Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Research Document 2026/035

Newfoundland and Labrador Region

Assessment of Northern Shrimp (*Pandalus borealis)* in Shrimp Fishing Areas 4–6 in 2023

N. Le Corre, K.D. Baker, W. Coffey, C. Malayny, D. Sullivan, D. Belanger, F. Cyr, M. Koen-Alonso, and H. Munro

Fisheries and Oceans Canada
Northwest Atlantic Fisheries Centre
80 East White Hills Rd.
St. John's, NL A1C 5X1

May 2026

Canada

Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
DFO.CSAS-SCAS.MPO@dfo-mpo.gc.ca

ISSN 1919-5044
ISBN 978-0-660-99362-1 Cat. No. Fs70-5/2026-035E-PDF

Correct citation for this publication:

Le Corre, N., Baker, K.D., Coffey, W., Malayny, C., Sullivan, D., Belanger, D., Cyr, F., Koen-Alonso, M., and Munro, H. 2026. Assessment of Northern Shrimp (*Pandalus borealis)* in Shrimp Fishing Areas 4–6 in 2023. DFO Can. Sci. Advis. Sec. Res. Doc. 2026/035. v + 148 p.

Aussi disponible en français :

*Le Corre, N., Baker, K.D., Coffey, W., Malayny, C., Sullivan, D., Belanger, D., Cyr, F., Koen-Alonso, M., et Munro, H. 2026. Évaluation de la crevette nordique (*Pandalus borealis*) dans les zones de pêche de la crevette 4 à 6 en 2023. Secr. can. des avis sci. du MPO. Doc. de rech. 2026/035. v + 155 p.*

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ABSTRACT

The status of Northern Shrimp (*Pandalus borealis*) in Shrimp Fishing Areas (SFAs) 4–6 has been assessed annually since 2015 and was last assessed in February 2022 (SFA 5–6) and March 2023 (SFA 4). The SFA 4–6 stocks have been assessed by examining multiple indicators derived from fishery-dependent data, Fisheries and Oceans Canada (DFO) multispecies survey data, and Northern Shrimp Research Foundation (NSRF) - DFO research survey data. In SFA 4, the Northern Shrimp Fishable Biomass (FB) and female spawning stock biomass (SSB) indices showed a year-over-year increase in 2023, and the recent trend suggests continued increases from a historic low in 2018. In 2023, Northern Shrimp in SFA 4 was above the USR with a 68% probability, placing the stock in the Healthy Zone. In SFA 5, FB and SSB indices have decreased since 2021, and were amongst the lowest levels in the time series in 2023. The 2023 Northern Shrimp SSB is above the LRP (with a 99% probability), but below the USR (with a 60% probability), placing the SFA 5 stock in the Cautious Zone. In SFA 6, FB and SSB indices have respectively remained stable and decreased since 2021, and remain amongst the lowest levels in the survey time series in 2023. The 2023 Northern Shrimp SSB in SFA 6 is below the LRP with a greater than 99% probability, placing the stock in the Critical Zone.

1 INTRODUCTION

1.1 SPECIES OVERVIEW

Shrimps (*Pandalus* spp.) are forage species (Policy on New Fisheries for Forage Species) and play a key role in the ecosystem, acting as an intermediary in the transfer of energy from the lower trophic levels (e.g., zooplankton) to the higher ones (i.e., predators, such as fish, marine mammals, and seabirds). Ecological relationships (e.g., predator-prey and competition) must be maintained among the species affected directly or indirectly by the fishery within the bounds of natural fluctuations in these relationships.

1.1.1 Life Cycle

Northern Shrimp (*Pandalus borealis*) are protandrous hermaphrodites; in northern waters, most are born and first mature as males, mate as males for several years beginning in their second year, and then change sex at approximately 17–21 mm carapace length (CL) (Bergström 2000; Hansen and Aschan 2000; DFO 2023, 2024a). Shrimp alter their size of transition in response to environmental and ecological conditions (Charnov and Anderson 1989; Bergström 2000). After transitioning, shrimp spend the rest of their lives as mature females. Although accurate ageing in wild populations remains difficult, Northern Shrimp individuals are generally thought to live for 6–8 years. Shrimp in northern parts of their range, such as those assessed herein, are thought to grow more slowly, have longer life spans, and reach larger sizes than shrimp in more southerly regions (Bergstrom 2000). Commercial trawls generally catch shrimp with CL greater than 17 mm (Aschan and Ingvaldsen 2009), thereby, targeting the largest males and females of all sizes. It has not been possible to infer recruitment from observations of small shrimp on the Newfoundland and Labrador (NL) shelves; no correlation between numbers of small ‘pre-fishable’ sized shrimp and subsequent changes in FB has been observed (Orr and Sullivan 2013).

Northern Shrimp females generally produce eggs in the late summer-fall and carry the eggs on their pleopods until they hatch in the spring (Allen 1959, 1963; Bergström 2000; Aschan and Ingvaldsen 2009). Larvae remain pelagic for several months (Ouellet and Chabot 2005; Rasmussen and Aschan 2011). At the end of the summer, larvae increasingly resemble adults and adopt suprabenthic (bottom-based) behavior (Pedersen and Storm 2002). These postlarvae and juveniles are too small to be caught by commercial fishing trawls. Spawning females that survive reproduction are distinguishable from those who have never spawned by the disappearance of sternal spines in the prenuptial moult and are called multiparous females (Hansen and Aschan 2000). Environmental conditions (e.g., timing of the spring phytoplankton bloom) influence the reproductive cycle of Northern Shrimp (e.g., spring egg hatching) (Koeller et al. 2009). For example, bottom water temperatures influence the duration of egg development on the female abdomen. Different populations of Northern Shrimp have adapted to local temperatures and bloom timing, matching egg hatching to food availability under average conditions (Koeller et al. 2009). However, this strategy is vulnerable to interannual oceanographic variability and long-term climate change.

1.1.2 Habitat

Northern Shrimp are found in the Northwest Atlantic from Baffin Bay south to the Gulf of Maine. Northern Shrimp are typically found on soft and muddy substrates and in bottom temperatures ranging from 1°C to 6°C (Shumway et al. 1985; Ouellet et al. 2007; Bourdages et al. 2022); however, the majority of Northern Shrimp are caught in waters from 2°C to 4°C. These conditions typically occur at depths of 150–600 m and exist throughout the NL offshore area.

Environmental conditions (e.g., phytoplankton bloom and sea surface temperatures [SSTs]) also affect Northern Shrimp recruitment from the larval stage until juveniles settle on the bottom (Brosset et al. 2019; Le Corre et al. 2020).

1.1.3 Larval Dispersal and Behavior

There is strong connectivity between the Canadian Arctic areas (Eastern Assessment Zone [EAZ] and Western Assessment Zone [WAZ]) and SFAs 4–7 (Le Corre et al. 2019, 2020) (Figure 1). Northern Shrimp larval dispersal modeling shows that larvae may travel several hundreds of kilometers prior to settlement, connecting all the different areas along the northeastern shelves of Canada (SFAs 0 to 7) and western Greenland consistently over the years. Those simulations suggest that Northern Shrimp larvae originating in the north (source: Arctic, SFAs 4 and 5) provide most of the potential settlers to southern populations (mostly directed towards SFA 6). However, research on Northern Shrimp larval dispersal did not consider potentially important factors such as temperature-dependent development or mortality (e.g., predation and post-settlement), and there were no recruitment data for Northern Shrimp to validate the simulated dispersal patterns. Initial genetic studies between Northern Shrimp populations in SFAs 0–7 (Jorde et al. 2015) demonstrated that individuals in these areas are largely genetically homogenous, but more recent preliminary research identified genetically-distinct pools in localized areas (e.g., SFA 6) that may be linked to smaller-scale oceanographic profiles (i.e., gyres) (DFO 2023; Bourret et al. 2024). This is most likely due to larval and pelagic transport by the Labrador Current.

1.1.4 Vertical and Horizontal Movements of Adults

In some regions, Pandalid shrimp perform daily vertical migrations (Crawford et al. 1992; Hudon et al. 1992). They rise in the water column at night to feed on plankton, and then return to the bottom during the day (Hudon et al. 1992). The scale of vertical migrations varies depending on the individual's developmental stage and local conditions (Hudon et al. 1992; Bergström 2000).

In addition to being found in SFA 4, Northern Shrimp are found in the EAZ and WAZ, directly to the north of SFA 4 (DFO 2021). Near the Hudson Strait, a highly dynamic system with strong currents and mixing (Drinkwater 1986), some adult shrimp (i.e., not only larvae) could be transported a great distance in a relatively short period of time, resulting in rapid shifts of shrimp into and out of SFA 4. Currently, the rates of exchange (export/import) between these zones are unknown; therefore, understanding resource dynamics as a whole requires integrating information from all assessment areas (DFO 2023, 2024b; Le Corre et al. 2024).

1.1.5 Predators

Northern Shrimp are important prey for many species such as Atlantic Cod (*Gadus morhua*), Greenland Halibut (*Reinhardtius hippoglossoides*), redfish (*Sebastes* spp.), American Plaice (*Hippoglossoides platessoides*), skates (*Raja radiata*, *Raja spinicauda*), wolffish (*Anarhichas* spp.), and harp seal (*Pagophilus groenlandicus*), especially during the period of low groundfish abundance on the NL shelves (Pedersen et al. 2022). Varying predation rates play an important role in regulating Northern Shrimp abundance across a wide range of regions, including Greenland (Wieland et al. 2007), Iceland (Jónsdóttir et al. 2013), the Gulf of Maine (Richards and Hunter 2021), and the Gulf of St. Lawrence, although recent studies in the Gulf of St. Lawrence also highlight the important role of plankton dynamics on Northern Shrimp growth (Brosset et al. 2019). The amount of shrimp consumed by predators varies in response to predator stock size, spatial overlap, and alternative prey options.

1.2 COMMERCIAL FISHERY

The fishery for Northern Shrimp off the coast of Labrador began in SFA 5 in the mid-1970s, primarily in the Hopedale and Cartwright Channels. Soon after, concentrations of Northern Shrimp were located within SFAs 4 and 6, leading to an expansion of the fishery into those areas (DFO 2007, 2009).The fishery expanded to Hawke Channel, St. Anthony Basin, Funk Island Deep, and slope edges of the continental shelf in SFAs 4–6 during the early-1990s, with associated Total Allowable Catches (TACs) periodically increasing over the next two decades (Figures 1 and 2).

Until 1996, the Northern Shrimp fishery in SFA 6 was executed solely by a large vessel (tonnage >500 t) fleet, which currently consists of 17 licenses. Commercial catch of Northern Shrimp increased rapidly from the mid-1990s into the early-2000s within SFA 6, where the resource was considered to be healthy and fisheries exploitation low. The majority of TAC increases in this period were allocated to a small vessel (<100 feet) fleet, which has since grown to include about 250 license holders. The number of active licenses varies by year and has been less than 250 for the past several years.

In 2003, the management year was changed from a calendar (January 1–December 31) to a fiscal (April 1–March 31) year such that the catches shown for 2003/04 are based on a 15-month fishing season. A seasonal “bridging” program was established that allows each license holder in the large-vessel fleet (starting in 2007) and small-vessel fleet (in 2012–15) to carry over some unused quota from the previous year, or borrow from next year’s quota. Each large-vessel license can bridge up to 750 t in each SFA and each small-vessel license can bridge up to 5% of their quota, up to 1,500 t for the small-vessel fleet combined, in SFA 6. Bridging had not been permitted in SFA 6 since about 3,200 t was bridged in 2015/16. However, some exceptions were made in SFA 6 in 2020/21 due to impacts of the COVID-19 pandemic (i.e., a high portion of unfished quota due to market conditions).

Despite the connectivity between SFAs 0–7, the assessments for Northern Shrimp are conducted at spatial scales reflecting management units that accommodate management preferences and historic practices, rather than ecological and biological processes. The biological units are recognized to be larger than the assessment scales and caution in interpreting and applying stock status information at smaller assessment scales is warranted (DFO 2023, 2024b; Le Corre et al. 2024).

All Northern Shrimp fisheries in eastern Canada are subject to the Atlantic Fisheries Regulations, established under the *Fisheries Act*. Pertinent regulations apply to bycatch, discards, vessel logs, etc., and include a minimum mesh size of 40 mm and mandatory use of sorting grates to minimize bycatch of non-target species (DFO 2023). Grate size is dependent upon the area fished. In SFAs 4–5 the maximum bar spacing is 28 mm. At-sea observers are required on all trips by the large vessel (LV) fleet (i.e., 100% observer coverage). A target of 10% observer coverage has been established for the small vessel (SV) fleet (DFO 2023), although coverage has ranged between 5–8% over the last 10 years. Observers onboard vessels are responsible for recording positions (Figure 2), catch size, and discards.

2 MATERIAL AND METHODS

The assessment considers fundamental aspects of biological measurement common to all renewable resources including how fast the resource is renewing itself, how renewal rates might change, and how human activity can affect renewal rates. In management terms, the rate at which a resource renews itself informs decisions on whether harvest rates are sustainable.

In 2023, the resource status of Northern Shrimp was assessed separately for each SFA using various data sources: DFO fall multispecies trawl survey data for SFAs 5–6, NSRF-DFO summer trawl survey data for SFA 4, commercial catch landings from the Atlantic Quota Monitoring System (AQMS), information on commercial shrimp fishing from at-sea observer reports (covering the NL, Nova Scotia, and Quebec regions), and logbook datasets (NL region). The assessments focus on a variety of stock indicators including biomass indices of various Northern Shrimp maturity stages, length frequencies, distribution, and fishery catch statistics. Trends in fishery performance were inferred from TAC, commercial catch-to-date, fishery catch per unit effort (CPUE), and fishing patterns. Ecosystem status in Northwest Atlantic Fisheries Organization (NAFO) divisions 2J3K and 2H (SFAs 5–6) was considered by examination of available oceanographic conditions, biological community structure, predator-prey interactions, genetic composition of shrimp components, and some human impacts (including trends in fishery performance). Data on ecosystem status in SFA 4 are more limited than in southern areas.

2.1 ECOSYSTEM AND ENVIRONMENT

Relevant physical and biological oceanographic information is provided based on Atlantic Zonal Monitoring Program (AZMP) and Northwest Atlantic Fisheries Organization (NAFO) Scientific Council Standing Committee on Fisheries Environment (STACFEN) analyses (Bélanger et al. 2022; Cyr et al. 2024b, 2024c).

Relevant information on the broader fish community, focusing on status and trends of fish functional groups, diet composition of key fish predators, and estimations of food consumption is provided by the NL Ecosystem Research Program (Koen-Alonso and Cuff 2018; NAFO 2021). Analyses focusing on shrimp production, predation, fishing pressures, and predation mortality index are also included, as well as analyses looking at potential drivers of per-capita net shrimp production (DFO 2016; DFO 2017). The examination of the sustainability of aggregated catches at the functional ecosystem level is based on the approach used by NAFO (Koen-Alonso et al. 2022; NAFO 2022).

2.1.1 Climate Index

The NL climate index (NLCI) (Cyr and Galbraith 2021) summarizes selected time series deemed representative of the ocean climate on the NL shelf and the Northwest Atlantic as a whole. The NLCI is available between 1951 to present and is updated annually. It integrates 10 equally weighted climate indicators over the time series (Cyr and Galbraith 2021). The NLCI can be interpreted as a measure of the overall state of the climate system, with positive values representing warm and fresh conditions with less sea-ice and, conversely, negative values representing cold and salty conditions.

2.1.2 Bottom Temperature and Salinity

The bottom temperature and salinity maps and statistics were obtained from the Canadian Atlantic Bottom Observations of Temperature-Salinity (CABOTS) data product (Coyne and Cyr 2024). This data product in SFAs 4–6 heavily relies on trawl-mounted Conductivity-Temperature-Depth (CTD) observations collected by both DFO multispecies (1980–2023) and the NSRF surveys (2006–23) and is completed with other available temperature-salinity profiles (e.g., from DFO's AZMP surveys, international oceanographic campaigns, Argo program, etc.). CABOTS is derived by data gridding using inverse distance-weighted interpolation that accounts for land barriers (see Cyr et al. 2024c for details). Bottom observations are restricted between 10 m and 1,000 m and are available for all years

and all seasons between 1980 and 2023, from which the climatological seasonal averages (averages over 1991–2020) are derived.

Before calculating statistics on bottom observations (e.g., mean temperature or salinity, area of the sea floor covered by a certain temperature range, etc.), missing observations on the annual maps (for example when no observations are available for a specific year) are filled with the climatology. This allows for calculation of these metrics on the same seafloor area (especially important for areas covered by a certain temperature range), however this method is conservative as it will tend to pull anomalies towards zero. The percentage area of each NAFO division covered is provided in CABOTS so users can assess the confidence of the observations for a certain year and season.

Bottom temperature and salinity maps for 2023, as well as their anomalies (difference between 2023 observations and the climatology), are shown together with the climatology. A number of statistics were derived from these maps to characterize the oceanographic seafloor habitat. These are the bottom mean temperature and salinity in the different fishing areas, the area of the bottom covered by water in various temperature ranges, etc.

2.1.3 Nutrients and plankton community

Nutrient and chlorophyll a (chl *a*) concentrations as well as zooplankton abundance and biomass were estimated using data collected along standard oceanographic sections (Figure 3) during AZMP seasonal surveys since 1999. Integrated nitrate (50–150 m) and chl *a* (0–100 m) inventories were calculated from concentration measured in Niskin water samples collected at discrete depths, while copepod abundance and zooplankton biomass were estimated from depth-integrated (near-bottom to surface) vertical plankton tows performed with a conical ring net (200-µm). Spring bloom timing (i.e., the time when chl *a* concentration is maximum) was estimated using daily average near-surface chl *a* concentration derived from satellite observations of ocean colour by the Moderate Resolution Imaging Spectroradiometer (MODIS) Aqua sensor since 2003. Spring bloom timing was calculated for several subregions (Figure 3) using R Shiny app PhytoFit (Clay et al. 2021). Standardized anomalies were calculated using a climatology of 1999–2020 for nutrients, chl. *a*, and zooplankton abundance and biomass, and 2003–20 for spring bloom timing. More details on AZMP and satellite-derived metric calculations can be found in Bélanger et al. (2024).

2.1.4 Ecosystem/Predation

Overview of the long-term trends in the fish community are provided based on biomass indices derived from the DFO multispecies survey in the NL region. This information alongside diet data from key predators are used to examine trends in shrimp as an important forage species across the region, and are combined to derive consumption estimates of the fish community, but also of key forage species such as shrimp.

An analysis contrasting shrimp availability to predation and catch impact was performed. Shrimp availability is estimated using Pandalid Shrimp biomass from the DFO multispecies survey plus the associated production that the estimated shrimp biomass is expected to generate, using a P/B ratio of 1.7 (Robertson 1979; Hopkins 1988). Predation is presented as the estimated fraction of consumption of shrimp by key predators. Nominal catch impact is the catch of shrimp in a given year plus the associated production that biomass is expected to generate, using the same ratio as above. This gives perspective on predation vs catch impacts but also how that relates to the amount of shrimp in the system. A shrimp predation mortality index can be calculated by dividing the estimated total shrimp consumed by predators by the estimated shrimp availability and can be used to inform on the predation pressure across different regions.

2.2 DFO MULTISPECIES SURVEY

Shrimp abundance, biomass, maturity, and CL data have been collected since autumn 1995 in SFA 5 and 6, as part of the DFO multispecies surveys conducted using the Canadian Coast Guard Ship (*CCGS) Wilfred Templeman* (hereafter, *Templeman*), *CCGS Alfred Needler* (hereafter, *Needler*), *CCGS Teleost* (hereafter, *Teleost*), *CCGS Capt. Jacques Cartier* (hereafter, *Cartier*), and *CCGS John Cabot* (hereafter, *Cabot*). Fishing sets of 15-minute duration and a towing speed of 3 knots were randomly allocated within depth strata, to depths of 1,500 m. Set allocations vary by NAFO division. All vessels used a Campelen 1800 shrimp trawl with a 40-mm codend mesh size and a 12.7-mm liner. SCANMAR sensors estimated that the mean wingspread was 16.8 m (Orr and Sullivan 2013). Though the timing of the survey, survey coverage (with the exception of specific years), and proportion of sets performed by different research vessels may change slightly from year to year, it is assumed that the effects are minimal. Survey coverage in SFA 6 has been extensive in areas where shrimp occur and reliable estimates of distribution, abundance, and biomass have been obtained each year since 1996. In SFA 5, DFO multispecies survey coverage has not been sufficient to resolve the highly patchy distribution of shrimp in 2000, 2002–03, 2005, 2007 and 2009. Since 2010, SFA 5 has been surveyed in its entirety. In 2022, there was no stratified random DFO multispecies survey because a DFO Comparative Fishing (CF) program had been performed in the NL Region. As the CF program targeted important commercial species and representative areas (e.g., depth, habitat), these data were not used to assess the Northern Shrimp biomass indices in 2022 in SFAs 5 and 6.

During the survey, shrimp were subsampled after each tow and sorted to species, counted, and weighed. Maturity/sex (male, transitional, primiparous, multiparous or ovigerous stages; Allen 1959; McCrary 1971), overall condition (e.g., presence of parasites), shell condition, and CL were recorded (Orr and Sullivan 2013). Fish and invertebrates were also sorted to species-level when possible, then counted and weighed. Following the survey, all weights and numbers were standardized to a 0.8-nm tow.

2.2.1 Implementation of conversion factors (outgoing vessels to new vessels equivalent)

The DFO CF campaign in 2022 provided the data necessary to make adjustments that account for differences in how the outgoing research vessels (*Teleost, Templeman,* and *Needler*) and the new Offshore Fishery Science Vessels (*Cabot* and *Cartier*) fish, ensuring the continuity of the existing survey time series (DFO 2024c). *Cabot/Cartier and Needler/Templeman* are sister ships and as such have the same fishing performance.

Based on the recommendations from the July 2023 Comparative Fishing CSAS peer review meeting (DFO 2024c), conversion factors (length-based and size-aggregated) were applied to calibrate DFO trawl survey catches for Northern Shrimp across the DFO multispecies survey area (SFAs 5 and 6), taking into account the differences in catchability between outgoing and new vessels. In addition to changing vessels, minor modifications (described in Wheeland et al. 2023) to the standard Campelen 1800 survey trawl's (Walsh et al. 2009) net and footgear were completed in 2020 for use in the survey going forward. Since outgoing vessels exhibited varying catchability compared to the new vessels, the historical survey time series (henceforth referred to as the unconverted or old vessel time series; DFO 2023) was adjusted to match the characteristics of the newer vessels (hereafter referred to as the new vessel time series) by applying vessel and area specific conversions. Additionally, the conversion to new vessel equivalents allowed for distinguishing variations among older vessels, which were previously assumed to have uniform catchability. Different conversion factors were applied to the *Teleost* and *Needler/Templeman* Northern Shrimp fall survey data, covering the historical survey period

from 1996–2023. This adjustment brought the data into units equivalent to those of the new research vessels. Specifically, conversion factors were applied to the data collected by the *Teleost* in Divs. 2HJ3KL and the *Needler/Templeman* in Divs. 3KL, as per the recommendations.

Additional analyses presented during the assessment showed consistency in environmental conditions (such as depth and temperature) and biological conditions (including the size distribution of Northern Shrimp caught) between the *Needler/Templeman* historical survey sets in Divs. 2HJ, *Needler* sets from the comparative fishing program in Divs. 3KL, and *Teleost* historical sets in Divs. 2HJ over the 2017–21 period (Figure 4). Based on these findings, the Northern Shrimp conversion factors originally intended for the *Needler/Templeman* in Divs. 3KL were also applied in Divs. 2HJ (DFO 2024a).

The conversion to a new vessel equivalent time series was implemented as follows:

- For each maturity stage, the Northern Shrimp abundances per 0.5-mm size bins ($LF_{raw\ abundance}$; length-frequency data) were converted using the appropriate length-based conversion factors (ρ_{LF}) for each trawl set performed by outgoing vessels (i.e., *Teleost*, *Needler* and *Templeman*) in the prescribed NAFO division. This conversion yielded new vessel equivalent abundances for each size bin, calculated as the old vessel abundance per size bin divided by the respective length-based conversion factor (i.e., old vessel abundance per size bin / ρ_{LF}).

$$LF_{conv.\ abundance\ (0\text{-}40mm)} = LF_{raw\ abundance\ (0\text{-}40mm)} / \rho_{LF\ (0\text{-}40mm)}$$

- For each maturity stage, Northern Shrimp abundances per 0.5-mm size bins were then converted to biomass per size bins using existing length-weight models from previous research studies (Orr and Sullivan 2013).

$$LF_{conv.\ biomass\ (0\text{-}40mm)} = f(LF_{conv.\ abundance\ (0\text{-}40mm)})$$

- The total catch estimates (Total $abundance_{raw}$ and Total $biomass_{raw}$) of Northern Shrimp per set (abundance and biomass) were also converted using the appropriate size-aggregated conversion factor (ρ_{SA}) for each outgoing vessel.

$$Total\ abundance_{converted} = Total\ abundance_{raw} / \rho_{SA\ abundance}$$

$$Total\ biomass_{converted} = Total\ biomass_{raw} / \rho_{SA\ biomass}$$

- As per the procedure utilized in recent years in the NL Region for Northern Shrimp assessment, biomass estimates per size bin (e.g., $LF_{conv.\ biomass\ (0\text{-}40mm)}$) were then scaled, based on the proportion per size bin, to the converted total catch estimates (Total $biomass_{converted}$) for a given survey set. This scaling approach of length-frequency data has been implemented in recent years to mitigate discrepancies between length-frequency estimates of abundance and biomass and the actual trawl total catch within a given survey set.

$$LF_{scaled\ abundance\ (0\text{-}40mm)} = Total\ abundance_{converted} \times (LF_{conv.\ abund.\ (0\text{-}40mm)} / sum\ (LF_{conv.\ abund.\ (0\text{-}40mm)}))$$

$$LF_{scaled\ biomass\ (0\text{-}40mm)} = Total\ biomass_{converted} \times (LF_{conv.\ biomass\ (0\text{-}40mm)} / sum\ (LF_{conv.\ biomass\ (0\text{-}40mm)}))$$

2.2.2 Implications of conversions to new vessels equivalent units

Using these converted data, biomass indices, exploitation rate indices (ERI), and reference points in SFAs 5 and 6 were recalculated for use in 2023 and going forward, using the same approach as in previous assessments. The absolute values of these recalculated indices are not directly comparable with the numbers reported in previous assessments. There is no known

significant impact on the interpretation of stock status as reference points and biomass estimates were both recalculated in an equivalent manner.

The biomass indices from the new vessels time series (1996–2021) show very similar trends but different values than the ones from the unconverted time series (i.e., reported in past assessments; Figures 5 and 6, Tables 1 and 2) because, for most Northern Shrimp sizes, the new vessels have a slightly different shrimp catchability (DFO 2024c). Biomass indices serve as relative measures of stock size, and the reductions observed in the rescaling of the biomass indices does not indicate a decrease in shrimp abundance in the environment during the corresponding period. Instead, these differences reflect variations in survey catchability associated with the new vessels.

Harvest Decision Rules for these stocks are directly calculated from FB indices. Due to the implementation of conversion factors, applying a given exploitation rate to the new vessels FB indices would result in a lower TAC compared to applying the same exploitation rate to the unconverted time series FB indices (DFO 2024a).

The conversion factors in the DFO multispecies fall survey for Northern Shrimp data included uncertainty estimates, which were not considered in the current assessment. Expanding Divs. 3KL Northern Shrimp conversion factors for the *Needler/Templeman* survey sets to adjacent Divs. 2HJ introduced slight additional uncertainties to biomass estimates, but only minimal impact on the assessment outcome is expected.

2.3 NORTHERN SHRIMP RESEARCH FOUNDATION SURVEY

The NSRF-DFO stratified random trawl survey, henceforth referred to as the NSRF survey, occurred in the summer months utilizing a commercial shrimp trawler with similar gear and survey protocols in place as the DFO spring and fall multispecies surveys (McCallum and Walsh 1996). The survey is deemed to effectively cover the entire distribution range of Northern Shrimp in the WAZ, EAZ, and SFA 4, where SFA 4 data are sufficient for generating survey indices from 2005–23 (Fulton et al. 2024; Baker et al. 2024; DFO 2024d). In most years, the survey occurred from July through August using the Ocean Choice International (OCI) vessel *Aqvik*. However, operational issues sometimes resulted in alternate OCI vessels being utilized or delays/breaks/extensions in survey timing. The effects of these adjustments have not been quantified. Sampling locations within each depth strata are allocated in accordance with Doubleday's (1981) method. The sampling locations were proportionally allocated to the size of the stratum area, with a minimum of two sets per stratum until 2018, regardless of its size. In 2018, the Hatton Basin Marine Refuge (MR) area was removed from the NSRF survey sampling area and set allocation exercise. This resulted in several strata that were redefined as a large portion of them was covered by the Hatton Basin MR. Given that the assessment methodology utilized for SFA 4 does not require two sets per stratum, three small strata with minimal historical shrimp catches were allocated only one set per strata from 2018 to present.

Vessels used to conduct the NSRF survey have varied since its inception in 2005. These included the F/V (Fishing Vessel) *Cape Ballard* (2005–11), F/V *Paamiut* (2007, 2009, 2011, 2013; SFA3 only), F/V *Kinguk* (2014), F/V *Katsheshuk* II (2015, 2020, 2023), and F/V *Aqviq* (2012, 2013, 2016–19, 2021–22). The *Cape Ballard*, *Aqviq* and *Kinguk* had similar specifications, but the *Katsheshuk II* was a larger, more powerful vessel. The relative catchabilities for the four research vessels (*Cape Ballard*, *Aqviq*, *Kinguk*, and *Katsheshuk II*) that have been used throughout the time series in SFA 4 is unknown. Considering the strong similarities in specification among three of these sampling platforms, it has been concluded that conversion factors are not required to continue with a comparable time series (S. Walsh, DFO Emeritus, pers. comm.). However, this assumption has not been empirically tested and research

has demonstrated that there are catchability effects resulting from vessel changes despite survey gear and protocols being equal (Benoit 2006; Perez-Rodriguez and Koen-Alonso 2010; Thorson and Ward 2014). Frequent vessel changes are undesirable and lead to uncertainty in interpreting survey results due to the likely violation of an assumed constant annual survey catchability.

Similarly to the DFO multispecies survey, the NSRF survey used a standard Campelen 1800 shrimp trawl. Each tow aimed for 15 minutes of bottom contact traveling at a targeted speed of 3.0 knots. A trawl-mounted CTD instrument recorded bottom temperature, salinity, and depth values corresponding with each tow. Further details on the survey are available in Siferd (2015).

During the survey, shrimp were subsampled (n ≈ 300 individuals) during each tow and sorted to species, counted, and weighed. Maturity/sex (male, transitional, primiparous, multiparous or ovigerous stages), overall condition (e.g., presence of parasites), shell condition, and CL were recorded (Siferd 2015). Fish and invertebrates (i.e., bycatch) were sorted to species-level, then counted and weighed. Following the survey, all weights and numbers were standardized to a 0.8-nm tow. More details on design and practices, trawl monitoring, environmental data sampling, shrimp catch processing, and additional field sampling during the NSRF survey are available in Fulton et al. 2024.

2.4 ASSESSMENT DATA ANALYSIS

All Northern Shrimp biomass and abundance indices (by SFA or survey stratum) are calculated using the Ogive Mapping (Ogmap) methodology applied to survey data spanning 2005 to present (Evans 2000; Evans et al. 2000; Orr and Sullivan 2013). Based on a dense set of Delauney triangles of known position and depth, Ogmap weighted values are calculated according to distances (horizontal and vertical) from each sample location. Points closer to the sample location receive higher weights (Evans et al. 2000). Ogmap is then used to compute the distribution of the biomass and other metrics across the area of interest (i.e., SFA or stratum). The point estimates were provided from the entire survey dataset, while the probability distribution is determined through Monte Carlo simulation (n = 599) and provide 95% confidence intervals.

In 2014, there were important refinements made to Ogmap which included the following corrections:

- Formerly, Ogmap chose bandwidths to minimize mean prediction error, whereas the updated version uses tests of the assertion that the survey observations are independent random samples from their respective probability distributions.
- The previous version of Ogmap used a kernel smoothing function that peaked at the origin and dropped exponentially with distance. This tended to overweight the nearest observation, possibly reducing the variability generated from resampling. The updated version utilizes a smoothing function with a flatter top and estimates the degree of flatness.
- Area of integration used in the previous version tended to omit all areas close to the border of the area of interest. This was particularly problematic when the highest concentrations of shrimp tended to be found on, or straddling, the borders. The revised version includes those areas.
- The bootstrapping methods for determining confidence limits were changed; unlike the other changes which are clear improvements, this is an area of ongoing research.

The annual fishable (>17 mm CL), female, total, and male biomass and abundance indices (and associated lower and upper confidence intervals) were presented in the current assessment.

Changes (indicated by % change) from the previous year were also calculated and presented. In addition, total biomass (kt) of Northern Shrimp was calculated by strata and depth range from 2005 to 2023 (SFA 4) or from 1996–2023 (SFAs 5–6). The percent contribution to total biomass per depth range over the survey period was also calculated.

Additionally, the proportions of total fishable vs pre-fishable (≤17 mm CL) biomass, total male vs. female biomass, male vs. female within the FB, and proportion of various maturities were calculated for Northern Shrimp in SFAs 4–6 based on the DFO multispecies and NSRF subsampled catches. Using the length frequency module of Ogmap on the survey shrimp data, Northern Shrimp abundance at length (expressed as a percentage of total abundance) were determined for the survey period. The subsample catches from both surveys were also utilized to calculate the mean size of shrimp of various maturities.

2.4.1 Size at 50% Transition

The annual size of transition was estimated using data from both surveys and generalized additive models (GAM) with binomial distributions (Eq. 1) for each SFA:

Eq. 1:

$$Y_i \sim binomial(1, p_i)$$

$$E(Y_i) = p_i$$
$$var(Y_i) = p_i \times (1 - p_i)$$

$$logit\ (p_i) = \beta_o + f_j(CL_i) + year_i$$

where, Y_i represents transitioned (i.e., transitional or female) or not yet transitioned (i.e., male) for an individual of a given CL (mm) in a given year, β_o is the intercept, and f_j is a unique smooth function of CL estimated using a thin plate smoothing spline for each year ($year_i$) (Baker et al. 2021). Each observation was weighted by the number of individuals in the set of that particular transitional-size category. The size at 50% transition was estimated for each year by determining the length at which the model fitted value was 0 (on the logit scale), which corresponds to 50% probability of transition (since logit(0) = $e^0/(1 + e^0)$ = 50% probability) (Pedersen et al. 2022).

2.4.2 Exploitation Rate

In SFA 4, ERI was determined by dividing the commercial catch (from the AQMS) from the fishing season by the NSRF survey FB index from the current year (i.e., 2022/23 commercial catch is divided by the 2022 FB index). In SFAs 5 and 6, the ERI was determined by dividing the commercial catch (from the AQMS) from the fishing season by the DFO multispecies fall survey FB index from the previous year (i.e., 2022/23 commercial catch is divided by the 2021 FB index).

The ERI was expressed as a percentage of the FB and 95% confidence intervals corresponded to the Ogmap FB confidence interval estimates. Because the fishing season for Northern Shrimp was still open at the time of the annual assessment, the reported ERI for the current year is considered incomplete and will be updated during the next assessment or update. The TAC is set for SFAs 4–6 Northern Shrimp under the assumption that biomass indices will not change from the most recent survey year to the next survey year. There is no ability to calculate the ERI one year in advance in SFA 4 due to the survey timing (summer) in relationship to the fishery removals timing. The ERI in SFAs 5 and 6 could not be calculated in 2023/24 as there were no biomass indices available for 2022 (no DFO multispecies survey).

The trawls used in the survey have a catchability coefficient below one, making them an index of biomass rather than a precise measure. The total fishery-induced mortality, encompassing both landed catch and incidental trawling deaths, is unknown, resulting in exploitation rates being relative rather than absolute.

Exploitation rates vary greatly across fisheries, regions, and time, introducing uncertainty when using commercial catch rates to gauge stock status. Factors like ice cover, bycatch, and market conditions impact commercial effort, while changes in fishing practices can unpredictably affect CPUE.

2.4.3 Northern Shrimp Precautionary Approach Framework

The initial framework for the assessment of Northern Shrimp off Labrador and the northeastern coast of Newfoundland previously followed a traffic light approach (DFO 2007). In 2008, a workshop was held with the objective of establishing a Precautionary Approach (PA) framework for Canadian shrimp and prawn stocks (DFO 2009). During that meeting, reference points based on proxies were introduced for Northern Shrimp resources in SFAs 4–6. The PA framework (which this assessment follows) is described in the Integrated Fisheries Management Plan (IFMP) which was first published in 2007 (DFO 2007) and updated in 2018 (DFO 2018). This framework was developed in 2008–10 following the 2008 framework workshop attended by a Marine Stewardship Council (MSC) working group which included representation from DFO Science, DFO Fisheries Management, and industry stakeholders. The Limit Reference Point (LRP) is defined as the stock status below which serious harm is being done to the stock and is based on best available information, and the Upper Stock Reference (USR) is defined based on the female Spawning Stock Biomass index (SSB) over a productive period (DFO 2009).

Northern Shrimp reference points in the IFMP PA framework were developed using proxies, relatively consistent with guidance in the DFO PA framework (DFO 2009). The USR was defined as 80%, and LRP as 30%, of the geometric mean of female SSB index over a productive period. Because of differences in survey history, the reference periods were taken to be 1996–2003 for SFA 6, 1996–2001 for SFA 5, and 2005–09 for SFA 4. The values of the reference points were revised slightly in 2016 and again in 2018, in accordance with refinements in the biomass estimation method. In 2019, the reference points for SFA 4 Northern Shrimp were modified to exclude the Hatton Basin MR which was not surveyed beginning in 2018. The reference point values were recalculated in 2024 for SFAs 5 and 6 after adjusting the biomass index estimates using conversion factors between new and outgoing CCGS vessels from the DFO comparative fishing program. The PA framework itself has not changed since its implementation. In SFA 4, the PA framework was applied over the period 2005–23 using an USR of 51,000 t and a LRP of 19,100 t superimposed upon the ERI trajectory over time. In SFA 5, the PA framework was applied over the period 1996–2023 using an USR of 39,700 t and a LRP of 14,900 t superimposed upon the ERI trajectory over time. In SFA 6, the PA framework was applied over the period 1996–2023 using an USR of 210,000 t and a LRP of 78,800 t superimposed upon the ERI trajectory over time.

Existing data (catch rates, and limited surveys in combination with stomach content analyses) indicate that Northern Shrimp biomass in SFAs 5 and 6 was considerably lower in the late-1980s and early-1990s, compared to the start of the research vessel time series (Pedersen et al. 2022). Incorporating and accurately estimating these historical shrimp biomass levels remains a research challenge.

2.5 COMMERCIAL FISHERY DATA

2.5.1 TACs and Catches

TACs and catches from 1977 to 2023/24 for the LV and SV fleets fishing Northern Shrimp in SFAs 4–6 were based upon the AQMS as of February 9, 2024. Quota transfers, bridging, and overruns were reflected in all catches and, since 2016/17, in the adjusted TAC column. All 2023/24 catches and adjusted TACs were preliminary. At-sea observer data were incomplete for 2023, such that LV fishery results shown for 2022/23–2023/24 management years are preliminary.

2.5.2 Catch Per Unit Effort

CPUE is a measure of fishery performance for the Northern Shrimp fisheries in SFAs 4–6. The observer database was used to determine CPUE for the LV Northern Shrimp fishing fleet in SFAs 4–6, divided into statistical areas (Figure 7). The NL Northern Shrimp logbook database was used to determine CPUE for the SV Northern Shrimp fishing fleet in SFA 6. Observed data were used because that dataset includes the number of trawls and usage of windows (escape openings) whereas the logbook dataset does not. However, the assessment took place while the fishery was ongoing and there was a delay receiving the data such that the most recent commercial data were not available for analyses in the assessment (i.e., 2023/24 data was incomplete for the 2024 assessment) and the most recent values presented are preliminary. Data were converted from calendar to management year from 2003 onwards. Commercial CPUE models for Northern Shrimp are outlined in Orr and Sullivan (2013).

Raw CPUE data were standardized using multiple regression and weighted by effort to account for variations related to year, month, fishing gear (e.g., number of trawls, window types), vessel, and other factors. The CPUE models for Northern Shrimp directed fisheries in SFAs 4–6 included all significant categorical variables from the 1989–2023 observer time series (1980–2023 for SFA 5) to track trends in fishing performance over time, standardized to initial-year values. Differences or similarities between the initial parameter estimates and those of subsequent years were inferred from the model output statistics. To focus only on experienced fishers, the standard dataset was limited to data from vessels with more than one year of shrimp fishing experience. SV CPUE models in SFA 6 were derived from logbook data from 1998–2023/24 and standardized by multiple regression to account for single trawl, year, month, and fishing area (Figure 7). The analyses were conducted using the Generalized Linear Model (GLM) procedure in SAS software (SAS 9.4).

Unstandardized CPUE (kg/hour) was calculated by depth range and stratum (i.e., the area and depth-based strata utilized for allocation of research survey sets) for the LV fleet fishing Northern Shrimp in SFAs 4–6 and SV fleet in SFA 6. The spatial distributions of catches, and CPUE by 0.1° grid square were compiled for LVs in SFAs 4–6 (>500 t) and SVs (≤500 t) in SFA 6 from 2021/22 to 2023/24 for both species, noting that the most recent data were incomplete. Seasonal variations of the unstandardized CPUE values (raw catch/effort averaged by year and week) were also presented for the LV (SFAs 4–6) and SV (SFA 6) fleet targeting Northern Shrimp in SFAs 4–6, based on the commercial fishing management year from 1993–2023/24.

2.5.3 Length Frequencies (Observer Data)

Observers onboard vessels targeting Northern Shrimp in NL waters measured random detailed samples of Northern Shrimp, which consisted of 250–400 individuals and included information on maturity (male, primiparous female, multiparous females, and ovigerous females), CL (to the

closest 0.1 mm), and pathogens. This dataset was used to provide annual estimates of commercially caught size frequencies in SFAs 4–6 and the annual mean CL of Northern Shrimp caught by the LV fleet in SFAs 4–6 and the SV fleet in SFA 6.

2.5.4 Logbook Data

Logbooks are completed for every Canadian vessel targeting Northern Shrimp. They are returned to the province in which the vessel is registered and stored in databases that differ by province. These data include information such as catch size, position, and discards. The SV CPUE dataset was created using NL logbook data because all shrimp fishing vessels must complete logbooks, whereas, observer coverage in the SV shrimp fishery may be as low as 3%.

The landings by small and large vessels allowed a comparison with the total observed catches for each fleet. This comparison provided an indication of the percent of total catch captured in each CPUE model. Logbooks were also utilized to determine the spatial distribution of the fishing effort.

3 RESULTS AND DISCUSSION

3.1 SURVEY SUMMARY

In 2023, the NSRF survey was conducted aboard the F/V *Katsheshuk II* and collected shrimp data from 70 survey sets in SFA 4, corresponding to 90% of planned sets being surveyed (Figure 8, Table 3). In 2023, sampling in SFA 4 occurred between July 23 and August 3. The 2023 NSRF survey faced a challenge as primary trawl sensor data were missing for 2/3 of the trawls. Bottom contact time was estimated for these trawls, including those in SFA 4, using a regression between CTD data and primary trawl sensor data, where available. Despite this deviation from the usual method, it is not anticipated to affect the assessment outcome. The relative catchabilities for the four research vessels (*Cape Ballard, Aqviq, Kinguk,* and *Katsheshuk II*) that have been used throughout the time series in SFA 4 have not been empirically tested, and thus the relative catchability between the vessels is unknown.

In 2023, the DFO multispecies fall survey was conducted in SFAs 5 and 6 aboard the *CCGS Cabot* and *CCGS Teleost* and collected shrimp data from 78 survey sets in SFA 5 (Figure 8, Table 4) and 176 survey sets in SFA 6 (Table 5), corresponding to most planned sets being surveyed. In 2023, sampling in SFAs 5 and 6 occurred between September 22 and November 24.

3.2 ECOSYSTEM AND ENVIRONMENT

3.2.1 Oceanography and Climate Index

The NL ocean climate varies on near-decadal time scales with known impacts on ecosystem productivity (Cyr et al. 2024a). The NL bioregion experienced a cooler climate in the mid-2010s (~2014–17), followed by a warming phase that has been ongoing since about 2018 (including the warmest year on record in 2021). These changes in climate regimes prevailing since the early 1950s are well captured by the NLCI (Figure 9). In 2023, the NLCI was high at +0.7 (among the top ten warmest years on record).

The environmental conditions at the seafloor in SFAs 4–6 are partly driven by the mean climate conditions, especially in the winter, and partly by the associated changes in the large-scale ocean circulation that accompany the changing climate (Figure 10 and Figure 11). Three main water sources converge in SFA 4 and continue south towards SFAs 5 and 6. The Baffin Island

Current, which carries Arctic-origin waters outflowing from the Davis Strait, eventually merges with the outflow from the Hudson Strait to form the Coastal Labrador Current. This current carries frigid and relatively fresh waters southward along the coast of Labrador. Further offshore at the shelf break, the Labrador Current, which carries sub-polar North Atlantic waters originating from the West Greenland Current, flows southward after bifurcating to the west and eventually to the south at the northern end of the Labrador Sea.

The coastal Labrador Current and the offshore (main) branch of the Labrador Current create an offshore-onshore gradient in bottom temperature in SFAs 4–6, with temperature ranging from 3 to 4°C along the shelf break to near freezing (<-1°C) close to the coast of Labrador (Figure 10 and Figure 11). This temperature gradient is also accompanied by salinity changes, with fresher water along the coast and the more saline waters offshore along the shelf break and in the deeper channels (not shown, see Cyr et al. 2024c for details). In the Hatton Basin, a deeper trough bounding the northern part of SFA 4, bottom temperatures are generally characterized by warmer (temperature >4°C) and saltier (salinity >34.5) sub-polar waters.

Despite the relatively short time series available (since 2006), it is possible to identify near decadal fluctuations in bottom conditions of SFAs 4–6 (Figure 12). For example, the year 2011, and also 2010 for SFA 6, stand as the warmest years of the time series for all areas. After a cooler period between about 2012 and 2017 that also characterized all areas, a warming phase was observed between about 2018–21. In the last two years, conditions have been slightly cold or normal, except SFA 5 was slightly warm in 2023.

3.2.2 Nutrients and plankton community

This ongoing warm phase likely contributed to the improved conditions observed at the lower trophic levels since the mid-2010s. These include earlier phytoplankton blooms, increased concentrations of nutrient and chlorophyll *a* (chl *a*), higher abundance of *Calanus* spp. copepods, and near-to-above normal zooplankton biomass (Figures 13 and 14). Chl *a* inventories, a proxy for net phytoplankton production, were near normal in SFAs 5–6 (sections SI and BB) in 2023 despite high nitrate availability of the past two years (Figure 13). However, other factors such as light availability can also limit phytoplankton production. The above-normal abundance of large *Calanus* spp. copepods contrasted with the near-normal zooplankton biomass observed across the region in 2023 (Figure 14).

3.2.3 Ecosystem/Predation

The NL bioregion underwent a regime shift in the early-1990s involving the collapse of the groundfish community and increases in shellfish. During this time, the increases in biomass of the shellfish did not compensate for the declines in groundfish, indicating a reduction in productivity. Since this shift, the NL ecosystems continue to experience overall low productivity conditions, likely driven by bottom-up processes (e.g., food limitation) with total biomass remaining well below pre-collapse levels. Since this shift the total biomass increased slightly in the early 2010's and saw declines in the late 2010s. Ecosystem trends in recent years (e.g., biomass trends, stomach content weights) indicate improvements from the lows in the late-2010s, but overall biomass has yet to reach the early-2010s level. Both Div. 2H (SFA 5-north) and Divs. 2J3KL (SFA 5-south and SFA 6) have returned to a groundfish dominated community structure, from the shellfish dominated one that characterized these regions in the years after the ecosystem collapse. This transition started in the south and occurred a few years later in the north.

Pandalid Shrimp (i.e., *P. borealis* for the vast majority in SFA 4–6) are an important forage species throughout the region appearing in diet analysis of key predators such as Atlantic Cod,

Greenland Halibut, American Plaice, and redfish. Shrimp are most dominant in the diets in the northern areas (~SFA 5), but its dominance has decreased in recent years. With accounting for the amount of shrimp available in the system and the estimated consumption by the fish predators in the system, the predation mortality index on shrimp remains at a high level in NAFO divisions 2J3KL (~SFA 6–7) even with the reduction in proportion of shrimp in the diets. In the south, the predation mortality index is four times lower in 2H (~SFA 5) (Figure 15), and preliminary research shows it is much lower in SFA 4, in the north.

When contrasting the shrimp availability to predation and catch impacts across the region, both fishing and predation have been shown to be potential drivers of the stock in Div. 2H (~SFA 5), while predation has been the stronger potential stock driver in Divs. 2J3KL (~SFA 6–7) (Figure 16). Periods where shrimp availability is much larger than predation and potential catch impacts indicate a potentially large scope for growth in the shrimp stock (i.e., potentially large shrimp surplus production), while periods where shrimp availability is of similar magnitude to predation and potential catch impacts indicate little scope for growth of the shrimp stock. In the most recent period, there is more scope for growth in the north than in the south.

The trend in shrimp per capita net production in Divs. 2J3KL (~SFA 6–7) is likely associated with impacts from predation, fishing, and ocean climate. Since the late-2010s, per capita net production has been relatively stable at low levels, and no major changes would be expected within the next 1–3 years based on these associations.

The NSRF survey bycatch data showed relatively high catch rates of several potential shrimp predators in 2023 (grenadier, redfish, Greenland Halibut, Atlantic Cod) whereas skate catch rates returned to a low level (Figure 17). NSRF survey catch in SFA 4 (Figure 17) and preliminary predation analysis in the SFA 4, EAZ and WAZ (DFO, unpublished data) showed the emergence of a large biomass of juvenile redfish over the last three years, which has been identified as a potential driver that may have indirect (competition) and/or direct (future predation) impacts on the shrimp population. The magnitude and duration of these impacts are currently not fully known, but it seems justifiable to assume that juvenile redfish resurgence, indirectly, will have a major impact on the ecosystem, including potential productivity of the shrimp population.

3.3 NORTHERN SHRIMP (*PANDALUS BOREALIS)* IN SFA 4

3.3.1 Biomass

The NSRF shrimp survey indicated an increase in most biomass indices in 2023 compared to 2022 levels, with the exception of males (Figure 18) (DFO 2024b; Le Corre et al. 2024). Despite unusually high values in 2021, both the FB and female SSB recent trends suggest continued increases from a historic low in 2018. The unusually high estimates in 2021 were influenced by two large, localized sets that could be considered as potential outliers in view of the biomass estimates in contiguous years (i.e., 2020 and 2022). It is uncertain how much of this 2021 index was due to changes in local shrimp productivity, sampling variation, or movement of shrimp into SFA 4 from neighboring areas. The degree to which the vertical distribution of Northern Shrimp changes within years, among years, or between spatial locations at a given time, is currently unknown. As biomass estimates are based on bottom trawl surveys (which will not sample shrimp that are not immediately adjacent to the benthos), an unquantified amount of observed biomass fluctuations may be due to changes in vertical distribution rather than the size of the shrimp population. Moreover, the relative catchabilities for the four research vessels (*Cape Ballard, Aqviq, Kinguk,* and *Katsheshuk II*) that have been used throughout the time series in SFA 4 have not been empirically tested, and thus the relative catchability between the vessels is unknown.

The FB in 2023 (81,100 t) remained stable (+2%) relative to the 2022 value and remained below the long-term mean (2005–22; 98,500 t) (Figure 18, Tables 6 and 7). The female SSB in 2023 (58,100 t; Figure 18, Table 8) increased (+13%) relative to the 2022 value but remained below the long-term mean (2005–22; 62,900 t). Similar to most years, in 2023, the highest concentrations of Northern Shrimp catch in SFA 4 were found in a relatively continuous band within the 201–300 m strata (68%) (Figures 19 and 20, Tables 9 and 10).

The female SSB that is relevant to the PA framework for an area consists of the animals whose spawning products will ultimately be caught in that area (as opposed to the animals that spawn in the area). The strong currents, which likely affect shrimp movement of all sizes, especially larvae, create significant challenges in estimating female SSB - particularly in SFA 4, where multiple strong currents converge. Accordingly, the true female SSB differs from the females observed by the survey alone. The existing management areas do not represent biological units and, therefore, changes in one management area quite likely produce effects in other management areas.

In SFA 4, Northern Shrimp size at 50% transition (21.7 mm) was above the long-term mean for the fourth consecutive year, decreasing from 23.2 mm in 2021, the highest value in the time series (Figure 21). The mean CL of most Northern Shrimp maturity indices (females, fishable, and total) have increased since 2022, and remain above the long-term means (Figure 22, Table 11). The males and pre-fishable mean CL decreased since 2022 and were just above the long-term means (Figure 22, Table 11). The proportion of males in the total biomass and FB slightly decreased since 2022 and was slightly below the long-term mean in 2023 (Figure 23 and 24). In 2023, the male biomass experienced a 17.5% decrease (26,400 t) compared to 2022 (Table 12).

3.3.2 Fishery

Over the 1978–2023/24 period, the Northern Shrimp TAC in SFA 4 has changed from a minimum of 500 t (1978–88) to a maximum of 15,725 t in 2018/19 (Figure 25, Table 13). TAC was increased from 12,944 t in 2022/23 (87% taken) to 14,886 t in 2023/24. Commercial catch typically follows the same pattern as the TAC. Total catch in 2023/24 was 8,759 t, 59% of the 14,886 t TAC (preliminary AQMS data as of February 9, 2024) (Figure 25, Table 13). Data from 2023/24 are considered preliminary.

Standardized LV CPUE varied without trend over 1989–2023/24, but has declined over the last 3 years and was below the long-term mean in 2023–24 (Figure 26, Table 14).

Several factors, including changes in management measures (i.e., different allocation tables) and species composition of catches (i.e., catches of both Northern and Striped Shrimp in the same area such that less Northern Shrimp catch might be recorded for equivalent effort), makes the interpretation of LV fishery performance more complex in this area. LV weekly CPUE varied without clear trend over the last 5 years (Figure 27).

Exploitation rate is far from being spatially uniform in all fisheries, areas, and time. Commercial effort is impacted by a variety of factors, including but not limited to ice cover, bycatch, and market conditions. Additionally, changing fishing practices impact CPUE in unknown ways.

The areas that sustain Northern Shrimp fishing in SFA 4 (Figures 2, 28, 29, and 30) have changed little in recent years and visually correspond to the spots where high concentrations of shrimp were generally observed during the NSRF survey (Table 15, Figures 19 and 20). The LV fleet fishes along the northeastern edge of the Saglek Bank, in depths as great as 750 m, and in the Ogak Channel (Figures 28, 29, and 30).

In 2020 and 2023, observer length frequency data showed a high proportion of large multiparous females, while a larger proportion of males was observed in 2022 compared to 2023 (Figure 31). The mean CL of Northern Shrimp caught by LVs in SFA 4 increased since 2022 (Figure 32).

3.3.3 Exploitation Rate Index

The ERI ranged between 6.8% and 36.7% from 2005/06 to 2022/23 (Figure 33, Table 6). As of February 9, 2024, the reported ERI for 2023/24 was 10.8% with 59% of the TAC taken. Should the entire 2023/24 TAC of 14,886 t be taken, the ERI would be 18.4%. The ERI increased from 2012/13–2018/19, corresponding to a period of declining biomass indices. The ERI was high in 2018 due to the significant decrease in FB index from 2017–18.

For all the ERI calculations (including SFA 5 and 6), both the numerator (catch) and denominator (FB) are uncertain. Trawls used in the surveys have shrimp catchability less than one, but the true value is unknown. Therefore, the survey underestimates biomass by an unknown percentage which may vary annually. Although the commercial catch is asserted to be known without error, the total fishery-induced mortality (i.e., landed catch plus incidental mortality from trawling) is unknown. Therefore, the ERI is likely underestimated by an unknown percentage.

3.3.4 Precautionary Approach Framework

In 2023, the female SSB index for Northern Shrimp in SFA 4 was above the USR with a 68% probability, placing the stock in the Healthy Zone within the IFMP PA framework. This represents the third consecutive year that the female SSB index was in the Healthy Zone, after four years in the Cautious Zone (2017–2020) (Figure 34).

3.4 NORTHERN SHRIMP (*PANDALUS BOREALIS)* IN SFA 5

3.4.1 Biomass

In SFA 5, the conversion of the historical time series to the equivalent of new vessels has led to median changes in the biomass indices of -7.4% for the SSB (range: -7.5–17.1%) and -7.1% for the FB (range: -7.4–18.9%) (Figure 5, Table 1).

In SFA 5, FB and female SSB indices declined since 2021 (no survey in 2022), by 17% (to 54,800 t) and 8% (to 36,500 t) respectively, and were amongst the lowest levels in the survey time series (Figure 35, Tables 16, 17, and 18). Similar to most years, in 2023, the highest concentrations of Northern Shrimp catch in SFA 5 were found in localized areas (channels) within the below-200 m (39%) and 201–300 m strata (32%) (Tables 19 and 20, Figure 36).

In SFA 5, the Northern Shrimp size at 50% transition has had an increasing trend since 2005 and was around the long-term mean in 2023 (21.6 mm) (Figure 37). The mean CL of fishable and female Northern Shrimp decreased from 2021 but remained above the long-term mean (Figure 38, Table 21). The total, male, and pre-fishable mean CL increased from 2021 but remained above (total) or around the long-term means (male and pre-fishable). The proportion of males in the total biomass and FB decreased from 2021, and was below the long-term mean in 2023 (Figures 39 and 40, Table 22). In 2023, male biomass decreased by 25.3% since 2021 (25,700 t) (Figure 35, Table 22).

3.4.2 Fishery

Over the 1978–2023/24 period, the Northern Shrimp TAC in SFA 5 has changed from a minimum of 3,570 t (1985) to a maximum of 33,084 t in 2003/04 (Figure 41, Table 23). TAC decreased from 15,606 t in 2022/23 (104% taken) to 14,200 t in 2023/24. Commercial catch typically follows the same pattern as the TAC. Total catch in 2023/24 was 12,911 t, 91% of the 14,200 t TAC (preliminary AQMS data as of February 9, 2024) (Figure 41, Table 23).

Standardized LV CPUE declined from a historic high in 2014 to reach its lowest value in two decades by 2022 (Table 24). It increased in 2023–24 but remained below the long-term mean (Figure 42, Table 24). LV weekly CPUE varied without clear trend over the last 5 years (Figure 43).

The areas that sustain Northern Shrimp fishing in SFA 5 (Figures 2, 44, 45, and 46) have changed little in recent years and visually correspond to the spots where high concentrations of shrimp were generally observed during the DFO multispecies survey (Figure 36) and correspond to strata where the highest CPUE values were observed (Table 25).

From 2021–23, observer length frequency data showed an increase in the proportion of males, compared to females (Figure 47). The mean CL of Northern Shrimp caught by LVs in SFA 5 decreased since 2022 to one of the lowest levels of the time series (Figure 32).

3.4.3 Exploitation Rate Index

The conversion of the FB time series from 1996–2021 has resulted in slightly different ERI estimates over the corresponding management periods (1997–2022/23). The median changes in ERI values were +1.14 percentage points in SFA 5 when compared to estimates calculated using the unconverted time series.

The ERI ranged between 6.6% and 31.5% from 1997–2022/23 (Figure 48, Table 16) and was not measurable in 2023/24 due to the absence of a survey in 2022.

3.4.4 Precautionary Approach Framework

In 2023, the SFA 5 Northern Shrimp SSB was above the LRP (with a 99% probability), but below the USR (with a 60% probability), placing the stock in the Cautious Zone (Figure 49).

3.5 NORTHERN SHRIMP (*PANDALUS BOREALIS)* IN SFA 6

3.5.1 Biomass

In SFA 6, the conversion of the historical time series to the equivalent of new vessels has led to median changes in the biomass indices of -1.3% for the SSB (range: -7.6–20.4%) and -1.0% for the FB (range: -6.6–21.7%) (Figure 6, Table 2).

FB and female SSB indices remain amongst the lowest levels in the survey time series since 2016 (Figure 50, Tables 26, 27, and 28). In 2021,and 2023 the FB index has remained stable (at 88,200 t) below the long-term mean (325,000 t). The fishable abundance index showed a similar trend as the biomass (Table 27). The SSB index decreased by 13% in 2023 (to 58,900 t), remaining below the long-term average (202,000 t) and marking the second-lowest value in the time series (Table 28). Similar to most years, in 2023, the highest concentrations of Northern Shrimp catch in SFA 6 were found in areas within 201–300 m (32%) and 301–400 m strata (46%) (Figure 51, Tables 29 and 30).

In SFA 6, the Northern Shrimp size at 50% transition was slightly above the long-term mean, at a similar level to 2021 (Figure 52). The mean CL of fishable and female Northern Shrimp

decreased from 2021, but remained above the long-term mean (Figure 53, Table 31). The total, male, and pre-fishable mean CL increased from 2021 and were above the long-term means in 2023. The proportion of males in the total biomass and FB increased from 2021, and was above the long-term mean in 2023 (Figures 54 and 55). In 2023, the male biomass experienced a 7.1% increase (48,000 t) compared to 2021 (Figure 50, Table 32).

3.5.2 Fishery

The Northern Shrimp TAC in SFA 6 has ranged from a minimum of 1,300 t (1978) to a maximum of 85,725 t in 2008/09 (Figure 56, Table 33). In 2023/24, the TAC was 9,430 t, at the same level as in 2022/23 (86% taken). Commercial catch typically follows the same pattern as the TAC. Total catch in 2023/24 was 5,632 t, 60% of the 9,430 t TAC (preliminary AQMS data as of February 9, 2024) (Figure 56, Table 33).

The standardized LV CPUE has been on a rising trend since 2016/17, though it remained below the long-term mean during this period (Figure 57, Table 34). In 2023/24, however, it increased further, surpassing the long-term mean. Standardized SV CPUE has been below the long-term mean since 2016/17, with the exception of 2022/23 (Figure 58, Table 35). In 2023/24, it returned to below the long-term mean. Both the LV and SV CPUE varied without seasonal trend over the last 5 years (Figures 59 and 60). It was noted during the assessment that the sea ice last occurrence (later than normal inshore) and higher than normal sea ice volumes in May on the Newfoundland and southern Labrador shelves in 2023 (Cyr et al. 2024c) might have impacted the SV catch and CPUE in SFA 6.

The areas that sustain Northern Shrimp fishing in SFA 6 (Figures 2, 61, 62, 63, 64, 65, and 66) have changed little in recent years and visually correspond to the spots where high concentrations of shrimp were generally observed during the DFO multispecies survey (Figure 52, Tables 29 and 30) and corresponded to strata showing the highest raw CPUE values (Tables 36 and 37).

From 2021–23, LV observer length frequency data showed an increase in the cumulative proportion of males compared to females (Figure 67). The mean CL of Northern Shrimp caught by LVs in SFA 6 decreased since 2022, whereas it increased for the SV (Figure 32).

3.5.3 Exploitation Rate Index

The conversion of the FB time series from 1996–2021 to a new vessel equivalent has led to slight variations in ERI estimates compared to those previously reported for the corresponding management periods (1997–2022/23). The median changes in ERI values were +0.02 percentage points in SFA 6 when compared to estimates calculated using the unconverted time series.

The ERI ranged between 5.8% and 22.3% from 1997–2022/23 (Figure 68, Table 26) and was not measurable in 2023/24 due to the absence of a survey in 2022. The rebuilding plan states a maximum ERI of 10% while the stock is in the Critical Zone. If the 2023/24 TAC is maintained and taken in 2024/25, the ERI would be 10.7% (Table 26).

3.5.4 Precautionary Approach Framework

In 2023, the SFA 6 Northern Shrimp SSB was below the LRP with a greater than 99% probability, placing the stock in the Critical Zone (Figure 69).

4 CONCLUSION

4.1 SFA 4 NORTHERN SHRIMP (*PANDALUS BOREALIS)*

Northern Shrimp FB and SSB indices have increased since 2022, and the recent trends suggest continued increases from historic lows in 2018. The LV CPUE has decreased since 2022/23 and was below the time-series average (1989–2022). The ERI was 10.8% in 2023/24. If the 2023/24 TAC is taken in 2024/25, the ERI would be 18.4%. The 2023 Northern Shrimp SSB was above the USR with a 68% probability, placing the stock in the Healthy Zone.

4.2 SFA 5 NORTHERN SHRIMP (*PANDALUS BOREALIS)*

Northern Shrimp FB and SSB indices have decreased from 2021, and were amongst the lowest levels in the time series (1996–2023). The LV CPUE has increased from 2022/23, but remained below the time-series average (1980–2022). The ERI was not measurable in 2023/24. If the 2023/24 TAC of 14,200 t is maintained and taken in 2024/25, the ERI would be 25.9%. The 2023 Northern Shrimp SSB was above the LRP (with a 99% probability), but below the USR (with a 60% probability), placing the stock in the Cautious Zone.

4.3 SFA 6 NORTHERN SHRIMP (*PANDALUS BOREALIS)*

Northern Shrimp FB and SSB indices have remained at or near time-series (1996–2023) lows without trends since 2016. The LV CPUE has increased from 2022/23 and was above the time-series average (1989–2022). The SV CPUE has decreased and was below the time-series average. The ERI was not measurable in 2023/24. If the 2023/24 TAC of 9,439 t is maintained and taken in 2024/25, the ERI would be 10.7%. The 2023 Northern Shrimp SSB was below the LRP with a greater than 99% probability, placing the stock in the Critical Zone.

5 ACKNOWLEDGEMENTS

Sincere thanks to the numerous technicians who have collected and analyzed the samples of the commercial fishery, DFO multispecies survey, and NSRF survey, as well as to the shrimp harvesters who filled and provided the logbooks.

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7 APPENDIX 1: GLOSSARY

AQMS: Atlantic Quota Monitoring System

AZMP: Atlantic Zonal Monitoring Program

CPUE: Catch Per Unit Effort

CL: Carapace Length

DFO: Fisheries and Oceans Canada

EAZ: Eastern Assessment Zone

ERI: Exploitation Rate Index

F/V: Fishing Vessel

FB: Fishable Biomass

IFMP: Integrated Fisheries Management Plan

LV: Large Vessel

LRP: Limit Reference Point

MSC: Marine Stewardship Council

NL: Newfoundland and Labrador

NLCI: Newfoundland and Labrador Climate Index

NSRF: Northern Shrimp Research Foundation

OCI: Ocean Choice International

PA: Precautionary Approach

SFA: Shrimp Fishing Area(s)

SSB: Spawning Stock Biomass

SV: Small Vessel

TAC: Total Allowable Catches

USR: Upper Stock Reference

WAZ: Western Assessment Zone

8 APPENDIX 2: TABLES

Table 1. Converted (new vessel equivalent) and unconverted (outgoing vessel) time series of Fishable and Female SSB indices (x 1,000 t) of Northern Shrimp in SFA 5 from 1996–2021. Biomass indices and confidence intervals (CI) are derived from Ogmap using DFO fall multispecies converted and unconverted survey data.

	Converted Timeseries (New Vessels Equivalent)						Unconverted Timeseries (Outgoing Vessels)					
Year	Lower FB Index CI	FB Index	Upper FB Index CI	Lower Female SSB Index CI	Female SSB Index	Upper Female SSB Index CI	Lower FB Index CI	FB Index	Upper FB Index CI	Lower Female SSB Index CI	Female SSB Index	Upper Female SSB Index CI
1996	43.5	92.8	145.0	20.0	32.4	46.0	46.1	99.4	155.0	21.4	34.9	50.0
1997	81.3	113.0	156.0	33.0	42.3	55.3	87.7	122.0	167.0	35.5	45.7	59.6
1998	50.6	75.0	103.0	28.0	37.7	49.3	54.7	80.7	110.0	30.0	40.7	52.9
1999	61.9	96.8	137.0	33.8	50.0	70.4	65.3	104.0	146.0	36.3	53.9	75.5
2000	-	-	-	-	-	-	-	-	-	-	-	-
2001	175.0	233.0	304.0	85.4	117.0	161.0	148.0	196.0	255.0	73.8	99.9	136.0
2002	-	-	-	-	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	-	-	-	-	-
2004	116.0	165.0	222.0	64.3	86.6	115.0	125.0	178.0	239.0	69.1	93.5	124.0
2005	-	-	-	-	-	-	-	-	-	-	-	-
2006	118.0	152.0	191.0	57.0	77.2	102.0	128.0	164.0	204.0	61.2	83.4	110.0
2007	-	-	-	-	-	-	-	-	-	-	-	-
2008	89.0	153.0	243.0	52.8	92.9	151.0	84.3	149.0	243.0	50.8	90.0	147.0
2009	-	-	-	-	-	-	-	-	-	-	-	-
2010	92.6	158.0	271.0	39.6	65.5	107.0	98.9	170.0	292.0	43.6	70.7	116.0
2011	106.0	138.0	171.0	48.0	69.8	92.8	113.0	148.0	184.0	51.9	75.3	99.8
2012	112.0	140.0	178.0	48.3	61.9	80.5	119.0	151.0	191.0	51.8	66.9	87.0
2013	51.4	74.5	104.0	29.7	43.3	64.1	56.1	80.0	113.0	32.1	46.8	68.9
2014	102.0	133.0	173.0	48.6	64.1	84.2	110.0	143.0	186.0	52.7	69.2	91.0
2015	94.6	138.0	192.0	50.2	76.7	109.0	102.0	149.0	206.0	54.3	82.8	117.0
2016	67.3	99.3	142.0	34.9	50.3	71.0	72.0	107.0	152.0	38.1	54.3	76.5

	Converted Timeseries (New Vessels Equivalent)						Unconverted Timeseries (Outgoing Vessels)					
Year	Lower FB Index CI	FB Index	Upper FB Index CI	Lower Female SSB Index CI	Female SSB Index	Upper Female SSB Index CI	Lower FB Index CI	FB Index	Upper FB Index CI	Lower Female SSB Index CI	Female SSB Index	Upper Female SSB Index CI
2017	77.0	131.0	217.0	30.8	51.6	81.3	82.4	141.0	230.0	32.7	55.8	88.1
2018	45.3	74.5	130.0	22.1	35.6	56.8	48.3	80.1	139.0	23.9	38.4	61.2
2019	36.7	59.8	93.7	23.6	41.2	66.2	40.4	64.4	101.0	26.3	44.5	72.1
2020	44.9	74.7	115.0	27.2	47.5	73.6	48.4	80.4	123.0	28.6	51.3	79.0
2021	42.3	66.1	97.3	22.9	39.6	62.0	44.8	71.0	106.0	24.6	42.8	66.8

Table 2. Converted (new vessel equivalent) and unconverted (outgoing vessel) time series of Fishable and Female SSB indices (x 1,000 t) of Northern Shrimp in SFA 6 from 1996–2021. Biomass indices and confidence intervals (CI) are derived from Ogmap using DFO fall multispecies converted and unconverted survey data.

	Converted Timeseries (New Vessels Equivalent)						Unconverted Timeseries (Outgoing Vessels)					
Year	Lower FB Index CI	FB Index	Upper FB Index CI	Lower Female SSB Index CI	Female SSB Index	Upper Female SSB Index CI	Lower FB Index CI	FB Index	Upper FB Index CI	Lower Female SSB Index CI	Female SSB Index	Upper Female SSB Index CI
1996	297.0	361.0	461.0	155.0	194.0	253.0	313.0	382.0	489.0	166.0	207.0	271.0
1997	307.0	341.0	400.0	151.0	176.0	209.0	330.0	365.0	429.0	164.0	190.0	227.0
1998	338.0	372.0	423.0	178.0	201.0	230.0	361.0	397.0	452.0	191.0	216.0	248.0
1999	373.0	418.0	477.0	220.0	250.0	289.0	398.0	447.0	513.0	237.0	269.0	310.0
2000	426.0	466.0	539.0	259.0	290.0	344.0	456.0	498.0	577.0	277.0	312.0	370.0
2001	482.0	563.0	649.0	300.0	360.0	425.0	459.0	538.0	624.0	292.0	351.0	414.0
2002	513.0	564.0	643.0	347.0	387.0	453.0	466.0	512.0	584.0	320.0	356.0	416.0
2003	461.0	518.0	607.0	282.0	326.0	391.0	469.0	528.0	620.0	293.0	336.0	403.0
2004	466.0	514.0	583.0	320.0	356.0	410.0	478.0	528.0	599.0	331.0	368.0	426.0
2005	598.0	681.0	792.0	394.0	459.0	547.0	525.0	600.0	702.0	346.0	404.0	482.0
2006	666.0	768.0	899.0	390.0	455.0	538.0	677.0	782.0	919.0	399.0	464.0	553.0
2007	575.0	650.0	764.0	391.0	447.0	537.0	575.0	651.0	766.0	393.0	450.0	540.0
2008	567.0	651.0	748.0	341.0	408.0	475.0	464.0	535.0	614.0	284.0	339.0	398.0
2009	244.0	334.0	423.0	157.0	211.0	266.0	230.0	322.0	414.0	149.0	205.0	260.0
2010	273.0	319.0	374.0	171.0	200.0	239.0	270.0	313.0	367.0	170.0	199.0	237.0
2011	346.0	394.0	456.0	201.0	232.0	271.0	371.0	422.0	487.0	216.0	251.0	292.0
2012	262.0	331.0	406.0	153.0	187.0	228.0	272.0	349.0	428.0	163.0	200.0	245.0
2013	185.0	230.0	280.0	112.0	145.0	179.0	175.0	216.0	262.0	107.0	137.0	169.0
2014	166.0	218.0	268.0	102.0	127.0	155.0	179.0	233.0	286.0	110.0	137.0	168.0
2015	111.0	130.0	153.0	68.1	83.0	100.0	119.0	139.0	163.0	72.9	89.6	108.0
2016	89.4	106.0	126.0	53.1	65.7	80.3	88.1	104.0	123.0	52.2	64.7	79.2

	Converted Timeseries (New Vessels Equivalent)						Unconverted Timeseries (Outgoing Vessels)					
Year	Lower FB Index CI	FB Index	Upper FB Index CI	Lower Female SSB Index CI	Female SSB Index	Upper Female SSB Index CI	Lower FB Index CI	FB Index	Upper FB Index CI	Lower Female SSB Index CI	Female SSB Index	Upper Female SSB Index CI
2017	87.0	99.4	116.0	51.4	60.1	72.6	76.5	87.3	102.0	45.3	52.7	63.6
2018	78.2	95.5	113.0	57.1	70.3	84.3	74.2	89.6	106.0	54.5	66.8	80.2
2019	70.5	87.7	108.0	40.4	52.6	66.7	66.7	82.9	101.0	38.5	49.9	63.1
2020	104.0	127.0	162.0	62.4	78.9	103.0	95.8	118.0	150.0	58.4	74.8	97.9
2021	66.2	88.2	110.0	47.9	67.5	87.3	70.0	94.3	118.0	51.1	72.9	94.2

Table 3. SFA 4 Northern Shrimp total biomass and abundance indices (2005–2023), with percentage change from previous survey year, number of successful survey sets, and the proportion of sets containing Pandalus borealis in SFA 4. Information was collected during NSRF summer surveys and estimates were calculated using Ogive Mapping (Ogmap).

Year	Total Biomass Index Lower CI (x 1,000 t)	Total Biomass Index (x 1,000 t)	Total Biomass Index Upper CI (x 1,000 t)	Change in Total Biomass Index from Previous Survey Year (%)	Total Abundance Index Lower CI (x 10^9)	Total Abundance Index (x 10^9)	Total Abundance Index Upper CI (x 10^9)	Change in Total Abundance Index from Previous Survey Year (%)	Number of Survey Sets in SFA 4	% Sets with *P. borealis*
2005	34.7	76.4	133.0	-	6.6	14.8	25.9	-	78	64
2006	54.8	97.9	165.0	28.1	9.8	18.1	31.4	22.0	76	76
2007	69.2	118.0	175.0	20.5	12.2	20.6	30.1	14.0	77	66
2008	60.9	124.0	189.0	5.1	13.0	24.7	36.9	20.0	69	80
2009	65.8	168.0	289.0	35.5	13.6	34.2	57.3	38.0	75	88
2010	57.9	130.0	225.0	-22.6	12.5	27.7	47.1	-19.0	72	64
2011	50.3	128.0	215.0	-1.5	9.8	24.7	41.3	-11.0	76	66
2012	91.6	167.0	243.0	30.5	18.9	35.1	51.1	42.0	77	66
2013	42.5	121.0	234.0	-27.5	8.5	24.9	46.6	-29.0	73	60
2014	60.4	107.0	164.0	-11.6	12.2	21.4	33.4	-14.0	75	65
2015	61.4	96.3	135.0	-10.0	12.1	18.5	26.2	-14.0	77	75
2016	52.0	98.3	164.0	2.1	9.6	18.5	30.3	0.0	75	59
2017	21.8	78.2	119.0	-20.4	5.4	14.2	21.3	-23.0	73	56
2018	22.1	44.8	68.5	-42.7	3.8	7.6	11.7	-47.0	75	56
2019	22.3	53.9	103.0	20.3	3.8	8.8	16.3	16.0	78	59
2020	22.3	60.2	106.0	11.7	3.4	9.1	15.8	4.0	78	56
2021	52.0	154.0	278.0	155.8	8.0	20.4	33.7	124.0	77	56
2022	41.7	83.3	131.0	-45.9	6.4	12.4	19.4	-39.2	78	65
2023	48.1	84.5	124.0	1.4	7.6	13.4	19.8	8.1	70	54

Table 4. SFA 5 Northern Shrimp total biomass and abundance indices (1995–2023), with percentage change from previous survey year, number of successful survey sets, and the proportion of sets containing Pandalus borealis in SFA 5. Information was collected during DFO fall multispecies surveys and estimates were calculated using Ogive Mapping (Ogmap).

Year	Total Biomass Index Lower CI (x 1,000 t)	Total Biomass Index (x 1,000 t)	Total Biomass Index Upper CI (x 1,000 t)	Change in Total Biomass Index from Previous Survey Year (%)	Total Abundance Index Lower CI (x 10^9)	Total Abundance Index (x 10^9)	Total Abundance Index Upper CI (x 10^9)	Change in Total Abundance Index from Previous Survey Year (%)	Number of Survey Sets in SFA 5	% Sets with *P. borealis*
1996	44.0	132.0	229.0		7.1	30.6	56.7	-	111	60.4
1997	92.5	131.0	179.0	-0.8	17.8	26.6	36.9	-13.1	111	74.8
1998	56.7	82.1	110.0	-37.3	10.5	15.2	20.8	-42.9	119	77.3
1999	68.9	106.0	148.0	29.1	12.6	19.7	27.5	29.6	117	68.4
2000	-	-	-	-	-	-	-	-	-	-
2001	226.0	300.0	391.0	183.0	45.9	61.5	79.9	212.2	90	82.2
2002	-	-	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	-	-	-
2004	133.0	189.0	251.0	-37.0	25.7	38.0	51.9	-38.2	120	63.3
2005	-	-	-	-	-	-	-	-	-	-
2006	138.0	174.0	215.0	-7.9	29.2	35.7	43.4	-6.1	118	74.6
2007	-	-	-	-	-	-	-	-	-	-
2008	114.0	180.0	268.0	3.4	23.2	34.2	48.4	-4.2	96	77.1
2009	-	-	-	-	-	-	-	-	-	-
2010	116.0	188.0	310.0	4.4	26.9	42.0	67.9	22.8	103	68.0
2011	130.0	163.0	200.0	-13.3	29.3	35.4	42.8	-15.7	112	67.9
2012	135.0	168.0	213.0	3.1	30.6	39.0	50.9	10.2	116	74.1
2013	62.9	87.0	118.0	-48.2	13.4	18.0	23.6	-53.8	118	67.8
2014	120.0	156.0	205.0	79.3	24.8	33.4	44.4	85.6	100	80.0
2015	107.0	154.0	209.0	-1.3	20.9	29.4	39.5	-12.0	87	89.7
2016	84.9	121.0	168.0	-21.4	17.3	24.5	33.5	-16.7	111	75.7
2017	84.5	142.0	231.0	17.4	16.9	27.7	45.2	13.1	100	85.0
2018	50.6	81.1	137.0	-42.9	9.0	15.1	26.5	-45.5	120	65.0
2019	44.8	68.7	103.0	-15.3	8.2	11.5	16.3	-23.8	80	85.0
2020	49.2	81.3	122.0	18.3	7.9	13.1	19.9	13.9	67	59.7

Year	Total Biomass Index Lower CI (x 1,000 t)	Total Biomass Index (x 1,000 t)	Total Biomass Index Upper CI (x 1,000 t)	Change in Total Biomass Index from Previous Survey Year (%)	Total Abundance Index Lower CI (x 10^9)	Total Abundance Index (x 10^9)	Total Abundance Index Upper CI (x 10^9)	Change in Total Abundance Index from Previous Survey Year (%)	Number of Survey Sets in SFA 5	% Sets with *P. borealis*
2021	48.0	74.0	107.0	-9.0	7.3	12.2	18.3	-6.9	78	65.4
2022	-	-	-	-	-	-	-	-	-	-
2023	34.6	62.2	96.4	-15.9	6.2	10.8	16.0	-11.5	78	87.2

Table 5. SFA 6 Northern Shrimp total biomass and abundance indices (1995–2023), with percentage change from previous survey year, number of successful survey sets, and the proportion of sets containing Pandalus borealis in SFA 6. Information was collected during DFO fall multispecies surveys and estimates were calculated using Ogive Mapping (Ogmap).

Year	Total Biomass Index Lower CI (x 1,000 t)	Total Biomass Index (x 1,000 t)	Total Biomass Index Upper CI (x 1,000 t)	Change in Total Biomass Index from Previous Survey Year (%)	Total Abundance Index Lower CI (x 10^9)	Total Abundance Index (x 10^9)	Total Abundance Index Upper CI (x 10^9)	Change in Total Abundance Index from Previous Survey Year (%)	Number of Survey Sets in SFA 6	% Sets with *P. borealis*
1996	400.0	470.0	579.0	-	84.9	97.7	117.0	-	258	79
1997	376.0	412.0	480.0	-12.3	78.8	85.1	98.5	-12.9	252	83
1998	393.0	432.0	490.0	4.9	84.2	92.1	105.0	8.2	253	86
1999	452.0	501.0	567.0	16.0	101.0	112.0	126.0	21.6	233	83
2000	512.0	555.0	632.0	10.8	113.0	122.0	138.0	8.9	241	84
2001	597.0	683.0	774.0	23.1	133.0	149.0	167.0	22.1	252	84
2002	626.0	682.0	766.0	-0.1	132.0	142.0	158.0	-4.7	253	85
2003	553.0	612.0	706.0	-10.3	125.0	136.0	156.0	-4.2	253	82
2004	563.0	620.0	696.0	1.3	113.0	125.0	140.0	-8.1	233	83
2005	684.0	772.0	892.0	24.5	127.0	141.0	159.0	12.8	249	84
2006	775.0	878.0	1020.0	13.7	165.0	184.0	212.0	30.5	234	81
2007	700.0	781.0	908.0	-11.0	144.0	161.0	183.0	-12.5	206	76
2008	687.0	777.0	882.0	-0.5	134.0	148.0	167.0	-8.1	180	82
2009	324.0	426.0	533.0	-45.2	76.5	96.9	122.0	-34.5	217	74
2010	334.0	383.0	440.0	-10.1	69.3	78.1	88.2	-19.4	253	77
2011	412.0	465.0	529.0	21.4	91.7	103.0	116.0	31.9	191	73
2012	317.0	395.0	478.0	-15.1	67.2	84.6	102.0	-17.9	224	75
2013	229.0	280.0	336.0	-29.1	47.9	56.8	67.2	-32.9	228	79
2014	208.0	271.0	330.0	-3.2	46.0	61.0	74.7	7.4	230	79
2015	150.0	174.0	201.0	-35.8	31.9	38.6	45.8	-36.7	231	78
2016	117.0	137.0	160.0	-21.3	23.8	28.0	32.4	-27.5	224	80
2017	102.0	116.0	134.0	-15.3	17.3	20.0	22.9	-28.6	235	72
2018	96.9	116.0	137.0	0.0	16.8	20.1	23.6	0.5	180	80
2019	88.3	108.0	129.0	-6.9	17.1	20.7	24.3	3.0	132	83
2020	134.0	164.0	205.0	51.9	26.2	32.1	40.5	55.1	171	71

Year	Total Biomass Index Lower CI (x 1,000 t)	Total Biomass Index (x 1,000 t)	Total Biomass Index Upper CI (x 1,000 t)	Change in Total Biomass Index from Previous Survey Year (%)	Total Abundance Index Lower CI (x 10^9)	Total Abundance Index (x 10^9)	Total Abundance Index Upper CI (x 10^9)	Change in Total Abundance Index from Previous Survey Year (%)	Number of Survey Sets in SFA 6	% Sets with *P. borealis*
2021	87.8	112.0	137.0	-31.7	18.1	22.4	27.3	-30.2	126	83
2022	-	-	-	-	-	-	-	-	-	-
2023	90.0	107.0	129.0	-4.5	16.8	20.5	25.0	-8.5	176	78

*Table 6. SFA 4 Northern Shrimp TACs, commercial catch to date, fishable biomass (FB) indices and exploitation rate (ER) indices (total commercial catch divided by the fishable biomass index in the same year). Biomass indices are derived from Ogmap using NSRF summer survey data. Catch is taken from the AQMS as of February 9, 2024, such that 2023/24 catch and exploitation rate (indicated with *) are preliminary.*

Catch Year	TAC (t)	Catch (t)	Survey Year	FB Index Lower CI (x 1,000 t)	FB Index (x 1,000 t)	FB Index Upper CI (x 1,000 t)	Change in FB Index from Previous Survey Year (%)	ER Index Lower CI (%)	ER Index (%)	ER Index Upper CI (%)
2005/06	10,320	10,247	2005	32.4	72.7	127.0	-	8.1	14.1	30.8
2006/07	10,320	10,084	2006	51.4	91.6	156.0	26.0	6.4	11.0	19.4
2007/08	10,320	10,009	2007	63.6	112.0	167.0	22.3	5.9	8.9	15.6
2008/09	11,320	9,682	2008	52.2	110.0	172.0	-1.8	5.6	8.8	18.7
2009/10	11,320	10,656	2009	56.1	152.0	264.0	38.2	4.0	7.0	18.9
2010/11	11,320	11,134	2010	50.5	118.0	209.0	-22.4	5.4	9.4	21.6
2011/12	11,320	10,441	2011	47.4	119.0	204.0	0.8	5.2	8.8	21.7
2012/13	13,018	13,908	2012	83.2	156.0	229.0	31.1	6.1	8.9	17.1
2013/14	14,971	14,969	2013	38.2	111.0	216.0	-28.8	7.0	13.5	40.0
2014/15	14,971	14,958	2014	51.4	95.2	147.0	-14.2	10.1	15.7	28.4
2015/16	14,971	15,050	2015	55.2	88.4	124.0	-7.1	12.2	17.0	27.5
2016/17	14,971	14,377	2016	46.1	90.4	151.0	2.3	9.5	15.9	31.4
2017/18	15,725	16,439	2017	18.0	72.7	112.0	-19.6	14.7	22.6	90.3
2018/19	15,725	15,697	2018	21.1	42.8	65.8	-41.1	23.8	36.7	74.4
2019/20	10,845	11,232	2019	21.1	52.4	101.0	22.4	11.0	21.4	54.3
2020/21	8,658	8,280	2020	21.2	58.7	104.0	12.0	8.0	14.1	38.5
2021/22	9,957	10,272	2021	48.0	151.0	276.0	157.2	3.7	6.8	21.4
2022/23	12,944	11,246	2022	39.1	79.5	124.0	-47.4	9.1	14.1	28.8
2023/24	14,886	8,759*	2023	46.3	81.1	120.0	2.0	7.3*	10.8*	18.9*

Table 7. Fishable abundance indices of Northern Shrimp in SFA 4. Abundance indices calculated using Ogmap on the NSRF summer survey data.

Year	Fishable Abundance Index Lower CI (x 10^9)	Fishable Abundance Index (x 10^9)	Fishable Abundance Index Upper CI (x 10^9)	Change in Fishable Abundance Index from Previous Survey Year (%)
2005	5.4	12.9	23.2	-
2006	8.0	15.1	26.3	17.1
2007	10.0	17.9	27.1	18.5
2008	8.9	18.1	28.0	1.1
2009	9.8	26.9	46.6	48.6
2010	9.4	22.6	40.9	-16.0
2011	7.1	20.5	36.6	-9.3
2012	15.6	30.0	44.8	46.3
2013	6.7	20.6	39.2	-31.3
2014	8.6	15.7	24.7	-23.8
2015	9.3	14.8	20.9	-5.7
2016	7.6	15.0	25.2	1.4
2017	3.7	11.5	17.5	-23.3
2018	3.3	6.7	10.4	-42.1
2019	3.2	8.0	15.5	19.8
2020	2.9	8.3	15.0	4.4
2021	6.8	18.8	32.4	125.7
2022	5.2	10.9	17.6	-42.0
2023	6.8	12.0	17.7	10.1

Table 8. Female SSB and abundance indices of Northern Shrimp in SFA 4. Biomass and abundance indices calculated using Ogmap on the NSRF summer survey data.

Year	Female SSB Index Lower CI (x 1,000 t)	Female SSB Index (x 1,000 t)	Female SSB Index Upper CI (x 1,000 t)	Change in Female SSB Index from Previous Survey Year (%)	Female Abundance Index Lower CI (x 10^9)	Female Abundance Index (x 10^9)	Female Abundance Index Upper CI (x 10^9)	Change in Female Abundance Index from Previous Survey Year (%)
2005	19.6	37.5	60.9	-	2.7	5.1	8.2	-
2006	31.0	49.5	77.2	32.0	3.9	6.1	9.6	20.4
2007	43.0	71.5	105.0	44.4	5.4	9.1	13.2	48.9
2008	33.8	73.7	117.0	3.1	4.5	9.9	15.9	8.5
2009	38.6	108.0	189.0	46.5	5.7	15.8	28.2	59.4
2010	23.9	60.9	109.0	-43.6	3.3	8.5	15.2	-46.3
2011	38.7	73.1	114.0	20.0	5.4	10.5	16.7	23.8
2012	52.0	87.2	122.0	19.3	8.3	14.0	19.5	33.3
2013	24.5	68.2	135.0	-21.8	3.8	10.4	20.1	-25.7
2014	34.4	64.3	94.9	-5.7	4.6	9.1	13.3	-12.9
2015	36.1	56.9	77.1	-11.5	5.0	8.0	11.0	-12.3
2016	27.0	52.9	87.5	-7.0	3.6	7.0	11.4	-12.3
2017	10.7	49.3	77.3	-6.8	1.5	6.4	9.8	-8.8
2018	15.2	32.6	50.7	-33.9	2.1	4.4	7.0	-30.3
2019	13.7	38.7	80.6	18.7	1.8	5.2	10.8	16.3
2020	15.2	43.0	78.6	11.1	1.8	5.3	9.7	2.3
2021	32.4	113.0	216.0	162.8	3.9	12.0	22.8	127.7
2022	26.0	51.3	79.9	-54.6	2.8	5.7	9.0	-52.2
2023	33.2	58.1	85.9	13.3	4.0	6.9	10.1	19.7

Table 9. Total biomass index (x 1,000 t) of Northern Shrimp in SFA 4 by strata from 2005–23. Depth range (in meters) represents the bottom depth range of the stratum. Colours indicate survey data quartiles, derived using Ogive Mapping on available NSRF summer survey data (green: lower quartile; white: middle two quartiles; pink: upper quartile).

Depth Range (m)	Stratum	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
<=200	909	4.7	1.9	6.2	5.6	8.0	3.8	12.2	8.7	5.4	3.4	8.6	1.7	3.5	3.7	1.7	1.7	3.9	3.3	5.9
<=200	910	3.2	1.7	3.4	4.8	3.2	2.9	6.9	6.5	2.5	3.7	6.4	1.9	3.5	2.0	1.1	2.0	4.7	7.9	5.0
<=200	925	1.3	3.7	4.4	5.4	2.2	2.7	2.2	6.9	2.1	4.8	4.9	4.2	2.7	1.3	1.9	1.2	6.1	4.7	2.1
<=200	965	4.8	2.3	6.7	5.0	7.4	4.3	10.9	9.4	8.1	3.3	9.0	1.5	2.8	4.4	2.3	1.8	3.4	2.8	5.2
<=200	966	1.1	0.9	2.4	1.0	2.1	1.1	1.7	1.3	2.1	0.8	1.6	0.4	0.3	0.9	0.7	0.8	0.5	1.1	0.9
201-300	901	14.6	13.6	32.2	33.1	48.0	25.7	19.7	28.4	42.2	13.9	13.7	9.5	7.8	7.3	12.2	12.5	11.2	7.6	13.6
201-300	908	19.1	14.6	21.9	25.9	53.5	30.0	32.8	33.2	39.6	14.9	17.2	10.2	12.1	10.3	16.1	14.0	13.8	10.1	19.3
201-300	911	12.0	3.2	6.9	7.4	8.2	10.0	22.3	23.0	5.4	8.4	10.7	3.5	10.8	6.2	1.8	6.2	13.7	17.1	12.9
201-300	924	6.9	20.1	21.8	23.0	17.9	20.8	12.1	37.1	7.4	18.8	14.9	29.4	18.8	5.6	10.1	11.7	48.7	16.5	11.6
201-300	926	2.2	11.9	5.1	3.5	6.2	8.7	3.0	5.8	1.4	27.2	6.0	20.1	7.1	1.2	1.8	2.9	17.9	5.1	3.0
301-400	902	1.2	0.7	2.0	4.4	4.4	2.9	1.2	3.5	3.8	1.2	0.5	2.5	0.8	0.3	0.9	1.1	0.9	0.4	0.9
301-400	912	0.1	0.1	0.1	0.1	0.3	0.3	0.2	0.3	0.1	0.4	0.1	0.2	0.2	0.1	0.1	0.4	0.1	0.1	0.1
301-400	923	4.1	17.1	3.0	2.4	4.5	9.4	2.1	2.1	0.4	3.1	1.3	8.0	5.0	0.8	1.7	2.7	22.7	4.8	2.1
301-400	927	0.6	4.5	1.1	1.3	1.4	6.5	0.4	0.5	0.1	2.3	1.0	4.2	2.1	0.2	1.1	0.8	4.9	1.5	0.8
401-500	903	0.1	0.2	0.1	0.2	0.3	0.1	0.1	0.2	0.2	0.2	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.2
401-500	913	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
401-500	967	0.2	1.2	0.3	0.4	0.5	1.1	0.1	0.2	0.1	0.4	0.3	0.8	0.6	0.1	0.3	0.2	1.2	0.3	0.5
501-750	904	0.0	0.1	0.2	0.3	0.1	0.0	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.2
501-750	914	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	All	76	98	118	124	168	130	128	167	121	107	96	98	78	45	54	60	154	83	84

Index <= 2.1	2.1 < Index < 6.9	6.9 <= Index

Table 10. Percent contribution to total biomass index of Northern Shrimp by surveyed depth range in SFA 4.

Depth Range (m)	No. of Strata	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
<=200	5	20	11	20	18	14	11	26	20	17	15	32	10	16	28	14	12	12	24	23
201-300	5	72	65	75	75	80	73	70	76	79	78	65	74	72	69	78	79	68	68	72
301-400	4	8	23	5	7	6	15	3	4	4	7	3	15	10	3	7	8	19	8	5
401-500	3	0	1	0	0	0	1	0	0	0	1	0	1	1	0	1	0	1	0	1
501-750	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 11. Mean size of Northern Shrimp (mm) in SFA 4 from NSRF survey by various maturity/size categories including females, males, fishable (≥17.5 mm), pre-fishable (<17.5 mm) and totals.

Year	Female	Male	Fishable	Pre-fishable	Total
2005	23.58	18.81	21.25	14.98	20.45
2006	23.93	18.66	21.52	15.13	20.45
2007	23.34	18.52	21.49	15.1	20.66
2008	23.65	17.81	21.79	15.67	20.15
2009	22.63	17.72	21.12	15.85	19.99
2010	23.06	18.2	20.55	15.87	19.7
2011	22.41	17.98	20.93	14.63	19.86
2012	22.06	18.43	20.55	15.92	19.88
2013	22.15	18.18	20.67	15.87	19.84
2014	22.87	17.47	21.42	15.19	19.76
2015	22.69	17.76	21.03	15.2	19.86
2016	23.2	18.17	21.08	15.58	20.06
2017	23.53	18.12	21.77	15.29	20.52
2018	23.19	18.64	22.07	15.6	21.3
2019	23.53	18.83	22.28	14.69	21.59
2020	24.46	19.73	23.12	15.2	22.47
2021	25.15	19.78	23.63	14.91	22.95
2022	24.08	19.32	22.35	15.56	21.51
2023	24.49	18.95	22.53	15.47	21.78

Table 12. Male biomass and abundance indices of Northern Shrimp in SFA 4. Biomass and abundance indices calculated using Ogmap on the NSRF summer survey data.

Year	Male Biomass Index Lower CI (x 1,000 t)	Male Biomass Index (x 1,000 t)	Male Biomass Index Upper CI (x 1,000 t)	Change in Male Biomass Index from Previous Survey Year (%)	Male Abundance Index Lower CI (x 10^9)	Male Abundance Index (x 10^9)	Male Abundance Index Upper CI (x 10^9)	Change in Male Abundance Index from Previous Survey Year (%)
2005	15.1	39.0	77.4	-	3.7	9.7	18.8	-
2006	22.3	48.4	94.6	24.1	5.4	12.0	22.0	23.3
2007	25.4	46.3	72.7	-4.3	6.4	11.4	17.3	-5.0
2008	25.1	50.1	77.5	8.2	7.7	14.8	22.9	29.8
2009	24.3	60.8	101.0	21.4	7.7	18.4	30.4	24.3
2010	24.4	69.5	131.0	14.3	7.4	19.2	34.8	4.3
2011	14.0	55.0	108.0	-20.9	4.5	14.2	26.4	-26.0
2012	37.4	79.9	125.0	45.3	10.5	21.1	32.7	48.6
2013	11.2	52.8	108.0	-33.9	3.6	14.5	29.0	-31.3
2014	22.6	42.7	77.6	-19.1	6.6	12.4	21.9	-14.5
2015	23.9	39.4	58.1	-7.7	6.7	10.6	15.5	-14.5
2016	23.0	45.4	77.4	15.2	5.9	11.5	19.1	8.5
2017	11.7	28.9	46.9	-36.3	3.4	7.9	12.7	-31.6
2018	6.3	12.2	19.4	-57.8	1.6	3.1	4.9	-60.2
2019	5.3	15.2	28.1	24.6	1.3	3.6	6.6	16.3
2020	6.1	17.2	30.6	13.2	1.5	3.8	6.5	4.7
2021	16.8	40.5	67.0	135.5	3.8	8.3	12.8	118.9
2022	14.9	32.0	53.7	-21.0	3.3	6.7	10.6	-19.5
2023	11.7	26.4	41.8	-17.5	2.9	6.6	10.6	-1.9

Table 13. TACs and catches in 1977–2023/24 for the LV and SV fleets fishing Northern Shrimp in SFA 4. In 2003 the fishing season was switched from a calendar year to a management year such that the catches shown for 2003/04 are based on a 15-month fishing season. Quota transfers, bridging and overruns are reflected in all catches and, since 2016/17, in the adjusted TAC column. All 2023/24 catches and adjusted TACs are preliminary and based upon the AQMS as of February 09, 2024.

Year	LV TAC (t)	LV Adjusted TAC (t)	LV Catch (t)	SV TAC (t)	SV Adjusted TAC (t)	SV Catch (t)	Total TAC (t)	Total Catch (t)
1978	500	-	-	-	-	-	500	-
1979	500	-	3	-	-	-	500	3
1980	500	-	1	-	-	-	500	1
1981	500	-	2	-	-	-	500	2
1982	500	-	5	-	-	-	500	5
1983	500	-	30	-	-	-	500	30
1984	500	-	-	-	-	-	500	-
1985	500	-	-	-	-	-	500	-
1986	500	-	2	-	-	-	500	2
1987	500	-	7	-	-	-	500	7
1988	500	-	1 083	-	-	-	500	1,083
1989	2 580	-	3 842	-	-	-	2,580	3,842
1990	2 580	-	2 945	-	-	-	2,580	2,945
1991	2 635	-	2 561	-	-	-	2,635	2,561
1992	2 635	-	2 706	-	-	-	2,635	2,706
1993	2 735	-	2 723	-	-	-	2,735	2,723
1994	4 000	-	3 982	-	-	-	4,000	3,982
1995	5 200	-	5 104	-	-	-	5,200	5,104
1996	5 200	-	5 160	-	-	-	5,200	5,160
1997	5 200	-	5 216	-	-	-	5,200	5,216
1998	8 008	-	7 918	312	-	133	8,320	8,051
1999	8 008	-	7 793	312	-	91	8,320	7,884
2000	8 008	-	7 300	312	-	82	8,320	7,382
2001	8 008	-	8 104	312	-	13	8,320	8,117
2002	8 008	-	8 322	312	-	65	8,320	8,387
2003/04	12 685	-	12 944	437	-	76	13,122	13,020
2004/05	9 883	-	9 549	437	-	95	10,320	9,644
2005/06	9 883	-	10 247	437	-	-	10,320	10,247
2006/07	9 883	-	10 084	437	-	-	10,320	10,084
2007/08	9 883	-	10 009	437	-	-	10,320	10,009
2008/09	10 783	-	9 682	537	-	-	11,320	9,682
2009/10	10 783	-	10 656	537	-	-	11,320	10,656

Year	LV TAC (t)	LV Adjusted TAC (t)	LV Catch (t)	SV TAC (t)	SV Adjusted TAC (t)	SV Catch (t)	Total TAC (t)	Total Catch (t)
2010/11	10 783	-	11 134	537	-	-	11,320	11,134
2011/12	10 783	-	10 441	537	-	-	11,320	10,441
2012/13	12 041	-	13 908	977	-	-	13,018	13,908
2013/14	13 969	-	14 969	1 002	-	-	14,971	14,969
2014/15	13 969	-	14 642	1 002	-	316	14,971	14,958
2015/16	13 969	-	14 766	1 002	-	284	14,971	15,050
2016/17	13 594	14 316	13 722	1 377	655	655	14,971	14,377
2017/18	13 579	15 002	15 124	2 146	1 315	1 315	15 725	16 439
2018/19	13 579	14 457	14 311	2 146	1 277	1 386	15 725	15 697
2019/20	9 415	10 595	10 360	1 430	847	872	10 845	11 232
2020/21	7 563	8 575	7 672	1 095	1 095	608	8 658	8 280
2021/22	8 663	9 040	9 621	1 294	654	651	9 957	10 272
2022/23	10 827	12 043	9 961	2 117	1 144	1 285	12 944	11 246
2023/24	12 409	11 238	7 509	2 477	1 247	1 250	14 886	8 759

Table 14. Standardized LV CPUE for Northern Shrimp in SFA 4 over the 1989–2023/24 period. Data from 2003 to present were converted to management year.

Management Year	TAC (t)	Fleet Catch (t)	Percent catch captured in model	CPUE relative to 1989	Modelled CPUE (kg/hour)	Calculated Effort (hours)
1978	500	-	-	-	-	-
1979	500	3	-	-	-	-
1980	500	1	-	-	-	-
1981	500	2	-	-	-	-
1982	500	5	-	-	-	-
1983	500	30	-	-	-	-
1984	500	-	-	-	-	-
1985	500	-	-	-	-	-
1986	500	2	-	-	-	-
1987	500	7	-	-	-	-
1988	500	1 083	-	-	-	-
1989	2 580	3 842	19	1.00	663	5 795
1990	2 580	2 945	74	0.93	615	4 791
1991	2 635	2 561	79	4.60	3 049	840
1992	2 635	2 706	80	2.97	1 968	1 375
1993	2 735	2 723	75	3.80	2 521	1 080
1994	4 000	3 982	69	5.90	3 912	1 018
1995	5 200	5 104	74	2.00	1 329	3 841
1996	5 200	5 160	69	1.99	1 318	3 916
1997	5 200	5 216	66	4.44	2 945	1 771
1998	8 008	7 918	94	3.34	2 216	3 573
1999	8 008	7 793	97	3.59	2 380	3 275
2000	8 008	7 300	101	3.97	2 630	2 775
2001	8 008	8 104	96	6.00	3 977	2 038
2002	8 008	8 322	101	3.67	2 431	3 424
2003–04	12 685	12 944	101	4.06	2 689	4 814
2004–05	9 883	9 549	109	3.42	2 270	4 207
2005–06	9 883	10 247	102	3.21	2 131	4 808
2006–07	9 883	10 084	99	3.43	2 272	4 437
2007–08	9 883	10 009	97	3.81	2 527	3 961
2008–09	10 783	9 682	108	3.80	2 519	3 844
2009–10	10 783	10 656	115	5.81	3 854	2 765

Management Year	TAC (t)	Fleet Catch (t)	Percent catch captured in model	CPUE relative to 1989	Modelled CPUE (kg/hour)	Calculated Effort (hours)
2010–11	10 783	11 134	101	6.25	4 146	2 686
2011–12	10 783	10 441	92	5.04	3 344	3 122
2012–13	12 041	13 908	97	4.39	2 911	4 777
2013–14	13 969	14 969	91	5.13	3 403	4 399
2014–15	13 969	14 642	99	4.86	3 222	4 544
2015–16	13 969	14 766	95	3.70	2 452	6 021
2016–17	13 594	13 722	102	5.81	3 851	3 563
2017–18	13 579	15 124	100	4.64	3 077	4 915
2018–19	13 579	14 311	97	4.49	2 975	4 810
2019–20	9 415	10 360	99	5.54	3 674	2 820
2020–21	7 563	7 672	90	5.60	3 711	2 067
2021–22	8 663	9 621	99	4.35	2 884	3 336
2022–23	10 827	9 961	138	4.41	2 927	3 403
2023–24	12 409	7 509	80	3.34	2 217	3 386

Table 15. Unstandardized CPUE (kg/hour) by depth range and stratum for the LV fleet fishing Northern Shrimp in SFA 4. Data were taken from observer data set; colour ranges are based on quartiles of the data from 1999–2022/23 (green: lower quartile; white: middle two quartiles; pink: upper quartile). Unavailable data is shown with black shading. Data for 2022/23 and 2023/24 are preliminary.

		CPUE <= 2997 kg/hr								2997 kg/hr < CPUE < 4362 kg/hr								4362 kg/hr <= CPUE								
Depth Range (m)	Stratum	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
<= 200	909				13707	433																1533				
	910																									
	925	1							47				1742	1030	660	2151	2497	451	174	331	804	1042		429	1049	135
	965				4169	4744			3184		1826							3015			4044	5213			3240	
	966					1261	1650			2681			3162	4514	4160	2403	6374	7072		2354	6602	2051		2862	2940	2009
201 - 300	901			3			910	126	6598	2644	1764	4216	3582	4481	3478	3215	6273	5072	3244	4289	4358	2190		2406	2873	2020
	908	1843	2877	3783	2983	2593	2990	2694	3208	3376	3452	5934	4397	4370	4341	5558	4833	3686	5722	3770	5339	3207	5389	3904	3342	2558
	911	2455	2616		1479	2134	469	2490	681	1576	2107	5369	2906	4153			2933		1610		3047	1542				
	924	3775	2812	4038	2196	3466	2914	1897	2911	2437	2322	3771	4529	4391	3289	3281	3201	2510	4059	3914	5499	5455	5013	3647	4253	4702
	926	2876	4804		1637			1824	963	2164	2102	3234	4301	2831	2503	2399	2997	1334	1973	604	2381	485	6904	725	2714	3806
301 - 400	902	1764	2831	5173	2893	3095	2374	2970	3266	4205	3832	4769	2447	3955	3885	7021	5622	2619	7826	5872	6870	2789	7762	4111	5367	2357
	912	2677			1522																					
	923	2424	2680	3969	2698	3432	2405	2088	2578	2395	2078	4401	4365	2807	1805	3571	4723	3421	3625	3871	8269	3947	3111	3639	3183	2476
	927	1171	2272	1225	1134	826	4108	1071	3064	2404	1604	2907	3246	3111		2463			1181	1530	7787	1052	771	473	1329	
401 - 500	903	1810	2186	5931	4512	4694	2295	3926	2453	3793	5615	6120		1834	4128	9871	5406	2767	8477	10756	6644	9309	6962	4418	9029	1367
	913	1667							588																	
	967	2243	2077	4181	2860	3534	2095	2604	1116	2290	373	4115	4513			26				2651	49669	5222	2031	1536		
501 - 750	904	1679		5128	3593	3340	1291	2676	3739		5206	5910			4976	26588	5794	2124	4441	5762	5454	10762			7912	
	914																									

*Table 16. SFA 5 Northern Shrimp TACs, commercial catch to date, fishable biomass indices and exploitation rate indices (catch in year y/fishable biomass index in year y-1). Biomass indices are derived from Ogmap using fall multispecies survey data. Catch is taken from the AQMS as of February 9, 2024, such that 2023/24 catch (indicated with *) is preliminary. Exploitation rate indices for 2024/25 in the below table (indicated with **) assume the 2023/24 TAC is unchanged in 2024/25.*

Catch Year	TAC (t)	Catch (t)	Survey Year	FB Index Lower CI (x 1,000 t)	FB Index (x 1,000 t)	FB Index Upper CI (x 1,000 t)	Change in FB Index from Previous Survey Year (%)	ER Index Lower CI (%)	ER Index (%)	ER Index Upper CI (%)
1997	15 300	15 103	1996	43.5	92.8	145.0		10.4	16.3	34.7
1998	15 300	15 170	1997	81.3	113.0	156.0	21.8	9.7	13.4	18.7
1999	15 300	15 109	1998	50.6	75.0	103.0	-33.6	14.7	20.1	29.9
2000	15 300	14 694	1999	61.9	96.8	137.0	29.1	10.7	15.2	23.7
2001	15 300	15 116	2000	-	-	-	-	-	-	-
2002	15 300	15 339	2001	175.0	233.0	304.0	140.7	5.0	6.6	8.8
2003/04	33 084	30 437	2002	-	-	-	-	-	-	-
2004/05	23 300	24 033	2003	-	-	-	-	-	-	-
2005/06	23 300	22 904	2004	116.0	165.0	222.0	-29.2	10.3	13.9	19.7
2006/07	23 300	22 612	2005	-	-	-	-	-	-	-
2007/08	23 300	23 768	2006	118.0	152.0	191.0	-7.9	12.4	15.6	20.1
2008/09	23 300	20 503	2007	-	-	-	-	-	-	-
2009/10	23 300	25 094	2008	89.0	153.0	243.0	0.7	10.3	16.4	28.2
2010/11	23 300	21 425	2009	-	-	-	-	-	-	-
2011/12	23 300	25 346	2010	92.6	158.0	271.0	3.3	9.4	16.0	27.4
2012/13	23 300	24 545	2011	106.0	138.0	171.0	-12.7	14.4	17.8	23.2
2013/14	23 300	22 146	2012	112.0	140.0	178.0	1.4	12.4	15.8	19.8
2014/15	20 970	21 850	2013	51.4	74.5	104.0	-46.8	21.0	29.3	42.5
2015/16	23 300	21 530	2014	102.0	133.0	173.0	78.5	12.4	16.2	21.1
2016/17	25 630	22 552	2015	94.6	138.0	192.0	3.8	11.7	16.3	23.8
2017/18	22 000	26 102	2016	67.3	99.3	142.0	-28.0	18.4	26.3	38.8
2018/19	25 630	23 257	2017	77.0	131.0	217.0	31.9	10.7	17.8	30.2
2019/20	22 100	23 440	2018	45.3	74.5	130.0	-43.1	18.0	31.5	51.7
2020/21	14 450	13 596	2019	36.7	59.8	93.7	-19.7	14.5	22.7	37.0
2021/22	16 080	11 129	2020	44.9	74.7	115.0	24.9	9.7	14.9	24.8

Catch Year	TAC (t)	Catch (t)	Survey Year	FB Index Lower CI (x 1,000 t)	FB Index (x 1,000 t)	FB Index Upper CI (x 1,000 t)	Change in FB Index from Previous Survey Year (%)	ER Index Lower CI (%)	ER Index (%)	ER Index Upper CI (%)
2022/23	15 606	16 222	2021	42.3	66.1	97.3	-11.5	16.7	24.5	38.4
2023/24	14 200	12 911*	2022	-	-	-	-	-	-	-
2024/25	-	-	2023	28.3	54.8	86.5	-17.1	16.4**	25.9**	50.2**

Table 17. Fishable abundance indices of Northern Shrimp in SFA 5. Abundance indices calculated using Ogmap on the fall multispecies survey data.

Year	Fishable Abundance Index Lower CI (x 10^9)	Fishable Abundance Index (x 10^9)	Fishable Abundance Index Upper CI (x 10^9)	Change in Fishable Abundance Index from Previous Survey Year (%)
1996	7.0	16.5	26.7	-
1997	13.9	20.3	28.6	23.0
1998	8.1	12.4	17.5	-38.9
1999	9.5	15.6	22.4	25.8
2000	-	-	-	-
2001	27.7	37.5	49.1	140.4
2002	-	-	-	-
2003	-	-	-	-
2004	19.5	29.2	40.1	-22.1
2005	-	-	-	-
2006	20.2	25.6	31.8	-12.3
2007	-	-	-	-
2008	13.4	23.3	37.2	-9.0
2009	-	-	-	-
2010	16.7	29.5	50.9	26.6
2011	19.2	24.3	29.8	-17.6
2012	20.8	26.6	33.9	9.5
2013	8.5	12.1	16.8	-54.5
2014	17.7	23.3	30.7	92.6
2015	15.1	22.4	31.1	-3.9
2016	11.2	16.7	24.0	-25.4
2017	13.3	23.1	39.1	38.3
2018	6.6	12.0	22.5	-48.1
2019	5.0	7.9	12.3	-34.4
2020	6.0	9.9	15.3	25.9
2021	5.4	8.5	12.7	-14.1
2022	-	-	-	-
2023	4.2	7.7	12.0	-9.0

Table 18. Female biomass and abundance indices of Northern Shrimp in SFA 5. Biomass and abundance indices calculated using Ogmap on the fall multispecies survey data.

Year	Female SSB Index Lower CI (x 1,000 t)	Female SSB Index Index (x 1,000 t)	Female SSB Index Upper CI (x 1,000 t)	Change in Female SSB Index from Previous Survey Year (%)	Female Abundance Index Lower CI ($x 10^9$)	Female Abundance Index ($x 10^9$)	Female Abundance Index Upper CI ($x 10^9$)	Change in Female Abundance Index from Previous Survey Year (%)
1996	20.0	32.4	46.0		2.2	3.6	5.2	-
1997	33.0	42.3	55.3	30.6	3.7	4.8	6.3	34.7
1998	28.0	37.7	49.3	-10.9	3.2	4.3	5.7	-10.4
1999	33.8	50.0	70.4	32.6	3.9	5.8	8.1	34.1
2000	-	-	-	-	-	-	-	-
2001	85.4	117.0	161.0	134.0	9.6	12.9	17.2	123.2
2002	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	-
2004	64.3	86.6	115.0	-26.0	8.3	11.1	14.7	-14.0
2005	-	-	-	-	-	-	-	-
2006	57.0	77.2	102.0	-10.9	6.9	9.4	12.4	-15.5
2007	-	-	-	-	-	-	-	-
2008	52.8	92.9	151.0	20.3	6.3	10.9	17.8	16.2
2009	-	-	-	-	-	-	-	-
2010	39.6	65.5	107.0	-29.5	5.1	8.4	13.8	-22.6
2011	48.0	69.8	92.8	6.6	6.1	8.9	11.8	5.3
2012	48.3	61.9	80.5	-11.3	6.5	8.3	10.8	-6.4
2013	29.7	43.3	64.1	-30.0	3.6	5.3	7.7	-36.9
2014	48.6	64.1	84.2	48.0	6.1	8.1	10.8	54.1
2015	50.2	76.7	109.0	19.7	6.2	9.3	13.3	15.2
2016	34.9	50.3	71.0	-34.4	4.2	6.0	8.4	-35.4
2017	30.8	51.6	81.3	2.6	3.7	6.4	10.2	5.8
2018	22.1	35.6	56.8	-31.0	2.5	4.0	6.3	-37.8
2019	23.6	41.2	66.2	15.7	2.5	4.3	6.9	7.6
2020	27.2	47.5	73.6	15.3	2.6	4.6	7.2	8.7
2021	22.9	39.6	62.0	-16.6	2.1	3.7	5.7	-21.0
2022	-	-	-	-	-	-	-	-

Year	Female SSB Index Lower CI (x 1,000 t)	Female SSB Index Index (x 1,000 t)	Female SSB Index Upper CI (x 1,000 t)	Change in Female SSB Index from Previous Survey Year (%)	Female Abundance Index Lower CI (x 10^9)	Female Abundance Index (x 10^9)	Female Abundance Index Upper CI (x 10^9)	Change in Female Abundance Index from Previous Survey Year (%)
2023	17.3	36.5	58.7	-7.8	2.0	4.0	6.4	9.6

Table 19. Total biomass index (x 1,000 t) of Northern Shrimp in SFA 5 by strata from 1996–2023. Depth range (in meters) represents the bottom depth range of the stratum. Colours indicate survey data quartiles, derived using Ogive Mapping on available DFO fall multi- species survey data (green: lower quartile; white: middle two quartiles; pink: upper quartile).

Depth Range (m)	Stratum	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
<=200	201	8.8	0.9	1.0	1.6		3.3			5.4		3.9		3.6		1.8	6.2	4.2	2.5	1.9	2.4	3.3	2.0	0.8	1.2	1.4	0.2		0.2
<=200	205	2.0	1.3	2.1	2.1		4.4			3.3		3.5		3.9		3.5	6.7	3.7	3.1	7.0	1.9	2.0	1.7	0.6	0.8	0.3	0.3		0.3
<=200	206	0.3	0.4	0.5	0.5		1.4			0.8		0.9		1.5		0.6	2.0	0.8	0.8	0.8	0.3	0.5	0.2	0.2	0.1	0.1	0.1		0.0
<=200	237	1.0	0.5	0.6	0.6		1.3			1.0		1.8		1.7		1.1	3.6	1.9	0.8	1.9	1.1	1.2	0.7	0.3	0.6	0.6	0.2		0.2
<=200	238	2.9	1.0	0.9	1.5		3.0			3.9		3.7		3.2		2.0	4.6	4.1	2.2	2.1	2.1	2.0	1.4	0.9	1.0	2.1	0.5		0.3
<=200	930	4.2	2.2	1.0	1.6		5.1			7.0		6.6		4.1		4.1	6.8	6.2	2.7	3.3	2.3	2.3	1.6	1.0	1.2	1.6	0.6		0.3
<=200	954	3.8	13.1	8.5	3.6		15.9			13.1		13.2		6.4		19.1	12.2	14.9	2.0	11.2	13.6	5.5	6.7	13.3	2.7	3.1	7.9		3.8
<=200	956	2.1	13.0	5.1	2.8		5.0			11.7		11.9		5.7		9.1	15.1	17.5	2.7	12.7	15.8	6.4	8.9	5.6	2.3	4.7	7.4		8.5
<=200	957	1.6	8.6	3.5	3.9		2.7			7.5		10.2		6.7		9.2	14.1	19.0	5.4	25.9	12.0	10.3	10.9	3.3	2.1	6.3	7.8		10.1
201-300	202	11.1	4.3	3.6	5.2		17.4			12.9		8.0		11.0		8.4	8.6	11.7	4.2	6.5	7.9	7.1	7.3	3.6	2.9	10.2	1.7		1.5
201-300	209	0.2	0.2	0.2	0.2		0.7			0.3		0.3		0.6		0.2	0.6	0.3	0.2	0.3	0.2	0.2	0.1	0.1	0.1	0.0	0.0		0.0
201-300	213	0.1	0.1	0.1	0.1		0.2			0.2		0.1		0.1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0		0.0
201-300	214	4.8	6.5	3.9	7.0		9.2			7.6		10.8		7.7		7.7	4.1	7.5	2.2	3.5	1.0	1.4	0.5	0.3	0.4	0.2	0.2		0.6
201-300	215	19.7	8.9	11.2	13.3		22.9			21.5		17.5		21.8		18.3	10.7	12.9	12.7	7.6	6.0	6.5	2.6	2.4	2.4	2.0	1.3		2.6
201-300	234	2.3	2.0	1.9	2.4		5.5			3.3		4.5		4.7		3.5	5.1	4.2	3.3	6.0	5.0	3.8	2.3	2.0	1.4	1.2	0.6		0.5
201-300	901	0.1	0.1	0.1	0.3		0.3			0.2		0.1		0.3		0.3	0.4	0.4	0.2	0.8	0.4	0.3	0.7	0.2	0.1	0.3	0.3		0.2
201-300	931	5.7	1.0	0.8	0.8		5.1			3.7		3.9		2.2		2.1	2.0	3.2	1.1	2.1	0.8	1.1	0.6	0.5	0.9	0.9	0.2		0.1
201-300	943	2.6	2.8	0.8	1.6		14.8			6.3		4.2		3.8		11.1	3.5	3.2	2.2	2.0	2.1	2.3	1.6	1.1	1.3	1.5	0.8		0.4
201-300	950	4.1	3.8	1.2	2.2		7.1			9.1		3.5		4.1		5.0	4.0	2.6	2.8	2.6	5.2	5.1	7.3	2.6	2.6	3.3	2.1		2.3
201-300	953	10.1	5.8	4.0	8.4		12.9			11.3		6.2		9.5		13.3	9.1	7.0	6.8	9.2	11.8	9.8	15.8	7.5	6.2	8.4	6.4		5.4
201-300	955	8.8	7.9	3.7	4.5		23.0			8.7		8.0		27.5		31.3	7.2	7.3	2.8	4.3	8.5	4.6	9.4	9.9	4.7	4.0	5.3		2.1
201-300	958	2.9	3.0	4.0	7.1		5.7			6.1		5.2		6.4		5.2	8.4	8.2	3.4	6.8	10.9	4.1	22.8	3.6	1.6	6.2	3.9		3.4
301-400	203	5.7	4.3	5.0	6.6		13.1			8.7		7.5		7.6		6.1	5.1	5.4	4.5	5.1	5.7	3.2	3.5	3.2	4.1	2.6	2.7		1.4
301-400	216	2.4	2.6	2.8	4.9		7.2			4.9		4.7		1.8		1.3	1.1	1.3	0.9	1.4	0.6	0.6	0.4	0.3	0.4	0.3	0.2		0.3
301-400	932	0.9	0.5	0.4	0.6		2.8			1.8		1.1		0.8		0.5	0.4	0.4	0.3	0.3	0.2	0.3	0.1	0.1	0.3	0.2	0.1		0.1
301-400	944	4.2	12.1	2.4	7.1		32.3			8.4		12.3		7.5		7.6	4.3	2.8	2.9	2.1	3.1	6.3	2.5	2.0	1.8	2.5	1.6		1.6
301-400	949	2.6	3.6	1.5	2.8		10.8			2.5		2.7		3.2		1.6	2.4	2.6	1.5	2.4	4.0	7.7	3.3	2.0	3.3	1.8	2.0		1.5
301-400	952	2.5	2.4	1.4	2.1		10.6			1.9		2.7		3.2		1.8	2.2	2.2	1.6	3.4	4.5	6.6	3.2	2.4	2.9	2.2	2.1		1.2
301-400	959	1.0	0.9	1.0	1.2		2.3			1.2		1.3		1.2		1.0	0.9	0.7	0.4	1.0	1.9	1.3	4.8	0.5	0.5	0.9	0.4		0.7

Depth Range (m)	Stratum	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
401-500	204	3.5	4.0	2.1	1.5		4.5			3.5		3.4		5.2		3.5	2.6	3.6	2.7	3.2	3.6	3.5	4.1	4.0	6.6	1.8	7.0		2.3
401-500	217	0.9	0.8	1.2	0.8		2.9			1.2		0.9		0.6		0.4	0.3	0.4	0.4	0.5	0.3	0.3	0.3	0.3	0.3	0.1	0.3		0.3
401-500	933	0.2	0.2	0.1	0.1		1.0			0.3		0.4		0.2		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.1	0.1		0.2
401-500	942	0.2	0.3	0.1	0.1		0.7			0.2		0.5		0.3		0.3	0.2	0.2	0.2	0.1	0.1	0.3	0.2	0.1	0.2	0.2	0.1		0.2
401-500	945	1.1	2.5	1.0	1.9		5.8			1.8		2.2		1.5		1.1	1.7	0.9	2.0	1.0	0.9	2.2	0.8	0.7	1.3	1.5	0.5		1.0
401-500	948	1.3	1.7	0.6	0.8		7.4			0.6		0.9		1.0		0.7	0.6	1.0	0.6	1.1	1.2	1.7	1.1	0.6	0.5	0.6	1.3		1.0
401-500	951	1.1	1.4	0.5	0.7		5.4			0.6		1.0		0.8		0.6	0.7	0.7	0.8	0.7	1.0	1.4	0.9	0.5	0.5	0.5	0.8		0.6
401-500	960	0.3	0.4	0.2	0.2		0.8			0.3		0.3		0.3		0.4	0.2	0.2	0.1	0.3	0.4	0.3	0.5	0.1	0.1	0.3	0.2		0.2
501-750	218	0.3	0.2	0.1	0.1		0.4			0.3		0.2		0.2		0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.2	0.0	0.1		0.1
501-750	239	1.5	1.5	0.8	0.9		2.1			1.2		1.1		3.0		1.1	0.9	1.6	0.8	1.6	1.2	1.1	1.3	1.4	2.5	0.8	2.9		1.6
501-750	934	0.1	0.1	0.1	0.1		0.8			0.1		0.2		0.3		0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.0	0.1	0.3	0.1	0.2		0.2
501-750	941	0.1	0.1	0.0	0.0		0.2			0.1		0.1		0.1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1	0.0		0.1
501-750	946	1.9	2.1	1.6	1.4		6.1			3.0		1.1		2.4		1.9	3.2	1.6	1.9	3.6	2.9	1.9	1.3	1.6	2.6	1.2	0.8		1.0
501-750	947	0.9	1.0	0.4	0.3		7.9			0.5		0.6		0.5		0.5	0.4	0.9	0.6	2.5	1.3	1.0	0.7	0.6	0.4	0.6	0.9		1.3
501-750	961	0.2	0.2	0.1	0.1		1.0			0.2		0.1		0.1		0.2	0.2	0.1	0.1	0.3	0.9	0.1	0.2	0.1	0.2	0.2	0.1		0.1
751-1000	219	0.1	0.1	0.1	0.1		0.1			0.1		0.1		0.5		0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.0		0.0
751-1000	935	0.0	0.0	0.0	0.0		0.1			0.0		0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0		0.0
751-1000	940	0.0	0.0	0.0	0.0		0.3			0.0		0.0		0.0		0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.2	0.0	0.3	0.1	0.0		0.0
751-1000	962	0.0	0.0	0.1	0.1		1.9			0.1		0.0		0.0		0.0	0.0	0.1	0.0	0.8	1.4	0.0	0.8	0.0	0.1	0.6	0.0		0.2
	All	132	130	82	106		295			188		173		179		188	163	168	87	151	148	120	136	81	67	78	72		60

Index <= 1.2 | 1.2 < Index < 3.6 | 3.6 <= Index

Table 20. Percent contribution to total biomass index of Northern Shrimp by surveyed depth range in SFA 5.

Depth Range (m)	No. of Strata	1996	1997	1998	1999	2001	2004	2006	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2023
<=200	9	20	31	28	17	14	29	32	21	27	44	43	26	44	35	28	25	32	18	26	35	39
201-300	13	55	36	43	50	42	48	42	56	57	39	41	48	34	41	39	52	42	37	49	32	32
301-400	7	15	20	18	24	27	16	19	14	11	10	9	14	10	14	22	13	13	20	14	13	11
401-500	8	7	9	7	6	10	5	6	6	4	4	4	8	5	5	8	6	8	15	7	14	10
501-750	7	4	4	4	3	6	3	2	4	2	3	3	4	6	5	4	3	5	10	4	7	7
751-1000	4	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	1	0	1	1	0	0

Table 21. Mean size of Northern Shrimp (mm) in SFA 5 from DFO fall multispecies surveys by various maturity/size categories including females, males, fishable (≥17.5 mm), pre-fishable (<17.5 mm) and totals.

Year	Female	Male	Fishable	Pre-fishable	Total
1996	23.2	17.39	19.91	16.04	18.1
1997	23.03	18.02	19.9	15.92	18.95
1998	22.93	18.15	20.45	15.64	19.53
1999	23.05	18.08	20.79	15.03	19.57
2001	22.79	17.23	20.12	15.74	18.41
2004	22.19	17.97	20.22	15.95	19.23
2006	22.67	17.36	20.52	14.46	18.79
2008	22.87	17.45	21.03	15.46	19.2
2010	22.5	17.63	19.99	15.43	18.64
2011	22.28	17.38	20.23	15.14	18.64
2012	22.22	17.38	19.98	15.11	18.44
2013	22.94	17.1	20.91	14.6	18.84
2014	22.65	17.49	20.34	15.17	18.77
2015	23.02	17.9	20.92	15.38	19.55
2016	22.86	17.78	20.43	15.67	19.11
2017	22.82	18.37	20.19	15.49	19.42
2018	23.46	18.11	20.76	14.7	19.54
2019	23.69	17.29	21.81	15.08	19.68
2020	24.1	17.45	21.71	14.1	19.86
2021	24.23	17.35	21.76	14.19	19.45
2023	23.7	17.48	21.64	15.14	19.78

Table 22. Male biomass and abundance indices of Northern Shrimp in SFA 5. Biomass and abundance indices calculated using Ogmap on the fall multispecies survey data.

Year	Male Biomass Index Lower CI (x 1,000 t)	Male Biomass Index (x 1,000 t)	Male Biomass Index Upper CI (x 1,000 t)	Change in Male Biomass Index from Previous Survey Year (%)	Male Abundance Index Lower CI (x 10^9)	Male Abundance Index (x 10^9)	Male Abundance Index Upper CI (x 10^9)	Change in Male Abundance Index from Previous Survey Year (%)
1996	24.5	100.0	190.0		5.3	27.0	52.9	-
1997	57.3	88.6	130.0	-11.4	13.7	21.8	31.7	-19.3
1998	27.2	44.5	65.0	-49.8	7.0	10.9	15.5	-50.0
1999	30.6	56.2	85.8	26.3	8.1	13.9	20.7	27.5
2000	-	-	-	-	-	-	-	-
2001	133.0	183.0	242.0	225.6	35.3	48.6	63.9	249.6
2002	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	-
2004	61.4	102.0	149.0	-44.3	16.4	26.8	38.6	-44.9
2005	-	-	-	-	-	-	-	-
2006	75.4	96.4	121.0	-5.5	21.3	26.4	32.6	-1.5
2007	-	-	-	-	-	-	-	-
2008	56.0	86.8	128.0	-10.0	16.2	23.3	32.0	-11.7
2009	-	-	-	-	-	-	-	-
2010	72.7	123.0	210.0	41.7	21.1	33.6	55.3	44.2
2011	78.3	93.3	113.0	-24.1	22.4	26.5	32.1	-21.1
2012	82.5	106.0	140.0	13.6	23.2	30.6	41.0	15.5
2013	30.4	43.7	59.5	-58.8	9.3	12.7	16.8	-58.5
2014	67.1	92.3	126.0	111.2	17.9	25.3	34.4	99.2
2015	50.6	77.5	111.0	-16.0	13.9	20.1	28.0	-20.6
2016	47.4	70.2	101.0	-9.4	12.7	18.5	25.9	-8.0
2017	52.1	90.4	158.0	28.8	12.5	21.4	36.7	15.7
2018	21.3	45.5	95.4	-49.7	5.6	11.1	22.2	-48.1
2019	18.3	27.6	41.0	-39.3	5.2	7.3	10.2	-34.7
2020	19.2	33.8	55.9	22.5	4.8	8.4	13.6	16.3
2021	19.1	34.4	55.6	1.8	4.4	8.6	14.2	1.7
2022	-	-	-	-	-	-	-	-

Year	Male Biomass Index Lower CI (x 1,000 t)	Male Biomass Index (x 1,000 t)	Male Biomass Index Upper CI (x 1,000 t)	Change in Male Biomass Index from Previous Survey Year (%)	Male Abundance Index Lower CI (x 10^9)	Male Abundance Index (x 10^9)	Male Abundance Index Upper CI (x 10^9)	Change in Male Abundance Index from Previous Survey Year (%)
2023	12.6	25.7	40.7	-25.3	3.6	6.8	10.3	-20.3

Table 23. TACs and catches in 1977–2023/24 for the LV and SV fleets fishing Northern Shrimp in SFA 5. In 2003 the fishing season was switched from a calendar year to a management year such that the catches shown for 2003/04 are based on a 15-month fishing season. Quota transfers, bridging and overruns are reflected in all catches and, since 2016/17, in the adjusted TAC column. All 2023/24 catches and adjusted TACs are preliminary and based upon the AQMS as of February 9, 2024.

Year	LV TAC (t)	LV Adjusted TAC (t)	LV Catch (t)	SV TAC (t)	SV Adjusted TAC (t)	SV Catch (t)	Total TAC (t)	Total Catch (t)
1977	-	-	-	-	-	-	-	2 686
1978	5 300	5 300	3 630	-	-	-	5 300	3 630
1979	4 000	4 000	3 727	-	-	-	4 000	3 727
1980	4 800	4 800	4 108	-	-	-	4 800	4 108
1981	4 800	4 800	3 449	-	-	-	4 800	3 449
1982	4 800	4 800	1 983	-	-	-	4 800	1 983
1983	4 800	4 800	1 000	-	-	-	4 800	1 000
1984	4 200	4 200	1 002	-	-	-	4 200	1 002
1985	3 570	3 570	1 689	-	-	-	3 570	1 689
1986	4 400	4 400	4 826	-	-	-	4 400	4 826
1987	4 800	4 800	5 956	-	-	-	4 800	5 956
1988	4 800	4 800	7 838	-	-	-	4 800	7 838
1989	6 000	6 000	5 985	-	-	-	6 000	5 985
1990	6 000	6 000	5 360	-	-	-	6 000	5 360
1991	6 375	6 375	6 118	-	-	-	6 375	6 118
1992	6 375	6 375	6 315	-	-	-	6 375	6 315
1993	6 375	6 375	5 719	-	-	-	6 375	5 719
1994	7 650	7 650	7 499	-	-	-	7 650	7 499
1995	7 650	7 650	7 616	-	-	-	7 650	7 616
1996	7 650	7 650	7 383	-	-	-	7 650	7 383
1997	9 180	9 180	15 103	6 120	6 120	-	15 300	15 103
1998	9 180	9 180	14 827	6 120	6 120	343	15 300	15 170
1999	9 180	9 180	14 945	6 120	6 120	164	15 300	15 109
2000	9 180	9 180	14 368	6 120	6 120	326	15 300	14 694
2001	9 180	9 180	15 001	6 120	6 120	115	15 300	15 116
2002	9 180	9 180	15 128	6 120	6 120	211	15 300	15 339
2003-04	26 564	26 564	29 882	6 520	6 520	555	33 084	30 437
2004-05	16 780	16 780	20 778	6 520	6 520	3 255	23 300	24 033
2005-06	16 780	16 780	21 762	6 520	6 520	1 142	23 300	22 904
2006-07	16 780	16 780	22 501	6 520	6 520	111	23 300	22 612
2007-08	16 780	16 780	23 747	6 520	6 520	21	23 300	23 768
2008-09	16 780	16 780	20 409	6 520	6 520	94	23 300	20 503

Year	LV TAC (t)	LV Adjusted TAC (t)	LV Catch (t)	SV TAC (t)	SV Adjusted TAC (t)	SV Catch (t)	Total TAC (t)	Total Catch (t)
2009-10	16 780	16 780	25 094	6 520	6 520	-	23 300	25 094
2010-11	16 780	16 780	21 045	6 520	6 520	380	23 300	21 425
2011-12	16 780	16 780	24 067	6 520	6 520	1 279	23 300	25 346
2012-13	16 780	16 780	23 159	6 520	6 520	1 386	23 300	24 545
2013-14	16 780	16 780	20 911	6 520	6 520	1 235	23 300	22 146
2014-15	16 050	16 050	20 821	4 920	4 920	1 029	20 970	21 850
2015-16	16 780	16 780	19 924	6 520	6 520	1 606	23 300	21 530
2016-17	18 256	23 133	19 705	7 374	2 544	2 847	25 630	22 552
2017-18	15 671	25 952	24 127	6 329	1 388	1 975	22 000	26 102
2018-19	18 256	24 300	*20 616*	7 374	1 680	*2 641*	25 630	*23 257*
2019-20	15 742	23 700	21 077	6 358	2 396	2 363	22 100	23 440
2020-21	10 293	16 873	12 900	4 157	840	696	14 450	13 596
2021-22	11 455	18 049	9 977	4 625	1 561	1 152	16 080	11 129
2022-23	10 115	18 971	15 439	5 491	2 961	783	15 606	16 222
2023-24	10 115	16 335	11 925	4 085	2 762	987	14 200	12 911

Table 24. Standardized LV CPUE for Northern Shrimp in SFA 5 over the 1980–2023/24 period. Data from 2003 to present were converted to management year.

Management Year	TAC (t)	Fleet Catch (t)	Percent catch captured in model	CPUE relative to 1989	Modelled CPUE (kg/hour)	Calculated Effort (hours)
1977	-	2 686	-	-	-	-
1978	5 300	3 630	-	-	-	-
1979	4 000	3 727	-	-	-	-
1980	4 800	4 108	49	0.95	745	5 513
1981	4 800	3 449	40	0.95	742	4 647
1982	4 800	1 983	34	0.90	706	2 808
1983	4 800	1 000	-	-	-	-
1984	4 200	1 002	15	0.70	549	1 825
1985	3 570	1 689	13	0.67	522	3 237
1986	4 400	4 826	-	-	-	-
1987	4 800	5 956	-	-	-	-
1988	4 800	7 838	-	-	-	-
1989	6 000	5 985	44	1.00	780	7 668
1990	6 000	5 360	91	0.99	770	6 959
1991	6 375	6 118	94	0.88	687	8 907
1992	6 375	6 315	85	0.86	671	9 413
1993	6 375	5 719	100	0.89	692	8 268
1994	7 650	7 499	99	1.02	798	9 398
1995	7 650	7 616	97	1.48	1 153	6 605
1996	7 650	7 383	93	2.02	1 573	4 692
1997	9 180	15 103	89	1.90	1 481	10 198
1998	9 180	14 827	83	2.15	1 675	8 850
1999	9 180	14 945	94	2.21	1 724	8 667
2000	9 180	14 368	101	2.37	1 849	7 770
2001	9 180	15 001	99	2.58	2 013	7 453
2002	9 180	15 128	93	2.56	1 998	7 573
2003–04	26 564	29 882	101	2.40	1 875	15 938
2004–05	16 780	20 778	104	2.41	1 877	11 069
2005–06	16 780	21 762	100	2.42	1 889	11 519
2006–07	16 780	22 501	99	2.19	1 713	13 137
2007–08	16 780	23 747	101	2.22	1 730	13 725
2008–09	16 780	20 409	107	2.29	1 787	11 422
2009–10	16 780	25 094	93	2.31	1 805	13 904
2010–11	16 780	21 045	102	2.20	1 715	12 269

Management Year	TAC (t)	Fleet Catch (t)	Percent catch captured in model	CPUE relative to 1989	Modelled CPUE (kg/hour)	Calculated Effort (hours)
2011–12	16 780	24 067	101	2.46	1 923	12 514
2012–13	16 780	23 159	103	2.92	2 279	10 164
2013–14	16 780	20 911	100	2.71	2 119	9 869
2014–15	16 050	20 821	100	3.08	2 404	8 662
2015–16	16 780	19 924	104	2.79	2 179	9 143
2016–17	18 256	19 705	100	2.86	2 229	8 842
2017–18	15 671	24 127	103	1.99	1 549	15 572
2018–19	18 256	20 616	97	2.13	1 666	12 376
2019–20	15 742	21 077	95	2.06	1 608	13 110
2020–21	10 293	12 900	67	1.71	1 337	9 647
2021–22	11 455	9 977	101	1.57	1 222	8 165
2022–23	10 115	15 439	101	1.29	1 003	15 393
2023–24	10 115	11 925	58	1.55	1 212	9 836

Table 25. Unstandardized CPUE (kg/hour) by depth range and stratum for the LV fleet fishing Northern Shrimp in SFA 5. Data were taken from observer data set; colour ranges are based on quartiles of the data from 1999–2022/23 (green: lower quartile; white: middle two quartiles; pink: upper quartile). Unavailable data is shown with black shading. Data for 2022/23 and 2023/24 are preliminary.

		CPUE <= 2 428 kg/hr								2 428 kg/hr < CPUE < 3 302 kg/hr								3 302 kg/hr <= CPUE								
Depth Range (m)	Stratum	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
<= 200	201	2732	2879		2902		2321	2293			2754	2223	913	668						3536						
	205			3012		991		2490			2524	703		826		1747	1966	1002							2795	
	206	2261	2447	1919	954	1097	1758	2505	1347	1628	1386	1904	3106													
	237				7535	2515	3864			1106										4178						
	238		16	42			6635			2771	756				767							1196				
	930																			6415						
	954	1696	939	2814	2145	1940	1145	3344	3837		2195	2534	2689	2192	3418	3024	1737	3253	3392	1794	2956	3870	2713	2108	1615	2153
	956	2	1301				1963						1033		1712	2538		4131	1236	1624	3527	3740	1874	698	1297	1938
	957																	1980					1812			
201 - 300	202		4546		17565		1931	1333		2712	763	2892			1260	1228					1228					
	209	1586	696	1858	1589	897		1356	1023				844		5110	1889	3761	2570	884	51	2014			290		
	213	1439	1104	1625	1896	1545	1797	1580	2115	1795	2136	1614	651	1151	2322	1292	510	120	15	9						
	214	1523	2009	2465	1410	3000	1626	2352	1338	2203	1984	2110	1124	2060	2204	1713	2005	1334	1391	454	1945			37	631	
	215	2481	2601	2550	2794	2396	2312	2465	2209	2375	2624	2876	2511	2364	3011	3228	2736	2311	644	3503	3257	1573	1517	2142	1744	1331
	234					63		2024	10					105	1127							1273		1207		
	901			3			910	126	6598	2644	1764	4216	3582	4481	3478	3215	6273	5072	3244	4289	4358	2190		2406	2873	2020
	931	2786	4982	2146	2693	3485	2462	3233	3625	2298	3126	2838	2604	1391	3907	2817	5019	1725		97				646		
	943		130					4987					526					1550								
	950							319	1815			5733		1669	213		15811									
	953	1896	1270	2357	1913	1883	1775	2778	2140	1775	1999	2263	1746	1956	2282	2540	2111	2835	2832	3165	7511	3374	2380	1685	1932	1958
	955	3677	2144	2392	3702	2427	3154	2505	2723	2832	2500	3258	2610	3004	3401	3328	3624	3814	4369	2788	3321	2825	2216	2299	1648	1552
	958		395		1194						1785	3483	3471	4585	4117	3579	3903	3687	4308	2825	2606	3647	1855	2315	1538	2844
301 - 400	203	2257	3699	2570	2886	1870	2237	2955	2169	3314	2700	3132	2230	2381	4053	3071	3792	2467	2438	4337	2562	2384	1939	1733	2031	1921
	216	1532	2310	1932	1911	2428	2263	2137	1883	2090	2084	1985	2516	2798	2621	1768	1969	1679	1305	51	42			101	12	
	932	2987	3464	3142	5093	3381	3812	3696	3498	2370	4183	4479	4912	3386	1801	4950	4405	2757								
	944	1377	2194	2509	2438	2817	2672	2325	2548	2672	2581	2948	2863	3305	3118	2913	3421	3465	3922	2236	3746	1722	1961	1226	1298	1451
	949		1499	939	1778	2691	1577	2370	1722		1964	1008		2842	2816	2946	1632	2695		1632	3561	2949	1946	3437	2321	1083
	952	1482	1628	1738	1841	2192	1591	2878	2544	2578	2175	2608	2055	2029	2416	2437	2400	2847	2610	2909	4530	3063	2185	2381	2032	2073
	959	234				7655		1045			2181	4739	3038	3178	4363	2546	4697	3869	3751	2851	3299	3178	1991	2143	1946	1115
401 - 500	204	3240	3037	2026	3464	2034	1194	2596	1762	2076	2884	3945	1897	2607	1300	2763	4684	1972	2950	4183	2014	2644	2272	1663	1911	1668
	217	2802	2548	3247	2989	3199	3153	2978	3140	2187	2632	2145	2934	3302	3346	2671	3515	1358	1187	1396	575					
	933	6141		3224	6411	4084	4257	3751	2171	2387	4931	4970				4934	4399									
	942	727	1334	2366	2857	3929	3253	4290	3562	2812	3736	3598	3266	4311	2418	4347	4636	4166	4963	3692	2792	2708		1140	1234	
	945	267	4103				1806	1278	1881	1793	411					5875		1635			354					
	948						605																			
	951	969	1352	951	1412	2178	1528	2920	2359	738	1553	1840	1964		2036	2324		2768	1578		2945	2606	1896	1906	2617	1759
	960					1057	3815		6752	2080		2188	647	3189	4909	6024	4973	2275	4887	3433	3904	2642	3143	2190	1061	187
501 - 750	218	2791	2459	3988	4466	3868	3427	4033	2563	2522	3159	3872	3450	4813	3394	2848	3601	2206	713	1775				1		
	239	2302		1582	6315	2981	845	2005	1980		3258	5317	2010	2830		2175		2306	1910	7731	2397	310	2223	2224	1307	241
	934	7072	8230	9536	5898	3782	3370	3428			5751	2731	1295			3291	3605									
	941	762	2350	2033	3786	3304	3177	5449	4243	2866	4132	4184	3060	3647	4494	5152	4873	3980	4567	3571	3021	3709		692	676	

		CPUE <= 2 428 kg/hr								2 428 kg/hr < CPUE < 3 302 kg/hr								3 302 kg/hr <= CPUE								
Depth Range (m)	Stratum	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
751 - 1000	946		3762																			1074				
	947																									
	961						5979		6018	2974	2092		2420	2241	4750	5453	10875	2243	4406	3819	2896	2745	1748	1740	1303	
	219		1830	2223	5918	3267	3000	4366	1166		1368	808		3135	2680	2148										
	935																									
	940					3655		3681	2087	2147		1238	3110			2880		11658	3340	1819		1312			662	
	962														7011							1501				

*Table 26. SFA 6 Northern Shrimp TACs, commercial catch to date, fishable biomass (FB) indices and exploitation rate indices (ERI: catch in year y/fishable biomass index in year y-1). Biomass indices are derived from Ogmap using fall multispecies survey data. Catch is taken from the AQMS as of February 9, 2024, such that 2023/24 catch (indicated with *) is preliminary. Exploitation rate indices for 2024/25 in the below table (indicated with **) assume the 2023/24 TAC is unchanged in 2024/25.*

Catch Year	TAC (t)	Catch (t)	Survey Year	FB Index Lower CI (x 1,000 t)	FB Index (x 1,000 t)	FB Index Upper CI (x 1,000 t)	Change in FB Index from Previous Survey Year (%)	ER Index Lower CI (%)	ER Index (%)	ER Index Upper CI (%)
1997	23100	21018	1996	297.0	361.0	461.0	-	4.6	5.8	7.1
1998	46200	46337	1997	307.0	341.0	400.0	-5.5	11.6	13.6	15.1
1999	58632	51202	1998	338.0	372.0	423.0	9.1	12.1	13.8	15.1
2000	61632	63224	1999	373.0	418.0	477.0	12.4	13.3	15.1	17.0
2001	61632	52590	2000	426.0	466.0	539.0	11.5	9.8	11.3	12.3
2002	61632	60384	2001	482.0	563.0	649.0	20.8	9.3	10.7	12.5
2003/04	85575	71227	2002	513.0	564.0	643.0	0.2	11.1	12.6	13.9
2004/05	77932	77776	2003	461.0	518.0	607.0	-8.2	12.8	15.0	16.9
2005/06	77932	74728	2004	466.0	514.0	583.0	-0.8	12.8	14.5	16.0
2006/07	77932	75673	2005	598.0	681.0	792.0	32.5	9.6	11.1	12.7
2007/08	77932	80725	2006	666.0	768.0	899.0	12.8	9.0	10.5	12.1
2008/09	85725	74505	2007	575.0	650.0	764.0	-15.4	9.8	11.5	13.0
2009/10	85725	45527	2008	567.0	651.0	748.0	0.2	6.1	7.0	8.0
2010/11	61632	61501	2009	244.0	334.0	423.0	-48.7	14.5	18.4	25.2
2011/12	52387	59608	2010	273.0	319.0	374.0	-4.5	15.9	18.7	21.8
2012/13	60245	58327	2011	346.0	394.0	456.0	23.5	12.8	14.8	16.9
2013/14	60245	58834	2012	262.0	331.0	406.0	-16.0	14.5	17.8	22.5
2014/15	48196	46340	2013	185.0	230.0	280.0	-30.5	16.5	20.1	25.0
2015/16	48196	48722	2014	166.0	218.0	268.0	-5.2	18.2	22.3	29.4
2016/17	27825	25143	2015	111.0	130.0	153.0	-40.4	16.4	19.3	22.7
2017/18	10400	10065	2016	89.4	106.0	126.0	-18.5	8.0	9.5	11.3
2018/19	8730	8702	2017	87.0	99.4	116.0	-6.2	7.5	8.8	10.0
2019/20	8961	8638	2018	78.2	95.5	113.0	-3.9	7.6	9.0	11.0
2020/21	8290	6267	2019	70.5	87.7	108.0	-8.2	5.8	7.1	8.9
2021/22	9535	9554	2020	104.0	127.0	162.0	44.8	5.9	7.5	9.2

Catch Year	TAC (t)	Catch (t)	Survey Year	FB Index Lower CI (x 1,000 t)	FB Index (x 1,000 t)	FB Index Upper CI (x 1,000 t)	Change in FB Index from Previous Survey Year (%)	ER Index Lower CI (%)	ER Index (%)	ER Index Upper CI (%)
2022/23	9430	8154	2021	66.2	88.2	110.0	-30.6	7.4	9.2	12.3
2023/24	9430	5632*	2022	-	-	-	-	-	-	-
2024/25	-	-	2023	73.7	88.2	106.0	0.0	8.9**	10.7**	12.8**

Table 27. Fishable abundance indices of Northern Shrimp in SFA 6. Abundance indices calculated using Ogmap on the fall multispecies survey data.

Year	Fishable Abundance Index Lower CI (x 10^9)	Fishable Abundance Index (x 10^9)	Fishable Abundance Index Upper CI (x 10^9)	Change in Fishable Abundance Index from Previous Survey Years (%)
1996	44.3	53.4	67.2	-
1997	50.3	55.1	64.9	3.2
1998	56.1	61.7	70.9	12.0
1999	60.0	67.4	77.4	9.2
2000	69.8	76.1	87.6	12.9
2001	79.7	91.8	105.0	20.6
2002	83.1	90.7	102.0	-1.2
2003	79.3	88.1	102.0	-2.9
2004	71.9	79.2	89.3	-10.1
2005	87.8	98.9	115.0	24.9
2006	103.0	118.0	139.0	19.3
2007	85.8	96.5	113.0	-18.2
2008	84.6	96.1	110.0	-0.4
2009	37.7	53.3	68.9	-44.5
2010	43.5	50.3	58.5	-5.6
2011	58.4	66.8	77.6	32.8
2012	40.7	53.8	67.2	-19.5
2013	27.5	33.7	40.9	-37.4
2014	26.0	34.8	43.3	3.3
2015	16.1	18.6	21.6	-46.6
2016	13.0	15.2	17.9	-18.3
2017	11.4	13.1	15.2	-13.8
2018	9.2	11.2	13.1	-14.5
2019	9.3	11.4	13.9	1.8
2020	13.3	16.1	20.5	41.2
2021	8.2	10.6	13.1	-34.2
2022	-	-	-	-
2023	10.0	12.1	14.8	14.2

Table 28. Female SSB and abundance indices of Northern Shrimp in SFA 6. Biomass and abundance indices calculated using Ogmap on the fall multispecies survey data.

Year	Female SSB Index Lower CI (x 1,000 t)	Female SSB Index (x 1,000 t)	Female SSB Index Upper CI (x 1,000 t)	Change in SSB Index from Previous Survey Year (%)	Female Abundance Index Lower CI (x 10^9)	Female Abundance Index (x 10^9)	Female Abundance Index Upper CI (x 10^9)	Change in Female Abundance Index from Previous Survey Year (%)
1996	155.0	194.0	253.0	-	16.6	20.6	26.8	-
1997	151.0	176.0	209.0	-9.3	17.1	19.8	23.4	-3.9
1998	178.0	201.0	230.0	14.2	21.6	24.5	28.2	23.7
1999	220.0	250.0	289.0	24.4	27.6	31.2	35.9	27.3
2000	259.0	290.0	344.0	16.0	32.5	36.6	43.6	17.3
2001	300.0	360.0	425.0	24.1	38.7	46.5	54.8	27.0
2002	347.0	387.0	453.0	7.5	45.5	50.5	58.7	8.6
2003	282.0	326.0	391.0	-15.8	38.3	44.1	52.9	-12.7
2004	320.0	356.0	410.0	9.2	41.7	46.4	53.7	5.2
2005	394.0	459.0	547.0	28.9	45.4	52.8	63.1	13.8
2006	390.0	455.0	538.0	-0.9	46.8	54.7	65.2	3.6
2007	391.0	447.0	537.0	-1.8	46.1	53.3	63.9	-2.6
2008	341.0	408.0	475.0	-8.7	39.4	47.1	55.0	-11.6
2009	157.0	211.0	266.0	-48.3	18.4	25.6	32.7	-45.6
2010	171.0	200.0	239.0	-5.2	21.3	24.9	29.7	-2.7
2011	201.0	232.0	271.0	16.0	25.5	29.5	34.4	18.5
2012	153.0	187.0	228.0	-19.4	18.6	23.0	28.2	-22.0
2013	112.0	145.0	179.0	-22.5	12.7	16.3	20.1	-29.1
2014	102.0	127.0	155.0	-12.4	11.6	14.6	18.0	-10.4
2015	68.1	83.0	100.0	-34.6	7.3	8.9	10.6	-39.2
2016	53.1	65.7	80.3	-20.8	5.4	6.6	8.0	-25.4
2017	51.4	60.1	72.6	-8.5	5.0	5.8	6.9	-12.7
2018	57.1	70.3	84.3	17.0	5.4	6.6	7.9	14.9
2019	40.4	52.6	66.7	-25.2	3.8	4.9	6.2	-26.2
2020	62.4	78.9	103.0	50.0	5.5	7.1	9.2	44.1
2021	47.9	67.5	87.3	-14.4	4.6	6.4	8.3	-9.1
2022	-	-	-	-	-	-	-	-

Year	Female SSB Index Lower CI (x 1,000 t)	Female SSB Index (x 1,000 t)	Female SSB Index Upper CI (x 1,000 t)	Change in SSB Index from Previous Survey Year (%)	Female Abundance Index Lower CI (x 10^9)	Female Abundance Index (x 10^9)	Female Abundance Index Upper CI (x 10^9)	Change in Female Abundance Index from Previous Survey Year (%)
2023	49.2	58.9	71.3	-12.7	5.1	6.2	7.5	-4.0

Table 29. Total biomass index (x 1,000 t) of Northern Shrimp in SFA 6 by strata from 1996–2023. Depth range (in meters) represents the bottom depth range of the stratum. Colours indicate survey data quartiles, derived using Ogive Mapping on available DFO fall multi- species survey data (green: lower quartile; white: middle two quartiles; pink: upper quartile).

Depth Range (m)	Stratum	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
101-200	205	2.2	3.9	4.7	4.9	5.5	7.4	7.0	6.1	5.7	8.9	8.6	10.7	8.1	9.8	6.0	10.3	5.4	7.8	10.0	2.3	2.8	0.9	0.5	0.6	0.3	0.2		0.3
101-200	206	6.0	7.8	12.2	10.8	8.6	17.6	16.6	11.3	10.9	15.0	19.0	22.9	23.6	9.3	8.7	15.7	10.1	11.6	4.7	2.0	1.7	0.7	0.4	0.7	0.3	0.5		0.3
101-200	207	4.3	4.2	4.1	6.3	7.3	10.4	8.4	5.6	10.3	7.7	8.2	16.0	13.3	5.7	8.8	14.2	10.7	7.0	3.6	3.2	1.6	0.8	1.0	1.1	1.7	2.6		0.3
101-200	237	0.1	0.2	0.1	0.2	0.2	0.6	0.4	0.2	0.3	0.6	0.5	1.3	1.0	0.2	0.5	1.4	0.3	0.2	0.3	0.1	0.2	0.0	0.1	0.0	0.0	0.0		0.0
101-200	608	0.2	0.6	0.6	4.4	0.7	0.8	1.2	0.9	4.1	1.9	1.6	10.8	3.5	3.5	1.0	4.9	4.5	4.1	3.9	3.0	2.3	1.6	2.2	1.6	2.8	1.7		1.7
101-200	612	0.1	0.1	0.3	2.6	0.5	0.5	0.6	0.6	0.8	0.5	0.7	3.6	3.0	1.1	0.7	3.5	2.7	1.5	2.8	1.7	1.3	0.3	1.0	0.4	1.7	0.5		0.7
101-200	616	0.1	0.0	0.1	0.4	0.1	0.1	0.2	0.1	0.1	0.3	0.2	0.8	0.5	0.2	0.5	1.0	0.7	0.4	0.6	0.5	0.2	0.1	0.2	0.1	0.6	0.2		0.1
101-200	618	1.8	2.5	2.6	3.9	3.9	5.1	4.5	2.6	4.9	4.1	5.7	11.2	8.0	2.8	3.0	6.4	7.3	4.8	4.1	4.7	1.5	0.6	0.5	1.3	2.7	2.1		0.4
101-200	619	0.9	0.9	1.8	2.4	2.8	3.6	5.7	1.8	3.6	3.6	4.5	8.1	5.9	1.7	3.5	6.3	5.4	5.0	5.7	3.3	1.8	0.9	2.0	1.0	4.0	2.4		1.1
201-300	209	9.0	6.9	3.8	12.5	6.9	12.9	10.0	11.0	6.4	14.2	11.8	9.7	10.9	7.7	6.1	8.8	9.0	6.5	9.0	1.9	2.6	0.6	1.7	1.3	0.7	1.9		0.5
201-300	210	19.1	11.5	10.4	17.1	11.6	14.4	12.7	12.8	14.0	16.9	17.7	16.9	12.1	10.9	10.4	18.9	16.2	12.2	5.9	3.3	2.9	1.9	1.2	2.4	2.9	2.3		1.3
201-300	213	25.8	26.6	27.3	27.6	19.9	52.9	28.5	27.9	18.7	38.1	81.9	38.8	61.6	20.7	14.2	20.9	20.1	11.8	5.9	2.7	2.2	0.6	0.5	0.7	0.3	0.5		0.8
201-300	214	7.3	19.1	9.2	18.9	12.5	22.8	13.5	22.4	16.2	24.6	26.5	17.6	27.1	34.5	11.1	14.1	12.8	5.0	8.3	1.7	3.0	0.6	0.4	0.4	0.2	0.1		0.7
201-300	228	88.6	33.0	42.0	29.5	34.6	42.6	29.3	27.9	40.7	60.6	91.8	66.0	29.7	29.0	37.9	42.1	55.8	6.1	5.7	3.0	2.4	2.0	0.9	1.5	3.2	2.0		2.8
201-300	609	0.5	0.7	1.1	2.7	1.6	2.2	2.5	1.9	5.7	2.2	3.5	8.0	6.5	3.3	2.0	3.2	2.7	3.5	1.9	2.2	1.6	1.2	1.8	1.8	1.9	1.6		1.5
201-300	611	0.3	0.3	0.6	2.5	1.0	1.1	2.1	1.6	2.9	1.4	1.3	5.1	4.0	2.2	1.9	3.7	4.4	2.4	2.3	1.8	1.3	0.6	1.8	0.7	1.6	1.1		1.2
201-300	615	0.1	0.1	0.1	1.1	0.2	0.3	0.2	0.2	0.4	0.3	0.3	1.2	0.9	0.2	0.6	1.8	2.0	0.6	1.0	0.4	0.2	0.1	0.6	0.2	0.2	0.3		0.4
201-300	620	14.0	15.9	18.2	31.4	27.0	24.0	30.2	19.1	21.3	27.2	35.7	41.7	34.8	17.8	16.7	31.8	26.2	33.3	43.3	17.0	14.0	7.0	9.1	8.0	17.5	7.4		4.5
201-300	621	7.9	6.2	11.3	17.0	16.5	18.0	18.9	21.4	18.9	12.8	27.9	35.7	26.9	19.2	14.3	25.6	29.9	28.3	20.9	18.6	11.5	6.8	13.4	10.2	15.1	8.9		7.1
201-300	624	19.2	14.6	14.1	16.3	17.9	15.8	16.3	13.1	20.3	29.1	36.4	25.1	16.1	11.0	12.3	20.2	14.4	5.1	4.7	2.9	1.9	1.9	0.9	2.1	3.4	1.5		1.9
201-300	634	18.2	14.2	19.3	19.3	36.8	33.2	20.4	12.6	19.5	33.4	60.2	40.1	30.9	16.7	12.4	7.1	5.2	3.7	7.0	2.5	5.7	3.6	1.9	3.2	4.1	1.6		2.5
201-300	635	7.2	7.6	8.7	10.9	13.8	10.3	10.6	7.2	11.3	17.7	20.0	25.9	25.4	12.8	9.9	8.9	9.2	7.3	8.0	4.9	4.8	4.6	3.9	4.2	4.2	2.2		3.7
201-300	636	15.1	11.9	16.1	18.9	27.9	16.2	21.4	13.4	28.0	31.4	21.8	25.1	36.9	13.5	9.0	6.0	5.9	3.9	5.7	4.1	3.5	3.3	2.4	2.8	3.1	2.2		2.6
201-300	637	6.3	8.0	9.1	11.9	17.8	13.7	16.6	17.3	23.7	27.9	21.7	31.9	24.2	14.5	10.1	7.0	4.1	3.5	3.4	3.6	3.2	4.0	2.9	2.3	5.0	3.7		2.7
301-400	208	9.0	7.4	7.1	6.7	8.4	9.8	7.3	9.6	8.3	15.5	8.4	6.7	5.3	4.6	7.4	7.3	6.0	7.2	10.4	1.9	3.6	0.7	0.6	1.3	1.7	1.4		1.8
301-400	211	9.8	11.5	7.9	6.6	8.5	7.9	7.8	7.8	6.1	10.4	11.7	12.5	5.8	3.9	5.0	9.2	7.2	4.4	3.8	2.1	1.3	0.8	0.4	1.3	1.9	0.8		2.2
301-400	216	0.6	0.9	0.8	1.8	2.0	2.0	0.7	2.1	1.2	0.8	1.3	0.4	0.9	0.3	0.3	0.1	0.3	0.1	0.7	0.1	0.1	0.0	0.0	0.0	0.0	0.0		0.0
301-400	222	4.8	4.1	5.2	4.8	7.4	5.9	4.5	6.1	3.8	4.6	7.4	3.0	6.7	1.0	1.5	1.6	1.5	0.9	1.9	0.4	0.4	0.2	0.2	0.3	0.2	0.1		0.4
301-400	229	14.3	9.2	8.8	8.0	9.8	12.1	8.4	13.0	11.6	19.1	20.1	6.3	7.9	2.8	3.7	3.9	1.9	1.1	1.1	0.6	0.4	0.4	0.2	0.2	0.5	0.4		0.9
301-400	610	0.7	0.7	1.4	3.6	3.2	3.9	7.6	4.6	2.8	3.9	4.0	7.0	5.5	5.3	5.6	4.4	3.7	3.0	2.5	2.4	1.7	2.2	2.6	2.1	2.4	1.4		1.7
301-400	614	0.0	0.0	0.1	1.9	0.2	0.2	0.3	0.2	0.3	0.3	0.3	2.3	2.0	0.9	0.2	2.4	2.2	0.6	1.4	0.7	0.5	0.3	0.9	0.5	0.3	0.5		0.7
301-400	617	9.4	7.9	8.4	7.5	9.0	8.3	15.2	11.0	8.7	12.5	10.7	11.3	13.4	4.2	6.0	10.9	8.7	5.0	5.9	4.0	2.2	2.7	1.8	2.8	5.8	4.1		2.4
301-400	623	5.4	6.6	8.8	11.1	8.1	10.7	13.7	12.4	11.0	11.6	12.8	12.6	18.7	6.3	6.4	11.2	7.8	7.2	9.6	5.8	4.0	3.6	4.0	2.6	5.5	3.8		3.6
301-400	625	12.1	13.8	11.9	18.9	16.9	21.4	21.5	15.4	19.2	25.1	26.0	19.6	21.0	11.8	10.8	15.9	16.2	10.9	9.2	6.5	5.3	5.3	4.2	4.6	5.5	3.3		3.9
301-400	626	4.8	7.4	7.1	13.6	13.1	28.3	19.1	26.4	15.2	15.3	21.0	23.6	26.6	21.3	16.6	13.6	9.5	14.4	7.6	7.9	6.7	7.6	10.2	11.4	8.7	6.5		6.6
301-400	628	4.8	4.7	6.7	9.6	16.9	17.7	26.5	16.5	29.4	18.7	25.1	32.4	29.0	20.2	18.5	12.3	6.4	7.7	4.8	5.1	4.8	5.7	5.4	3.2	9.0	5.6		4.9

Depth Range (m)	Stratum	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
301-400	629	3.2	3.1	3.8	4.4	5.3	9.8	9.1	7.0	6.8	9.1	8.1	6.8	12.1	6.2	6.9	5.0	4.1	3.1	2.5	2.9	3.2	2.8	2.6	2.7	2.6	2.1		2.5
301-400	630	3.1	4.8	4.4	4.3	5.3	9.4	8.8	5.7	5.4	7.4	6.6	5.6	10.6	3.1	3.0	4.2	3.4	2.1	2.2	2.2	3.1	2.3	1.7	1.4	1.6	1.9		2.1
301-400	633	44.1	39.1	38.4	37.8	56.3	75.0	45.5	58.6	57.8	88.8	95.9	38.7	45.2	21.4	16.6	24.3	9.5	5.6	6.6	7.1	5.4	5.6	3.7	2.8	9.8	6.1		8.4
301-400	638	20.7	20.2	23.0	24.2	20.6	30.0	53.2	50.6	45.7	42.4	27.2	53.2	26.7	16.4	14.2	11.2	5.5	4.4	5.4	4.6	2.5	4.6	3.4	2.6	4.9	6.9		4.1
301-400	639	21.0	20.1	20.4	21.8	33.2	20.0	26.5	18.5	37.4	30.5	14.4	14.8	29.2	8.9	5.3	3.7	2.7	2.1	2.9	2.5	1.6	2.8	1.9	1.7	2.7	3.0		2.1
401-500	217	0.1	0.2	0.2	0.3	0.3	0.4	0.1	0.5	0.2	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
401-500	223	1.2	0.9	1.3	1.0	2.6	1.5	0.6	1.6	0.7	1.1	1.0	0.7	0.8	0.2	0.3	0.4	0.4	0.2	0.4	0.1	0.0	0.1	0.1	0.1	0.1	0.0		0.0
401-500	227	3.7	2.8	4.5	3.0	6.2	4.4	3.0	6.8	2.9	3.9	5.3	3.7	3.9	1.0	2.7	1.7	1.5	1.6	1.0	0.4	0.2	1.0	0.7	0.5	0.5	0.6		0.4
401-500	235	4.3	5.3	7.0	3.9	4.6	5.7	4.9	5.2	5.2	5.1	5.5	5.6	3.5	2.0	3.2	4.0	4.2	2.9	4.2	1.6	0.7	1.4	0.8	0.9	1.5	0.8		1.7
401-500	240	1.4	1.1	1.0	1.3	1.7	1.9	1.1	2.2	1.9	3.5	1.7	0.8	0.9	0.3	0.4	0.5	0.3	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1		0.1
401-500	613	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.2	0.0	0.3	0.2	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.1
401-500	622	8.3	8.2	7.7	6.6	6.0	6.3	17.3	12.2	7.5	10.2	13.6	9.8	20.6	3.2	5.2	6.0	5.6	4.2	6.0	5.4	2.3	4.9	3.0	2.1	4.9	3.2		2.3
401-500	627	9.1	11.1	8.7	11.0	11.6	27.3	48.0	37.8	18.8	22.9	15.4	11.2	30.6	19.6	28.3	8.0	9.1	6.7	3.8	9.4	5.2	6.4	6.9	6.0	7.6	4.5		6.5
401-500	631	12.8	17.1	12.5	9.8	16.1	25.0	45.9	32.2	15.9	21.1	20.8	12.5	26.2	8.6	9.2	12.9	7.7	5.5	5.4	7.4	6.2	7.2	6.2	3.8	5.7	4.5		6.7
401-500	640	0.9	0.3	0.3	0.3	0.4	0.4	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.1	0.2	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.3	0.0		0.0
401-500	645	0.8	0.7	1.4	0.6	1.1	3.4	1.0	1.2	1.4	1.9	1.4	0.7	0.5	0.3	0.3	0.9	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.8	0.1		0.2
401-500	650	1.4	0.3	0.2	0.3	0.6	0.3	1.1	0.5	0.5	0.7	0.2	0.5	0.2	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.2		0.0
501-750	212	1.3	3.8	2.4	1.0	1.4	3.9	2.4	3.4	2.5	2.0	1.9	2.2	4.2	1.6	2.5	3.5	2.9	2.3	2.2	0.5	0.6	1.6	0.9	0.8	0.7	0.7		0.6
501-750	218	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
501-750	224	0.2	0.2	0.2	0.1	0.5	0.2	0.3	0.4	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
501-750	230	0.5	0.3	0.3	0.3	0.6	0.6	0.3	0.5	0.3	0.4	0.4	0.2	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1		0.0
501-750	641	0.2	0.1	0.1	0.1	0.2	0.2	0.3	0.2	0.2	0.4	0.1	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0		0.0
501-750	646	0.3	0.5	0.7	0.3	0.5	1.3	0.4	1.0	0.6	0.8	0.4	0.3	0.5	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.3	0.1		0.1
501-750	651	0.4	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1		0.0
751-1000	219	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
751-1000	231	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0		0.0
751-1000	236	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0		0.0
751-1000	642	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1		0.0
751-1000	647	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1		0.0
751-1000	652	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0		0.0
	All	469	411	431	500	555	682	681	611	619	772	878	781	776	425	383	464	394	280	271	174	137	116	115	105	164	111		106

Index <= 2.2 | 2.2 < Index < 7.9 | 7.9 <= Index

Table 30. Percent contribution to total biomass index of Northern Shrimp by surveyed depth range in SFA 6.

Depth Range (m)	No. of Strata	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2023
101-200	9	3	5	6	7	5	7	7	5	7	6	6	11	9	8	9	14	12	15	13	12	10	5	7	6	9	9	5
201-300	15	51	43	44	47	44	41	34	34	40	44	52	50	45	50	44	47	55	48	49	41	45	34	38	40	39	34	32
301-400	17	36	39	38	37	40	40	40	43	44	41	34	33	34	33	33	30	24	29	29	33	34	41	38	39	39	43	46
401-500	12	9	12	10	8	9	11	18	16	9	9	7	6	11	8	13	8	7	8	8	14	11	19	16	13	13	13	17
501-750	7	1	1	1	0	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0	1	2	1	1	1	1	1
751-1000	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 31. Mean size of Northern Shrimp (mm) in SFA 6 from DFO fall multispecies surveys by various maturity/size categories including females, males, fishable (≥17.5 mm), pre-fishable (<17.5 mm) and totals.

Year	Female	Male	Fishable	Pre-fishable	Total
1996	23.08	16.75	20.8	14.92	18.12
1997	22.81	17.13	20.41	14.95	18.49
1998	22.31	16.81	20.45	13.97	18.32
1999	22.52	16.43	20.89	14.04	18.18
2000	22.46	16.45	20.79	14.2	18.3
2001	22.34	16.52	20.71	14.66	18.4
2002	22.06	16.61	20.62	15.02	18.59
2003	22.07	16.46	20.58	14.34	18.33
2004	21.89	16.61	20.73	14.96	18.62
2005	22.3	16.76	20.82	14.33	18.89
2006	22.56	16.41	20.9	13.95	18.32
2007	22.63	16.36	21.18	14.47	18.5
2008	22.46	16.92	20.73	15.06	18.71
2009	22.38	16.17	20.58	14.54	17.86
2010	22.31	16.96	20.72	15.05	18.7
2011	22.44	16.77	20.64	14.34	18.45
2012	22.42	16.74	20.59	14.36	18.33
2013	22.7	16.54	20.99	14.55	18.38
2014	23.02	16.48	20.81	14.48	18.09
2015	23.33	16.05	21.18	14.55	17.76
2016	23.22	16.48	20.81	14.88	18.12
2017	23.19	17	21.04	14.63	18.84
2018	23.52	16.14	21.95	14.53	18.66
2019	23.6	16.21	21.23	14.11	18.03
2020	23.83	16.11	21.51	14.31	17.93
2021	23.95	15.23	22.13	13.89	17.82
2023	23.35	16.51	21.36	14.62	18.61

Table 32. Male biomass and abundance indices of Northern Shrimp in SFA 6. Biomass and abundance indices calculated using Ogmap on the fall multispecies survey data.

Year	Male Biomass Index Lower CI (x 1,000 t)	Male Biomass Index (x 1,000 t)	Male Biomass Index Upper CI (x 1,000 t)	Change in Male Biomass Index from Previous Survey Year (%)	Male Abundance Index Lower CI (x 10^9)	Male Abundance Index (x 10^9)	Male Abundance Index Upper CI (x 10^9)	Change in Male Abundance Index from Previous Survey Year (%)
1996	234.0	276.0	335.0	-	66.9	77.1	91.6	-
1997	216.0	236.0	279.0	-14.5	60.3	65.3	76.3	-15.3
1998	209.0	231.0	268.0	-2.1	61.5	67.6	78.4	3.5
1999	223.0	251.0	289.0	8.7	71.4	80.5	92.3	19.1
2000	245.0	265.0	300.0	5.6	78.8	85.5	97.0	6.2
2001	288.0	322.0	362.0	21.5	92.1	102.0	115.0	19.3
2002	266.0	295.0	329.0	-8.4	83.7	91.7	102.0	-10.1
2003	262.0	286.0	327.0	-3.1	84.5	92.1	105.0	0.4
2004	232.0	264.0	298.0	-7.7	69.5	78.7	89.5	-14.5
2005	277.0	313.0	357.0	18.6	78.1	88.0	100.0	11.8
2006	372.0	423.0	498.0	35.1	115.0	130.0	151.0	47.7
2007	296.0	335.0	386.0	-20.8	94.8	107.0	123.0	-17.7
2008	329.0	369.0	426.0	10.1	91.7	101.0	116.0	-5.6
2009	162.0	215.0	278.0	-41.7	56.6	71.3	90.6	-29.4
2010	155.0	183.0	210.0	-14.9	46.7	53.2	60.1	-25.4
2011	204.0	233.0	267.0	27.3	64.7	73.1	83.2	37.4
2012	159.0	208.0	260.0	-10.7	47.6	61.6	75.9	-15.7
2013	111.0	135.0	165.0	-35.1	33.7	40.5	48.7	-34.3
2014	102.0	145.0	183.0	7.4	33.7	46.4	58.2	14.6
2015	74.7	90.9	109.0	-37.3	23.4	29.8	36.8	-35.8
2016	60.0	71.5	84.4	-21.3	17.8	21.4	25.2	-28.2
2017	46.9	55.8	65.6	-22.0	11.8	14.2	16.6	-33.6
2018	37.8	46.2	55.4	-17.2	11.0	13.4	16.4	-5.6
2019	45.3	55.7	66.5	20.6	12.7	15.8	18.6	17.9
2020	69.0	84.6	108.0	51.9	19.8	25.1	32.0	58.9
2021	35.1	44.8	55.7	-47.0	12.6	16.0	20.2	-36.3
2022	-	-	-	-	-	-	-	-

Year	Male Biomass Index Lower CI (x 1,000 t)	Male Biomass Index (x 1,000 t)	Male Biomass Index Upper CI (x 1,000 t)	Change in Male Biomass Index from Previous Survey Year (%)	Male Abundance Index Lower CI ($x 10^9$)	Male Abundance Index ($x 10^9$)	Male Abundance Index Upper CI ($x 10^9$)	Change in Male Abundance Index from Previous Survey Year (%)
2023	37.9	48.0	60.6	7.1	11.3	14.3	18.1	-10.6

Table 33. TACs and catches in 1977–2023/24 for the LV and SV fleets fishing Northern Shrimp in SFA 6. In 2003 the fishing season was switched from a calendar year to a management year such that the catches shown for 2003/04 are based on a 15-month fishing season. Quota transfers, bridging and overruns are reflected in all catches and, since 2016/17, in the adjusted TAC column. All 2023/24 catches and adjusted TACs are preliminary and based upon the AQMS as of February 9, 2024.

Year	LV TAC (t)	LV Adjusted TAC (t)	LV Catch (t)	SV TAC (t)	SV Adjusted TAC (t)	SV Catch (t)	Total TAC (t)	Total Catch (t)
1977	-	-	1	-	-	-	-	1
1978	1 300	-	-	-	-	-	1 300	-
1979	2 250	-	5	-	-	-	2 250	5
1980	1 350	-	-	-	-	-	1 350	-
1981	1 350	-	135	-	-	-	1 350	135
1982	1 350	-	1	-	-	-	1 350	1
1983	1 350	-	-	-	-	-	1 350	-
1984	1 350	-	-	-	-	-	1 350	-
1985	1 350	-	-	-	-	-	1 350	-
1986	2 050	-	-	-	-	-	2 050	-
1987	3 000	-	3 523	-	-	-	3 000	3 523
1988	3 000	-	11 596	-	-	-	3 000	11 596
1989	5 600	-	8 517	-	-	-	5 600	8 517
1990	5 600	-	7 527	-	-	-	5 600	7 527
1991	4 301	-	7 476	-	-	-	4 301	7 476
1992	7 565	-	9 624	-	-	-	7 565	9 624
1993	9 180	-	11 707	-	-	-	9 180	11 707
1994	11 050	-	10 978	-	-	-	11 050	10 978
1995	11 050	-	10 914	-	-	-	11 050	10 914
1996	11 050	-	10 923	-	-	-	11 050	10 923
1997	14 050	-	14 954	9 050	-	6 064	23 100	21 018
1998	16 360	-	16 264	29 840	-	30 073	46 200	46 337
1999	17 603	-	17 587	41 029	-	33 615	58 632	51 202

Year	LV TAC (t)	LV Adjusted TAC (t)	LV Catch (t)	SV TAC (t)	SV Adjusted TAC (t)	SV Catch (t)	Total TAC (t)	Total Catch (t)
2000	20 103	-	20 021	41 529	-	43 203	61 632	63 224
2001	20 103	-	19 905	41 529	-	32 685	61 632	52 590
2002	20 103	-	20 520	41 529	-	39 863	61 632	60 384
2003–04	33 276	-	29 371	52 299	-	41 856	85 575	71 227
2004–05	25 333	-	24 460	52 599	-	53 316	77 932	77 776
2005–06	25 333	-	24 996	52 599	-	49 732	77 932	74 728
2006–07	25 333	-	24 856	52 599	-	50 817	77 932	75 673
2007–08	25 333	-	27 507	52 599	-	53 218	77 932	80 725
2008–09	26 112	-	16 741	59 613	-	57 764	85 725	74 505
2009–10	26 112	-	18 633	59 613	-	26 894	85 725	45 527
2010–11	20 103	-	20 379	41 529	-	41 122	61 632	61 501
2011–12	16 928	-	23 369	35 459	-	36 239	52 387	59 608
2012–13	18 952	-	17 477	41 293	-	40 850	60 245	58 327
2013–14	18 952	-	18 284	41 293	-	40 550	60 245	58 834
2014–15	16 559	-	13 602	31 637	-	32 738	48 196	46 340
2015–16	16 559	-	17 344	31 637	-	31 378	48 196	48 722
2016–17	8 459	8 780	7 513	19 366	19 366	17 630	27 825	25 143
2017–18	3 161	3 234	3 246	7 239	7 239	6 819	10 400	10 065
2018–19	2 654	2 675	*2 665*	6 076	6 076	*6 038*	8 730	*8 702*
2019–20	2 724	2 743	2 705	6 237	6 237	5 933	8 961	8 638
2020–21	2 520	2 610	2 714	5 770	6 001	3 553	8 290	6 267
2021–22	2 898	2 913	2 803	6 637	6 637	6 750	9 535	9 554
2022–23	2 867	2899	2 969	6 563	6563	5 184	9 430	8 154
2023–24	2 867	2884	1 018	6 563	6572	4 614	9 430	5 632

Table 34. Standardized LV CPUE for Northern Shrimp in SFA 6 over the 1989–2023/24 period. Data from 2003 to present were converted to management year.

Management Year	TAC (t)	Fleet Catch (t)	Percent catch captured in model	CPUE relative to 1989	Modelled CPUE (kg/hour)	Calculated Effort (hours)
1978	1 300	-	-	-	-	-
1979	2 250	5	-	-	-	-
1980	1 350	-	-	-	-	-
1981	1 350	135	-	-	-	-
1982	1 350	1	-	-	-	-
1983	1 350	-	-	-	-	-
1984	1 350	-	-	-	-	-
1985	1 350	-	-	-	-	-
1986	2 050	-	-	-	-	-
1987	3 000	3 523	-	-	-	-
1988	3 000	11 596	-	-	-	-
1989	5 600	8 517	27	1.00	397	21 441
1990	5 600	7 527	51	1.03	410	18 356
1991	4 301	7 476	76	1.39	552	13 549
1992	7 565	9 624	71	1.66	661	14 565
1993	9 180	11 707	69	2.04	810	14 462
1994	11 050	10 978	96	2.80	1 111	9 882
1995	11 050	10 914	92	3.64	1 447	7 543
1996	11 050	10 923	90	3.89	1 546	7 067
1997	14 050	14 954	81	4.51	1 791	8 348
1998	16 360	16 264	89	3.86	1 532	10 617
1999	17 603	17 587	97	3.72	1 478	11 901
2000	20 103	20 021	103	4.30	1 709	11 717
2001	20 103	19 905	99	4.28	1 702	11 697
2002	20 103	20 520	98	3.71	1 474	13 918
2003–04	33 276	29 371	98	3.76	1 493	19 667
2004–05	25 333	24 460	104	4.24	1 683	14 536
2005–06	25 333	24 996	103	4.27	1 695	14 747
2006–07	25 333	24 856	102	4.35	1 727	14 392
2007–08	25 333	27 507	103	3.97	1 578	17 429
2008–09	26 112	16 741	100	3.59	1 426	11 736
2009–10	26 112	18 633	102	3.07	1 219	15 282
2010–11	20 103	20 379	103	3.16	1 254	16 257
2011–12	16 928	23 369	94	3.59	1 428	16 369
2012–13	18 952	17 477	102	3.42	1 359	12 856
2013–14	18 952	18 284	102	3.11	1 234	14 815
2014–15	16 559	13 602	100	3.13	1 245	10 924
2015–16	16 559	17 344	104	2.33	925	18 750
2016–17	8 459	7 513	102	1.39	553	13 574
2017–18	3 161	3 246	109	1.91	759	4 277
2018–19	2 654	2 665	101	2.08	825	3 229
2019–20	2 724	2 705	103	1.74	690	3 921
2020–21	2 520	2 714	103	2.27	902	3 008
2021–22	2 898	2 803	103	2.54	1 010	2 776
2022–23	2 867	2 969	101	2.56	1 016	2 922
2023–24	2 867	1 018	101	3.35	1 330	766

Table 35. Standardized SV CPUE for Northern Shrimp in SFA 6 over the 1998–2023/24 period. Data from 2003 to present were converted to management year.

Management Year	Fleet TAC (t)	Fleet Catch (t)	Percent catch captured in model	CPUE relative to 1998	Modelled CPUE (kg/hour)	Calculated Effort (hours)
1997	9 050	6 064	-	-	-	-
1998	29 840	30 073	90	1.00	304	99 005
1999	41 029	33 615	94	0.99	300	112 205
2000	41 529	43 203	93	1.08	330	131 092
2001	41 529	32 685	93	1.18	359	91 106
2002	41 529	39 863	95	1.03	313	127 299
2003–04	52 299	41 856	96	1.01	308	135 835
2004–05	52 599	53 316	95	1.44	436	122 226
2005–06	52 599	49 732	91	1.51	459	108 434
2006–07	52 599	50 817	94	1.59	484	104 941
2007–08	52 599	53 218	95	1.62	492	108 103
2008–09	59 613	57 764	96	1.45	440	131 317
2009–10	59 613	26 894	95	1.24	376	71 464
2010–11	41 529	41 122	91	1.20	364	112 859
2011–12	35 459	36 239	97	1.31	397	91 209
2012–13	41 293	40 850	95	1.46	445	91 854
2013–14	41 293	40 550	97	1.39	421	96 209
2014–15	31 637	32 738	98	1.58	481	68 088
2015–16	31 637	31 378	93	1.54	469	66 947
2016–17	19 366	17 630	97	0.99	301	58 476
2017–18	7 239	6 819	94	0.78	238	28 710
2018–19	6 076	6 038	97	0.74	226	26 744
2019–20	6 237	5 933	95	0.75	227	26 189
2020–21	5 770	3 553	94	0.74	224	15 894
2021–22	6 637	6 750	96	1.05	319	21 193
2022–23	6 563	5 184	97	1.25	380	13 634
2023–24	6 563	4 614	80	0.81	247	18 665

Table 36. Unstandardized CPUE (kg/hour) by depth range and stratum for the LV fleet fishing Northern Shrimp in SFA 6. Data were taken from observer data set; colour ranges are based on quartiles of the data from 1999–2022/23 (green: lower quartile; white: middle two quartiles; pink: upper quartile). Unavailable data is shown with black shading. Data for 2022/23 and 2023/24 are preliminary.

Legend:		CPUE <= 1 639 kg/hr								1 639 kg/hr < CPUE < 2 267 kg/hr								2 267 kg/hr <= CPUE								
Depth Range (m)	Stratum	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
101 - 200	205			3012		991		2490			2524	703		826		1747	1966	1002							2795	
	206	2261	2447	1919	954	1097	1758	2505	1347	1628	1386	1904	3106													
	207			12718	19440			358					503		1904							1096				
	237				7535	2515	3864			1106										4178						
	608																									
	612						2989																			
	616																									
	618																			1680	1100					
	619																									
201 - 300	209	1586	696	1858	1589	897		1356	1023				844		5110	1889	3761	2570	884	51	2014			290		
	210	1381	3677	1089	992	2624	2275	2092	2006	2422	2271	1411	1420	1551	2000	2360	2675	1581	845	3122	2499	1774	2256	2380	2209	7628
	213	1439	1104	1625	1896	1545	1797	1580	2115	1795	2136	1614	651	1151	2322	1292	510	120	15	9						
	214	1523	2009	2465	1410	3000	1626	2352	1338	2203	1984	2110	1124	2060	2204	1713	2005	1334	1391	454	1945			37	631	
	228	1812	3751	2490	1895	2169	2450	2876	2584	2219	2275	2199	2004	1906	2159	1454	1170	903	1069	808	1064	1072	1518	1211	1053	
	609																									
	611																									
	615																									
	620	579			4519	822		789	1365	1655	2378			280		1303	1094	418	765			161		2076		
	621					3											118			100						
	624		2730			1619	1459	1658	1701	1386	1752		757	1172	349	2166	2279	1780	1369		1257		1575	460		
	634						1613	1557	1917	1267	2016	853	1381	884	2100	73		86		525						
	635										1038		16	245												
	636						1526		1590	1437	1194	569	621	407												
	637							2026	219					328												
301 - 400	208	2277	3646	2124	2193	1510		1663	525	42	443			299	763	1768	568	3640	1255	20496	308			113	603	
	211	2432	4067	3050	2407	2654	3851	3620	3919	1952		2143	1842	3661	2312	1038	2811							584		
	216	1532	2310	1932	1911	2428	2263	2137	1883	2090	2084	1985	2516	2798	2621	1768	1969	1679	1305	51	42			101	12	
	222	1108	1473	1608	1620	1704	1943	2022	2389	1853	2303	1763	1600	2191	2236	395	698	80	72	1						
	229	2301	2789	2247	2180	1975	2391	2925	2482	2287	1619	1627	2409	3288	2297	2107			2	130				496		
	610																									
	614																									
	617	1674	2835	3042	1953	1982	2207	2325	2372	2303	2002	1726	2041	2712	1993	2163	2134	1806	1182	987	1767	1466	1681	2323	2457	3154
	623				96	277	2540	1797	2085	1271	1029	71	304	493	2333	2694	973	1550	1012	410	681	1110	350	2703	1685	2458
	625					1802	1919	1106		3026	2906		978	1723	1689	1533	1885	1319	1069	1012	1372	592	250	302	591	
	626		1207			1285	440			3112			15		1024	2049	2017	1033	860	545	345		769	469	308	
	628	214				304	1135	612					317			163		608	256						36	
	629	926	750		412	865	1211		661			120						554	177							
	630			336		260	1316	1930	2199	2318	2075	36	1556	1060	1318	1345	944	635					349			
	633	1274	3285	3381	1046	2397	2270	2106	2288	2248	1686	1908	1588	1713	1495	1190	2102	908	585	1273	1057	1482		1178	836	
	638		474	89	291	959	145	1932	875	835	319	528			1421	346	744	205	63							

Legend:		CPUE <= 1 639 kg/hr								1 639 kg/hr < CPUE < 2 267 kg/hr								2 267 kg/hr <= CPUE									
Depth Range (m)	Stratum	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	639	1222	205	529	656	1426	1682	1674	1597			558	177	91							6488	614				
401 - 500	217	2802	2548	3247	2989	3199	3153	2978	3140	2187	2632	2145	2934	3302	3346	2671	3515	1358	1187	1396	575					
	223	1529	2213	2483	1748	2329	2431	2583	1891	1808	3310	2079	2437	1195	1024	72		220								
	227	1318	1544	1527	1716	2255	2179	2582	2001	1873	2259	1246	1631	1617	1312	1672		33		17						
	235	1387	2163	2714	2095	2781						3145			2224				541							
	240	1802	2299	2191	1211	2144	3024	1647	1678	3354	20	223	713				56									
	613																									
	622	578		1523	73	276	2574	2537	1404	1102	1926		510	2225	2512	2357	1904	1718	1028	572	1158	1111	1331	1351	1680	1273
	627		640	2459		988	183									633	544	698	253	554					26	
	631	368	764	1907	2539	2340	2267	2231	2100	2273	1543	1828	1444	1833	1481	1049	2198	972	735	1269	1321	1203	1564	378	840	
	640																									
	645				1127	1653	515																			
	650					175		1903				1														
501 - 750	212	1122		3350	1787		750	2637	4892	5984	1381		1243	8057	1587											
	218	2791	2459	3988	4466	3868	3427	4033	2563	2522	3159	3872	3450	4813	3394	2848	3601	2206	713	1775				1		
	224	1758	2507	1945	1741	2585	1854	2367	5300	1766	1021	1036	3023		3299	6		597								
	230	2204	1736	1812	1350	2085	2014		4706	809		1075														
	641																									
	646																				1168					
	651						952																			
751 - 1000	219		1830	2223	5918	3267	3000	4366	1166		1368	808		3135	2680	2148										
	231		802	855		3551												1860								
	236		2030	3646	2558	1276		733					3691					2353								
	642																									
	647																									
	652																									

Table 37. Unstandardized CPUE (kg/hour) by depth range and stratum for the SV fleet fishing Northern Shrimp in SFA 6 from 1999–2023/24. Data were taken from logbooks; colour ranges are based on quartiles of the available data from 1999–2022/23 (green: lower quartile; white: middle two quartiles; pink: upper quartile). Unavailable data is shown with black shading. Data from 2022/23 and 2023/24 are preliminary.

		CPUE <= 401 kg/hr								401 kg/hr < CPUE < 514 kg/hr								514 kg/hr <= CPUE									
Depth Range (m)	Stratum	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
101 - 200	205	420	455		484		473				860		569	541	278	604	475	809								
	206	341	264	444	227	263	443		526	489	489	442	444	728	536	446	632	504	160						437	
	207			471		250							637		747	482	435									
	237																									
	608	230	466	311		391	393		364	418	563	331	659	151	545	400	485	712				173	239			366
	612		304																							
	616																									
	618		401	517	131	200		477		445	408	660	814	706	435	409	473						569	541		
	619			166							512		296	545	1102			704				256			1054	
201 - 300	209	330	451	332	334		396	188		564		411	572	666	670	572	703	517	120							
	210	311	603	369	320	417		804	605	342			684	752	228	535	578	629	79						612	
	213	383	436	415	385	313	478	554	661	579	671	499	534	621	434	560	360	329			120	112				289
	214	617	442	426		296	475	260	523	542	698	467	581	509	285	688	454	412								
	228	401	397	502	409	379	452	618	584	552	723	340	480	633	640	356	592	355	303		90	200		465		215
	609	289	445	306	217	337			832	389	479	406	256	361	468	358	758	515	89			177			382	
	611										433															
	615															364										
	620	268	346	431	305	379	598	482	551	467	480	418	334	394	553	532	576	465	167	168	298	177	233	343	360	280
	621	268	395	428	340	162	354	2394	438	396	456	447	426	382	476	410	437	530	197	106	225	171	223	286	404	63
	624	321	363	397	331	420	541	583	576	594	548	234	495	530	656	465	262	677	355	357	246	212	252	365		280
	634	392	334	455		408	694	534	505	639	566	445	488	405	349	398	546	659	337	444	114	160		360		
	635	204	341	352	292	356			172	490	532	416	402	426	295	392		495	355	262	229			298		292
	636	398	443	298	304	377	549	560	583	499	502	245	374	356	107	345	559	1113	116		38					
	637	343	231			556	535	411	502	559	576				729						61					
301 - 400	208	322	451	502	396							351	477	731	759	598	397	149	106							
	211	387	324	591	409	227		478							608				379		463				207	
	216		303	547		307	130					81	577													
	222	338	372	433	371	331	390	580	745		593	411	952	635	993	390	222	836			6					
	229	377	426	391	395	309	553	560	664	641	244	108	427	398	1217			271	337							
	610				293																					
	614																									
	617	304	368	395	316	339	315	551	532	457	466	436	339	447	653	497	543	310	248	125	205	153	283	340	338	225
	623	224	403	437	322	320	288	501	508	433	463	363	321	419	558	465	578	465	194	160	202	172	256	357	435	261
	625	303	387	385	345	326	435	522	549	538	473	308	398	494	518	445	502	490	179	129	164	200	209	285	308	199
	626	291	340	345	329	290	337	451	520	468	419	399	382	346	406	386	431	438	214	214	278	203	174	272	385	240
	628	189	210	143	279	212	292	360	1075	426	456	304	259	340	433	417	492	385	203	162	167	223	118	229	329	257
	629	237	284	433	281	208	337	223	47	473	489	340	379	500	309	345	411	454	246	276	195	114	212	352		172
	630		430		347	374	507	495	541	499	513	423	436	459	415	315	577	469	362	361	316	151	183	407		146
	633	499	418	368	381	414	574	571	603	815	590	427	463	467	513	494	664	626	351	260	221	286		121	69	125
	638	316	459	417	322	388	525	518	579	625	579	423	314	363	359	438			299							

		CPUE <= 401 kg/hr								401 kg/hr < CPUE < 514 kg/hr								514 kg/hr <= CPUE									
Depth Range (m)	Stratum	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	639	423	450	388	365	361	592	551	602	568	530	468	446	455	288	380	587	541	371			171				
401 - 500	217			248											624											
	223	347	353	405	374	373	350	25	573		323	813			633						99					
	227	304	357	391	386	319	338									619		105	268							
	235	264	261	518	435	473		263			416	385			514	425	321	706	226		88		339	467		266
	240	312	794	283	419	384	562		539																	
	613																									
	622	287	354	347	307	325	327	626	503	378	429	433		503	609	473	568	494	542	259	267	266	321	372	447	271
	627	339	343	385	271	217	269	500	479	778	864	365	371	342	373	375	472	553	412	289	204	246	214	220	578	283
	631	422	360	323	363	354	686	565	548	809	566	444	428	488	550	499	531	651	480	385	226	263	234	417	578	321
	640	407		315	299	502	555	689						568	282	354										
	645		346	35							721	539														
	650			427		355	596		547																	
501 - 750	212	474	416	361	343		280	781	626	486	472	605	381	448	708	288	872	535	516		196		278	484	460	282
	218					395			662																	
	224	341	610	288	409	326	267				681		198	623	190											
	230	360	452	292	402	301	620																	269		
	641		269	368	227	443	612	474		447		405	381	711	454	383	650	196	206							754
	646		728				743				1897						659									
	651	440	2563	1996	316	553	401	519	757	689	817				306											
751 - 1000	219					616																				
	231	133			320		538	781	781																	
	236	234	459	261	577	362	378							384										183		
	642	312	395	525	318	265	530	313	349	494	178	456	295	259	399	418	449	285	333	251		83		357	335	759
	647	251		495		470	972				229	325	465	267		226										
	652	497	390	280	359	597	517	603	247	511	667	458	265	180	378	407	553		152							

9 APPENDIX 3: FIGURES

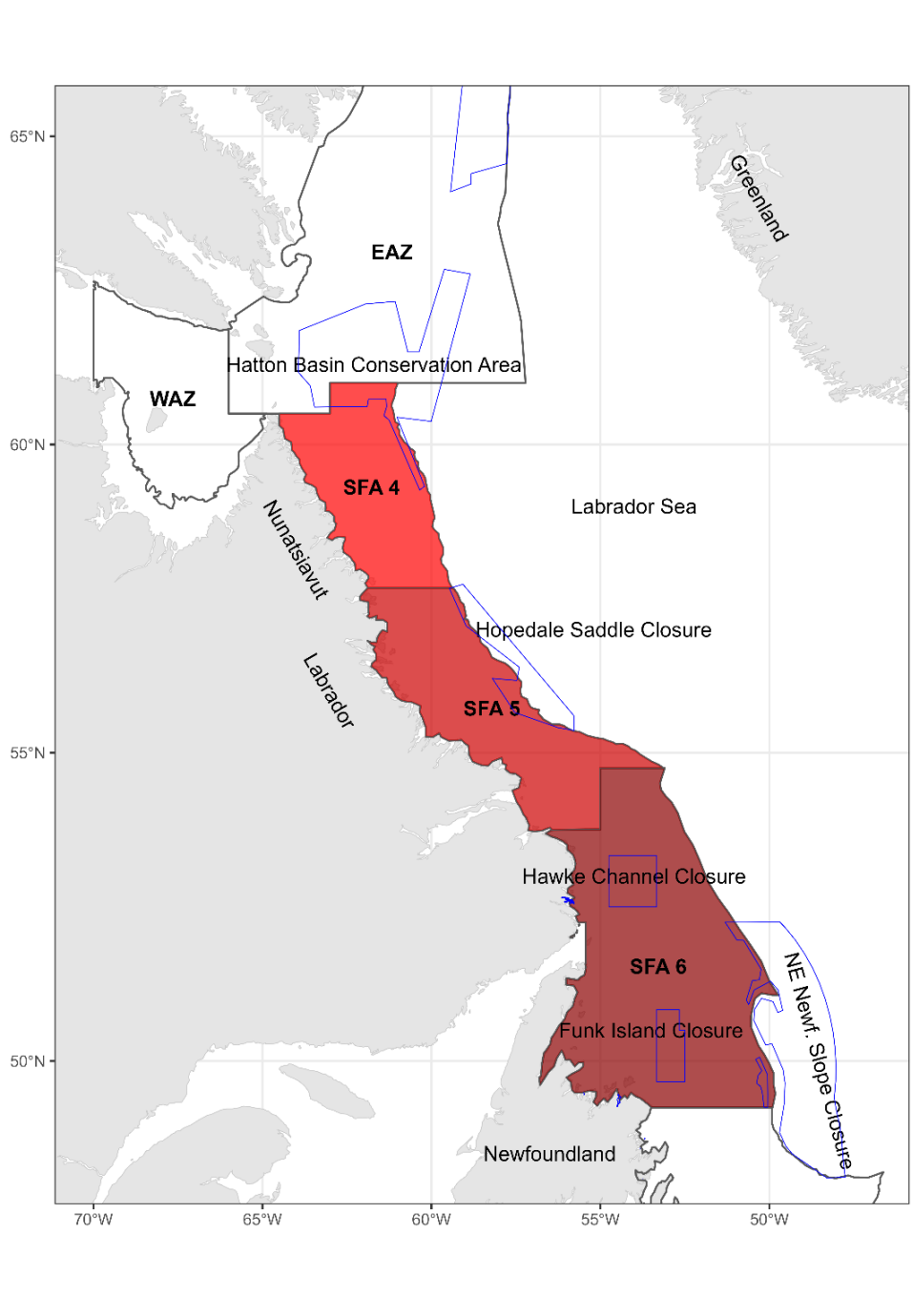

Figure 1. Shrimp Fishing Areas (SFAs) 4, 5, 6 (filled in red), and the East and West Assessment Zones (EAZ and WAZ) (black lines). Hatton Basin Conservation Area, Hopedale Saddle, Hawke Channel, Northeast Newfoundland Slope Closure and Funk Island Closures are represented with blue lines.

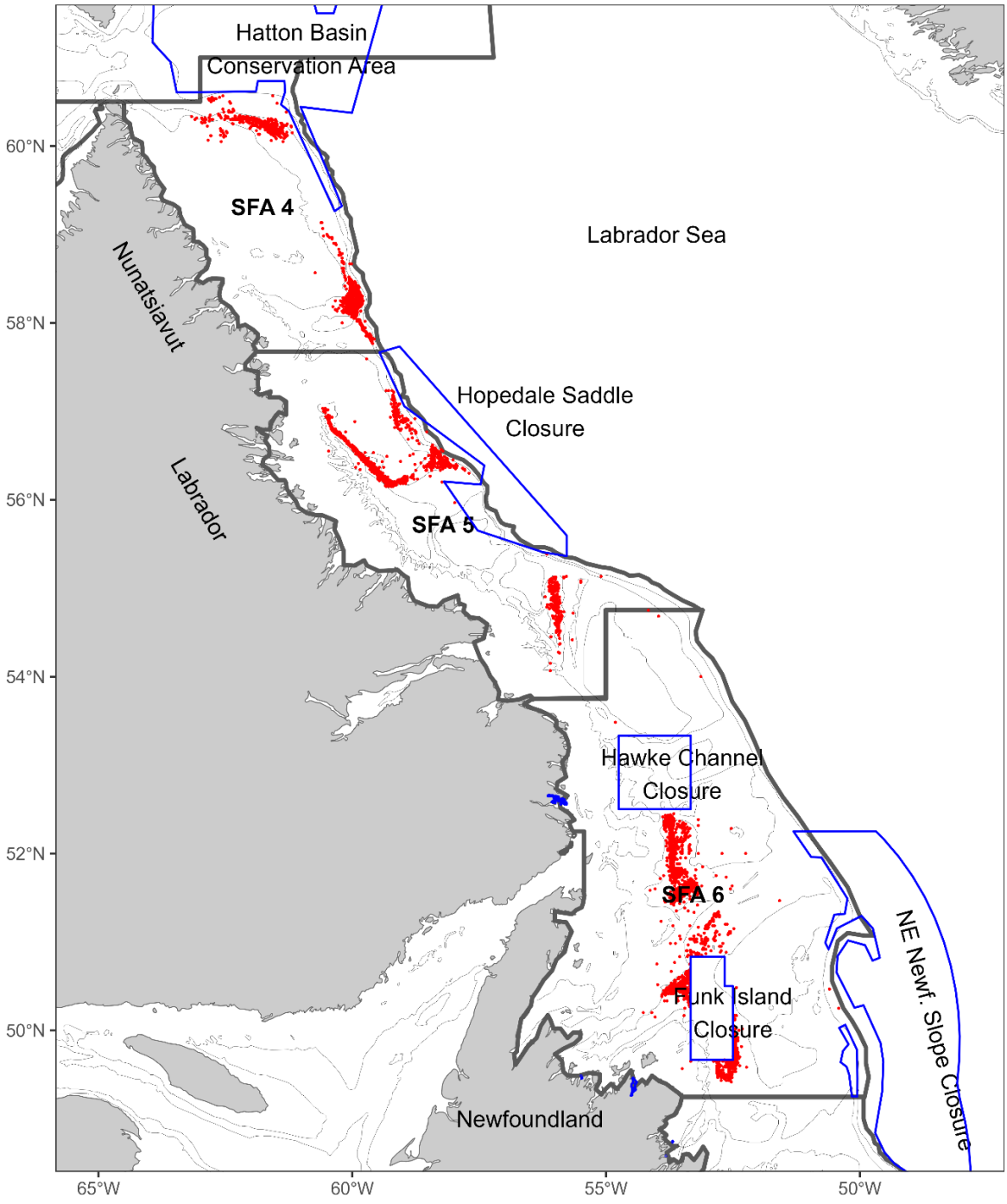

Figure 2. Preliminary Northern Shrimp fishing positions for 2023/24; red crosses indicate fishing positions of vessels directing for Northern Shrimp. Blue outlines indicate closed areas and gray outlines indicate SFAs. LV positions were taken from preliminary observer data and SV from preliminary logbook data.

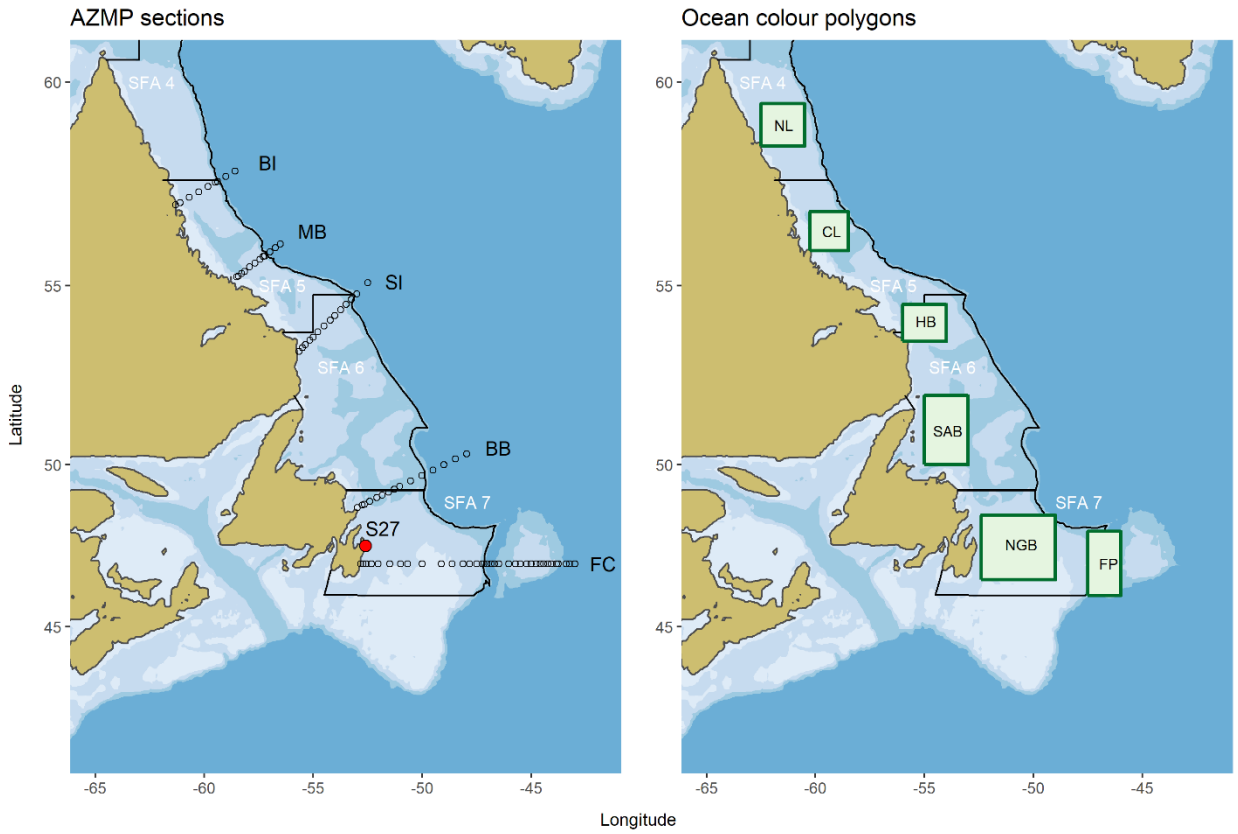

Figure 3. Left: Location of standard oceanographic sections Beachy Island (BI), Makkovik Bank (MB), Seal Island (SI), Bonavista Bay (BB), and Flemish Cap (FC) and high frequency sampling site Station 27 (S27) where nutrient, chlorophyll a, and zooplankton data were collected during seasonal AZMP surveys. Right: Polygons of Northern Labrador (NL), Central Labrador (CL), Hamilton Bank (HB), St. Anthony Basin (SAB), Northern Grand Bank (NGB) and Flemish Pass (FP) for which the spring bloom timing metric was calculated using satellite ocean colour observations. Bathymetric shading: lighter blue tones denote shallower depths, whereas darker blue tones correspond to deeper areas.

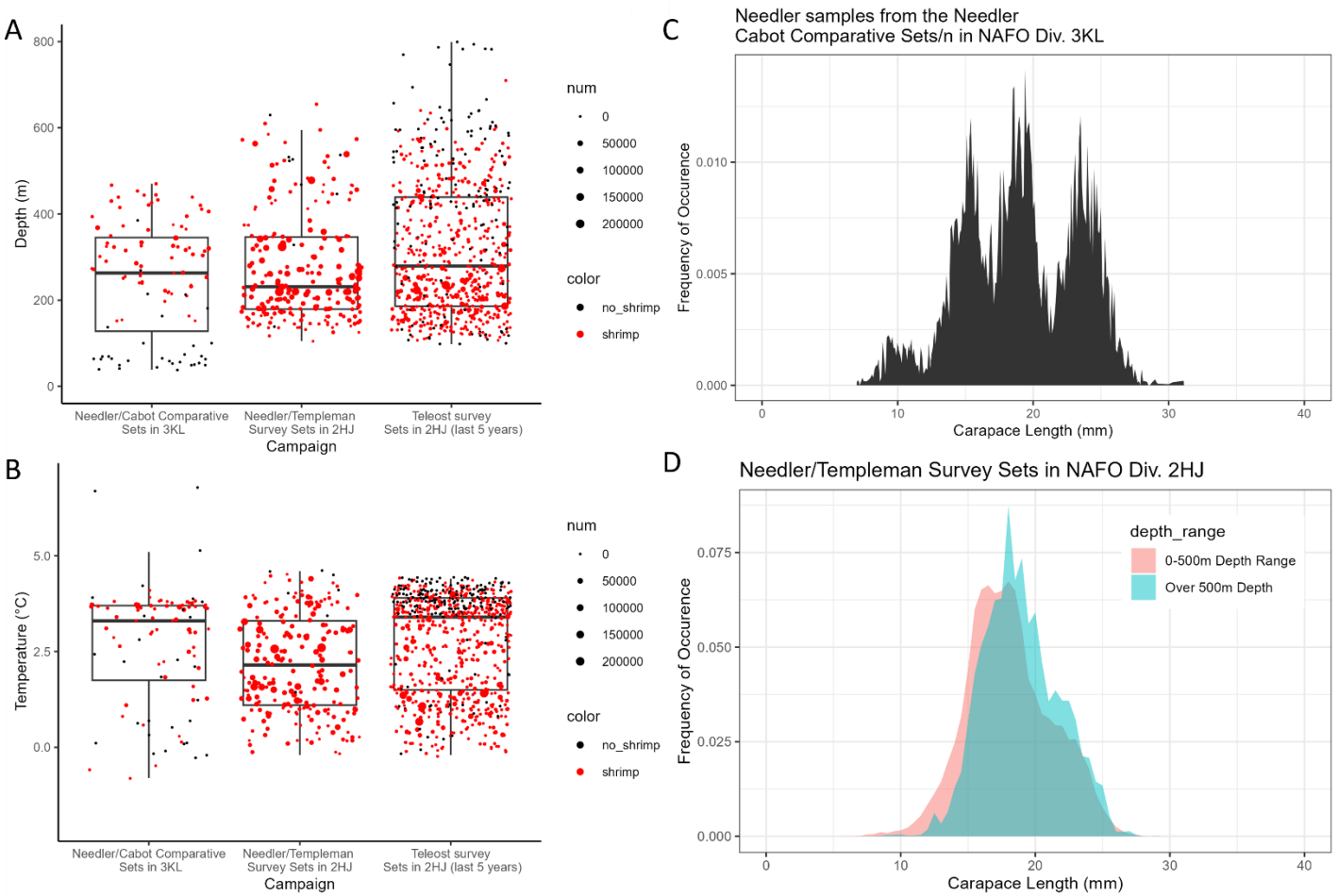

Figure 4. Comparative Analysis of Northern Shrimp Catch and Length Frequency Data Across DFO Multispecies Research Vessels, Bottom Temperature and Depths. (A) Depth comparison of Northern shrimp catches from Needler/Cabot comparative sets in NAFO Divs. 3KL, Needler/Templeman survey sets in NAFO Divs. 2HJ, and Teleost survey sets in NAFO Divs. 2HJ over the last five years. Note that no Needler comparative sets were conducted beyond 500 m depth, the size of the dot reflects the abundance per set, and red dots represent sets with shrimp (These notes are also valid for Panel B). (B) Temperature comparison of Northern shrimp catches from Needler/Cabot comparative sets in NAFO Divs. 3KL, Needler/Templeman survey sets in NAFO Divs. 2HJ, and Teleost survey sets in NAFO Divs. 2HJ over the last five years. (C) Length frequency distribution of Northern Shrimp catch from Needler comparative fishing sets in NAFO Divs. 3KL. (D) Length frequency distribution of Northern Shrimp catch from Needler/Templeman survey sets in NAFO Divs. 2HJ (1996–2021), with a distinction between sets conducted at depth <500 m (pink) and depth >500 m (green).

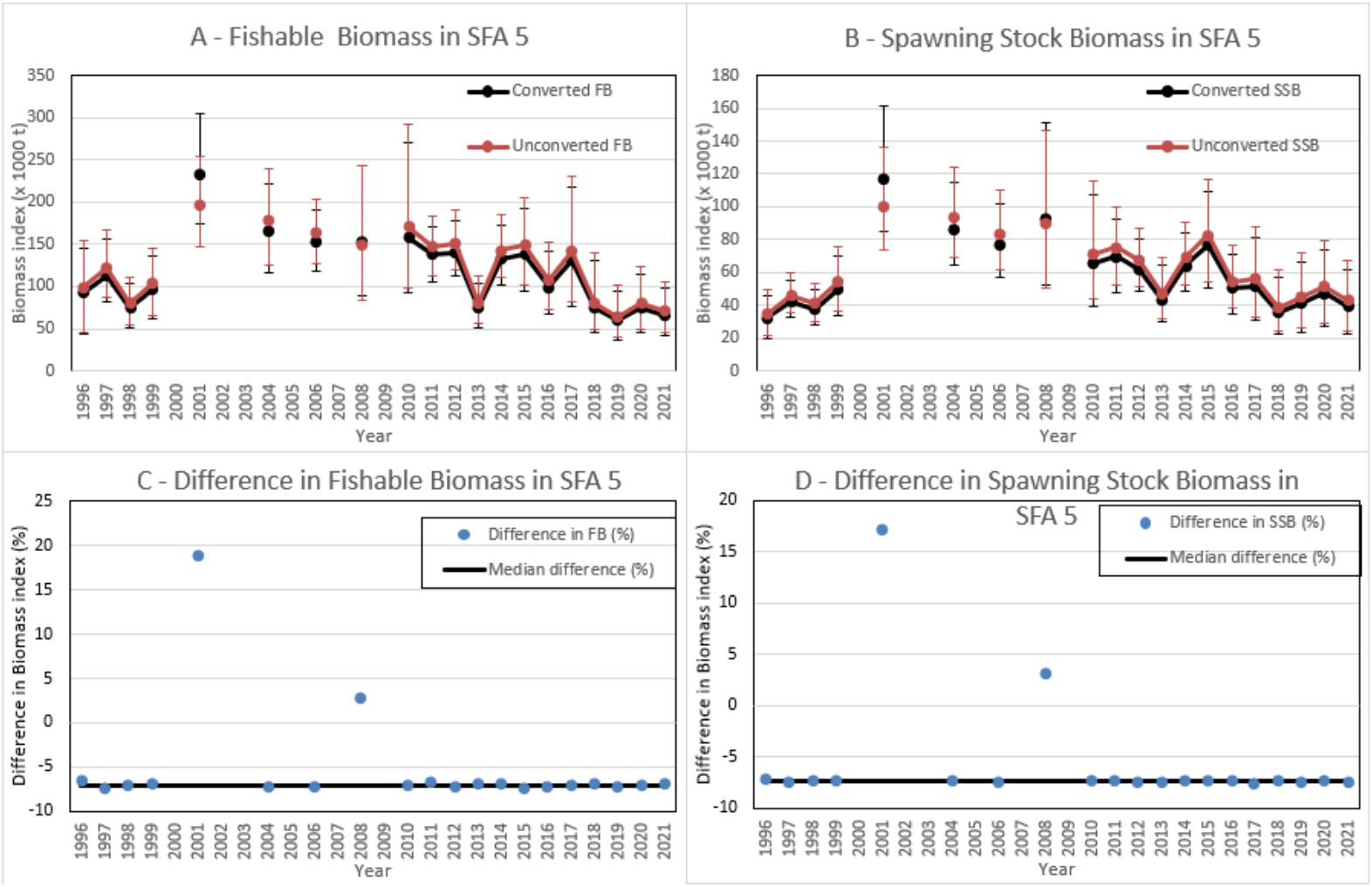

Figure 5. Comparison of converted (new vessels equivalent - black) and unconverted (old vessels - orange) fishable and spawning stock biomass index time series in SFA 5 from 1996–2021. 95% Confidence intervals are represented with vertical bars. Panel A: SFA 5 converted and unconverted fishable biomass indices. Panel B: SFA 5 converted and unconverted spawning stock biomass indices. Panel C: Percentage differences between yearly estimates of unconverted and converted fishable biomass indices (blue points), and median difference over the 1996–2021 time series (black line). Panel D: Percentage differences between yearly estimates of unconverted and converted spawning stock biomass indices (blue points), and median difference over the 1996–2021 time series (black line).

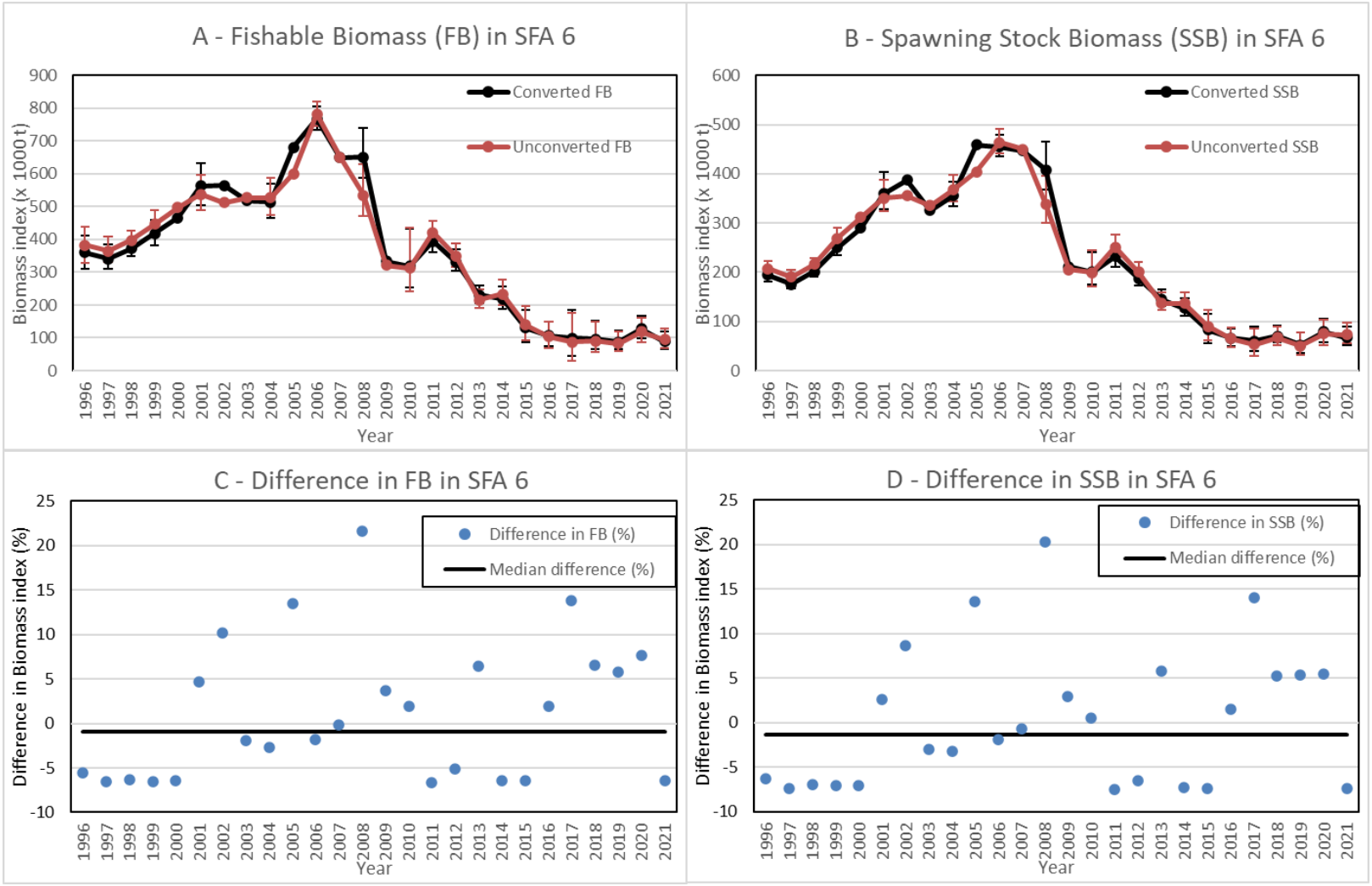

Figure 5. Comparison of converted (new vessels equivalent - black) and unconverted (old vessels - orange) fishable and spawning stock biomass indices timeseries in SFA 6 from 1996–2021. 95% Confidence intervals are represented with vertical bars. Panel A: SFA 6 converted and unconverted fishable biomass indices. Panel B: SFA 6 converted and unconverted spawning stock biomass indices. Panel C: Percentage differences between yearly estimates of unconverted and converted fishable biomass indices (blue points), and median difference over the 1996–2021 time series (black line). Panel D: Percentage differences between yearly estimates of unconverted and converted spawning stock biomass indices (blue points), and median difference over the 1996–2021 time series (black line).

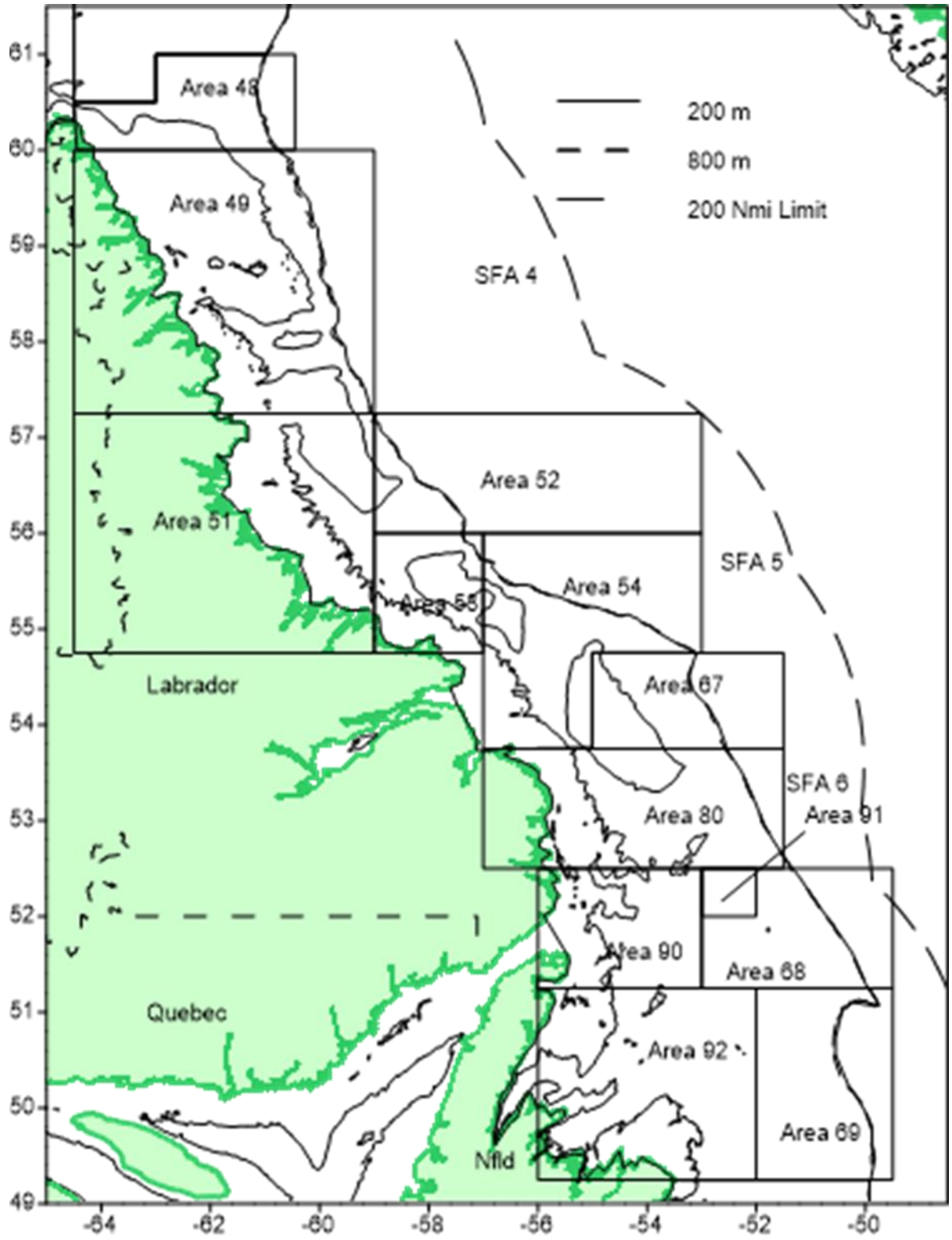

Figure 6. The statistical areas of SFAs 4, 5 and 6 which are used in commercial catch per unit effort models.

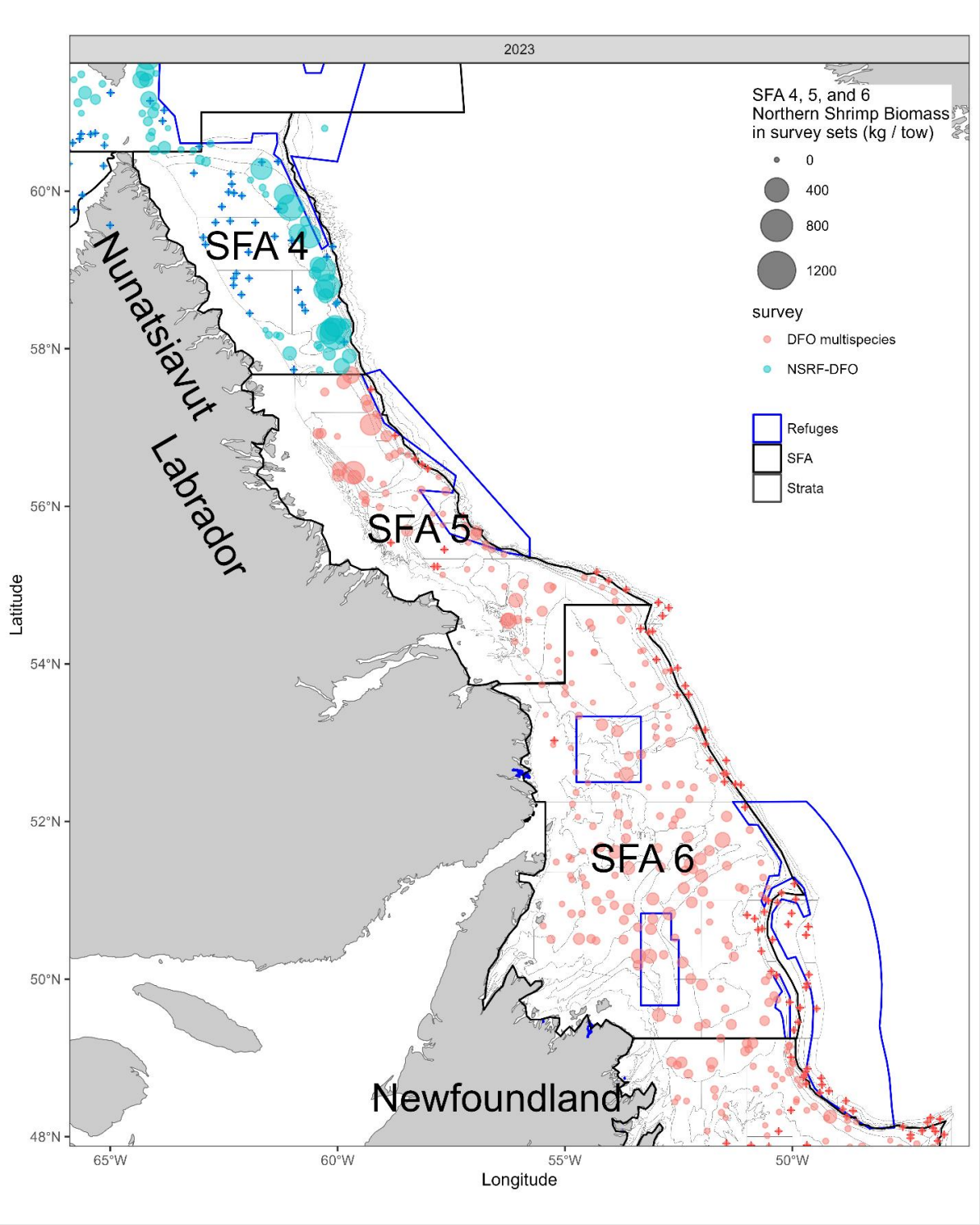

Figure 7. Positions occupied by the DFO multispecies fall survey (red circles in SFAs 5-6) and the NSRF shrimp survey (blue circles in SFA 4) in 2023. Circle sizes are scaled to size of Northern Shrimp catch. Solid blue lines indicate Marine Refuges. Crosses (+) indicate DFO multispecies (red) and NSRF (blue) survey sets with no Northern Shrimp caught.

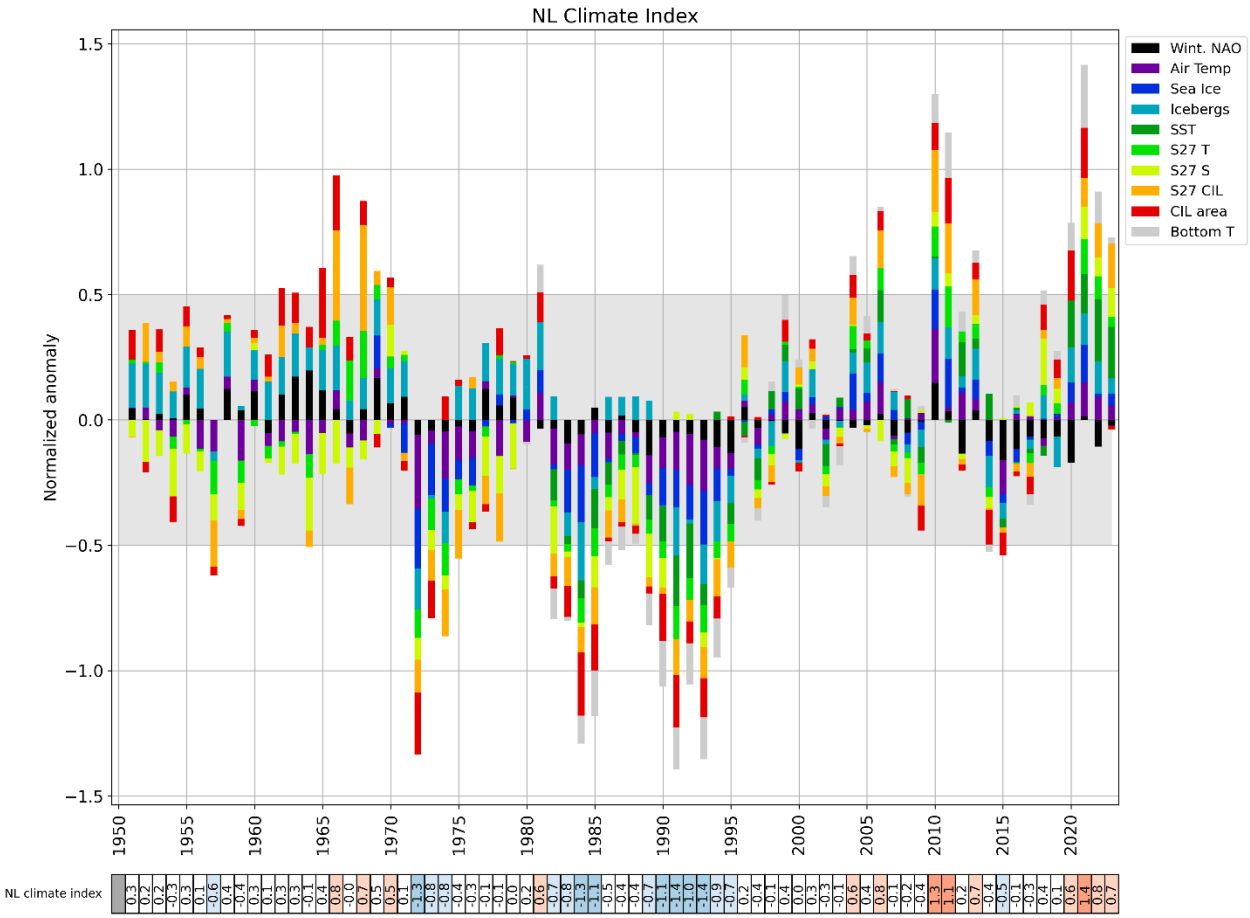

Figure 8. Newfoundland and Labrador Climate Index (Cyr and Galbraith 2021).This normalized index is made of the average of 10 sub-indices representing different aspects of the ocean climate (see legend). A positive index is generally indicative of a warmer climate, while a negative index is indicative of a colder climate. Values within the grayed area (±0.5 SD) are considered normal. The numerical values of this time series are reported in a colour-coded scorecard at the bottom of the figure. Positive anomalies (>0.5 SD) are coloured red, while negative anomalies (SD) are coloured blue.

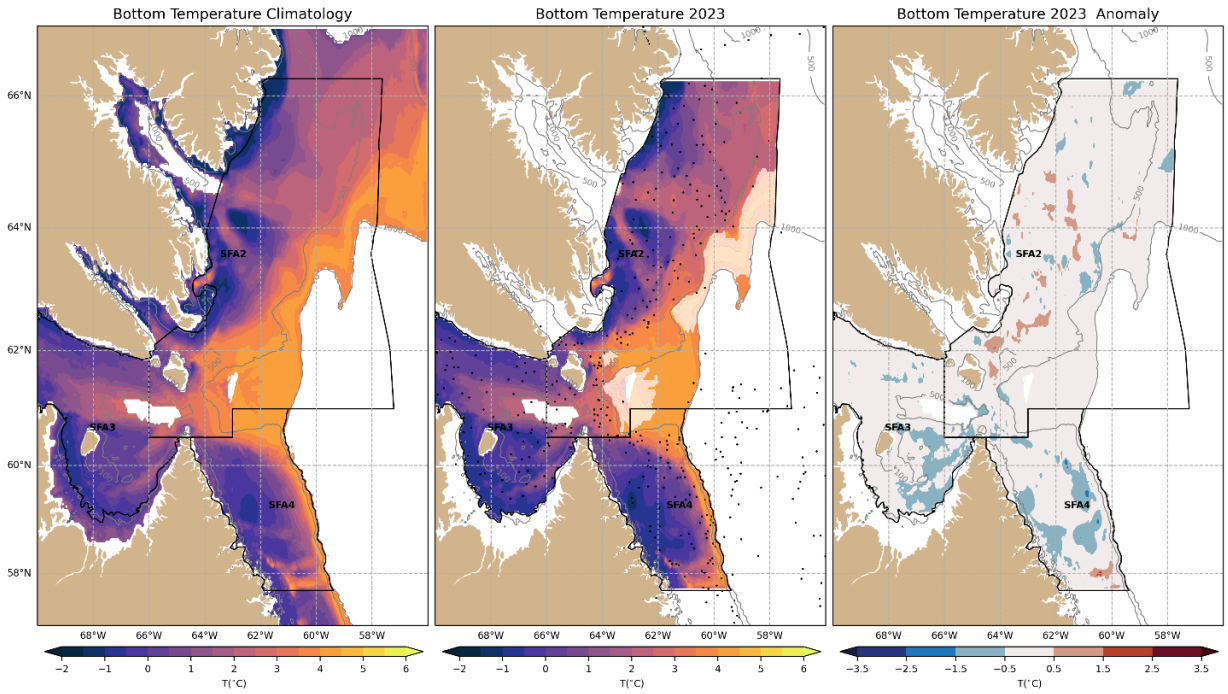

Figure 9. Maps of the climatological (1991–2020) mean summer bottom temperature (left), and summer 2023 bottom temperature (center) and anomalies (right) for SFA 2-4. The location of observations used to derive the temperature field is shown as black dots in the center panel. When applicable, the portion of the shelf where missing bottom temperature were filled with the climatology and left semi-transparent (center panel).

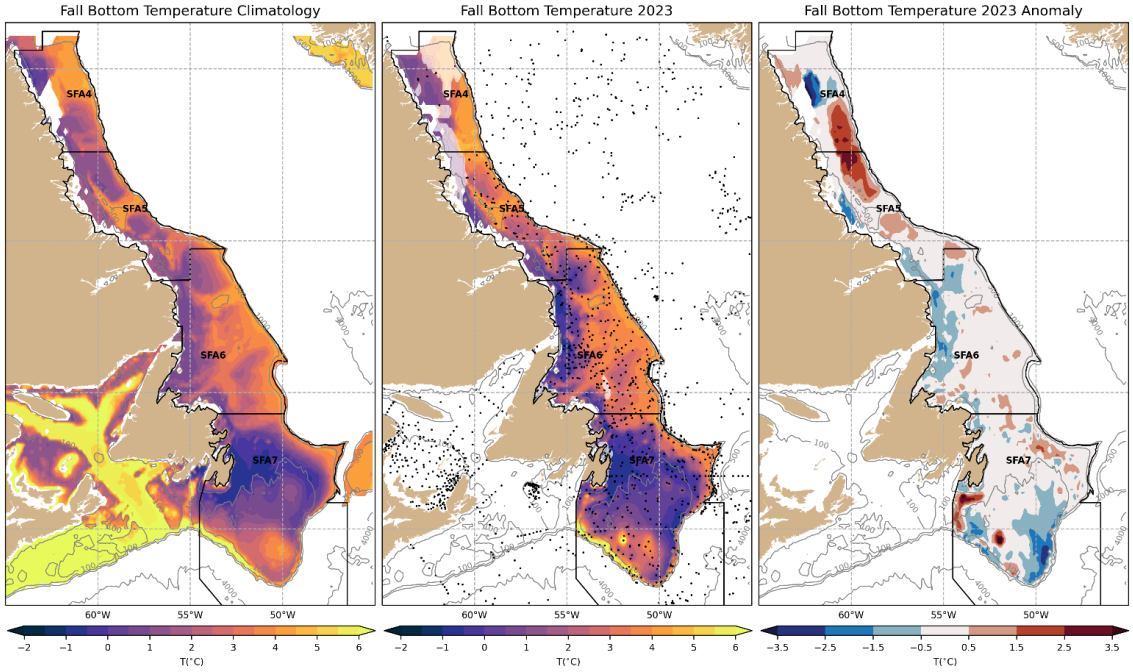

Figure 10. Maps of the climatological (1991–2020) mean fall bottom temperature (left), and fall 2023 bottom temperature (center) and anomalies (right) for SFA 4-7. The location of observations used to derive the temperature field is shown as black dots in the center panel. When applicable, the portion of the shelf where missing bottom temperature were filled with the climatology are left semi-transparent (center panel).

	-- SFA4 Summer --																			
	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	$\bar{x}$	SD
T_{bot}	-0.7	0.5	1.3	-1.1	0.4	2.0	-0.1	-1.3	-1.0	1.2	-0.9	-1.1	0.4	0.4	0.0	1.0	0.0	-0.5	1.3	0.4
$T_{bot<200m}$	-0.5	0.3	1.2	-1.2	0.3	2.1	-0.4	-1.1	-1.0	1.4	-1.0	-0.8	0.2	0.4	0.2	1.0	0.2	-0.6	0.2	0.5
$Area_{>2°C}$	-0.9	0.8	0.6	-1.0	0.2	1.9	0.1	-1.6	-0.9	1.3	-0.5	-1.2	0.8	0.5	0.1	0.7	-0.7	-0.3	17.4	3.4
$Area_{<1°C}$	0.7	-0.4	-0.9	1.4	-0.4	-2.3	0.1	1.2	0.7	-1.2	0.6	1.1	-0.3	-0.2	0.0	-0.8	0.3	0.8	28.3	5.0
	-- SFA5 Fall --																			
T_{bot}		0.7		-1.2		2.1		-0.3	-0.5	-0.6	-0.4	-1.4	0.5	0.7	0.4	1.2	-0.2	1.2	2.1	0.4
$T_{bot<200m}$		0.6		-1.2		2.0		-0.6	-0.6	-0.3	-0.1	-1.5	0.3	1.0	0.6	1.0	0.1	1.0	1.2	0.5
$Area_{>2°C}$		-0.8		-1.4		2.4		0.0	-0.4	-0.5	-0.3	-0.5	0.2	0.7	0.5	1.0	-0.9	1.3	36.7	13.9
$Area_{<1°C}$		-0.7		0.6		-1.1		1.0	0.8	0.2	0.0	1.9	-0.9	-1.0	-0.8	-1.0	-0.6	-0.1	15.1	14.3
	-- SFA6 Fall --																			
T_{bot}	-0.7	0.9	-0.1	-0.3	1.5	2.1	-0.5	-0.4	-1.2	-1.0	-0.6	-1.3	0.6	0.8	0.1	1.0	-0.1	-0.2	2.6	0.4
$T_{bot<200m}$	-1.0	1.0	-0.7	-0.2	1.6	1.7	-0.7	-0.7	-1.4	-1.0	0.4	-0.7	0.5	1.2	0.0	0.7	-0.7	-1.3	1.0	0.7
$Area_{>2°C}$	-0.6	1.0	-0.4	-0.8	1.7	1.8	-0.8	-0.4	-1.0	-0.8	-0.6	-1.1	0.7	1.1	0.3	0.8	-0.2	0.0	123.6	21.1
$Area_{<1°C}$	1.0	-1.1	0.8	0.4	-1.2	-1.3	1.0	0.6	1.2	1.0	-0.5	0.9	-1.0	-1.3	-0.5	-1.0	0.6	0.6	27.3	20.6

Figure 11. Scorecards of normalized bottom temperature anomalies (mean temperature, mean temperature for area shallower than 200 m, and area of sea floor covered by water above 2°C and below 1°C, respectively) for SFA 4 (summer) and SFAs 5 and 6 (fall).

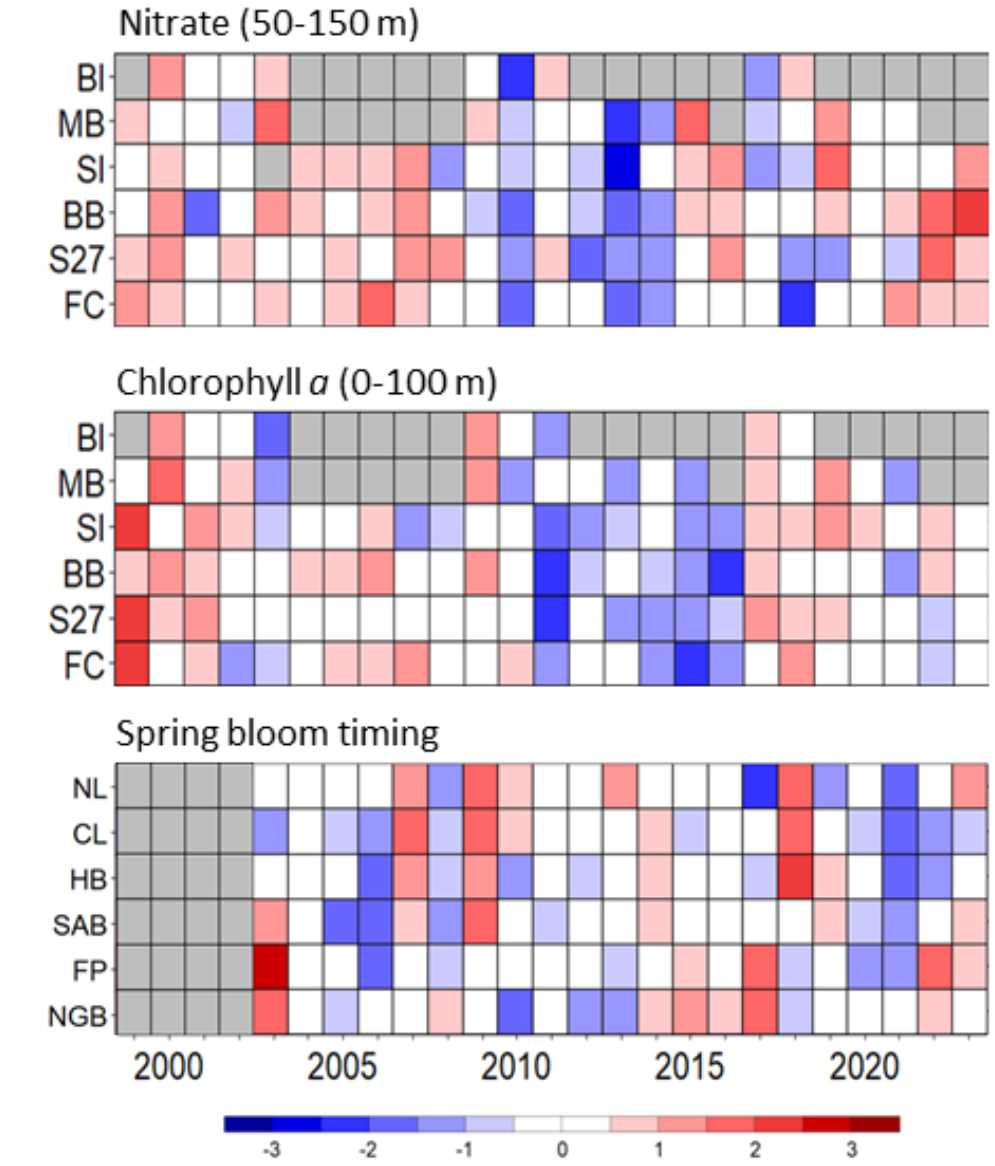

Figure 12. Anomaly scorecards of integrated nitrate (top) and chlorophyll a (middle) inventories, and spring phytoplankton bloom timing (bottom). Colour shades indicate deviation from long-term mean conditions in standard deviation (sd). White cells indicate near normal conditions (±0.5 sd). Red/blue cells indicate conditions above/below (top and middle) or later/earlier (bottom) than normal. See figure 3 for geographical locations of AZMP sections (top and middle) and ocean colour polygons (bottom) listed on the left.

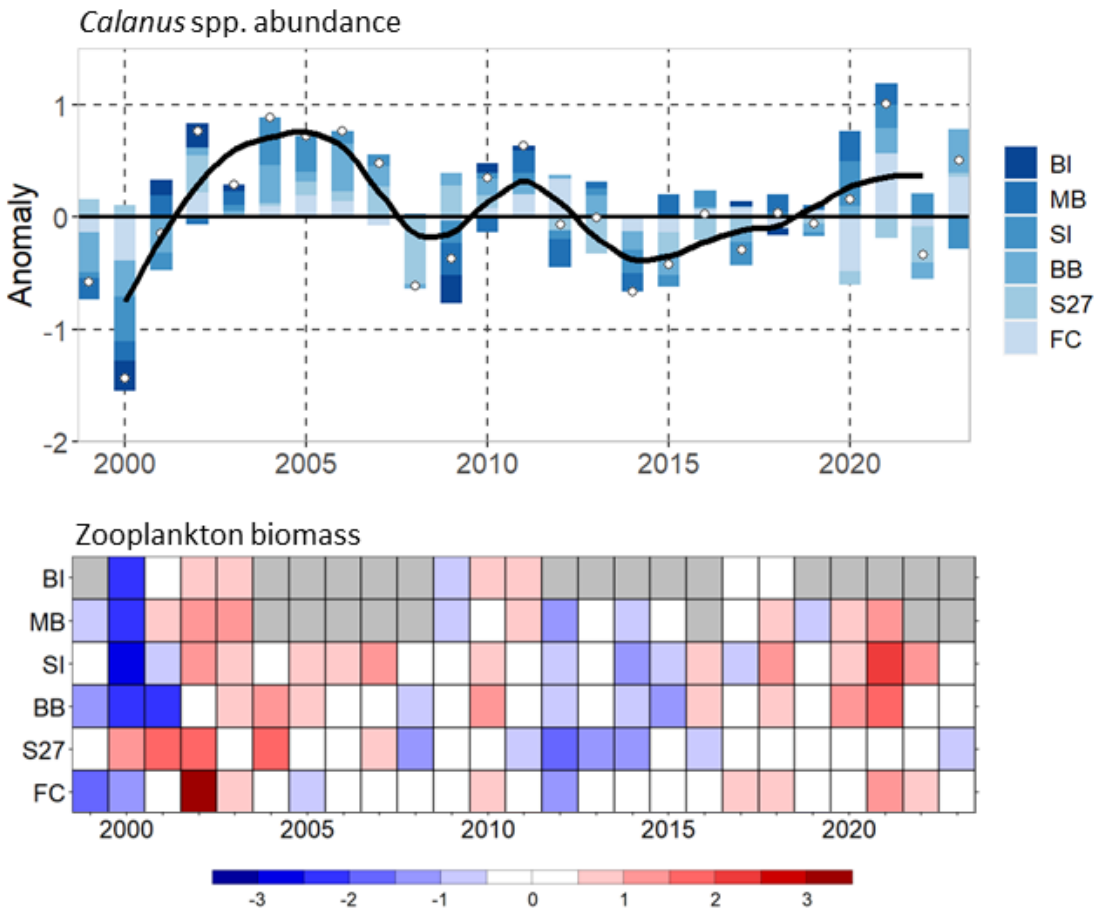

Figure 13. Top: Annual anomaly of Calanus spp. abundance. Colour shades indicate the relative contribution of each AZMP section to the mean annual anomaly (white circles). Bottom: Anomaly scorecard of total zooplankton biomass. Colour shades indicate deviation from the long-term mean conditions in standard deviation (sd) with white cells indicating near normal conditions (±0.5 sd), and red/blue cells indicating conditions above/below normal. See figure 3 for geographical location of AZMP sections.

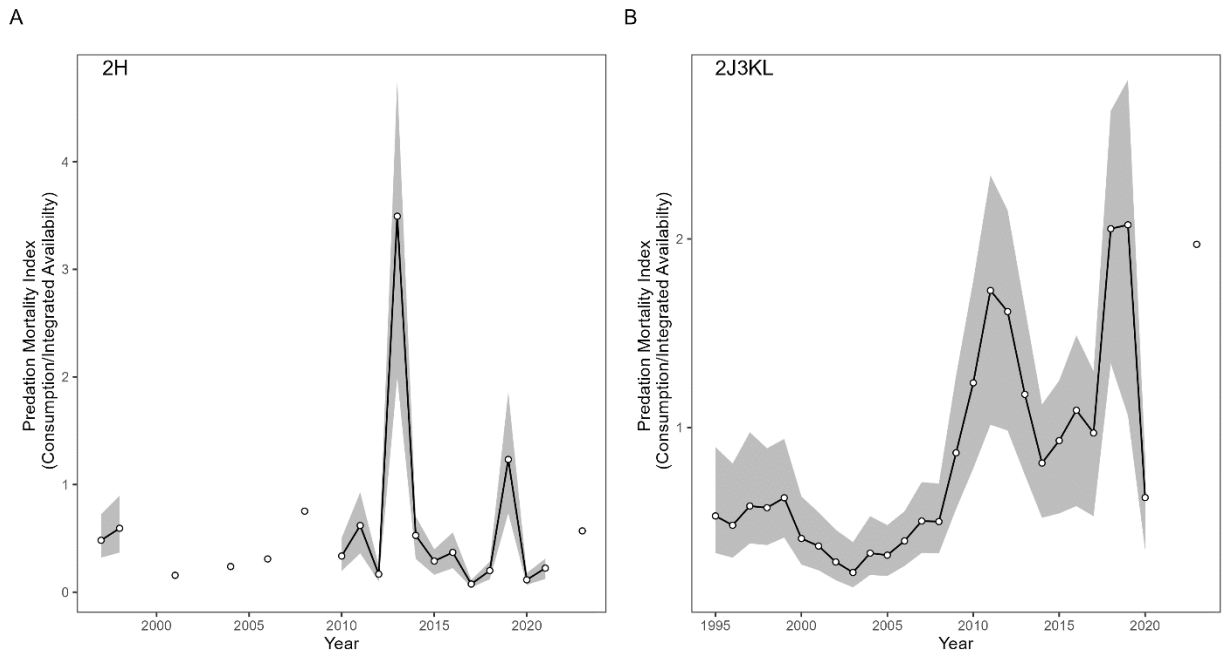

Figure 14. Predation mortality index for Northern Shrimp in NAFO Divs. 2H (A) and 2J3KL (B). White dots are estimates based on median consumption of Northern Shrimp by fish predators and gray ribbon is the range based on minimum and maximum consumption.

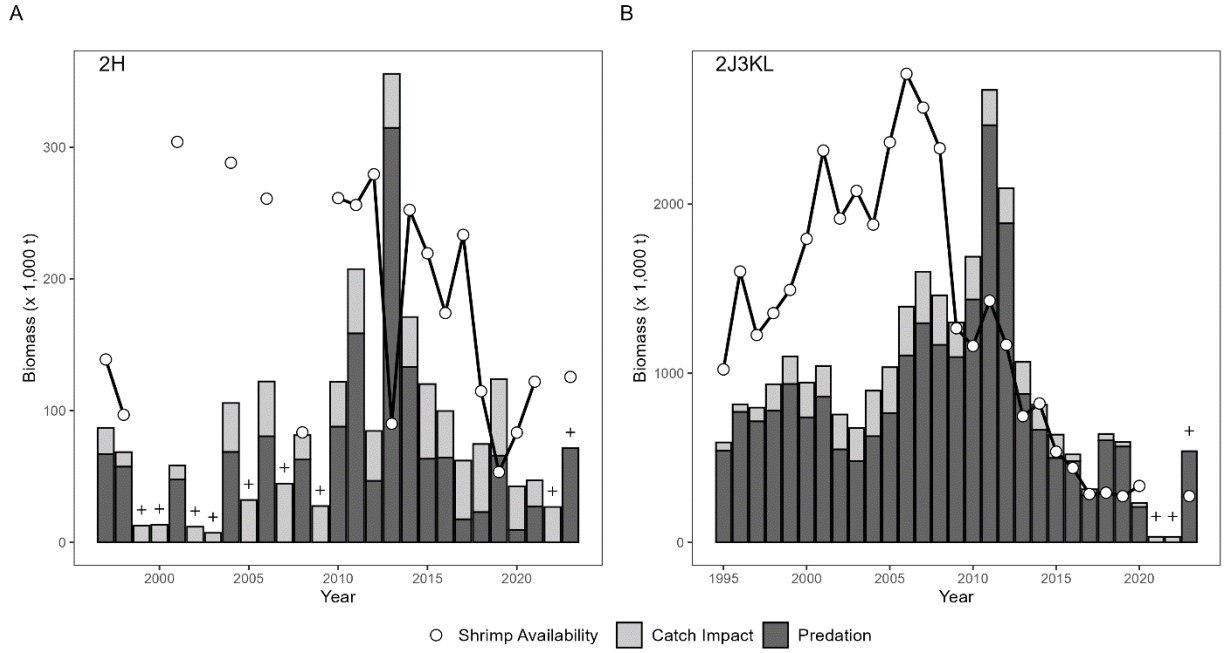

Figure 15. Evaluation of the potential impacts of predation and fishing in relation to Northern Shrimp availability in NAFO Divs. 2H (A) and 2J3KL (B). Estimated magnitudes of predation (dark gray) and potential catch impacts (light gray) vs estimated Northen Shrimp availability (white points). The "+" marker indicates that either predation or potential catch impact estimates are missing that year.

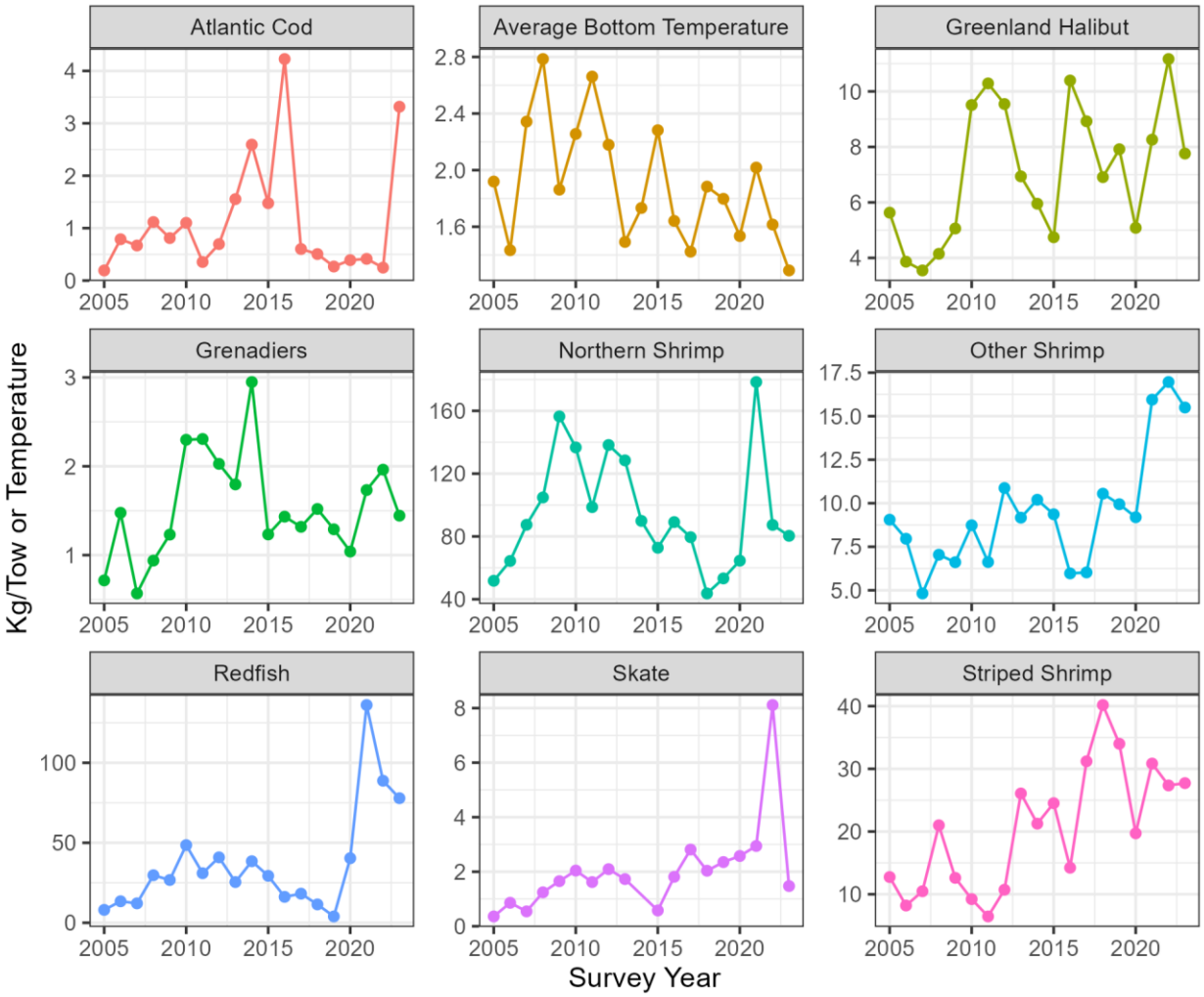

Figure 16. SFA 4 catch rates of predators (Atlantic Cod, Greenland Halibut, grenadiers, redfish, skate), Shrimp (Northern, Striped, and others), and average bottom temperature from NSRF shrimp survey data 2005–23.

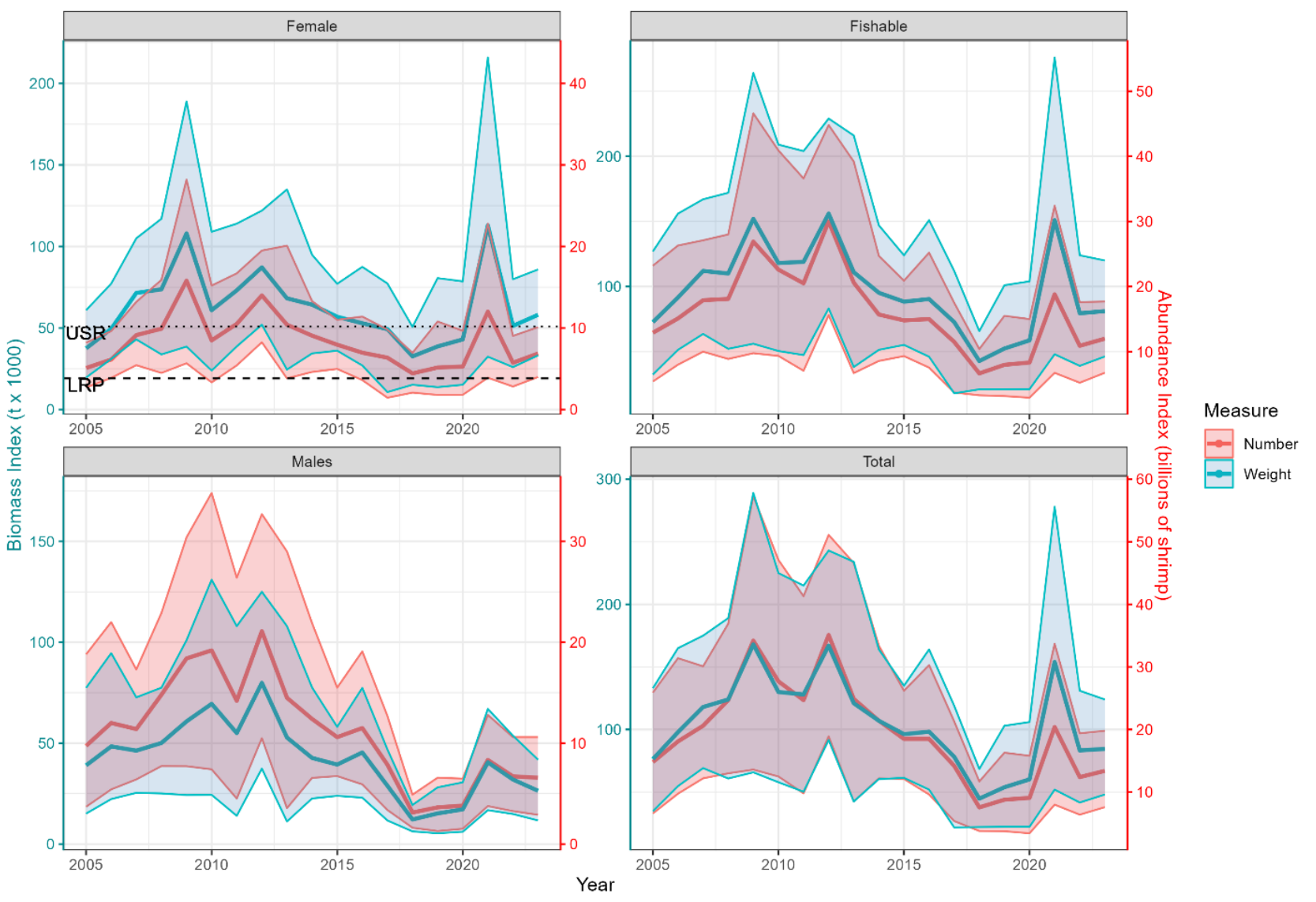

Figure 17. SFA 4 biomass and abundance indices of Northern Shrimp as derived by Ogmap using NSRF summer shrimp survey data. Shaded areas indicate 95% confidence intervals and the dashed lines in the female figure represent the LRP and USR as used in the IFMP PA framework.

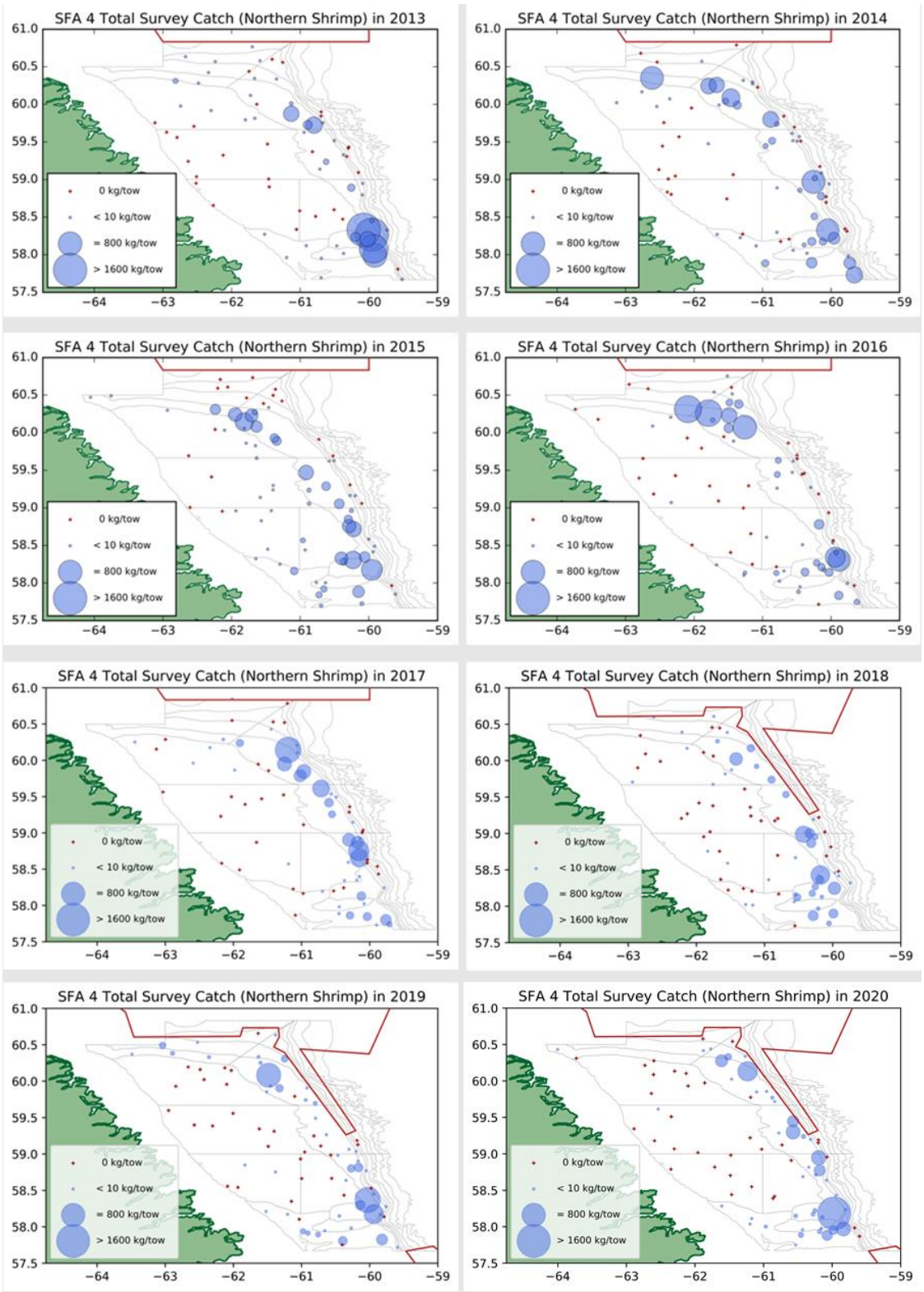

Figure 18. SFA 4 Northern Shrimp NSRF shrimp survey data catches for 2013–20. Circle sizes are scaled to size of Northern Shrimp catch and red crosses indicate zero catch. Solid red lines indicate closed areas.

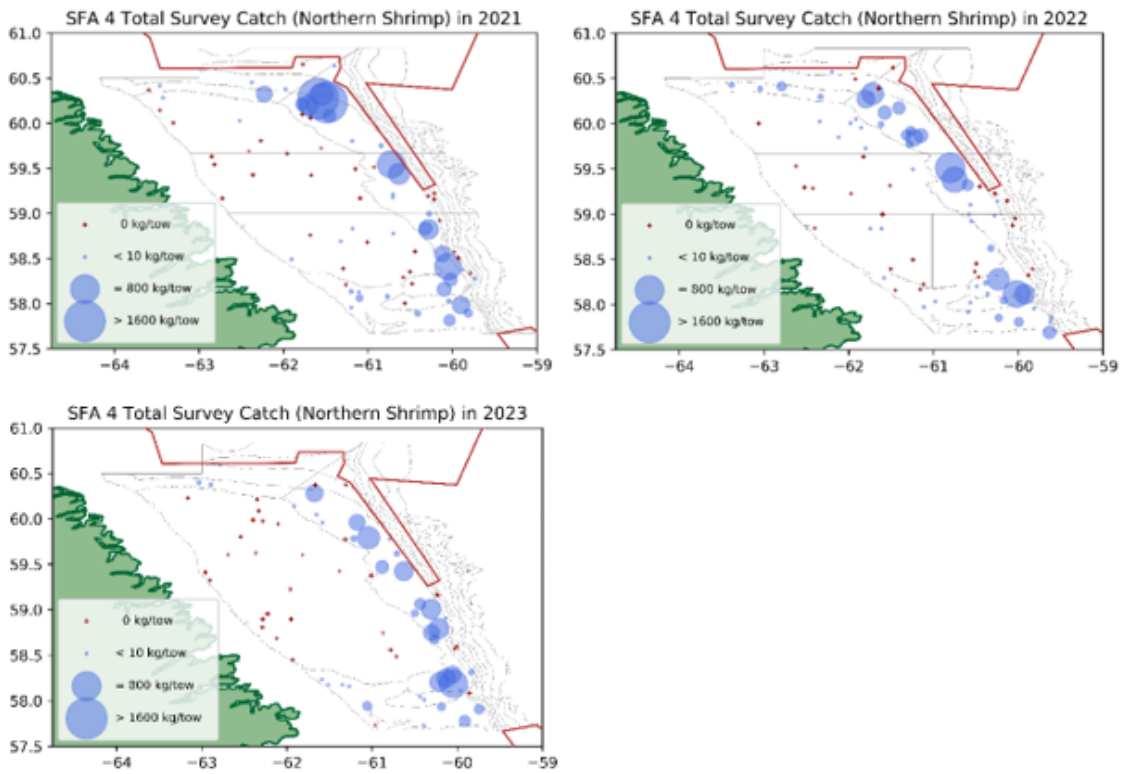

Figure 19. SFA 4 Northern Shrimp NSRF shrimp survey data catches for 2021, 2022, and 2023. Circle sizes are scaled to size of Northern Shrimp catch and red crosses indicate zero catch. Solid red lines indicate closed areas.

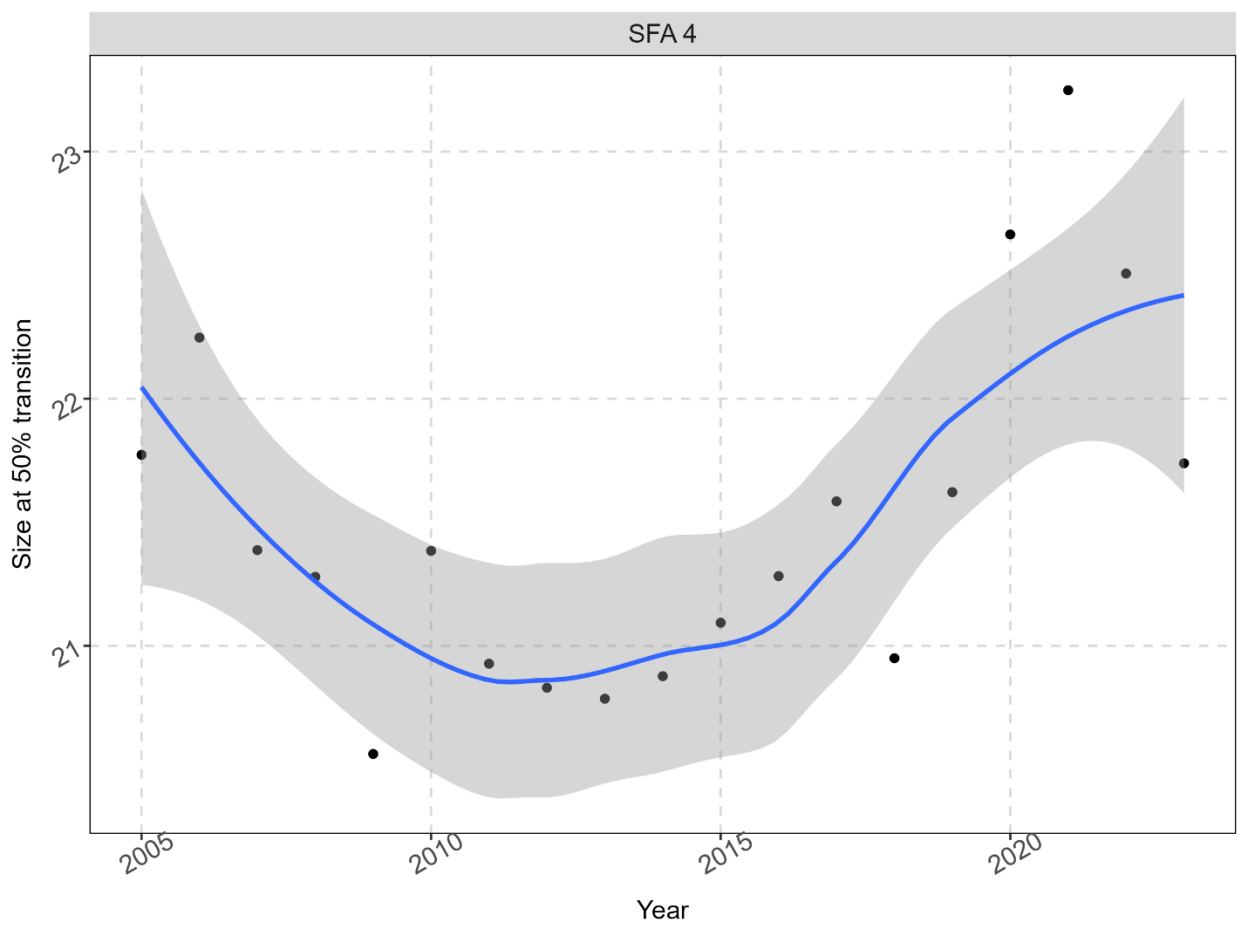

Figure 20. Annual estimated size at 50% transition of Northern Shrimp in SFA 4. Black points indicate annual estimates, the blue line represents a smoothed trend, and the grey band shows the 95% confidence intervals around the smooth.

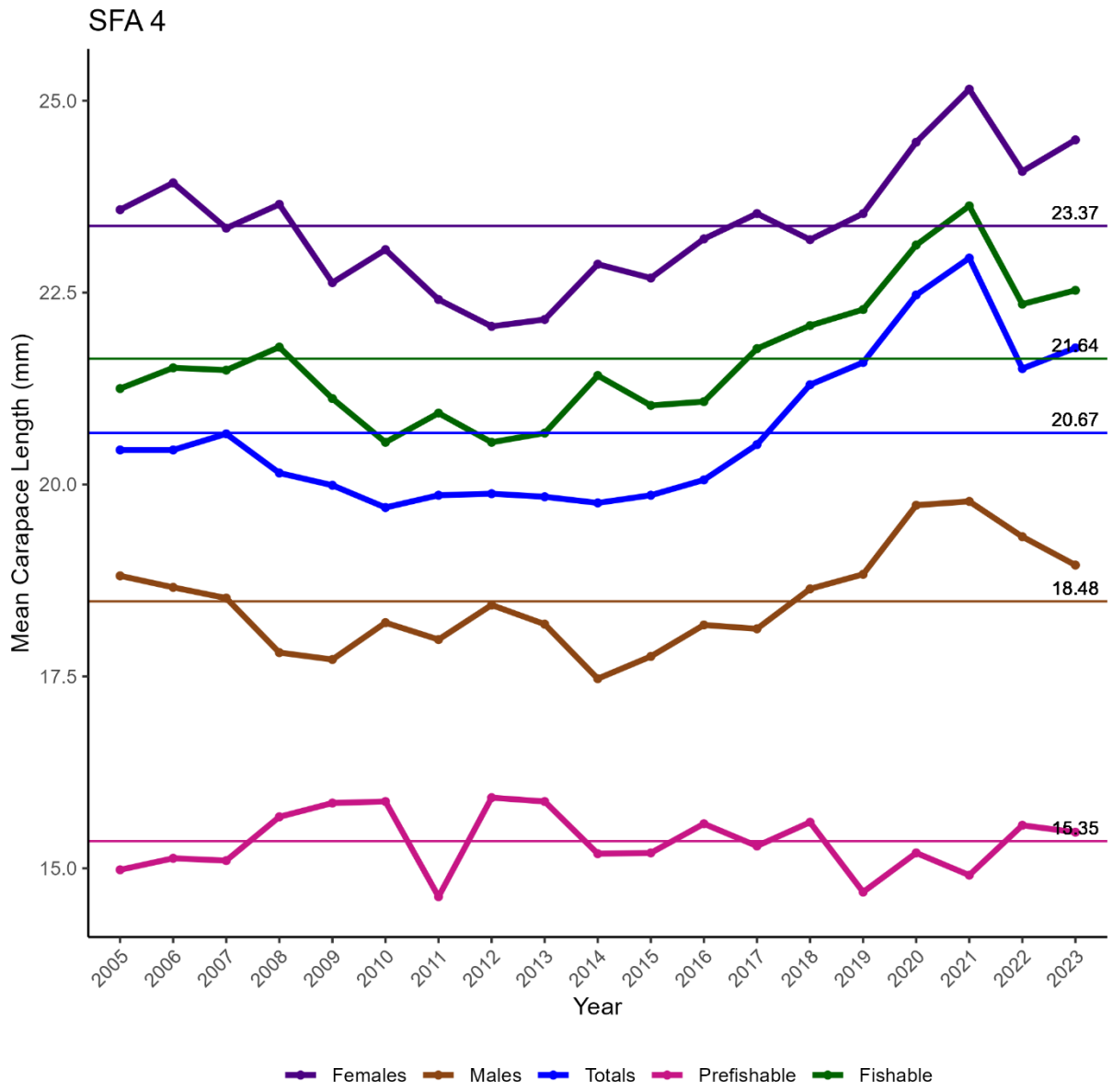

Figure 21. SFA 4 mean carapace length of totals, females, males, pre-fishable (CL <17.5 mm) and fishable (CL ≥17.5 mm) Northern Shrimp. Long-term average size for each maturity is indicated by the straight line and number at the right of each series.

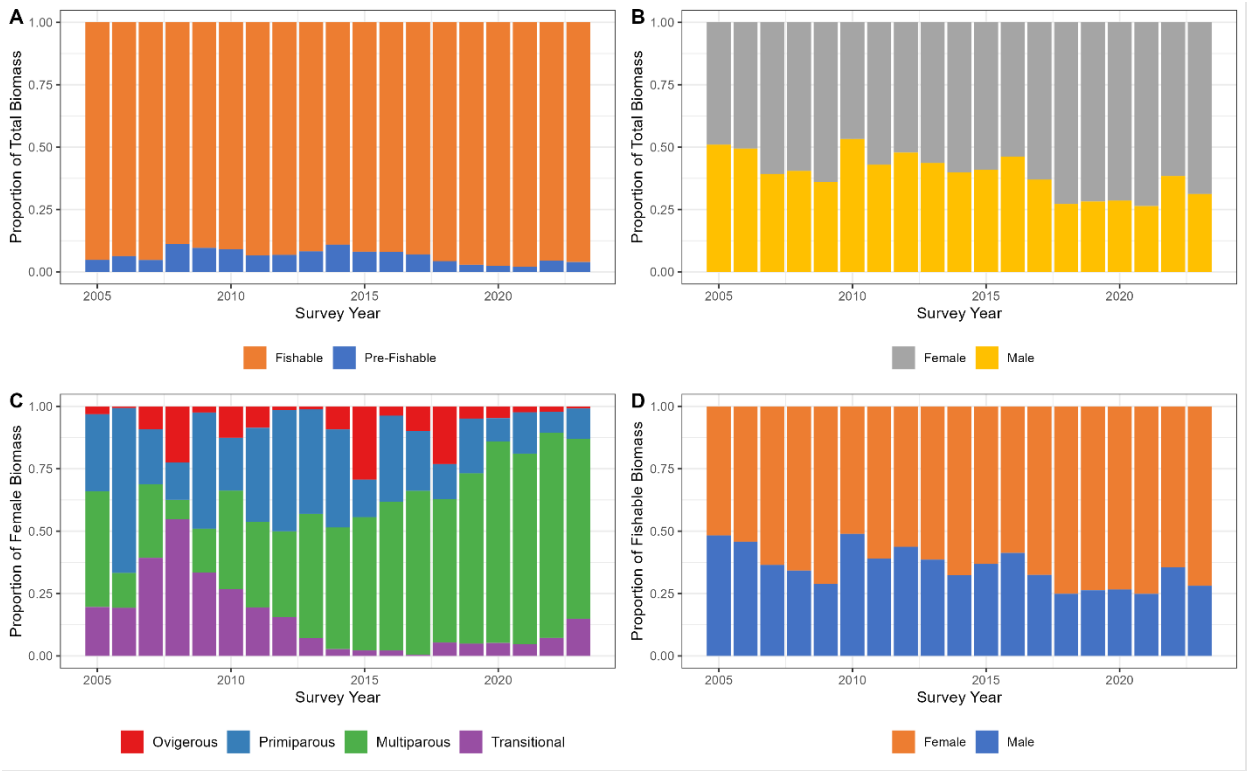

Figure 22. Proportions of biomass of various Northern Shrimp maturities in SFA 4 as sampled during the NSRF summer survey. (A) Proportion of fishable size (≥17.5 mm CL) compared to pre-fishable size of the total biomass. (B) Proportion of female compared to male Northern Shrimp in the total biomass. (C) Proportion of ovigerous, primiparous, multiparous and transitional Northern Shrimp in the female biomass. (D) Proportion of female compared to male Northern Shrimp in the fishable biomass.

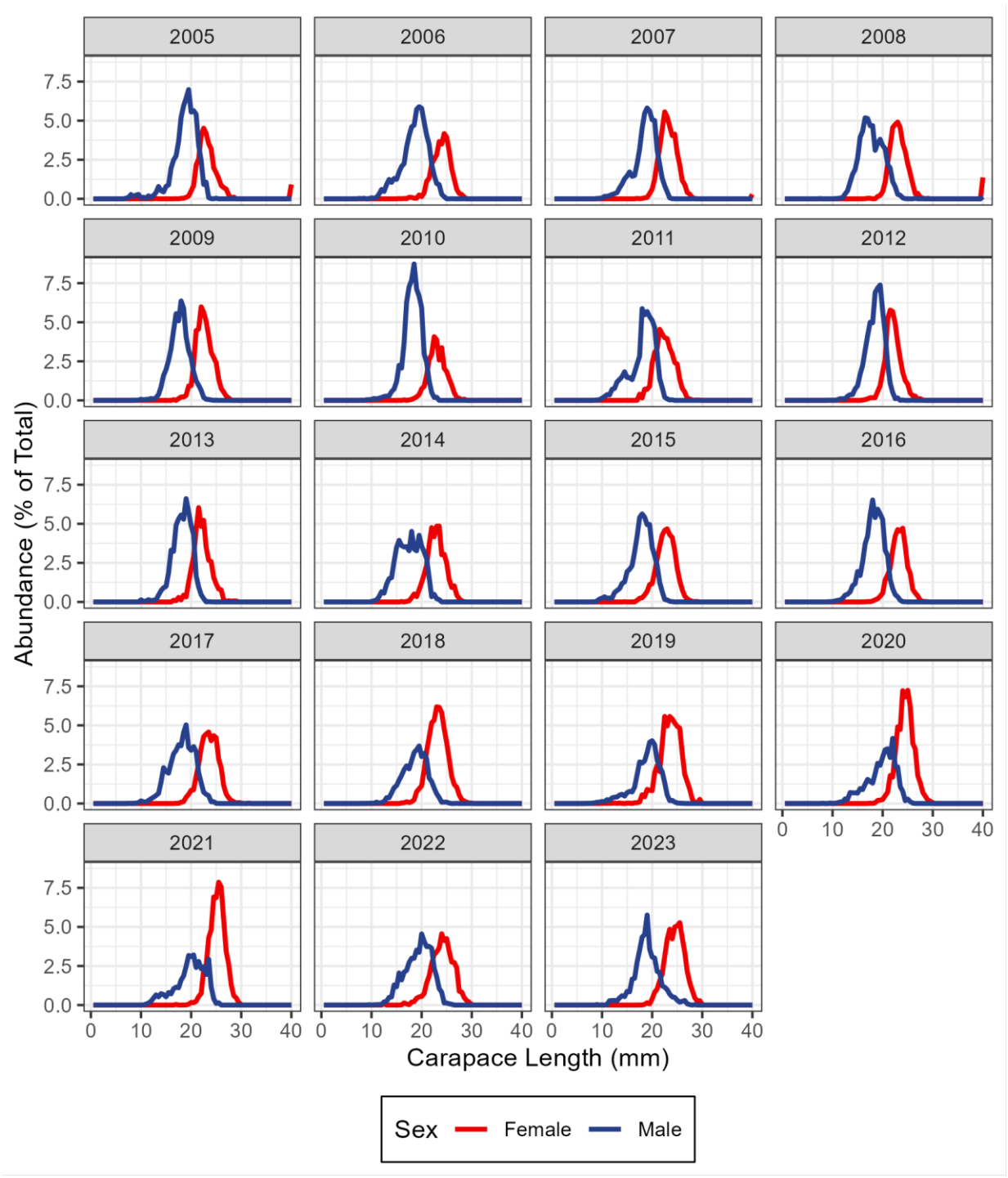

Figure 23. SFA 4 Northern Shrimp abundance at carapace length (expressed as a percentage of total abundance), as determined using Ogmap on NSRF summer shrimp data for 2005–23.

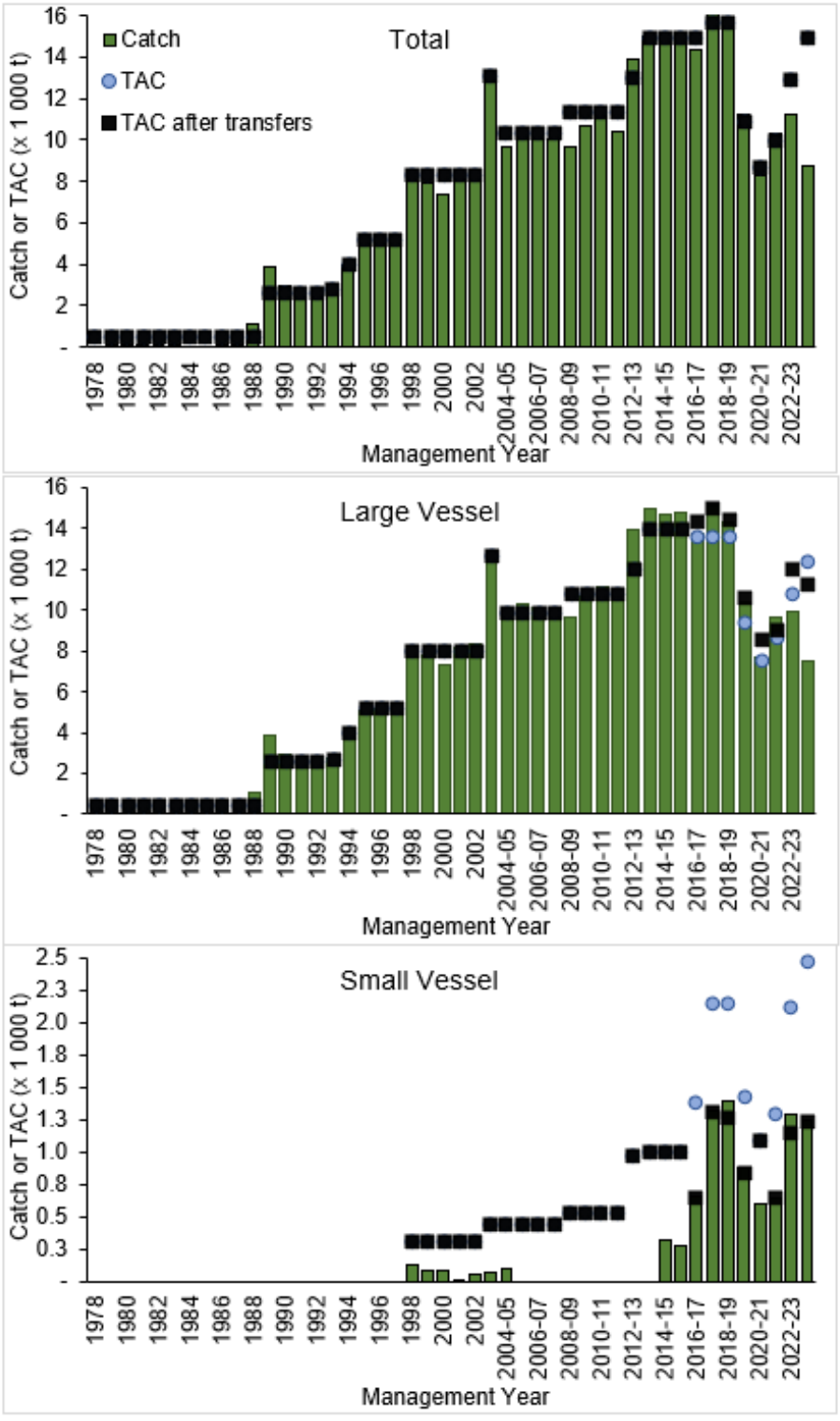

Figure 24. Historical Northern Shrimp TACs and commercial catch for 1977–2023/24 in SFA 4. Catches are preliminary as of the February 09, 2024, AQMS. In 2003, the management year was switched from a calendar year to a management year such that 2003/04 represents a 15-month-long fishing season. While quota transfers and bridging are reflected in catch numbers, they are only reflected in TACs from 2016/17–2023/24.

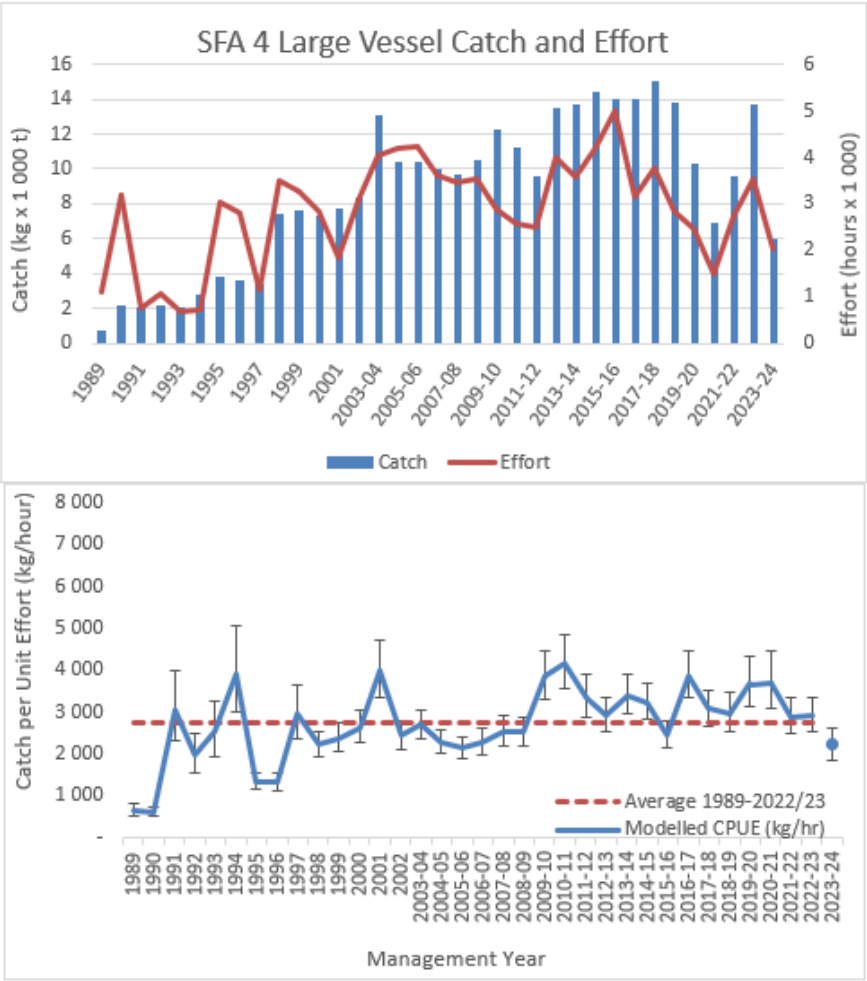

Figure 25. Top: Catch and effort as captured in observer records and used in the CPUE model. Bottom: CPUE for the LV fleet fishing for Northern Shrimp in SFA 4 from 1989–2023/24. Data for 2022/23–2023/24 are incomplete.

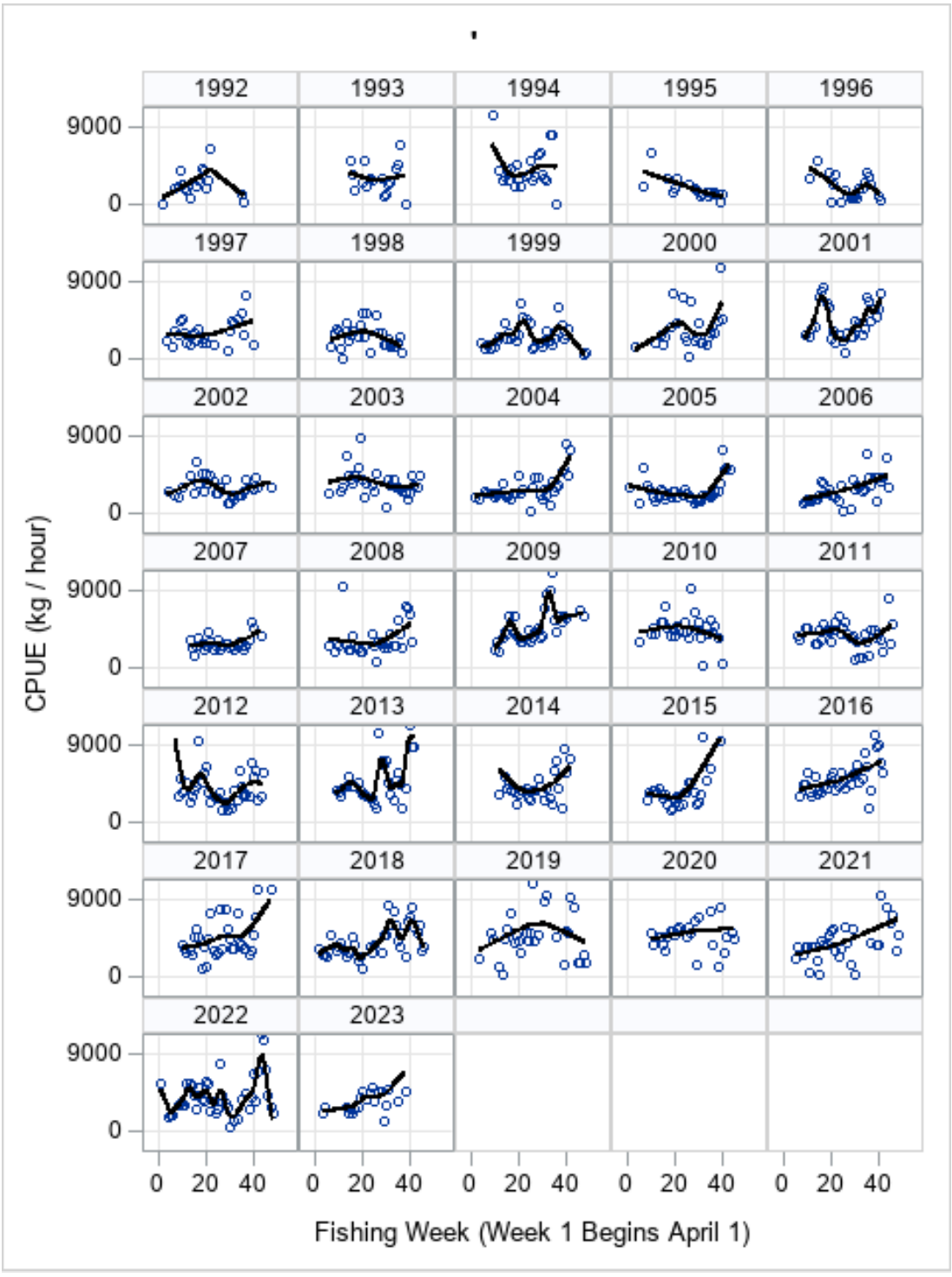

Figure 26. CPUE by year and week (of fishing season starting April 1) for the LV fleet targeting Northern Shrimp in SFA 4 from 1992–2023.

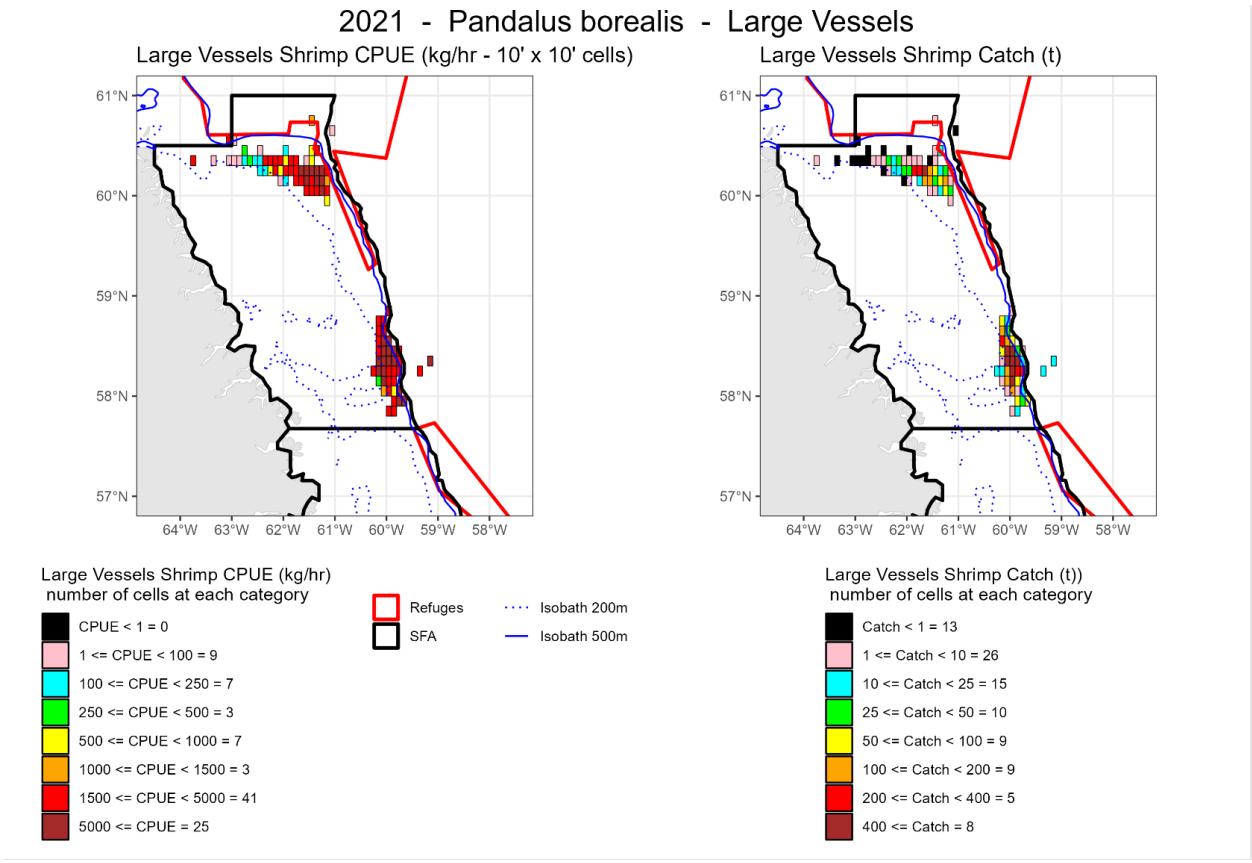

Figure 27. LV fleet (>500 t) catch and average fishery performance within the 2021/22 SFA 4 Northern Shrimp fishery. Positions of catch and effort taken from observer data set with 99% of the LV commercial catch represented in these maps.

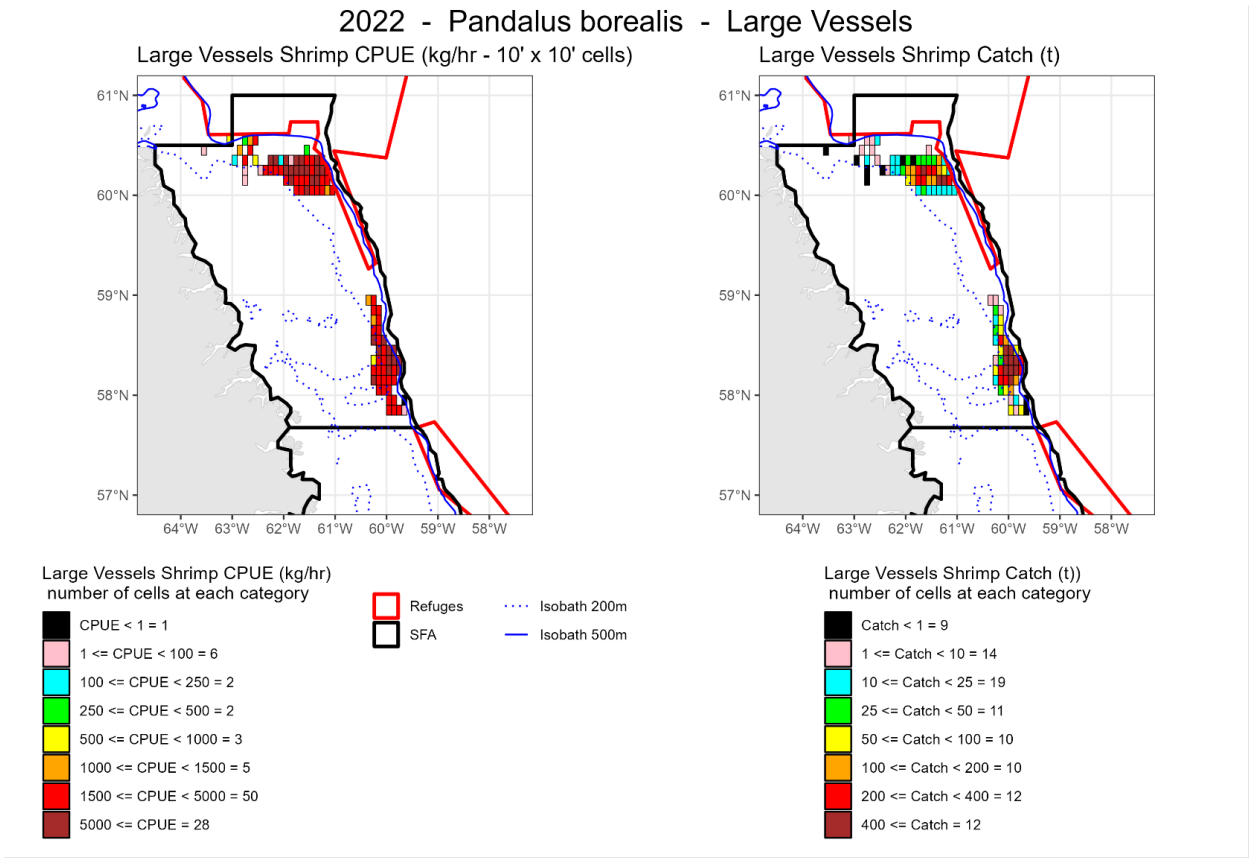

Figure 28. LV fleet (>500 t) catch and average fishery performance within the 2022/23 SFA 4 Northern Shrimp fishery. Positions of catch and effort taken from observer data set with 138% of the LV commercial catch represented in these maps.

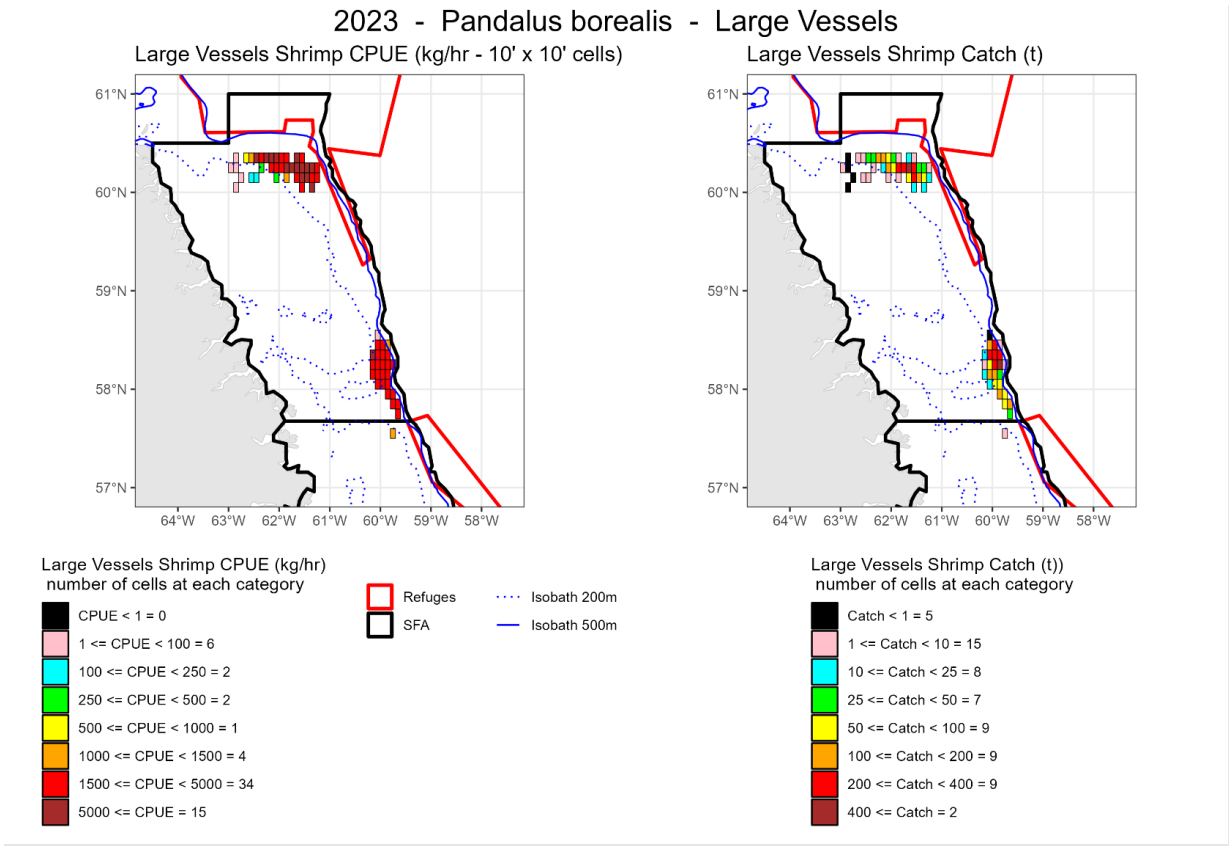

Figure 29. LV fleet (>500 t) catch and average fishery performance within the 2023/24 SFA 4 Northern Shrimp fishery. Positions of catch and effort taken from observer data set with 80% of the LV commercial catch represented in these maps.

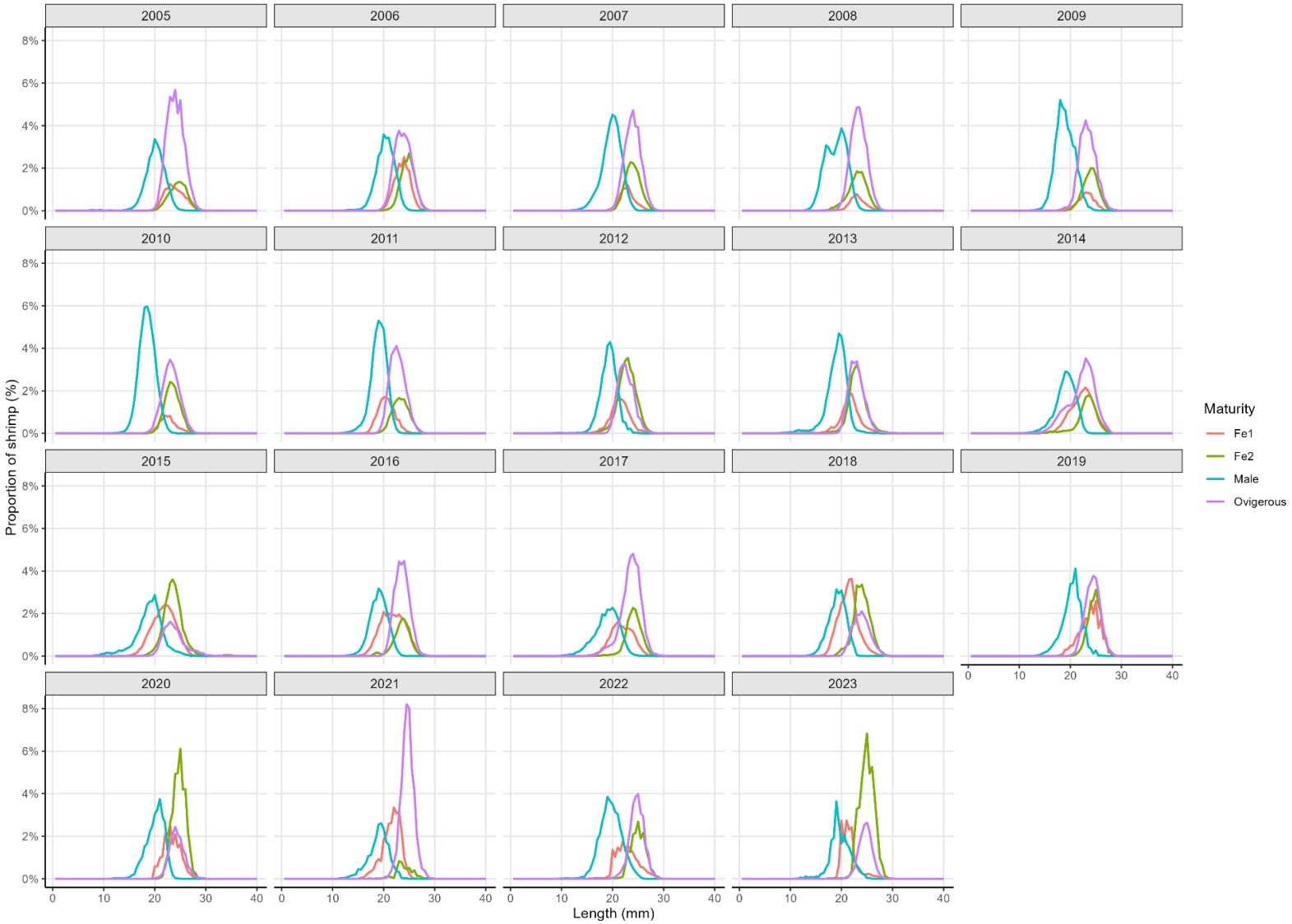

Figure 30. Observer carapace length frequencies of different maturity stages (Male, Primiparous (Fe1), Multiparous (Fe2),and Ovigerous Females) from LV fleet targeting Northern Shrimp in SFA 4 over the 2005–23 period. Data for 2023–24 are preliminary.

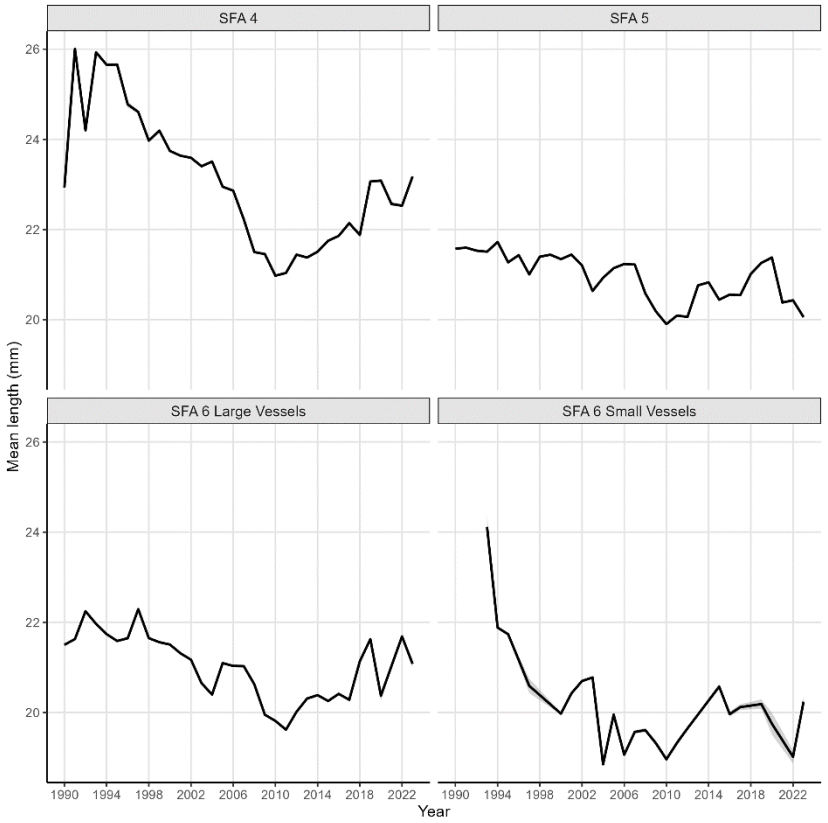

Figure 31. Mean (±95% Confidence Intervals) CL of Northern Shrimp caught by LV fleet in SFA 4 (top left panel), 5 (top right panel), 6 (bottom left panel), and SM fleet in SFA 6 (bottom right panel). Data are from detailed observer sampling. Please note that confidence intervals are shown but barely visible.

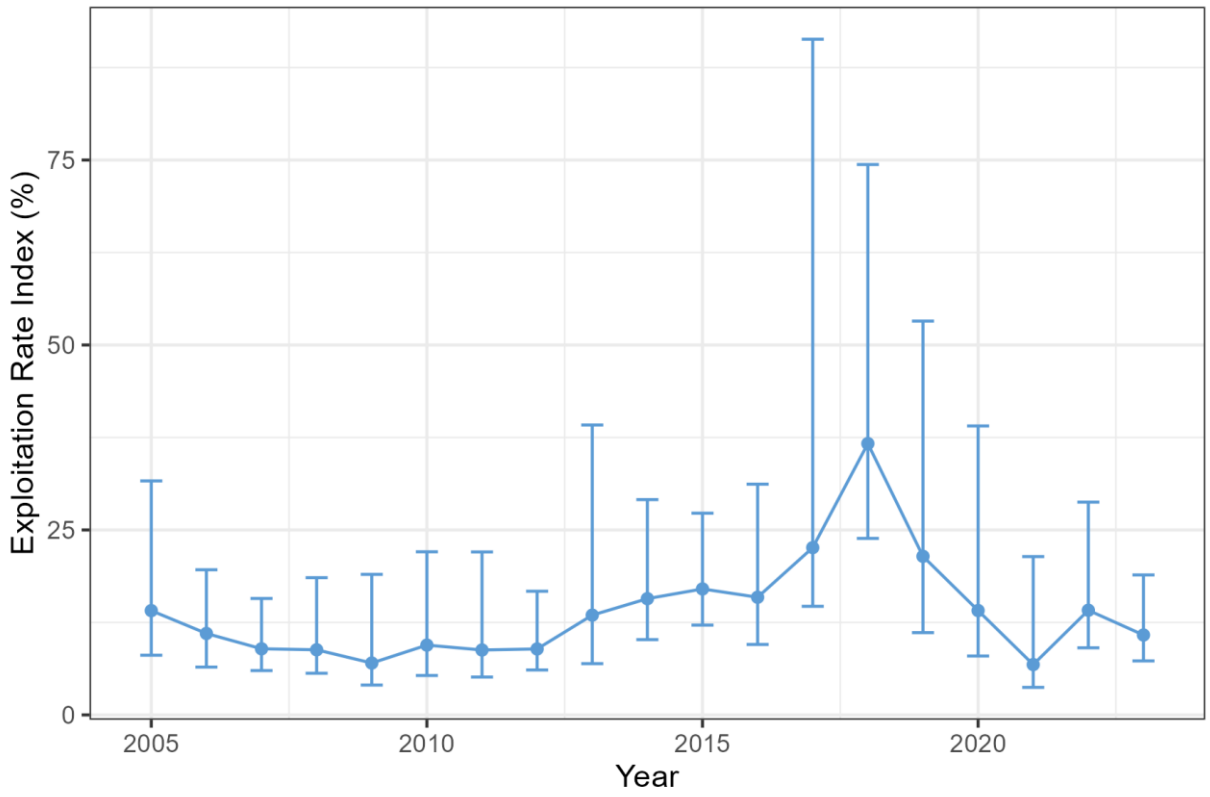

Figure 32. SFA 4 Northern Shrimp ERI based on total catch/fishable biomass from the same year, expressed as a percentage. Error bars indicate 95% confidence intervals. The 2023/24 value is based on the catch (59% of the TAC) as of the February 9, 2024, AQMS.

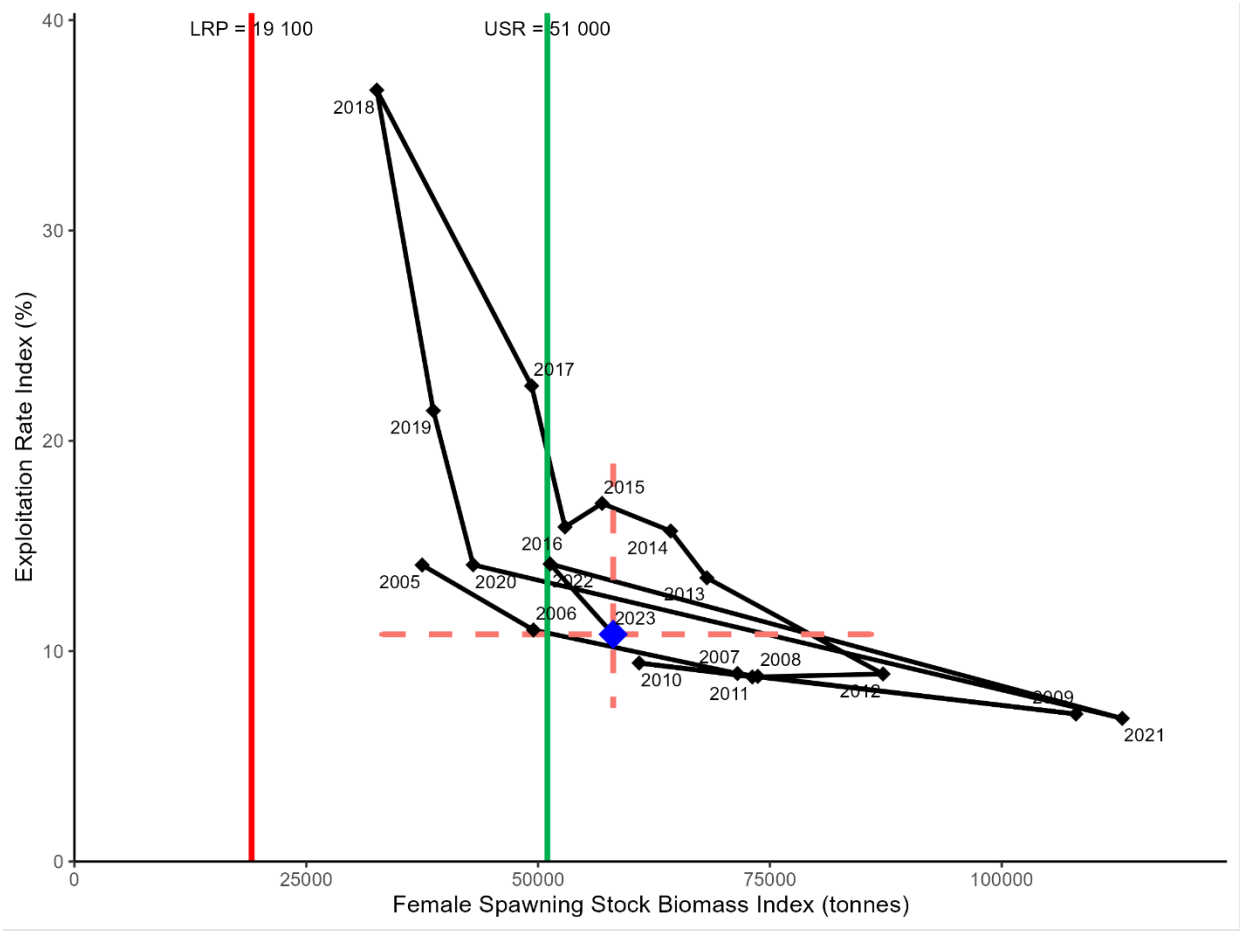

Figure 33. SFA 4 Northern Shrimp IFMP PA framework with ERI versus female SSB index. Data point labels denote management year. The 2023/24 fishery was ongoing; therefore the 2023/24 point is preliminary (in blue); the February 9, 2024, AQMS indicated that the TAC had been 59% taken. The red cross indicates 95% confidence intervals for the summer 2023 female SSB index (horizontal line) and the 2023/24 ERI (vertical line).

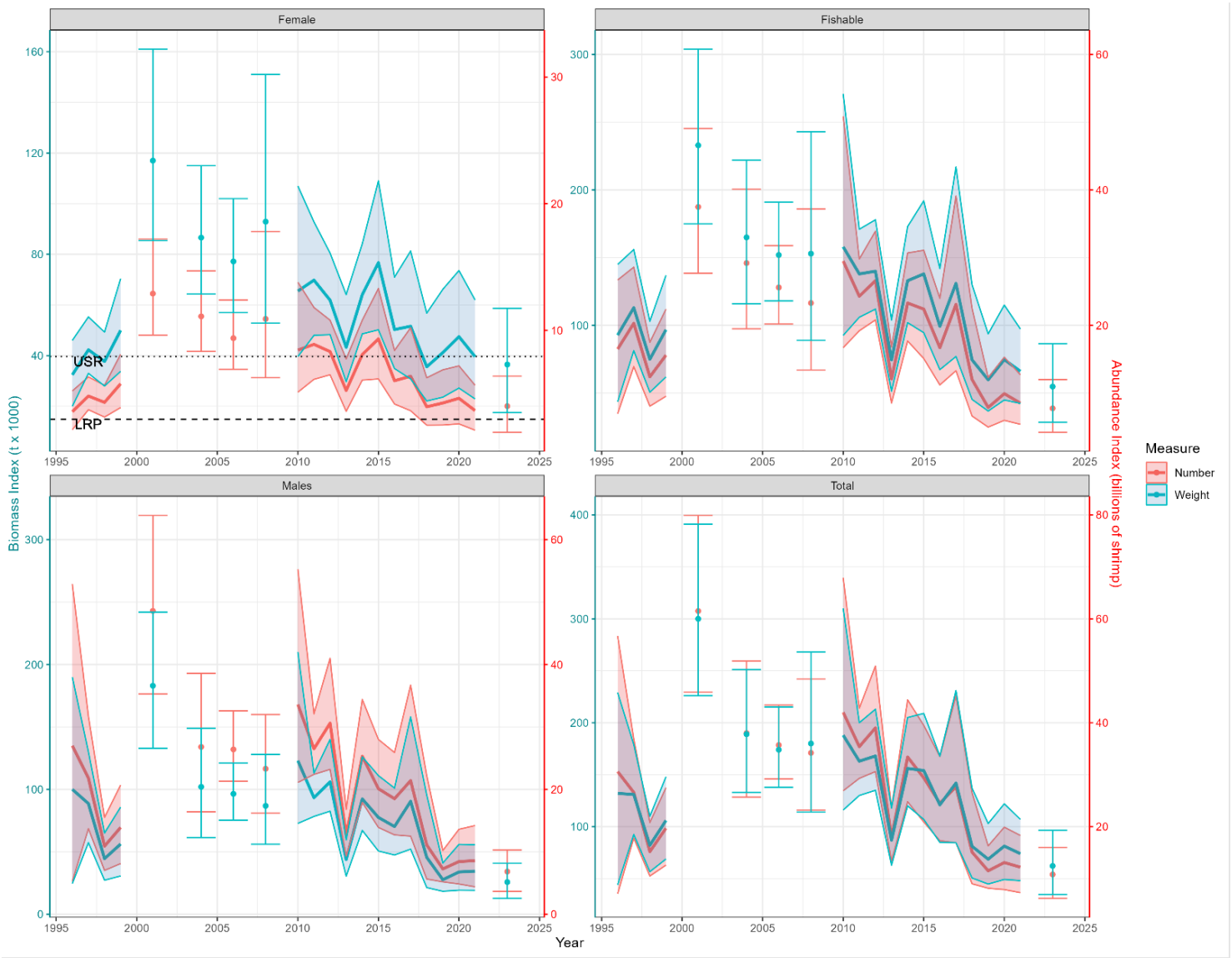

Figure 34. SFA 5 biomass and abundance indices of Northern Shrimp as derived by Ogmap using DFO multispecies fall survey data. Shaded areas indicate 95% confidence intervals and the dashed lines in the female figure represent the LRP and USR as used in the IFMP PA framework.

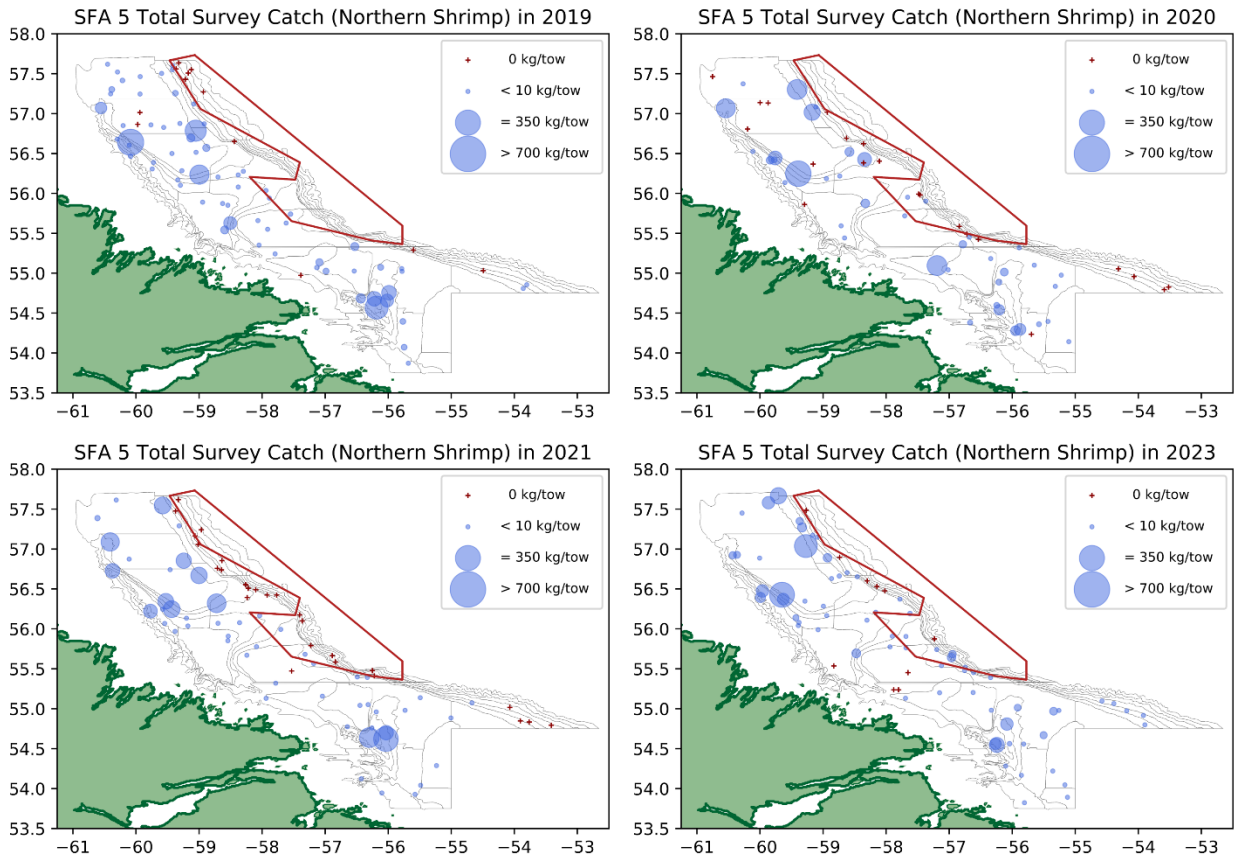

Figure 35. SFA 5 Northern Shrimp DFO multispecies fall survey catches for 2019–23 (no survey in 2022). Circle sizes are scaled to size of Northern Shrimp catch and red crosses indicate zero catch. Solid red lines indicate closed areas.

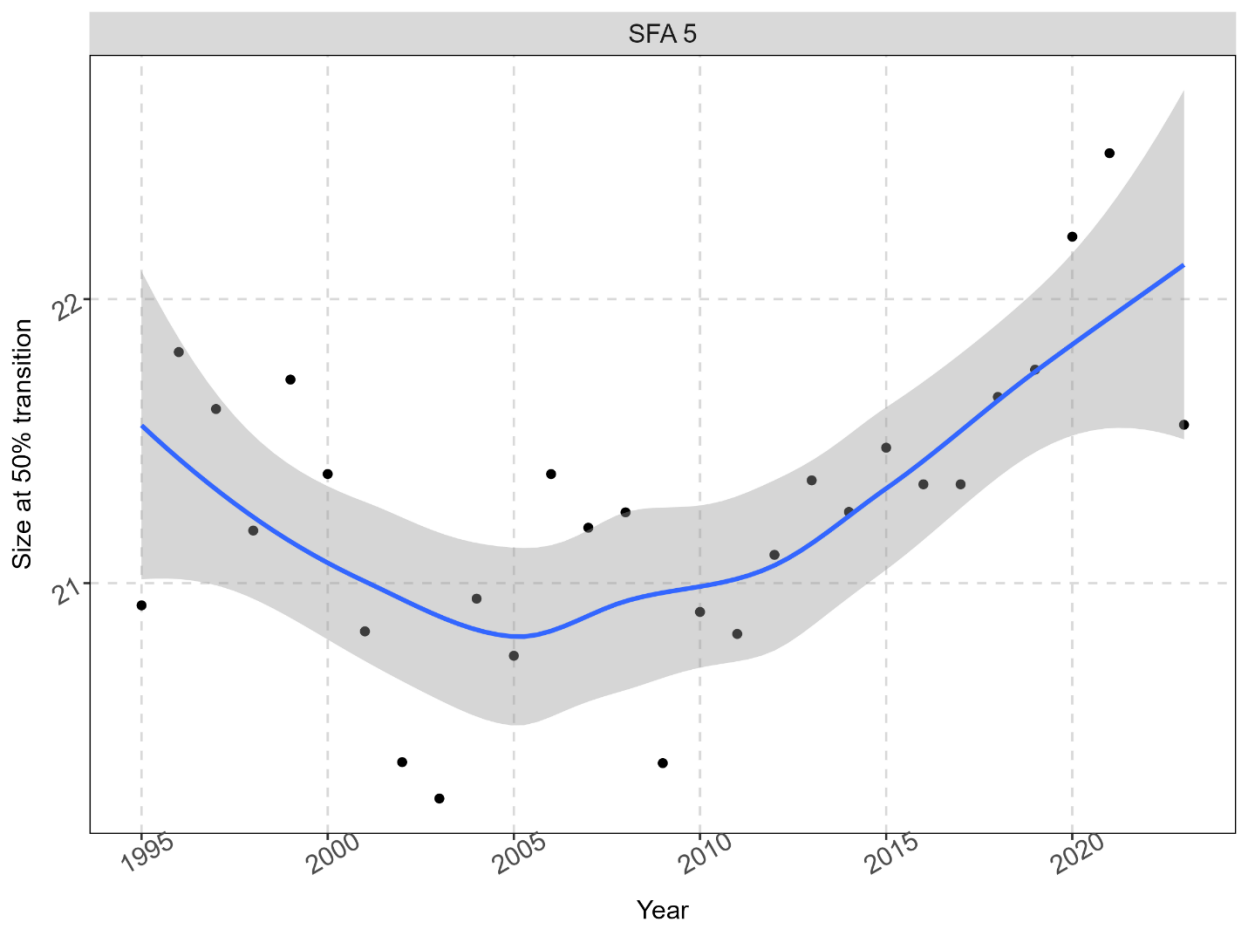

Figure 36. Annual estimated size at 50% transition of Northern Shrimp in SFA 5. Black points indicate annual estimates, the blue line represents a smoothed trend, and the grey band shows the 95% confidence intervals around the smooth.

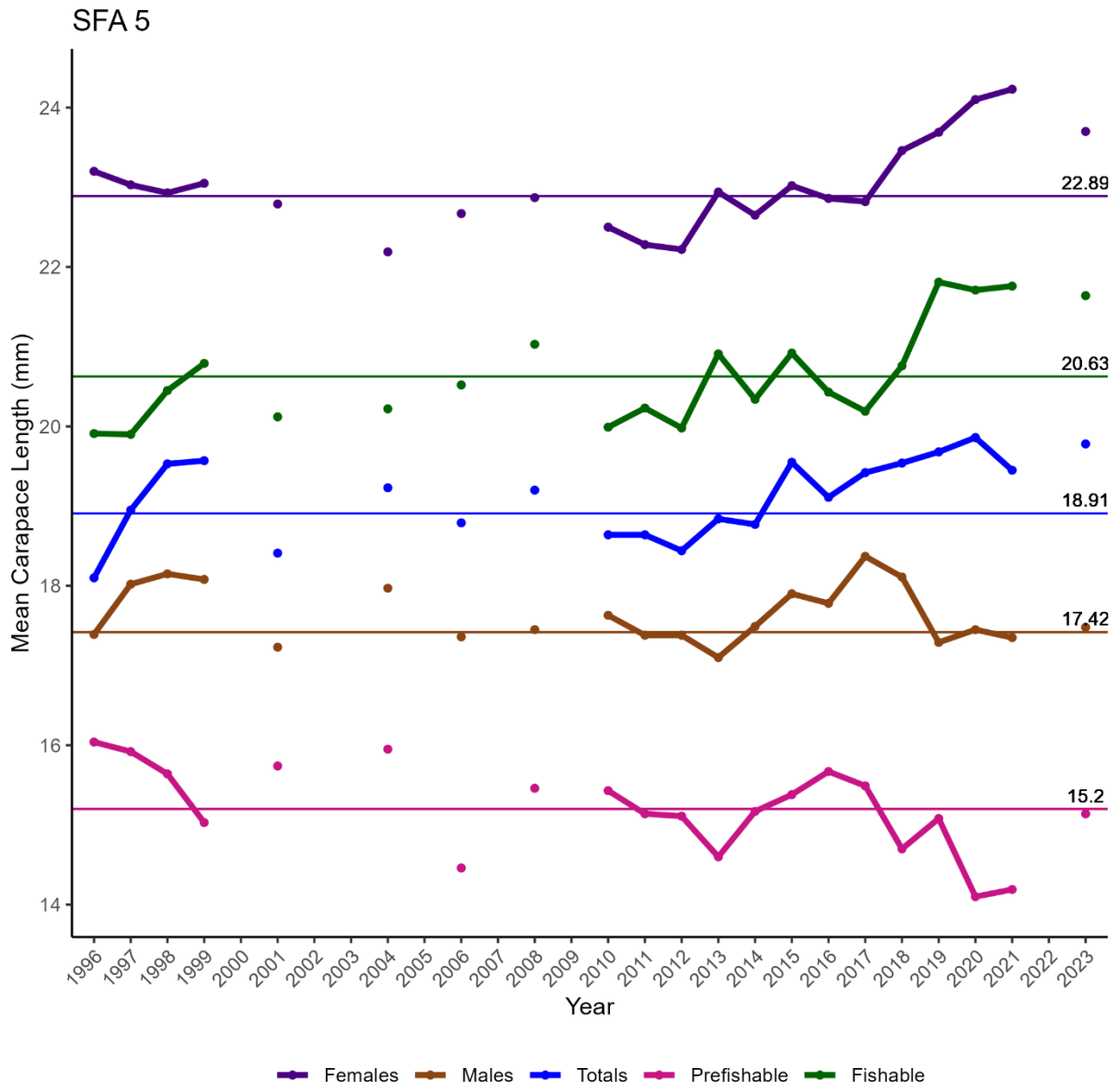

Figure 37. SFA 5 mean carapace length of totals, females, males, pre-fishable (CL <17.5 mm) and fishable (CL ≥17.5 mm) Northern Shrimp. Long-term average size for each maturity is indicated by the straight line and number at the right of each series.

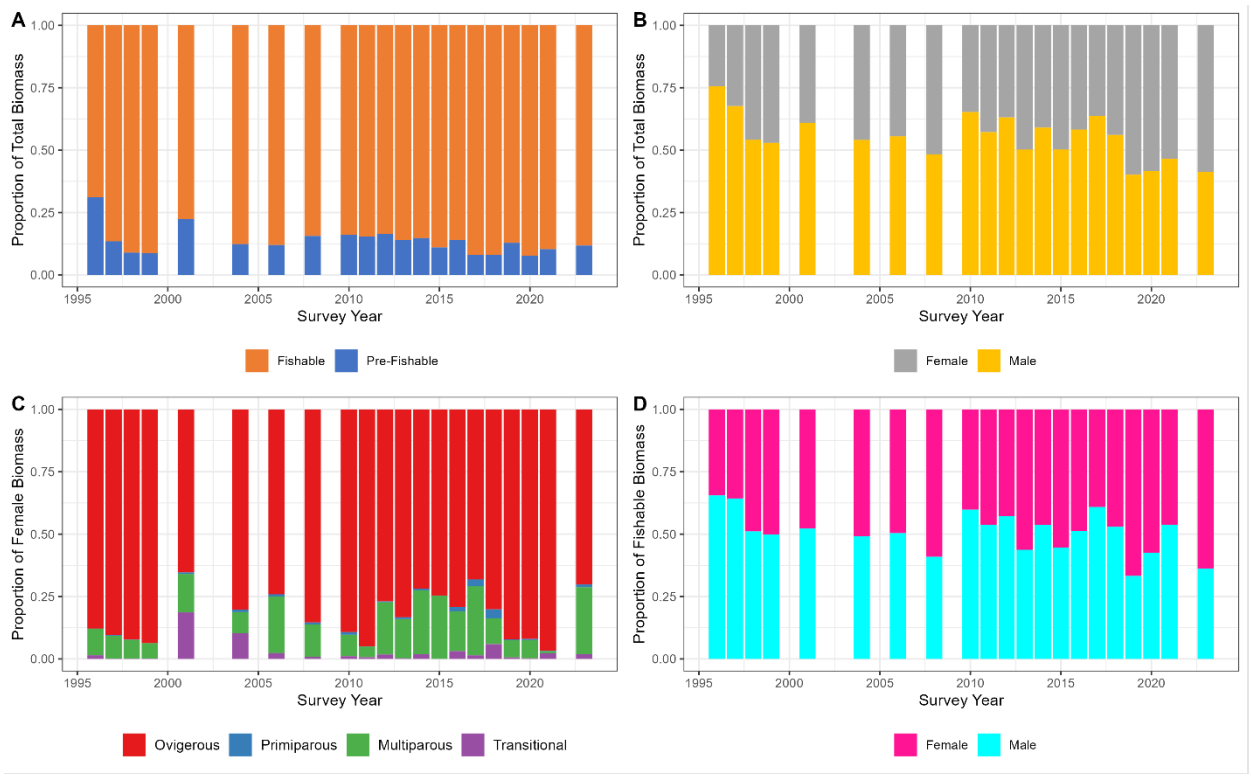

Figure 38. Proportions of biomass of various Northern Shrimp maturities in SFA 5 as sampled during the DFO multispecies fall survey (1996–2023). (A): Proportion of fishable size (≥17.5 mm CL) compared to pre-fishable size of the total biomass index. (B): Proportion of female compared to male Northern Shrimp in the total biomass index. (C): Proportion of ovigerous, primiparous, multiparous and transitional Northen Shrimp in the female biomass index. (D): Proportion of female compared to male Northen Shrimp in the fishable biomass index.

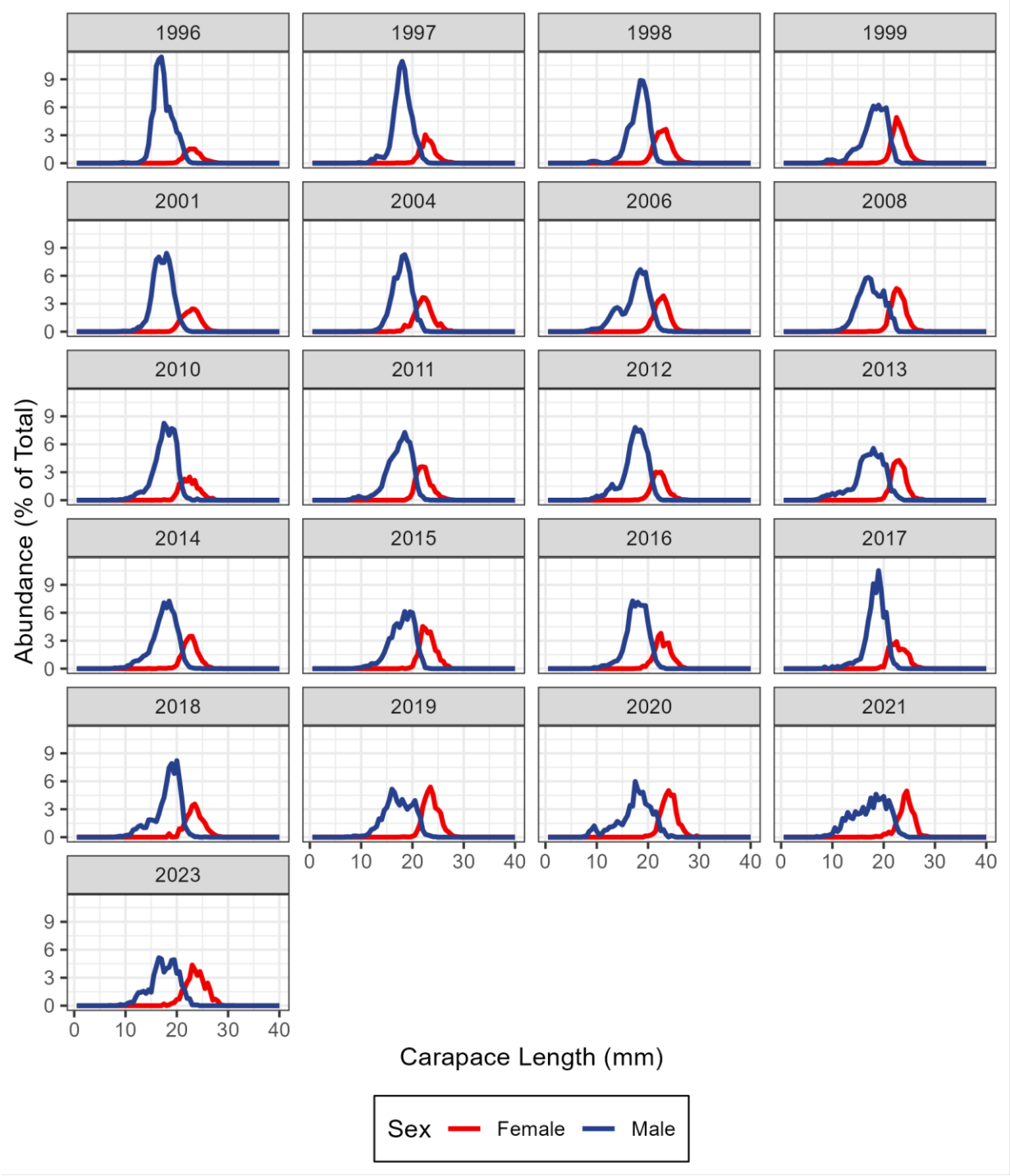

Figure 39. SFA 5 Northern Shrimp abundance at carapce length (expressed as a percentage of total abundance), as determined using Ogmap on DFO fall multispecies survey data for 1996–2023.

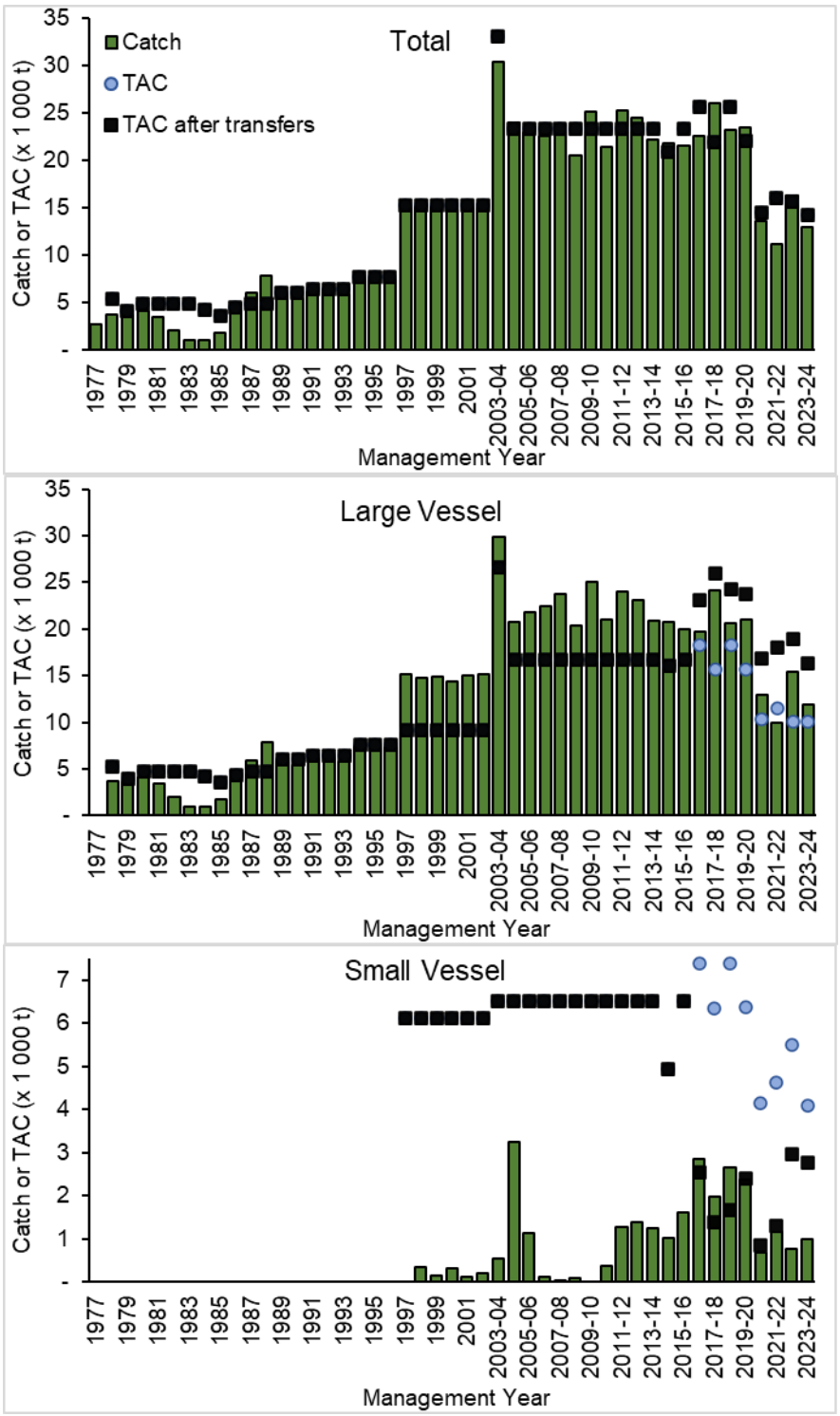

Figure 40. Historical Northern Shrimp TACs and commercial catch for 1977–2023/24 in SFA 5. Catches are preliminary as of the February 09, 2024, AQMS. In 2003, the management year was switched from a calendar year to a management year such that 2003/04 represents a 15-month-long fishing season. While quota transfers and bridging are reflected in catch numbers, they are only reflected in TACs from 2016/17–2023/24.

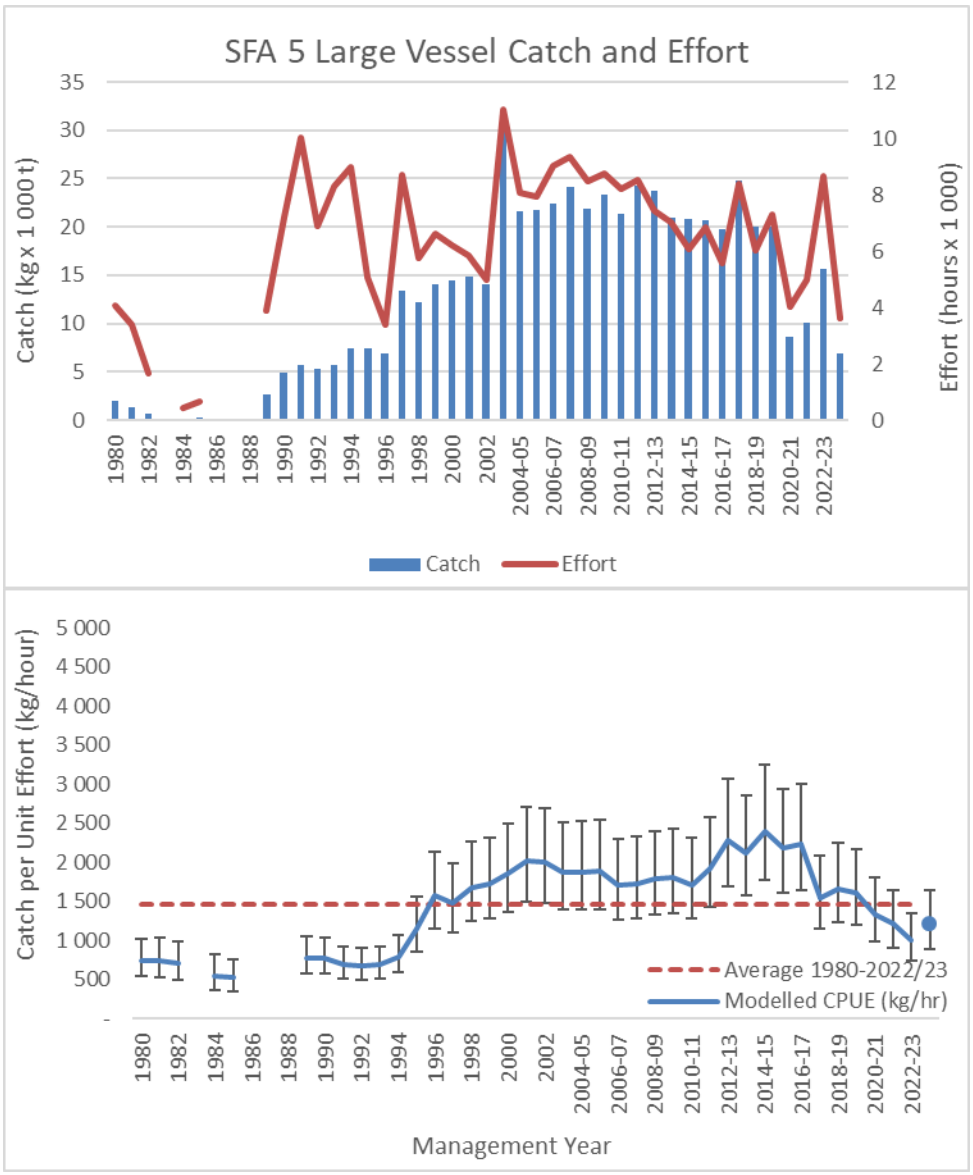

Figure 41. Top: Catch and effort as captured in observer records and used in the CPUE model. Bottom: CPUE for the LV fleet fishing for Northern Shrimp in SFA 5 from 1980–2023/24. Data for 2022/23–2023/24 are incomplete.

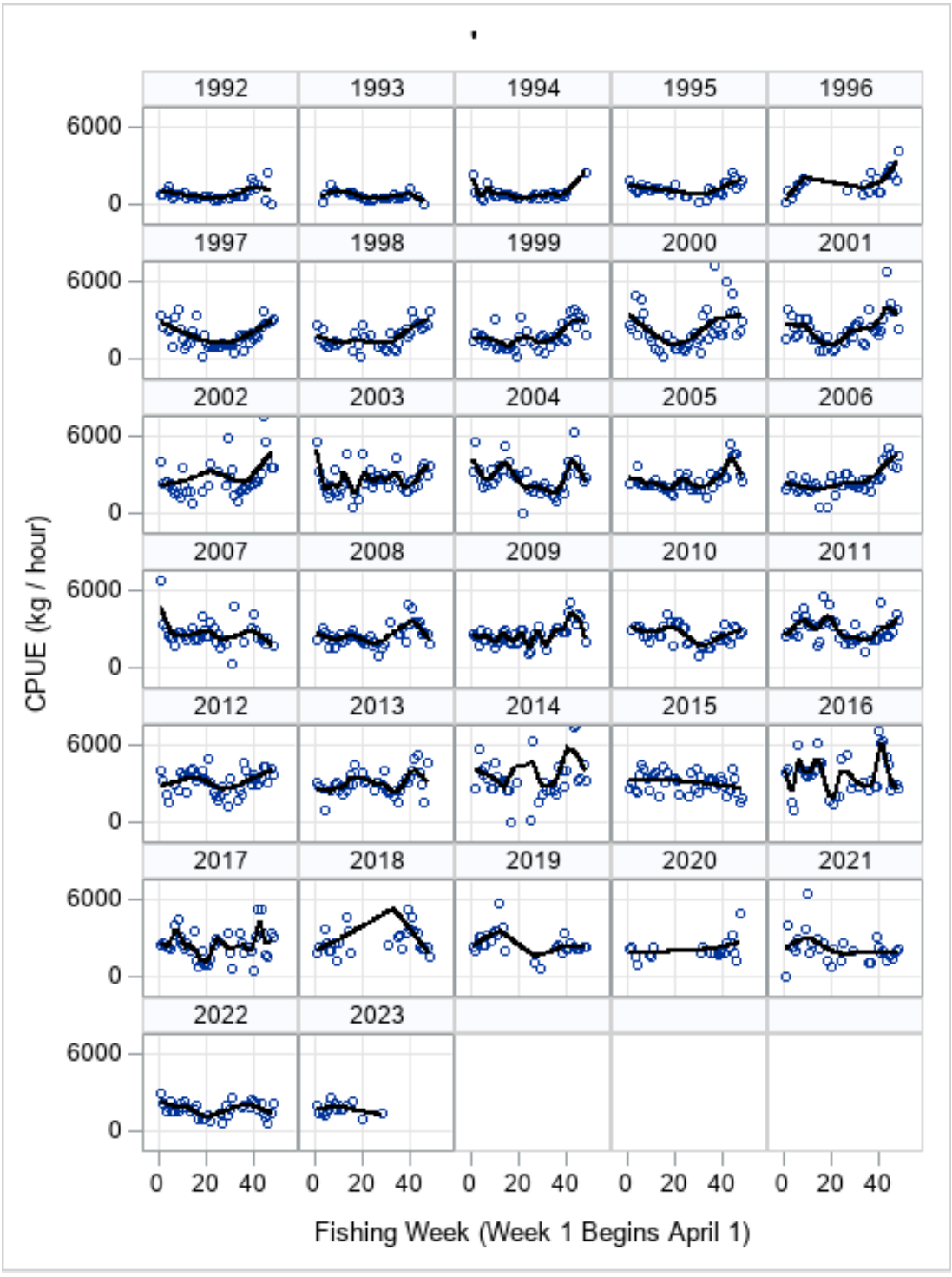

Figure 42. CPUE by year and week (of fishing season starting April 1) for the LV fleet targeting Northern Shrimp in SFA 5 from 1992–2023.

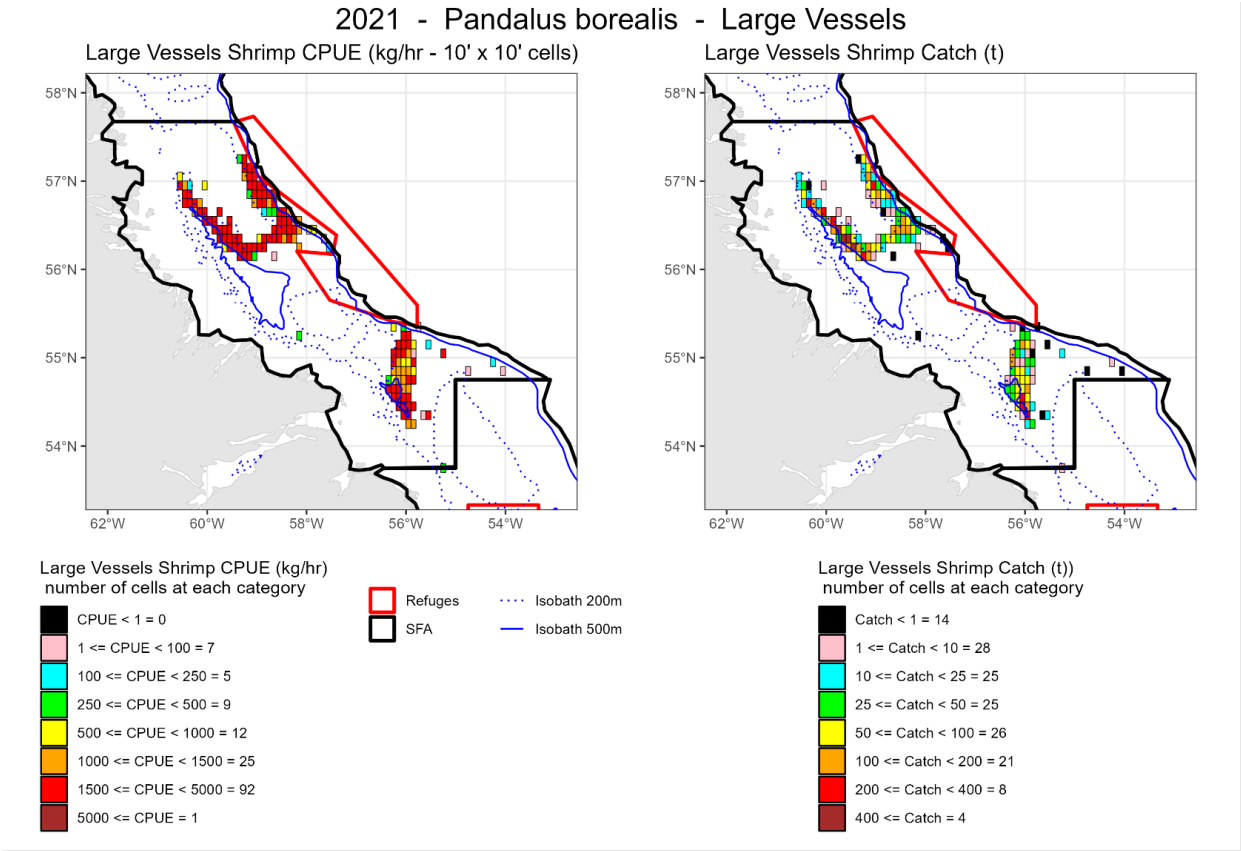

Figure 43. LV fleet (>500 t) catch and average fishery performance within the 2021/22 SFA 5 Northern Shrimp fishery. Positions of catch and effort taken from observer data set with 101% of the LV commercial catch represented in these maps.

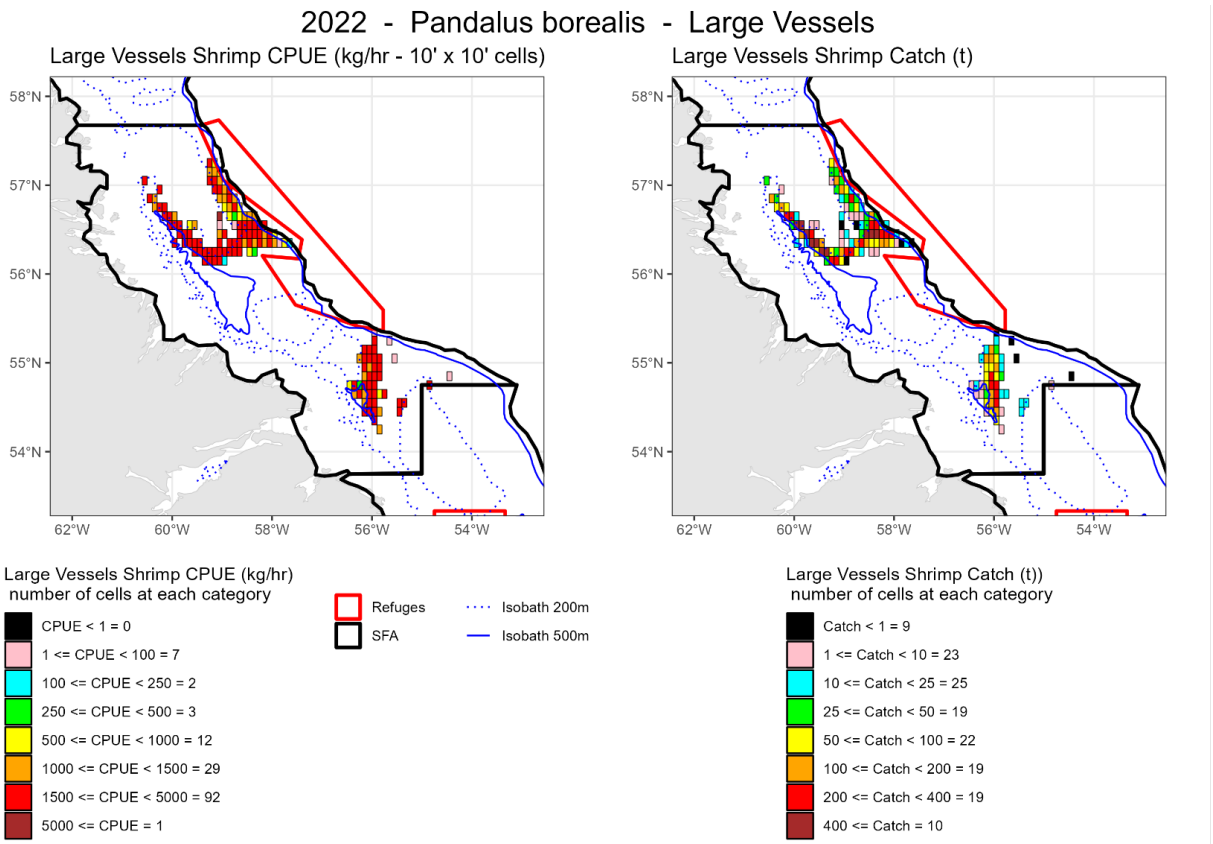

Figure 44. LV fleet (>500 t) catch and average fishery performance within the 2022/23 SFA 5 Northern Shrimp fishery. Positions of catch and effort taken from observer data set with 101% of the LV commercial catch represented in these maps.

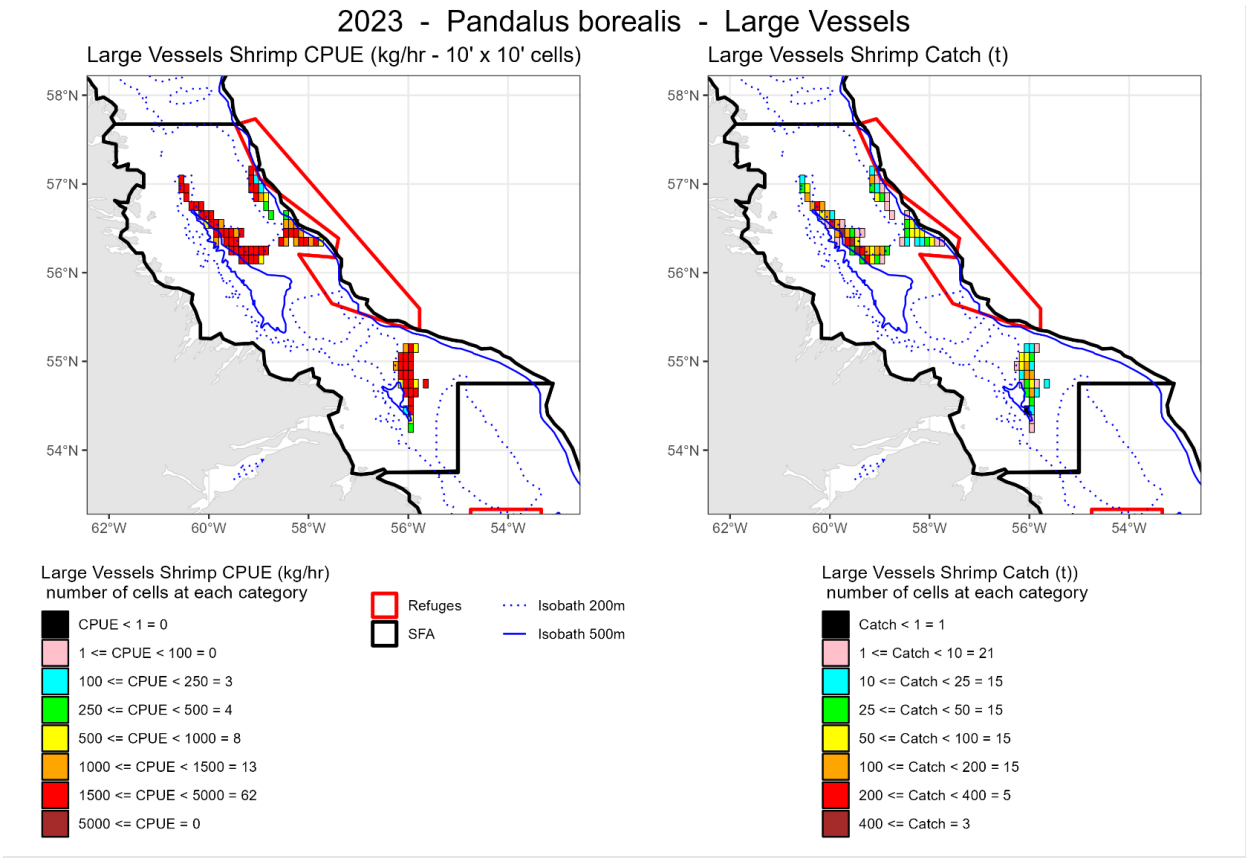

Figure 45. LV fleet (>500 t) catch and average fishery performance within the 2023/24 SFA 5 Northern Shrimp fishery. Positions of catch and effort taken from observer data set with 58% of the LV commercial catch represented in these maps.

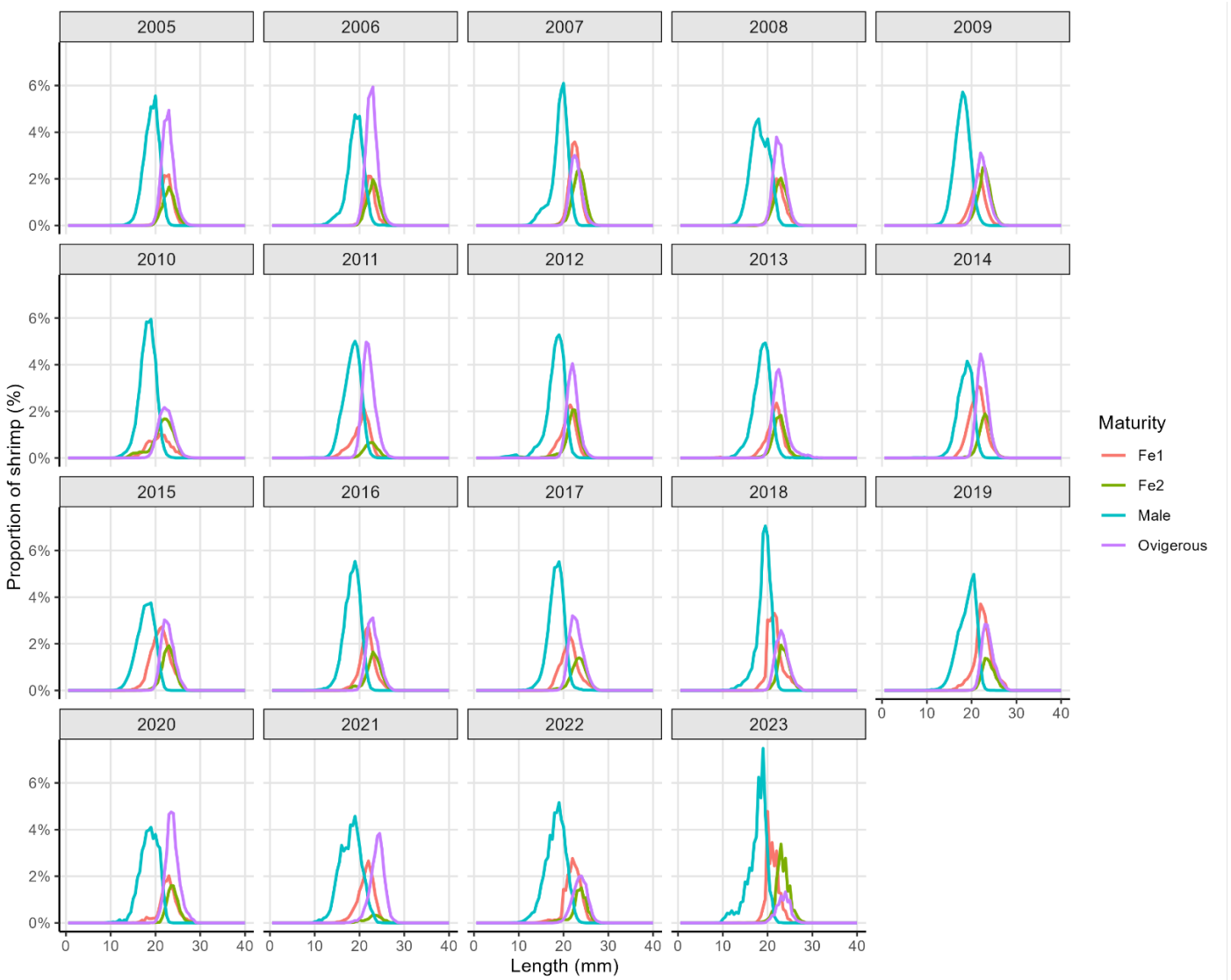

Figure 46. Observer carapace length frequencies of different maturity stages (Male, Primiparous (Fe1), Multiparous (Fe2),and Ovigerous Females) from LV fleet targeting Northern Shrimp in SFA 5 over the 2005–23 period. Data for 2023–24 are preliminary.

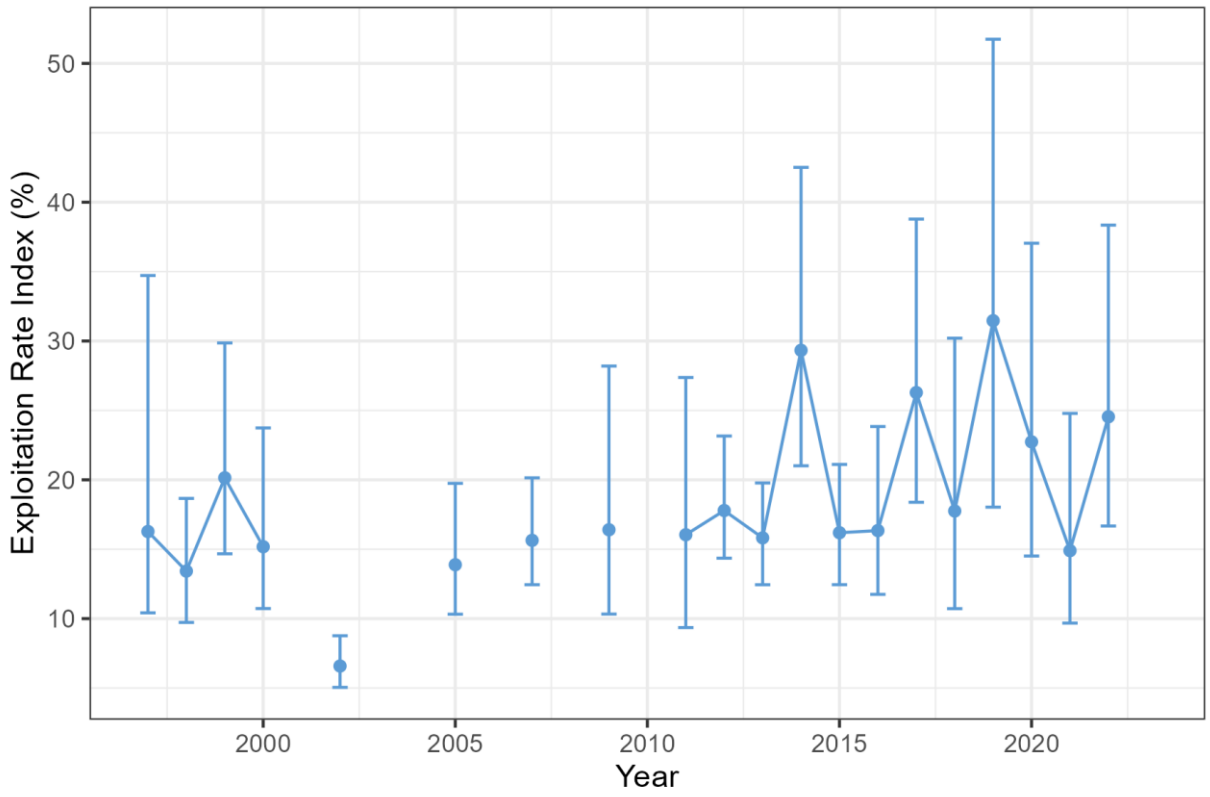

Figure 47. SFA 5 Northern Shrimp ERI based on total catch/fishable biomass index from the previous year, expressed as a percentage. Error bars indicate 95% confidence intervals. The 2023/24 value is not available as there was no DFO fall multispecies survey in 2022.

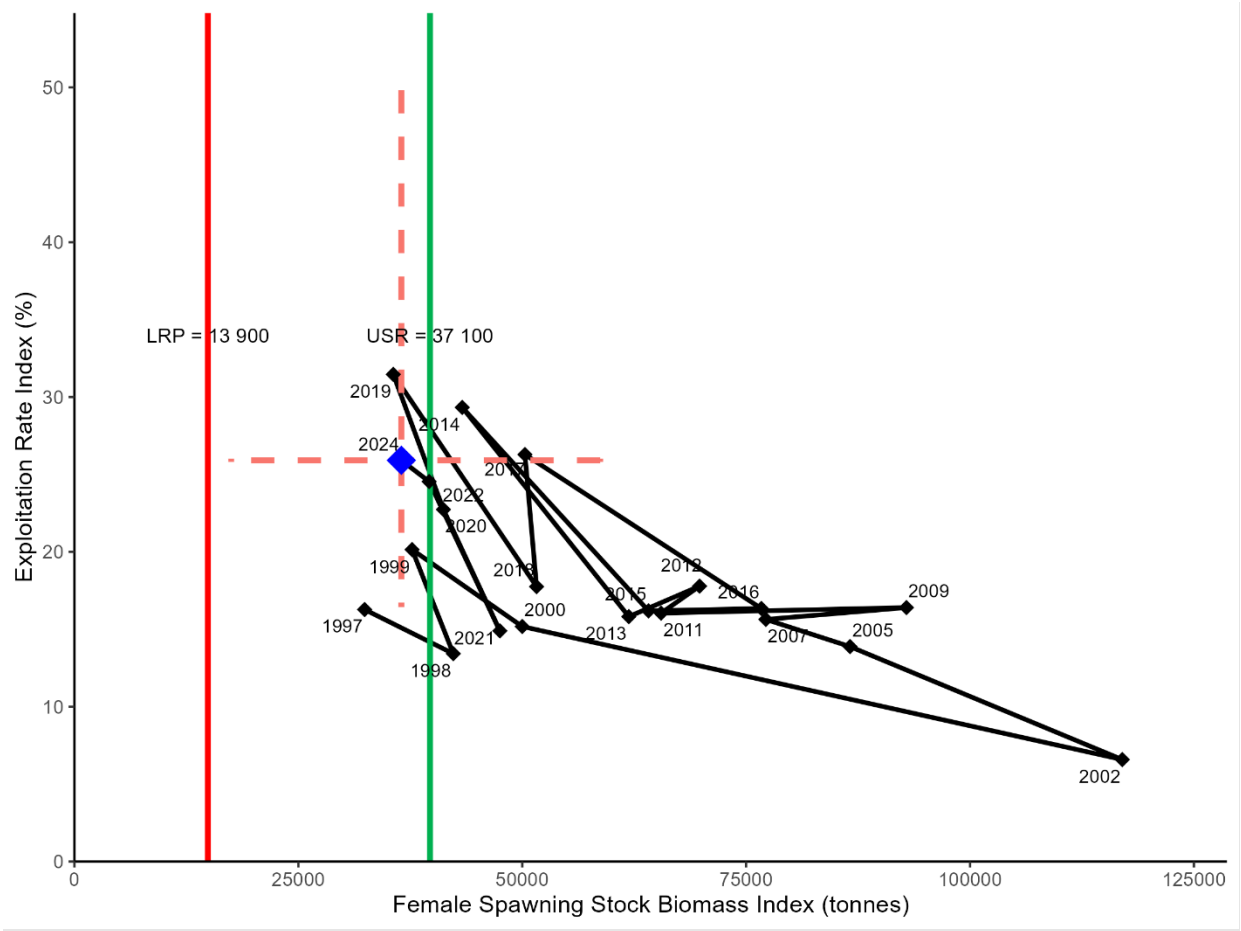

Figure 48. SFA 5 Northern Shrimp IFMP PA framework with ERI versus female SSB index. Data point labels denote the first year of management years. The 2023/24 value is not available as there was no DFO fall multispecies survey in 2022. The 2024/25 point (blue) is based upon 2023 female SSB index and assumes that the 2023/24 TAC of 14,200 t is unchanged, and subsequently caught, in 2024/25. The red cross indicates 95% confidence intervals for the fall 2023 female SSB index (horizontal line) and for the projected ERI (vertical line).

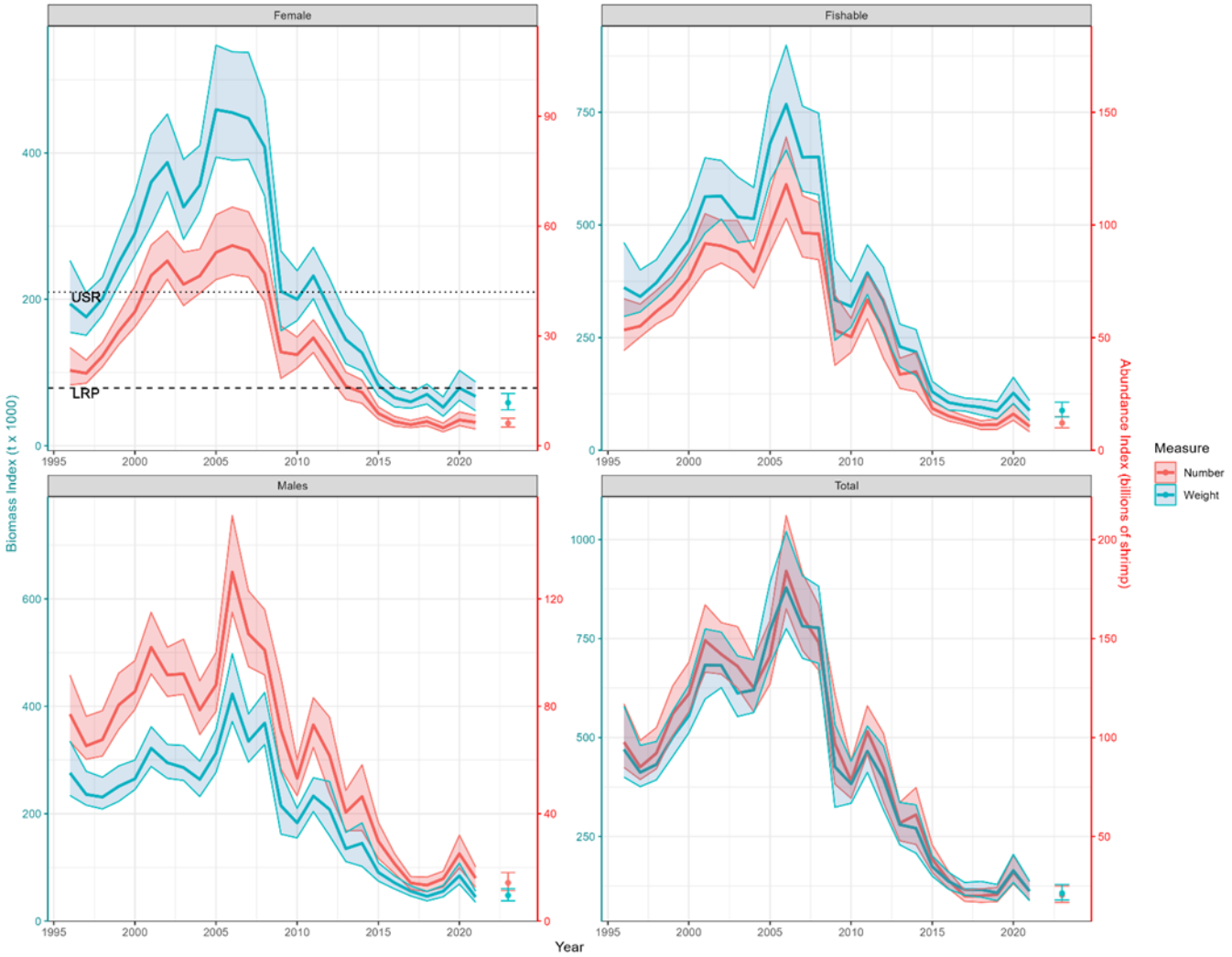

Figure 49. SFA 6 biomass and abundance indices of Northern Shrimp as derived by Ogmap using DFO multispecies fall survey data. Shaded areas indicate 95% confidence intervals and the dashed lines in the female figure represent the LRP and USR as used in the IFMP PA framework.

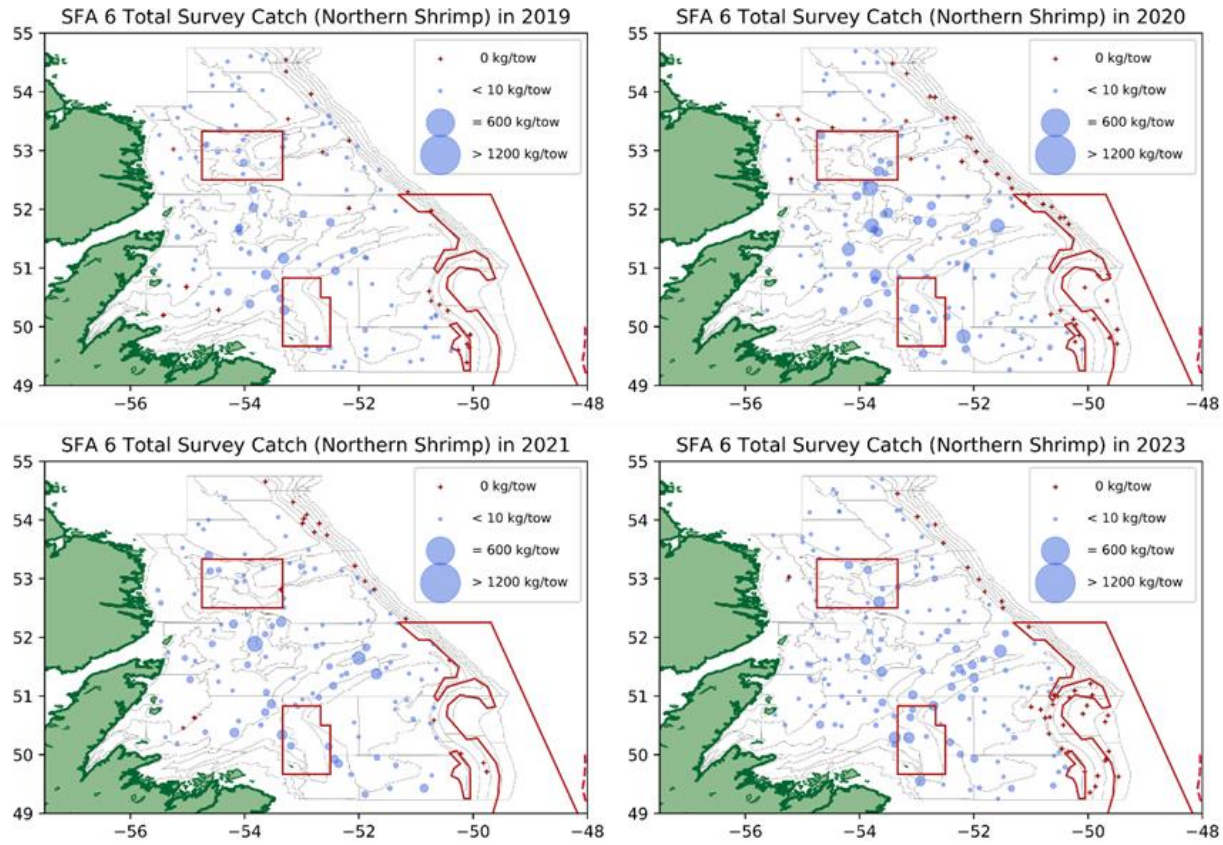

Figure 50. SFA 6 Northern Shrimp DFO multispecies fall survey data catches for 2019–23. Circle sizes are scaled to size of Northern Shrimp catch and red crosses indicate zero catch. Solid red lines indicate closed areas.

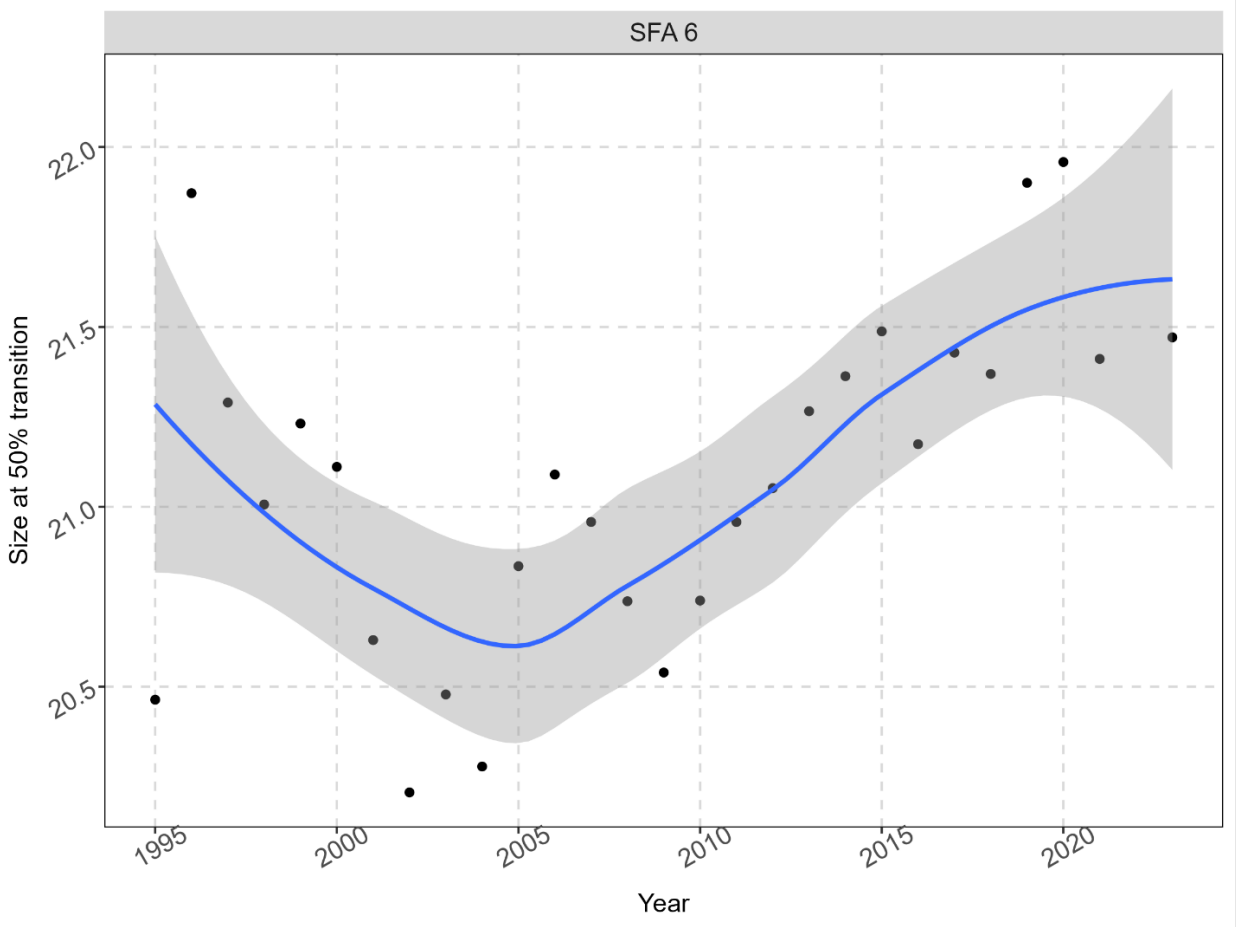

Figure 51. Annual estimated size at 50% transition of Northern Shrimp in SFA 6. Black points indicate annual estimates, the blue line represents a smoothed trend, and the grey band shows the 95% confidence intervals around the smooth.

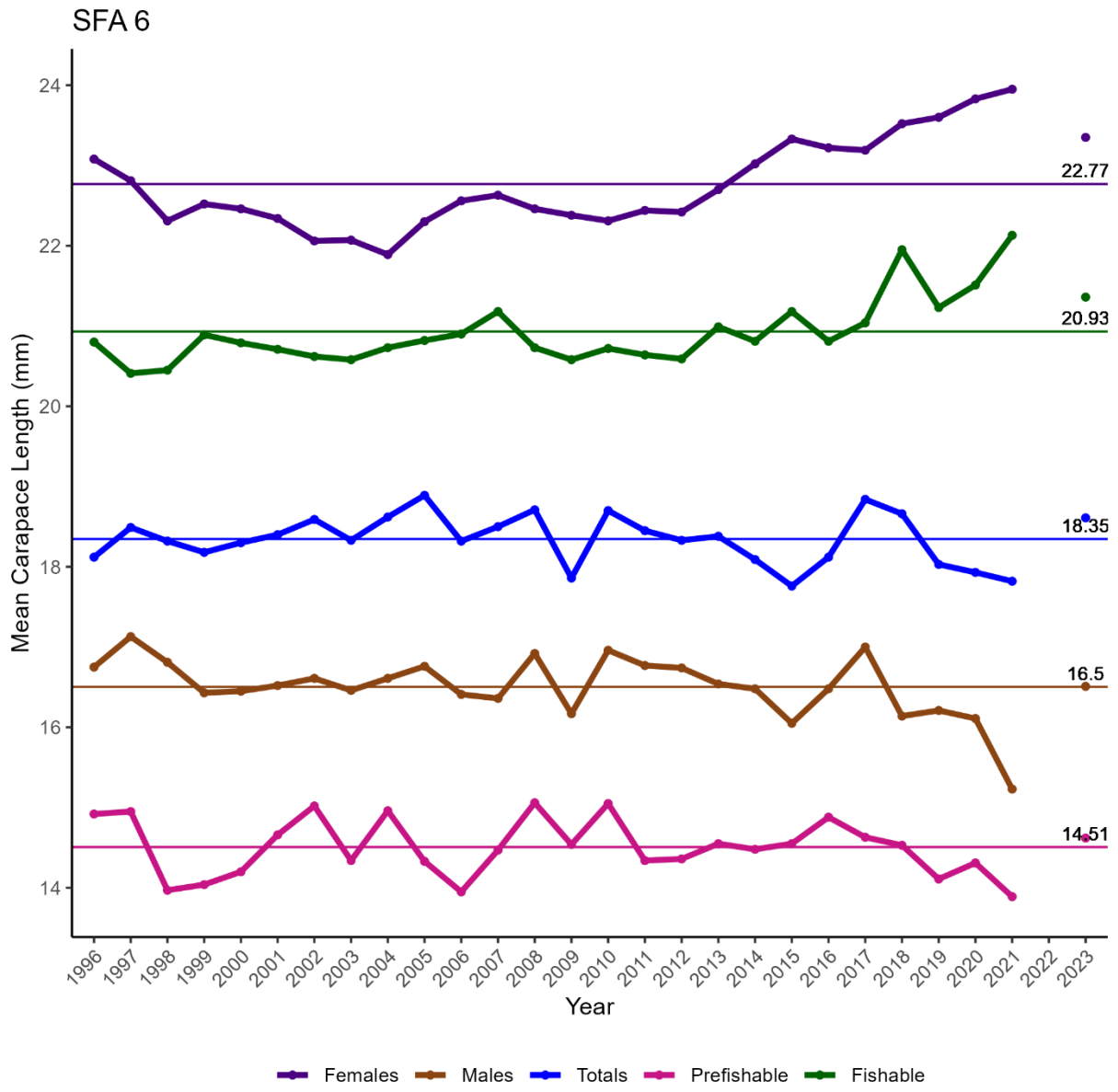

Figure 52. SFA 6 mean carapace length of totals, females, males, pre-fishable (CL <17.5 mm) and fishable (CL ≥17.5 mm) Northern Shrimp. Long-term average size for each maturity is indicated by the straight line and number at the right of each series.

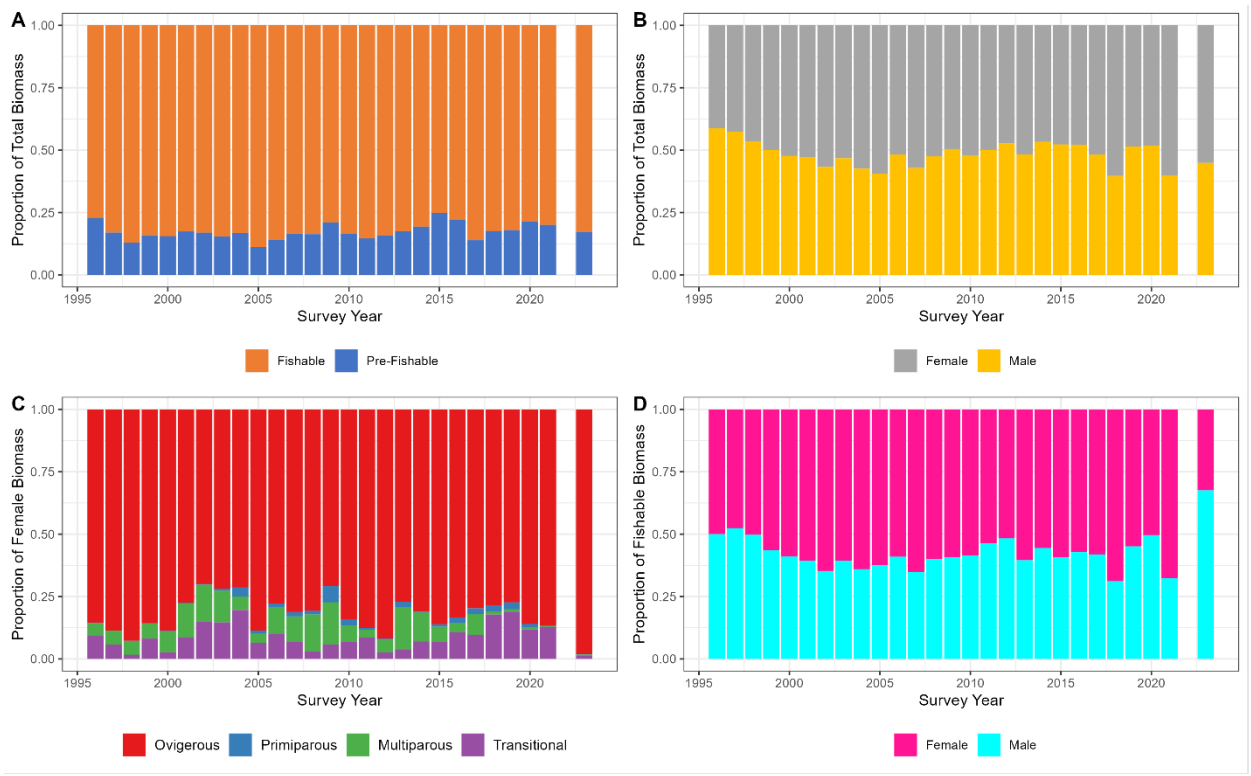

Figure 53. Proportions of biomass of various Northern Shrimp maturities in SFA 6 as sampled during the DFO multispecies fall survey. (A) Proportion of fishable size (≥17.5 mm CL) compared to pre-fishable size of the total biomass index. (B) Proportion of female compared to male Northern Shrimp in the total biomass index. (C) Proportion of ovigerous, primiparous, multiparous and transitional Northern Shrimp in the female biomass index. (D) Proportion of female compared to male Northern Shrimp in the fishable biomass index.

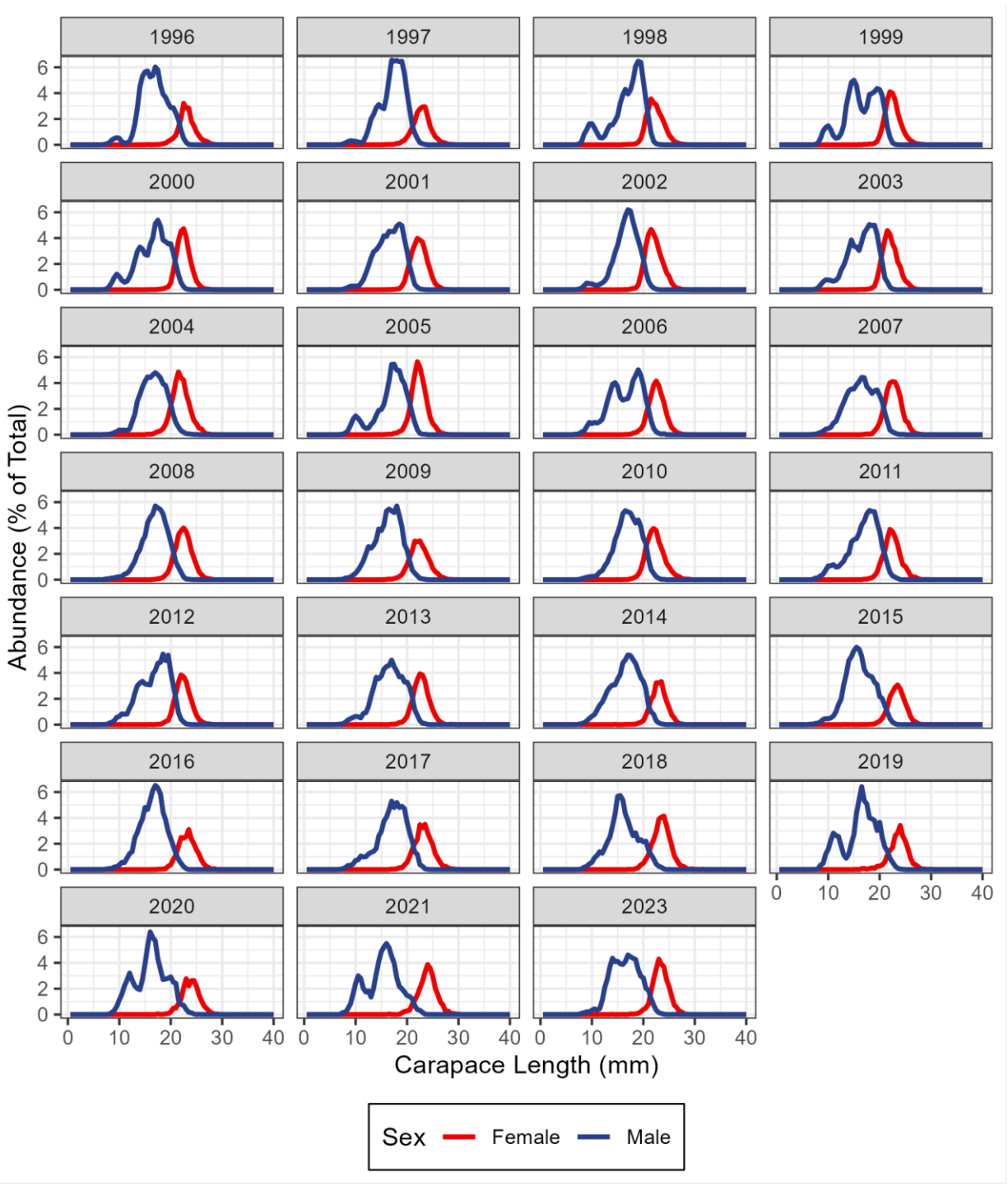

Figure 54. SFA 6 Northern Shrimp abundance at carapace length (expressed as a percentage of total abundance), as determined using Ogmap on DFO fall multispecies survey data for 1996–2023.

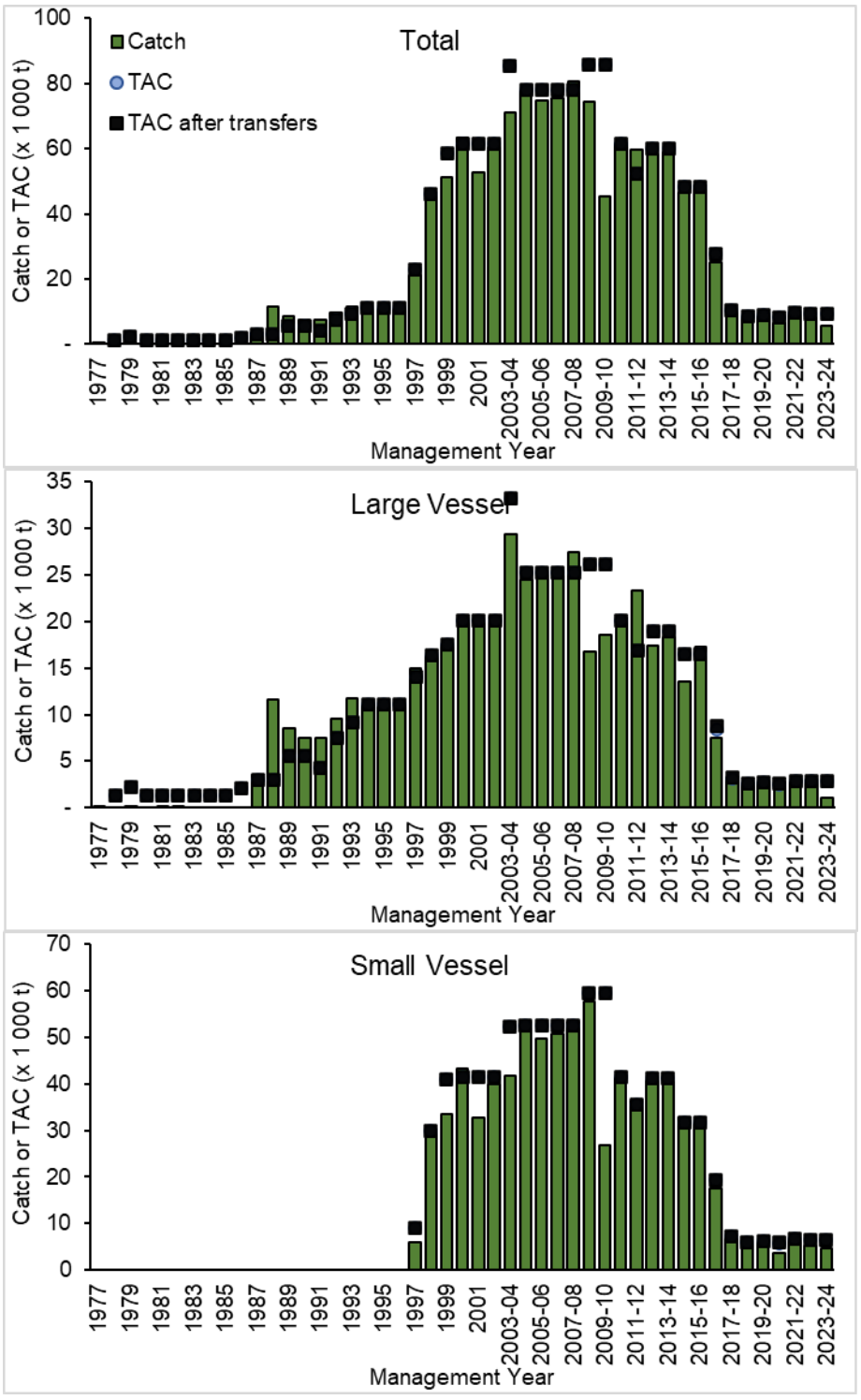

Figure 55. Historical Northern Shrimp TACs and commercial catch for 1977–2023/24 in SFA 6. Catches are preliminary as of the February 09, 2024, AQMS. In 2003, the management year was switched from a calendar year to a management year such that 2003/04 represents a 15-month-long fishing season. While quota transfers and bridging are reflected in catch numbers, they are only reflected in TACs from 2016/17–2023/24.

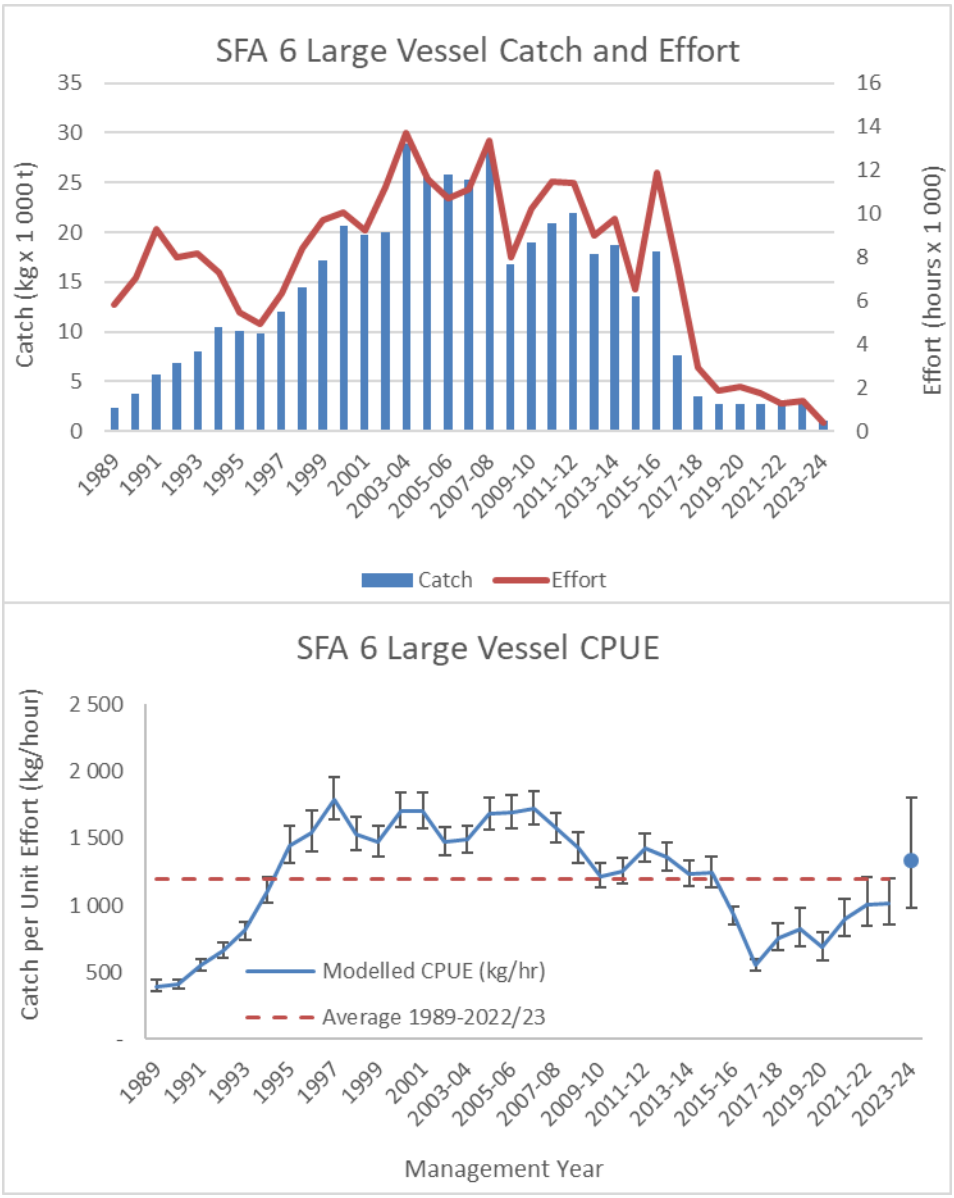

Figure 56. Top: Catch and effort as captured in observer records and used in the CPUE model. Bottom: CPUE for the LV fleet fishing for Northern Shrimp in SFA 6 from 1989–2023/24. Data for 2022/23–2023/24 are incomplete.

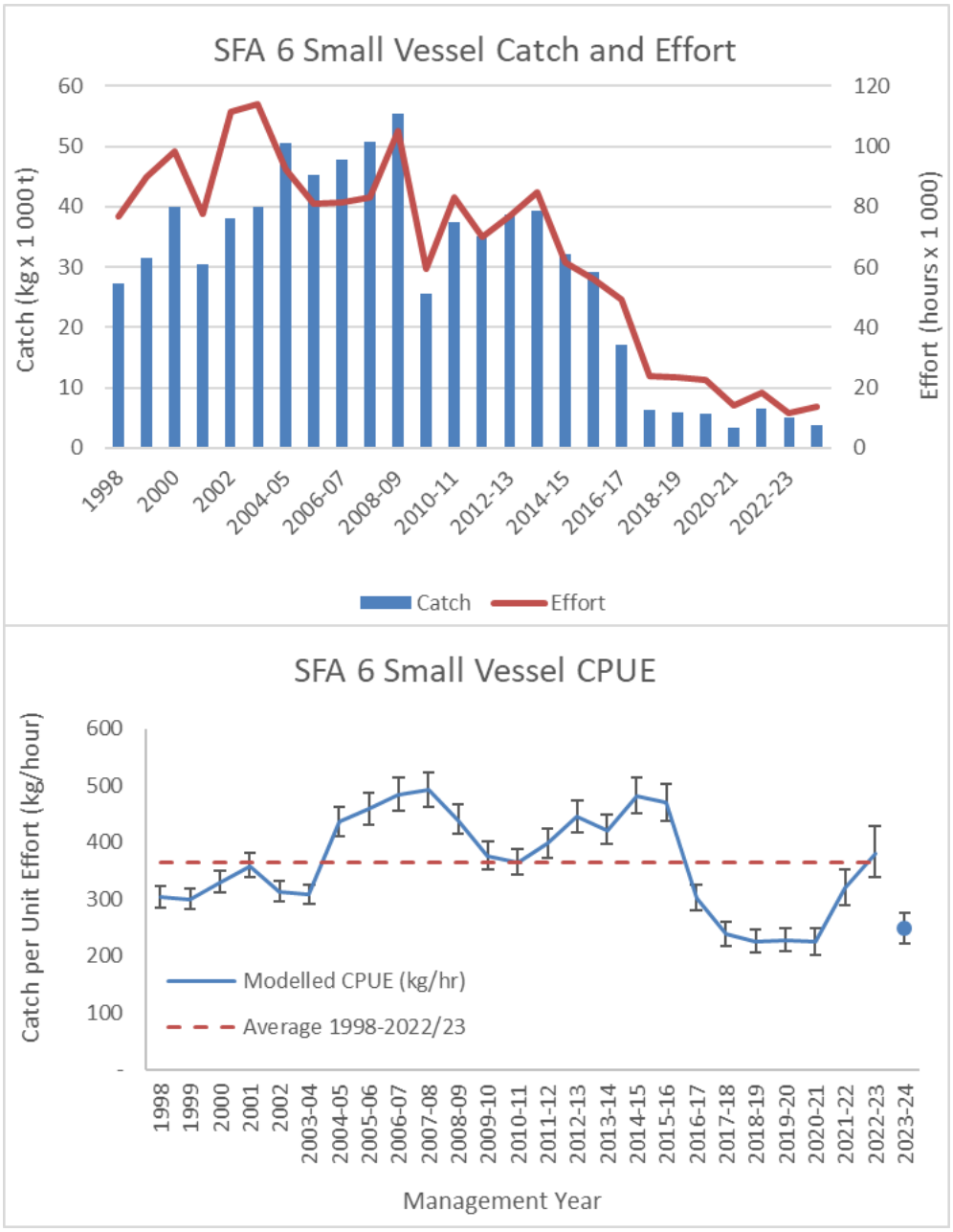

Figure 57. Top: Catch and effort as captured in logbook records and used in the CPUE model. Bottom: CPUE for the SV fleet fishing for Northern Shrimp in SFA 6 from 1998–2023/24. Data for 2023/24 are preliminary.

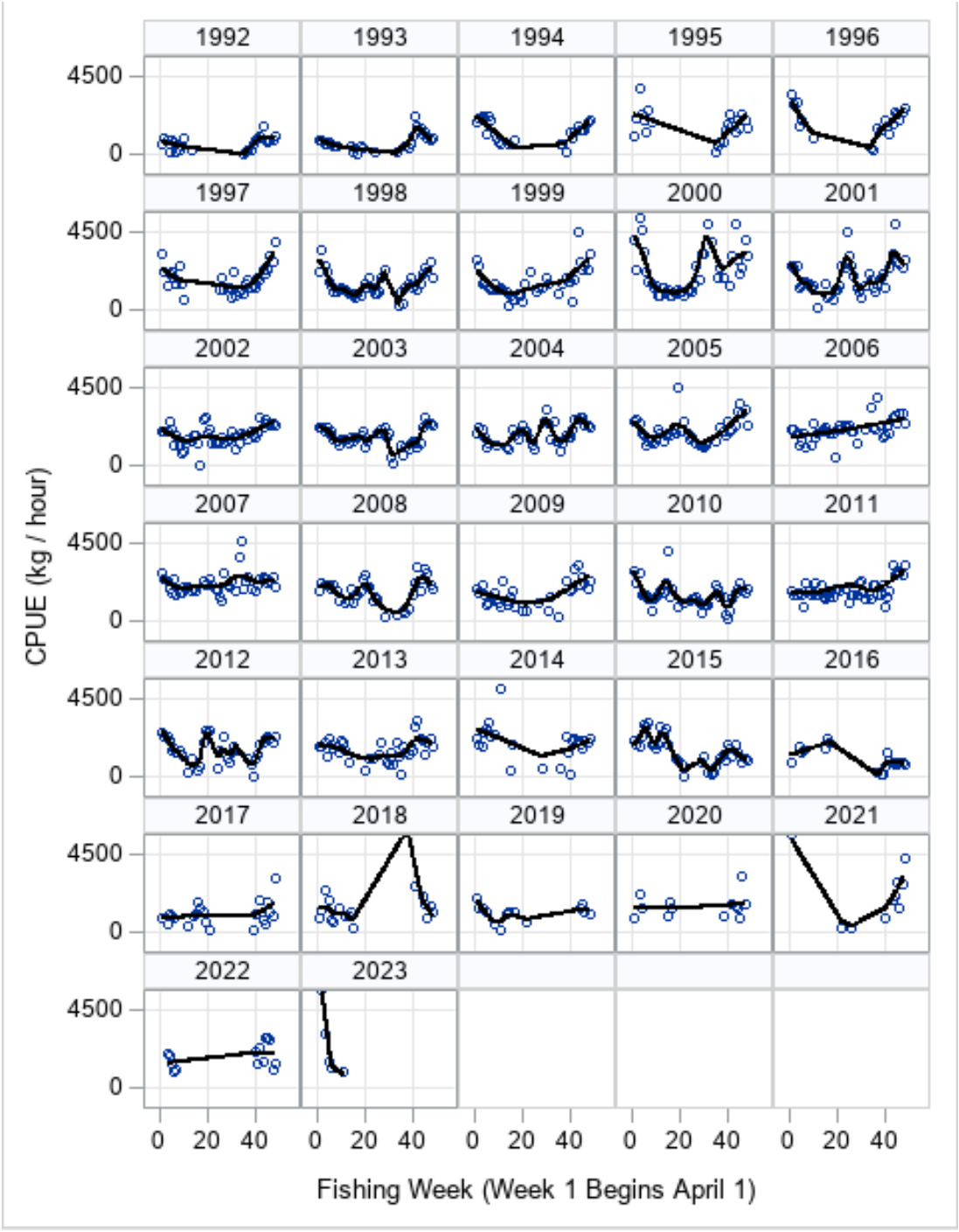

Figure 58. CPUE by year and week (of fishing season starting April 1) for the LV fleet targeting Northern Shrimp in SFA 6.

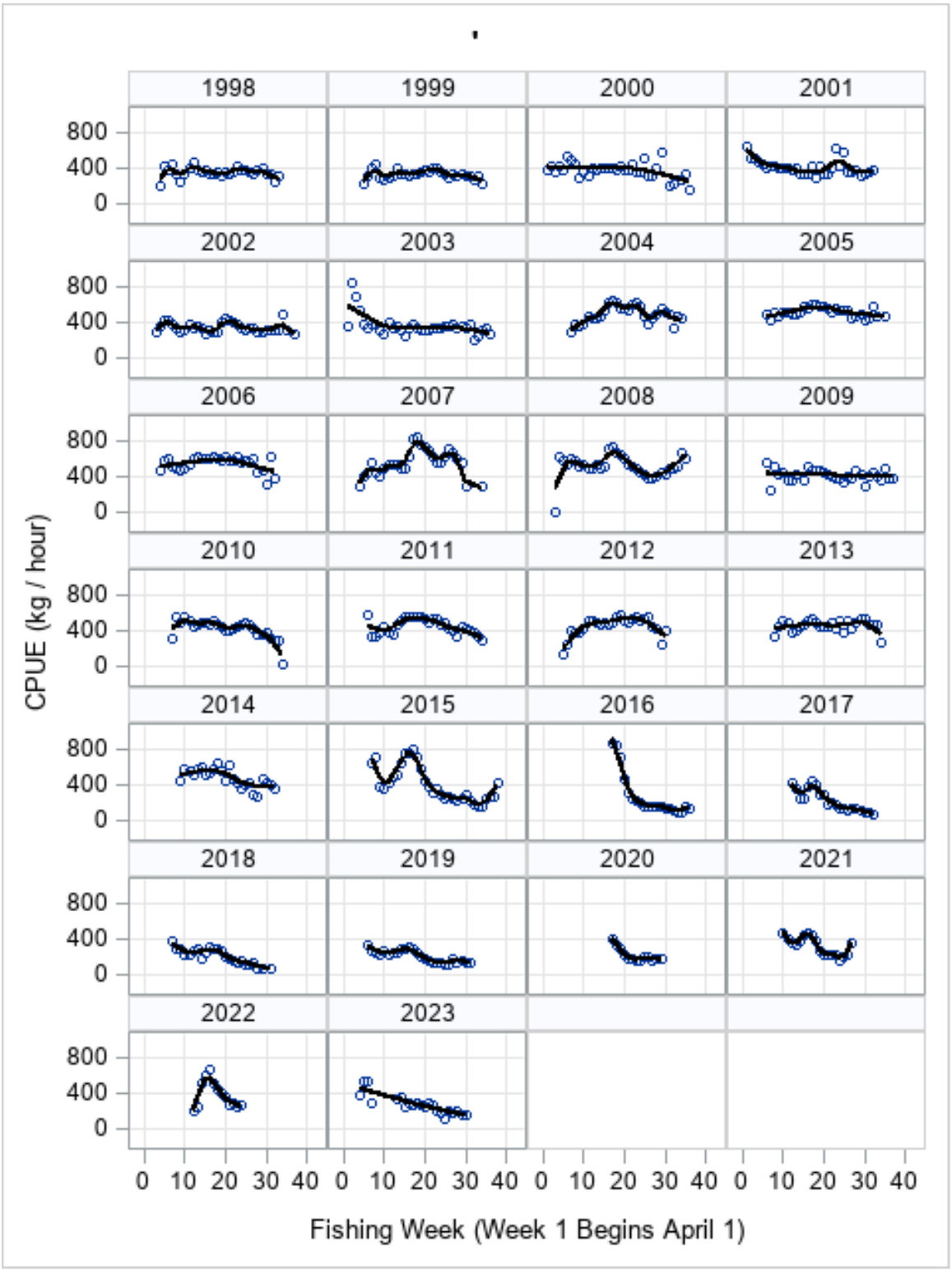

Figure 59. CPUE by year and week (of fishing season starting April 1) for the SV fleet targeting Northern Shrimp in SFA 6.

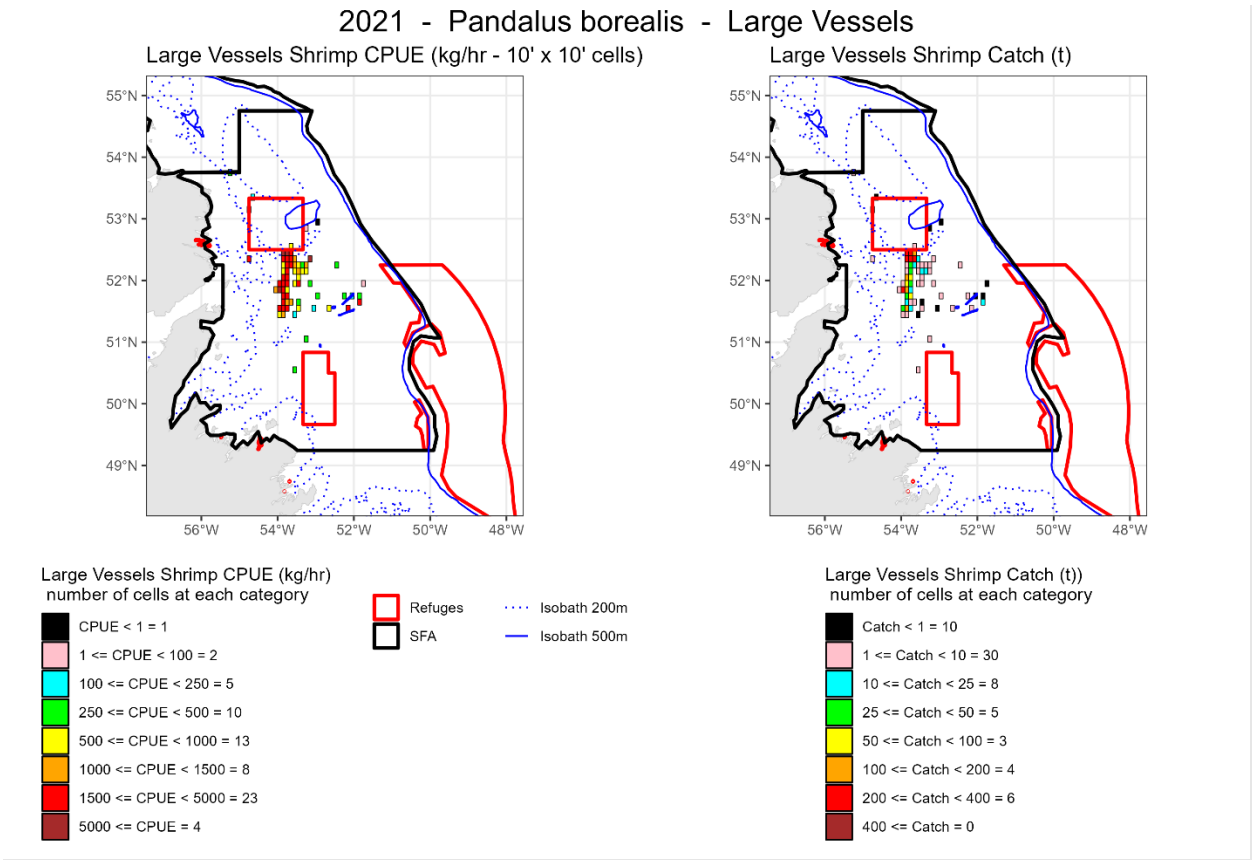

Figure 60. LV fleet (>500 t) catch and average fishery performance within the 2021/22 SFA 6 Northern Shrimp fishery. Positions of catch and effort taken from observer data set with 103% of the LV commercial catch represented in these maps.

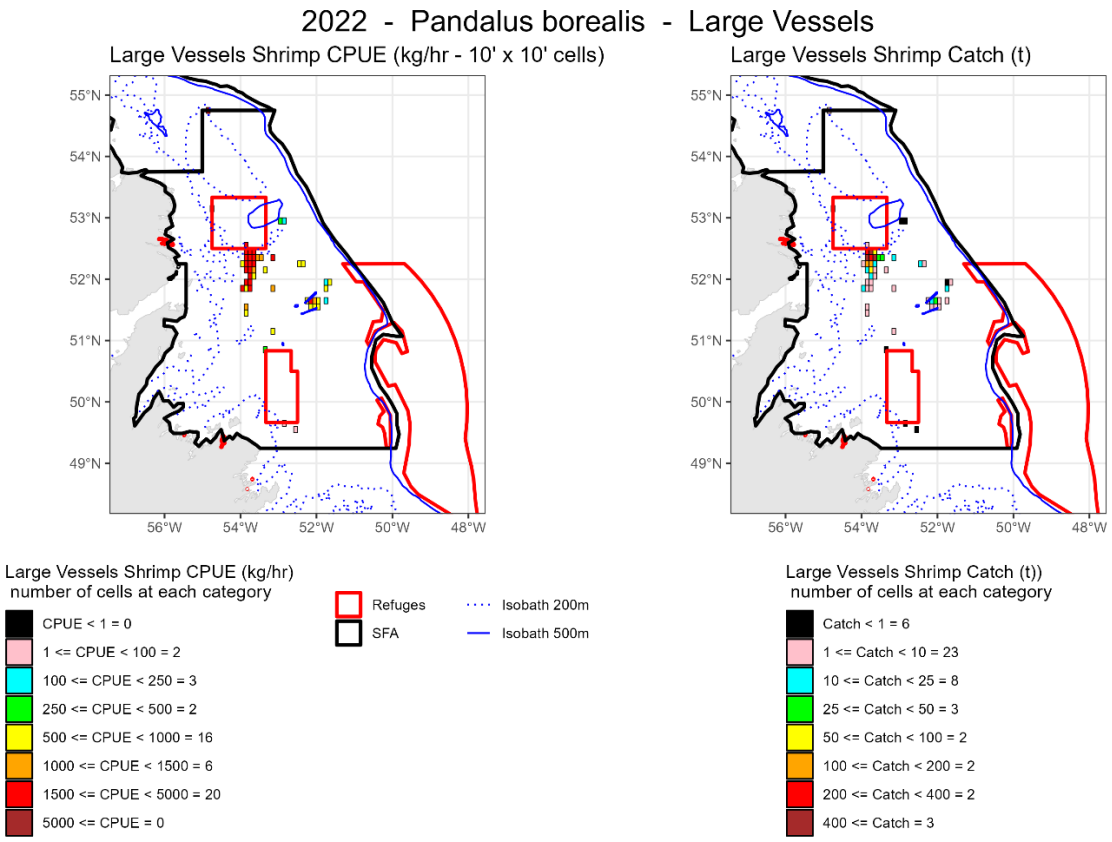

Figure 61. LV fleet (>500 t) catch and average fishery performance within the 2022/23 SFA 6 Northern Shrimp fishery. Positions of catch and effort taken from observer data set with 101% of the LV commercial catch represented in these maps.

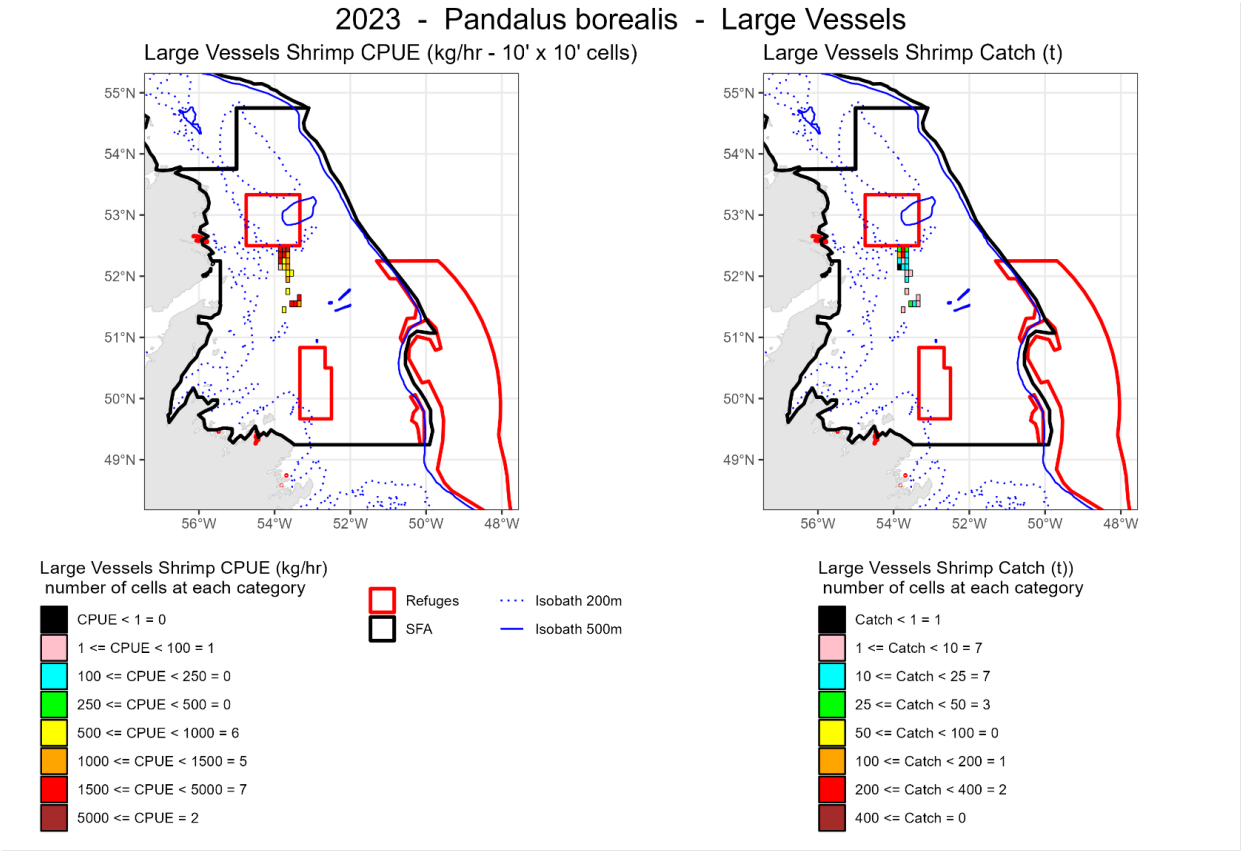

Figure 62. LV fleet (>500 t) catch and average fishery performance within the 2023/24 SFA 6 Northern Shrimp fishery. Positions of catch and effort taken from observer data set with 101% of the LV commercial catch represented in these maps.

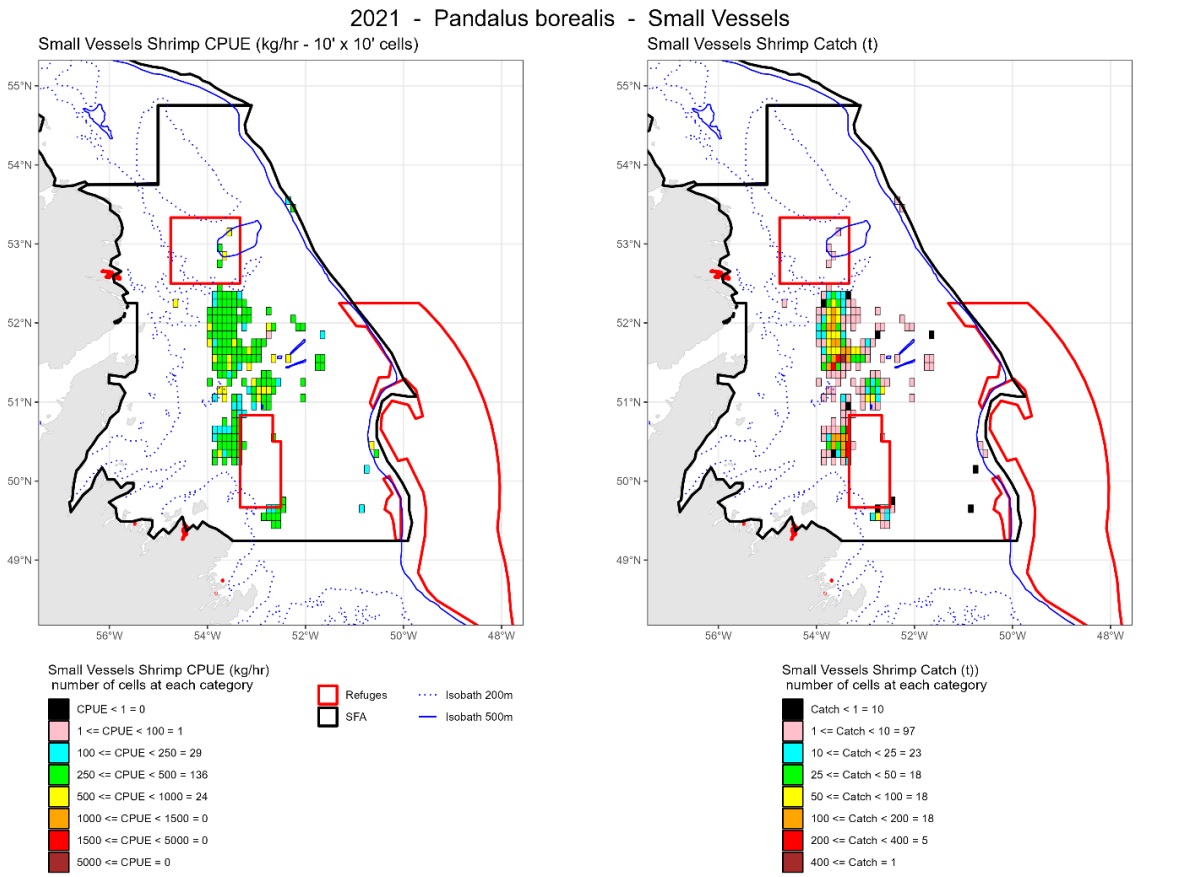

Figure 63. SV fleet (<= 500 t, LOA <100') catch and average fishery performance within the 2021/22 SFA 6 Northern Shrimp fishery. Positions of catch and effort taken from logbook data set with 96% of the SV commercial catch represented in these maps.

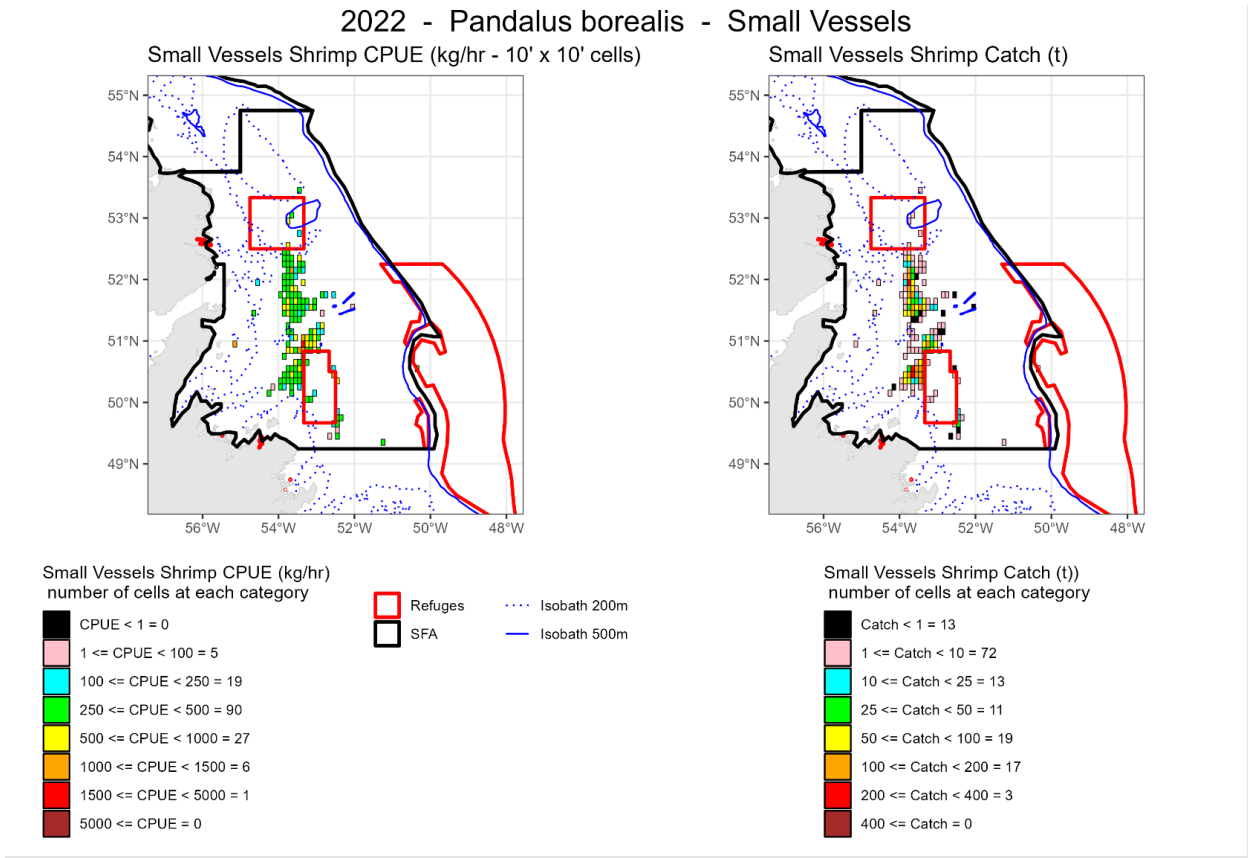

Figure 64. SV fleet (<= 500 t, LOA <100') catch and average fishery performance within the 2022/23 SFA 6 Northern Shrimp fishery. Positions of catch and effort taken from logbook data set with 97% of the SV commercial catch represented in these maps.

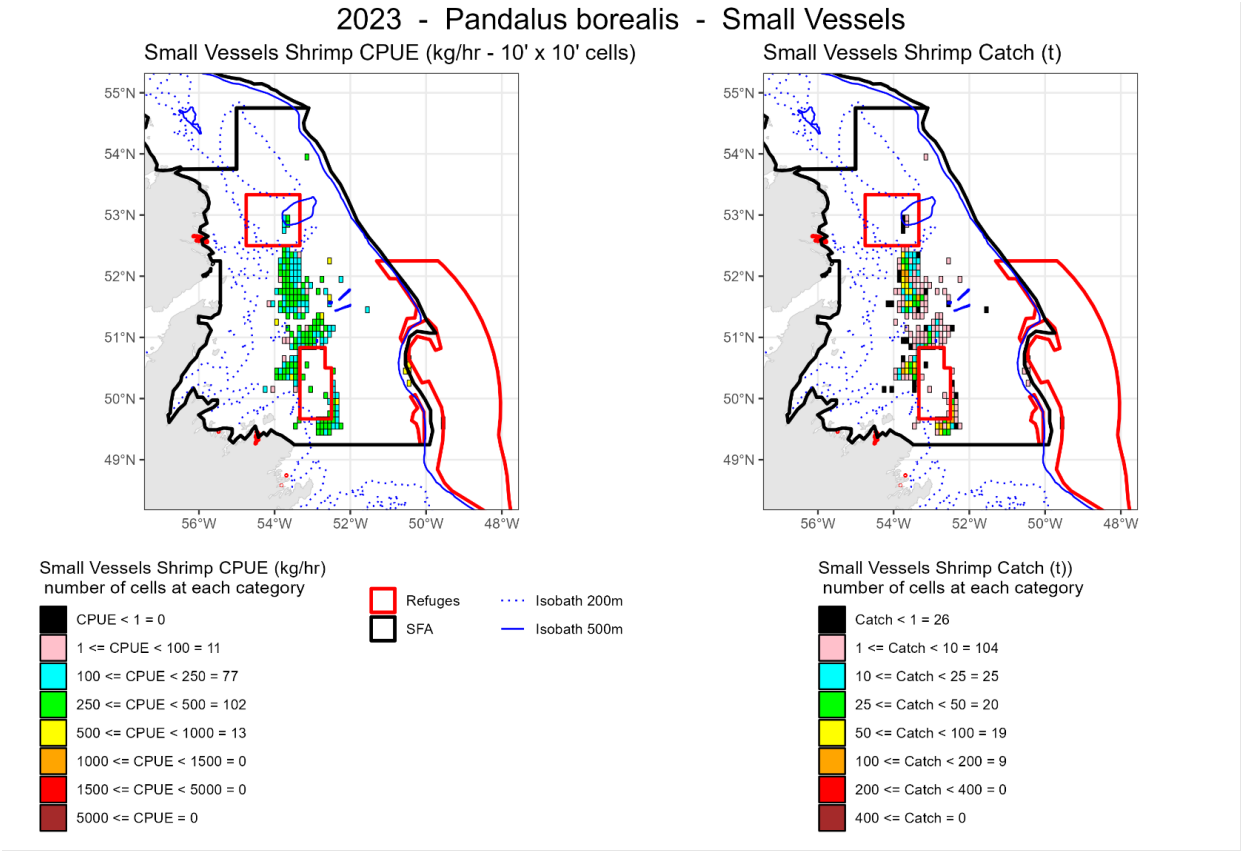

Figure 65. SV fleet (<= 500 t, LOA <100') catch and average fishery performance within the 2023/24 SFA 6 Northern Shrimp fishery. Positions of catch and effort taken from logbook data set with 80% of the SV commercial catch represented in these maps.

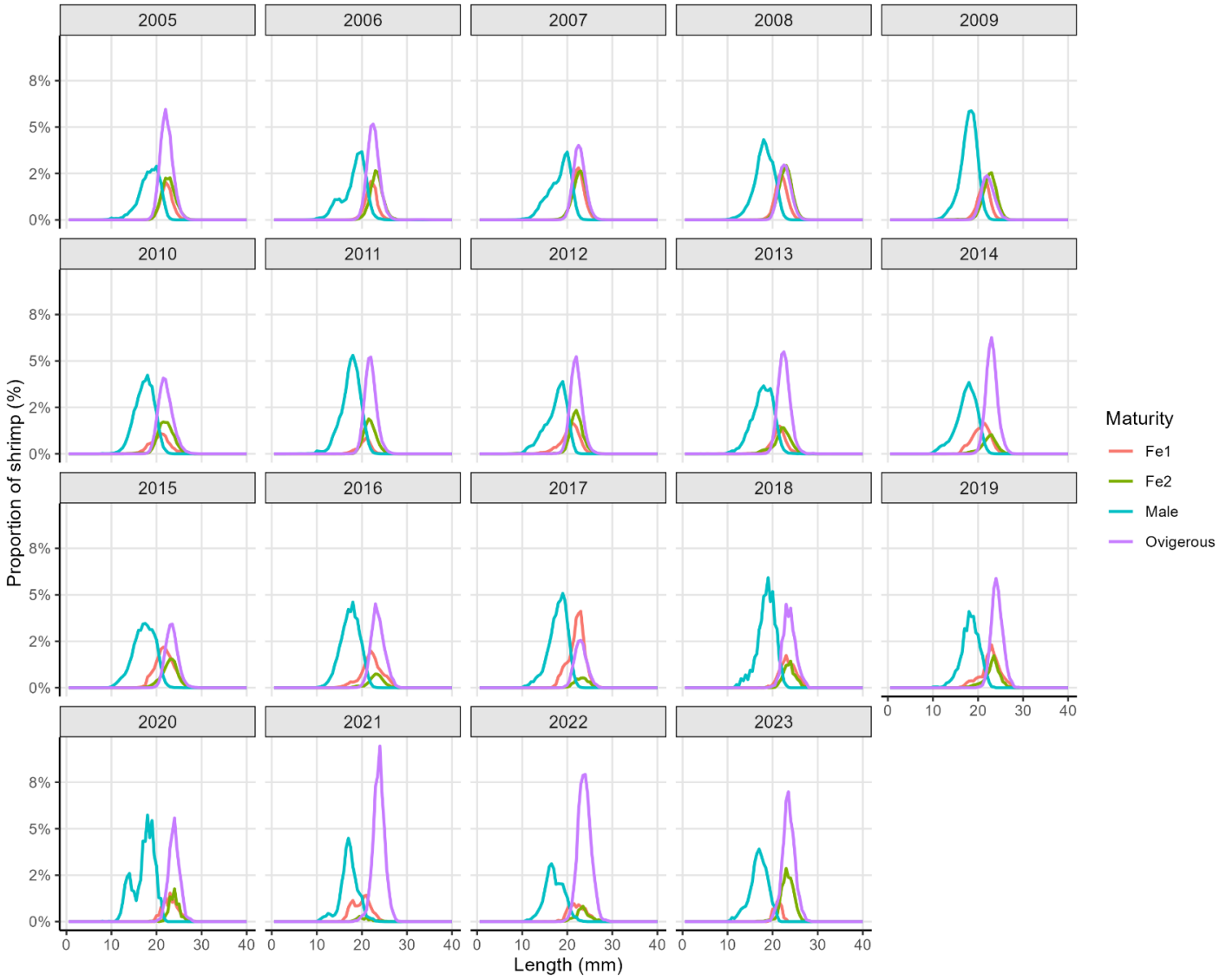

Figure 66. Observer carapace length frequencies of different maturity stages (Male, Primiparous (Fe1), Multiparous (Fe2),and Ovigerous Females) from LV fleet targeting Northern Shrimp in SFA 6 over the 2005–23 period. Data for 2023–24 are preliminary.

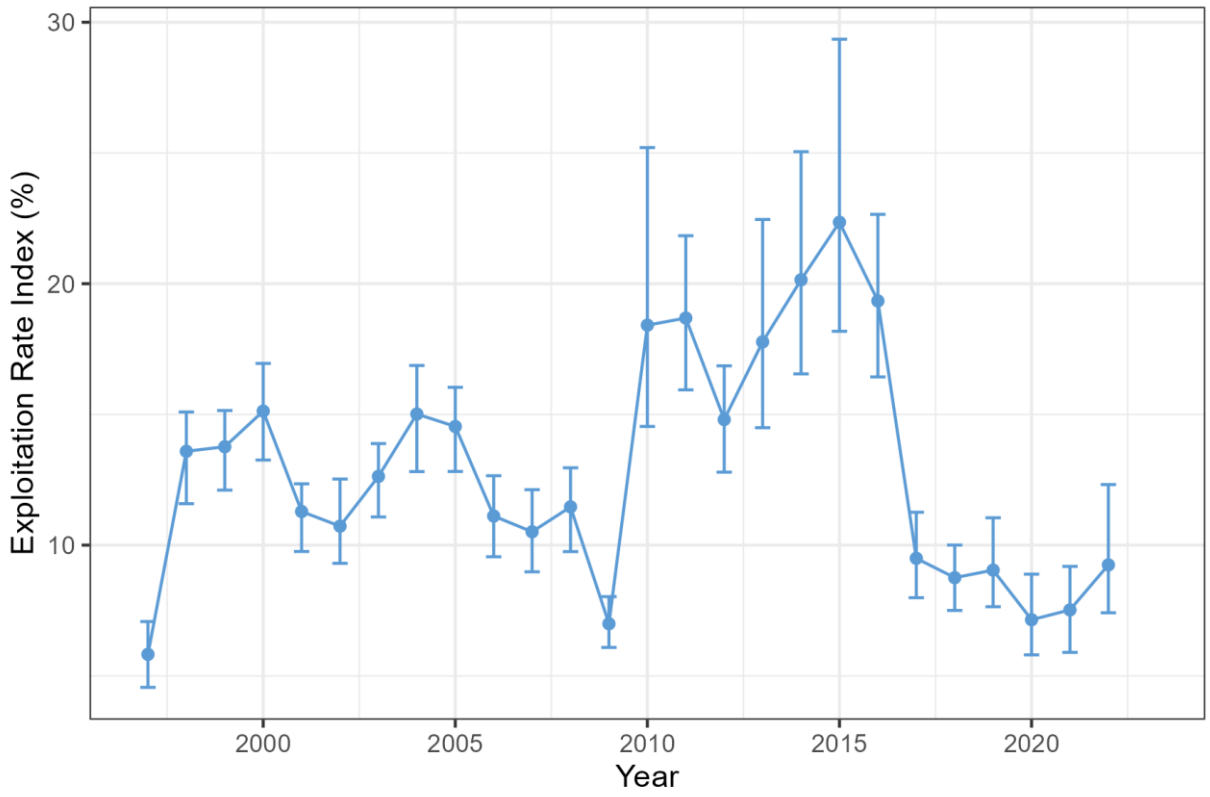

Figure 67. SFA 6 Northern Shrimp ERI based on total catch/fishable biomass index from the previous year, expressed as a percentage. Error bars indicate 95% confidence intervals. The 2023/24 value is not available as there was no DFO multispecies fall survey in 2022.

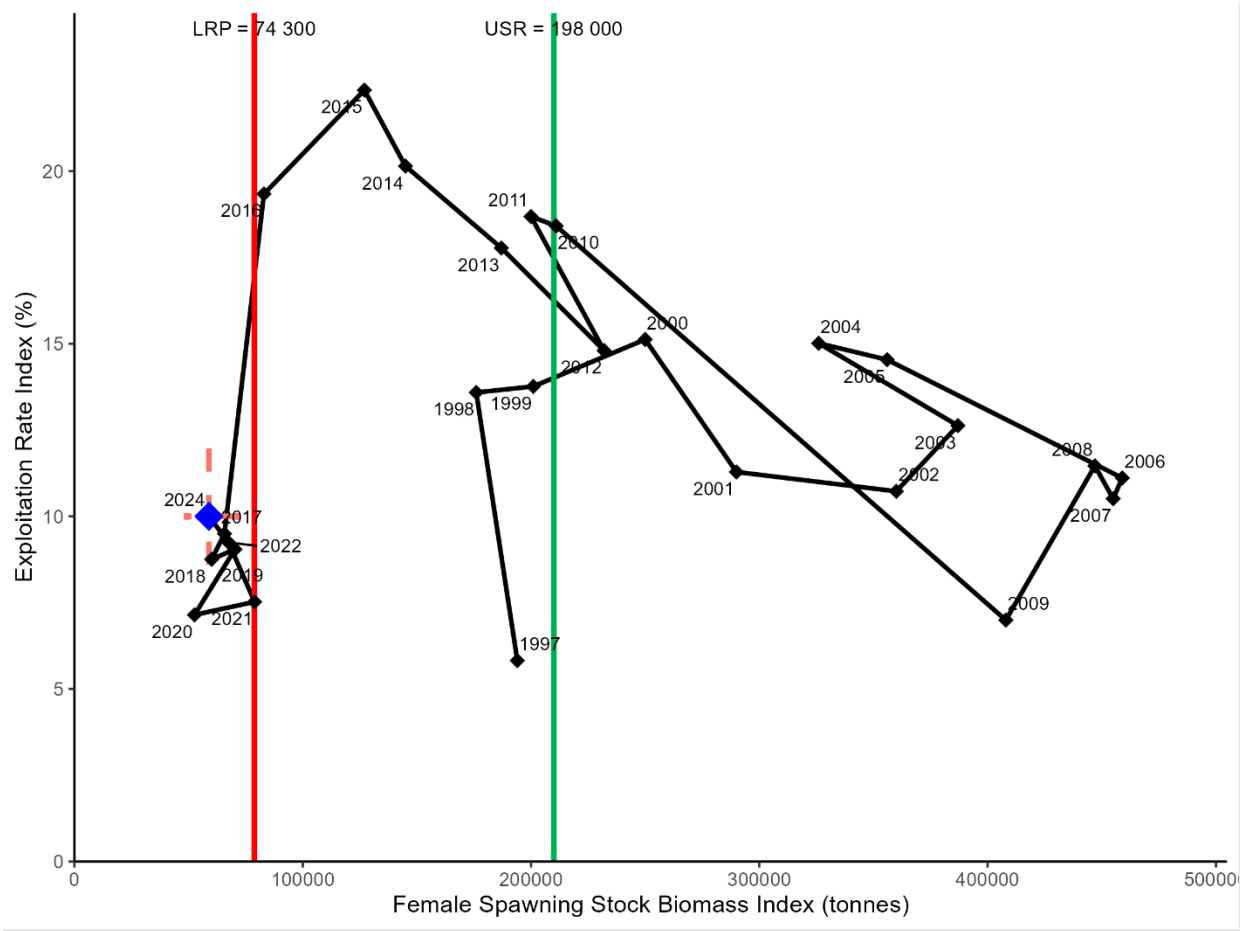

Figure 68. SFA 6 Northern Shrimp IFMP PA framework with ERI versus female SSB index. Data point labels denote the first year of management years. The 2023/24 value is not available as there was no DFO multispecies fall survey in 2022. The 2024/25 point (blue) is based upon 2023 female SSB index and assumes that the 2023/24 TAC of 9,439 t is unchanged, and subsequently caught, in 2024/25. The red cross indicates 95% confidence intervals for the fall 2023 female SSB index (horizontal line) and for the projected exploitation rate (vertical line).