STOCK STATUS UPDATE OF GEORGES BANK SCALLOPS (*PLACOPECTEN MAGELLANICUS*)

Context

Advice on the status of the Georges Bank Scallop stock is requested annually by Fisheries and Ocean Canada (DFO) Resource Management to help determine a 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 2016 Scallop survey and fishery to provide science advice for the management of the 2017 fishery. The last peer-reviewed Regional Advisory Process for this stock occurred in 2013 (DFO 2013, Hubley et al. 2013) and updates were conducted for years 2014-2016 (DFO 2014, 2015, 2016).

The management of the main Scallop fishery on Georges Bank refers to zone 'a'. Georges Bank zone 'b' is a marginal growth area for scallops and has separate management measures (Appendix 1). The assessment and advice presented in this document uses the assessment framework established in 2009 (Jonsen et al. 2009) and are for Georges Bank zone 'a' only; some elements of the fishery in zone 'b' are also presented for historical purposes.

This Science Response reports results from the Science Response Process of April 3, 2017, on the Stock Status Update of Offshore Scallop: Browns Bank North and Georges Bank.

Analysis and Response

The 2016 TAC was 3,000 tonnes (t) for zone 'a' and 400 t for zone 'b'. With quota carry forward, the adjusted 2016 TAC for zone 'a' was 3,075 t. Total reported landings in 2016 were 3,054 t for zone 'a' and 394 t for zone 'b' (Figure 1). Based upon preliminary analysis of the 2016 fishery data and the annual stock survey data, an interim TAC of 3,000 t was set in December 2016 for the 2017 Georges Bank zone 'a' fishery and 200 t for zone 'b'.

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. (2013). The model fit to the survey estimates of fully-recruited (> 95 mm shell height) biomass, recruit (85-94.9 mm) biomass, and fishery catch per unit effort (CPUE, kg/(hour-meter)) are shown in Figure 2. Estimates of fully-recruited biomass in 2016 and projections of fully-recruited biomass for 2017 under various catch scenarios are presented and compared to established reference points for this stock (Figure 3 and Table 1).

The median fully-recruited biomass is estimated to be 20,591 t in 2016 (Figure 3; the long-term median calculations (1986-2015) exclude the current year (2016) estimates). This is an increase from the 2015 estimate (18,800 t), and above the long-term median of 15,913 t. The median recruit biomass is estimated to be 6,988 t in 2016, a decrease from the 2015 estimate (8,193 t), but well above the long-term median biomass of 3,228 t.

Georges Bank 'a' reference points are based on 30% and 80% of the mean biomass from 1986 to 2009. The Lower Reference Point (LRP) is 7,137 t and the Upper Stock Reference (USR) is 13,284 t. The probability that the 2016 biomass is currently above the USR and in the Healthy

Zone is above 0.99 (Table 1). The model forecasted median fully-recruited biomass for 2017 is 23,752 t. This forecast assumes:

a) a catch of 3,000 t (the interim TAC),

b) the condition in 2017 will be unchanged from 2016 (16.1 g/dm^3), and

c) that natural mortality in 2017 will be unchanged from 2016 (0.24).

This represents an estimated 14% increase in fully-recruited biomass from 2016 to 2017.

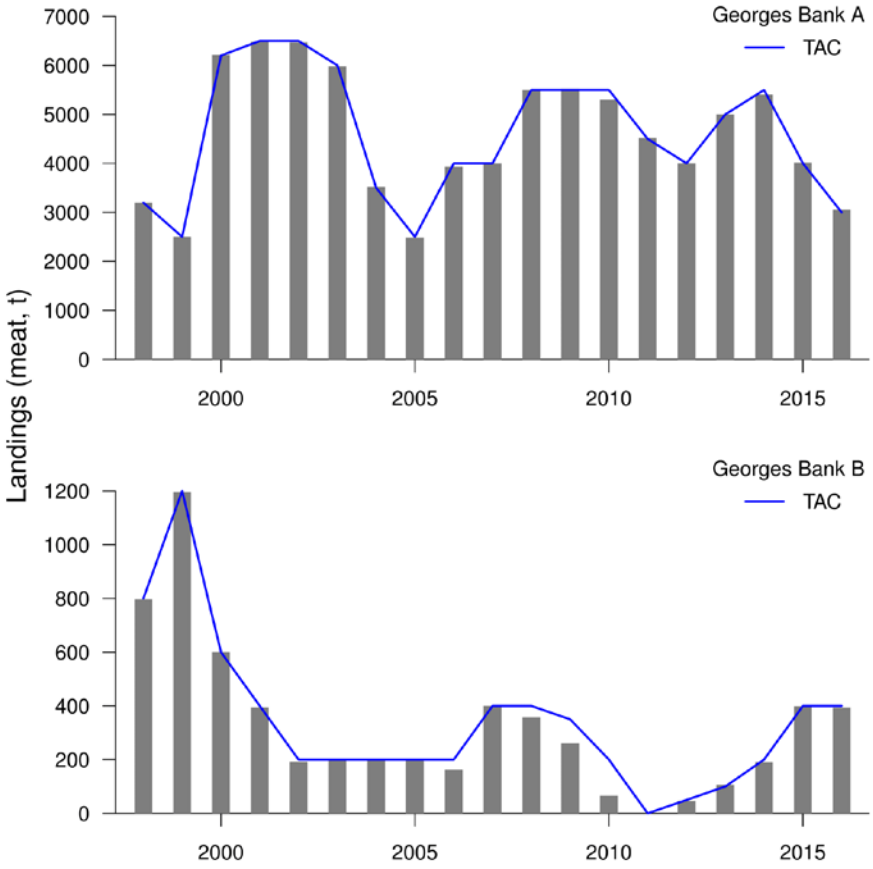

Figure 1. Landings of Scallop meats (tonnes) from Georges Bank 'a' (top panel), and 'b' (bottom panel) between 1998 and 2016. The blue solid line represents total allowable catch (TAC), in tonnes (t). Prior to 1998, landings from Georges Bank 'a' and 'b' were combined.

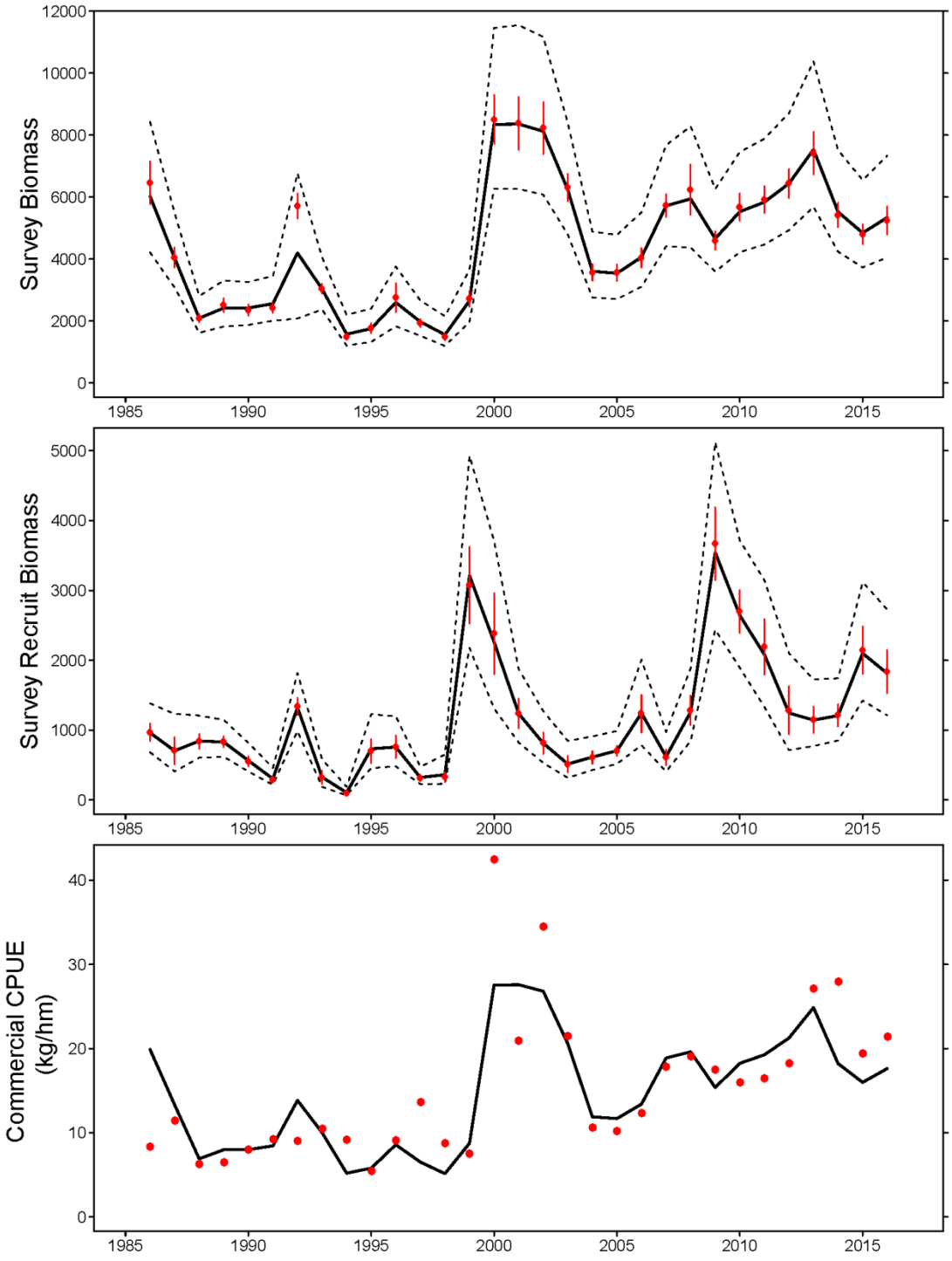

Figure 2. Summary of model results and inputs for fully-recruited survey biomass (top panel, in tonnes), recruit survey biomass (middle panel, in tonnes) and CPUE (bottom panel, in kg/hm) for Georges Bank 'a'. The thick black line is the model estimate with 95% credible interval (dotted line). Circles represent observed values from the survey and the fishery. For the survey data, the vertical lines represent the standard error associated with the observed values.

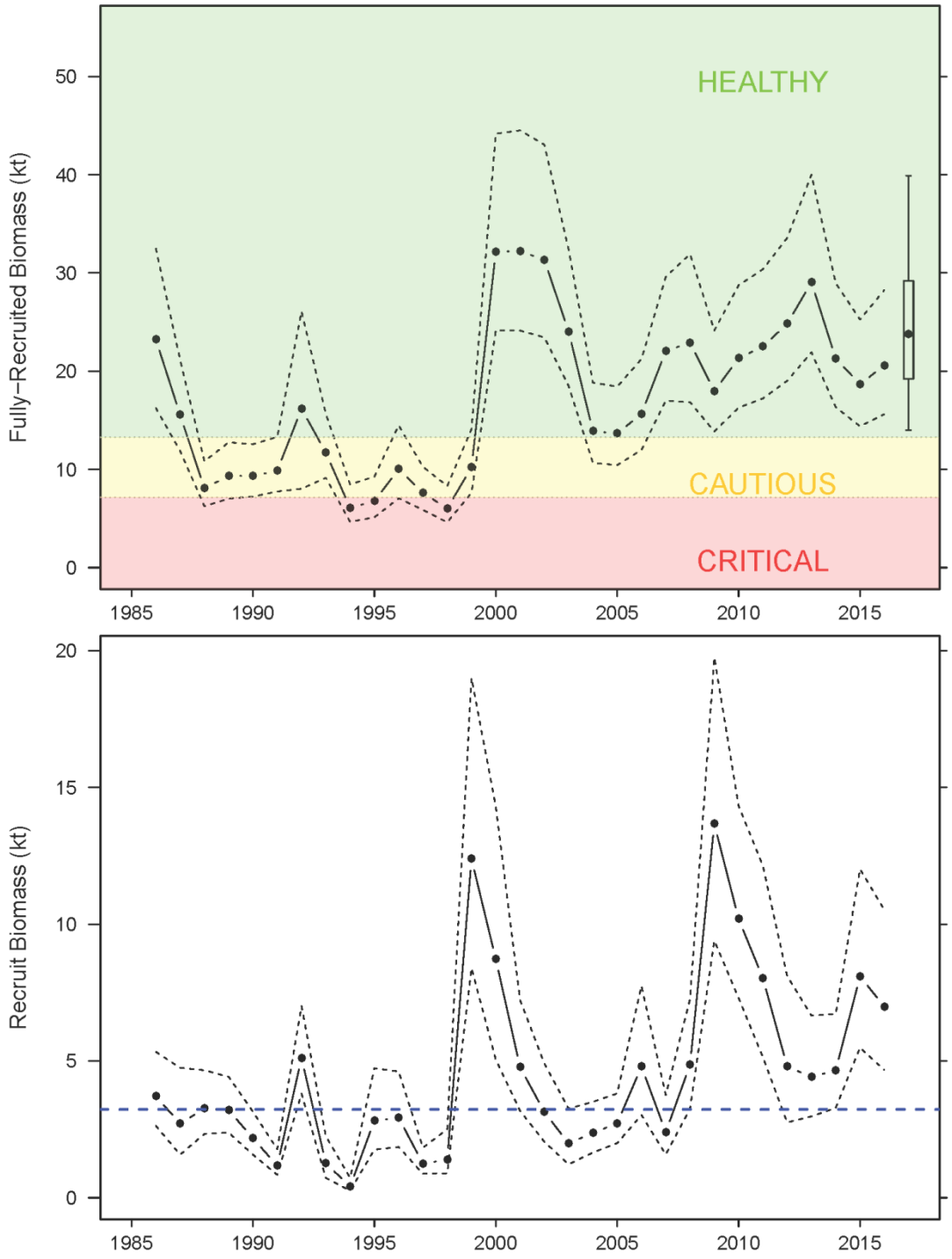

Figure 3. Biomass estimates for fully-recruited (top panel) and recruit (lower panel) scallops from the stock assessment model fit to the Georges Bank 'a' survey and commercial data. Dashed lines are the upper and lower 95% credible limits on the estimates. Coloured zones (from top to bottom) represent 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 recruit biomass. The forecasted fully-recruited biomass for 2017, assuming a catch of 3,000 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 2017 in terms of exploitation and expected changes in fully-recruited biomass. Potential catches in 2017 are evaluated in terms of the probability of a decline in biomass and exceeding reference points (Upper Stock Reference (USR) and Lower 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
1000	0.05	0.28	24	0.94	>0.99
1500	0.07	0.30	21	0.94	>0.99
2000	0.09	0.32	19	0.93	>0.99
2500	0.10	0.34	17	0.93	>0.99
3000	0.12	0.36	14	0.92	>0.99
3500	0.14	0.38	12	0.91	>0.99
4000	0.16	0.40	10	0.90	>0.99
4500	0.18	0.42	7	0.89	>0.99
5000	0.20	0.45	5	0.88	>0.99
5500	0.21	0.47	2	0.87	>0.99
6000	0.23	0.49	1	0.86	>0.99
6500	0.25	0.52	-2	0.85	0.99

Conclusions

The 2017 interim TAC of 3,000 t results in an exploitation rate of 0.12. Catch scenarios ranging from 1,000 t to 6,500 t are presented in Table 1. All catch scenarios below 6,500 t are projected to result in increases in fully-recruited biomass, with a probability of biomass decline ranging from 0.28 to 0.52. The probability that biomass will remain in the Healthy Zone is ≥ 0.85 for all catch scenarios presented (Table 1).

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Sources of Information

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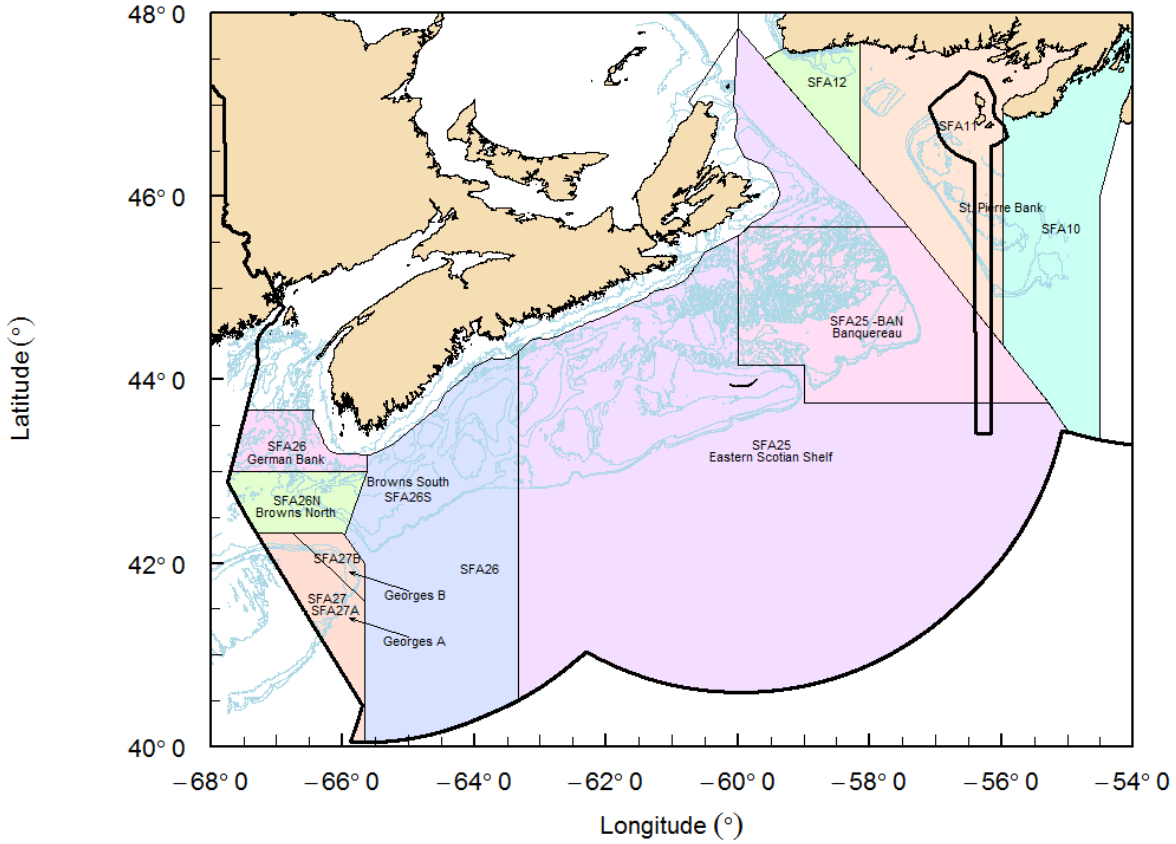
Appendix

Appendix 1. Map showing the offshore scallop fishing areas (SFAs) 25-27 used for management purposes in the Maritimes Region. Note the division of Georges Bank 'a' and 'b' as subareas of SFA 27.



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