Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
Gulf Region
Canadian Science Advisory Secretariat
Science Advisory Report 2012/002

REVISED REFERENCE POINTS FOR SNOW CRAB TO ACCOUNT FOR THE CHANGE IN ESTIMATION AREA OF THE SOUTHERN GULF OF ST. LAWRENCE BIOLOGICAL UNIT

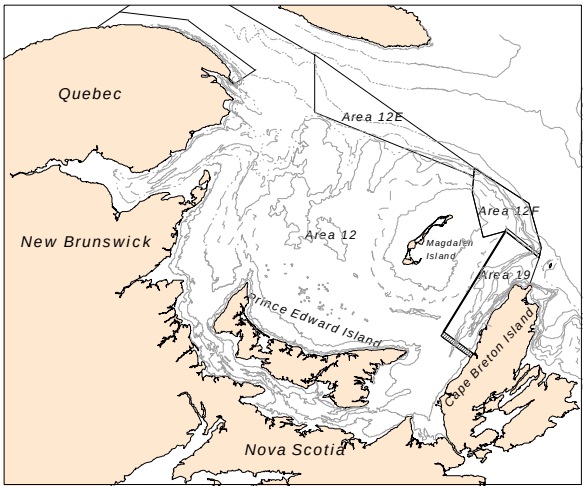

Figure 1. Map of the southern Gulf of St. Lawrence showing the Crab Fishing Areas.

Context :

Precautionary Approach (PA) reference points for the snow crab (Chionoecetes opilo) biological unit of the southern Gulf of St. Lawrence were defined in 2010 (DFO 2010). The reference points included a biomass limit reference point (B_{lim}), a biomass upper stock reference point (B_{USR}) and a removal rate limit reference point (F_{lim}). These reference points were developed based on biomass estimates for an area of the southern Gulf of St. Lawrence measuring 44,302 km² and which encompassed over 98% of the snow crab fishery effort (Hebert et al. 2010).

During a science review of assessment methods for snow crab in November 2011, it was recommended that the estimation area for the snow crab of the southern Gulf of St. Lawrence biological unit be expanded to include the area encompassed by the 20 to 200 fathom depth contours, a surface area representing 57,840 km².

At the science peer review meeting of the 2011 snow crab assessment, estimates of commercial adult male snow crab biomass were provided for this expanded polygon covering 57,840 km². Revised reference points were developed based on the revised biomass estimates using the same approach originally used to define the reference points in 2010 (DFO 2010). The regional peer review meeting took place Feb. 7 and 8, 2012 in Moncton, NB. Participants at the science review included DFO Science, DFO Fisheries Management, university researchers, an expert from USA, the fishing industry, provincial governments and Aboriginal organizations. This document provides revised reference points for the new and larger estimation area for the southern Gulf snow crab biological unit.

SUMMARY

- Revised reference points based on an expanded assessment area of 57,840 km² are provided for the southern Gulf of St. Lawrence snow crab biological unit.

- Revised reference are based on estimates of commercial-sized adult male crab biomass for the expanded area and the same approach used to originally define the reference points in 2010 (DFO 2010).

- The revised biomass limit reference point (B_{lim}) is 10,000 t of hard-shelled commercial-sized adult male crab, which was available to the fishery, and as estimated from the post-fishery snow crab trawl survey assessment.

- The revised biomass upper stock reference point (B_{USR}) is 41,400 t of commercial-sized adult male crab all carapace conditions, which become hard-shelled crab on January 1 of the next year's fishery, and as estimated from the post-fishery snow crab trawl survey assessment.

- The revised removal rate limit reference point (F_{lim}) is 0.346 which is the average exploitation rate expressed as catch in fishing year divided by the commercial sized adult male crab biomass estimate of the previous year for the 1998 to 2009 fishing years.

BACKGROUND

Reference points consistent with the Precautionary Approach (DFO 2009) were defined for the snow crab (*Chionoecetes opilio*) biological unit of the southern Gulf of St. Lawrence (DFO 2010). At that time, the biomass of commercially exploitable snow crab was assessed using a surface area (polygon) of 44,302 km² which encompassed over 98% of the snow crab fishing effort during 2006 to 2010 (Figure 2). At a science framework review of assessment methods for snow crab, it was recommended that the snow crab abundance for the southern Gulf of St. Lawrence biological unit be assessed based on a surface area that encompassed the 20 to 200 fathoms depth contours, an area corresponding generally to the areal extent of bottom temperatures < 5 ºC which are favourable for snow crab. The total area of this estimation polygon is 57,840 km². The fishery independent trawl survey in 2006 to 2011 sampled the majority of this expanded polygon. Sampling during 1997 to 2005 was less intensive within this expanded polygon but the science framework review of November 2011 concluded that the sampling had been sufficient to derive revised biomass values for the expanded polygon for the period 1997 to 2011.

The reference points need to be revised to account for the change in biomass values. The same approach as described in DFO (2010) has been used to revise the reference points.

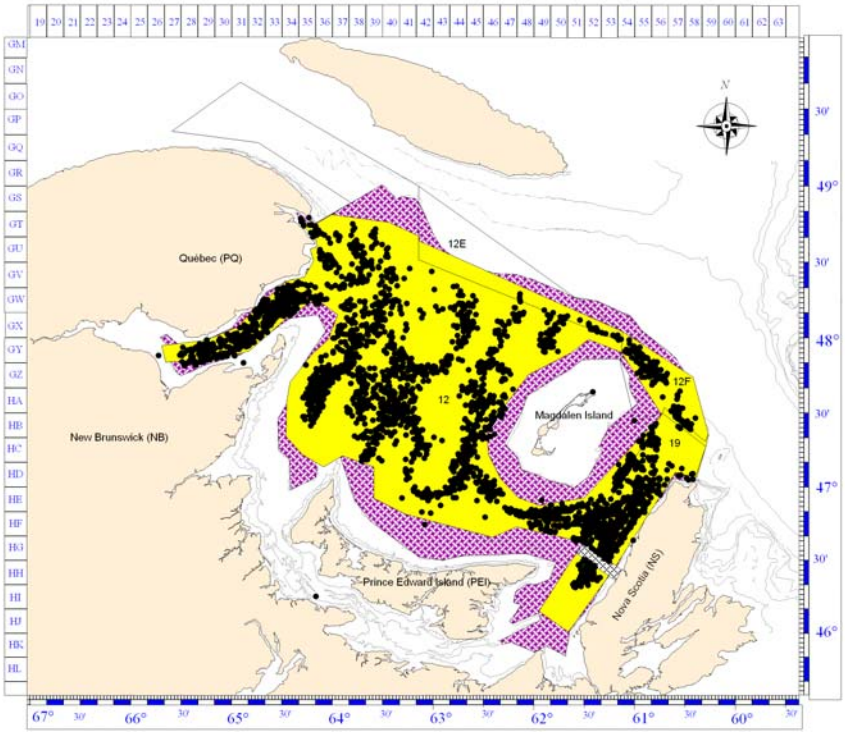

Figure 2. The estimation polygon of 44,302 km² (yellow area) used for the development of reference points in 2010 (DFO 2010) and the expanded estimation polygon of 57,840 km² (purple and yellow areas combined) used for the revised reference points. The points in the plot show the positions of snow crab fishing effort for 2006 to 2010 based on at-sea observer data.

ASSESSMENT

Revised reference points for the southern Gulf snow crab biological unit

As per DFO (2010), the estimate of B_{MSY} is taken as 50% of the maximum biomass over a productive period (Figure 3; DFO 2009). For snow crab in the southern Gulf, a productive period was identified as the period 1997 to 2008. During this time period, the maximum biomass value for the expanded polygon area of 57,840 km² was estimated in 2004 at 103,400 t (DFO 2012). This translates to a B_{MSY} value of 51,700 t (Figure 3).

As stated in DFO (2010), it is unknown if this is a sustainable level (i.e. a good proxy for B_{MSY}) because recruitment of terminal molted large males from these biomass levels has only been measured for a few year classes to date.

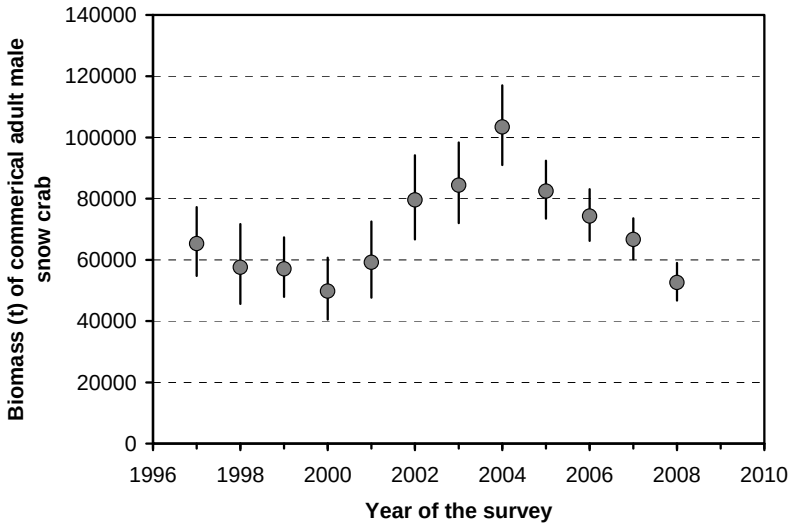

Figure 3: Biomass (t) of commercial-sized adult male crab (all carapace conditions) estimated from the trawl survey in the southern Gulf of St. Lawrence for the expanded polygon measuring 57,840 km² (DFO 2012) during the period 1997 to 2008.

The upper stock reference point (B_{USR} = 80% of B_{MSY}) is 41,400 t of commercial-sized adult male crab of all carapace conditions as estimated from the trawl survey. These crab become hard shelled commercial-sized adult male crab as of 1 January of the year following the trawl survey.

The limit reference point for the stock status was chosen as the lowest biomass of hard shelled commercial-sized adult male crab (post-fishery as estimated from the trawl survey) which produced good recruitment rates of juvenile crab at Instar VIII (DFO 2010). This B_{lim} value was estimated at 10,000 t from the 2000 trawl survey year.

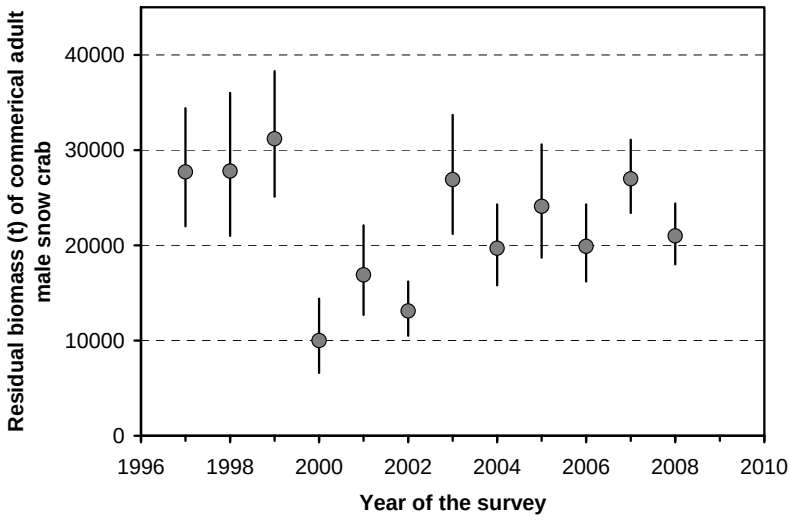

Figure 3: Residual (hard-shelled commercial adult males snow crab >= 95 mm CW) biomass (t) estimated from the post-fishery trawl survey in the southern Gulf of St. Lawrence for the expanded polygon measuring 57,840 km² (DFO 2012) during the period 1997 to 2008..

The estimate of F_{MSY} for snow crab from the southern Gulf was taken as the average exploitation rate over the same period used to estimate B_{MSY}. The F_{lim} value was calculated at 0.346, the

average exploitation rate (harvest in year t divided by biomass in year t-1 estimated from the trawl survey) over the 1998 to 2009 fishery period (Figure 5) (DFO 2012).

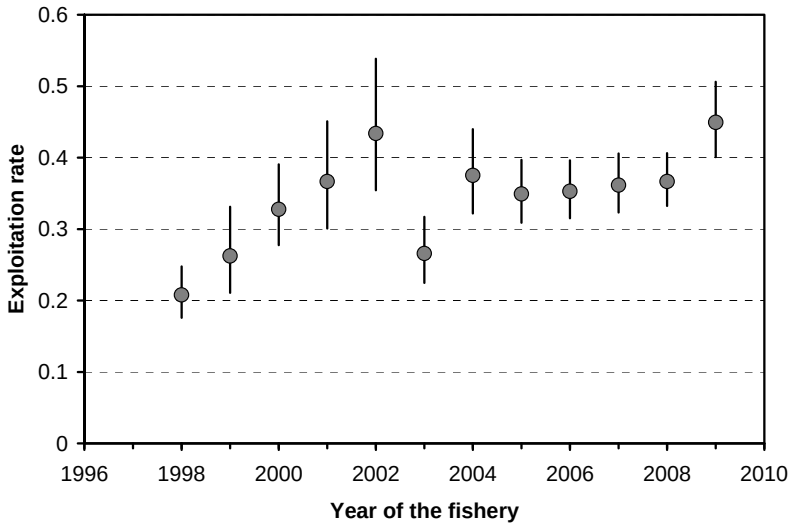

Figure 4: Exploitation rate (expressed as catch in year t divided by trawl survey biomass estimate in year t-1) for the fishing years 1998 to 2009 in the southern Gulf of St. Lawrence (DFO 2012).

The recent history of stock performance relative to these reference points is shown in Figure 5.

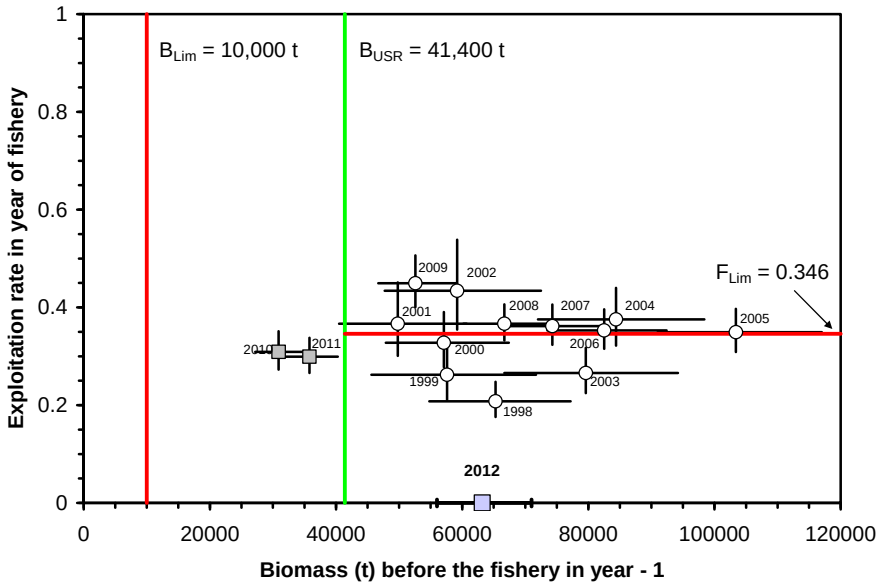

Figure 5: Trajectory of the southern Gulf of St. Lawrence snow crab stock along the stock status axis (biomass of snow crab (t)) and the exploitation rate axis (catch / biomass) for the 1997 to 2008 survey years. Year of the fishery is labeled on the figure. Error bars are 95% confidence interval ranges. White symbols are biomass and exploitation rate levels used to define the reference points (DFO 2012).

CONCLUSIONS AND ADVICE

The revised reference points for snow crab from the southern Gulf of St. Lawrence are summarized in the table below. The biomass reference points are expressed as weight of commercial-sized adult male crab of hard shell carapace condition as of 1 January of the fishing year.

Reference point	Value
B_{MSY} (weight of commercial-sized adult male crab)	51,700 t
B_{USR} (weight of commercial-sized adult male crab)	41,400 t
B_{lim} (weight of commercial-sized adult male crab)	10,000 t
F_{lim} (annual exploitation rate)	0.346

SOURCES OF INFORMATION

This Science Advisory Report is from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, regional advisory meeting of February 7-8, 2012 on the Assessment of the status of the southern Gulf of St. Lawrence snow crab stock. Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

DFO. 2009. A fishery decision-making framework incorporating the Precautionary Approach. http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/fish-ren-peche/sff-cpd/precaution-eng.htm (2009-03-23).

DFO. 2010. Reference points consistent with the precautionary approach for snow crab in the southern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/014.

DFO. 2012. Assessment of snow crab in the southern Gulf of St. Lawrence (Areas 12, 19, 12E and 12F). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/003.

Hébert, M., E. Wade, M. Biron, P. DeGrâce, J-F. Landry and M. Moriyasu. 2011. The 2010 assessment of snow crab, *Chionoecetes opilio*, stocks in the southern Gulf of St. Lawrence (Areas 12, 19, E and F). DFO Can. Sci. Advis. Secr. Res. Doc. 2011/082.

FOR MORE INFORMATION

Contact: Marc Lanteigne
Fisheries and Oceans Canada
P.O. Box 5030
Moncton, NB
E1C 9B6
Tel: 506 851 6212
Fax: 506 851 2620
E-Mail: Marc.lanteigne@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
Gulf Region
Fisheries and Oceans Canada
P.O. Box 5030
Moncton, NB
E1C 9B6

Telephone: 506 851 6253
Fax: 506 851 2620
E-Mail: csas-sccs@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1919-5079 (Print)
ISSN 1919-5087 (Online)

La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2012. Revised reference points for snow crab to account for the change in estimation area of the southern Gulf of St. Lawrence biological unit. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/002.