ASSESSMENT UPDATE OF GEORGES BANK SCALLOPS (*PLACOPECTEN MAGELLANICUS*)

Context

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

The management of the main Scallop fishery on Georges Bank refers to zone 'a' (Georges Bank 'a'). Georges Bank zone 'b' (Georges Bank '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 'a' only; some elements of the fishery in Georges Bank 'b' are also presented for historical purposes.

This Science Response reports results from the Science Response Process of April 6, 2016, on the Stock Status Update of Offshore Scallop: Browns Bank North and Georges Bank.

Analysis and Response

The 2015 TAC was 4,000 t for Georges Bank 'a' and 400 t for Georges Bank 'b'. With quota carry forward, the adjusted 2015 TAC for Georges Bank 'a' was 4,075 t. Total reported landings in 2015 were 4,016 t for Georges Bank 'a' and 399 t for Georges Bank 'b' (Figure 1). Based upon preliminary analysis of the 2015 fishery data and the annual stock survey data, an interim TAC of 3,000 t was set for the 2016 Georges Bank 'a' fishery and 400 t for Georges Bank 'b'.

Science advice for this stock is provided 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 2015 and projections of fully-recruited biomass for 2016 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, estimated to be 18,800 t in 2015 (Figure 3), decreased from the 2014 estimate (21,390 t) but remains above the 29-year median of 15,710 t. This decrease in biomass reflects decreases in both survey abundance and weight per tow. The median recruit biomass is estimated to be 8,193 t in 2015, this represents an increase from the 2014 estimate (4,670 t), and is above the 29-year median biomass of 3,219 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 2015 biomass is currently above the USR and in the healthy zone is above 0.99. The model forecasted median fully-recruited biomass for 2016 is 22,464 t. This forecast assumes:

1. a catch of 3,000 t (the interim TAC),
2. the condition in 2016 will be unchanged from 2015, (17.7 g/dm^3), and
3. that natural mortality in 2016 will be unchanged from 2015 (0.26; note that in the 2015 update the 3-year average mortality was used for the forecast; that was the only instance that a 1-year mortality was not used).

This represents an estimated 19% increase in fully-recruited biomass from 2015 to 2016 (Table 1).

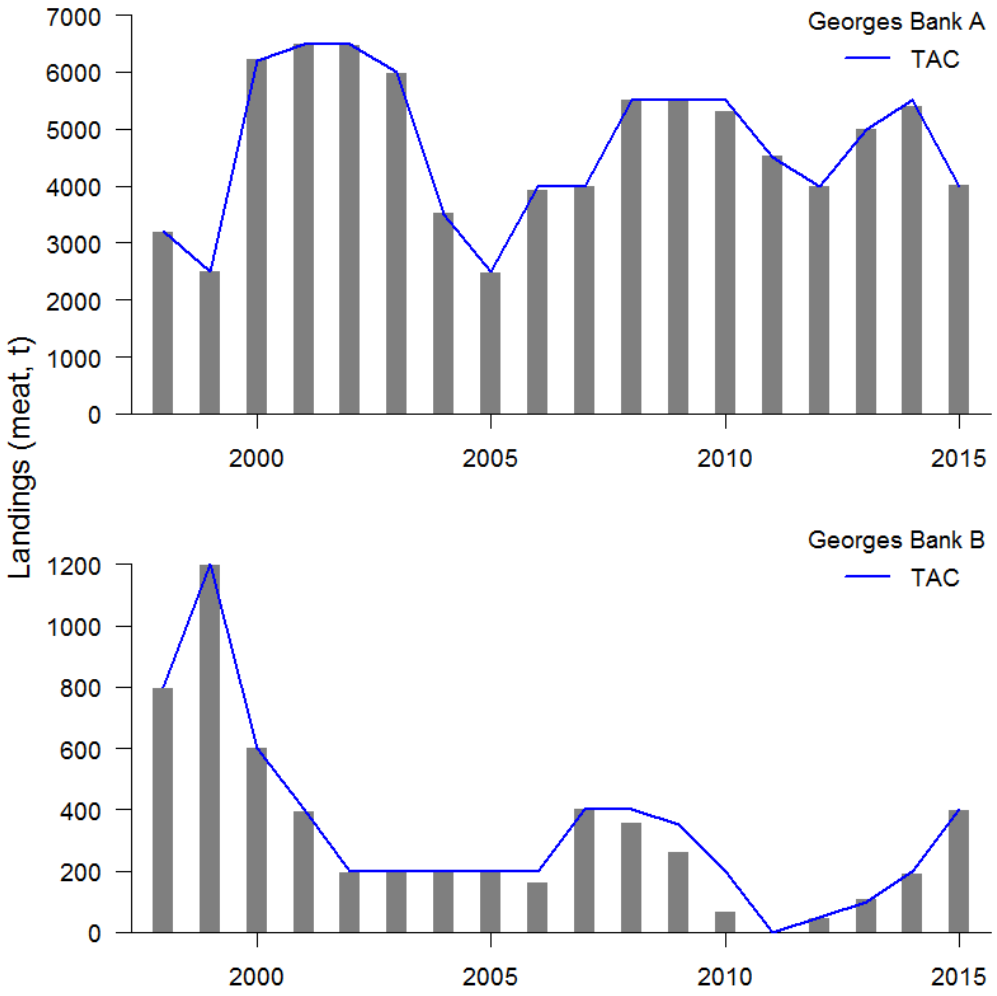


Figure 1. Landings of Scallop meats (tonnes) from Georges Bank 'a' (top panel), and 'b' (lower panel) between 1998 and 2015. The blue line represents total allowable catch (TAC) in metric tons. Prior to 1998, landings from Georges Bank 'a' and 'b' were combined.

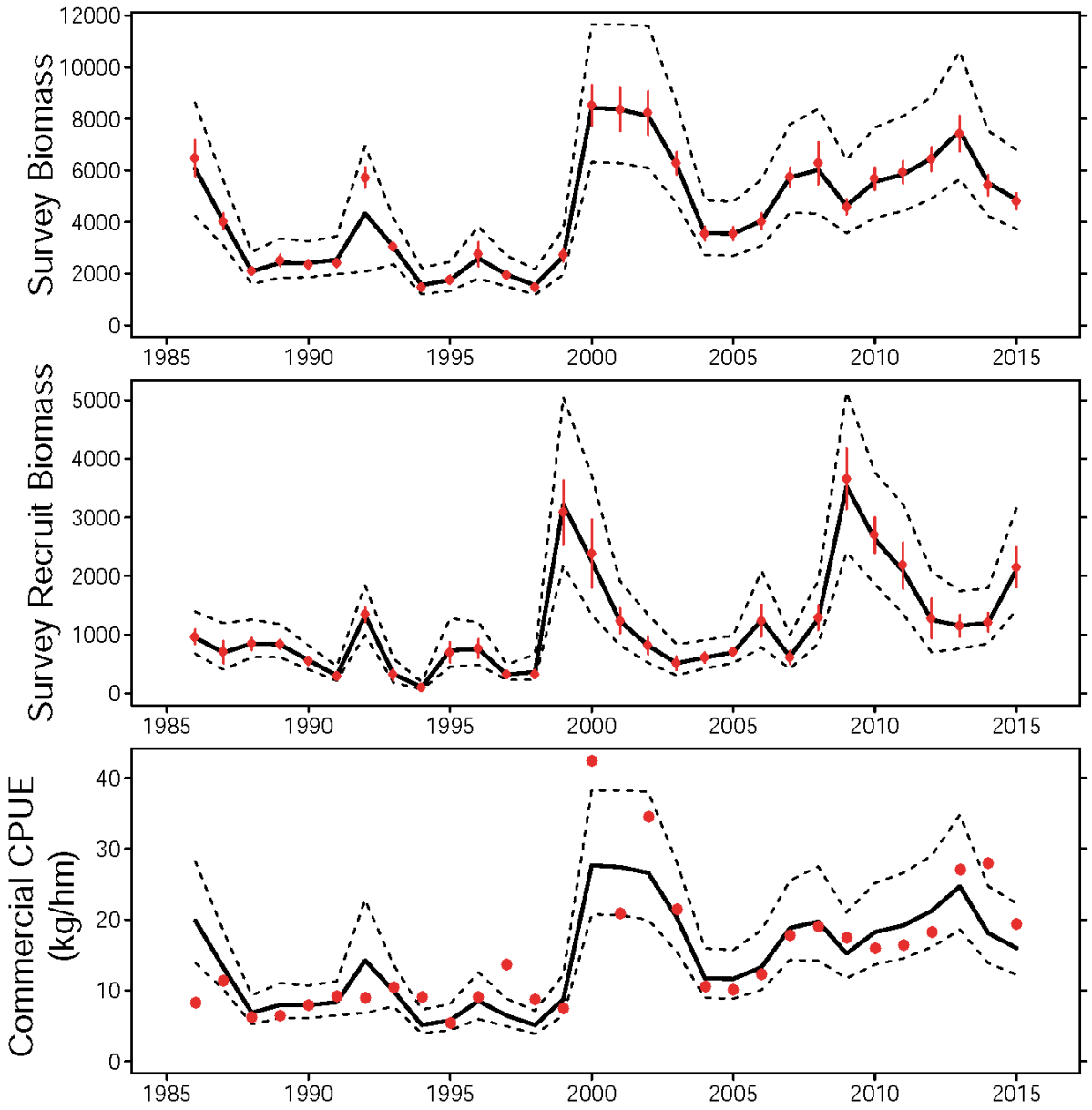


Figure 2. Summary of model results and inputs for fully-recruited survey biomass (top panel, in tonnes), recruit survey biomass (middle panel, in tonnes) and CPUE (bottom panel, in kg/hm) for Georges Bank 'a'. The thick black line is the model estimate with 95% credible interval (dotted line). Circles 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.

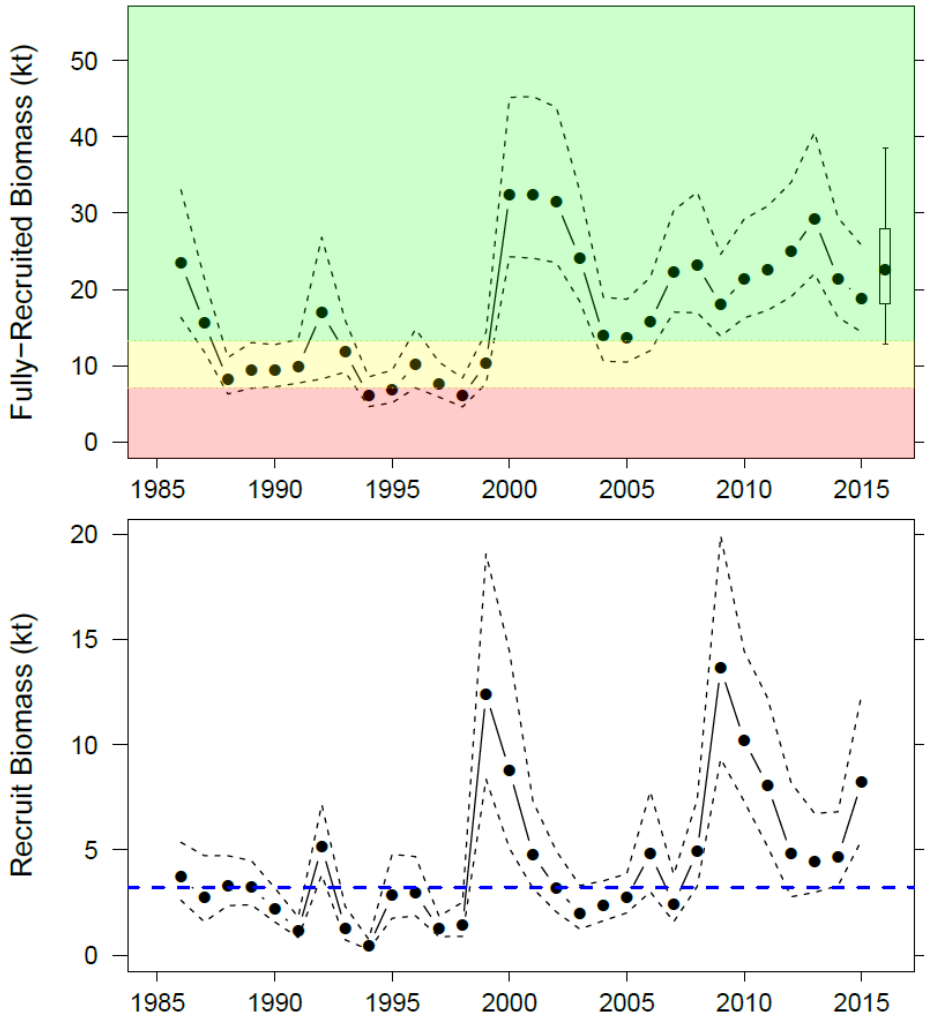


Figure 3. Biomass estimates for fully-recruited (top panel) and recruit (lower panel) scallops from the stock assessment model fit to the Georges Bank 'a' survey and commercial data. Dashed lines are the upper and lower 95% credible limits on the estimates. Coloured zones (from top to bottom) represent 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 29-year median (1986-2014) for recruitment. The forecasted fully-recruited biomass for 2016, 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 2016 in terms of exploitation and expected changes in fully-recruited biomass. Potential catches in 2016 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
2000	0.11	0.30	23	0.91	>0.99
2500	0.13	0.32	20	0.89	>0.99
3000	0.14	0.33	19	0.89	>0.99
3500	0.16	0.35	16	0.88	>0.99
4000	0.18	0.38	13	0.87	>0.99
4500	0.20	0.39	12	0.86	>0.99
5000	0.22	0.41	9	0.84	0.99
5500	0.24	0.44	6	0.83	0.99
6000	0.26	0.46	4	0.82	0.99
6500	0.28	0.49	1	0.80	0.98

Conclusions

The 2016 interim TAC of 3,000 t results in an exploitation rate of 0.14. Catch scenarios ranging from 2,000 t to 6,500 t are presented in Table 1. All catch scenarios shown are projected to result in increases in fully-recruited biomass with a probability of biomass decline ranging from 0.24 to 0.49. The probability that biomass will remain in the healthy zone is ≥ 0.80 for all catch scenarios presented (Table 1).

Contributors

Name	Affiliation
David Keith (Lead)	DFO Science, Maritimes Region
Alan Reeves	DFO Science, Maritimes Region
Mike McMahon (Reviewer)	DFO Science, Maritimes Region
Mark Showell (Reviewer)	DFO Science, Maritimes Region
Leslie Nasmith	DFO Science, Maritimes Region
Christa Waters	DFO Science, Maritimes Region

Approved by

Alain Vézina
Regional Director of Science, DFO Maritimes Region
Dartmouth, Nova Scotia
Ph. 902-426-3490
Date: May 27, 2016

Sources of Information

DFO. 2013. Assessment of Georges Bank Scallops (*Placopecten magellanicus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/058.

DFO. 2014. Assessment Update of Georges Bank Scallops (*Placopecten magellanicus*). DFO Can. Sci. Advis. Sec. Sci. Resp. 2014/038.

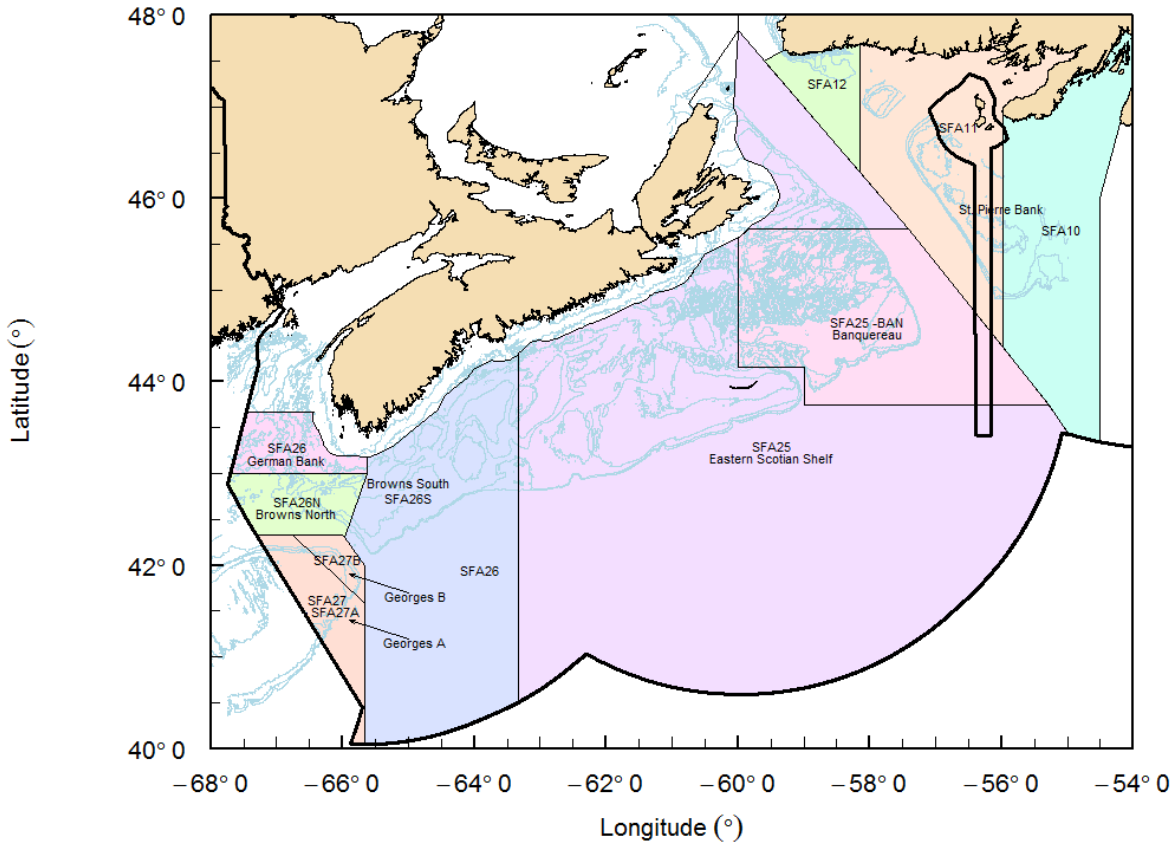
DFO. 2015. Assessment Update of Georges Bank Scallops (*Placopecten magellanicus*). DFO Can. Sci. Advis. Sec. Sci. Resp. 2015/025.

Hubley, P.B., A. Reeves, S.J. Smith, and L. Nasmith. 2013. Georges Bank 'a' and Browns Bank 'North' Scallop (*Placopecten magellanicus*) Stock Assessment. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/079.

Jonsen, I.D., A. Glass, B. Hubley, and J. Sameoto. 2009. Georges Bank 'a' Scallop Framework Assessment: Data Inputs and Population Models. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/034.

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.



This Report is Available from the

Centre for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
PO Box 1006, Station B203
Dartmouth, Nova Scotia
Canada B2Y 4A2

Telephone: 902 426-7070
E-Mail: XMARMRAP@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-3769

Correct Citation for this Publication:

DFO. 2016. Assessment Update of Georges Bank Scallops (*Placopecten magellanicus*). DFO Can. Sci. Advis. Sec. Sci. Resp. 2016/040.

Aussi disponible en français :

MPO. 2016. Mise à jour de l'évaluation du pétoncle du banc de Georges (Placopecten magellanicus). Secr. can. de consult. sci. du MPO, Rép. des Sci. 2016/040.