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Science Advisory Report 2010/063

ASSESSMENT OF THE ARCTIC SURFCLAM (*MACTROMERIS POLYNYMA*) STOCK ON GRAND BANK

Technographics BIO

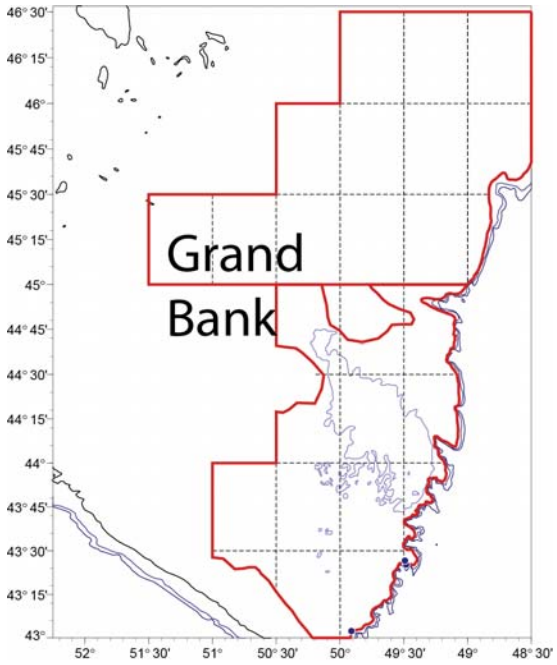

Figure 1: Map of the Grand Bank Survey Area.

Context:

The hardshell clam fishery on the Grand Bank started in 1989, after two years of exploratory fishing. The species targeted is the Arctic Surfclam (Mactromeris polynyma).

There are currently licences for four offshore clam vessels, of which two are currently active. The offshore fishery is pursued by large freezer processors that fish on both the Scotian Shelf and Grand Bank Newfoundland. Effort has switched back and forth between these areas over time, with effort currently concentrated on Banquereau.

The management methods for the offshore fishery can be found in the Offshore Clams Integrated Fishery Management Plan, Maritimes and Newfoundland regions. The main management tools for the offshore fishery are limited entry licences, a TAC (total allowable catch) divided into EA's (enterprise allocations), 100% dockside monitoring, mandatory logbooks and VMS (vessel monitoring systems).

A survey (Fig. 1) of the Grand Bank Arctic Surfclam stock took place in 2006, 2008 and 2009 with different areas surveyed each year. This assessment provides a summary of the status of the stock using the framework developed for the Banquereau surfclam stock during Jan. - Apr. 2007, for the period until the next survey takes place.

SUMMARY

- Arctic Surfclams are long lived and slow growing. If the resource were to be depleted it will take a long time before the stock recovers.
- There has been an Arctic Surfclam fishery on Grand Bank since 1989.
- Clam dredges have an immediate impact on the substrate and benthic organisms, and there continue to be uncertainties about the impact of dredges on overall benthic productivity.
- Hydraulic clam dredge fisheries occur on fairly mobile, well-sorted sand, which helps mitigate the overall impact on some elements of the benthic community.
- The proportion of clam species caught is variable and bycatch of non-clam species in the Arctic Surfclam fishery is low.
- The Framework recommended a constant F approach and an F target has not been selected for Grand Bank.
- Selection of a target F will depend on a range of factors, including the different growth and maturity rates, for Grand Bank in comparison to Banquereau, the patchiness and variable density of clam beds, impact of densities on effective F and catch per unit effort, benthic impact, and bycatch issues.

BACKGROUND

Species Biology

The **Arctic Surfclam** (*Mactromeris polynyma*) is a large, long lived species found mainly in coarse sand bottoms. It is a strong, active burrower, capable of burrowing several inches below the sediment surface. A distinguishing feature is that most specimens have a purple colour in the foot and mantle that turns red upon cooking, similar to lobster and shrimp.

In the western Atlantic, they occur from the Strait of Belle Isle to Rhode Island. In the Pacific they are found from the Juan de Fuca Strait to Point Barrow Alaska, and also from Sakhalin Island, Russia. All Atlantic populations are subtidal down to 110m, but in Alaska there are intertidal populations as well.

Slow growing and long-lived, significant numbers of surfclams appear to reach 40 years of age. On Grand Bank the oldest clam aged so far was 73 years old, and the largest observed was 142mm shell length. On Banquereau, the oldest animal aged so far was 61 years old; the largest observed was 157mm. The Alaskan population appears to be shorter lived with a maximum age of about 25 years.

Natural mortality (M) for the Alaskan population was estimated as 0.13 - 0.25, and for the Banquereau and Grand Bank stocks, it was estimated as 0.08.

Based on life history and selectivity parameter estimates, the age of maximum biomass per recruit occurs past the age of 50% selectivity of the commercial gear. Therefore growth overfishing is unlikely to occur. The age of 50% maturity is also below the age of 50% selectivity, indicating that the average surfclam will be able to spawn over a period of 17 years before being recruited to the fishery. Although there have been no studies of the relative fecundity of young versus older surfclams, this should help ensure that recruitment overfishing does not occur.

Fishery

Following the development of a fishery for **Arctic Surfclams** on Banquereau in 1986, exploratory fishing on Grand Bank in 1987 and 1988 led to the expansion of the fishery to this area in 1989. Two exploratory licences and two exploratory permits were issued for one year for 3LNO (the Grand Banks), with a "precautionary" total allowable catch (TAC) of 20,000t (DFO, 1999). The TAC was based on an economic Break-Even analysis, as there was little information on the available biomass in the area. In 1990 the TAC was rolled over for the 1990-1994 period, with access by 4 licences. With no biological advice on biomass, and the TAC never being reached, the TAC has continued at the same level to the present.

Although the number of vessels has fluctuated over time, it currently consists of 2 factory freezer-processors fishing year round. The vessels have access to both Grand Bank and Banquereau, and effort has switched between the banks over time (Figure 2). The fishery has never caught the TAC. Landings have been as high as 18,905t, but have been below 300t for the last 4 years, as effort has concentrated on Banquereau.

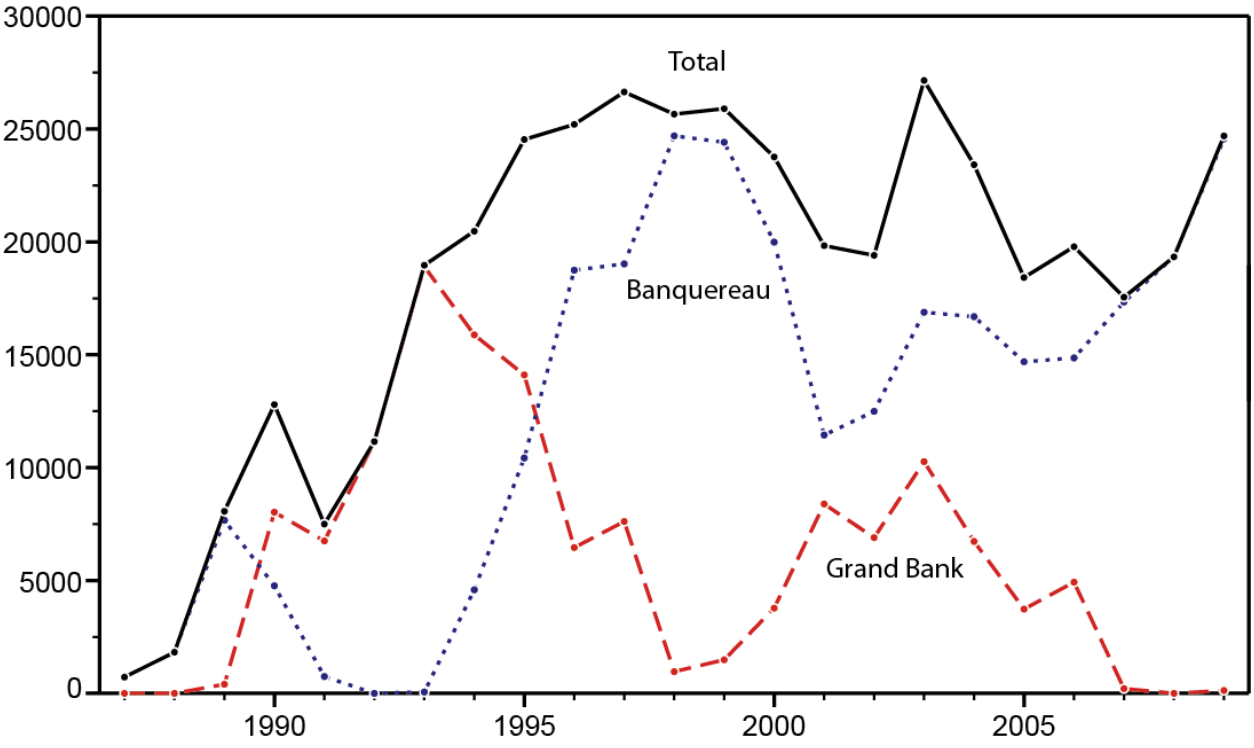

Figure 2. Arctic Surfclam landings(t) for Banquereau and Grand Bank.

The Offshore Clam Industry has started a survey program that will survey the various banks involved in the fishery. Sable Bank was surveyed in 2003 and Banquereau in 2004, Arctic Surfclams on Grand Bank were surveyed in 2006, 2008 and 2009 with different areas surveyed each year. Hereafter referred to as the 2006-2009 survey.

ASSESSMENT

Stock Trends and Current Status

The **Arctic Surfclam** fishery operates on both Banquereau and Grand Bank. Past analysis has shown that the spatial distribution of fishing effort has changed through time, as a result, catch per unit effort was not used as an indication of abundance in this assessment.

The Research Vessel Biomass Estimates (B_{RV}) from the 2004 Banquereau and 2006-2009 Grand Bank surveys are shown in Table 1.

Efficiency experiments did not produce a reliable estimate of dredge efficiency and an efficiency of 1 was assumed in the biomass estimation. This assumption would have the effect of under-estimating biomass.

Table 1. B_{RV} estimates for the Arctic Surfclam surveys.

Survey	Year	Biomass (t)	Area km^2
Banquereau	2004	1,462,097	10,265
Grand Bank	2006-09	1,140,682	49,473

In the 2006-09 Grand Bank **Arctic Surfclam** survey (Figure 3), areas with a density less than 75 g/m^2 contain 51% of the total biomass (Table 2). Only 37% of the total biomass is in areas with a density of at least 100 g/m^2, and 30% is in areas with a density of 120 g/m^2 or more. Survey densities on Banquereau were higher than Grand Bank (Roddick et al. 2007).

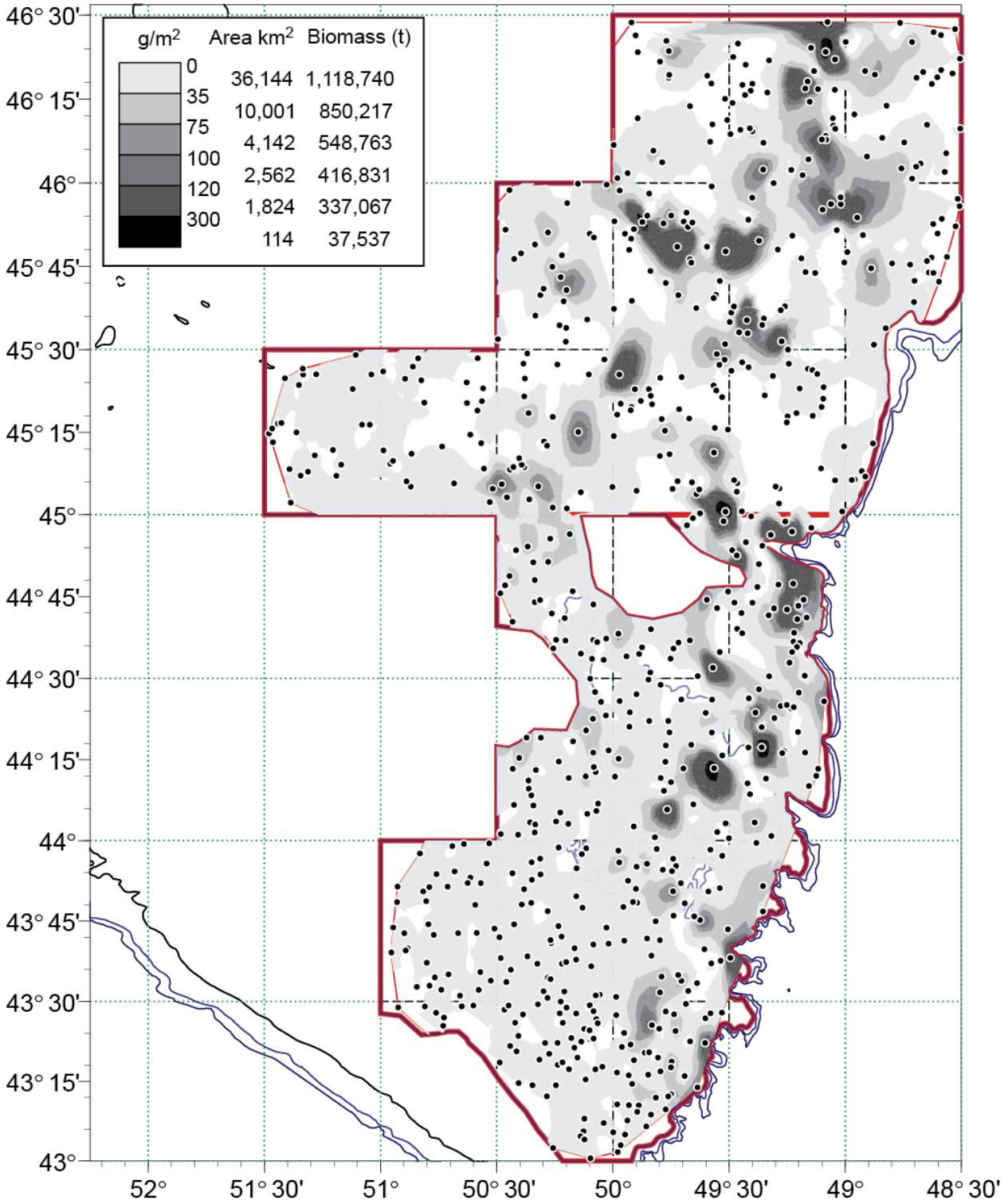

Figure 3. Contour map of the catch for the 2006-2009 Grand Bank Arctic Surfclam survey.

Table 2. Percent of total survey area and biomass within density contours for Grand Bank Arctic Surfclam survey.

Density g/m^2	% Area	% Biomass
>0	73	100
35+	20	76
75+	8	49
100+	5	37
120+	4	30
300+	0.2	3

Ecosystem Considerations

Habitat

With only two vessels currently active in the offshore clam fishery, the swept area estimated in km^2 (footprint) is relatively small compared to other mobile gear fisheries, and the spatial extent of the target species. Since the Grand Bank surfclam fishery began in 1989, approximately 1,138 km^2 have been swept, with most of this activity in the 1990-1998 period (Figure 4). This area swept is not corrected for overlap of tows, and still is only 2% of the area surveyed. There is considerable spatial and temporal variation of area swept over the timeframe of the fishery, with areas of high clam biomass fished more frequently and intensely than other sections, and periods when the fishery concentrated on Banquereau instead of Grand Bank. The average annual area swept during the last five years of the fishery (2005-2009) is approximately 26 km^2, with low effort in that period.

Clam dredges have an immediate impact on the substrate and benthic organisms because they liquefy the sediment down to at least 8 inches (20 cm), remove many large organisms and cause sedimentation adjacent to the track. On **Banquereau**, the impacts are being studied through an experiment at a site at 70 m depth. This is considered one of the most rigorous fishing gear impact studies done to date. The experiment demonstrated immediate impacts on both habitat and non-target organisms within the first two years following dredging. In this timeframe, there was considerable recovery of the composition of non-target benthic species, such as echinoderms, with a shift in relative abundance of the species present. Visual evidence of dredge tracks disappeared after one year (Gilkenson et al. 2005). There continue to be uncertainties about the long term impacts on overall benthic productivity.

The site was sampled in 2008 to look at the effects 10 years after dredging including recovery of the target species. Preliminary results indicate that sidescan sonar was still able to detect dredge tracks. In comparison to track persistence in the study site, which was at 70 m, 6 of 12 tracks at less than 40 m depth on Sable Bank were not detected one year later (Ned King, Atlantic Geoscience Centre, pers. comm.). There were few juvenile clams in the experimental grab samples (pers. comm. Kent Gilkenson, DFO Newfoundland).

There are differences between the community structure of Banquereau and Grand Bank, but it was concluded that study results are at least broadly applicable to similar habitat areas, such as Banquereau and Grand Bank (Rice 2006, Roddick et al. 2007).

Hydraulic clam dredge fisheries occur on fairly mobile, well-sorted sand, which helps mitigate the overall impact on some elements of the benthic community (NMFS 2002).

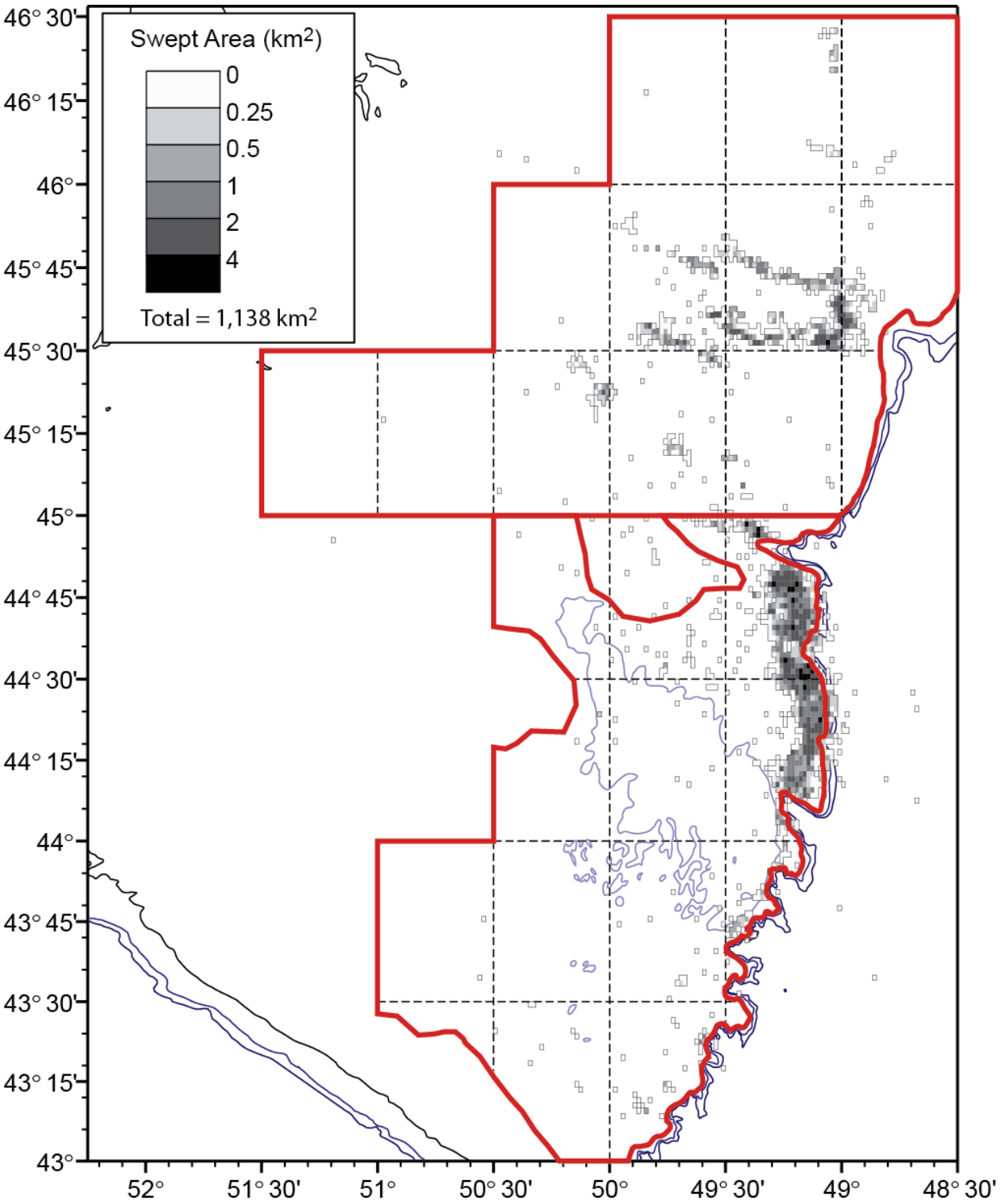

Figure 4. Spatial distribution of area swept for 1988 to July 2010 from log data. Total km^2 dredged is aggregated by one minute squares (not corrected for overlap of dredge tracks or logbook errors).

Bycatch

The proportion of clam species caught is variable, and bycatch of non-clam species in the Arctic Surfclam fishery is low (Table 3).

Table 3. – Catch composition from on-board sampling of unsorted catch from commercial clam vessels from 2002 to 2009 on Grand Bank.

Common Name	Scientific Name	Weight	%	Comm. %
Arctic Surfclam	*Mactromeris polynyma*	410.06	24.65	24.65
Greenland Cockle	*Serripes groenlandicus*	351.63	21.14	45.80
Sand dollars	*Echinarachnius parma*	315.61	18.98	64.77
Northern Propellerclam	*Cyrtodaria siliqua*	304.71	18.32	83.09
Shell	*Shell*	200.17	12.04	95.13
Rock	*Rock*	50.05	3.01	98.14
Cancer crabs	*Cancer sp.*	8.90	0.53	98.67
Starfish	*Asterias sp.*	5.72	0.34	99.02
Ocean Quahog	*Arctica islandica*	4.54	0.27	99.29
Whelk - *Buccinum sp.*	*Buccinum sp.*	4.07	0.24	99.53
Unidentified	*Unidentified*	1.85	0.11	99.65
Whelk - *Colus sp.*	*Colus sp.*	1.56	0.09	99.74
Wrinkle Whelk	*Neptunea lyrata decemcostata*	1.45	0.09	99.83
Sand Lance (ns)	*Ammodytes sp.*	1.42	0.09	99.91
Sea urchin	*Strongylocentrotus droebachiensis*	1.27	0.08	99.99
Hermit crab	*Pagurus sp.*	0.19	0.01	100.00

In the 2006-2009 survey, the breakdown for tows with a catch of Arctic Surfclams of at least 100 g/m^2, representing areas likely to be fished commercially, Arctic Surfclams make up about 14% of the catch weight, second only to shell. Looking at living material only for these tows, surfclams make up 37% of the catch, followed by sand dollars at 27%, propellerclams at 18%, Greenland Cockles 10% and sea cucumbers at 3%. These five are the only organisms that make up more than 1% of the catch, and together account for 95% of the catch of living organisms from the areas likely to be fished.

The results of the survey and fishery observer sampling are consistent with the on-board sampling and support the conclusion that bycatch of non-clam species is low.

Sources of Uncertainty

Dredge efficiency in the survey was not able to be quantified and was assumed to be 100%. Hence, the biomass is under-estimated.

The variability around the estimate that was presented was based on sampling error only. It is under-estimated because the variability around the selectivity and the tow distance corrections were not included.

Two vessels and three dredges were used during the different parts of a survey spread over four years and this also contributes to the uncertainties.

Another source of uncertainty in this assessment is the lack of understanding of the temporal and spatial changes in the recruitment, growth, and fecundity of these species. Recruitment appears to vary both temporally and spatially over Grand Bank, and although the Arctic Surfclam is distributed over the surveyed area, density varies with large areas of low density.

CONCLUSIONS AND ADVICE

The life history of these species has implications for management. Arctic Surfclams are long lived and slow growing. If the resource were to be depleted it will take a long time before the stock recovers.

The Framework (DFO 2007a) recommended a constant F approach; A Science Response to clarify the advice (DFO 2007b) stated that as F approaches 0.5 M, increased stock risk could be expected. As a result, the Banquereau assessment adopted F_{MCY} = 0.33 M as an appropriate F (Table 4). This was considered a relatively risk-neutral point given the survey frequency and biological characteristics of the stock.

An F target has not been selected for Grand Bank. Selection of a target F will depend on a range of factors, including the different growth and maturity rates, for Grand Bank in comparison to Banquereau, the patchiness and variable density of clam beds, impact of densities on effective F and CPUE, benthic impact, and bycatch issues.

Table 4. Example fishing mortality targets and yields for Grand Bank.

Harvest Strategy	F	(t)	Comment
F_{MCY}	0.026	30,114	$0.33MB_{RV}$
F current	0.018	20,000	Equivalent to the current TAC of 20,000 t.

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FOR MORE INFORMATION

Contact: Dale Roddick
Population Ecology Division
Fisheries and Oceans Canada
Bedford Institute of Oceanography
PO Box 1006 Dartmouth, NS B2Y 4A2

Tel: (902) 426-6643
Fax: (902) 426-1862
E-Mail: Dale.Roddick@mar.dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice,
Maritimes Region
Department of Fisheries and Oceans
P.O. Box 1006, Stn. B203
Dartmouth, Nova Scotia
Canada B2Y 4A2

Phone number: 902-426-7070
Fax: 902-426-5435
e-mail address: XMARMRAP@mar.dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

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