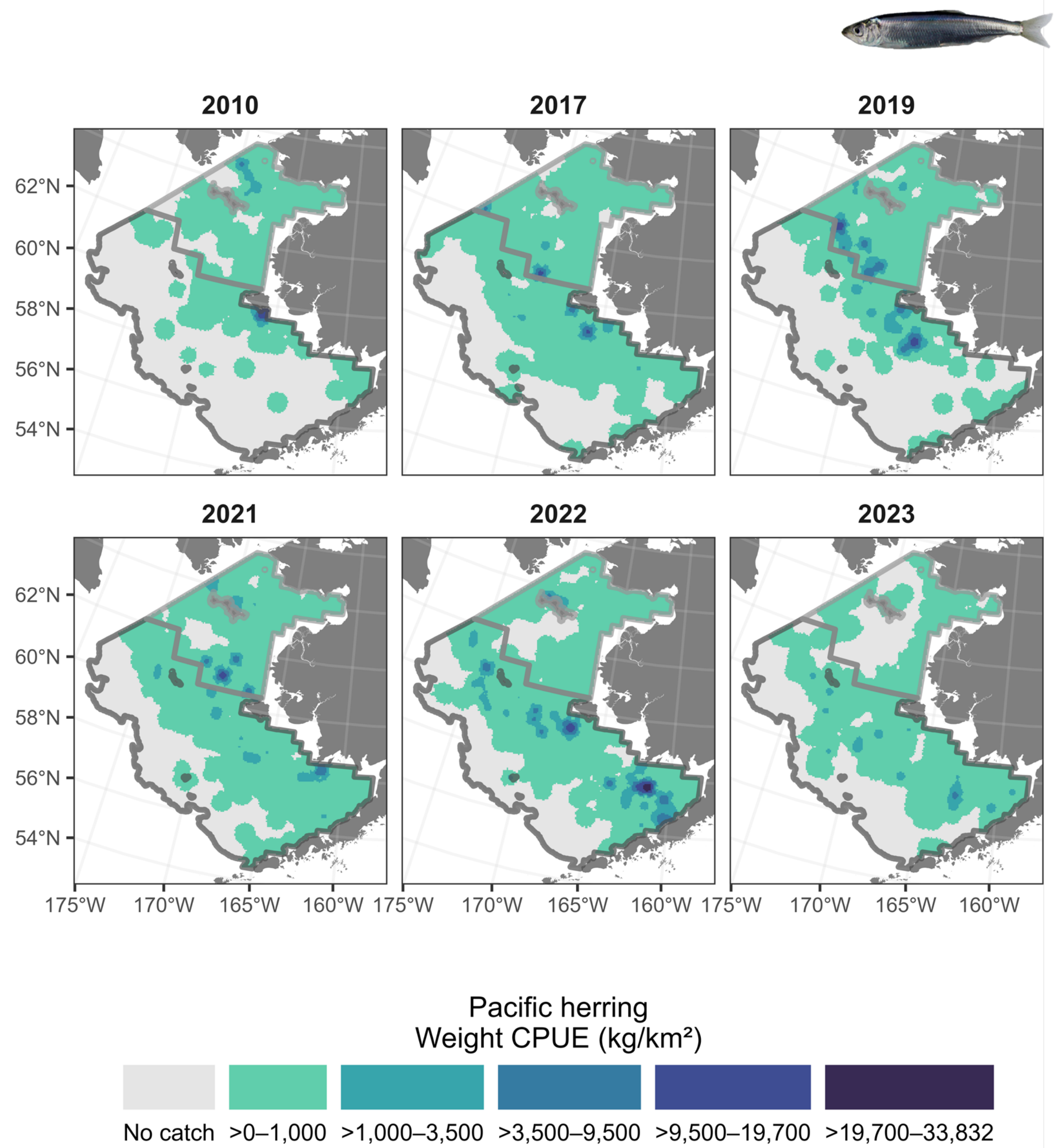


Figure 68. -- Distribution (Weight CPUE (kg/km^2)) of Pacific herring (*Clupea pallasii*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Snailfishes (Liparidae)

Russian: Липаровых

In 2023, biomass increased by 159% for snailfishes in the northern Bering Sea (Table **24**; Figure **69**). In the northern Bering Sea survey area, snailfishes were captured in the waters surrounding St. Lawrence Island, as well as in Norton Sound in 2023 (Figure **70**). The species of snailfish most commonly encountered during the northern Bering Sea surveys include the variegated snailfish (*Liparis gibbus*), with 233 individuals captured in 2023. The other species of snailfish captured during the 2023 northern Bering Sea survey were monster snailfish, nebulous snailfish, festive snailfish, peachskin snailfish, showy snailfish, and kelp snailfish.

Table 24. -- Summary of catch location environmental variables, as well as biomass and population estimates, for snailfishes (Liparidae) in the eastern and northern Bering Sea survey areas.

	Eastern Bering Sea	Northern Bering Sea
Stations Present	58 of 376 (15.4%)	62 of 116 (53.4%)
Bottom Depth (m)	36 — 147	18 — 78
Bottom Temperature (°C)	-1.6 — 4.4	-1.6 — 9.6
Surface Temperature (°C)	2.2 — 10.7	4.5 — 14.1
Population	8.7 million	10.1 million
Biomass (t)	2,236	1,632
Biomass % Total	<0.01%	0.1%
Biomass % Change	255% increase from 2022	159% increase from 2022

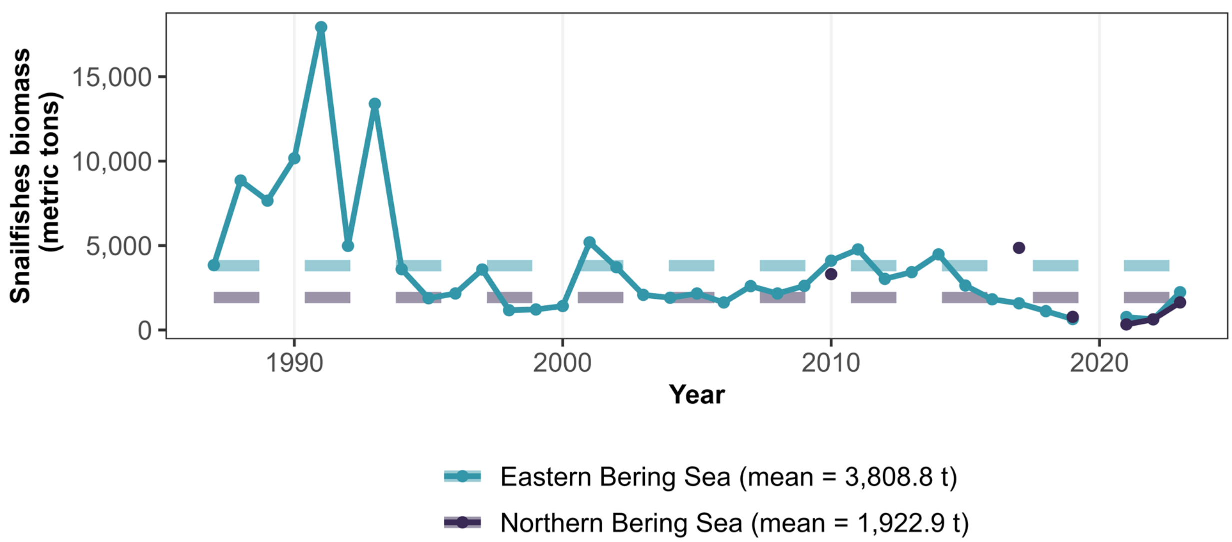


Figure 69. -- Estimates of snailfishes (Liparidae) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

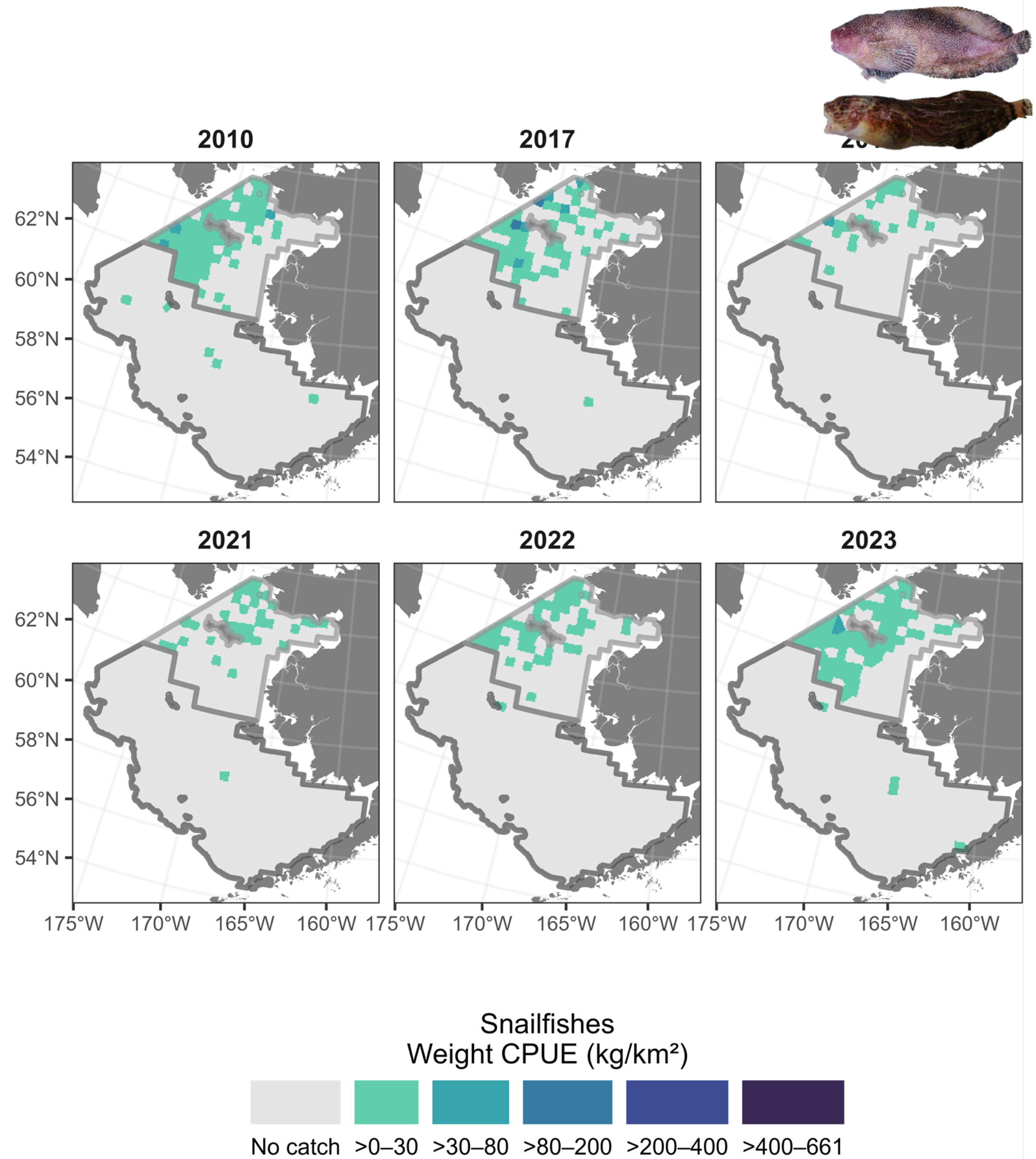


Figure 70. -- Distribution (Weight CPUE (kg/km^2)) of snailfishes (Liparidae) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Pacific Capelin (*Mallotus villosus*)

Russian: Тихоокеанская мойва

In 2023, biomass increased by 543% for Pacific capelin in the northern Bering Sea (Table **25**; Figure **71**). Capelin are widely distributed throughout the northern Bering Sea in waters shallower than 100 m (Figure **72**).

Table 25. -- Summary of catch location environmental variables, as well as biomass and population estimates, for Pacific 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

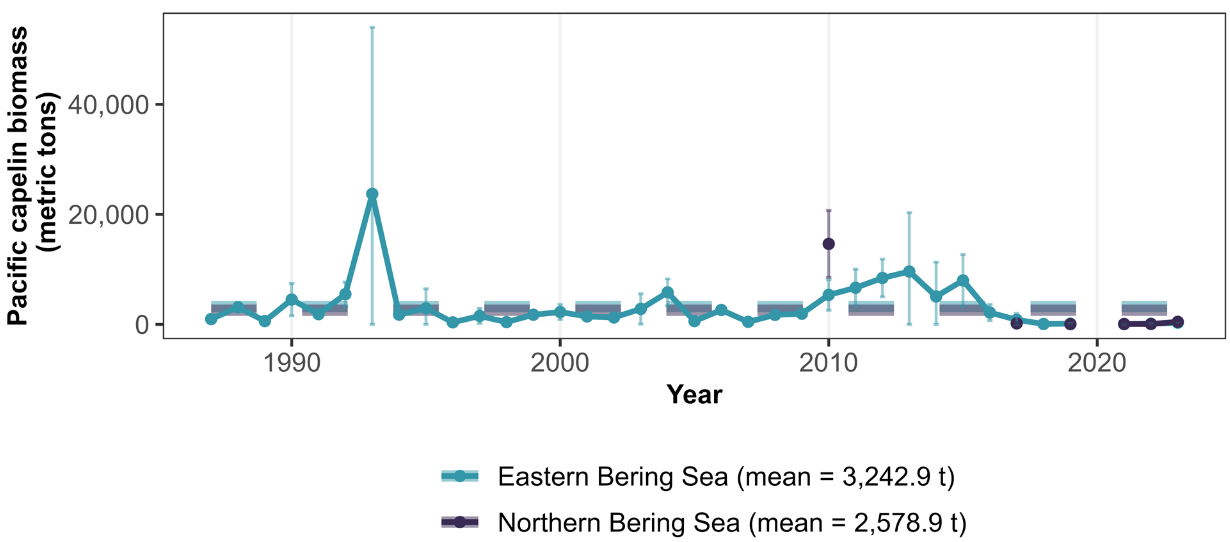


Figure 71. -- Estimates of Pacific capelin (*Mallotus villosus*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

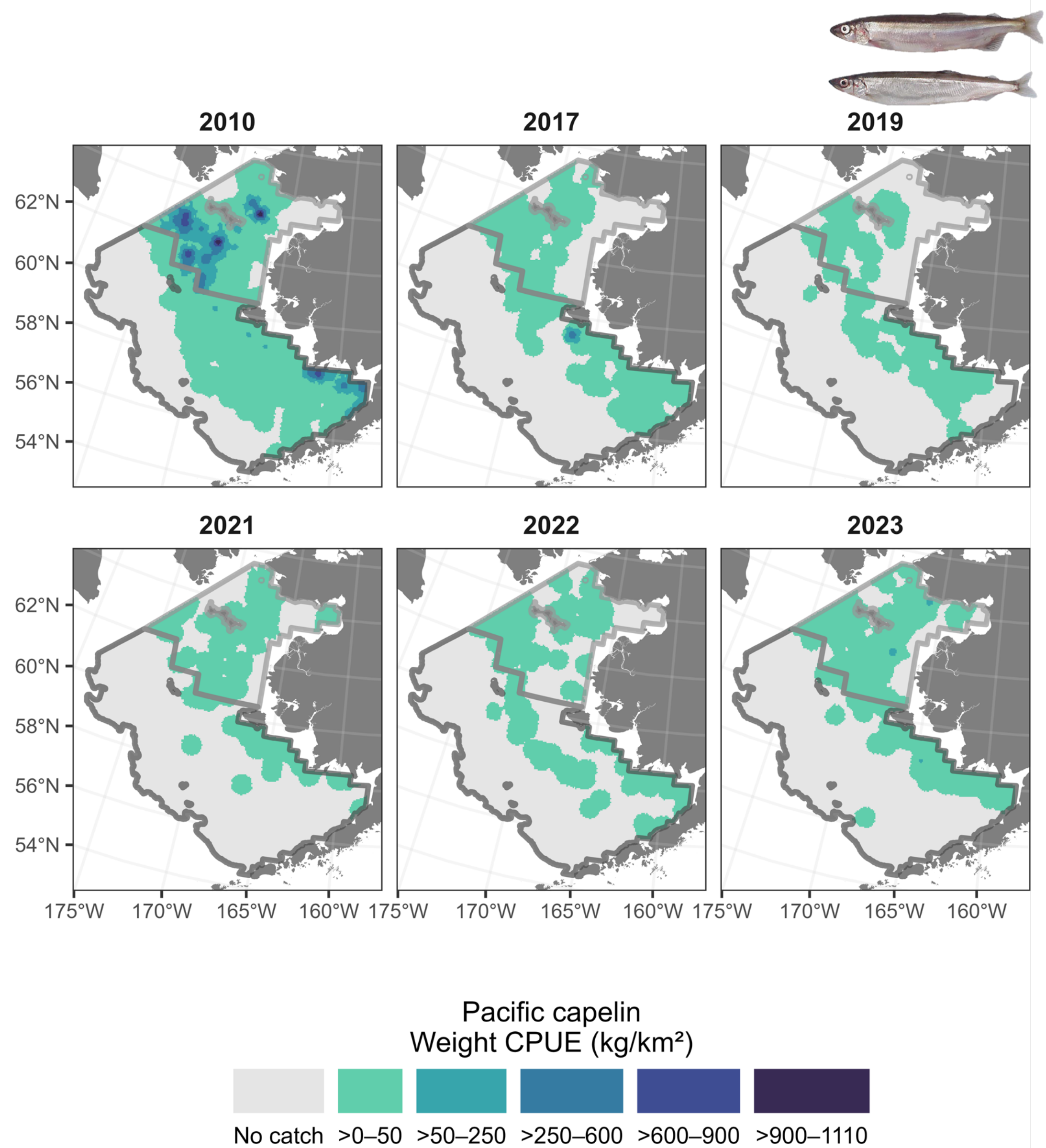


Figure 72. -- Distribution (Weight CPUE (kg/km^2)) of Pacific capelin (*Mallotus villosus*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

Rainbow Smelt (*Osmerus mordax*)

Russian: Корюшка зубастая

In 2023, biomass increased by 15% for rainbow smelt in the northern Bering Sea (Table **26**; Figure **73**). The rainbow smelt is primarily a coastal and brackish water species. As in previous surveys of the northern Bering Sea survey, this species was primarily distributed throughout the coastal waters from Nunivak Island to the Bering Strait and throughout Norton Sound in 2023 (Figure **74**). Rainbow smelt lengths have not historically been recorded during the eastern and northern Bering Sea surveys because they are consistently caught in a small size range.

Table 26. -- Summary of catch location environmental variables, as well as 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

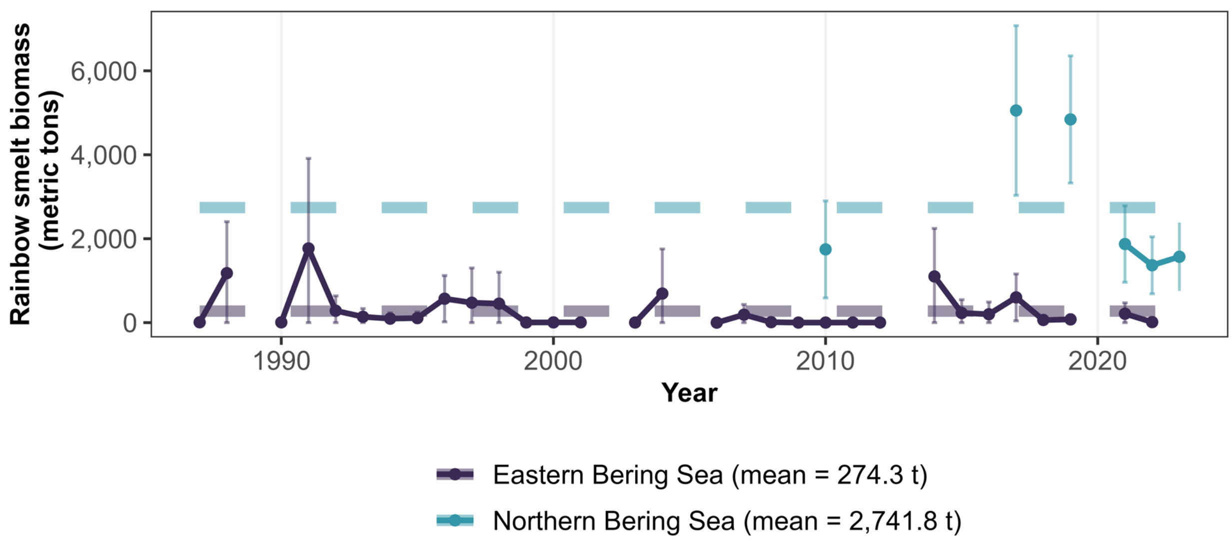


Figure 73. -- Estimates of rainbow smelt (*Osmerus mordax*) biomass (t) from the 1987-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

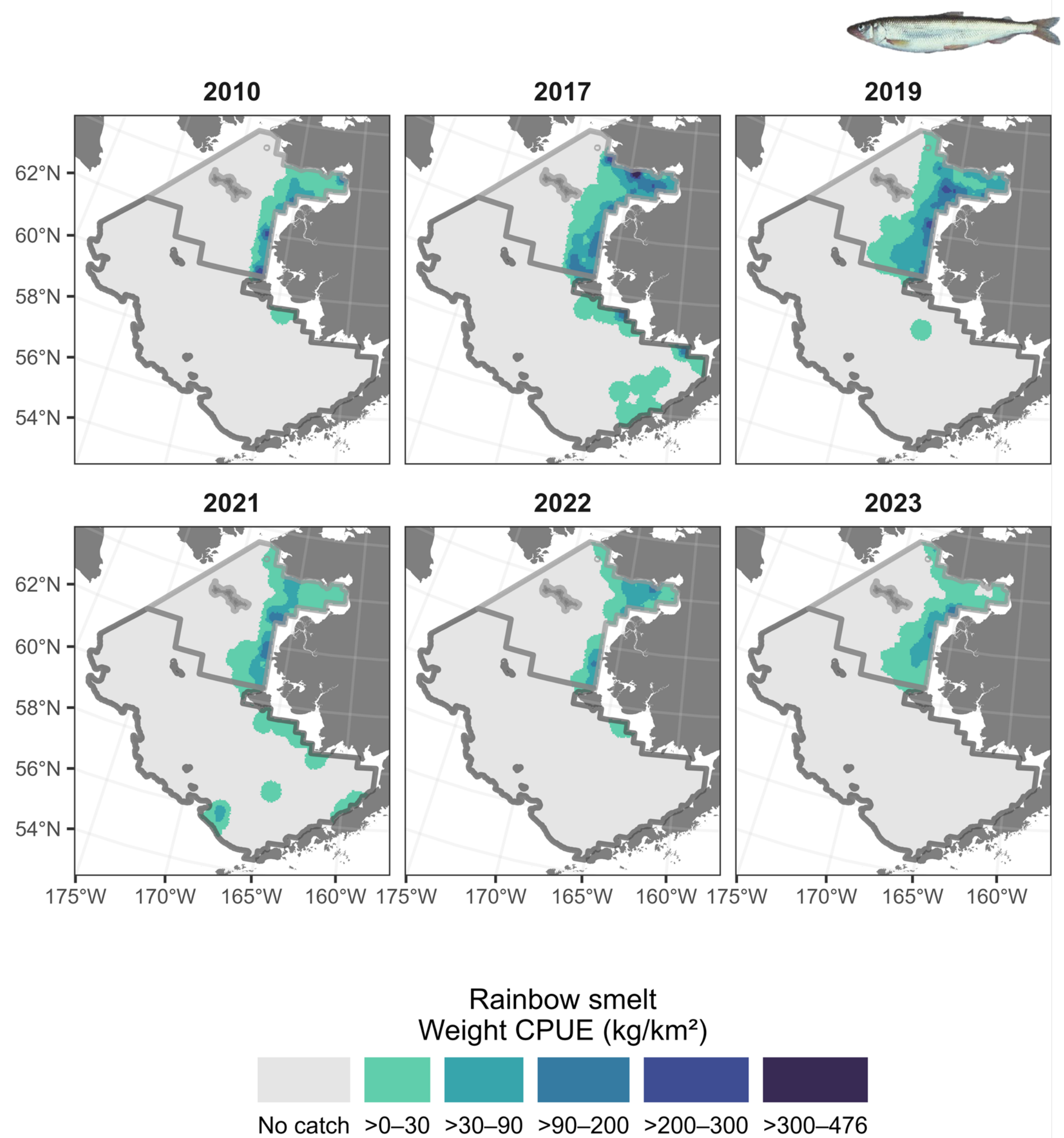


Figure 74. -- Distribution (Weight CPUE (kg/km^2)) of rainbow smelt (*Osmerus mordax*) from the 2010, 2017, 2019, and 2021-2023 eastern and northern Bering Sea shelf bottom trawl surveys.

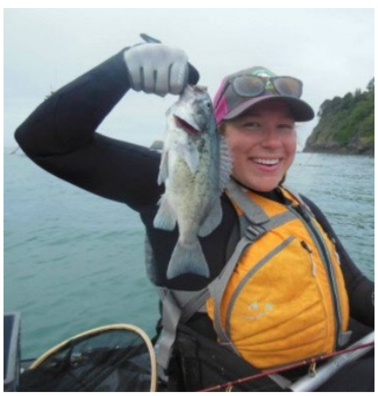
Groundfish Assessment Program Scientist Profiles

Duane Stevenson

Duane is a Supervisory Research Fishery Biologist and the Bering Sea Survey Team Lead with the NOAA Fisheries Alaska Fisheries Science Center in Seattle, Washington, and has been working with the AFSC in the Bering Sea for 20 years. He is an expert in the taxonomy and evolutionary relationships of marine fishes, and his research focuses on the identification and distribution of fishes in Alaska's marine ecosystems. He recently became the team lead for the Bering Sea trawl survey group, overseeing AFSC bottom trawl surveys in the Bering Sea and Arctic. In his free time, Duane enjoys chasing birds with his dogs and riding anything with two wheels.

Emily Markowitz

Em is a Research Fisheries Biologist in Seattle, Washington. Prior to working at AFSC, she was as a 2018 Sea Grant Knauss Marine Policy Fellow and contractor for the protected species and fisheries socioeconomics teams at NOAA Fisheries' Office of Science and Technology in Silver Spring, Maryland. Em develops open science workflows with her team for everything from survey preparation to statistical fisheries model production. Em maintains strong opinions about New York pizza and bagels, and enjoys cooking, puzzles, and exploring above and below the ocean surface, near and far!



Liz Dawson

Liz has been a Fish Biologist with the group since January 2017. Prior to beginning her current position with NOAA, Liz worked as a contractor for the National Marine Fisheries Service in Arcata, California on Endangered Species Act consultations. In her current position, Liz participates in the annual Bering Sea surveys and helps senior scientists in the Bering Sea group with survey logistics, packing and planning, and analyzing and publishing the survey results. Liz grew up snowmobiling and ice fishing in Minnesota. Liz is married to her college sweetheart, Jack, and they have two young children, Teddy (3) and Miggy (1), and a dog named Lily.

Chris Anderson

Chris has been a Fisheries Biologist with NOAA at the Alaska Fisheries Science Center in Seattle, Washington since 2019. Prior to joining the Bering Sea group, he worked as an Alaskan Fisheries Observer and with the Fisheries Monitoring & Analysis Division assisting and guiding observers deployed in the field. He grew up in Minnesota hunting, fishing, snowmobiling, and cross-country skiing. Chris participates in the annual Bering Sea surveys, planning and preparing, and analyzing survey findings. When not at sea Chris enjoys cooking, diving, and playing games of all kinds, whether board games, video games, or tabletop roleplaying games.

Sean Rohan
Sean is a Research Fisheries in Seattle, Washington. He has been working with the AFSC in the Bering Sea since 2011, initially as a contractor with the University of Washington. In addition to his work on surveys, Sean conducts research on behavioral interactions between fish and fishing gear and the ecology of the Bering Sea ecosystem. Outside of work, Sean enjoys cooking, watching football, and spending time outdoors.

Nicole Charriere
Nicole is a Fish Biologist in Seattle, Washington. Prior to joining the Bering Sea group in January 2021, Nicole spent over a decade at the Ecosystems Surveys Branch at the Northeast Fisheries Science Center in Woods Hole, Massachusetts. She provided essential leadership and mission support to bottom trawl, scallop/HabCam, clam, and cooperative gear study surveys, and enjoyed spending about a third of the year out at sea to help conduct those same fisheries research expeditions. Nicole was born and raised in Massachusetts, but is a proud citizen of Belize, as well. When she's not working out at sea, preparing for surveys, or exploring her hometown of Seattle, Nicole enjoys soccer, WW2 code breaking history, scuba diving, and playing the guitar.

Data Sources

Groundfish Assessment Program's Bering Sea Team and the Shellfish Assessment Program conducts the eastern Bering Sea bottom trawl survey take place each summer. The data collected from the survey are then extrapolated to catch-per-unit-effort (CPUE), population-level abundance, population-level abundance by size class, and population-level biomass estimates.

This document 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 catch, environmental, and location data collected and calculated from the survey can be directly accessed and downloaded from Fisheries One Stop Shop (FOSS; https://www.fisheries.noaa.gov/foss). FOSS is a web-based data portal that 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. Data from NOAA surveys are also used in the NOAA Fisheries Distribution Mapping and Analysis Portal (DisMAP) that provides public access to maps and other information about the distributions of marine species in U.S. Marine Ecosystems https://apps-st.fisheries.noaa.gov/dismap/.

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/f?p=501:2000:17098464527744:::::) provides access to data, data visualizations, and other tools for understanding the economic and sociocultural dimensions of Alaska fisheries.

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Acknowledgments

We would like to thank the many communities of the Bering Strait region and their members who have contributed 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 residents of the region who have shared their insights, including the local names used for the species covered by this document, identification of species of interest or concern that should be included in this document, and participation in 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 home lands 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 are 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.

Glossary of Terms

Table 27. -- Glossary of terms.

Term	Definition
Alaska Department of Fish & Game (ADF&G)	The Alaska Department of Fish and Game manages active fisheries, game management units, and special areas. They work to foster the highest standards of scientific integrity and promote innovative sustainable fish and wildlife management programs to optimize public uses and economic benefits. https://www.adfg.alaska.gov/
Alaska Fisheries Science Center (AFSC)	AFSC studies Alaska's marine life to ensure the sustainable use of living marine resources in federal waters. https://www.fisheries.noaa.gov/about/alaska-fisheries-science-center
Biomass	The total weight of organisms in a given area or volume.
Body Condition	A measure of the physical state of an organism in terms of health, size, and/or fitness. A Body Mass Index (BMI) in humans, for example.
CTD	CTD stands for conductivity, temperature, and depth, and refers to a package of electronic devices used to detect how the conductivity and temperature of water change relative to depth. CTDs measure important information about physical, chemical, and biological properties of the water column.
Carapace	The hard top shell of a turtle, crustacean, or arachnid.
Catch	The total number and weight of fish captured from an area over a period of time.

Term	Definition
Catch Per Unit of Effort (CPUE) or Catch Rate	CPUE is the estimated catch of organisms caught (in kilograms (kg) or number of individuals) per amount of effort (generally, a combination of gear type, gear size, and tow duration), and can be used as a measure of the density of a species. CPUE is often considered an index of fish biomass or abundance.
Charter Vessel	Commercial fishing vessels that are contracted by AFSC to conduct surveys.
Cod-end	The end of a trawl net. Fish are eventually pushed into the cod-end as the net is pulled through the water.
Continental Shelf	The edge or extended perimeter of a continent that lies under the ocean.
Downwelling	An oceanographic process that occurs when the water on the surface of the ocean becomes denser (often due to colder temperatures) than the water beneath it, and sinks or prevailing seasonal winds create surface currents that cause surface water to sink. Deeper, nutrient-poor, ocean water is then brought to the surface.
Ecosystem	A geographically specified system of organisms, including humans, the environment, and the processes that control the dynamics of the system.
Effort	The amount of time and fishing power used to harvest fish. Fishing power includes gear size, boat size, and horsepower.
Exclusive Economic Zone (EEZ)	As prescribed by the 1982 United Nations Convention on the Law of the Sea, EEZs are an area of the sea in which a sovereign state has exclusive rights regarding the exploration and use of marine resources, including energy production from water and wind. https://oceanservice.noaa.gov/facts/eez.html
Fishery	A fishery is an area where fish are caught for commercial or recreational purposes. It can be a defined body of water or a collection of fishing activities that have been agreed upon by countries and fishers. A fishery is often comprised of the people involved, species or type of fish, area of water, method of fishing, class of boats, purpose of the activities, engaged in raising or harvesting seafood.
Fishery Management Council (FMC)	A fisheries management body established by the Magnuson-Stevens Fishery Conservation & Management Act to manage fishery resources. https://www.pcouncil.org/
Fishery Management Plan (FMP)	A plan, and its amendments, that contains measures for conserving and managing specific fisheries and fish stocks. https://www.fisheries.noaa.gov/rules-and-announcements/plans-and-agreements
Fishing	The catching, taking, or harvesting of fish; the attempted catching, taking, or harvesting of fish; any other activity that can reasonably be expected to result in the catching, taking, or harvesting of fish; any operations at sea in support of, or in preparation for, any of these activities.
Groundfish	A species or group of fish that lives most of its life on or near the sea bottom.

Term	Definition
Habitat	The place and its associated environmental conditions where an organism naturally lives, grows, and reproduces; such conditions include characteristics of the substrate, water, and biological community.
International Pacific Halibut Commission (IPHC)	The International Pacific Halibut Commission is an International Fisheries Organization, having Canada and the United States as its members, responsible for the management of stocks of Pacific halibut within the Pacific waters of its member states: https://iphc.int/
Juvenile	An organism that has not reached sexual maturity.
Knot	A nautical unit of speed. One knot equals 1 nautical mile per hour (approximately 51 centimeters per second).
Mean	The mean is found by adding a collection of the numbers together and dividing by the number of items in the set. This is also known as the "average."
Median	The median is found by ordering the number set from lowest to highest and finding the exact middle.
Metric Ton (t)	One metric ton is equal to 2,200 pounds (lbs). A U.S. ton weighs 2,000 pounds.
Mode	The mode is the most common number in a data set.
National Marine Fisheries Service (NMFS)	Also known as NOAA Fisheries. This government organization is responsible for the stewardship of the nation's ocean resources and their habitat. It provides vital services for the nation, all backed by sound science and an ecosystem-based approach to management. Focus areas include productive and sustainable fisheries, safe sources of seafood, recovery and conservation of protected resources, and healthy ecosystems. https://www.fisheries.noaa.gov/
National Oceanic and Atmospheric Administration (NOAA)	The National Oceanic and Atmospheric Administration is a Washington, D.C.–based scientific and regulatory agency within the United States Department of Commerce, a United States federal government department. https://www.noaa.gov/
Nautical Mile (mi)	Nautical miles are used on ocean and coastal waters. Statute miles are used for inland areas such as the Intracoastal Waterway and the Great Lakes. A nautical mile is 1/60th of a degree, or one minute, of latitude. Roughly seven nautical miles equals eight statute miles.
North Pacific Fisheries Management Council (NPFMC)	North Pacific Fishery Management Council is one of eight regional councils established by the Magnuson-Stevens Fishery Conservation and Management Act in 1976 to manage fisheries in the 200-mile Exclusive Economic Zone, 3 miles off the coast of Alaska. https://www.npfmc.org/
Resource Assessment and Conservation Engineering (RACE)	RACE is a division of the Alaska Fisheries Science Center. https://www.fisheries.noaa.gov/about/resource-assessment-and-conservation-engineering-division
Species	A group of organisms that are closely related and capable of interbreeding to produce offspring that can reproduce.
Standardized	Designed and administered in a consistent and uniform manner.

Term	Definition
Systematic Survey Design	A type of probability sampling method in which fixed and gridded sample stations are sampled
Taxon	A category of organism that is based on their similarities and evolutionary relationships (for example, a species or family).
Time-series	A sequence of data points that are recorded in order over a period of time.
Trawl	The act of fishing with a net that can be dragged through the ocean water to catch fish.
Water Column	The water, from the surface to the bottom, at a given latitude and longitude.

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