



STOCK STATUS UPDATE OF SHRIMP FISHING AREA 4 STRIPED SHRIMP (*PANDALUS MONTAGUI*) IN 2023

Context

The last full stock assessment of Striped Shrimp (*Pandalus montagui*) in Shrimp Fishing Area (SFA) 4 took place in March 2023 (DFO 2021, DFO 2024). The Resource Management Branch of Fisheries and Oceans Canada (DFO) has requested a SFA 4 Striped Shrimp stock status update as the basis for harvest advice for the 2024/25 fishing season. This Science Response Report results from the Regional Peer Review held January 25, 2024 on the Stock Status Update of Striped Shrimp in Shrimp Fishing Area (SFA) 4 ([Integrated Fisheries Management Plan](#)). Participants included DFO Science and DFO Resource Management personnel from Ontario and Prairies, National Capital, and the Newfoundland and Labrador Regions.

Background

Basis for Assessment

The assessment of Striped Shrimp was based on Northern Shrimp Research Foundation (NSRF) - DFO summer trawl survey data and commercial catch data (landings). The commercial fishery exploitation rate index (ERI), calculated using catch and the fishable biomass index (FB - shrimp larger than 17 mm carapace length) from Ogmap (Evans et al. 2000), was also utilized. The fishing season is based on a fiscal year starting April 1 and ending on March 31. Therefore, commercial catch and ERI for the 2023/24 season is preliminary in this report.

In accordance with DFO's Precautionary Approach (PA) Framework, a Limit Reference Point (LRP) to determine the stock status for SFA 4 Striped Shrimp was adopted during the March 2023 Canadian Science Advisory Secretariat (CSAS) peer review meeting (Baker et al. 2024, DFO 2024, Baker et al. in press). The LRP used to determine the stock status in SFA 4 represents a FB index for the Striped Shrimp population in SFA 4, the Eastern Assessment Zone (EAZ), and the Western Assessment Zone (WAZ) (FB_{pop}) and was developed using a spatiotemporal model based on NSRF survey data time series (2005–22) (Baker et al. 2024).

In addition to reporting on the status of the stock in relation to the LRP, three additional indicators of stock health are reported during each assessment: ecosystem outlook – potential predator index, reproductive outlook – total egg production index, and the Ogmap-derived SFA 4-specific FB index. The ecosystem outlook is based on the three-year moving average of a population-wide (i.e., SFA 4, EAZ, and WAZ combined) potential predator index incorporating available predator data from the NSRF survey (large Redfish, Greenland Halibut, skates, and grenadiers) in a spatiotemporal model (Baker et al. in press). Similarly, the reproductive outlook is based on the three-year moving average of a population-wide total egg production index taking into consideration both the abundance and size distribution of females at each NSRF set location in a spatiotemporal model (Baker et al. in press). The SFA 4-specific FB index represents the biomass estimates calculated using Ogmap on NSRF survey data in SFA 4 only

(Orr and Sullivan 2013). Those three indicators are assessed against historical values (i.e., long-term average) to identify potential concerns about stock health.

Description of the Fishery

Commercial catch of Striped Shrimp is taken as bycatch in the SFA 4 Northern Shrimp fishery. Until 2012, the sole source of catch information for Striped Shrimp was logbooks; however, bycatch was recorded in the reported fishery landings within the Atlantic Quota Monitoring System (AQMS) beginning in 2013.

Analysis and Response

Fishery

A bycatch limit of 4,033 t was implemented in 2013/14 and has remained unchanged since, with the commercial catch ranging between 1,113 t and 3,755 t (Table 1, Figure 1). AQMS data from January 2, 2024, indicated the preliminary catch in 2023/24 to be 1,552 t, which was 38% of the Total Allowable Catch (TAC) (Table 1, Figure 1).

Biomass

Typically survey trawl length (i.e., bottom contact) is calculated using trawl sensor data to determine when each trawl starts and stops fishing. In 2023 the primary trawl sensor data were unavailable for 2/3 of the trawls, therefore bottom contact time was estimated for the missing trawls. This estimation was calculated using a regression between bottom contact times measured by CTD (Conductivity, Temperature, Depth sensor) and the primary trawl sensor for the trawls where both were measured. Although this calculation deviates from the typical approach, it is not expected to impact the outcome of the assessment.

From 2005 to 2022, the FB index averaged 29,100 t. It was 38,400 t in 2023, a 1% decrease from 2022 (Table 2, Figure 2). From 2005 to 2022, the female biomass index averaged 22,400 t. It was 23,600 t in 2023, a 23% decrease from 2022 (Table 2, Figure 2).

Exploitation

The ERI ranged between 0.8% and 23.3% from 2005/06 to 2022/23. Preliminary total catch data acquired from the AQMS database on January 2, 2024, indicated an ERI of 4.0% in 2023/24 (Figure 3, Table 3). If the entire TAC was taken in 2023/24, the ERI would be 10.5%.

Current Outlook

In 2023, FB_{pop} was estimated to be 4.5 times the LRP (Figure 4). The stock has remained above the LRP since 2007. Striped Shrimp in SFA 4 is considered to be in a healthy state within the PA Framework.

Other Indicators of the Stock Status

The population-wide potential predator index showed an increasing trend since 2021, with a 64% increase from 2022 mostly driven by large Redfish biomass (Figure 5), which could potentially influence predation pressure on the stock. Other indices of stock health, including population-wide total egg production index (Figure 6) and SFA 4-specific FB index (Figure 2) showed no cause for concern.

Conclusions

The FB index was determined to be above the long-term mean and has been on an increasing trend since 2020. The female biomass index declined in 2023 compared to 2022 but remains above the long-term mean. In 2023, the SFA 4 Striped Shrimp stock was more than 4 times higher than the adopted LRP and was considered to be in a healthy state within the PA Framework. If the bycatch limit is taken, the ERI will be 10.5% in 2023/24.

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March 19, 2024

Sources of Information

Baker, K.D., Anderson, S.C., Mullaney, D.R.J., Walkusz, W., and Skanes, K.R. 2024. [Moving away from a scale mismatch: Spatiotemporal modelling of Striped Shrimp \(*Pandalus montagui*\) density in Canada’s subarctic](#). Fish. Res. 270: 106898.

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- Orr, D., and Sullivan, D.J. 2013. [The February 2013 assessment of Northern Shrimp \(*Pandalus borealis*\) off Labrador and Northeastern Newfoundland](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2013/055.

Appendix I: Tables

Table 1. SFA 4 Striped Shrimp commercial catches and by-catch quotas from 2002 to 2023/24. Catches for 2023/24 are preliminary as of January 2, 2024 (obtained from AQMS database). Management year was changed from a calendar year to a fiscal year (April 1 to March 31) in 2003.

Year	By-Catch Quotas (t)	Catch (t)
2002	-	25
2003–04	-	-
2004–05	-	83
2005–06	-	813
2006–07	-	1,805
2007–08	-	2,182
2008–09	-	278
2009–10	-	617
2010–11	-	1,115
2011–12	-	3,236
2012–13	-	4,708
2013–14	4,033	1,611
2014–15	4,033	1,236
2015–16	4,033	2,135
2016–17	4,033	1,113
2017–18	4,033	2,611
2018–19	4,033	2,572
2019–20	4,033	3,035
2020–21	4,033	2,734
2021–22	4,033	3,146
2022–23	4,033	3,755
2023–24*	4,033	1,552

Table 2. SFA 4 Striped Shrimp fishable and female biomass indices from 2005 to 2023. Biomass indices and confidence intervals (CIs) were calculated using Ogmap methods on NSRF survey data.

Survey Year	Fishable Biomass Index Lower 95% CI (x1,000 t)	Fishable Biomass Index (x1,000 t)	Fishable Biomass Index Upper 95% CI (x1,000 t)	Change in Fishable Biomass Index From Last Year (%)	Female Biomass Index Lower 95% CI (x1,000 t)	Female Biomass Index (x1,000 t)	Female Biomass Index Upper 95% CI (x1,000 t)	Change in Female Biomass Index From Last Year (%)
2005	9.6	18.0	28.9	-	6.4	12.2	20.3	-
2006	7.7	13.4	22.2	-26	3.7	7.5	13.4	-38
2007	8.6	16.7	26.3	25	5.2	9.0	13.8	19
2008	21.0	35.6	55.4	113	14.6	28.5	45.2	218
2009	11.0	20.0	32.3	-44	8.3	15.7	25.9	-45
2010	8.6	14.3	23.0	-28	6.4	11.1	17.8	-29

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Survey Year	Fishable Biomass Index Lower 95% CI (x1,000 t)	Fishable Biomass Index (x1,000 t)	Fishable Biomass Index Upper 95% CI (x1,000 t)	Change in Fishable Biomass Index From Last Year (%)	Female Biomass Index Lower 95% CI (x1,000 t)	Female Biomass Index (x1,000 t)	Female Biomass Index Upper 95% CI (x1,000 t)	Change in Female Biomass Index From Last Year (%)
2011	8.0	13.9	22.6	-3	5.7	8.9	14.5	-20
2012	13.5	25.3	38.3	82	10.5	21.0	31.4	136
2013	25.3	36.9	53.8	46	20.0	29.6	44.7	41
2014	21.8	31.5	47.9	-15	17.3	24.8	37.4	-16
2015	28.6	44.7	67.9	42	22.6	34.4	52.3	39
2016	16.3	23.2	36.1	-48	12.5	17.7	28.3	-49
2017	26.8	43.7	70.6	88	18.4	33.5	52.5	89
2018	33.9	53.7	79.6	23	28.9	45.9	71.2	37
2019	24.9	38.9	60.9	-28	19.2	32.3	48.1	-30
2020	16.6	24.6	36.6	-37	11.9	18.1	27.3	-44
2021	17.0	31.0	47.4	26	12.3	22.4	33.3	24
2022	29.6	38.8	53.6	25	23.7	30.6	42.5	37
2023	25.2	38.4	58.2	-1	15.0	23.6	36.3	-23

Table 3. SFA 4 Striped Shrimp ERIs from 2005 to 2023/24. The ERI for 2023/24 is preliminary and based on AQMS catch data from January 2, 2024.

Management Year	Exploitation Rate Index Lower 95% CI (%)	Exploitation Rate Index (%)	Exploitation Rate Index Upper 95% CI (%)
2005/06	2.8	4.5	8.5
2006/07	8.1	13.5	23.5
2007/08	8.3	13.1	25.4
2008/09	0.5	0.8	1.3
2009/10	1.9	3.1	5.6
2010/11	4.8	7.8	12.9
2011/12	14.3	23.3	40.2
2012/13	12.3	18.6	34.9
2013/14	3.0	4.4	6.4
2014/15	2.6	3.9	5.7
2015/16	3.1	4.8	7.5
2016/17	3.1	4.8	6.8
2017/18	3.7	6.0	9.7
2018/19	3.2	4.8	7.6
2019/20	5.0	7.8	12.2
2020/21	7.5	11.1	16.5
2021/22	6.6	10.1	18.5
2022/23	7.0	9.7	12.7
2023/24*	2.7	4.0	6.2

Appendix II: Figures

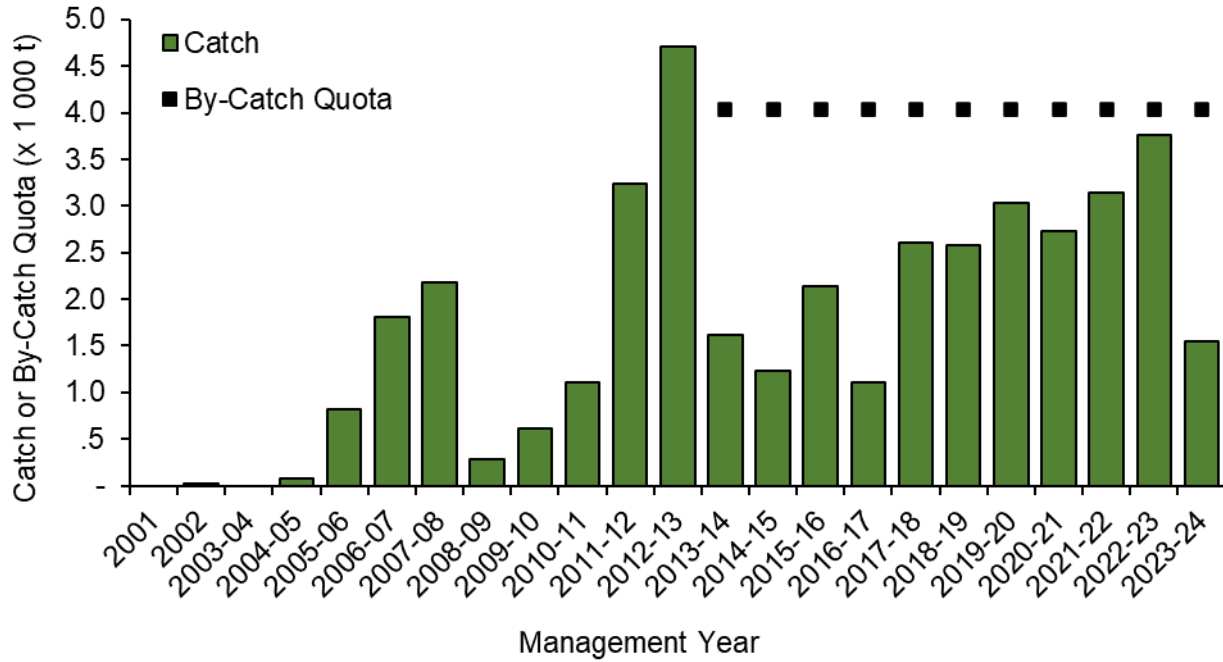


Figure 1. SFA 4 Striped Shrimp commercial catches and by-catch quotas from 2002 to 2023/24. Catches for 2023/24 are preliminary as of January 2, 2024 (obtained from AQMS database).

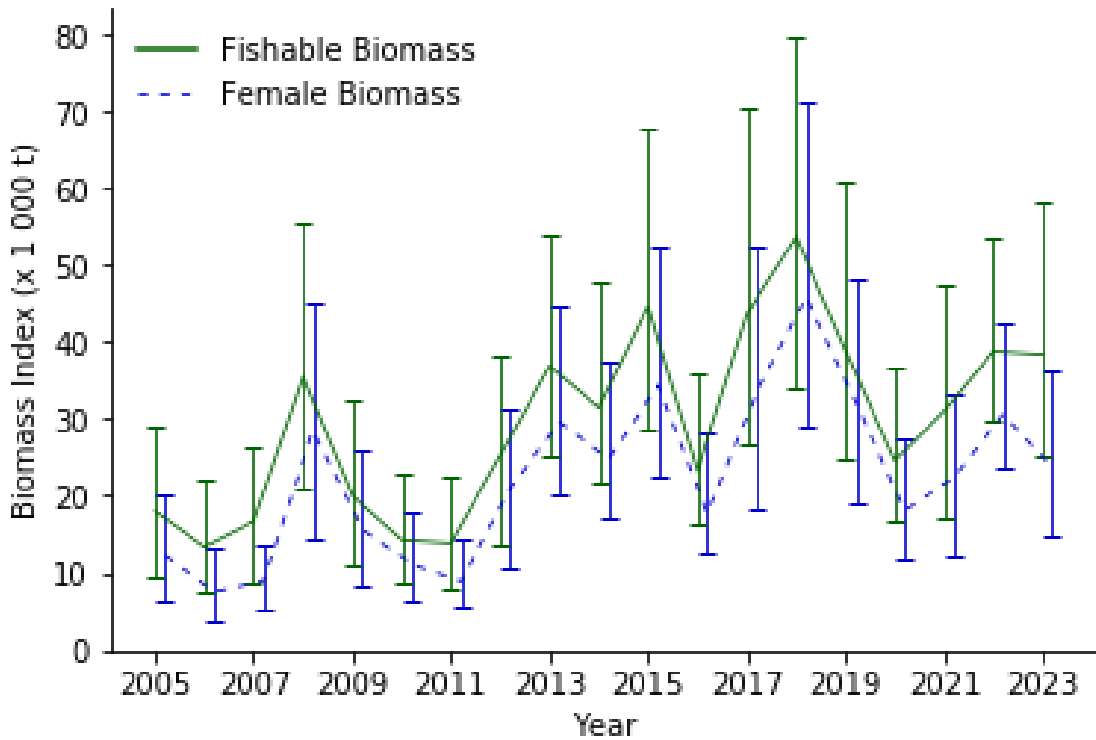


Figure 2. SFA 4 Striped Shrimp fishable and female biomass indices from 2005 to 2023. Biomass indices were calculated using Ogmap on NSRF survey data and error bars reflect 95% CIs.

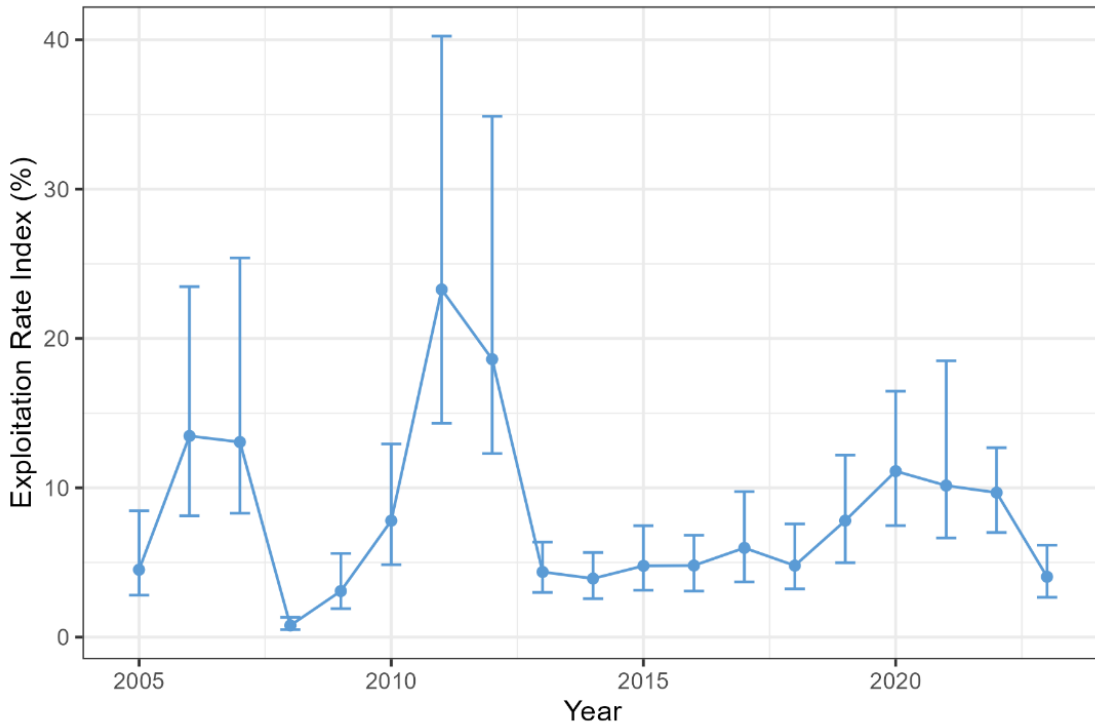


Figure 3. SFA 4 Striped Shrimp ERIs from 2005 to 2023/24. The ERI for 2023/24 is preliminary and based on catches from January 2, 2024 (obtained from AQMS database). Error bars reflect 95% CIs.



Figure 4. SFA 4 Striped Shrimp Precautionary Approach Framework: modelled Striped Shrimp fishable biomass index in the WAZ, EAZ, and SFA 4 combined (solid line) based on NSRF surveys (2005 to 2023) with 95% confidence limits (grey shading) (values scaled to LRP).

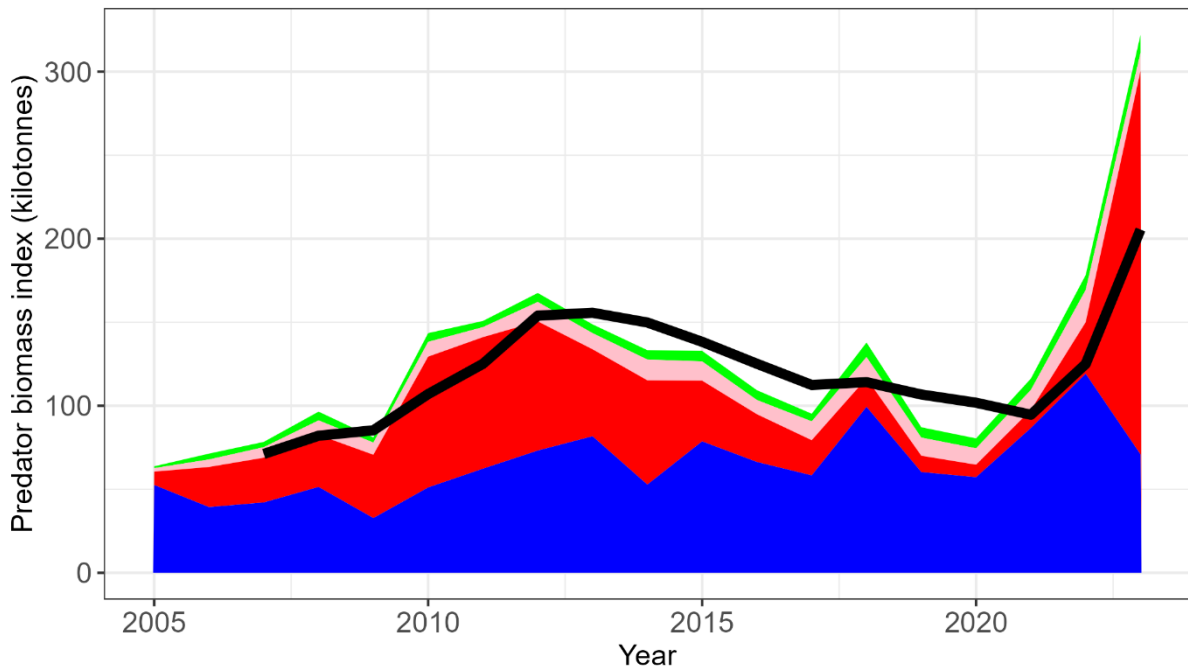


Figure 5. Modelled annual biomass indices (stacked shaded areas) and three-year moving average (black solid line) of potential predator indices (kilotonnes) in WAZ, EAZ, and SFA 4 combined. Blue area – annual Greenland Halibut biomass index, red area – annual large Redfish biomass index, pink – annual skate biomass index, green – annual grenadier biomass index.

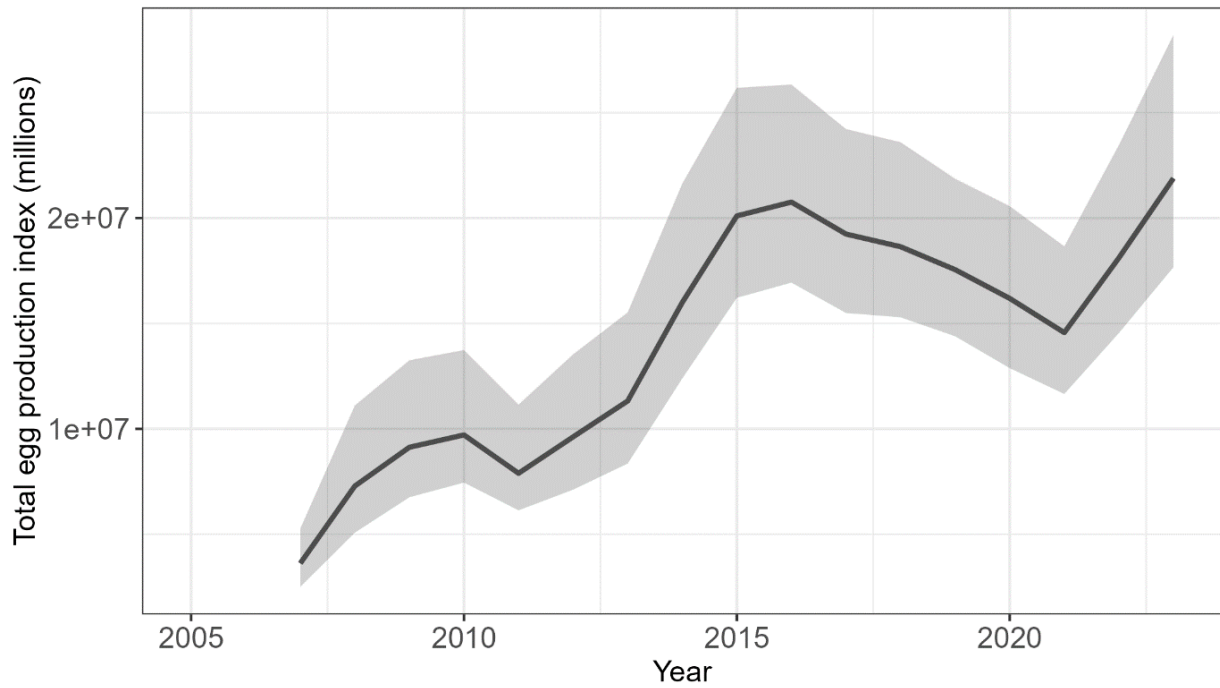


Figure 5. Three-year moving average of modelled total egg production index (millions) of Striped Shrimp in WAZ, EAZ, and SFA 4 combined, based on NSRF survey data (2005 to 2023), with 95% confidence limits (grey shading).

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de pêche de la crevette 4 en 2023. Secr. can. des avis sci. du MPO. Rép. des Sci.
2024/028.*