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

Canadian Science Advisory Secretariat
Newfoundland and Labrador Region | Science Advisory Report 2024/018

ASSESSMENT OF THE ORANGE-FOOTED SEA CUCUMBER (*CUCUMARIA FRONDOSA*) RESOURCE ON THE ST. PIERRE BANK (NAFO SUBDIVISION 3PS) IN 2022

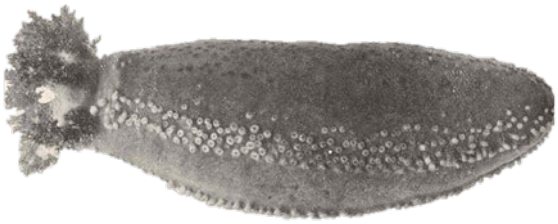

*Image. The orange-footed sea cucumber (*Cucumaria frondosa*). (Source: Freshwater and Marine Image Bank)*

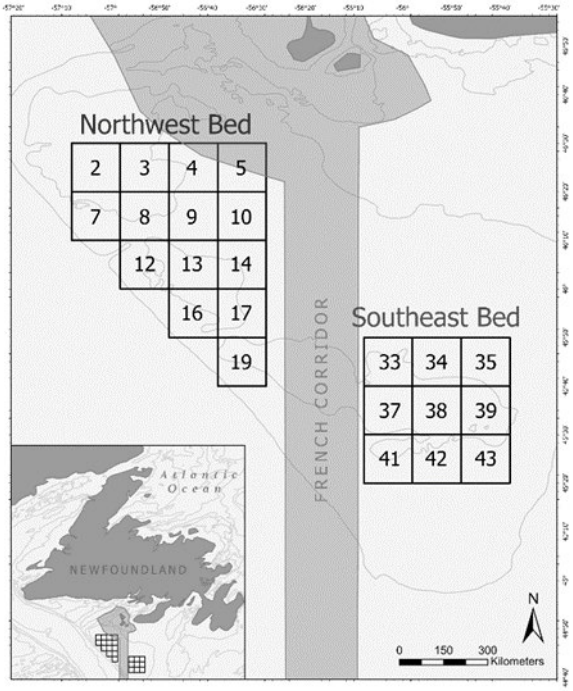

Figure 1. Map showing the sea cucumber fishing grounds on the St. Pierre Bank (northwest and southeast areas).

Context:

The orange-footed sea cucumber (Cucumaria frondosa*) is a slow-growing, long-lived sea cucumber species. It has been reported almost circumpolar in the northern hemisphere. Populations off Newfoundland and Labrador (NL) are found at the highest densities at depths from 30 to 60 m, usually on hard bottoms with a cobble-shell-boulder substrate composition.*

In 2003, a sea cucumber drag fishery, under the umbrella of the New Emerging Fisheries Policy, was established on the St. Pierre Bank (Subdiv. 3Ps) with eight participants sharing a total allocation of 454 t. There are two main sea cucumber concentrations on the Canadian portion of the St. Pierre Bank, one northwest and one southeast of the French Economic Zone. Until 2017, the fishery occurred in the northwest area; the allocation increased gradually to 2,242 t in 2013, where it remains. The southeast area opened to fishing with five-year temporary permits of 3,773 t in 2017. The allocation in the southeast area increased to 4,717 t in 2019, where it has remained.

As part of the emerging fisheries policy, the harvesters entered into a five-year Joint Project Agreement (JPA) with Fisheries and Oceans Canada (DFO) to conduct a resource assessment survey from 2004 to 2008. The fishery transitioned to a commercial fishery in 2013. Since then, DFO

sea cucumber surveys on the St. Pierre Bank have occurred in the southeast area in September 2016 and 2022 and in the northwest area in 2017.

The last Regional Peer Review Meeting to assess the status of sea cucumber was in 2016. There was also a Regional Science Response Process in 2017. This Science Advisory Report is from the March 13, 2023, Regional Peer Review Meeting on the Stock Assessment of Sea Cucumber in NAFO Subdivision 3Ps. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

Environment and Ecosystem

- The ocean climate in Northwest Atlantic Fisheries Organization (NAFO) Subdiv. 3Ps has been experiencing significant warming in recent years. In 2022, surface and bottom temperature reached all-time highs, and 2021 is the second warmest year on record for the same metrics.
- Overall conditions of the past 3–4 years are indicative of improved productivity at the lower trophic levels along the NL bioregion (Divs. 2J3KLNO and Subdiv. 3Ps). This includes earlier phytoplankton blooms, higher chlorophyll concentrations, and increased zooplankton biomass with a higher abundance of larger, more energy-rich *Calanus* copepods.
- Marine ecosystem conditions indicated overall limited productivity of the fish community. Total biomass of the entire fish community remained below pre-collapse. The ecosystem has undergone structural changes with increased dominance of warm water species starting in 2010. In recent years (2019–21), ecosystem indicators have suggested that conditions could be improving. However, the lack of conversion factors for new offshore survey vessels in 2022 prevented an updated evaluation of these trends.

Stock Status

- Resource status of sea cucumbers in NAFO Subdiv. 3Ps was assessed based on commercial catch data, emerging fishery survey (2004–08), and DFO sea cucumber survey (2016, 2017, 2022).
- The sea cucumber fishery was initiated in the northwest area in 2003, with the allocation gradually increasing to 2,242 t in 2013, where it has remained. The fishery opened in the southeast area in 2017 with an allocation of 3,773 t and increased to 4,717 t in 2019, where it has remained. In 2022, landings were 2,065 t in the northwest area and 4,019 t in the southeast area.
- Sea cucumbers may be decreasing in size in both areas throughout the time series.
- A spatiotemporal model was used to estimate biomass and abundance indices.
- In 2022, the biomass index for the northwest area increased from 2017 to near the average observed during the emerging fishery (2004–08). In 2022, the biomass index for the southeast area also increased from 2017 but remains below the average biomass index observed from 2004–08. There is more uncertainty around the biomass and abundance estimates in recent years.
- The abundance index in the northwest area increased in 2022 from 2017, with a general increasing trend since the beginning of the survey. The abundance index in the southeast area varied without trend throughout the time series.

- Exploitation rate indices are anticipated to remain relatively stable in 2023, assuming status-quo total allowable catch (2.4% in the northwest area and 2.9% in the southeast area). Sustainable exploitation rates are unknown for this species. Exploitation rate indices are a minimum estimate due to variation in sea cucumber landed water loss.
- Given the uncertainty with the assessment of stock status of this species, there is no scientific basis for assessing the risk of the current or any change in the harvest level.

BACKGROUND

Species Ecology

Orange-footed sea cucumbers (*Cucumaria frondosa*), herein referred to as sea cucumbers, are commonly distributed down to 100 m in waters off Newfoundland, with the highest densities between 30–60 m. Global scientific knowledge of the species is now fairly broad (Gianasi et al. 2021). Briefly, they are mainly found on hard rock, gravel, and shell substrates but are also occasionally observed on softer sandy habitats (So et al. 2010). Sea cucumbers move by crawling or bloating their body for active or passive (carried by the current) rolling (Sun et al. 2018). They are suspension feeders that filter food from the water column. Sea cucumbers reproduce using broadcast spawning, meaning that both sexes coordinate the release of their gametes into the water column for external fertilization. Growth rates of juveniles and adults are slow and vary by season, maturity, diet, and location (Gianasi et al. 2017; Hamel and Mercier 1996). The purple sunstar (*Solaster endeca*) is the main predator of sea cucumbers at all life stages. Injured sea cucumbers can attract and are more vulnerable to scavengers and predators (So et al. 2010).

Compared to other Canadian sea cucumber populations, sea cucumbers on the St. Pierre Bank exhibit the longest and earliest spawning season, which occurs annually from February to May (Coady 1973; Mercier and Hamel 2010; So et al. 2010). 100% of sea cucumbers on the St. Pierre Bank were found to be sexually mature at a contracted length of 11.5 cm (Grant et al. 2006). Laboratory studies have shown a slower juvenile growth rate in Newfoundland than in other parts of Eastern Canada, with an estimated 25 years to reach 15 cm under natural conditions (So et al. 2010). Sea cucumbers are 6.5–82% water weight (MI 2005).

The Fishery

There are two main sea cucumber concentrations on the Canadian portion of the St. Pierre Bank, one northwest and one southeast of the French Economic Zone (Figure 1). The grid of 23 strata (originally 52 in 2003) used to delineate the two areas for fishing and survey activity is based on historical surveys led by DFO and the NL Department of Fisheries and Aquaculture (DFA). The fishery is open annually from June 1 to December 31 to avoid the sea cucumber spawning season. The modified sea urchin drag from Maine is the standardized fishing gear used in the sea cucumber fishery in NL.

In 2003, eight harvesters were given an allocation of 454 t on the St. Pierre Bank to explore commercial concentrations of sea cucumbers. In 2004, a sea cucumber fishery was established on the St. Pierre Bank under the New Emerging Fisheries Policy. As a condition of the license, all harvesters were required to actively participate in the fishery each year, complete surveys, and submit detailed fishing logs. After completing the assigned survey stations, participants could take their allotted total allowable catch (TAC) while adhering to all license conditions. Participants were not permitted to take more than 25% of their landings from strata 2 and 7 (the most heavily fished strata in 2003). In 2006, the policy was revised so that participants could not

take more than 30% of their landings from any one stratum. This regulation remained in place until the end of the emerging fishery in 2008. The allocation increased from 454 t in 2003 to 612 t in 2005 to compensate for the fraction of landed weight that was water, debris, or damaged/undersized sea cucumber. Upon the completion of the emerging fishery, allocation in the northwest area increased to 907 t, and the southeast area closed to fishing as a measure to conserve the resource until the effects of fishing could be evaluated.

In 2013, the emerging fishery formally transitioned to a commercial fishery. At this time, ten new licenses were issued, which increased the TAC in the northwest area to 2,242 t, where it remains. In 2017, the southeast area was open to fishing with temporary permits with a total allocation of 3,773 t, set to expire in 2022. These permits were increased to 4,717 t in 2019, where the southeast TAC remains. Currently, 8,490 t of sea cucumber are permitted to be harvested annually from the St. Pierre Bank. Gross landings (including water and debris) are the weights recorded against allocations.

ASSESSMENT

Stock status was assessed based on commercial catch data, emerging fishery survey data (2004–08) and DFO sea cucumber survey catch data (2016, 2017, and 2022). Though data from the emerging fishery and the DFO sea cucumber surveys are two separate time series, data from the emerging fishery were used as a proxy for a 'pre-commercial fishery' reference period.

The trends in fishery performance were inferred using TAC, landings, and catch per unit effort (CPUE; kg/tow) data. Commercial CPUE from 2004 to 2008 were standardized to 0.5 nautical miles (nm) tows; however, logbooks since 2009 could not be standardized because tow-by-tow information was not documented.

The dedicated sea cucumber surveys (the emerging fishery surveys and the DFO sea cucumber surveys) utilized the same methodology. Sample sites were selected using a random-stratified approach in the strata grid. The surveys were conducted using a 6-foot modified sea urchin dredge towed for 0.5 nm at 2.5 knots with a warp-to-depth (m) ratio of 3:1.

The sea cucumber surveys provided catch information on the weight of sea cucumbers, numbers of sea cucumbers, other species caught, and biometrics of individual sea cucumbers. Biometric data was collected on up to 50 sea cucumber in each set, measuring length (tip to tip; mm), girth (mm), and whole wet weight (g; to the nearest 0.1). For up to an additional 100 sea cucumbers, only weights were recorded. Each set’s total sea cucumber weights and numbers were subsequently standardized to 0.5 nm. Average individual weight was calculated for each tow by dividing the total weight of sea cucumber in the catch by the number of sea cucumbers. Weight data from these surveys are the ‘wet weight’ of sea cucumbers measured as soon as possible after capture with no drainage or water absorption adjustments.

In previous assessments, biomass and abundance indices were estimated using STRAP (Stratified Analysis Programs; Smith and Somerton, 1981). STRAP is a spatial expansion method that uses survey catch rate data and requires sampling of at least two sets per stratum in each year of a survey to maintain a consistent time series and trend analyses. Spatial coverage in recent years has been inconsistent, with no DFO sea cucumber survey covering the entire survey area in any given year, so biomass and abundance indices in this assessment were estimated using a new spatio-temporal model (sdmTMB; Anderson et al. 2022) to accommodate poor survey coverage. The sdmTMB model used survey catch rates to predict sea cucumber biomass and abundance annually (when survey data was available) across the entire survey area.

A proxy for exploitation rate for the emerging fishery surveys was calculated by dividing the commercial catch from the fishing season by the survey biomass index from each year. The DFO sea cucumber surveys were treated as post-season surveys; thus, the proxy for exploitation rate indices for these surveys were calculated by dividing the commercial catch weight from the year following the survey by the biomass index from each survey.

The Fishery

The landings in the northwest area averaged 671 t over the period 2003–14, except in 2007 when landings were 190 t due to poor market conditions (Figure 2). Landings averaged 2,239 t from 2015 to 2021, and 2,065 t in 2022. The southeast area opened to fishing in 2017, with landings of 1,429 t. Landings averaged 4,020 t from 2018 to 2021 and 4,019 t in 2022.

CPUE steadily increased in the northwest and southeast areas throughout the time series (2004–22). CPUE reached a time-series high in the northwest area in 2020 with 1,100 kg/tow and in the southeast area in 2022 with 1,169 kg/tow (*prelim.*). The 2022 CPUE data are preliminary, reflecting only logbooks received and processed by February 2023. Commercial CPUE is not usually a reliable metric of stock status as several other factors confound interpretations of fishery performance. Additionally, CPUE trends for this stock would be likely to exhibit hyperstability because fishing efforts are targeted on known successful fishing grounds (i.e., fishing is not randomly distributed), and sea cucumbers on the St. Pierre Bank exhibit a highly patchy spatial distribution (MI 2006; So et al. 2010).

The main bycatch in the fishery (by weight) consists of various species including sea scallop (*Placopecten magellanicus*), sand dollar (*Echinarachnius parma*), some sea stars (*Solaster endeca*, *Leptasterias polaris*), sea urchin (*Strongylocentrotus droebachiensis*), sea snail (Gastropoda), Iceland scallop (*Chlamys islandica*), and toad crab (*Hyas* spp.).

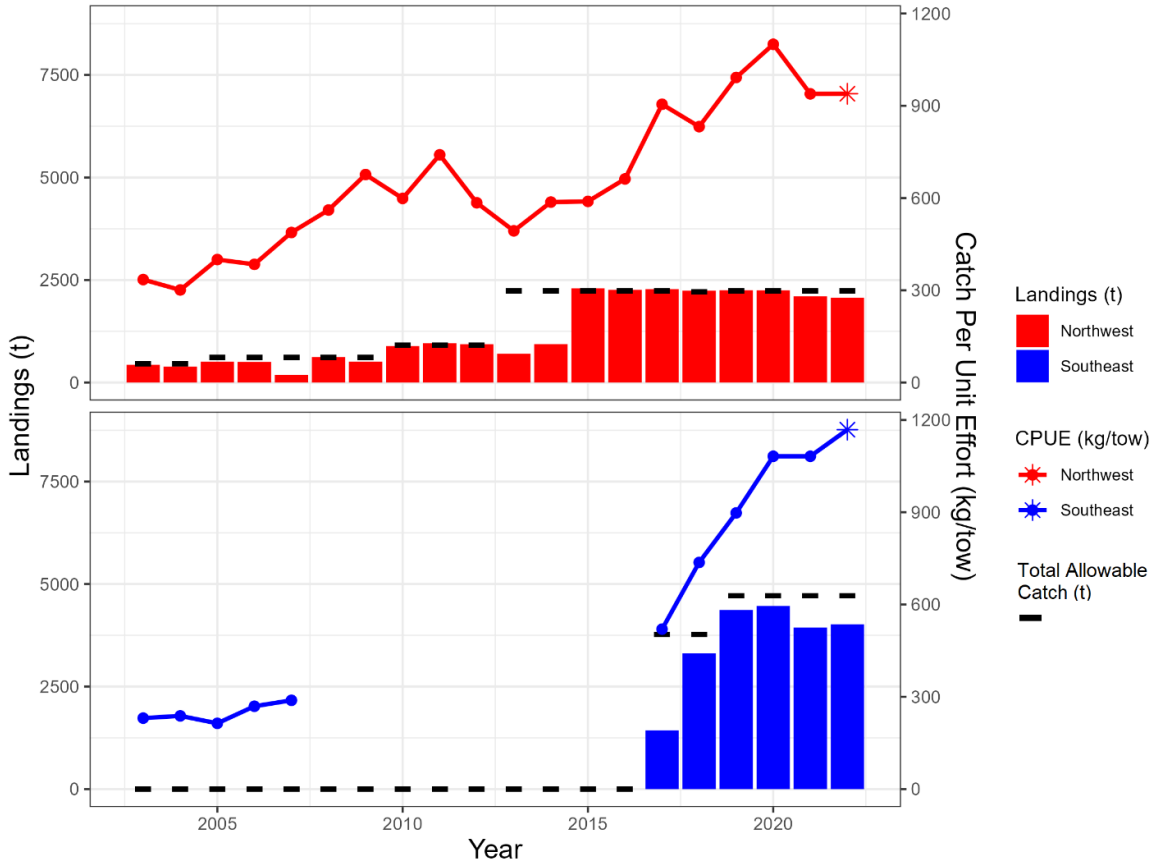

Figure 2. Landings (bars), catch per unit effort (CPUE) (lines), and total allowable catch (TAC) (black hashes) of sea cucumbers (Cucumaria frondosa) *in the northwest (top) and southeast (bottom) sea cucumber areas on the St. Pierre Bank from the start of the Emerging Fishery to the present (2003–22). The 2022 logbook data are preliminary (denoted by stars) and were last updated in February 2023.*

Individual Weight

The average individual sea cucumber whole wet weights in the northwest and southeast areas have declined since the emerging fishery (Figure 3). During the emerging fishery, the mean individual sea cucumber weight was 0.61 kg in the northwest area and 0.42 kg in the southeast area. During DFO sea cucumber surveys, the mean individual sea cucumber weight was 0.41 kg in the northwest area and 0.28 kg in the southeast area. The reason for the observed decrease in size is unknown. Other factors, such as survey timing, confound the interpretation of these results.

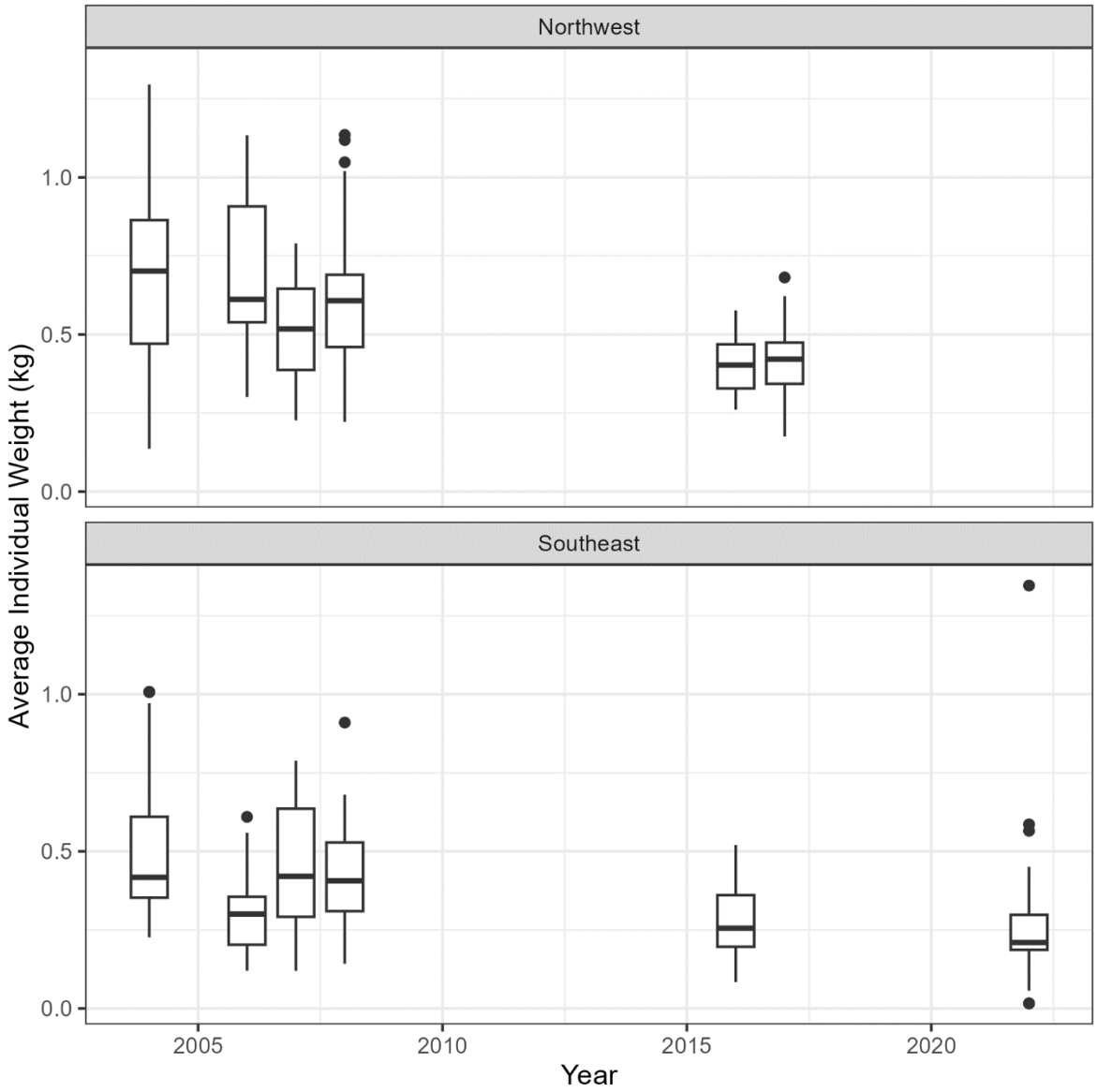

*Figure 3. Average whole wet weight of individual sea cucumbers (*Cucumaria frondosa*) in the northwest (top) and southeast (bottom) sea cucumber areas on the St. Pierre Bank. The average weight was estimated from the emerging fishery and DFO sea cucumber survey data by dividing the total weight of sea cucumbers in each tow by the total number of sea cucumbers in that tow.*

Biomass

In 2022, the biomass index was 94 kt for the northwest area and 162 kt for the southeast area (Figure 4). However, despite point estimate increases from the most recent survey in 2017, the northwest area was near the average observed during the emerging fishery (86 kt from 2004–08), and the southeast area remains below the average biomass index observed from 2004–08 (224 kt). As a result of poor survey coverage, there is a larger degree of uncertainty around recent biomass estimates.

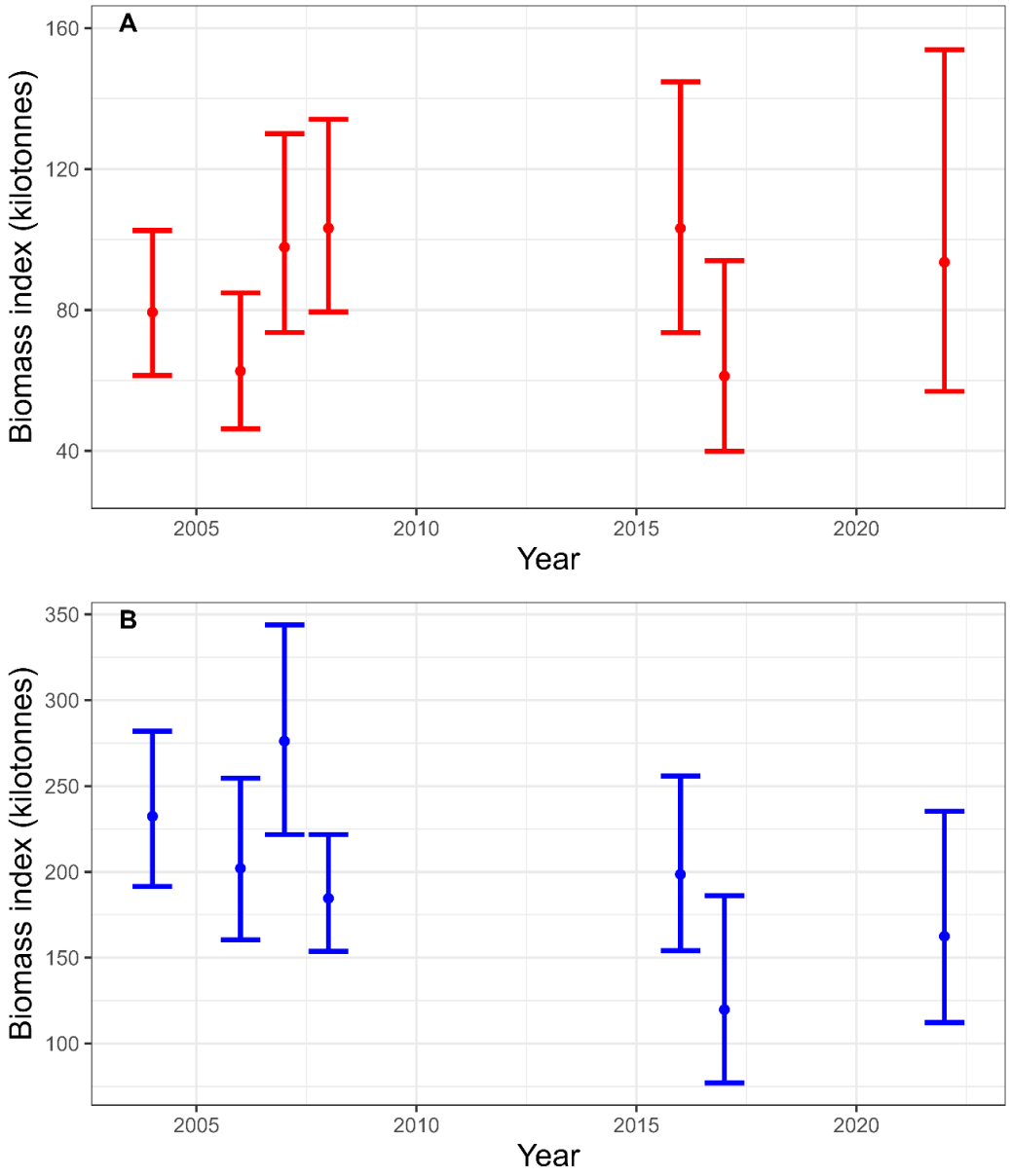

*Figure 4. Biomass indices for sea cucumbers (*Cucumaria frondosa*) on the (A) northwest and (B) southeast areas on the St. Pierre Bank using the sdmTMB model. Bars represent 95% confidence intervals.*

Abundance

In 2022, the abundance index was 287 million for the northwest area and 751 million for the southeast area (Figure 5). In the northwest area, abundance indices have been consistently higher than the average pre-commercial indices (2004–08) and have a general increasing trend from the beginning of the survey. In 2022, the point estimates of both areas increased from the 2017 survey. However, despite these point increases from the most recent survey, the abundance index from the southeast area varied without trend throughout the time series. As a result of poor survey coverage, there is a larger degree of uncertainty around recent abundance estimates.

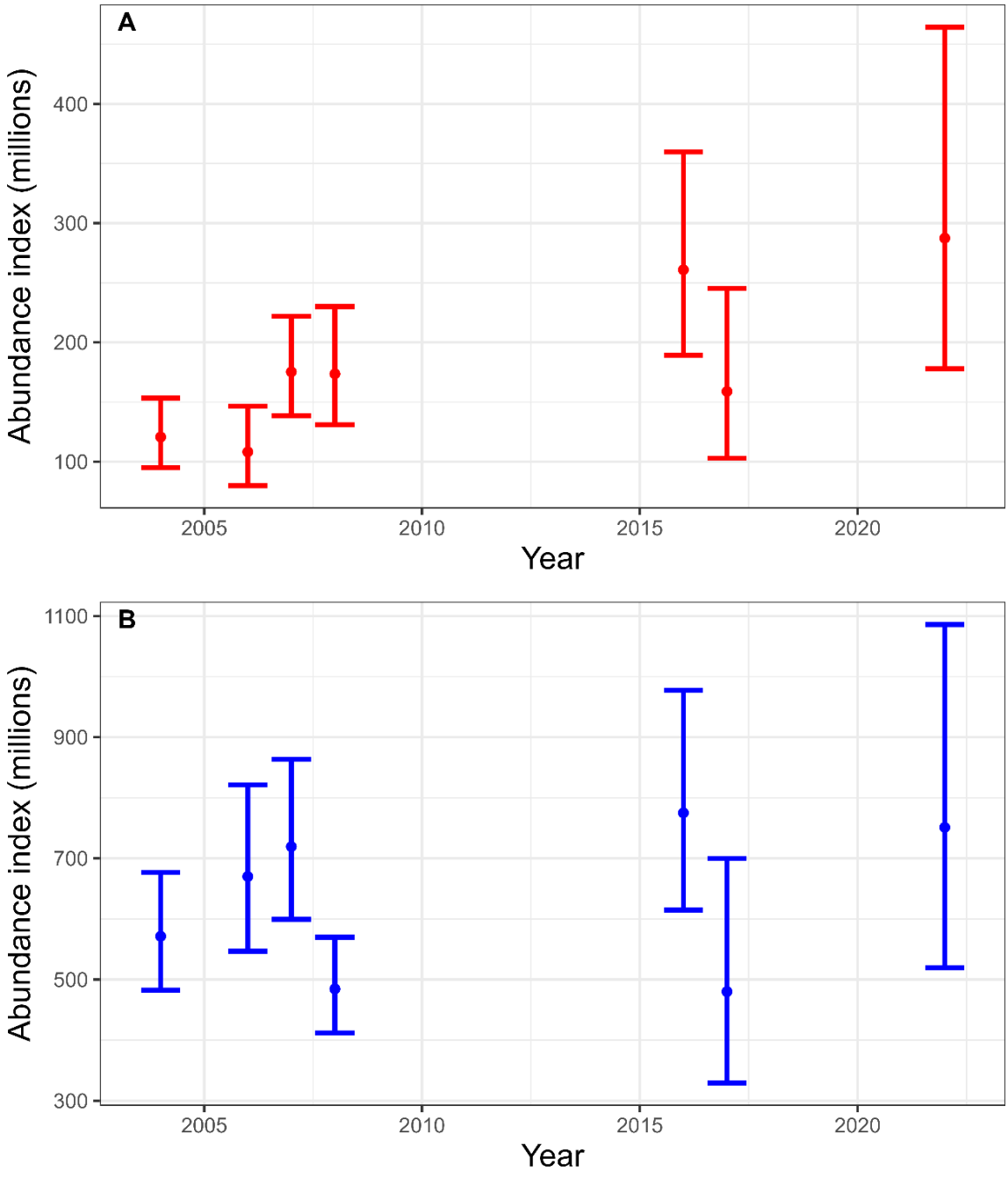

*Figure 5. Abundance indices for sea cucumbers (*Cucumaria frondosa*) on the (A) northwest and (B) southeast areas on the St. Pierre Bank using a sdmTMB model. Bars represent 95% confidence intervals.*

Exploitation Rate Index

The exploitation rate index (ERI) has ranged from 0.2% to 3.7% for the northwest area and 0.7% to 2.8% for the southeast area throughout the fishery (Figure 6). The ERI is projected to be 2.4% in the northwest area and 2.9% in the southeast area in 2023 with status-quo TAC. The ERI in both areas has been relatively stable in recent years. Sustainable exploitation rates are unknown.

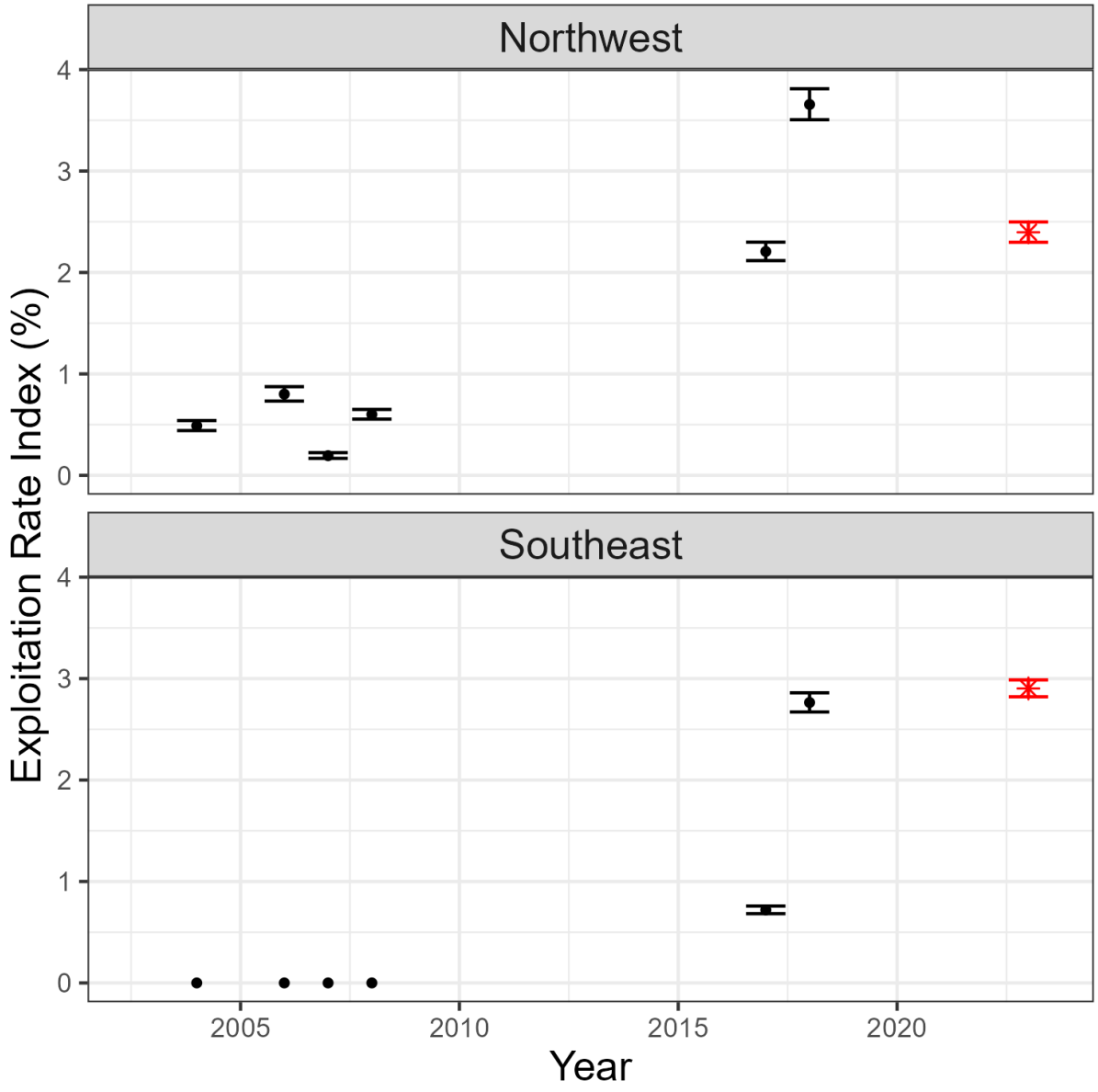

*Figure 6. Exploitation rate indices of sea cucumbers (*Cucumaria frondosa*) of the northwest (top) and southeast (bottom) sea cucumber areas on the St. Pierre Bank since the start of the emerging fishery to present (2003–22). These indices were calculated using the ratio of the landings to the biomass estimates from the sdmTMB model. Indices after the emerging fishery (2008) were calculated with landings one year lagged from the biomass estimate. The 2023 (red) index is based on status quo TAC.*

Sources of Uncertainty

Basic morphometrics such as weight, length, and girth are difficult to assess for sea cucumbers due to the plasticity of their physical characteristics. These measurements depend on the sea cucumber's tonus (muscle tension) and water content, as sea cucumbers are normally comprised of between 6.5 and 82% water (MI 2005), and their water-to-flesh ratio can go up to 740% when they are stressed (Hamel et al. 2019). Data were collected from sea cucumbers as

soon as possible after being removed from the water to minimize water loss and approximate wet weight. However, some variability in these measurements is inherent with this species.

ERI is calculated using commercial 'gross landings' and biomass indices from the surveys. Gross landings are measured by dockside monitoring companies as they are removed from the vessels. Sea cucumbers remain in the vessel's hold during the trip and the transit back to the wharf, which can last 2–3 days. During surveys, sea cucumber weights are recorded as soon as possible to represent the 'wet weight'. ERI is a minimum estimate due to water loss issues inherent with this species and the mismatch in methodology (i.e., time after removal) between the commercial landings and survey weight measurements.

Biomass and abundance indices are considered minimums because sea cucumber catchability is unknown but is believed to be less than one (MI 2006).

Inconsistent survey methods are a source of uncertainty when comparing survey data throughout the time series. Some logistical changes occurred during the emerging fishery surveys, including removing strata that had not caught sea cucumbers in previous years. Additionally, the emerging fishery surveys occurred at the beginning of fishing seasons, whereas DFO sea cucumber surveys occurred after most fishing was complete in a given year (i.e., September).

DFO sea cucumber surveys have occurred sporadically throughout the time series and have lacked full spatial coverage in each survey. Additionally, there was a reduction in the number of sets and depth coverage completed in 2022. This reduction in survey coverage increases the uncertainty of values derived from these surveys. The lack of consistent surveys can result in important changes in population dynamics being easily missed, with the lack of full spatial coverage exacerbating this potential issue.

The population dynamics of sea cucumbers on the St. Pierre Bank are not fully understood. Size-at-age structures are not developed for this species, so there is limited information on recruitment, age-structure, growth, and sustainable harvest levels of this population (Gianasi et al. 2021). Sea cucumbers can also change in weight and length due to variation in food input and season (So et al. 2010). The natural mortality of sea cucumbers on the St. Pierre Bank is unknown.

Survival of discards has not been evaluated. The consequences of harvesting methods and removals on ecosystem structure and function are not fully understood.

CONCLUSION

There is minimal confidence in indices due to the physical plasticity of this species and the reduction in DFO sea cucumber survey coverage in recent years. Exploitation rate indices are a minimum estimate due to variation in sea cucumber landed water loss. Sustainable exploitation rates are unknown.

Given the uncertainties with the assessment of stock status of this species on the St. Pierre Bank, there is no scientific basis for assessing the risk of harvest levels.

LIST OF MEETING PARTICIPANTS

Name	Affiliation
Annie Mercier	Memorial University of Newfoundland / Department of Ocean Sciences
April Wiseman	Fish, Food and Allied Workers Union (FFAW)
Atef Mansour	DFO-NL – Science
Krista Baker	DFO-NL – Science
David Bélanger	DFO-NL – Science
Kaitlyn Charmley	DFO-NL – Science
Ryan Chlebak	DFO-NCR – Science
William Coffey	DFO-NL – Science
Janice Costello	DFO-NL – Science
Elizabeth Coughlan	DFO-NL – Science
Erika Parrill	DFO-NL – Science
Frédéric Cyr	DFO-NL – Science
Kelly Dooley	DFO-NL – Resource Management
Gemma Rayner	Oceans North
Keith Watts	Torngat Fisheries Co-op
Kevin C.K. Ma	Memorial University of Newfoundland / Department of Ocean Sciences
Kurtis Kerivan	FFAW Harvester
Laurie Hawkins	DFO-NL – Resource Management
Nicholas Duprey	DFO-Pacific – Science
Nicolas Le Corre	DFO-NL – Science
Darrell Mullowney	DFO-NL – Science
Hannah Munro	DFO-NL – Science

Name	Affiliation
Renae Butler	Association of Seafood Producers
Jodi Riggs-Power	DFO-NL – Resource Management
Darren Sullivan	DFO-NL – Science
Mary Thiess	DFO-NCR – Science
Bruce Wells	DFO-NL – Science
Sanaollah Zabihi-Seissan	DFO-NL – Science
Hilary Rockwood	DFO-NL – Centre for Science Advice
Eugene Lee	DFO-NL – Centre for Science Advice
Dawn Maddock Parsons	DFO-NL – Science (Co-Chair)
Luiz Mello	DFO-NL – Science (Co-Chair)
Katie Morrissey	DFO-NL – Science

SOURCES OF INFORMATION

This Science Advisory Report is from the Regional Peer Review on March 13, 2023 on the Stock Assessment of Sea Cucumber in NAFO Subdivision 3Ps. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Anderson, S.C., Ward, E.J., English, P.A., and Barnett, L.A.K. 2022. sdmTMB: an R package for fast, flexible, and user-friendly generalized linear mixed effects models with spatial and spatiotemporal random fields. BioRxiv.

Coady, L.W. 1973. Aspects of the reproductive biology of Cucumaria frondosa (Gunnerus, 1770) and Psolus fabricii (Düben and Koren, 1846) (Echinodermata: Holothuroidea) in shallow waters of the Avalon Peninsula, Newfoundland. Masters Thesis. Memorial University of Newfoundland. St. John's, NL. 117 p.

Gianasi, B.L., Hamel, J.-F., Montgomery, E.M., Sun, J., and Mercier, A. 2021. Current Knowledge on the Biology, Ecology, and Commercial Exploitation of the Sea Cucumber *Cucumaria frondosa*. Rev. Fish. Sci. Aquacult. 29(4): 582–653.

Gianasi, B.L., Parrish, C.C., Hamel, J.-F., and Mercier, A. 2017. Influence of diet on growth, reproduction and lipid and fatty acid composition in the sea cucumber *Cucumaria frondosa*. Aquacult. Res. 48(7): 3413–3432.

Grant, S.M., Squire, L., and Keats, C. 2006. Biological resource assessment of the orange footed sea cucumber (*Cucumaria frondosa*) occurring on the St. Pierre Bank. Centre for Sustainable Aquatic Resources, Fisheries and Marine Institute of Memorial University of Newfoundland. St. John's, NL, Canada. P-137 and P-172: 75 p.

Hamel, J.-F., and Mercier, A. 1996. Early development, settlement, growth, and spatial distribution of the sea cucumber *Cucumaria frondosa* (Echinodermata: Holothuroidea). Can. J. Fish. Aquatic Sci. 53(2): 253–271.

Hamel, J.-F., Sun, J., Gianasi, B.L., Montgomery, E.M., Kenchington, E.L., Burel, B., Rowe, S., Winger, P.D., and Mercier, A. 2019. Active buoyancy adjustment increases dispersal potential in benthic marine animals. J. Animal Ecol. 88(6): 820–832.

Mercier, A., and Hamel, J.-F. 2010. Synchronized breeding events in sympatric marine invertebrates: role of behavior and fine temporal windows in maintaining reproductive isolation. Behavior. Ecol. Sociobiol. 64(11): 1749–1765.

MI. 2005. Determining water-loss in sea cucumbers. Marine Institute, Memorial University of Newfoundland. Prepared for the DFA (Government of Newfoundland), project P 1453: 53 p.

MI. 2006. Habitat utilization and density of the sea cucumber (*Cucumaria frondosa*) on St. Pierre Bank, Newfoundland: observations using a towed camera sled in 2004 and 2005. Marine Institute, Memorial University of Newfoundland. St. John's, NL, Canada. 16 p.

Smith, S.J., and Somerton, G.D. 1981. STRAP: A user-oriented computer analysis system for groundfish research trawl survey data. Can. Tech. Rep. Fish. Aquat. Sci. 1030: iv + 66 p.

So, J.J., Hamel, J.-F., and Mercier, A. 2010. Habitat utilisation, growth and predation of *Cucumaria frondosa*: implications for an emerging sea cucumber fishery. Fish. Manage. Ecol. 17(6): 473–484.

Sun, J., Hamel, J.-F., and Mercier, A. 2018. Influence of flow on locomotion, feeding behaviour and spatial distribution of a suspension-feeding sea cucumber. J. Exp. Biol. 221(20): jeb189597.

THIS REPORT IS AVAILABLE FROM THE:

Center for Science Advice (CSA)
Newfoundland and Labrador Region
Fisheries and Oceans Canada
PO Box 5667
St. John's, NL A1C 5X1

E-Mail: DFONLCentreforScienceAdvice@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-5087
ISBN 978-0-660-70587-3 N° cat. Fs70-6/2024-018E-PDF

Correct Citation for this Publication:

DFO. 2024. Assessment of the Orange-Footed Sea Cucumber (*Cucumaria frondosa*) Resource on the St. Pierre Bank (NAFO Subdivision 3Ps) in 2022. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2024/018.

Aussi disponible en français :

*MPO. 2024. Évaluation des ressources en holothurie touffue (*Cucumaria frondosa*) sur le banc de Saint-Pierre (sous-division 3Ps de l'OPANO) en 2022. Secr. can. des avis sci. du MPO. Avis sci. 2024/018.*