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# STOCK STATUS UPDATE OF GEORGES BANK 'A' SCALLOPS (*PLACOPECTEN MAGELLANICUS*) FOR THE 2023 FISHING SEASON

## Context

Advice on the status of the Georges Bank Scallop stock is requested annually by Fisheries and Oceans Canada (DFO) Resource Management to help determine an annual Total Allowable Catch (TAC, meat weight) in support of the fishery. The purpose of this report is to update the status of Georges Bank Scallop with data from the 2022 Scallop survey and fishery (January 1 to December 31) to provide science advice for the management of the 2023 fishery.

This Stock Status Update uses the assessment framework established in 2009 (Jonsen et al. 2009) and accepted during the peer-reviewed Regional Advisory Process of 2013 (DFO 2013; Hubley et al. 2014). Updates have been conducted annually since, with the exception of 2021, which did not occur because the 2020 DFO Science Offshore Scallop Survey was cancelled due to challenges associated with the COVID-19 pandemic (DFO 2022).

This update for the Scallop fishery on Georges Bank pertains to zone 'a'. Georges Bank zone 'b' has separate management measures. Some elements of the fishery in zone 'b' are also presented for continuity.

This Science Response Report results from the regional peer review of April 11, 2023, on the Stock Status Update of Offshore Scallop: Browns Bank North and Georges Bank 'a'.

## Analysis and Response

The location of Georges Bank 'a' and the other Offshore Scallop Fishing Areas (SFAs) is provided in Figure 1. The final 2022 TAC was 3,800 tonnes (t) for zone 'a', and 700 t for zone 'b'. With quota carry forward, the final adjusted 2022 TAC for zone 'a' was 3,905 t. Total reported landings in 2022 were 3,906 t for zone 'a', and 684 t for zone 'b' (Figure 2). Based upon preliminary analysis of the 2022 fishery data and the annual stock survey data, an interim TAC of 3,800 t was set in December 2022 for the 2023 Georges Bank zone 'a' fishery and 700 t for zone 'b'.
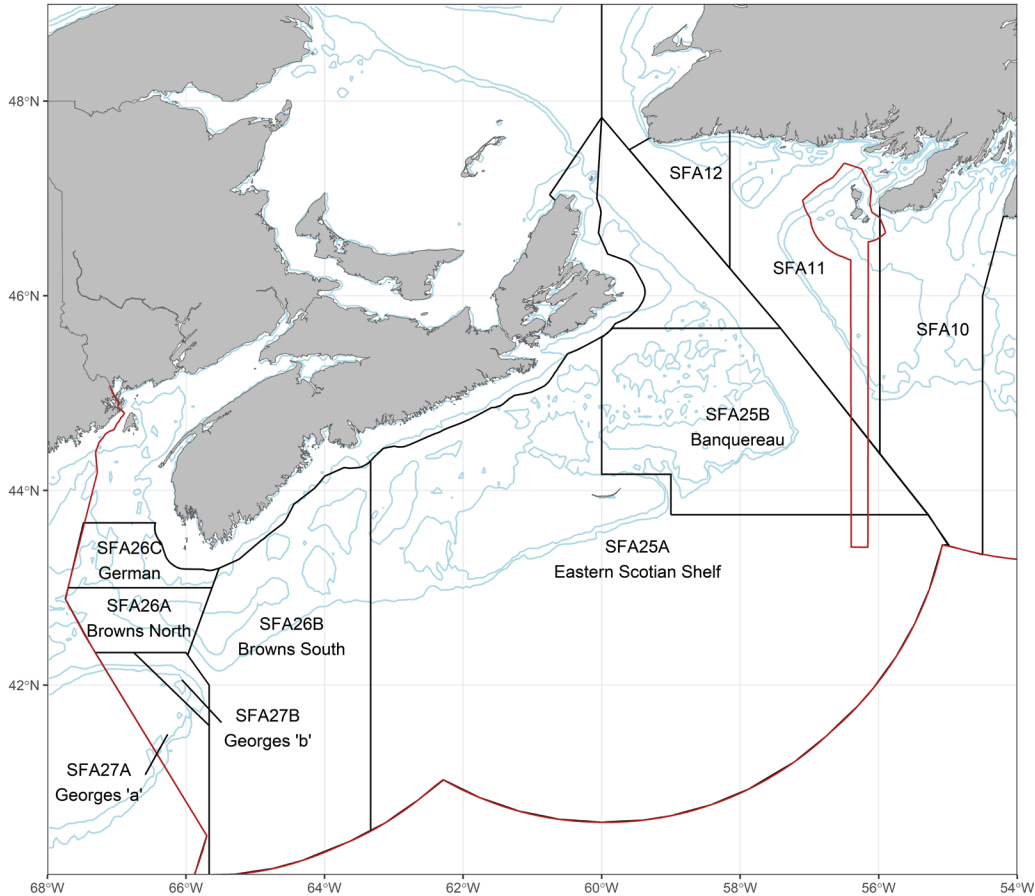
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*Figure 1. Map showing the offshore Scallop Fishing Areas (SFAs) 25–27 used for management purposes in the Maritimes region.*

Science advice is provided for this stock using a Bayesian state-space modified delay difference assessment model that integrates both fishery and survey data and is described in Hubley et al. (2014). The model fit to the survey estimates of fully-recruited (≥ 95 mm shell height) biomass, recruit (85–94.9 mm shell height) biomass, and fishery Catch Per Unit Effort [CPUE, kg/(hour-metre)] are shown in Figure 3. Estimates of fully-recruited biomass in 2022 and projections of fully-recruited biomass for 2023 under various catch scenarios are presented and compared to established reference points for this stock (Table 1 and Figure 4).

The 2020 model inputs were imputed using the average of the 2019 and 2021 survey indices, except for growth, which used the long-term median from 1986–2019. This approach has been used to address missing information for other Scallop stocks (e.g., Nasmith et al. 2016).

The modelled median fully-recruited biomass is estimated to be 22,967 t in 2022 (Figure 4), which is above the long-term median of 18,515 t. The 2021 estimate was 18,118 t. The median recruit biomass is estimated to be 3,154 t in 2022, which is below the long-term median biomass of 3,434 t. The 2021 estimate was 3,173 t. The long-term median calculations (1986–2021) exclude the current year (2022) estimates.

## Indicator of Stock Status

Georges Bank 'a' reference points are based on 30% and 80% of the mean modelled biomass from 1986 to 2009, which changes annually as new data are included in the model (Smith and

Hubley 2012, Hubley et al. 2014). From the 2023 model run, the Limit Reference Point (LRP) is 4,680 t, and the Upper Stock Reference (USR) is 12,480 t. The probability that the 2022 biomass is currently above the USR and in the Healthy Zone is approximately greater than 0.99. The model forecasted median fully-recruited biomass for 2023 is 22,429 t. This forecast accounts for fisheries removals (617 t) occurring after the survey in 2022, and assumes:

- a catch of 3,800 t (the interim TAC),

- the condition of Scallop in 2023 will be unchanged from 2022 (17.1 g/dm$^3$), and

- that natural mortality in 2023 will be unchanged from 2022 (0.16).

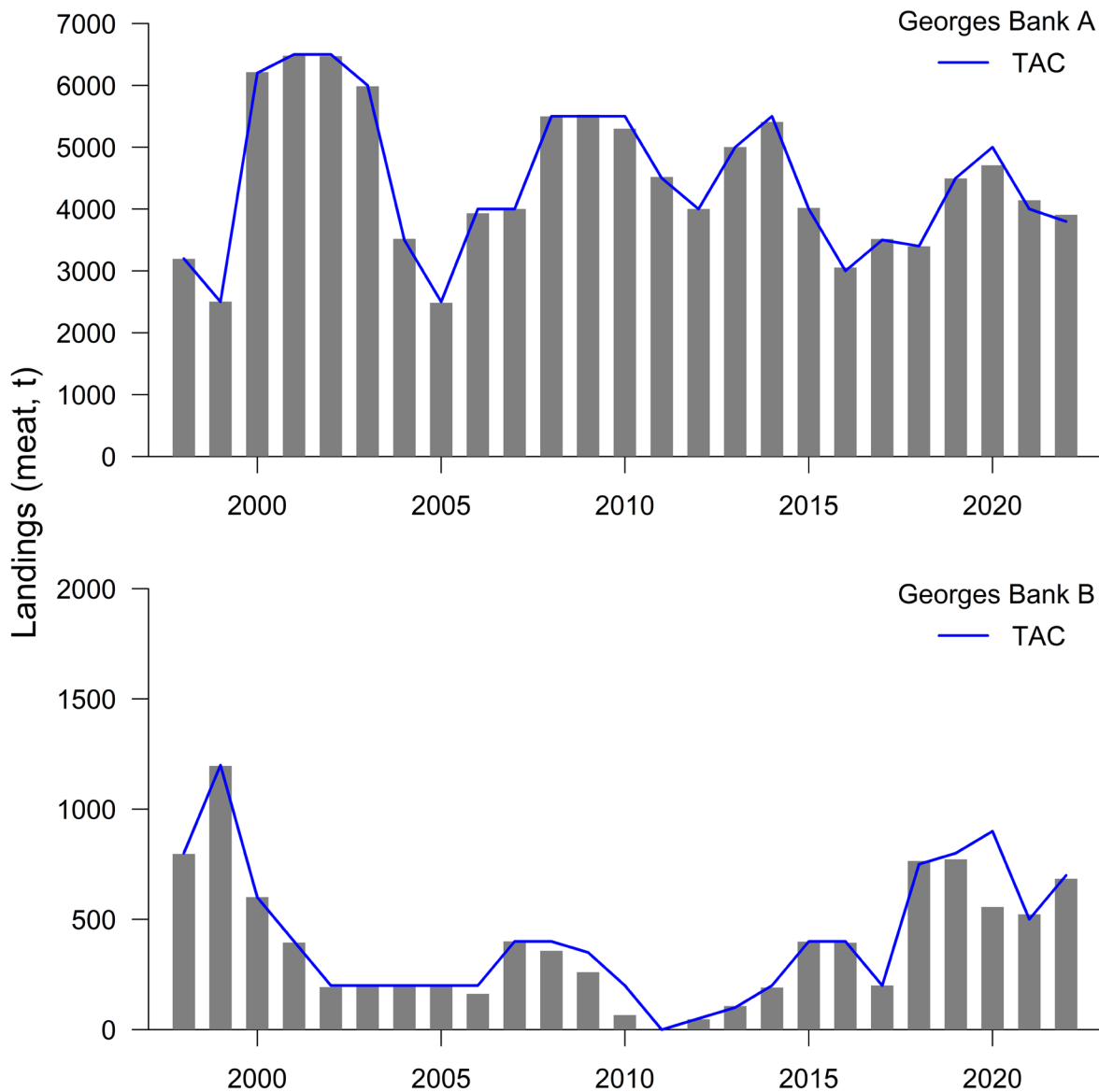This represents an estimated 3% decrease in fully-recruited biomass from 2022 to 2023.



*Figure 2. Landings of Scallop meats (tonnes) from Georges Bank 'a' (top panel), and 'b' (lower panel) between 1998 and 2022. The blue line represents Total Allowable Catch (TAC), in tonnes. Prior to 1998, landings from Georges Bank 'a' and 'b' were combined.*
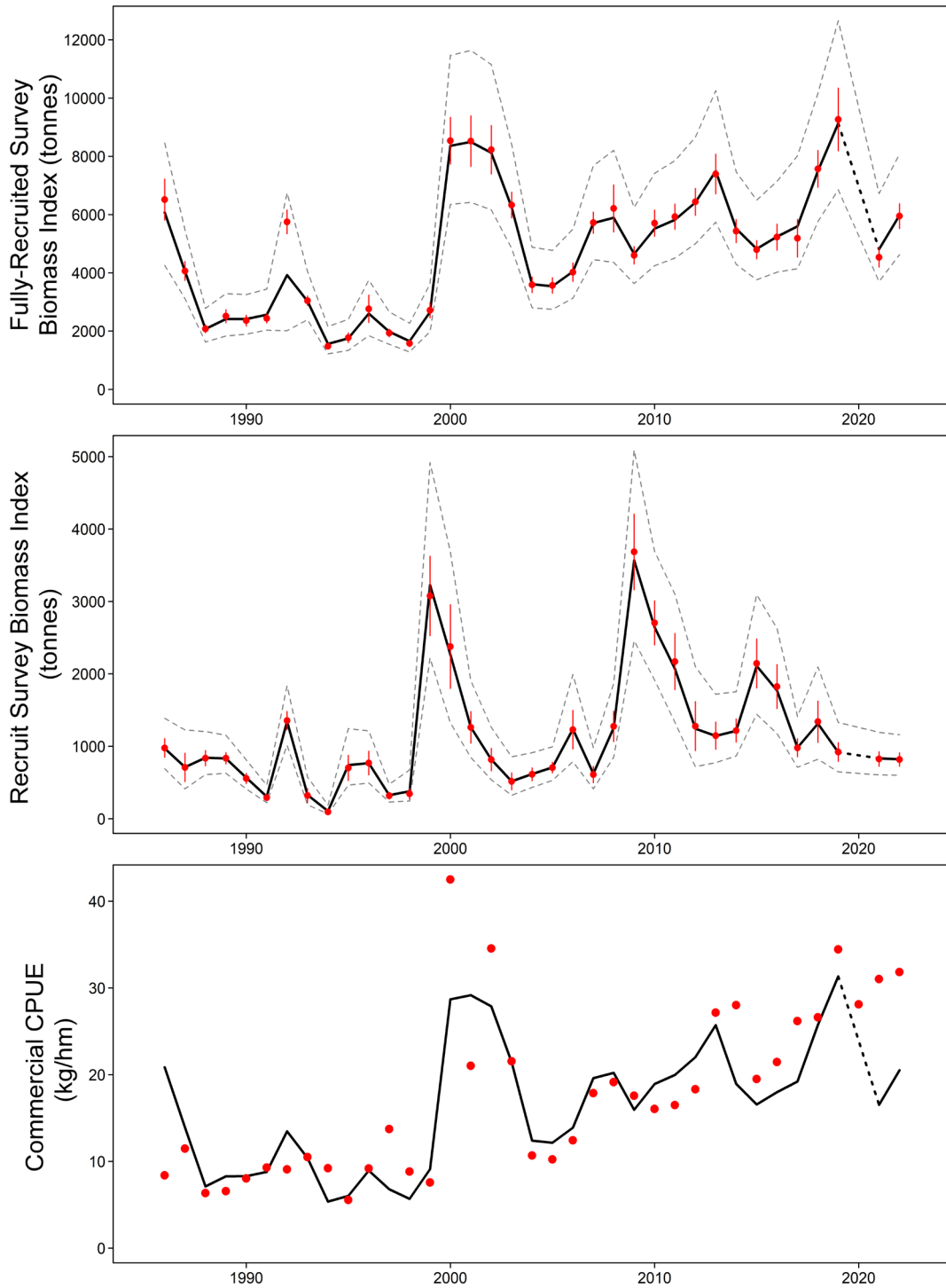
*Figure 3. Summary of model results and inputs for fully-recruited survey biomass (top panel, in tonnes), recruit survey biomass (middle panel, in tonnes) and commercial CPUE (bottom panel, in kg/hour-metre) for Georges Bank 'a'. The solid black line is the model estimate, and the red circles represent observed values from the survey and the fishery. A black dashed line is used from 2019–2021 as there were no survey or model results for 2020. For the survey data, the vertical lines represent the standard error associated with the observed values and the grey dashed lines represent the modelled 95% credible intervals.*
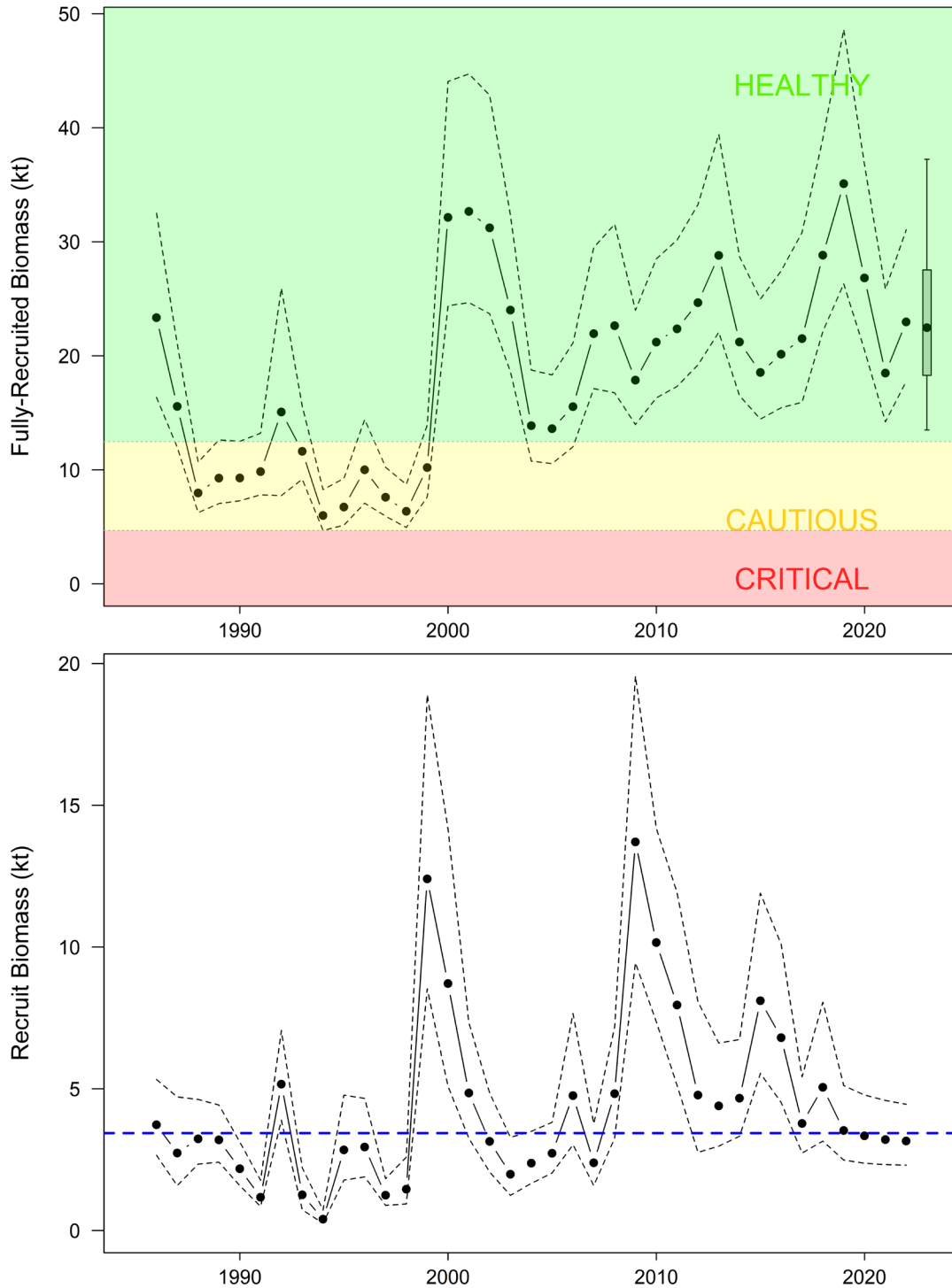
*Figure 4. Biomass estimates (kilotonnes) for fully-recruited (top panel) and recruit (lower panel) Scallops from the stock assessment model fit to the Georges Bank 'a' survey and commercial data. Dashed lines are the upper and lower 95% credible limits. Coloured zones (from top to bottom) represent the Healthy (green), Cautious (yellow) and Critical (red) zones (reference points described in text). The blue horizontal dashed line in the lower panel represents the long-term median (1986–2021) recruit biomass. The forecasted fully-recruited biomass for 2023, assuming a catch of 3,800 t, is displayed as a box plot with median (●), 50% credible limits (box) and 80% credible limits (whiskers).*

*Table 1. Catch scenarios for Georges Bank 'a' in 2023 in terms of exploitation and expected changes in fully-recruited biomass. Potential catches in 2023 are evaluated in terms of the probability of a decline in biomass and exceeding the Upper Stock Reference (USR) and Limit Reference Point (LRP). These probabilities account for uncertainty in the biomass forecasts.*

| Catch (t) | Exploitation Rate | Probability of Biomass Decline | Expected Change in Biomass (%) | Probability biomass will exceed USR | Probability biomass will exceed LRP |
|---|---|---|---|---|---|
| 1,000 | 0.06 | 0.40 | 9 | 0.97 | > 0.99 |
| 1,500 | 0.08 | 0.42 | 7 | 0.96 | > 0.99 |
| 2,000 | 0.10 | 0.44 | 5 | 0.95 | > 0.99 |
| 2,500 | 0.12 | 0.46 | 3 | 0.95 | > 0.99 |
| 3,000 | 0.13 | 0.49 | 1 | 0.94 | > 0.99 |
| 3,500 | 0.15 | 0.52 | −2 | 0.94 | > 0.99 |
| 4,000 | 0.17 | 0.55 | −4 | 0.93 | > 0.99 |
| 4,500 | 0.19 | 0.57 | −6 | 0.92 | > 0.99 |
| 5,000 | 0.21 | 0.59 | −8 | 0.91 | > 0.99 |
| 5,500 | 0.23 | 0.62 | −10 | 0.90 | > 0.99 |
| 6,000 | 0.25 | 0.64 | −12 | 0.89 | > 0.99 |
| 6,500 | 0.26 | 0.67 | −15 | 0.87 | > 0.99 |
| 7,000 | 0.28 | 0.70 | −17 | 0.85 | > 0.99 |
| 7,500 | 0.30 | 0.72 | −19 | 0.84 | > 0.99 |

# Conclusions

Catch scenarios ranging from 1,000 t to 7,500 t are presented in Table 1, assuming condition and total natural mortality remain unchanged from 2022. All catch scenarios in Table 1 below 3,500 t are projected to result in increases in fully-recruited biomass, with a probability of biomass decline ranging from 0.40 to 0.49. The probability that biomass will remain in the Healthy Zone is 0.84 or greater for all catch scenarios presented (Table 1). Catch of 3,800 t (the 2023 interim TAC) results in an exploitation rate of 0.16.

# Contributors

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# Sources of Information

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