



Intertek Moody Marine

Ref: 82531/Banq/v5

Assessors: Dr. Andy Brand, Dr. Rob Blyth-Skyrme and John Angel

MSC Assessment Report for

Banquereau Arctic Surfclam Fishery

Client: Clearwater Seafoods Limited Partnership

Version: 5 Public Certification Report

Certification Body:
Intertek Moody Marine
99 Wyse Road
Suite 815
Dartmouth
Nova Scotia
Canada
Tel: +1 422 4511
Fax: +1 422 9780

Client Contact:
Christine Penney
Clearwater Seafoods Limited Partnership
757 Bedford Highway
Bedford
Nova Scotia
B4A 3Z7
Canada
Tel: +44 (0) 1332 544663
Fax: +44 (0) 1332 675020

CONTENTS

1	SUMMARY	5
2	INTRODUCTION.....	7
2.1	THE FISHERY PROPOSED FOR CERTIFICATION	7
2.2	REPORT STRUCTURE AND ASSESSMENT PROCESS	7
2.3	STAKEHOLDER MEETINGS ATTENDED.....	8
2.4	OTHER INFORMATION SOURCES	8
3	GLOSSARY OF ACRONYMS AND ABBREVIATIONS USED IN THE REPORT	15
4	BACKGROUND TO THE FISHERY.....	16
4.1	INTRODUCTION	16
4.2	BIOLOGY OF THE TARGET SPECIES	16
4.3	HISTORY OF THE FISHERY	18
4.4	FLEET AND GEAR DESCRIPTION	20
4.4.1	<i>Vessels</i>	20
4.4.2	<i>Gear</i>	21
5	STOCK ASSESSMENT	23
5.1	MANAGEMENT UNIT	23
5.2	ASSESSMENTS AND STOCK STATUS	23
5.2.1	<i>Stock differentiation</i>	23
5.2.2	<i>Catch and landings</i>	23
5.2.3	<i>Survey biomass and abundance trends</i>	25
5.2.4	<i>Size distribution</i>	29
5.2.5	<i>Assessment models</i>	30
5.2.6	<i>Biological reference points</i>	32
5.2.7	<i>Fishing mortality</i>	32
5.2.8	<i>Recruitment</i>	33
5.2.9	<i>Natural Mortality</i>	34
5.2.10	<i>Incidental mortality</i>	35
5.2.11	<i>Stock status</i>	35
5.3	MANAGEMENT ADVICE	36
6	FISHERY MANAGEMENT FRAMEWORK	38
6.1	FISHING RIGHTS, LICENSING ETC	38
6.2	FISHING LOCATIONS	38
6.3	ADMINISTRATIVE ARRANGEMENTS AND BOUNDARIES	38
6.4	LEGISLATION AND REGULATION	39
6.5	HARVEST CONTROLS	39
6.6	MONITORING, CONTROL AND SURVEILLANCE	40
6.7	CONSULTATION AND DISPUTE RESOLUTION	40
7	ECOSYSTEM CHARACTERISTICS	41
7.1	ECOSYSTEM CHARACTERISTICS	41
7.2	BY-CATCH AND DISCARDING	43
7.3	ENDANGERED, THREATENED OR PROTECTED (ETP) SPECIES	46
7.4	HABITAT EFFECTS	47
7.5	ECOSYSTEM IMPACTS.....	49
8	OTHER FISHERIES AFFECTING THE TARGET STOCK.....	51
9	STANDARD USED.....	52
9.1	PRINCIPLE 1	52
9.2	PRINCIPLE 2	52
9.3	PRINCIPLE 3	53
10	BACKGROUND TO THE EVALUATION	55
10.1	EVALUATION TEAM.....	55
10.2	PREVIOUS CERTIFICATION EVALUATIONS	55

10.3	INSPECTIONS OF THE FISHERY	55
11	STAKEHOLDER CONSULTATION.....	56
11.1	STAKEHOLDER ISSUES	57
12	OBSERVATIONS AND SCORING.....	58
12.1	INTRODUCTION TO SCORING METHODOLOGY	58
13	LIMIT OF IDENTIFICATION OF LANDINGS FROM THE FISHERY	59
13.1	TRACEABILITY WITHIN THE FISHERY	59
13.2	AT-SEA PROCESSING.....	59
13.3	POINTS OF LANDING	59
13.4	ELIGIBILITY TO ENTER CHAINS OF CUSTODY.....	59
13.5	TARGET ELIGIBILITY DATE.....	59
14	ASSESSMENT RESULTS.....	60
14.1	CONDITIONS AND ACTION PLAN.....	60
14.2	NON-BINDING RECOMMENDATIONS.....	64
15	APPENDIX A - SCORING TABLE.....	65
16	APPENDIX B - STAKEHOLDER EVIDENCE FOR SITE VISIT	112
16.1	LETTER FROM THE SIERRA CLUB OF CANADA, RECEIVED ON THE 9TH JUNE, 2011.	112
16.2	INFORMATION FROM THE WORLD WILDLIFE FUND, CANADA, RECEIVED ON 17TH JUNE, 2011.....	113
16.3	INFORMATION FROM THE ECOLOGY ACTION CENTRE, RECEIVED ON 17TH JUNE, 2011.....	117
17	APPENDIX C – LETTER OF SUPPORT FOR ACTION PLAN FROM DFO	119
18	APPENDIX D – PEER REVIEW 1.....	120
19	APPENDIX E - PEER REVIEW 2.....	137
20	APPENDIX F - STAKEHOLDER COMMENTS.....	154
20.1	LETTER FROM WWF INTERNATIONAL, DATED 25 TH MAY 2012.....	154
20.2	LETTER FROM THE MSC, UNDATED.....	162
21	APPENDIX G - REGISTERED COMPANIES / VESSELS WITHIN THE UOC.....	165
22	APPENDIX H - DETERMINATION OF SURVEILLANCE LEVEL	166

LIST OF TABLES

Table 1:	Attendance at meetings conducted during the assessment site visit.	8
Table 2:	Annual Arctic surfclam landings (t) for Banquereau Bank, Grand Bank and the Scotian Shelf fisheries, 1987 – 2010 (modified from Roddick <i>et al.</i> 2011, with data for 2010 from CSLP).	20
Table 3:	Specifications of the Canadian hydraulic Arctic surfclam dredge (DFO 2010).	21
Table 4:	Research vessel biomass estimates (B_{RV}) for the four clam surveys carried out on Banquereau Bank (Roddick <i>et al.</i> 2007, DFO 2012).	27
Table 5:	Research vessel biomass estimates (B_{RV}) estimates for the Arctic surfclam surveys on Banquereau and Grand Bank (DFO 2010).	27
Table 6:	Principle Acts and policy documents.....	39
Table 7:	Catch composition from sampling of the unsorted catch from the 2005 Banquereau offshore clam fishery (DFO 2007a).....	44
Table 8:	Species composition for tows from the 2004 Banquereau offshore clam survey (Roddick <i>et al.</i> 2007).	45
Table 9:	Catch composition from on-board sampling of unsorted catch from commercial clam vessels from 2002 to 2009 on Grand Bank (Roddick <i>et al.</i> 2011).....	46
Table 10:	Key issues discussed at a meeting with the DFO	56
Table 11:	Key issues discussed with stakeholders.	57

LIST OF FIGURES

Figure 1: Offshore Banks of the Maritimes and Newfoundland Regions (from DFO 2006).....	16
Figure 2: Arctic surfclam dredge sitting on a tipping ramp. Dredge head is 12.5 ' (3.8 m) wide (CSLP pers. comm.).....	22
Figure 3: Arctic surfclam landings (t) for Banquereau and Grand Bank (DFO 2010).	24
Figure 4: Catch per unit effort (CPUE) and effort for the Banquereau Arctic surfclam fishery, 1986-2006 (DFO 2007a).....	24
Figure 5: Contours of Arctic surfclam catch (kg/ 500 m ² tow) for the 2004 Banquereau survey (Roddick <i>et al.</i> 2007).	26
Figure 6: Average catch per tow at different depths for the 2004 Banquereau Arctic surfclam survey (Roddick <i>et al.</i> 2007).	26
Figure 7: CPUE (kg/m ² dredged) for the Arctic surfclam fishery on Grand Bank and Banquereau. CPUE is calculated on a trip basis (Roddick <i>et al.</i> 2011).	28
Figure 8. Estimated total length frequency for the Arctic surfclam catch for the 2004 Banquereau Arctic surfclam survey (Roddick <i>et al.</i> 2007).	28
Figure 9: Aged Arctic surfclam samples from the 2004 Banquereau survey used for the construction of the age-length key. The histograms on the left are the size frequency distribution of the aged sample and the population. The center plot shows the age-length data and the fitted von Bertalanffy growth curve, and the bottom histogram is the resulting age histograms for the aged sample and the population (Roddick <i>et al.</i> 2007).	29
Figure 10: Estimated maturity and selectivity at age, and biomass per recruit with no fishing for the Banquereau Arctic surfclam population (Roddick <i>et al.</i> 2007).	30
Figure 11: Age distribution for Banquereau survey numbers at age. Catch curve estimates of total mortality (Z) are done using log transformed numbers at age (top linear regression, filled circles are points used for the regression). Estimated recruitment at age 20 using the numbers at age and estimated Z from catch curve are shown in lower panel (Roddick <i>et al.</i> 2007).	34
Figure 12: Yield and spawning stock biomass (SSB) per recruit for Banquereau Arctic surfclams. The top yield per recruit curve (dashed) is with no incidental mortality. The lower curve is with a 15% mortality of small clams that pass through the dredge (DFO 2007).	35
Figure 13: Map of seafloor complexity on the Scotian Shelf, showing seafloor slopes greater than 0.5 degree, calculated from 3x3 neighbourhoods using 500 m cell grid. Steep slopes in the near shore zone and on the shelf slope are not shown (adapted from Kostylev 2004).	41
Figure 14: Maximum significant wave height (m) occurring on the Scotian Shelf 1958-1999 (Kostylev 2004).	42
Figure 15: Bottom tidal current velocities. Red- strong tidal currents, blue- weak tidal currents (Kostylev 2004).	42
Figure 16: Surficial sedimentary facies on the Scotian Shelf (NR Canada official publication, adapted from Kostylev 2004).	43
Figure 17: Spatial distribution of area swept for 2005 and 2006 (approx. 257 km ²). Total km ² dredged is aggregated by one minute squares (not corrected for overlap of dredge tracks (DFO 2007c).	48
Figure 18: Sidescan of Arctic surfclam dredge tracks from CFV Concordia on Banquereau, 1996. Dredge tracks scaled to 12 feet, box used for area analysis is 500 m x 125 m, percentage of ground covered within box is 67.4% (adapted from Roddick & Smith 1999).	48
Figure 19: Contouring of surfclam catch (kg/500 m tow) for the 2004 Banquereau surfclam survey, showing The Gully MPA (Roddick <i>et al.</i> 2007).	50

1 SUMMARY

This report sets out the results of the assessment of the Clearwater Seafoods Limited Partnership (CSLP) Banquereau Arctic surfclam (*Mactromeris polynyma*) fishery against the Marine Stewardship Council (MSC) Principles and Criteria for Sustainable Fishing. This version of the report is the Public Certification Report (PCR), such that changes have already been made as a result of peer reviews that were undertaken by appropriate, independent scientists, and following public consultation. A final 15 day consultation period of the Final Determination Report has also been undertaken, but no stakeholders have objected to the certification of the fishery; the fishery is therefore certified.

The assessment of the fishery was undertaken by Dr. Andy Brand, Dr. Rob Blyth-Skyrme and John Angel, covering Principle 1 (target stock), Principle 2 (environment) and Principle 3 (management) components of the MSC standard respectively. A site visit to Halifax, Nova Scotia, was undertaken in June 2011 to meet with scientists, fishery managers and stakeholders, as well as representatives of CSLP. During the two days that the team was convened, opportunities to meet with the team were provided for all stakeholders who expressed such a desire.

The CSLP Banquereau Arctic surfclam fishery is conducted offshore, on the Eastern Scotian Shelf off Nova Scotia. CSLP holds three offshore clam licences, which enables the company to employ up to four vessels in the fishery, as one of the licences entitles two vessels to fish. In total, only two vessels are currently engaged in the fishery, however. Two hydraulic dredges of approximately 3.8 m (12.5') width x 6 m (20') length each are used by each vessel to extract the Arctic surfclams from the sediment, and these are typically towed at 2 knots for 8 - 12 minutes before being returned to the surface so that the catch can be recovered. The most recent survey in 2004 estimated that the Banquereau stock of Arctic surfclams amounted to 1,462,097 tonnes (t), while the total allowable catch (TAC) is 24,000 t per year.

Arctic surfclam is a long-lived bivalve; significant numbers on Banquereau appear to reach 40 years of age, while the oldest aged so far from the bank was aged at 61 years old. While the long life and slow growth of Arctic surfclams could be a concern if exploitation rates from the population were high, the total allowable catch (TAC) from Banquereau is set at a precautionary level, well below the calculated level of maximum sustainable yield. The age of 50% maturity is also below the age of 50% selectivity, meaning that individual Arctic surfclams should be able to spawn approximately 10 times before growing to a size that would be selected by the fishery. The Banquereau Arctic surfclam stock is estimated to be at approximately the virgin biomass level.

Hydraulic dredges are known to have the potential to be damaging to bottom habitats and communities. However, the seabed of Banquereau is composed almost exclusively of well or very well sorted sand, and the community is adapted to levels of natural perturbation. A long-term hydraulic dredge-impact study was started on Banquereau in 1998, and results have shown that evidence of the dredge tracks had essentially disappeared within approximately 10 years, while the community, with the exception of the target bivalve species, appeared to have largely recovered after two years. The most recent results from resurveying the experimental site in 2008 are still being analysed, but are expected to confirm that recovery has continued to occur.

The Banquereau fishery is managed through the offshore clams integrated fishery management plan (IFMP). The IFMP lays out management objectives, measures and responsibilities, as well as the specific strategy relating to enforcement of the fishery, and the research program that is undertaken between CSLP and the Department of Fisheries and Oceans (DFO). The establishment of an Offshore Clams Advisory Committee (OCAC) provides a route through which stakeholders may participate in and contribute to the management of the fishery.

The Banquereau Arctic surfclam fishery achieved overall scores of 85.0 for Principle 1, 91.3 for Principle 2, and 85.6 for Principle 3. As such, it is recommended that the fishery is certified according to the MSC standard as being sustainable.

Three conditions of certification were placed on the fishery, however, for Performance Indicators (PIs) 1.1.2, 1.2.2 and 3.1.2; these require the following outcomes to be achieved:

For PI 1.1.2

The client is required to demonstrate by the 2nd annual audit that:

- The management system includes a limit reference point that is appropriate for the stock and can be estimated.
- The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity.

For PI 1.2.2

The client is required to demonstrate by the 2nd annual audit that:

- Well defined harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.
- The selection of the harvest control rules takes into account the main uncertainties.

For PI 3.1.2

The client is required to demonstrate by the 2nd annual audit that the management system includes:

- Consultation processes that regularly seek and accept relevant information, including local knowledge.
- Consideration of the information obtained
- Opportunity for all interested and affected parties to be involved

Two non-binding recommendations were also made, concerning PI 3.1.2 and PI 3.2.1. These were that advance notice of the time and place of advisory committee meetings, and the minutes of such meetings, should be posted on the DFO website, and that the Integrated Fisheries Management Plan (IFMP) should be posted on the DFO website or in some other way made publicly available.

The fishery will be eligible for remote annual surveillance audits. The first surveillance announcement will indicate whether the first surveillance audit will be an on-site or an off-site surveillance audit.

INTRODUCTION

This report sets out the results of the assessment of the Clearwater Seafoods Limited Partnership (CSLP) Banquereau Arctic surfclam (*Mactromeris polynyma* Stimpson, 1860) fishery against the Marine Stewardship Council (MSC) Principles and Criteria for Sustainable Fishing.

1.1 The fishery proposed for certification

The MSC Guidelines to Certifiers specify that the unit of certification is "The fishery or fish stock (=biologically distinct unit) combined with the fishing method/gear and practice (=vessel(s) pursuing the fish of that stock) and management framework." The fishery proposed for certification is therefore defined as:

Species:	Arctic surfclam (<i>Mactromeris polynyma</i>)
Geographical Area:	Banquereau, Scotian Shelf, Canada
Method of Capture:	Hydraulic clam dredge
Management System:	Department of Fisheries and Oceans (DFO) and the Offshore Clams Integrated Fishery Management Plan
Client Group:	Clearwater Seafoods Limited Partnership (CSLP)

In the course of the certification it is possible that further companies/vessels may join the client group. This would be in accordance with the MSC's stated desire to allow fair and equitable access to the certification.

1.2 Report Structure and Assessment Process

The aims of the assessment are to determine the degree of compliance of the fishery with the MSC Principles and Criteria for Sustainable Fishing, as set out in Section 8.

This report contains the following information:

- The background to the certified fishery and the context within which it operates in relation to the other areas where the target species is fished
- The qualifications and experience of the team undertaking the assessment
- The standard used (MSC Principles and Criteria)
- The stakeholder consultation carried out. Stakeholders include all those parties with an interest in the management of the fishery and include fishers, management bodies, scientists and environmental Non-Governmental Organisations (ENGO's)
- The methodology used to assess ('score') the fishery against the MSC Standard.
- A scoring table with the Scoring Indicators adopted by the assessment team and Scoring Guidelines which aid the assessment team in allocating scores to the fishery. The commentary in this table then sets out the position of the fishery in relation to these Scoring Indicators.
- The Certification Recommendation of the assessment team, and any Conditions of Certification that have been set in order for the fishery to meet the MSC Standard.
- Any comments received from the peer reviewers and stakeholders, together with the assessment team's response.

This version of the assessment report is the Public Certification Report (PCR). It is noted that, to get to this stage, the report has been subject to critical review by two independent scientists at Peer Review, and by stakeholders at the Public Consultation; the comments received at Peer Review and during Public Consultation are appended to this report, with responses from the assessment team. Any changes made to the report as a result of any comments are also noted. Intertek Moody Marine's Governing Board (a body independent of the assessment team) has also reviewed the report at Final Determination, and the Governing Board made the final certification determination on behalf of Intertek Moody Marine Ltd.

It is also noted that no objections were received from stakeholders during the final public consultation period on the Final Determination, and so the fishery is certified.

1.3 Stakeholder meetings attended

Information used in the main assessment has been obtained from interviews and correspondence with stakeholders in this fishery, notably:

Table 1: Attendance at meetings conducted during the assessment site visit.

Date	Attendee	Representing
09/06/11	Rob Blyth-Skyrme Andy Brand John Angel Christine Penney Catherine Boyd Tony Jabbour (from 12:30) Jennifer Hewitt (from 12:45)	Intertek Moody Marine Ltd Intertek Moody Marine Ltd Intertek Moody Marine Ltd CSLP CSLP CSLP CSLP
09/06/11	Rob Blyth-Skyrme Andy Brand John Angel Susanna Fuller	Intertek Moody Marine Ltd Intertek Moody Marine Ltd Intertek Moody Marine Ltd Ecology Action Centre
10/06/11	Rob Blyth-Skyrme Andy Brand John Angel Christine Penney Catherine Boyd Wendy Williams Stefan Leslie Carl MacDonald Scott Coffen-Smout Dale Roddick Wade Barney Annette Rumbolt Kent Gilkinson (from 11:15)	Intertek Moody Marine Ltd Intertek Moody Marine Ltd Intertek Moody Marine Ltd CSLP CSLP DFO DFO DFO DFO DFO DFO – on telephone DFO – on telephone DFO – on telephone
10/06/11	Rob Blyth-Skyrme Andy Brand John Angel Daniela Diz	Intertek Moody Marine Ltd Intertek Moody Marine Ltd Intertek Moody Marine Ltd World Wildlife Fund

1.4 Other information sources

Published information and unpublished reports used during the assessment are listed below:

Abbott, R.T. (1974). American Seashells, 2nd edition. Van Nostrand Reinhold Co, New York.

Almeida, F.P. & T.F. Sheehan (Editors). (1997). Age Determination Methods for Northwest Atlantic Species. An Update of NOAA Technical Report NMFS 72. Penttila, J. and Dery, L.M. (Editors) - December 1988. [Internet]. National Marine Fisheries Service, Northeast Fisheries Science Center. Woods Hole, Mass.[Updated June 19, 2007, cited June 26, 2007].

Amaratunga, T. & T.W. Rowell (1986). New estimates of commercially harvestable biomass of Stimpson's Surf Clam, *Spisula polynyma*, on the Scotian Shelf based on the January through

- April 1986 test fishery and new age data. Canadian Atlantic Fisheries Scientific Advisory Committee, research document 86/112: 24 pp.
- Arsenault, D.J. & J.H. Himmelman (1998). Size-related decrease in spatial refuge use by Iceland scallops *Chlamys islandica*: ontogenetic behavioural changes or decreasing refuge availability? Marine Ecology Progress Series, V. 162, pp. 153-161.
- Atlantic Fisheries Regulations (1985). Published by the Minister of Justice and retrieved from the website of the Department of Justice at <http://laws-lois.justice.gc.ca/PDF/SOR-86-21.pdf>. Accessed 31st July 2011.
- Beamish, R.J. & G.A. Macfarlane (1983). Validation of age determination estimates, the forgotten requirement. NOAA Technical Report, National Marine Fisheries Service, V. 8, pp. 29-33.
- Black, J. (1991). ACON Data Visualization Software User Manual [Internet]. Version 10.7.05. Dartmouth (Nova Scotia): Fisheries and Oceans Canada, Maritimes Region; [Updated 2007 May 11; cited 2007 May 26]. Available from: <http://www.mar.dfo-mpo.gc.ca/science/acon/>.
- Bundy, A. (2005). Structure and functioning of the eastern Scotian Shelf ecosystem before and after the collapse of groundfish stocks in the early 1990s. Canadian Journal of Fisheries and Aquatic Science, V. 62, pp. 1453–1473
- Caddy, J. F. & R. Mahon (1995). Reference points for fisheries management. FAO Fisheries Technical Paper No. 347. 83 pp.
- Campana, S. E. (2001). Accuracy, precision and quality control in age determination, including a review of the use and abuse of age determination methods. Journal of Fish Biology, V. 59, pp. 197-242.
- Cassista, M. C. & M.W. Hart (2005). Isolation and characterization of new microsatellite markers in the surfclam *Mactromeris polynyma*. Molecular Ecology Notes, V. 5, pp. 218-219.
- Cassista, M.C & M.W. Hart (2007). Spatial and temporal genetic homogeneity in the Arctic surfclam (*Mactromeris polynyma*). Marine Biology, V. 152, pp. 569-579.
- Chaisson, D.R. & T.W. Rowell (1985). Distribution, Abundance, Population structure, and Meat Yield of the Ocean Quahaug (*Arctica islandica*) and Stimpson's Surf Clam (*Spisula polynyma*) on the Scotian Shelf and Georges Bank. Canadian Industrial Report on Fisheries and Aquatic Science, Number 155: ix + 125 pp.
- Chamberlin, J. L. & F. Sterns (1963). A Geographic Study of the Clam, *Spisula polynyma* (Stimpson). New York Serial Atlas of The Marine Environment, V. 3, pp. 1-12.
- Charnov E.L. (1993). Life history invariants: Some explorations of symmetry in evolutionary ecology. Oxford Press, Oxford.
- Choi, J.S., Frank, K.T., Petrie, B.D. & W.C. Leggett (2005). Integrated assessment of a large marine ecosystem: a case study of the devolution of the Eastern Scotian Shelf, Canada. Oceanography and Marine Biology: An Annual Review, V. 43, pp. 47–67.
- Christian, J.R., Grant, C.G.J., Meade, J.D. & L.D. Noble (2010). Habitat requirements and life history characteristics of selected marine invertebrate species occurring in the Newfoundland and Labrador Region. Canadian Manuscript Report on Fisheries and Aquatic Science, Number 2925: vi + 207 pp.
- Coastal Fisheries Protection Act (1985). Published by the Minister of Justice and retrieved from the website of the Department of Justice at <http://laws-lois.justice.gc.ca/PDF/C-33.pdf>. Accessed 31st July 2011.

- Criminal Code (1985). Published by the Minister of Justice and retrieved from the website of the Department of Justice at <http://laws-lois.justice.gc.ca/PDF/C-46.pdf>. Accessed 31st July 2011.
- David, P., Perdieu, M-A., Pernot, A-F. & P. Jarne (1997). Fine-grained spatial and temporal population genetic structure in the marine bivalve *Spisula ovalis*. *Evolution*, V. 51, pp. 1318-1322.
- Davis, C.V. & S.E. Shumway (1996). Larval and juvenile growth of Stimpson's surfclam – a new candidate species for aquaculture development? Annual Meeting of the National Shellfish Association, April 1996. Abstract: *Journal of Shellfish Research*, V. 15(2), pp. 479-480.
- DFO (1989). *Underwater World: Atlantic Shellfish*. Communications Directorate, Ottawa, Ontario, 7 pp.
- DFO (1992). *Aboriginal fisheries strategy*. Fisheries and Oceans Canada, <http://www.dfo-mpo.gc.ca/fm-gp/aboriginal-autochtones/afs-srapa-eng.htm>. Accessed 31st July 2011.
- DFO (1999). *Banquereau Bank Arctic surfclam*. DFO Science Stock Status Report, C3-34. 3 pp.
- DFO (2004). *A policy framework for the management of fisheries on Canada's Atlantic coast*. Fisheries and Oceans Canada, 46 pp.
- DFO (2004). *The Stimpson's surfclam in Quebec coastal waters in 2003*. DFO Canadian Stock Assessment Secretariat, Stock Status Report 2004/002. 3 pp.
- DFO (2006). *Offshore clams integrated fishery management plan, Maritimes and Newfoundland Regions, 2005-2009*. 36 pp.
- DFO (2007a). *Assessment of the ocean quahog (*Arctica islandica*) stocks on Sable Bank and St. Mary's Bay, and the Arctic surfclam (*Mactromeris polynyma*) stock on Banquereau*. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, Science Advisory Report 2007/034. 17 pp.
- DFO (2007b). *Placentia Bay - Grand Banks large ocean management area science-based conservation objectives*. Canadian Science Advisory Secretariat Science Advisory Report 2007/042, 19 pp.
- DFO (2007c). *Clarification on offshore Arctic surfclam clam and ocean quahog TACs*. Canadian Science Advisory Secretariat, Science Response 2007/018
- DFO (2007d). *Proceedings of the Maritime Provinces regional advisory process on assessment and management strategy framework for Banquereau Arctic surfclam and ocean quahogs on Sable Bank and in St. Mary's Bay; 17-18 January 2007 and 4-5 April 2007*. DFO Canadian Science Advisory Secretariat, Proceedings Series 2007/008.
- DFO (2008a). *The Gully Marine Protected Area*. Fisheries and Oceans Canada, <http://www.dfo-mpo.gc.ca/oceans/marineareas-zonesmarines/mpa-zpm/atlantic-atlantique/factsheets-feuillets/gully-eng.htm>. Accessed 28th July 2011.
- DFO (2008b). *New emerging fisheries policy*. Fisheries and Oceans Canada, <http://www.dfo-mpo.gc.ca/fm-gp/politiques-politiques/efp-ppn-eng.htm>. Accessed 31st July 2011.
- DFO (2009a). *Proceedings of a Workshop on Canadian Science and Management Strategies for Whelk; 3-4 June 2008*. DFO Canadian Science Advisory Secretariat, Proceedings Series 2009/02, 21 pp.
- DFO (2009b). *Assessment of Quebec coastal waters whelk stocks in 2008*. Canadian Science

Advisory Secretariat Science Advisory Report 2009/02. 10 pp.

- DFO (2009c). Sustainable fisheries framework. Fisheries and Oceans Canada, <http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/fish-ren-peche/sff-cpd/overview-cadre-eng.htm>. Accessed 31st July 2011.
- DFO (2009d). Policy to manage the impacts of fishing on sensitive benthic areas. Fisheries and Oceans Canada, <http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/fish-ren-peche/sff-cpd/benthi-eng.htm>. Accessed 31st July 2011.
- DFO (2009e). Assessment of the Stimpson's surfclam stocks of Quebec coastal waters in 2008. Canadian Science Advisory Secretariat, Science Advisory Report 2009/021, 8 pp.
- DFO (2009f). Analysis of activities impacting cod spawning on the Southeast Shoal and Tail of the Grand Bank, <http://www.dfo-mpo.gc.ca/Library/342998rank38.pdf>. Accessed 12th September 2011.
- DFO (2009g). Marine protected areas on the Eastern Scotian Shelf: selecting the next Area of interest. Fisheries and Oceans Canada, Dartmouth, 20pp.
- DFO 2010. Assessment of the Arctic surfclam (*Mactromeris polynyma*) stock on Grand Bank. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Science Advisory Report 2010/063. 10 pp.
- DFO (2011a). Licence number 142072, Stimpson surf clams, offshore drag. Registration(s) and/or fishing license(s), Clearwater Seafoods Limited Partnership. Fisheries and Oceans Canada, March 1, 2011. 7 pp.
- DFO (2011b). The Gully MPA regulations. Fisheries and Oceans Canada, <http://www.mar.dfo-mpo.gc.ca/e0010439>. Accessed 25th July 2011.
- DFO (2011c). Offshore clams integrated fishery management plan; Maritimes and Newfoundland Regions. Fisheries and Oceans Canada, May 2011, 42 pp.
- DFO (2011d). Protocols and sampling forms for on board sampling of the catch of *Mactromeris polynyma*. DFO unpublished document.
- DFO (2011e). Current marine protected area planning activities. Fisheries and Oceans Canada, <http://www.mar.dfo-mpo.gc.ca/e0010392>. Accessed January 26th 2012.
- DFO (2011f). Arctic surfclam, Grand Bank announcement, <http://www.dfo-mpo.gc.ca/decisions/fm-2011-gp/atl-036-eng.htm>. Accessed 25th August 2011.
- DFO (2012). Assessment of the Arctic Surfclam (*Mactromeris polynyma*) stock on Banquereau in 2010. DFO Canadian Science Advisory Secretariat, Science Advisory Report 2011/068. 12 pp.
- Doherty, P. & T. Horsman (2007). Ecologically and biologically significant areas of the Scotian Shelf and environs: A compilation of scientific expert opinion. Canadian Technical Report of Fisheries and Aquatic Science, No. 2774, xii + 57 pp.
- FAO (1995). Code of Conduct for Responsible Fisheries. Published by the Published by the Food and Agriculture Organisation of the United Nations at <http://www.fao.org/docrep/005/v9878e/v9878e00.HTM>. Accessed 31st July 2011.
- Fisheries Act (1985). Published by the Minister of Justice and retrieved from the website of the Department of Justice at <http://laws-lois.justice.gc.ca/PDF/F-14.pdf>. Accessed 31st July 2011.

- Fishery (General) Regulations (1993). Published by the Minister of Justice and retrieved from the website of the Department of Justice at <http://laws-lois.justice.gc.ca/PDF/SOR-93-53.pdf>. Accessed 31st July 2011.
- Fish Inspection Act (1985). Published by the Minister of Justice and retrieved from the website of the Department of Justice at <http://laws-lois.justice.gc.ca/PDF/F-12.pdf>. Accessed 31st July 2011.
- Frank, K., Petrie, B., Fisher, J.A.D. & W.C. Leggett (2011). Transient dynamics of an altered large marine ecosystem. *Nature*, V. 477, pp. 86-89.
- Gardner Pinfold Consulting Economists Limited (1998). An economic analysis of the Arctic surfclam industry. February 1998. Industry report.
- Gilkinson, K.D., Gordon Jr. D.C., MacIsaac, K.G., McKeown, D.L., Kenchington, E.L.R., Bourbonnais, C. & W.P. Vass (2005). Immediate impacts and recovery trajectories of macrofaunal communities following hydraulic clam dredging on Banquereau, eastern Canada. *ICES Journal of Marine Science*, V. 62, pp. 925–947.
- Green, G.A. & J.J. Brueggeman (1991). Sea otter diets in a declining population in Alaska. *Marine Mammal Science*, V. 7, pp. 395-401.
- Himmelman, J.H. & J.R. Hamel (1993). Diet, behaviour and reproduction of the whelk *Buccinum undatum* in the northern Gulf of St. Lawrence, eastern Canada. *Marine Biology*, V. 116, pp. 423-430.
- Hughes, S.E. & N. Bourne (1981). Stock assessment and life history of a newly discovered Alaska surfclam (*Spisula polynyma*) resource in the southeastern Bering Sea. *Canadian Journal of Fisheries and Aquatic Science*, V. 38, pp. 1173-1181.
- Jennings, S. & M.J. Kaiser (1998). The effects of fishing on marine ecosystems. *Advances in Marine Biology, Volume 34* (eds J.H.S. Blaxter, A.J. Southward & P.A. Tyler), pp. 203-354. Academic Press, London
- Jonsen, I.D. (2007). Management strategy evaluation for Banquereau Arctic surf clam (*Mactromeris polynyma*). RAP Working Paper 2007/17.
- Kaiser, M.J., Collie, J.S., Hall, S.J., Jennings, S. & I.R. Poiner (2002). Modification of marine habitats by trawling activities: prognosis and solutions. *Fish and Fisheries*, V. 3, pp. 114 - 136.
- Kilada, R.W., Campana, S.E. & D. Roddick (2009). Growth and sexual maturity of the northern propellerclam (*Cyrtodaria siliqua*) in Eastern Canada, with bomb radiocarbon age validation. *Marine Biology*, V. 156, pp. 1029–1037.
- Kilada, R.W., Roddick, D. & K. Mombourquette (2007). Age determination, validation, growth and minimum size of sexual maturity of the Greenland smoothcockle (*Serripes groenlandicus*, Brugiere, 1789) in Eastern Canada. *Journal of Shellfish Research*, V. 26, pp. 443–450.
- Kulka, D., C. Hood & J. Huntington (2007). Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada. Fisheries and Oceans Canada: Newfoundland and Labrador Region. St. John's, NL. x + 103 pp.
- Larkin, P.A. (1977). An epitaph for the concept of maximum sustainable yield. *Transactions of the American Fisheries Society*, 106, 1-11.
- Lambert, J. & P. Goudreau (1997). Biologie et Exploitation de la mactre de Stimpson (*Mactromeris polynyma*) sur les Côtes du Québec. Canadian Stock Assessment Secretariat, Research

Document 97/101. 44 pp.

- Lutz, R.A., & D.C. Rhoads (1980). Growth patterns within the molluscan shell: an overview. In: Rhoads, D.C., and R.A. Lutz (eds.), *Skeletal growth of aquatic organisms*, pp. 203-254. Plenum Press, New York.
- Mace, P. M. (1994). Relationships between common biological reference points used as thresholds and targets for fisheries management strategies. *Canadian Journal of Fisheries and Aquatic Science*, 51, 110-122.
- Ministry of Fisheries. (2007). Report from the Fishery Assessment Plenary, May 2007: stock assessments and yield estimates. Ministry of Fisheries, Wellington, New Zealand. 1015 pp.
- Morissette, S. & J.H. Himmelman (2000). Subtidal food thieves: interactions of four invertebrate kleptoparasites with the sea star *Leptasterias polaris*. *Animal Behaviour*, V. 60, pp. 531-543.
- MSC (2010a). Marine Stewardship Council Fisheries assessment methodology and guidance to certification bodies; including default assessment tree and risk-based framework, version 2.1, release date: 1st May 2010. Marine Stewardship Council, London, 120 pp.
- MSC (2010b). Marine Stewardship Council Policy Advisory 12 version 2, issued 19 January 2011. Marine Stewardship Council, London, 3 pp.
- Nesis, K.I. (1963). Soviet investigations of the benthos of the Newfoundland-Labrador fishing area, pp. 214-220. In: Y.Y. Marti (ed). *Soviet Fisheries Investigations in the Northwest Atlantic*. VNIRO-PINRO, Moscow (Translated for the US Department of the Interior and the National Science Foundation, Washington, D.C., by Israel Program for Scientific Translations, Jerusalem. 370 pp.)
- OAGC (1999). Fisheries and oceans: managing Atlantic shellfish in a sustainable manner. Chapter 4 in a report to Parliament by the Office of Auditor General of Canada, <http://www.oag-bvg.gc.ca/internet/docs/9904ce.pdf>. Accessed 31st July 2011.
- OAGC (2000). Fisheries and oceans: fleet management. Chapter 31 in a report to Parliament by the Office of Auditor General of Canada, <http://www.oag-bvg.gc.ca/internet/docs/0031ce.pdf>. Accessed 31st July 2011.
- OAGC (2004). Fisheries and oceans Canada: salmon stocks, habitat, and aquaculture. Chapter 5 in a report to Parliament by the Office of Auditor General of Canada, <http://www.oag-bvg.gc.ca/internet/docs/c20041005ce.pdf>. Accessed 31st July 2011.
- OAGC (2008). Ecosystems: control of aquatic invasive species. Chapter 6 in a report to Parliament by the Office of Auditor General of Canada, http://www.oag-bvg.gc.ca/internet/docs/aud_ch_cesd_200803_06_e.pdf. Accessed 31st July 2011.
- OAGC (2009). Protecting fish habitat. Chapter 1 in a report to Parliament by the Office of the Auditor General of Canada, http://www.oag-bvg.gc.ca/internet/docs/parl_cesd_200905_01_e.pdf. Accessed 31st July 2011.
- Oceans Act (1996). Published by the Minister of Justice and retrieved from the website of the Department of Justice at <http://laws-lois.justice.gc.ca/PDF/O-2.4.pdf>. Accessed 31st July 2011.
- Pentilla, J & L.M. Dery (1988). Age determination methods for Northwest Atlantic species. NOAA Technical Report. National Marine Fisheries Service V. 72, pp. 129-132.
- Rochette, R., Morissette, S. & J.H. Himmelman (1995). A flexible response to a major predator provides the whelk *Buccinum undatum* L. with nutritional gains. *Journal of Experimental Marine Biology and Ecology*, V. 185, pp. 167-180.

- Roddick, D., Brading, J., Carrigan, L., Davignon-Burton, T., Graham, S. & C. McEwen (2011). Assessment of the Arctic surfclam (*Mactromeris polynyma*) stock on Grand Bank. Canadian Science Advisory Secretariat Research Document 2011/052. 61 pp.
- Roddick, D.L. & E. Kenchington (1990). A review of the Banquereau Bank fishery for *Mactromeris polynyma* for the 1986 to 1989 period. Canadian Atlantic Fisheries Science Advisory Committee Research Document 90/14. 27 pp.
- Roddick, D., Kilada, R. & K. Mombourquette (2007). Assessment of the Arctic surfclam (*Mactromeris polynyma*) stock on Banquereau, Nova Scotia, 2004. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, Research Document 2007/035, 39 pp.
- Roddick, D. & D. Lemon (1992). Exploratory survey for small Arctic surfclams on the eastern Scotian Shelf. Canadian Industrial Report on Fisheries and Aquatic Science Number 215. 33 pp.
- Roddick, D. & S.J. Smith (1999). Assessment of the Banquereau Bank Arctic Surfclam, 1999. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, Research Document 1999/69. 29 pp.
- Rowell, T.W. & T. Amaratunga (1986). Distribution, abundance and preliminary estimates of production potential for the Ocean Quahaug (*Arctica islandica*) and Stimpson's Surf Clam (*Spisula polynyma*) on the Scotian Shelf. Canadian Atlantic Fisheries Science Advisory Committee Research Document 86/56. 21 pp.
- Rowell, T.W. & D.R. Chaisson (1983). Distribution and abundance of the ocean quahaug (*Arctica islandica*) and Stimpson's surf clam (*Spisula polynyma*) resource on the Scotian Shelf. Canadian Industrial Report on Fisheries and Aquatic Science Number 142: v + 75 pp.
- Smith, B.C. & G.H. Wikfors (1992). Phytoplankton pigments accumulated by the Arctic surfclam, *Mactromeris polynyma* (Stimpson, 1860). Journal of Shellfish Research, V. 11, pp. 479-483.
- Species at Risk Act (2002). Published by the Minister of Justice and retrieved from the website of the Department of Justice at <http://laws-lois.justice.gc.ca/PDF/S-15.3.pdf>. Accessed 31st July 2011.
- Stanley, D.J., Swift, D.J.P., Silverberg, N., James, N.P. & R.G. Sutton (1972). Late quaternary progradation and sand spillover on the outer continental margin off Nova Scotia, Southeast Canada. Smithsonian Contributions to the Earth Sciences, Number 8. Smithsonian Institution Press, Washington. iv + 86 pp.
- Territorial Sea Geographic Co-ordinates (Area 7) Order (1985). Published by the Minister of Justice and retrieved from the website of the Department of Justice at <http://www.laws.justice.gc.ca/PDF/SOR-85-872.pdf>. Accessed 31st July 2011.
- UN (1982). United Nations Convention on the Law of the Sea of 10 December 1982. Published by the United Nations at http://www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf. Accessed 31st July 2011.
- Weinberg, J.R. (1999). Age-structure, recruitment and adult mortality in populations of the Atlantic surfclam, *Spisula solidissima*, from 1978 to 1997. Marine Biology, V. 134, pp. 113-125.
- Zwanenburg, K.C.T. (2000). The effects of fishing on demersal fish communities of the Scotian Shelf. ICES Journal of Marine Science, V. 57, pp. 503-509.

2 GLOSSARY OF ACRONYMS AND ABBREVIATIONS USED IN THE REPORT

CHEA	Canadian Hokkigai Export Association
CSLP	Clearwater Seafoods Limited Partnership
DFO	Department of Fisheries and Oceans
EA	Enterprise Allocation
EAC	Ecology Action Centre
EBSA	Ecologically and biologically significant area
ESSIM	Eastern Scotian Shelf Integrated Management (Initiative/Project)
ETP	Endangered, threatened or protected (species)
IFMP	Integrated fisheries management plan
JPA	Joint project agreement
LOMA	Large ocean management area
LRP	Limit reference point
MCY	Maximum constant yield
MPA	Marine protected area
MSC	Marine Stewardship Council
MSY	Maximum sustainable yield
NAFO	Northwest Atlantic Fisheries Organization
OCAC	Offshore Clam Advisory Committee
OCMB	Offshore Clam Management Board
PPT	Parts per thousand
RAP	Regional advisory process
RDG	Regional Director General (DFO)
SSB	Spawning stock biomass
TAC	Total allowable catch
TRP	Target reference point
VME	Vulnerable marine ecosystem
WWF	World Wildlife Fund

3 BACKGROUND TO THE FISHERY

3.1 Introduction

This assessment report is of the Clearwater Seafoods Limited Partnership (CSLP) Banquereau Arctic surfclam (*Mactromeris polynyma* Stimpson, 1860) fishery. The fishery is undertaken offshore, on the eastern Scotian Shelf, and is one of two principal areas targeted by the CSLP Arctic surfclam fleet, the other area being Grand Bank (Figure 1). The CSLP Grand Bank Arctic surfclam fishery is undergoing MSC assessment at the same time as the Banquereau fishery as a separate unit of certification (UoC). A separate assessment report has been generated for the Grand Bank UoC.

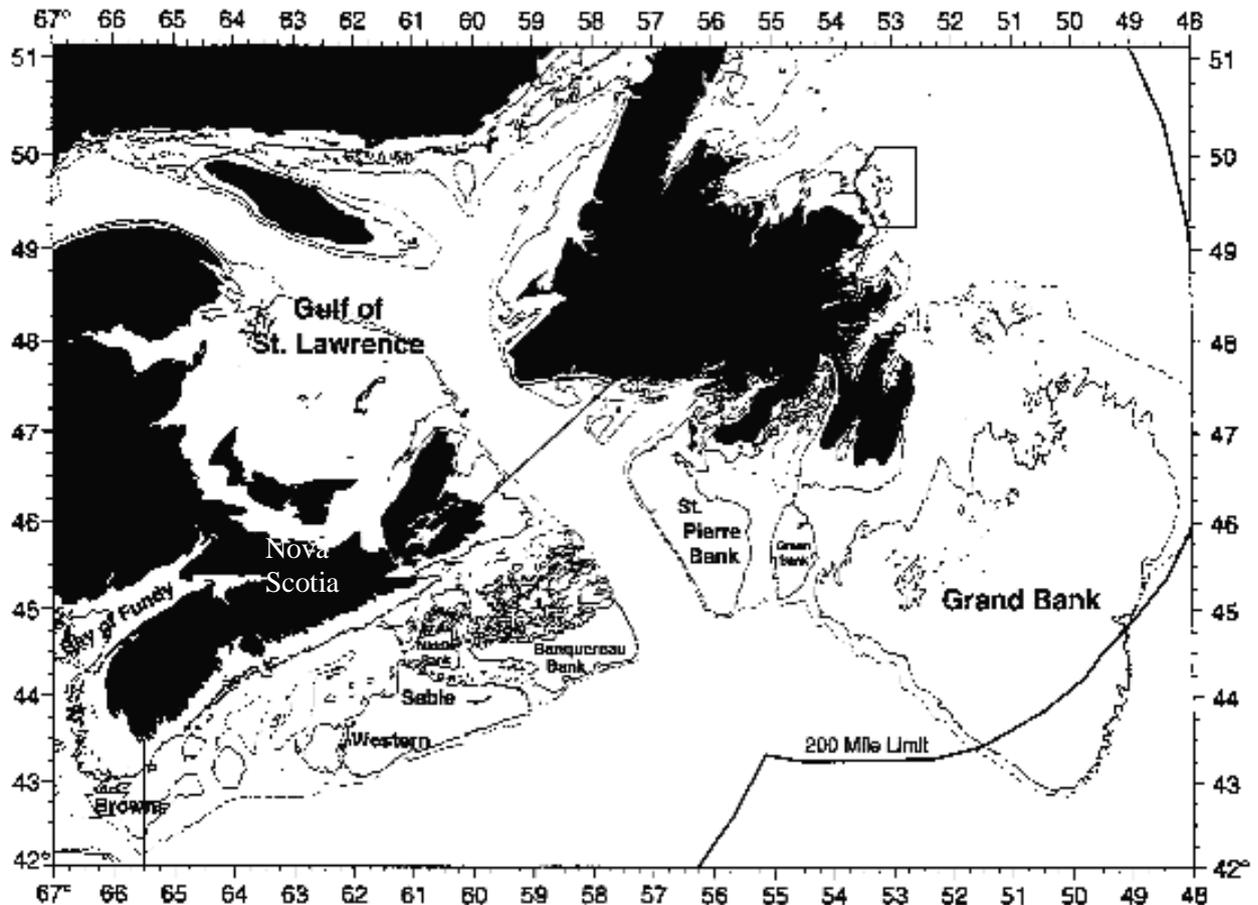


Figure 1: Offshore Banks of the Maritimes and Newfoundland Regions (from DFO 2006).

3.2 Biology of the Target Species

The Arctic surfclam, (*Mactromeris polynyma*), is a large, long-lived, bivalve found mainly in medium to coarse, well-sorted, sandy sediments. It is a strong, active burrower, capable of burrowing to approximately 20 cm into the sediment, or the depth to which the siphons extend. A distinguishing feature is that most specimens have a purple colour in the foot and mantle that turns red upon blanching, similar to lobster and shrimp. This makes it an attractive species for the sushi and sashimi market in Japan, and it has become the object of a substantial commercial fishery in Canada since the late 1980s (Roddick & Kenchington 1990).

Mactromeris polynyma is a circumboreal species, inhabiting the Arctic, Atlantic and Pacific Oceans (Christian *et al.* 2010), in waters colder than 15°C. It is the largest clam in the northwestern Atlantic and occurs from Labrador to Rhode Island (Abbott 1974). In the Canadian part of its range, this

species occurs in commercial quantities in the offshore areas of the Scotian Shelf and eastern Grand Banks and in inshore areas off southwest Nova Scotia and in the Gulf of St. Lawrence (DFO 1989a; 1999; 2004a). 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 110 m depth but in Alaska there are some intertidal populations (DFO 2010). In the Bering Sea the densest aggregations occurred at about 30m depth and at a salinity range of 29-32 ppt (Hughes & Bourne 1981), while on Banquereau Bank the highest densities in surveys were between approximately 50 and 65 m depth (Roddick *et al.* 2007). Arctic surfclam appear to prefer habitats with high salinity (> 18 ppt) and lower water temperatures (Roddick & Smith, 1999).

Despite the commercial fishery, the biology and ecology of *M. polynyma* has not been very thoroughly studied, as reflected in the limited list of publications on the species. Some key aspects of the natural history and population biology of *M. polynyma* are unknown so they have often been inferred from the closely related Atlantic surfclam *Spisula solidissima*, for which there is a substantial literature (e.g. Chamberlin & Sterns 1963; Mann *et al.* 1990; Weinberg 1999).

Mactromeris polynyma is a slow-growing, long-lived species and significant numbers appear to reach more than 40 years of age. On Banquereau, the oldest Arctic surfclam aged was 61 years old and the largest observed was 157mm shell length, while on Grand Bank the oldest clam aged was 73 years old, and the largest observed was 142mm shell length. The Alaskan populations appear to have a shorter live-span, with a maximum age of about 25 years (DFO 2010). *M. polynyma* are patchily distributed, and commercially targeted populations may be widely separated from each other by hundreds of kilometers of ocean bottom in which the clams are relatively scarce. These populations also show significant variations in age structure including large variation in the relative abundance of age-classes 50 years old or more (Roddick & Smith, 1999). Such variability in age-structure is accompanied by significant genetic variation among age-classes in some *Spisula* species (David *et al.* 1997). However, studies of Arctic surfclam populations from various locations, examined in a study using microsatellite markers (Cassista & Hart 2005; 2007), found broad spatial homogeneity of allele frequencies among northwest Atlantic populations and significant spatial differentiation only on the largest geographic scale (i.e. between Atlantic and Pacific oceans).

Arctic surfclams are dioecious (they have separate sexes) and typically reach reproductive maturity at 5 to 8 years of age. They are broadcast spawners, with eggs and sperm released into the water column where fertilization and larval development occur. Like other similar large bivalves, fecundity is very high; C.V. Davis (pers. comm.) recalls spawns of 1-2M eggs per female under hatchery conditions. Spawning generally occurs during the late summer or fall, although some inshore populations may also exhibit spring spawning (DFO 1999; Christian *et al.* 2010). After a few weeks in the plankton the larvae metamorphose and settle on the seabed on inshore or offshore shallow sandy banks (Lambert & Goudreau 1997; Roddick & Smith 1999; DFO 2009e). Under laboratory conditions Arctic surfclam larvae hatched one day after spawning at 15°C and four days after spawning at 8.5°C (Davis & Shumway 1996). In the same study, metamorphosis to the post-larval stage occurred in 24 days at 15°C and in 42 days at 10°C.

There have been no studies of larval habitat selection but Davis & Shumway (1996) reported that the growth rate was greatest in silt/sand substrates. Arctic surfclams are filter feeders with a microalgal diet (e.g., diatoms and dinoflagellates), though they probably also utilise re-suspended organic detritus and bacteria from the bottom of the water column.

Many bivalve molluscs can be reliably aged from prominent concentric growth rings on the surface of the shell; these can be validated as annual rings (Beamish & MacFarlane 1983; Campana 2001). However, in long-lived, slow growing species this is rarely possible and it is necessary to utilize microscopic internal bands or annuli within the shell or the resilium (the hinge ligament) (Lutz & Rhodes 1980; Pentilla & Dery 1988; Kilada *et al.* 2009). In *Mactromeris polynyma*, age has been estimated by counting annuli in thin sections of the hinge area of the shell (Almeida & Sheehan 1997) and has been used to determine age frequency distributions through time to show variations in annual recruitment, temporal and spatial differences in growth rates, and to establish age at maturity (DFO 2010, Roddick *et al.* 2007). DFO undertakes training and testing of Arctic surfclam agers, with a

maximum permitted coefficient of variance of 5% being adopted before agers can routinely age Arctic surfclam; this is considered to be conservative (Roddick *et al.* 2011). For Arctic surfclams from Banquereau, Roddick *et al.* (2007) reported that the size at 50% maturity was 47.2 mm shell length, well below the size of 50% retention of the dredge, and the age at 50% maturity was 6.7 years old. DFO (2012) provided new estimates for size and age at 50% maturity for Banquereau of 45.2 mm and 8.3 years respectively, but these figures are still well below the size of 50% retention.

Arctic surfclams have numerous predators. During the pelagic phase, the larvae are eaten by larger zooplankton and planktivorous fish. On the seabed, they are consumed by various predatory invertebrates and vertebrates. Rochette *et al.* (1995) and Himmelman & Hamel (1993) observed predation on the Arctic surfclam by the sea star *Leptasterias polaris* in the northern Gulf of St. Lawrence. In the same area the waved whelk (*Buccinum undatum*) attempted to scavenge meat from the Arctic surfclam, despite the presence of the sea star that also prey on whelks. Morissette & Himmelman (2000) indicated that other kleptoparasites, including sea stars (*Asterias rubens*), rock crab (*Cancer irroratus*) and lyre crab (*Hyas araneus*) fed on Arctic surfclam. Large groundfish, such as Atlantic cod (*Gadus morhua*) on Banquereau Bank, are also primary predators on *Mactromeris polynyma* (Roddick & Lemon 1992). Arctic surfclam has also been documented as a principal prey item for sea otters in Alaska (Green & Brueggeman 1991). There are also other faunal interactions with Arctic surfclams on the seabed. For example, in the northern Gulf of St. Lawrence, Iceland scallops (*Chlamys islandica*) were observed using empty *M. polynyma* shells as refuges (Arsenault & Himmelman 1998).

3.3 History of the Fishery

The CSLP Arctic surfclam fishery takes place in two areas in the northwest Atlantic – Banquereau Bank and Grand Bank (Figure 1). Although the presence of Arctic surfclams on the Grand Banks was reported as early as 1885 (Chamberlin and Sterns, 1963) and its distribution on parts of the Grand Bank was mapped in the 1960s (Nesis 1963), the start of the Canadian offshore clam fishery dates back to 1980 when DFO commenced a resource survey to determine the commercial potential of underutilised clam species in the Scotia-Fundy Region. These surveys took place from 1980 to 1983 and found commercial densities of Arctic surfclams on Banquereau Bank, for which there was commercial interest as a potential substitute for the highly valued Atlantic surfclam *Spisula solidissima*, which has a very limited distribution in Canadian waters (Rowell & Chaisson 1983; Chaisson & Rowell 1985). Commercial densities of Arctic surfclam were not found in other areas of the Scotian Shelf but these exploratory surveys were not comprehensive so the possibility of commercial quantities elsewhere could not be excluded.

Based on the survey results it was estimated that Banquereau Bank had a commercially exploitable biomass of Arctic surfclams of 561,000 t and a maximum sustainable yield (MSY) of 16,821 t (Rowell & Amaratunga 1986). A three-month test fishery then took place with three companies participating, each company using a chartered US vessel equipped with a single hydraulic clam dredge, as a result of which the estimated MSY was raised to 24,000 t (Amaratunga & Rowell 1986).

In 1987 a three-year Offshore Clam Enterprise Allocation (EA) Program was developed with the industry. Total Allowable Catches (TAC's) and EA's were set for each of the three years of the program based on biological information provided by the surveys and the test fishery, and an economic break-even analysis on the required resource to make a vessel and processor viable. Three companies participated in the fishery. The TAC was set at 30,000 t for Banquereau Bank. One company, not having access to Banquereau Bank, tried experimental fishing on the Grand Bank (Northwest Atlantic Fisheries Organization (NAFO) area 3LNO). A review of the development of the fishery up to 1989 is available in Roddick & Kenchington (1990).

Arctic surfclams officially became a regulated species under the Atlantic Fishery regulations in February 1989 (DFO 2011c). In that year the fishery expanded to Grand Bank (NAFO area 3LNO) with the issuing of two exploratory licenses and two exploratory permits; these were issued to the three original participants plus a fourth, Newfoundland based, company. For the Grand Bank a preliminary resource assessment estimated the exploitable biomass at 504,000 t and the fishery

operated with a precautionary TAC of 20,000 t. In addition, access to the Scotian Shelf was expanded to include the new company, and the TAC for the Scotian Shelf outside of Banquereau Bank was increased to 20,000 t (Roddick *et al*, 2007); since that time there has been some exploration of these grounds, but no sustained fishing.

In 1990 the Offshore Clam Enterprise Allocation Program was extended for the five-year period, 1990-1994. However, one company stopped fishing in the spring of 1991 due to financial problems, and went out of business in 1992. The Offshore Clam allocations were then revised from January 1, 1992, giving the remaining three offshore clam companies equal access and allocations on all banks. While the TACs for each fishing area remained unchanged (Banquereau Bank 30,000t; Grand Bank 20,000 t) it was decided that any future changes in the TAC would also be split equally between the licence holders. Since early 1993 there have been 2 or 3 factory processing vessels fishing year round and the EA program has continued through each management plan until the present day.

The 1995-1997 Offshore Clam Fishery Multi-Year Harvesting Plan stressed the need for improved scientific data to ensure sustainable harvesting and several information gaps were cited for both Banquereau Bank and Grand Bank, including the lack of reliable estimates of standing stock biomass, growth rates, recruitment and natural mortality. With industry looking to long-term investments in the offshore clam fishery they required regular, up-to-date, estimates of the clam stocks; as such, they entered into a Joint Partnership Agreement (JPA) with DFO to jointly fund the scientific studies. This program undertook to survey the various clam species and offshore banks involved in the fishery on a rotating basis. Under this program, Banquereau Bank was surveyed in 1996-97 (Roddick & Smith 1999), which resulted in a reduction of the TAC for Banquereau from 30,000 t to 24,000 t in 2004, but the results of the Grand Bank part of this survey were never completed due to the demise of the scientist in charge (DFO 2010). No change was made the Grand Bank TAC at that time. Subsequent surveys under this program were conducted on Banquereau in 2004, followed by Grand Bank in 2006-2009 and Banquereau again in 2010 (DFO 2011c; DFO, 2012). In addition, the industry also undertook to fund an economic study of the fishery (Gardner Pinfold Consulting Economists Ltd. 1998), and a dockside-monitoring program (DFO 2011c).

The 1998-2002 Offshore Clams Integrated Fishery Management Plan (IFMP) incorporated similar management measures to the previous plan and stressed the need to determine a sustainable yield and scientifically based TAC. It also identified factors to be evaluated when considering applications for new licences, such as the total TAC exceeding historic levels, the uncertainty surrounding recruitment, sustainability of the fishery and market conditions (DFO 2006). The 1998-2002 Plan was extended by the 2005-2009 IFMP on a five-year rolling or “evergreen” basis. Thus, at the end of each year of the agreement, a subsequent year was added to the Offshore Clam IFMP, thereby ensuring that a five-year plan was always in place. This “evergreen” process was subject to either the Minister of Fisheries and Oceans or the licence holders providing formal notification, within 15 days before the end of each calendar year of the Plan, of their intention whether or not to agree an annual renewal of the Plan. The 2005-2009 IFMP was recently updated in May 2011 with a new IFMP, which remains in effect until replaced (DFO 2011c). This new Offshore Clam IFMP is to be reviewed and amended as required at the end of each year.

When the Arctic surfclam fishery started, participation was initially based mainly on expectations of a strong US market. However, this failed to materialize, due mainly to the distinctive coloration of the Arctic surfclam meat that deterred US buyers. From 1987 onwards, the clam fishing companies therefore focused their efforts on penetrating the Japanese market. This was initially slow to respond, and by the end of 1989 the economic situation of the fishery had deteriorated (DFO 2011c). In response, Canadian exporters formed the Canadian Hokkigai Export Association (CHEA) to expand the marketing of hokkigai (Arctic surfclams) in Japan. Together with the Canadian and provincial governments, CHEA implemented a major marketing campaign at supermarkets and stores throughout Japan to introduce consumers to Canadian hokkigai. This led to a gradual increase in Japanese market demand, with over 4000 t of Canadian Arctic surfclam exported to Japan by 1995. However, reliance on a single market would have left the industry potentially vulnerable so the industry continued efforts to diversify and expand markets throughout China, Southeast Asia and elsewhere (DFO 2011c). By 2006, exports of Arctic surfclams by market were: Japan 41%, North

America 20%, China 29%, and other 10% (DFO, 2011c). However, despite these marketing efforts, the fishery has generally been constrained by market demand (Table 2).

Table 2: Annual Arctic surfclam landings (t) for Banquereau Bank, Grand Bank and the Scotian Shelf fisheries, 1987 – 2010 (modified from Roddick *et al.* 2011, with data for 2010 from CSLP).

Year	Grand Bank (3LNO)	Banquereau	Scotian Shelf	Total
1987	0	717	1	718
1988	0	1,824	0	1,824
1989	402	7,666	0	8,068
1990	8,027	4,765	0	12,792
1991	6,753	746	0	7,500
1992	11,154	0	0	11,154
1993	18,905	60	0	18,965
1994	15,881	4,590	0	20,471
1995	14,108	10,427	0	24,535
1996	6,458	18,745	0	25,203
1997	7,614	19,025	0	26,639
1998	963	24,695	0	25,658
1999	1,487	24,413	0	25,900
2000	3,775	19,989	0	23,764
2001	8,389	11,443	0	19,832
2002	6,901	12,492	10	19,403
2003	10,265	16,883	0	27,148
2004	6,731	16,686	0	23,417
2005	3,732	14,689	0	18,422
2006	4,927	14,859	0	19,786
2007	211	17,337	0	17,548
2008	0	19,336	0	19,336
2009	127	24,565	0	24,692
2010	0	22,845	0	22,845
Annual Mean	5,700	12,867	0	18,568

3.4 Fleet and Gear Description

3.4.1 Vessels

The Canadian Arctic surfclam fishery initially charted US hydraulic dredging boats, with shucking and processing taking place at shore-based plants. However, by 1988, the fleet was required to use Canadian-registered vessels so the fishing companies bought three converted oil rig supply ships, 53-61 m length, equipped with two stern mounted hydraulic dredges (Roddick & Kenchington, 1990). Since 1992, the fishery has used large freezer processor vessels. Although the number of vessels in the fishery has fluctuated over time and up to four vessels may fish, only two factory freezer-processors currently prosecute the fishery, the *Ocean Concord* and the *Arctic Endurance*. These vessels meet the requirements of Schedule 111 of the Fish Inspection Regulations and operate under a

certified Quality Management Program (DFO 2011c). The replacement value of a vessel is estimated at \$45 million, which includes \$4.5 million for the onboard processing equipment (DFO 2011c). All crew must be Canadian citizens or have landed immigrant resident status in Canada (DFO 2011c). These vessels operate year round and can fish on both Banquereau and Grand Bank, and effort has switched between the two banks over time.

3.4.2 Gear

Arctic surfclam vessels tow two hydraulic dredges, each approximately 3.8 m wide x 6 m long x 1.2 m high, and weighing some 9 t (DFO 2006). The dimensions and specifications are shown in Table 3

Table 3: Specifications of the Canadian hydraulic Arctic surfclam dredge (DFO 2010).

Characteristic	Value
Dredge width	3.8 m (12.5 feet)
Dredge height	1.2 m (4 feet)
Dredge length	6 m (20 feet)
Blade depth	18 cm (7 inches)
Dredge weight (in air)	9.5 tonnes
Tow speed	About 2 knots
Hose diameter	22.5 cm (10 inches)
Bar spacing	2.8 – 3.2 cm (1 1/8 – 1 1/4 inches)
Nozzles on the manifold	32

The dredge is a large rectangular steel box or cage, on skis that run the entire length of both sides (Figure 2). In operation, seawater is pumped through a large diameter water hose from the vessel to a manifold on the front of the dredge where a series of nozzles direct the water backward at a 45° angle into the seabed. The nozzles shoot high-powered water jets at about 125 - 190 p.s.i. into the sediment; this fluidizes the sand in advance of the dredge and exposes and lifts the underlying clams. A cutting blade spanning most of the width of the dredge then scoops the clams up into the cage at the rear of the dredge. As the dredge moves forward the clams pass over a series of spacing bars that retain commercial-sized clams and allow smaller clams to drop through. The first portion of the cage is left open to allow debris to drop out immediately. The size of this opening can be adjusted with the insertion or removal of additional steel plates. Clams are retained in the dredge until recovered at the surface and offloaded on the vessel. Dredges are typically towed in pairs with the centres of the dredges about 30m (100 feet) apart. Two dredges are used whenever possible but during bad weather, or when dredge repairs are being carried out, a single dredge may be towed. A typical tow is of some 12 min duration at a speed of about 2 knots.

Hydraulic clam dredges are used only to fish for clam species and can be deployed only on sandy seabeds. Ships' captains target the medium to coarse sand bottoms where clams are found and take great care to stay away from rough bottoms to avoid damage to the gear and lost fishing time. The fleet uses RoxAnn & WASSP acoustical bottom imaging systems to identify suitable clam bottoms and thereby avoid disturbing the seabed in areas unlikely to contain commercial densities of clams. The RoxAnn & WASSP system is integrated with differential GPS and a Microplot system that provides a permanent record of where the vessel has fished. The captain views this information in order to continually refine the areas to be fished.

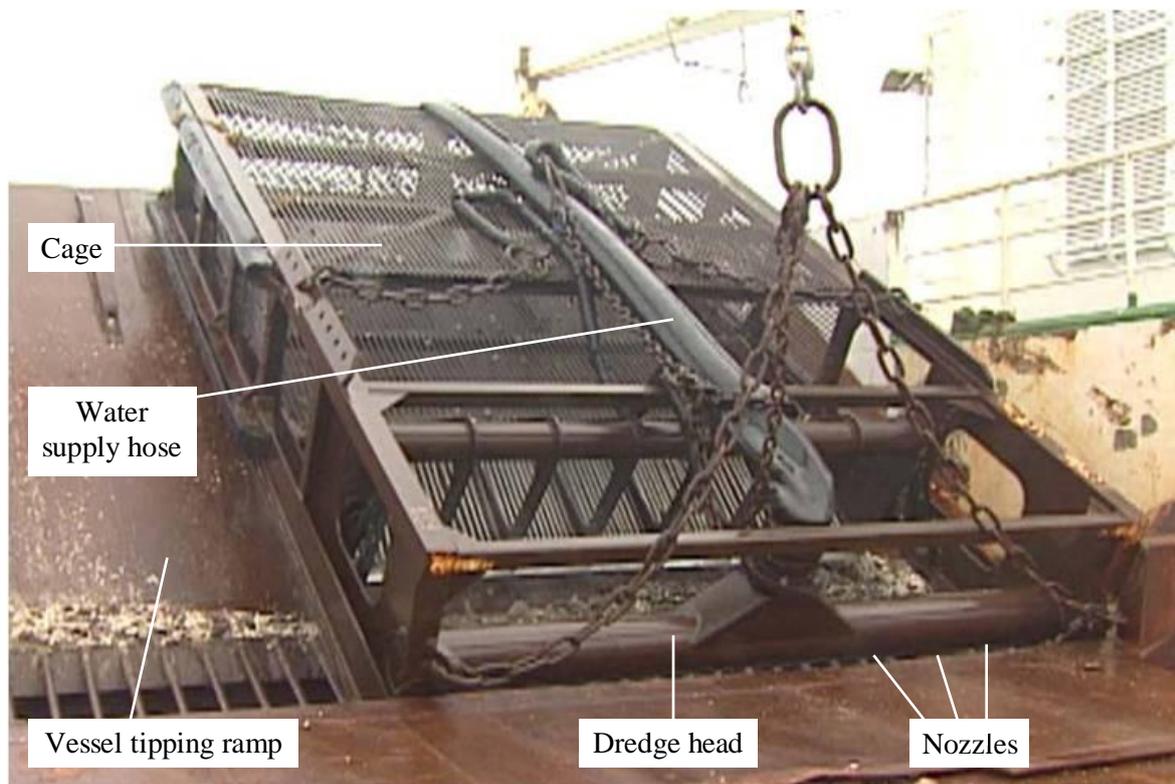


Figure 2: Arctic surfclam dredge sitting on a tipping ramp. Dredge head is 12.5 ' (3.8 m) wide (CSLP pers. comm.).

4 STOCK ASSESSMENT

4.1 Management Unit

The Arctic surfclam *Mactromeris polynyma* is the subject of a hydraulic dredge fishery on Banquereau Bank, Grand Bank and occasionally at some other offshore banks on the Scotian Shelf (Figure 1). These fisheries are managed under the Offshore Clams Integrated Fishery Management Plan, Maritimes and Newfoundland Regions (DFO 2011c). This plan applies to both the Banquereau and Grand Bank fisheries and the same fishing vessels (currently two) are licenced to fish in both areas and to switch grounds whenever they require. The Arctic surfclam stocks on these two grounds have been surveyed several times since 1986 through a collaborative industry/DFO program, and the resulting assessments form the basis for setting an individual TAC for each ground. Due to the time period between assessments the TAC's are set for a multi-year period, using the framework for these stocks developed during 2007 (DFO 2007d), and the TAC's generally remain in place until the next survey takes place.

While fishing and management processes for Banquereau and Grand Bank are integrated, and the populations on the two grounds are genetically homogeneous and belong to the same stock (Cassista & Hart 2007), the two banks are geographically well separated, ecological conditions and Arctic surfclam population parameters differ and separate TAC's are set, so they are best treated as separate management units.

The following MSC assessment is therefore directed specifically at the Banquereau Bank fishery but there is inevitably some scientific and management interaction with the Grand Bank Arctic surfclam fishery that is being assessed at the same time as the Banquereau fishery.

4.2 Assessments and stock status

4.2.1 Stock differentiation

One potentially important consideration for the management of this fishery is the extent of genetic variation within and among *M. polynyma* populations. The genetics of Arctic surfclam populations on Banquereau and Grand Bank were examined in a study using microsatellite markers (Cassista & Hart 2007). They found broad spatial homogeneity of allele frequencies among northwest Atlantic populations with no evidence of differentiation between harvested Arctic surfclam populations on either side of potential barriers to larval dispersal and gene flow such as offshore banks or the narrow straits that separate Gulf of St. Lawrence from Atlantic Ocean populations. Significant spatial differentiation occurred only on the largest geographic scale, between Atlantic and Pacific Ocean populations. All Arctic surfclams in the Canadian northwest Atlantic can therefore be considered to belong to a single stock. However, as Arctic surfclams are sedentary after settlement, geographically separated populations are demographically distinctive, with different age structures, growth rates, reproductive cycles and reproductive output (Cassista & Hart, 2007), as well as different fishing patterns, the fisheries on Banquereau and Grand Bank are best considered as separate management units. However, the genetic homogeneity indicates that there is some gene flow between these regional components of the stock through larval transport, which could contribute to episodic recruitment events.

4.2.2 Catch and landings

Three fishing vessels have operated for most years but the fleet currently consists of two factory freezer-processors fishing year round. These vessels have access to both Banquereau and Grand Bank grounds, and effort has switched between the banks through time (Table 2; Figure 3). The fishery started on Banquereau in 1987 and on Grand Bank in 1989. From 1990 - 1995 landings from Banquereau were lower than those from the Grand Bank, often considerably so, but since 1996 landings from Banquereau have been substantially greater. Banquereau landings have been as high as

24,695 t but the TAC (30,000 t from 1987-2003; 24,000 thereafter) has rarely been taken and recent landings are of the order of 15,000 t. The combined landings from the two fisheries have fluctuated somewhat from year to year but overall have remained fairly stable since 1993, at a level constrained mainly by market demand.

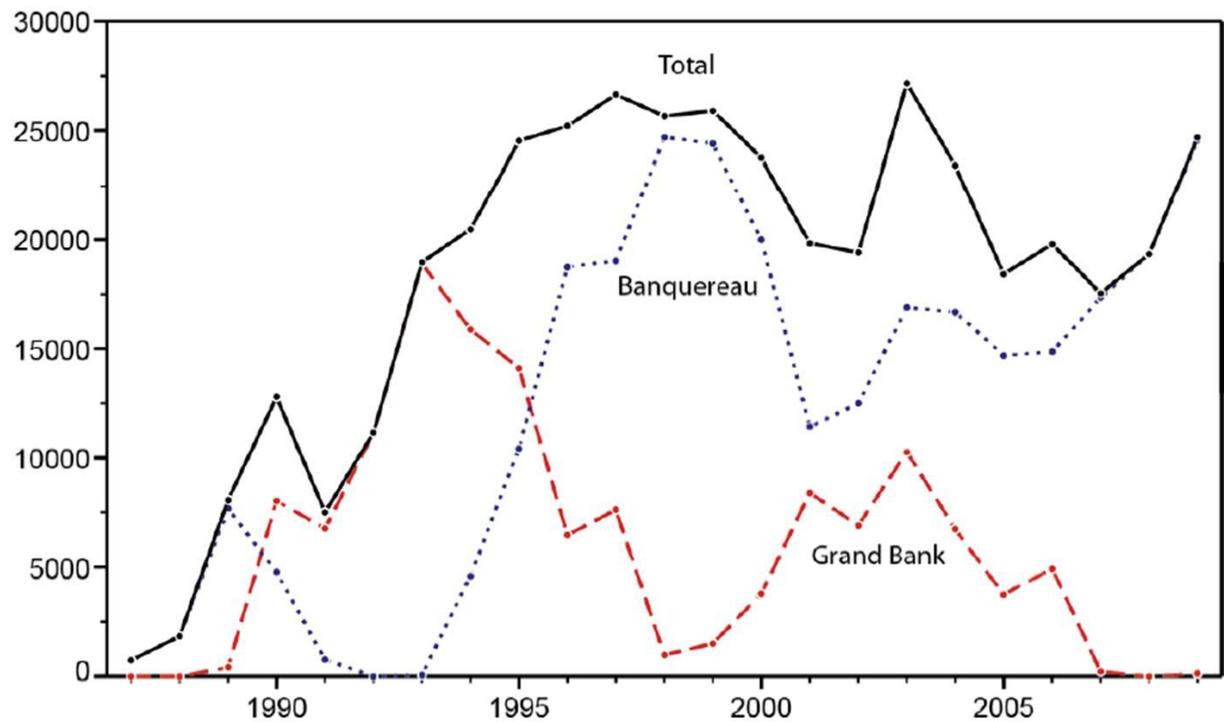


Figure 3: Arctic surfclam landings (t) for Banquereau and Grand Bank (DFO 2010).

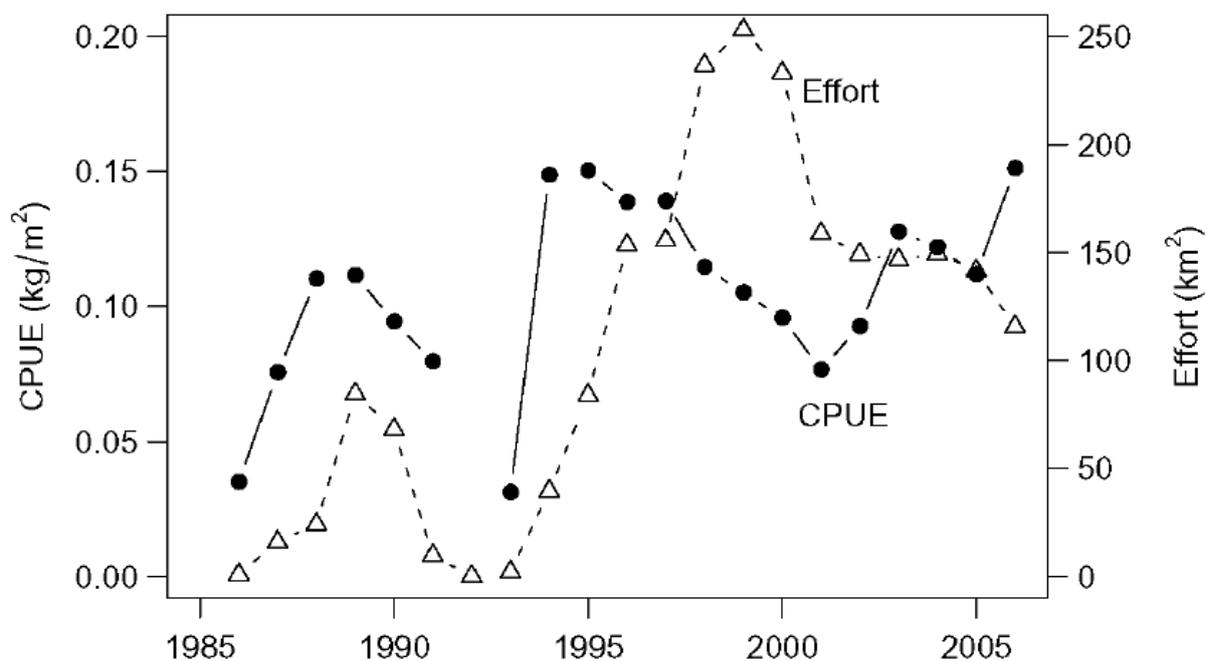


Figure 4: Catch per unit effort (CPUE) and effort for the Banquereau Arctic surfclam fishery, 1986-2006 (DFO 2007a).

With the fishery periodically switching between Banquereau and Grand Bank, the spatial distribution of fishing effort on Banquereau has varied greatly through time, making catch per unit effort (CPUE) an unreliable index of abundance (Figure 4). Jonsen (2007) suggests that catch rates are not well correlated to the stock abundance due to the spatial distribution of the stock, the selectivity of the area fished by the fishery, and the low spatial resolution of the effort data. Research vessel survey biomass estimates therefore provide the best data to assess the stocks.

4.2.3 Survey biomass and abundance trends

Arctic surfclams on Banquereau were surveyed in 1981-82 (Rowell & Chaison, 1983), 1996-97 (Roddick & Smith 1999), 2004 (Roddick *et al.* 2007) and most recently in 2010 (DFO, 2012). The results of the 2004 survey will be described in more detail here as there is more published information available about this survey. The 2004 survey design was based on 250 stations, randomly assigned within the 40-100m contours, with an assignment function that allowed a minimum spacing of 3.0 km between tows. During the survey, however, it was found that the dredge did not operate efficiently below 90 m and some stations were too rocky for the dredge, so the number of stations sampled was reduced to 210 and the depth range restricted to 40-90 m.

The survey was carried out on the *Cape Keltic*, a 43 m 360 GT side-dragger, equipped with a hydraulic clam dredge. The survey dredge was smaller than that used by the commercial boats, being 226 cm wide and 445 cm long, with a 177 cm cutting blade. The average bar spacing in the cage section was 23 mm on the top and sides and 28 mm on the bottom. The depth of the cutting blade was set to 14.3 cm below the runners (Roddick *et al.* 2007). Tow distance was measured and tow track recorded by the Microplot 7 navigation package, and the suitability of the seabed for the gear at each station was checked by the RoxAnn bottom discrimination system (Sonavision Ltd., Scotland, UK). The standard tow length was 300m and large numbers of clams were measured on the boat, while smaller samples were returned frozen to the DFO laboratory for morphometric and ageing studies. A new dredge of similar design was used in the 2010 survey but modifications were made to the dredge to allow a safer deck handling system and these affected both the size selectivity and the efficiency of the dredge. Studies were conducted to estimate both the selectivity and the efficiency of this dredge and these were incorporated into the biomass estimates. This had the unfortunate effect of producing biomass estimates that are uncertain, due to the large confidence interval around the survey dredge efficiency, so these estimates are not directly comparable with biomass estimates from previous surveys (DFO 2012)

A contour map of the Arctic surfclam biomass for the 2004 Banquereau Bank survey is shown in Figure 5. The areas of high biomass generally coincided with those observed in the 2010 survey (DFO 2012) and with the previous surveys. These areas also corresponded to the areas where the fishery has concentrated its effort from the start of the fishery. This observation, that the areas of greatest effort are still the areas with the highest biomass, indicates that serial depletion, a concern with fisheries for sedentary species, is not happening in this fishery (DFO 2007a).

The average catch per tow at different depths (Figure 6) shows that the best catches were obtained between 50 and 65 m depth, and catches fell rapidly with depth so that below 90 m catches would be expected to be minimal, although the research dredge did not operate efficiently at this depth.

Two methods were used to calculate the biomass in the survey area: simple statistics were used for the tows inside the 90 m depth contour, while the ACON Data Visualization package software (Black 1991) also used the deeper stations and calculated biomass by contouring (interpolating) using areal expansion with inverse distance weighting to create estimates of biomass between the point biomass data collected during the survey. Catches were standardized to the average tow length of 329 m, giving a tow area of 530 m². Dredge efficiency could not be quantified in the 2004 survey so it was assumed to be 100%. This is prudent, given the uncertainty about the efficiency of the survey dredge (DFO 2007c, 2011) but means that the biomass is likely to be underestimated to some extent.

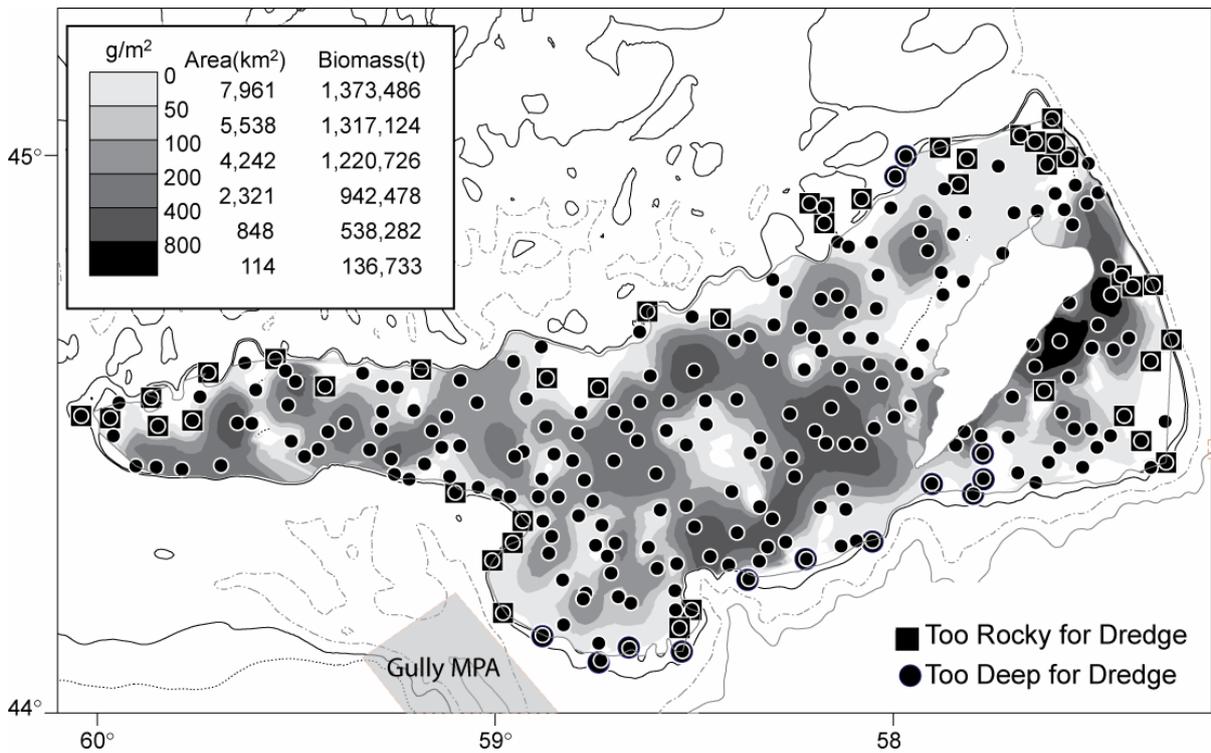


Figure 5: Contours of Arctic surfclam catch (kg/ 500 m² tow) for the 2004 Banquereau survey (Roddick *et al.* 2007).

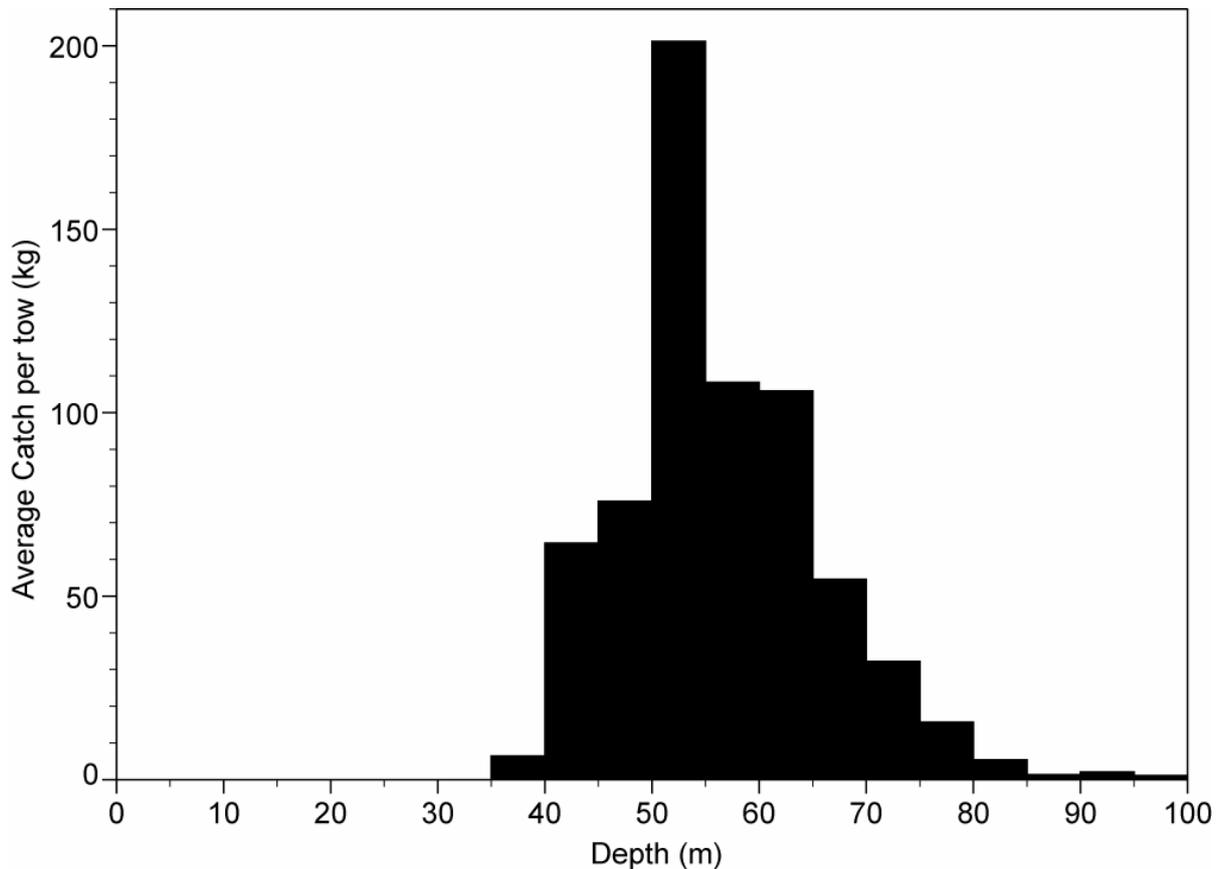


Figure 6: Average catch per tow at different depths for the 2004 Banquereau Arctic surfclam survey (Roddick *et al.* 2007).

The distribution of the stock was very similar for the 2010 survey and the contouring indicated that areas with densities of 75 g/m² contained 91% of the efficiency corrected fishable biomass (DFO, 2012). However, the dredge efficiency estimation, based on a single depletion experiment, gave very large confidence intervals and work is in progress to improve the survey dredge efficiency estimation.

The research vessel biomass estimate for Banquereau Arctic surfclams in 2004 was 1,462,097 ± 24,944 t (Table 4) and this fell to 1,150,585 t in 2010, but this decline was considered to be related to changes in vessels and gear, rather than an actual change in abundance (DFO, 2012). The two most recent estimates are much larger than the two earlier surveys, which gave similar densities, although their coverage was different. However, all four surveys were carried out using different vessels and different gear, and the 2010 survey was corrected for both dredge efficiency and size selectivity, so the surveys do not provide a reliable time series of comparable data.

Table 4: Research vessel biomass estimates (B_{RV}) for the four clam surveys carried out on Banquereau Bank (Roddick *et al.* 2007, DFO 2012).

Year	Area	Biomass (t)	Reference
1981-82	9,182	822,415	Rowell & Chaisson, 1983
1996-97	5,200	469,839	Roddick & Smith, 1999
2004	9,259	1,462,097	Roddick <i>et al.</i> 2007
2010	N.A.	1,150,585	DFO 2012

The research vessel biomass estimate (B_{RV}) for the 2004 Banquereau survey is shown in Table 5, together with the estimate from the 2006-9 Grand Bank survey for comparison. The estimate for Grand Bank of 1,140,682 ± 35,933 t is 78% of that estimated for Banquereau (Roddick *et al.* 2011), but this is for a survey area some 4.8 times larger. A large part of the survey biomass for Grand Bank comes from a large area with a low density of clams, while for Banquereau, areas of fishable densities of >75 g/m² contained 91% of the fishable biomass. Note that the stated area surveyed on Banquereau differs between Table 4 and Table 5. It is presumed the difference is due to changes in the boundary definition of the survey between publication of the reports.

Table 5: Research vessel biomass estimates (B_{RV}) estimates for the Arctic surfclam surveys on Banquereau and Grand Bank (DFO 2010).

Survey	Year	Biomass (t)	Area (km ²)
Banquereau	2004	1,462,097	10,265
Grand Bank	2006-2009	1,140,682	49,473

The commercial CPUE for Banquereau and Grand Bank is shown in Figure 7, with CPUE calculated on a per vessel-trip basis, for trips approximately one month long. CPUE has risen recently on Banquereau as a large recruitment pulse has entered the fishery (Roddick *et al.* 2007), though this could also be due, in part, to increased knowledge and experience of the fishermen in catching the clams using the new bottom profiling technology to accurately target clam concentrations (DFO 2007d). Taking the 1993 to 2006 period to avoid the recent increase, the average CPUE for Banquereau was 0.111 kg/m² fished (S.D. = 0.041, n = 222), while the average for Grand Bank (1993-2010) was lower at 0.096 kg/m² (S.D. 0.040, n = 172).

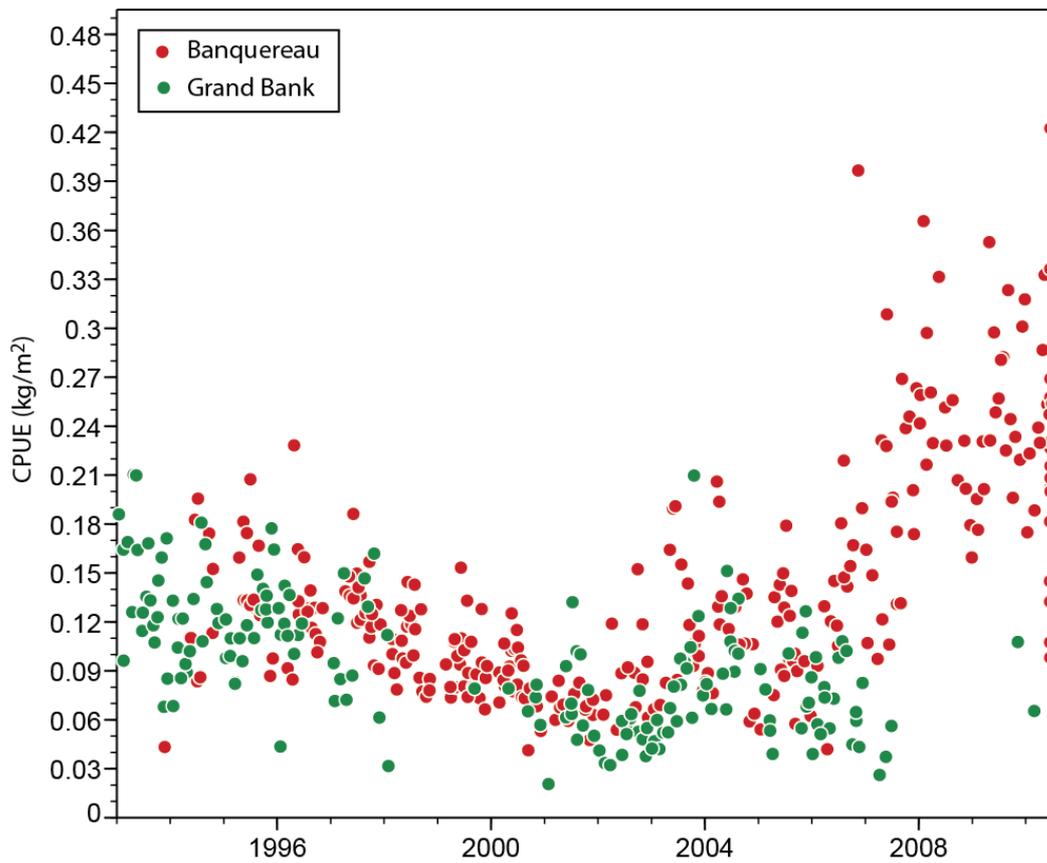


Figure 7: CPUE (kg/m² dredged) for the Arctic surfclam fishery on Grand Bank and Banquereau. CPUE is calculated on a trip basis (Roddick *et al.* 2011).

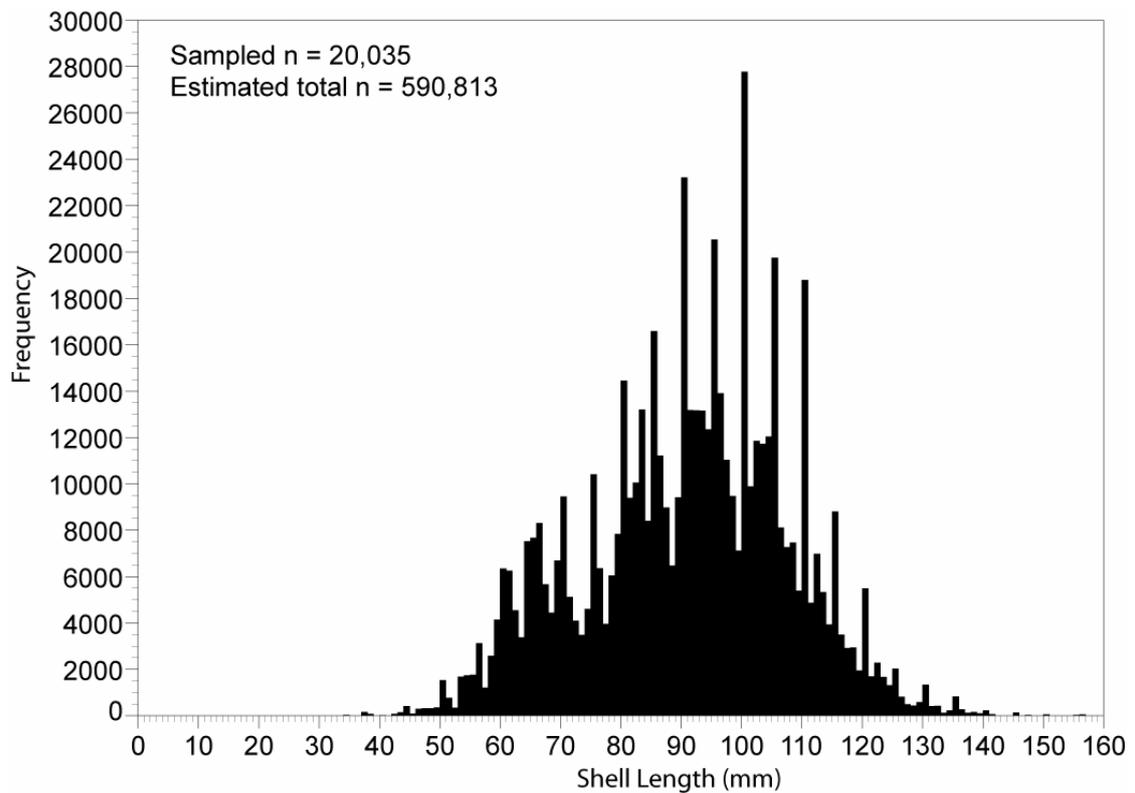


Figure 8. Estimated total length frequency for the Arctic surfclam catch for the 2004 Banquereau Arctic surfclam survey (Roddick *et al.* 2007).

4.2.4 Size distribution

The length frequency distribution of the catch was determined for >20,000 clams, based on measured samples of approximately 100 clams taken from each tow of the survey (Figure 8). Most of the catch came within the size range of 50 – 130 mm shell length, with a median size of about 95 mm. For the 2004 survey, there was an obvious problem of measurement bias with greater numbers of clams being recorded at lengths with the last digit of 0 or 5. As a consequence, for most of analyses involving length frequencies, lengths were aggregated to 5 mm increments in order to remove this effect (Roddick *et al.* 2007). Smaller samples of whole clams taken on the survey were returned frozen to the DFO laboratory for analysis of length-weight relationships, spawning cycles, age structures and size and age at maturity. On-board sampling procedures were designed to ensure that these samples covered the full size range of the clams captured in the dredges (DFO 2011d) and they were later sub-sampled to provide a length-stratified sample for ageing studies.

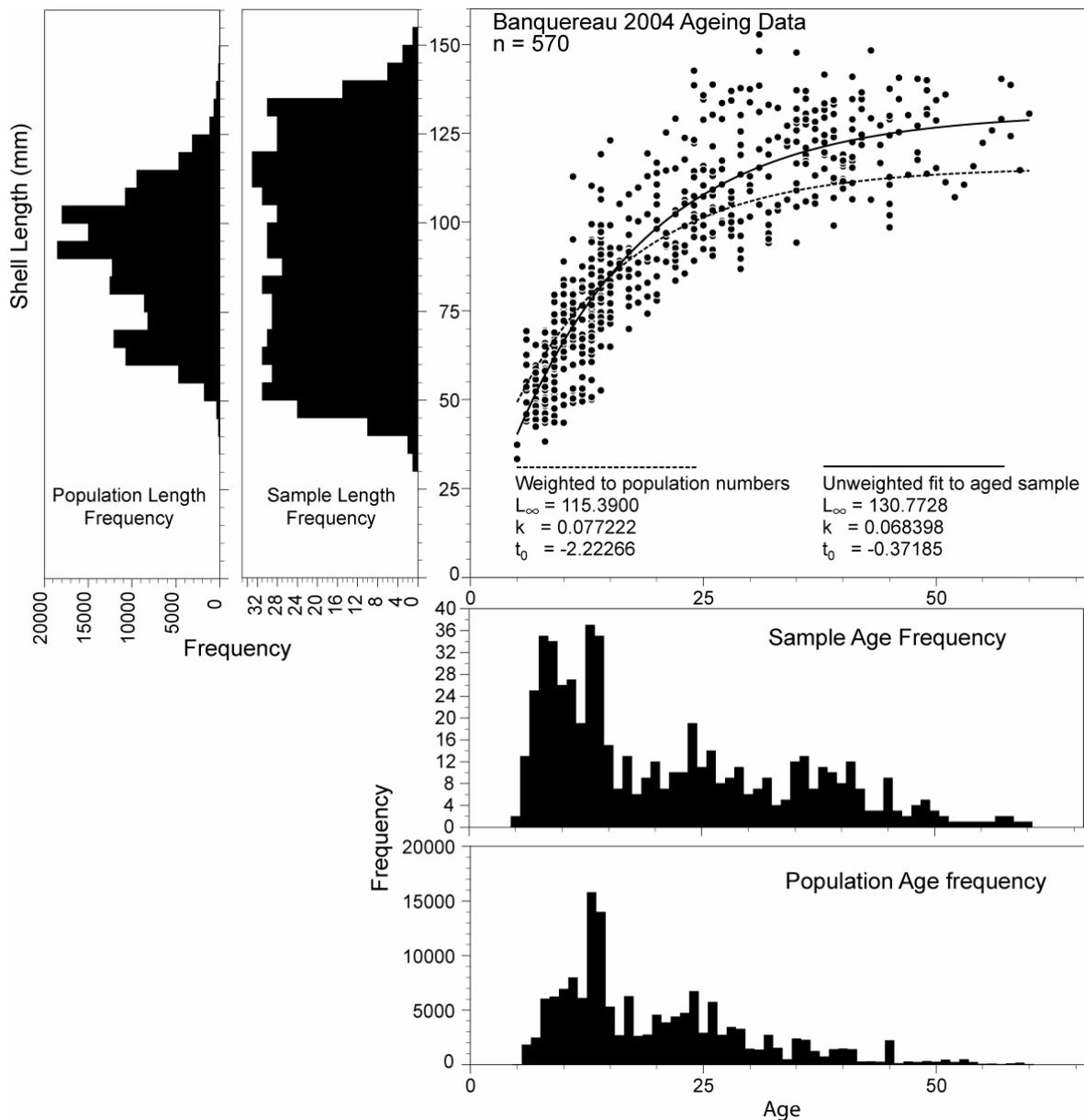


Figure 9: Aged Arctic surfclam samples from the 2004 Banquereau survey used for the construction of the age-length key. The histograms on the left are the size frequency distribution of the aged sample and the population. The center plot shows the age-length data and the fitted von Bertalanffy growth curve, and the bottom histogram is the resulting age histograms for the aged sample and the population (Roddick *et al.* 2007).

The procedures for estimating the survey age frequency distribution is illustrated in Figure 9, which shows the histograms of the length-stratified sample and of the survey size frequency distribution, together with the fitted von Bertalanffy growth curve. These data are then used to construct an age-length key to convert the length frequency distribution to the resulting age frequency histogram for the aged sample and to estimate the survey age frequency distribution (DFO 2007d). The survey age frequency distribution provides information on year-class strength and indicates fluctuations in recruitment through time. Recruitment occurs every year, with no missing year-classes, but with stronger year-classes evident every few years. At present, the commercial landings are not converted to age structure, as it would take a lot of additional resources to institute an ageing program that could process enough shells to do this accurately (DFO 2007d).

4.2.5 Assessment models

Fishery dependent information like catch per unit effort (CPUE) is not used for assessment in this fishery since catch rates are not well correlated to stock abundance due to the spatial distribution of the stock, the selectivity of the area fished and the low spatial resolution of the available effort data (Jonsen 2007). An attempt was made to fit biomass dynamic models like the Schaefer surplus production model and a delay difference model to the only time-series data available, the commercial logbook data, but the biomass estimates were poor and it was concluded that the absence of an historical time-series of abundance did not permit modeling to determine stock trends and life history parameters (Roddick *et al.* 2007). Instead, the management strategy would have to rely on the survey biomass data to provide the best basis for recommending harvest levels. Apart from the most recent survey (DFO, 2012) the confidence limits around the biomass estimates are narrow (DFO 2010, Roddick *et al.* 2007), and sources of uncertainty are described in the Regional Assessment Process (RAP) (DFO 2007a, DFO 2010) and taken into consideration when deciding management advice.

Based on life history and selectivity parameter estimates, the age of maximum biomass per recruit occurs close to the age of 50% selectivity (Figure 10), so growth overfishing is unlikely to occur. The age of 50% maturity (6.7 – 8.3 years) is well below the age of 50% selectivity (approx 16.5 years), indicating that individual Arctic surfclams on Banquereau will be able to spawn about 7 – 10 times before recruiting to the fishery (Roddick *et al.* 2007, DFO 2012). Although there have been no studies of the relative fecundity of young compared with older Arctic surfclams, this should help to ensure that recruitment overfishing does not occur. There is, therefore, a high degree of certainty that neither recruitment nor growth overfishing is occurring in this fishery.

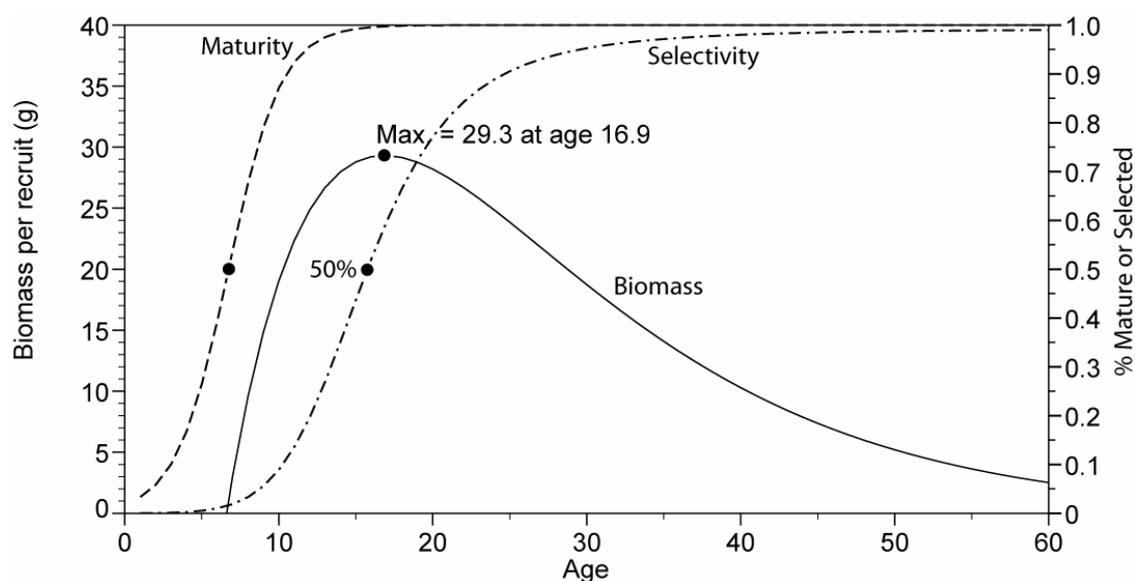


Figure 10: Estimated maturity and selectivity at age, and biomass per recruit with no fishing for the Banquereau Arctic surfclam population (Roddick *et al.* 2007).

As production equals recruitment plus growth minus mortality, an estimate of production for the Banquereau stocks can be made from the data available (Roddick *et al.* 2007). Thus production from the present age 20+ population is 19,640 t. Using the average recruitment at age 20 from the catch curve analysis, recruitment at age 20 contributes an average of 19,100 t per year, for a total production of 38,740 t. This is a very rough estimate of production, and does not include any density dependent feedback to growth or mortality, but it indicates that the 1987-2006 average landings of 11,200 t should not have had a large effect on the biomass and provides support for the contention that the fishery is still very close to the virgin biomass.

The Banquereau fishery operated with a precautionary TAC of 30,000 t from 1986 – 2003. This was then reduced to 24,000 t in 2004 and has remained at this level since then. The reduction to 24,000 t followed a scientific evaluation using two methods; the first was MSY-based and used the model $MSY = 0.5 MB_o$, (B_o = virgin biomass, M estimated by $M=3/T_{max}$, where T_{max} is the maximum age corresponding to the 95 percentile for the distribution of ages in the population). However, it was recognized that this approach made some assumptions, especially that of equilibrium conditions, that probably do not hold. Furthermore, the estimates were based on very limited data and, as a result, the estimate of MSY was probably not very accurate (Roddick *et al.* 2007). The second method, following the approach previously used by Amaratunga & Rowell (1986), assumed that biomass was a finite resource, and made no assumptions about natural mortality, growth or recruitment. The level of exploitation (TAC) that would enable the estimated 600,000 t resource to last 10, 20 or 25 years was simply calculated as 60,000 t, 30,000 t or 24,000 t (Roddick *et al.* 2007). The most precautionary level of exploitation was chosen as 25 years/24,000 t. While both these approaches have considerable limitations, the setting of the TAC at a level that approximated $F_{MSY/600,000t}$ was precautionary and it is apparent that the stock has been maintained at very high levels.

The appropriate level of the TAC was evaluated more fully as part of the 2007 Framework Assessment process. With no time series of catch per unit effort or biomass for this fishery, yield estimates have been based on empirical equations relating biomass, growth and mortality to production. Various commonly used harvesting levels were evaluated, notably the constant yield levels, Maximum Sustainable Yield (MSY), 2/3MSY, and Maximum Constant Yield¹ (MCY) and the constant fishing mortality level $F_{0.1}$. A constant fishing mortality approach to setting TAC levels was found to be preferable to a constant yield approach (DFO, 2007a) and it was recommended that the harvest rate should be applied to the survey biomass, B_{RV} and not to the virgin biomass, B_o . The constant fishing mortality is preferred as it allows adjustment of catch every time a survey is conducted and is a more responsive strategy to changes in the population.

The Offshore Clam Framework Assessment meeting (DFO 2007a; DFO 2007d) agreed that the fishing mortality, F, should be a function of the natural mortality, M. A range of fishing mortalities (F) and the resulting TAC's were calculated, including $F = M$ and $F = 0.5M$ (DFO 2007a), but a conservative TAC set at around $F \sim MCY$ (F of 0.33M), was suggested to be appropriate (DFO 2007c), based on a strategy of setting a yield that is low enough to be sustainable at all probable biomass levels. In the event, however, the fishery management decided to retain the more precautionary *status quo* TAC of 24,000 t. A TAC set at around $F \sim MCY$ was, however, subsequently incorporated into the IFMP (DFO, 2011c) as being the appropriate strategy for the offshore clam fisheries. This is based on harvesting a percentage (the exploitation rate) of the estimated harvestable biomass (i.e. of the biomass $> 75 \text{ g/m}^2$). The fishing mortality target at MCY is estimated to be one-third of natural

¹ Maximum Constant Yield (MCY) is defined as “the maximum constant catch that is estimated to be sustainable, with an acceptable level of risk, at all future levels of biomass” (Caddy & Mahon, 1995; Ministry of Fisheries, 2007). MCY is conceptually similar to MSY but considers random fluctuations in production, rather than assuming deterministic dynamics following a Schaefer surplus production model (Sissenwine 1978). MCY is clearly explained in relation to MSY and other biological reference points in Mace (1994) and Caddy and Mahon (1995), while methods for calculating are detailed in Francis (1992). MCY is not a new concept but with the well-known pitfalls of MSY as a safe target reference point (e.g. Larkin, 1977; Sissenwine, 1978) many fisheries in New Zealand (Annala, 1993) and elsewhere opt for MCY as a more conservative option (Deroba & Bence, 2008).

mortality. F_{MCY} is applied to the harvestable biomass, such that the TAC is set at 2.64% of the harvestable biomass (DFO 2011c). Risk of detrimental effects to the stock were expected to increase to unacceptable levels as the TAC approached $F = 0.5M$, unless survey frequency increased, while $F = M$ was not considered to be a sustainable management target (DFO 2007c). This method for setting the TAC was implemented for the first time in setting the TAC for the Grand Bank fishery in 2011 (DFO, 2011f) and may be used for the Banquereau fishery in 2012, where it would produce a TAC of 27,592 t (DFO, 2012). However, with the modified gear and assessment methods used for the 2010 survey, the fishable biomass estimate is highly uncertain, due to the large confidence interval around the survey dredge efficiency.

4.2.6 Biological reference points

Although there is no analytical assessment for this fishery and explicit biological reference points cannot be calculated, there is sufficient information and analysis available to determine that implicit reference points are used in the management of the fishery and that these comply with the MSC Policy Advisory 12 (2010b) on implicit reference points, which states “*target reference points should be such that the stock is maintained at a level consistent with B_{MSY} or above, or some measure or surrogate with similar intent or outcome.*” Since 2004, the implicit target reference point has been $B_{MSY/600,000t}$, which is more conservative than B_{MSY} or a fishing strategy that resulted in an $F \sim MCY$ (F of 0.33M). However, $F \sim MCY$ was subsequently accepted as appropriate for the offshore Arctic surf clam fisheries, based on the long-lived and slow growing nature of the species, and has been incorporated in the IFMP (DFO 2011c) and implemented for the first time in the Grand Bank fishery in 2011 (DFO, 2011f). As $M = 0.08$, this strategy is inherently conservative and precautionary and strives to maintain the biomass at the level of B_{MCY} , a higher level than that of the MSC default target of $0.4B_0$.

While $B_{MSY/600,000t}$ (or B_{MCY}) is an implicit target reference point, there is no limit reference point (LRP) or threshold that would trigger management action if the stocks become overfished. MSC guidance indicates that in the absence of explicit limit reference points, an appropriately conservative assumption is that LRP for stocks with average productivity is $\frac{1}{2} B_{MSY}$ or 20% of B_0 (MSC 2010a). However, the Banquereau Arctic surfclam clam stocks are very large and exploitation rates have been small, so the stock is far above such a suggested LRP. Applying estimated mortality, recruitment and growth rates to the survey population structure, suggests that production exceeds the level of removals by the fishery (DFO 2007a). In some 25 years of fishing, the stock has not been heavily impacted by the fishery and is probably still near the virgin biomass level. Serial depletion of grounds could become an issue but there is no indication of it at present. With the current restriction on fishing effort (only two boats fishing), any decline in biomass will be slow to occur and would be detected through the survey programme, and action taken, long before it affected reproductive output. Therefore, while a limit reference point would be desirable, it is not currently a priority for this fishery. In any case, the operational costs of exploiting the offshore Arctic surfclam stocks are such that fishing would be limited for economic reasons long before there is an appreciable risk that recruitment is impaired (DFO 2007a).

4.2.7 Fishing mortality

Estimates of fishing mortality (F) have been made for the Banquereau fishery based on the relationship:

$$\text{Fishing mortality (F)} = \text{Total mortality (Z)} - \text{Natural mortality (M)}$$

Total mortality (Z) was estimated using two methods of Chapman & Robson (1960), a catch curve method and another that uses the mean age of animals above the recruitment age. These gave estimates of $Z = 0.11$ (Figure 11) and $Z = 0.10$ respectively which, with the accepted value for natural mortality of $M = 0.08$ (Amaratunga & Rowell 1986), gives estimates of fishing mortality of $F = 0.03$ and $F = 0.02$ respectively. Based on the survey biomass estimate, the present TAC of 24,000 t would produce an estimated fishing mortality rate of $F = 0.016$ (Roddick *et al.* 2007). However, over the last 10 years the average annual catch has been 17,517 t, which gives an F of 0.012. These figures suggest

that the low values estimated for F are reasonable, confirming that Banquereau Bank has only been subjected to a low level of exploitation.

4.2.8 Recruitment

Recruitment of Arctic surfclams on Banquereau appears to have been fairly consistent, with no missing year-classes, but with some evidence of stronger pulses of recruitment about 10 years apart (Figure 11). However, the age distribution in Figure 11 is for the population over the whole area of the survey and it is likely that considerably greater variation in recruitment between years would occur at smaller spatial scales. For example, there appears to be a difference between the east and west portions of Banquereau, which it has been suggested may arise from increased retention of larvae through oceanographic processes in the western end (DFO 2007d).

An approximate estimate of recruitment has been obtained by taking the distribution of numbers at age and calculating the numbers at recruitment age using the estimated mortality rate:

$$N_{RA} = \frac{N_A}{e^{-Z(A-RA)}}$$

where N_{RA} are the number at recruitment age RA , N_A are the numbers at age A and Z is the total mortality rate. This assumes constant mortality, but produces an estimate of recruitment for the time period corresponding to the age of recruitment to the maximum age observed in the age frequency distribution (Figure 11, lower panel). The solution of the catch curve equation for age 20 gives the number of Arctic surfclams caught in the survey tows, which expanded to the area of commercial density over the whole survey area ($>100 \text{ g/m}^2$) gives an estimate of 185,616,162 clams recruiting at age 20 per year. This analysis also provides an indication of recruitment variability through time. For recruitment at age 20 in 2004, all the Arctic surfclams in this analysis were spawned from 1944 to 1984, before the start of the fishery in 1986. Over this period recruitment has fluctuated from year to year, with good years separated by a variable number of years of below average recruitment. The history of the fishery is still too short and population levels have been too stable to estimate feedback effects such as the occurrence of a stock-recruit relationship. However, as a high fecundity, broadcast spawner, with external fertilization, a close stock-recruitment relationship is unlikely to occur except at very low stock densities.

In most bivalve fisheries, understanding recruitment processes is one of the most important, and challenging, aspects of understanding and modeling the dynamics of a fishery. For the Banquereau Arctic surfclam fishery it is a major source of uncertainty, with many questions yet to be answered. For example, are there any spatial or temporal patterns of settlement or recruitment over the bank? Do density-dependent mechanisms operate and at what spatial scale? For a long-lived, slow-growing, sessile bivalve like Arctic surfclam, these are particularly important questions, for it is necessary for managers to know how long it will take for heavily fished areas to repopulate before they can be fished again.

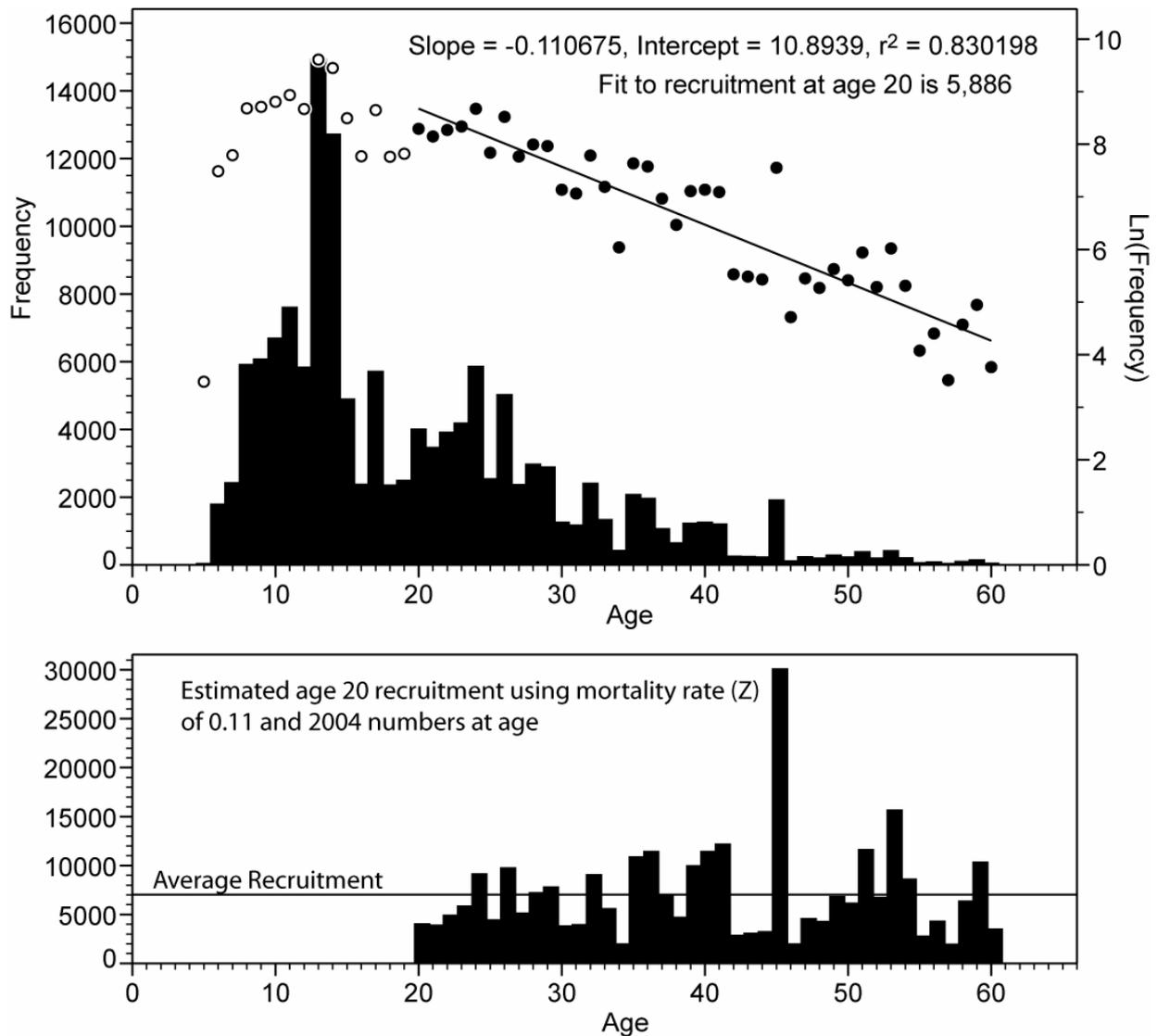


Figure 11: Age distribution for Banquereau survey numbers at age. Catch curve estimates of total mortality (Z) are done using log transformed numbers at age (top linear regression, filled circles are points used for the regression). Estimated recruitment at age 20 using the numbers at age and estimated Z from catch curve are shown in lower panel (Roddick *et al.* 2007).

4.2.9 Natural Mortality

Natural mortality (M) is one of the most difficult parameters to estimate in fishery research and, as a result, it has often been calculated from empirical relationships with other parameters, such as the well-known constant relationship between M and the growth constant k (Charnov 1993). For the Arctic surfclam, M was calculated from the simple relationship $Z = 3/T_{\max}$, where T_{\max} is the lifespan, which was taken as the cut off for the upper 5% of the recruited age distribution (Amaratunga Rowell 1986). As the estimated lifespan for Banquereau Arctic surfclam was 40 years, $3/40$ gave an estimate of $Z = 0.075$ and, since there was no fishery at the time, Z was considered to be equal to the natural mortality rate (M). This value has subsequently been accepted as the appropriate M to use in the assessment of stocks on both Banquereau and Grand Bank, and various analyses have suggested that it is reasonable (DFO 2010, Roddick *et al.* 2007). Natural mortality (M) estimates for Alaskan populations, however, have been much higher at $M = 0.13 - 0.25$, which is to be expected given the shorter lifespan (Hughes & Bourne 1981).

4.2.10 Incidental mortality

In a study of the incidental mortality of small clams that pass through the dredge, conducted on Banquereau, it was estimated that 15% of the clams passing through the dredge suffered lethal damage (DFO 2007a). Yield per recruit analysis with and without a 15% incidental mortality indicated that incidental mortality greatly reduced both the yield at high fishing mortality rates and F_{MAX} . Spawning stock biomass (SSB) remained relatively high at fishing mortalities around the $F_{0.1}$ level (Figure 12). When incidental mortality was included in the model, the $F_{0.1}$ estimate was within the upper range of fishing mortalities recommended by the framework (DFO 2007a).

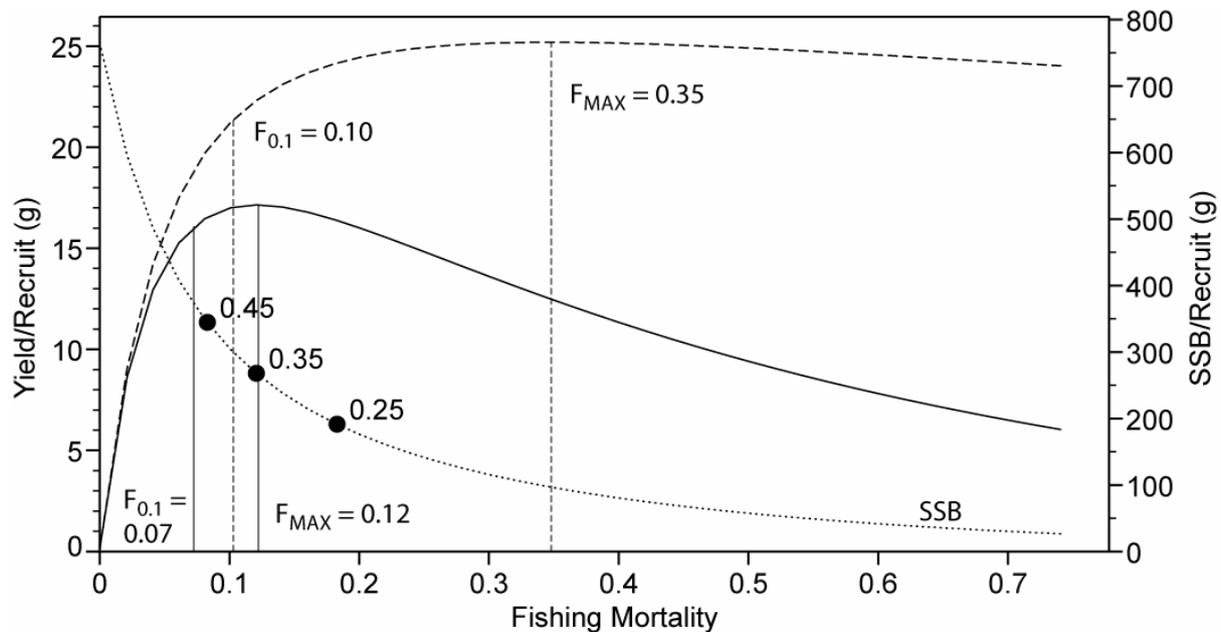


Figure 12: Yield and spawning stock biomass (SSB) per recruit for Banquereau Arctic surfclams. The top yield per recruit curve (dashed) is with no incidental mortality. The lower curve is with a 15% mortality of small clams that pass through the dredge (DFO 2007).

4.2.11 Stock status

Based on the last two assessments, the stock status of the Arctic surfclam stock on Banquereau Bank appears to be very good. The 2004 research vessel survey provided an estimate of the biomass of $1,462,097 \pm 24,944$ t of Arctic surfclams, which is much higher than previous surveys in 1982/3 and 1996/7 but the surveys covered different areas of the bank, and there were differences in the boat and gear, so the results are not directly comparable.

The 1982/3, 1996/7 and 2004 surveys were considered to provide good estimates of fishable biomass (DFO 2010, Roddick *et al.* 2007) but these biomass values are likely to be underestimates since they conservatively assumed a dredge efficiency of 100%. The 2010 survey provided a size and gear efficiency corrected estimate of fishable biomass but was less reliable because of the large confidence intervals around the dredge efficiency estimates (DFO, 2012). Applying estimated mortality, recruitment and growth rates to the survey population structure suggests that production exceeds the level of removals by the fishery (Roddick *et al.* 2007) so the stock has not been heavily impacted by 25 years fishing and is probably still near the virgin biomass level. The areas of high biomass in the 2004 and 2010 surveys generally coincided with those in previous surveys and also corresponded to the areas where the fishery has concentrated its effort early in the fishery. This suggests that serial depletion, a concern with fisheries for sedentary species, is not occurring.

The size at 50% selectivity in this fishery is larger than the size at maturity and near the size at

maximum cohort biomass so recruitment and growth overfishing are not likely to occur with the present gear selectivity pattern. Recruitment on Banquereau is fairly consistent, with no missed year-classes, but with some evidence of stronger pulses of recruitment about 10 years apart.

With only two vessels currently fishing both the Banquereau and Grand Bank grounds, fishing effort and the exploitation rate are low. The 2007 Framework Assessment recommended that the fishery should be managed by a constant F approach, with a fishing mortality (F) target at MCY estimated to be one-third of natural mortality (DFO 2007a; DFO 2007c). However, the *status quo* TAC of 24,000 t was maintained because of concerns to maintain a precautionary strategy while implementing a constant fishing mortality approach with the current low frequency of surveys.

The management strategy for offshore clams, set out in the latest IFMP (DFO 2011), states that the TAC is primarily based on harvesting a percentage (the exploitation rate) of an estimate of the harvestable biomass (the fishable biomass $> 75\text{g/m}^2$) which is intended to optimize yield and not expose the resource to risk of over-exploitation. Thus, a fishing mortality target (F) at Maximum Constant yield (MCY) is estimated to be one-third of natural mortality (M) and F_{MCY} is applied to the harvestable biomass, such that the TAC is set at 2.64% of the harvestable biomass. This mechanism was used for the first time to set the TAC for the Grand Bank Arctic surfclam fishery in 2011 (DFO 2010) and may be used for the Banquereau fishery in 2012, when it would provide a TAC of 27,592 t (SAR, 2011/068) but this has not been confirmed. The estimated fishing mortality rate at maximum conservation yield (F_{MCY}) would be $F = 0.026$, but a *status quo* TAC of 24,000 t would give a more precautionary exploitation rate of $F = 0.021$. While the F level maintained in this fishery since 2004 appears to be conservative, the infrequent survey schedule means that the allowable catch must be set low enough to ensure that the stock will not be overfished in the event of a period of poor recruitment or other declines in biomass between assessment updates.

4.3 Management advice

The management objectives and methods for the Banquereau Bank offshore Arctic surfclam fishery can be found in the Offshore Clams Integrated Fishery Management Plan (IFMP), Maritimes and Newfoundland regions (DFO 2011c).

The long-term objectives set out in the IFMP are to:

- Increase certainty that harvesting occurs at an optimum sustainable level to ensure the long-term viability of the resource,
- Enhance industry's level of participation in the management of this resource to benefit Canadians,
- Maintain the long-term viability of the industry, and
- Assess, evaluate and minimize any adverse environmental effects of the fishing methods on the habitat.

With regard to conservation and sustainability the primary objective of the plan is stated to be “to ensure that a biologically and economically sustainable clam fishery continues through the auspices of scientifically-based management plans involving collaborative enforcement, monitoring and regulatory measures. A further objective includes the continued cooperation between the licence holders and the Department in establishing ongoing management measures that will minimize impacts of harvesting on the habitat”

The main management tools for the fishery set out in the IFMP are limited entry licences, a TAC (total allowable catch) divided into EA's (enterprise allocations), 100% dockside monitoring, mandatory logbooks and VMS (vessel monitoring system).

When the fishery started, a precautionary TAC of 30,000 t was maintained for a number of years until it was revised down to 24,000 t in 2004, following analysis of the 1996/7 biomass survey data. The TAC of 24,000t is precautionary, and the TAC has remained at this level ever since. However, a TAC

set at $F \sim MCY$ (F of 0.33M), was considered to be appropriate for the offshore Arctic surfclam fisheries (DFO 2007c) and was subsequently incorporated into the IFMP (DFO 2011c). This was implemented for the first time in the Grand Bank fishery in 2011 (DFO 2011f) and is likely to be introduced into the Banquereau fishery in 2012. While $B_{MSY/600,000t}$ (or B_{MCY}) is an implicit target reference point, there is no limit reference point (LRP) or threshold that would trigger management action if the stocks become overfished, and no explicit description of how management would respond if the stocks were to sharply decline. However, with only one company exploiting the fishery, with only two licenced vessels fishing very large areas of seabed, good stocks of Arctic surfclams and regular recruitment, this is not a fishery under pressure. Exploitation rates are very low, annual production exceeds removals by the fishery and stocks have remained at or around the virgin biomass levels for some 25 years. Thus, while a LRP would be desirable for this fishery, should effort be allowed to increase or stocks decline suddenly, it is not currently a priority for managers.

The scientific advisors for this fishery are well aware that for a long-lived, slow-growing, late recruiting sessile species, managed under a constant fishing mortality approach, it is necessary to set a very precautionary target fishing mortality level (DFO 2007a; DFO 2010). The Arctic surfclam vessels fishing Banquereau operate by regularly changing fishing areas, moving to new grounds when catches decline. Although it is not considered that overfishing is occurring at this time, the pattern of constantly moving to new grounds, while using highly efficient gear, means that sequential overfishing is a potential danger. This would not show up in trends of CPUE until the vessels started running out of grounds but it would be detected in the biomass surveys. However, these surveys take place infrequently, which is an additional reason for maintaining very conservative levels of target fishing mortality and TAC.

In the continuous, if periodic, scientific monitoring of this fishery, the concern with environmental effects, close involvement of the industry in both the surveys and the management, and wide level of consultation and participation in the RAP process, the fishery management is making notable efforts to meet its objectives stated in the IFMP. Provided fishing effort remains low, the rather low frequency biomass surveys and relatively simple system for assessing and managing these stocks should be adequate to ensure the long-term viability of this fishery.

It is noted that, as of February 2012, the latest (2011) version of the IFMP is not available on the DFO website. Although the IFMP is available upon request, it would be helpful if it was also made available on-line.

5 FISHERY MANAGEMENT FRAMEWORK

5.1 Fishing rights, licensing etc

Fishing of marine species in Canada falls under the jurisdiction of the federal Minister of Fisheries and Oceans (DFO) pursuant to the *Fisheries Act 1985*. The *Fishery (General) Regulations, 1993*, made under the authority of the Act provide a framework for the issue of leases and licences to fish.

In addition to the legislative framework, there are a number of policy directives, the major one of which is the 'Policy Framework for the Management of Fisheries on Canada's Atlantic Coast' (DFO 2004). It contains four objectives:

1. Conservation and sustainable use: Conservation of marine resources and habitat, and rebuilding of resources and restoration of habitat where necessary, will remain the highest priority for the management of all fisheries.
2. Self-reliance: Self-reliant fisheries and continued collaboration with the provinces and Nunavut, communities, aboriginal groups, industry and others will contribute to the well-being of coastal communities.
3. A stable and transparent access and allocation approach: The access and allocation of fisheries resources will be more stable and predictable, and decisions will be made and conflicts resolved through a more fair, transparent and rules-based processes.
4. Shared stewardship: Participants will be effectively involved in fisheries management decision-making processes at appropriate levels; they will contribute specialized knowledge and experience, and share in accountability for outcomes.

Other policy directives include the "Sustainable Fisheries Framework" that focuses on the incorporation of the precautionary and ecosystem approaches to fishery management (DFO 2009c); the "Policy to Manage the Impacts of Fishing on Sensitive Benthic Areas" dealing with the mitigation of the impacts of fishing on sensitive benthic areas (DFO 2009d); the Emerging Species Policy that sets out the requirements and procedures for new fisheries (DFO 2008b), and the Aboriginal Fisheries Strategy (DFO 1992).

Clearwater Seafoods Limited Partnership (CSLP) is the sole participant in this fishery. Three licences – one to CSLP (Nova Scotia) that authorizes two vessels to fish, one to CSLP (Newfoundland) and one to Arctic Surf Co Inc. (Newfoundland), a wholly owned subsidiary of CSLP - are included in the Unit of Certification. Two purpose-built factory-freezer clam vessels are employed in the fishery and they operate year round. All product is landed in Argentia, NL for further processing at Grand Bank, NL.

5.2 Fishing locations

There are two major fishing areas for Arctic surfclam covered within the offshore clam fishing licence – Banquereau off the coast of Nova Scotia and the Grand Bank off the island of Newfoundland and Labrador (Figure 1); this assessment is of the Banquereau fishery.

5.3 Administrative Arrangements and Boundaries

Under the *Fisheries Act, 1985*, the Minister of DFO has the ultimate responsibility for the fishery and his/her authority is delegated to officials through the organizational structure of the department. The unit of certification (Banquereau Bank) falls within the Maritimes Region of DFO. The management of both the Banquereau and Grand Bank fishing areas is conducted by the Resource Management Branch of DFO in Halifax, Nova Scotia. Within the Canadian management system, Integrated Fishery Management Plans (IFMPs) are developed that outline the fisheries objectives and management measures by stock and area. The Offshore Clams IFMP is a comprehensive document that was updated in May 2011 (DFO 2011c). The harvest is controlled through the establishment of annual Total Allowable Catches (TAC) in each area. The fishery is managed through an Enterprise

Allocation Program whereby each of the four licences receives an equal allocation in both fishing areas.

The Offshore Clam Advisory Committee (OCAC) (see section 6.7 below) is the main consultative and management body for the fishery. It is composed of major stakeholders in the fishery. The chair of the committee is a DFO official and is rotated between the Maritimes and Newfoundland and Labrador regions. The final decision-making authority for the fishery is the Regional Director General (RGD) of the Maritimes Region of DFO.

5.4 Legislation and Regulation

The legislative authority for the management of seacoast and inland fisheries in Canada falls under the exclusive jurisdiction of the Parliament of Canada. There are several pieces of legislation that apply to fishing, the major one being the *Fisheries Act, 1985*. That *Act* grants wide discretionary authority to the Minister of Fisheries and Oceans and provides for the enactment of regulations respecting the management of the fishery. *The Atlantic Fishery Regulations, 1985* and the *Fishery (General) Regulations* are the main regulatory instruments governing the fishery. These and other legislative instruments are outlined in Table 6, below.

Table 6: Principle Acts and policy documents

Principal Acts and Policy Documents	Description
<i>The Fisheries Act, 1985</i>	Provides absolute discretion to the Minister for the management of fisheries and for the establishment of fishing licences, regulations, reporting requirements, powers of fishery officers, protection of fish habitat and pollution prevention.
<i>The Atlantic Fishery Regulations, 1985</i>	Prescribes conditions for the operation of the fishery including seasons, closures, management and conservation measures, etc. Variation Orders are used to alter conditions and to shorten or lengthen the fishing season as appropriate.
<i>The Fishery (General) Regulations 1993</i>	Provides for the issue of licences and the authority to specify conditions in a fishing licence, e.g. allocations, vessel monitoring systems, hail-in/hail-out requirement, observer coverage, dockside monitoring, etc.
<i>The Coastal Fisheries Protection Act, 1985</i>	Prescribes conditions under which foreign vessels are permitted to fish in Canadian waters.
<i>The Species at Risk Act 2002</i>	Authorizes actions aimed at managing species of special concern, preventing the extirpation or extinction of endangered marine species, or promoting their recovery.
<i>The Oceans Act 1996</i>	Prescribes the Canadian oceans management strategy, including sustainable development, the precautionary approach, and the implementation of integrated management of marine activities.
<i>The Fish Inspection Act 1985</i>	Governs fish processing operations on shore and aboard vessels in Canadian waters.

The regulations noted above create the legal framework for the management, licensing and registration of participants of fisheries in Canada and more specifically for harvesters participating in the offshore clam fishery. They also provide a ticketing and court sanction system with fines ranging from low to as high as hundreds of thousands of dollars and even jail time in extreme cases. The court also has the discretion to forfeit catch and equipment upon conviction.

5.5 Harvest controls

Annual catch limits (TAC) based on formal scientific assessments are the major harvest control

measure used for the offshore clam fishery. The TAC in each of the areas is based on harvesting a percentage of an estimate of the harvestable biomass and is intended to optimize yield and not expose the resource to risk of over-exploitation. TACs of 24,000mt for Banquereau and 20,000 for Grand Bank remained unchanged for the period 1998-2010. In 2011, the Grand Bank TAC was revised to 14,756 following detailed scientific advice from the 2010 fishery assessment. The TAC for each area is divided among the four licences in equal portions called Enterprise Allocations.

5.6 Monitoring, Control and Surveillance

The DFO is the responsible enforcement agency for fishing in Canadian waters. It has a staff of land-based and seagoing Fishery Officers and a complete system of monitoring, control and surveillance (MCS) for the offshore clam fishery, including:

- At-sea surveillance by patrol vessels and fixed-wing aircraft
- Limited on-board observer coverage with protocols to monitor catch, species, etc.
- 100% dockside monitoring of landings
- Submission of vessel fishing log books
- Catch and Effort database to track catch against allocations
- Electronic vessel monitoring systems (VMS) on each vessel
- A ticketing system for minor offences and a court-based process for serious offences which can result in fines up to \$500,000, jail terms and forfeiture of catch and gear
- Detailed conditions of licence for each participant in the fishery

DFO advised that the offshore clam fishery has not had any serious compliance issues and that there is no evidence of systematic non-compliance (DFO, pers. comm.).

5.7 Consultation and Dispute Resolution

The major consultative mechanism in the fishery is the Offshore Clam Advisory Committee (OCAC), the Terms of Reference of which are outlined in Appendix II of the IFMP (DFO 2011c). The committee is composed of representatives of licence holders, other fishermen and fishermen's associations/unions, processors, First Nations representatives (standing invitation), the Federation of Newfoundland Indians, and provincial government representatives from Newfoundland and Labrador, and Nova Scotia and other stakeholders. Meetings are open to the public, while fishery managers, scientists and enforcement staff from DFO attend the committee and provide advice and assistance.

The purpose of the committee is to provide input and advice to the DFO on the conservation, protection and management of the offshore clam resource. The committee also serves as an open public consultation forum on all issues affecting the offshore clam fishery on Canada's Atlantic coast. Information including scientific and management advice is presented at committee meetings and recommendations on harvest levels and management measures are forwarded to the regulator for final decisions on management plans.

A second committee called the Offshore Clam Management Board (OCMB) is charged with the responsibility of overseeing and directing the implementation of the management plan. This committee is composed of two representatives each of the two licence holding companies (both wholly owned by the client, CSLP) and four representatives of DFO, two each from science and management. The OCMB is co-chaired by an industry member and DFO staff person. The Board meets annually or as required. Most disputes are resolved using the representational framework in the OCAC/OCMB forum. Regional managers of DFO have a particular role to play in brokering solutions on policy related issues, with most unresolved disputes being referred to the RDG or the minister for decision.

6 ECOSYSTEM CHARACTERISTICS

6.1 Ecosystem characteristics

Banquereau is an offshore bank that forms the easternmost part of the Scotian Shelf. In total, the Scotian Shelf comprises an area of approximately 120,000 square km (Stanley *et al.* 1972), of which Banquereau makes up approximately 10,900 square km (DFO 2007a). The bank is centred approximately 200 km to the south-east of Cape Breton Island, or 400 km roughly due east of Halifax. At its closest point, Banquereau lies 110 km off the Nova Scotia coast. There is a shoal area of shallow water less than 40 m deep on the eastern half of the bank, but it is otherwise relatively flat-topped, with an average water depth of less than 80 m. The limits of the bank are defined by deeper water with complex post-glacial bottom topography to the north, the shelf break to the south and the Laurentian Channel to the east. The Gully, the largest submarine canyon in eastern North America, lies at the south-west corner (Figure 13).

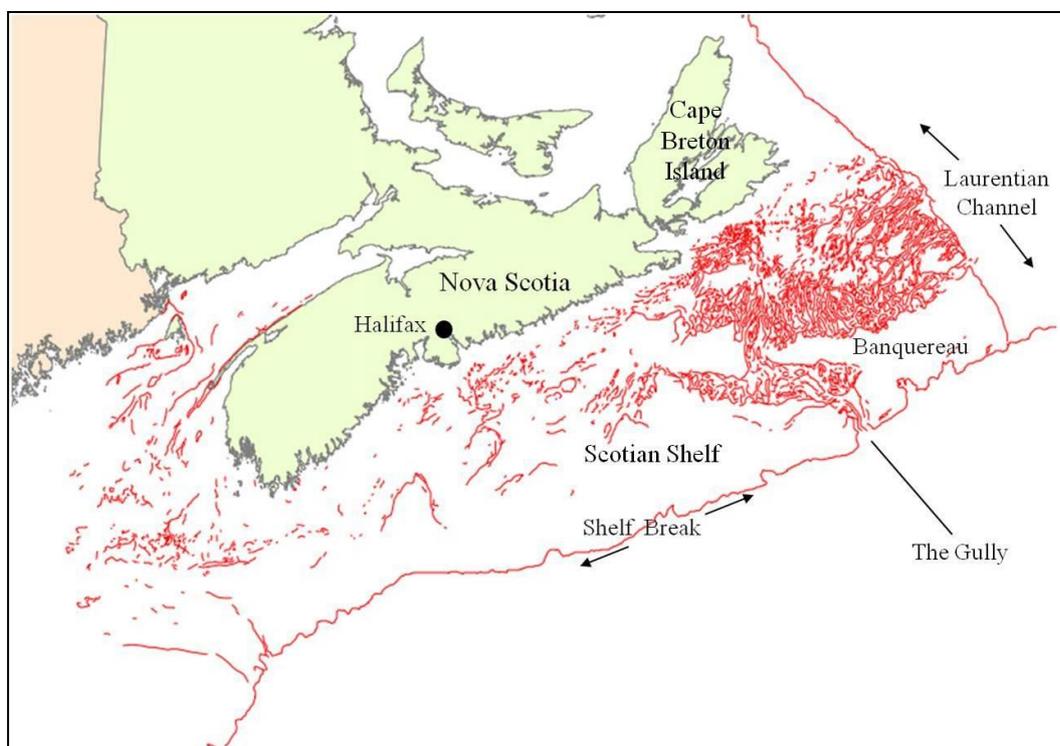


Figure 13: Map of seafloor complexity on the Scotian Shelf, showing seafloor slopes greater than 0.5 degree, calculated from 3x3 neighbourhoods using 500 m cell grid. Steep slopes in the near shore zone and on the shelf slope are not shown (adapted from Kostylev 2004).

Banquereau is very exposed to severe weather, and the maximum significant wave height is estimated to exceed 12 m (Kostylev 2004). Figure 14, below, is thought likely to over-estimate wave height on the tops of banks, although the data still suggest that the bottom habitats of Banquereau are impacted by major storms; benthic disturbance effects from fully developed wind waves of 14 m height can extend to a water depth of approximately 100 m (Kostylev 2004).

The current regime on Banquereau is moderate, with peak water velocities of 15-25 cm per over much of the bank (Figure 15). The wave and tidal disturbance suggest that the surface sediments are likely to be mobilised at frequent intervals, and this is supported by observations of well or very well sorted sand across much of the bank (Stanley *et al.* 1972 and

Figure 16).

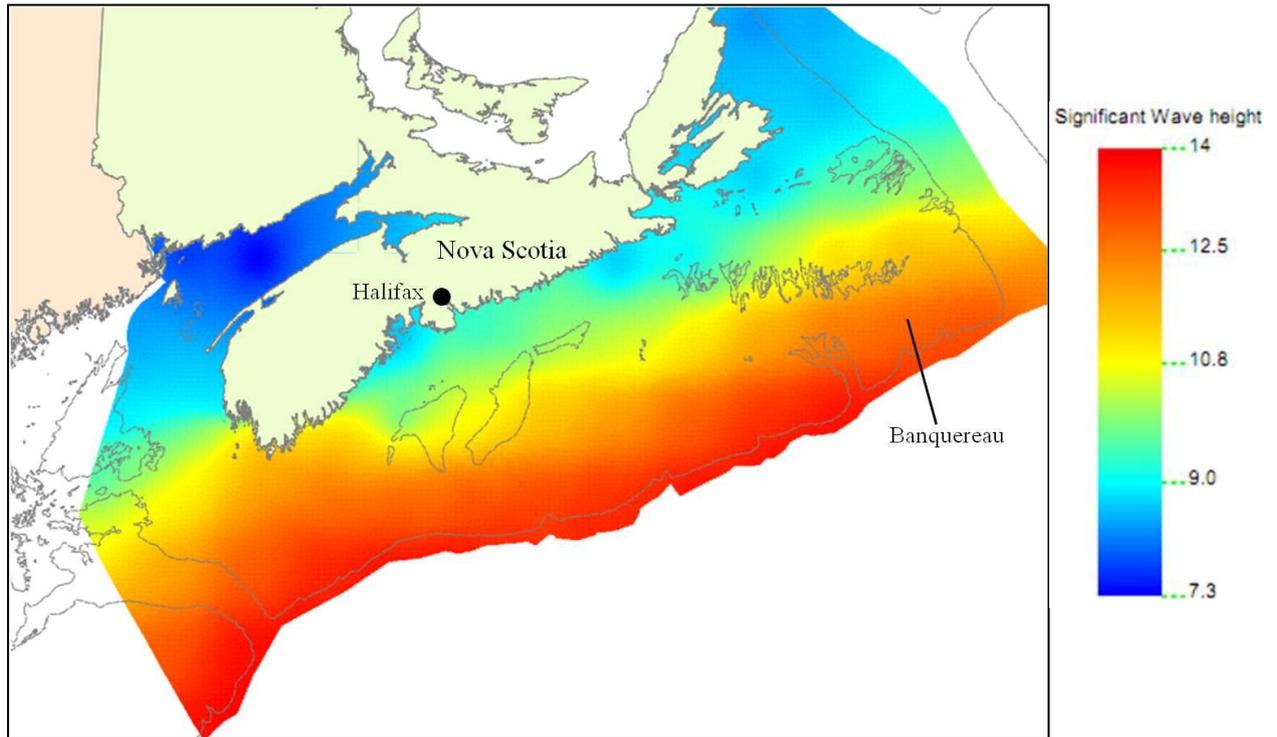


Figure 14: Maximum significant wave height (m) occurring on the Scotian Shelf 1958-1999 (Kostylev 2004).

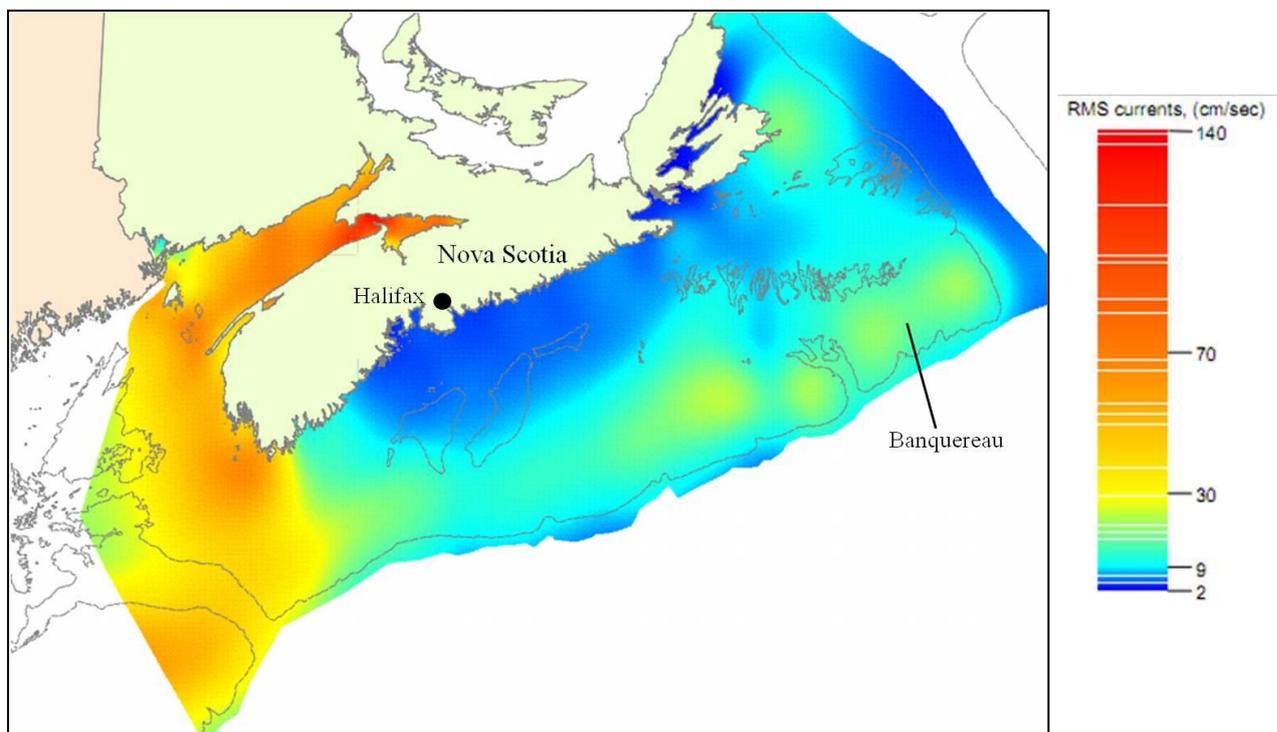


Figure 15: Bottom tidal current velocities. Red- strong tidal currents, blue- weak tidal currents (Kostylev 2004).

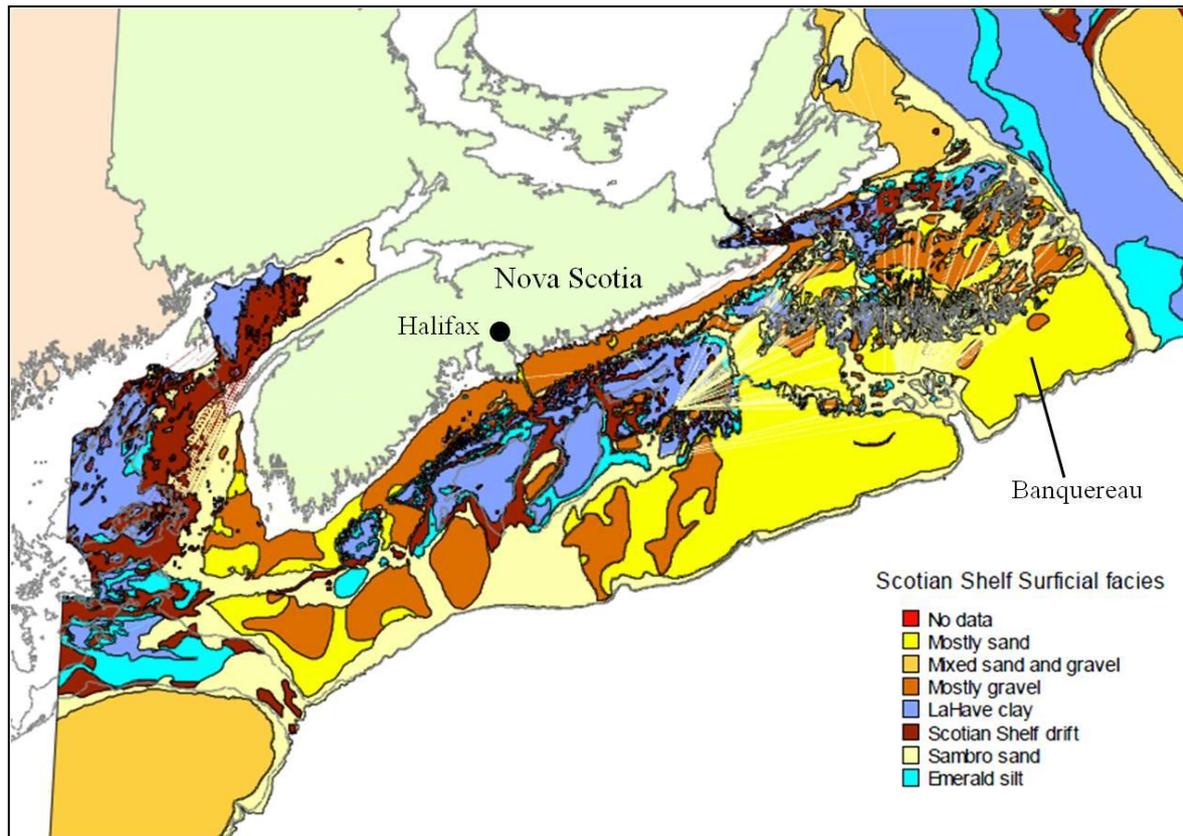


Figure 16: Surficial sedimentary facies on the Scotian Shelf (NR Canada official publication, adapted from Kostylev 2004).

6.2 By-catch and discarding

The Arctic surfclam fishery on Banquereau generally takes relatively small quantities of bycatch of other species. These may be divided into commercially valuable species that are retained, and other species that are discarded. In the former group, ocean quahog (*Arctica islandica*) are listed as a permitted species under CSLP's offshore clam licence and may therefore be retained with Arctic surfclams. Northern propellerclam (*Cyrtodaria siliqua*) and Greenland cockle (*Serripes groenlandicus*) may also be retained as co-occurring molluscan shellfish species (DFO 2011a).

The Greenland cockle and ocean quahog bycatch is small relative to the catch of Arctic surfclam, comprising 0.14% and 0.06% respectively of the target species catch in 2005, while the northern propellerclam catch was estimated to be 3.98% in the same year (Table 7). There is no reason to think that these proportions would have increased significantly since that time, and none of the species are considered to be vulnerable; as such, none of these species are considered to be main retained species in the Arctic surfclam fishery as defined by the MSC as comprising more than 5% of the total catch.

An ocean quahog stock of approximately 1,300,000 tonnes exists on Sable Bank, but the stock is much smaller on Banquereau, where Arctic surfclam dominate and the environmental conditions appear to be less suitable for ocean quahog (DFO, pers. comm.). Greenland cockle has a circum-polar distribution in the northern hemisphere, and northern propellerclam is also widely distributed in the North Atlantic from Cape Cod to Norway. It is understood that formal assessments of either species have not been conducted in Canadian waters. Greenland cockle are, though, estimated to mature at a minimum shell length and age of 28 mm and 2.8 years for males, and 37 mm and 3.7 years for females (Kilada *et al.* 2007) while northern propellerclam are estimated to mature at 4.7 years of age or 28.6 mm shell length (Kilada *et al.* 2009), suggesting that individuals of both species mature well

below the size at which they are likely to be selected for in the Arctic surfclam fishery, as the dredges employ a bar spacing of 28 mm, and the selectivity is related to shell height rather than shell length. Furthermore, there is no directed fishery for either species on Banquereau, and while northern propellerclam is a long-lived species, analysis of commercial catches from the bank showed that the population is dominated by old animals to ages exceeding 100 years (Kilada *et al.* 2009). These data suggest that neither species is at risk of serious harm from the Arctic surfclam fishery.

Table 7: Catch composition from sampling of the unsorted catch from the 2005 Banquereau offshore clam fishery (DFO 2007a).

Common Name	Scientific Name	Weight (kg)	%	Cumm %
Arctic surfclam	<i>Mactromeris polynyma</i>	673.00	80.04	80.04
Shell	Shell	47.34	5.63	85.67
Sand dollar	Order Clypeasteriodes	45.80	5.45	91.12
Northern propellerclam	<i>Cyrtodaria siliqua</i>	33.50	3.98	95.10
Stones and rocks	Stones and rocks	24.05	2.86	97.97
Sea cucumbers	Holothuroidea	4.05	0.48	98.45
Sea mouse	<i>Aphrodita hastata</i>	2.79	0.33	98.78
Sea urchins	<i>Strongylocentrotus sp.</i>	2.72	0.32	99.10
Crab	Crab	1.63	0.19	99.30
Whelks	<i>Buccinum so.</i>	1.56	0.19	99.48
Greenland cockle	<i>Serripes groenlandicus</i>	1.20	0.14	99.62
New England neptune	<i>Neptunea decemcostata</i>	0.97	0.12	99.74
Starfish	<i>Asteroidea sp.</i>	0.66	0.08	99.82
Spindle shell	<i>Colus sp.</i>	0.53	0.06	99.88
Seasnail	<i>Liparis sp.</i>	0.50	0.06	99.94
Ocean quahog	<i>Arctica islandica</i>	0.50	0.06	100

Of the discarded bycatch species, only the sand dollar, *Echinarachnius parma*, comprised more than 5% of the catch, as reported from on-board sampling data (Table 7) or from the 2004 Banquereau survey data (Table 8). As such, and for the purposes of this assessment, *E. parma* is considered to be the only main bycatch species. Although comparatively large amounts may be taken in the fishery, *E. parma* is a very widespread species, with a circum-polar distribution in the northern hemisphere (Mooi and Telford 1982). There is no indication that the population on Banquereau has been impacted significantly over time by the Arctic surfclam fishery (DFO, pers. comm). Other animals may be caught and discarded in relatively small amounts, including a variety of echinoderm and crustacean species, as well as sand lance (*Ammodytes sp.*) and seasnail (*Liparis sp.*). Although there is some grouping of species in Table 7, there is no reason to suspect that any unusual or rare species are included. The survey data in Table 8 represent a more complete picture of the species that may be present as bycatch in the fishery. However, it is also likely that some species are over-represented (Roddick *et al.* 2007), as the survey extends across the complete bank and covers a greater range of possible Arctic surfclam habitat than would normally be targeted by the commercial fishery. Additionally, the survey dredge is understood to use 23 mm bar spacing rather than the 28 mm used in the commercial dredges (DFO, pers. comm.), which would result in a greater number of small animals being retained.

In addition to the bar spacing of 28 mm, which will allow many small animals to pass through the dredge, part of the reason for the low bycatch of non-bivalve species in the commercial fishery is likely to be that there is a gap between the cutting bar carrying the hydraulic jets and the top of the dredge cage, such that fish or other mobile animals may escape the dredges rather than being retained (Figure 2). Although a similar gap is also present on the bottom side of the dredge, it is understood that this is covered by a selector grid when fishing on clean ground to maximise the Arctic surfclam catch. If rocks or other debris are caught in significant quantities, the grid may be removed in order to

improve the efficiency of the dredges (CSLP, pers. comm.). It is noted that Roddick *et al.* (2007) reported the presence of cobble/rock areas that were unsuitable for dredging during a stock survey on Banquereau, but these areas were almost exclusively on the periphery of the bank in deeper water that is marginal habitat for Arctic surfclam.

Table 8: Species composition for tows from the 2004 Banquereau offshore clam survey (Roddick *et al.* 2007).

Common name	Scientific name	Weight (kg)	%	Cumulative %
Arctic surfclam	<i>Mactromeris polynyma</i>	17762.28	34.08	34.08
Rocks and stones	Rocks and stones	10128.90	19.44	53.52
Northern propeller clam	<i>Cyrtodaria siliqua</i>	7416.98	14.23	67.75
Sand dollar	<i>Echinarachnius parma</i>	6524.56	12.52	80.27
Shell	Shell	5742.28	11.02	91.29
Shell and sand	Shell and sand	2037.17	3.91	95.20
Greenland cockle	<i>Serripes groenlandicus</i>	700.39	1.34	96.54
Iceland scallop	<i>Chlamys islandica</i>	551.07	1.06	97.60
Sea cucumber	<i>Cucumaria frondosa</i>	491.08	0.94	98.54
Ocean quahog	<i>Arctica islandica</i>	221.90	0.43	98.97
Sand and gravel	Sand and gravel	186.66	0.36	99.33
Sea mouse	<i>Aphrodita hastata</i>	81.95	0.16	99.48
Whelk - Buccinum sp.	<i>Buccinum sp.</i>	40.56	0.08	99.56
Sea urchin	<i>Strongylocentrotus droebachiensis</i>	37.38	0.07	99.63
Snow crab	<i>Chionoecetes opilio</i>	31.46	0.06	99.69
Smooth brittle star	<i>Ophiura sarsi</i>	20.97	0.04	99.73
Sea scallop	<i>Placopecten magellanicus</i>	20.91	0.04	99.77
Hermit crab	<i>Pagurus sp.</i>	19.07	0.04	99.81
Thorny skate	<i>Amblyraja radiata</i>	13.80	0.03	99.84
Rattail sea cucumber	<i>Caudina arenata</i>	11.14	0.02	99.86
Rough/Spiny sunstar	<i>Crossaster papposus</i>	8.69	0.02	99.87
American sand lance	<i>Ammodytes americanus</i>	7.67	0.02	99.89
Slender armed sea star	<i>Leptasterias tenera</i>	7.32	0.01	99.90
Sea anemone	<i>Anthozoa sp.</i>	6.28	0.01	99.92
Rough razor clam	<i>Siliqua squama</i>	5.61	0.01	99.93
Smooth tube worm	<i>Chone infundibuliformis</i>	5.39	0.01	99.94
Purple sunstar	<i>Solaster endeca</i>	4.22	0.01	99.94
Arctic lyre crab	<i>Hyas coarctatus</i>	4.05	0.01	99.95
Yellowtail flounder	<i>Limanda ferruginea</i>	3.65	0.01	99.96
Wrinkle whelk	<i>Neptunea lyrata decemcostata</i>	3.60	0.01	99.97
Truncate softshell	<i>Mya truncata</i>	3.14	0.01	99.97
Whelk - Colus sp.	<i>Colus sp.</i>	2.66	0.01	99.98
Seaweed	Seaweed	2.19	0.00	99.98
Unidentified	Unidentified	2.17	0.00	99.99
Basket star	<i>Gorgonocephalus arcticus</i>	1.80	0.00	99.99
Unidentified worms	Unidentified worms	1.02	0.00	99.99
Atlantic rock crab	<i>Cancer irroratus</i>	1.00	0.00	99.99
Northern moonsnail	<i>Euspira heros</i>	0.82	0.00	99.99
Encrusted tube worm	<i>Thelepus cincinnatus</i>	0.71	0.00	100.00
Sea strawberry	<i>Eunephthya rubiformis</i>	0.48	0.00	100.00
Sea star	<i>Asterias forbesi</i>	0.46	0.00	100.00
Arctic roughmya	<i>Panomys norvegica</i>	0.39	0.00	100.00
Skate egg case	<i>Raja sp.</i> eggs	0.33	0.00	100.00
Unidentified tunicate	Unidentified tunicate	0.25	>0.001	100.00
Daisy brittle star	<i>Ophiopholis aculeata</i>	0.06	>0.001	100.00

Although the levels of bycatch in the Arctic surfclam fishery are low, unobserved mortality of bycatch species will occur. For example, Gilkinson *et al.* (2005) reported observing large numbers of northern propellerclams on the sediment surface after experimental dredge tows, with varying levels of shell damage from minor to potentially lethal. Approximately 15% of the small Arctic surfclam that pass through the dredge are thought to suffer lethal damage (DFO 2007a). Individuals of other species that are found in the path of the dredge but that pass through the dredge bars will also suffer varying levels of damage; quantifying this impact, including any sub-lethal effects that result in a higher predation risk for impacted animals, is very difficult, however.

6.3 Endangered, threatened or protected (ETP) species

Species of relevance to this section include any that are protected under international law, as well as those listed under the Canadian Species At Risk Act (SARA 2009). The listing of a species by the COSEWIC (Committee on the Status of Endangered Wildlife in Canada) does not result in a species being considered under the Endangered Threatened and Protected (ETP) species performance indicators for MSC assessments. As such, winter skate (*Leucoraja ocellata*) or Atlantic cod (*Gadus morhua*) do not qualify currently as ETP species.

No ETP species were reported from observed fishery catches on Banquereau in 2005 (Table 7), the 2004 Banquereau survey (Table 8) or from observed Arctic surfclam fishery catches on the nearby Grand Bank from 2002 to 2009 (Table 9). In any case, there are likely to be very few, if any, large ETP species that may be impacted by the gear, as the dredges are narrow, have a very low mouth opening, and are towed at only 2 knots. The narrow dredge swathe and slow dredge speed means that most mobile animals should be able to avoid the gear. Also, the small mouth opening means that whales, including northern bottlenose whales (*Hyperoodon ampullatus*) from the resident population in The Gully (DFO 2008a), as well as other large ETP species such as leatherback turtle (*Dermochelys coriacea*), are highly unlikely to be impacted.

Table 9: Catch composition from on-board sampling of unsorted catch from commercial clam vessels from 2002 to 2009 on Grand Bank (Roddick *et al.* 2011).

Common Name	Scientific Name	Weight (kg)	%	Cumm %
Arctic surfclam	<i>Mactromeris polynyma</i>	410.06	24.65	24.65
Greenland Cockle	<i>Serripes groenlandicus</i>	351.63	21.14	45.80
Sand dollars	<i>Echinarachnius parma</i>	315.61	18.98	64.77
Northern propellerclam	<i>Cyrtodaria siliqua</i>	304.71	18.32	83.09
Shell	Shell	200.17	12.04	95.13
Rock	Rock	50.05	3.01	98.14
Cancer crabs	<i>Cancer sp.</i>	8.90	0.53	98.67
Starfish	<i>Asterias sp.</i>	5.72	0.34	99.02
Ocean quahog	<i>Arctica islandica</i>	4.54	0.27	99.29
Whelk	<i>Buccinum sp.</i>	4.07	0.24	99.53
Unidentified	Unidentified	1.85	0.11	99.65
Whelk	<i>Colus sp.</i>	1.56	0.09	99.74
Wrinkle whelk	<i>Neptunea lyrata decemcostata</i>	1.45	0.09	99.83
Sand Lance (ns)	<i>Ammodytes sp.</i>	1.42	0.09	99.91
Sea urchin	<i>Strongylocentrotus droebachiensis</i>	1.27	0.08	99.99
Hermit crab	<i>Pagurus sp.</i>	0.19	0.01	100

There are no Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) listed bird species that are likely to co-occur with the Banquereau Arctic surfclam fishery. The only SARA listed seabird that may co-occur with the fishery appears to be the roseatte tern (*Sterna dougallii*). There is no reason, though, to suspect that the Arctic surfclam fishery poses any

threat to this species, as there is little or no bycatch of interest to this species, and there are no long, trailing tow warps or guide wires that would pose a threat through entanglement or bird-strike.

Northern wolffish (*Anarhichas denticulatus*), spotted wolffish (*Anarhichas minor*) and Atlantic wolffish (*Anarhichas lupus*) are classified as ETP species through their listing on schedule 1 of the SARA. Knowledge of the habitat associations of these three wolffish species is limited and is based on their occurrence in research trawls in areas of known water depth and temperature (Kulka *et al.* 2007). The distribution of *A. denticulatus* is centred on the Grand Banks and Labrador Shelf. It has been found on mud, sand, pebbles, small rock and hard bottoms at depths from 38 m to 1504 m (the deepest depth surveyed), but is most common between 500 m and 1000 m, although slightly shallower in the warmer months. The distribution of *A. minor* is similar to that of *A. denticulatus*, although this species is found at water depths from 56 m to 1046 m, but most commonly between 200 m and 750 m. *A. lupus* is a more southern species that is distributed predominantly on the southern Grand Banks and Scotian Shelf, as well as being the most common wolffish species in the Gulf of St. Lawrence. This species is found from the nearshore to depths of 918 m, but is most common between 150 m and 350 m on rocky bottoms (Kulka *et al.* 2007).

Arctic surfclam dredges can only be used effectively in well-sorted sand in relatively shallow water. The three wolffish species that occur in the Banquereau area prefer water that is deeper than is prosecuted for Arctic surfclams, and appear to be more common on harder or mixed substrates; as such, the potential for wolffish to be taken in the fishery is low. This is supported by by-catch data (Table 7, Table 8 and Table 9), which show an absence of wolffish in the catches. In addition, the potential for damage to be caused to wolffish spawning sites by this fishery is very low due to the reported preference for wolffish to spawn in stony or rocky habitats (Kulka *et al.* 2007).

6.4 Habitat effects

Towed bottom fishing gears, including hydraulic dredges as used in the Banquereau Arctic surfclam fishery, have the potential to cause significant and long-lasting impacts to benthic habitats and communities (Jennings and Kaiser, 1998). In particular, chronic fishing disturbance can cause the removal of high-biomass, emergent seabed organisms that increase the topographic complexity of the seabed and have been shown to provide shelter for fish and other species (Kaiser *et al.*, 2002). However, the nature, scale and recovery time of these impacts vary widely depending on a combination of factors including the frequency of use, the previous history of towed bottom gear use at a site, the benthic habitat and community composition, and the level of natural perturbation that the area is subject to (DFO, 2006a). In general, communities in areas with higher levels of natural perturbation are more resilient to towed gear use because they are adapted to regular disturbance (Hiddink *et al.*, 2006).

Hydraulic dredges use high pressure water jets to fluidise the seabed in front of the dredge, allowing the cutting bar to progress through the sediment to a deeper depth than would otherwise be possible. Arctic surfclam dredges are designed to target surfclams to a depth within the sediment of at least 18 - 20 cm, at a speed of 2 knots. Because of this mode of operation, hydraulic dredges can only be used effectively in non-compacted soft sediments, and Arctic surfclams are found at water depths of less than 110 m. The commercially exploited Arctic surfclam beds on Banquereau are found in depths of \leq 70 m, where some natural perturbation from storms will occur due to the bank's highly exposed location. The bank is also subject to moderate strength tidal currents, and so the surficial sediments are well or very well sorted (Stanley *et al.* 1972). Natural perturbation will therefore be expected to limit the potential for hydraulic dredging impacts to have lasting, detrimental effects on the benthic habitat of Banquereau.

In order to determine the impact of the Arctic surfclam fishery on offshore banks, a dredge impact study was started on Banquereau in 1998, and repeat surveys have been undertaken to assess recovery. The experimental site was chosen to closely reflect fished areas, but was also selected slightly away from the main fishery in order to ensure that the results of the study would not be confounded by previous hydraulic dredging events. At 70 - 80 m, the study site was also at the maximum depth of the commercial fishery, and recovery would therefore be expected to be as slow or

slower than anywhere in the fishery. In fact, visual evidence of the experimental dredge tracks had disappeared after one year (Gilkinson *et al.* 2005), while side-scan sonar was still barely able to detect dredge tracks after 10 years. In contrast, 6 of 12 dredge tracks at a 40 m depth site on nearby Sable Bank were reported to be undetectable after just one year (DFO 2010).

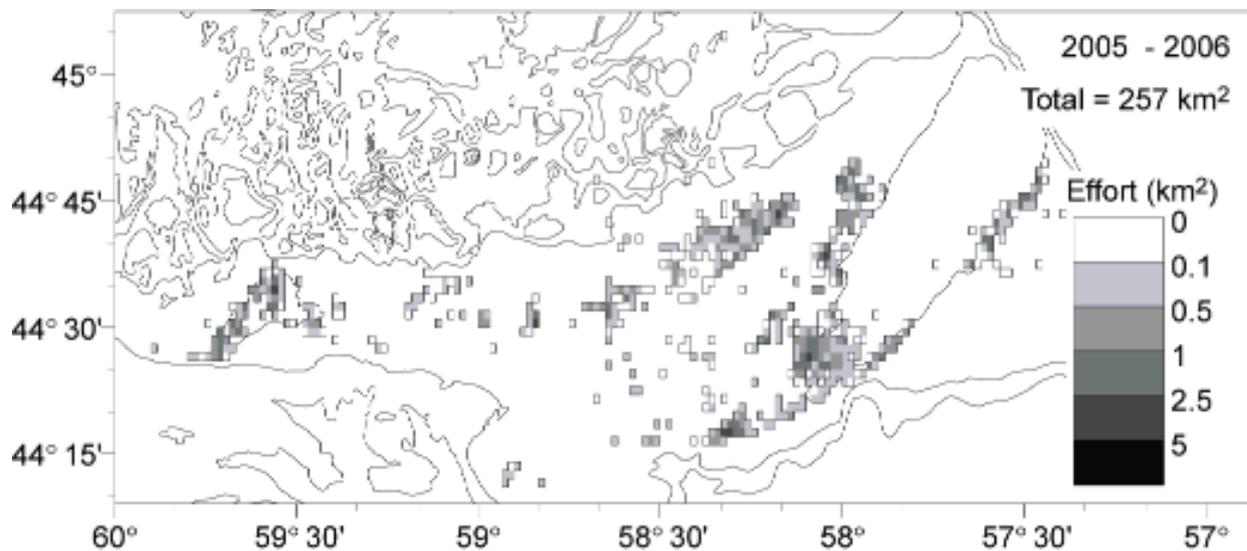


Figure 17: Spatial distribution of area swept for 2005 and 2006 (approx. 257 km²). Total km² dredged is aggregated by one minute squares (not corrected for overlap of dredge tracks (DFO 2007c).

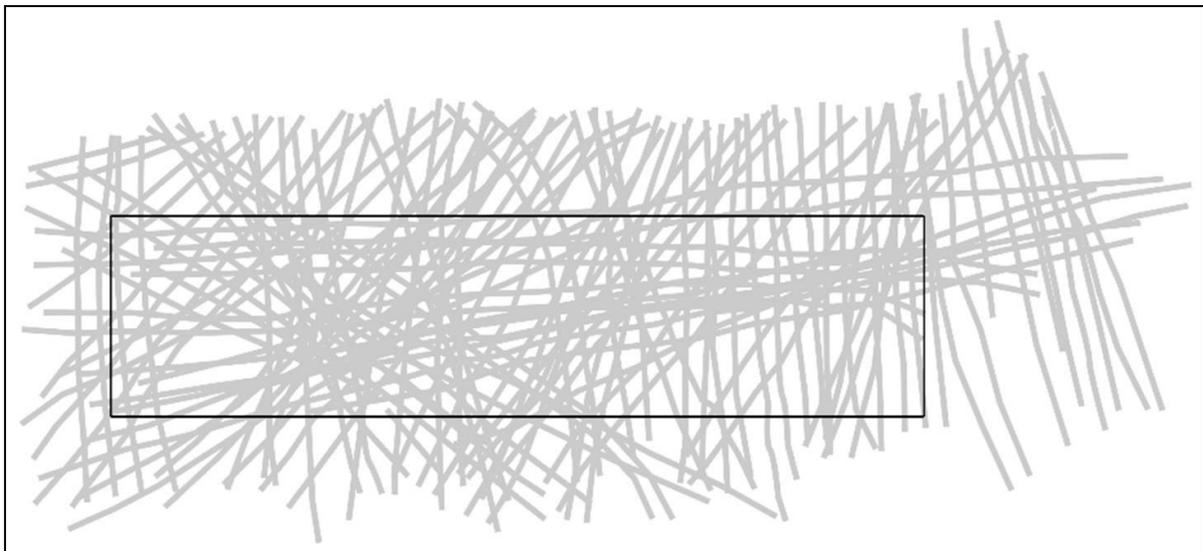


Figure 18: Sidescan of Arctic surfclam dredge tracks from CFV Concordia on Banquereau, 1996. Dredge tracks scaled to 12 feet, box used for area analysis is 500 m x 125 m, percentage of ground covered within box is 67.4% (adapted from Roddick & Smith 1999).

An important factor to consider is the extent of the fished area relative to the size of Banquereau. The bank extends over approximately 10,900 square km, although this includes a shallow, shoal area of less than 40 m water depth. The total area of Banquereau between 100 m and 40 m depth that comprises habitat suitable for Arctic surfclam is therefore approximately 10,180 square km (DFO 2007a). In turn, the DFO (2007a) estimated that the annual swept area of the fishery on Banquereau was 140 square km ($\approx 1.4\%$ of the total surfclam habitat) and that the total swept area of the fishery since 1986 had been 2220 square km ($\approx 21.8\%$ of the total surfclam habitat) (Figure 17). These

figures do not account for repeated dredging over the same sites, which is likely to occur to a greater extent where stock density is highest (Figure 18).

6.5 Ecosystem impacts

Banquereau is considered to be part of the Eastern Scotian Shelf large marine ecosystem, which includes Emerald, Western, Sable and Misaine Banks, as well as Banquereau; The Gully and inshore areas adjacent to eastern Nova Scotia and Cape Breton Island are also within this system (Choi *et al.* 2005). Within the Eastern Scotian Shelf, the area outside Canada's 12 nautical mile territorial limit is managed strategically through the Eastern Scotian Shelf Integrated Management (ESSIM) Initiative, which was Canada's first integrated ocean management plan under the Oceans Act. It is now one of three large ocean management areas (LOMAs) in the Canadian Atlantic, with the Gulf of St. Lawrence and the Placentia Bay/Grand Banks LOMAs being the other two.

In common with the Grand Banks and the Gulf of St. Lawrence, the Eastern Scotian Shelf suffered a collapse of groundfish stocks in the late-1980s to early-1990s. This collapse followed intensive fisheries exploitation by domestic fishing fleets, and resulted in a moratorium being placed on groundfish species in these areas in 1993 (Zwanenburg 2000). Fisheries landings fell from a high of 450,000 t in 1973, to less than 15,000 t in 1997. Although very large catches, such as those of 1973, were clearly not sustainable, the fact that the moratorium is still in place today is indicative of the unprecedented scale and duration of the collapse.

Prior to the groundfish collapse, the Eastern Scotian Shelf ecosystem was dominated by gadoids, such as Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*), marine mammals, including grey seals (*Halichoerus grypus*), but few pelagic fish. Subsequently, while the abundance of groundfish fell dramatically, the abundance of forage fish, such as sand lance (*Ammodytes* spp.), and populations of invertebrate groups, including crabs and shrimp, have increased markedly, and the grey seal population has also grown (Bundy 2005). These changes appear to have comprised a 'regime shift' (Choi *et al.* 2005). Importantly, these ecosystem-level changes on the Eastern Scotian Shelf were entrained well before the development of the Arctic surfclam fishery. Also, the changes were largely mirrored elsewhere on the Canadian Atlantic shelf. As such, the Arctic surfclam fishery cannot be considered to have been the cause of, or even a contributing factor towards, the changes observed in the Eastern Scotian Shelf system after 1990. As the standing stock of Arctic surfclam on Banquereau is estimated to exceed 1,460,000 t, it also appears to be highly unlikely that the fishery is retarding the recovery of groundfish species or the ecosystem more generally through critically reducing the abundance of prey items. In fact, the first signs of a recovery in groundfish stocks has recently been reported, linked to a decline in the abundance of forage fish after they outstripped the supply of their zooplankton prey (Frank *et al.* 2011).

In addition to fisheries exploitation and changes in the abundance of forage fish, an important factor in the changes observed on the Eastern Scotian Shelf in the 1980s and 1990s appears to have been water temperature fluctuation. The average bottom temperature on Banquereau is estimated to be 1 - 4°C, but in the 1980s, a 15 year period of colder than average bottom temperatures commenced on the eastern side of the Scotian Shelf, including Banquereau. By the late 1990s, above-average bottom temperatures were observed in the same areas (Bundy 2005). The inter-annual water temperature variability on the bank is estimated to be high at roughly 2°C, and it is thought that this level of variability may limit the potential for very stable benthic communities to persist (Kostylev 2004).

As part of the effort to develop integrated, ecosystem-based management of Canada's oceans, the DFO has been working with stakeholders to identify ecologically and biologically significant areas (EBSAs) within large ocean management areas (LOMAs). EBSAs may be identified for their structural properties, or because of the functions they serve in the ecosystem (Doherty & Horsman 2007). In some LOMAs, for example within the Placentia Bay/Grand Bank LOMA, the EBSA process has resulted in EBSAs being identified, and conservation objectives outlined (DFO 2007b). The Scotian Shelf process is understood to be some way behind, in that stakeholders have met and expressed support or otherwise for different areas to become EBSAs, but the decision to identify EBSAs in this area has yet to be taken. In any case, EBSAs have no legal status and their use as tools

for planning and management has yet to be clarified (Doherty & Horsman 2007). With this in mind, it is still worth noting that the Eastern Shoal and Banquereau were listed in the group of possible EBSAs, primarily for their abundance of infaunal animals, including bivalves. There was only limited support for those proposals, while greater support appeared to have been expressed for EBSAs that were proposed for the deep canyons that extend off Banquereau in to deeper water on the southern side of the bank (Doherty & Horsman 2007). It is unlikely that this latter group would include habitat of relevance to Arctic surfclams or the Arctic surfclam fishery.

The vast majority of Banquereau is not included within any marine protected area (MPA). Misaine Bank and Eastern Shoal (of Banquereau) were combined and selected as one of three candidate areas of interest for a new MPA on the Eastern Scotian Shelf. A consultation was held by DFO in 2009, with the consultation document noting the area's highly complex and diverse seabed, sensitive bottom habitats and species, that it is an important overwintering and mixing area for Atlantic cod and a significant habitat for at-risk and commercial species, as well as it being a migration and feeding area for whales and fish (DFO 2009g). However, the Misaine Bank and Eastern Shoal Candidate Area of Interest was not taken forward; instead, St. Ann's Bank, also on the Eastern Scotian Shelf, was selected as the Area of Interest for a new MPA on the Eastern Scotian Shelf (DFO 2011e).

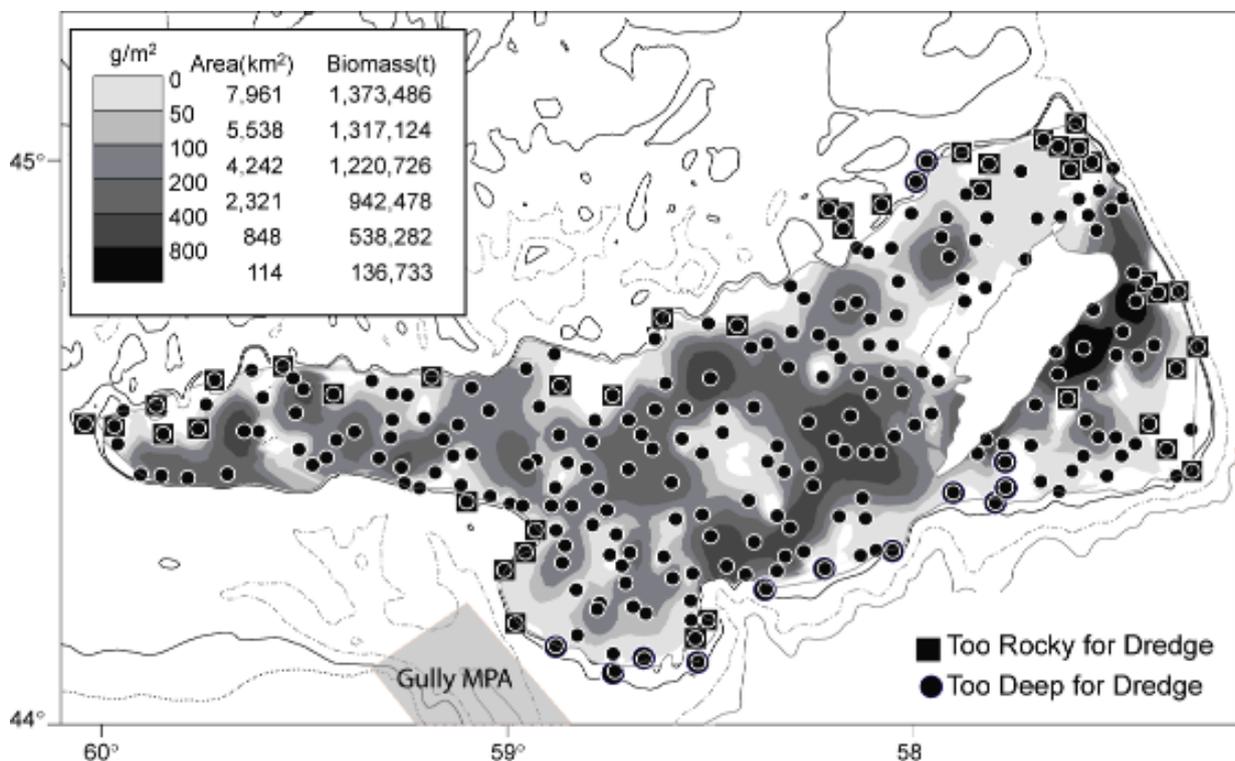


Figure 19: Contouring of surfclam catch (kg/500 m tow) for the 2004 Banquereau surfclam survey, showing The Gully MPA (Roddick *et al.* 2007).

The Gully MPA, designated in 2004, lies at the western edge of Banquereau. The Gully is one of the most prominent seafloor features on the east coast of Canada, and is over 64 km long and 14 km wide, while the MPA extends across approximately 2,365 square km (DFO 2011b). A zone of limited fisheries use within the MPA stretches on to the south-western edge of Banquereau, but this zoning does not allow for the use of mobile bottom gears. In any case, the shallowest depth of the MPA in this area is > 100 m (DFO 2008a), so it is unlikely to harbour significant quantities of Arctic surfclam, and is below the depth at which the Arctic surfclam dredges work effectively (Figure 19).

At depths of < 100 m, hydraulic dredging is an efficient method for catching infaunal bivalve species. The removal of large, bioturbating bivalves, together with other epifaunal and infaunal benthic species

(see section 6.2), has the potential to affect community structure and biomass. Bivalve burrows provide habitat complexity in structurally limited seabeds, and dense aggregations of Arctic surfclam, northern propellerclam and other long-lived bivalves are likely to support the settlement of the benthic larvae of other species, as well as acting as important competitors of suspension and deposit feeders. Gilkinson *et al.* (2005) reported that the immediate effects of hydraulic dredging on Banquereau were to significantly reduce the total abundance of target and non-target species by an average of 46%, while community biomass also declined significantly; the effects of dredging were most pronounced within the dredge tracks. After one year, however, there was a pronounced increase in abundance of non-target species, including some species of polychaete worms and micro-crustaceans (mainly amphipods) that had reached numbers in excess of the pre-dredging condition. Community recovery was incomplete two years after the experimental dredging ceased, with some species, such as the opportunistic polychaete *Spiophanes bombyx*, continuing to increase in abundance; in contrast, the abundance of target bivalve species had not changed from the levels observed immediately post-dredging, a not unexpected result given the variable recruitment patterns, slow growth and very limited motility of those species.

The impact of hydraulic dredging on Banquereau should be placed in the context of the extent of the fishery in comparison to the size of the bank. Although Gilkinson *et al.* (2005) found that recovery of the benthic community was still occurring two years after dredging, the fishery covers a maximum of only approximately 1.4% of the bank each year. Arctic surfclam vessels are also reported to return to productive locations after approximately 10 years (CSLP, pers. comm.), leaving the majority of the bank in recovery or untouched in any year. Similarly, there will be areas of unfished ground left even within intensively fished areas (e.g. Figure 18) that will help to promote recovery of the benthic community within nearby fished areas through emigration (Kaiser *et al.* 2002).

A separate issue investigated by the assessment team was an anecdotal report of large volumes of hydraulic fluid being lost from an Arctic surfclam vessel or vessels. Such losses would certainly be a matter of concern regarding the wider environmental impact of the fishery on the Banquereau ecosystem. However, upon review, DFO could find no observer reports or other evidence of hydraulic fluid being lost by vessels in the fishery, and DFO fishery enforcement specialists considered that such losses would in any case be highly unlikely. As such, losses of hydraulic fluid were not considered further in this assessment. It should be noted that while the fishery employs 'hydraulic' dredges, the term refers to the use of high pressure water jets to dig into the seabed, rather than because hydraulic fluid runs to the dredges when they are working on the seabed.

7 OTHER FISHERIES AFFECTING THE TARGET STOCK

Arctic surfclam is a sessile, infaunal species, and there is likely to be only relatively localised movement of post-settled individuals, possibly as a result of storm disturbance of the seabed. It is also thought that there is only very limited genetic mixing between the Grand Bank and Scotian Shelf Arctic surfclam populations, probably mainly in a north-south direction, through larval dispersal in the Labrador Current (DFO, pers. comm.). The Arctic surfclam stock on the Scotian Shelf can therefore be considered to be isolated from other stocks.

CSLP is licenced to use up to four vessels in the Banquereau Arctic surfclam fishery; no other entities are licenced to operate in the offshore fishery on the Scotian Shelf. Although it is theoretically possible that Arctic surfclams could be taken by other vessels using gears other than hydraulic dredges (for example, by vessels using groundfish trawls), such catches would be accidental and the quantities taken would inevitably be extremely small as other gears are not designed to penetrate the sediment to a depth that would result in Arctic surfclams being caught. As such, there is very little potential for Arctic surfclams from Banquereau, other than those caught by the CSLP fleet, to enter the commercial market.

There are no aboriginal or recreational fisheries for Arctic surfclam on Banquereau (DFO 2011c).

8 STANDARD USED

The MSC Principles and Criteria for Sustainable Fisheries form the standard against which the fishery is assessed and are organised in terms of three principles. Principle 1 addresses the need to maintain the target stock at a sustainable level; Principle 2 addresses the need to maintain the ecosystem in which the target stock exists, and Principle 3 addresses the need for an effective fishery management system to fulfil Principles 1 and 2 and ensure compliance with national and international regulations. The Principles and their supporting Criteria are presented below.

8.1 Principle 1

A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.²

The intent of this principle is to ensure that the productive capacities of resources are maintained at high levels and are not sacrificed in favour of short term interests. Thus, exploited populations would be maintained at high levels of abundance designed to retain their productivity, provide margins of safety for error and uncertainty, and restore and retain their capacities for yields over the long term.

Criteria:

1. The fishery shall be conducted at catch levels that continually maintain the high productivity of the target population(s) and associated ecological community relative to its potential productivity.
2. Where the exploited populations are depleted, the fishery will be executed such that recovery and rebuilding is allowed to occur to a specified level consistent with the precautionary approach and the ability of the populations to produce long-term potential yields within a specified time frame.
3. Fishing is conducted in a manner that does not alter the age or genetic structure or sex composition to a degree that impairs reproductive capacity.

8.2 Principle 2

Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

The intent of this principle is to encourage the management of fisheries from an ecosystem perspective under a system designed to assess and restrain the impacts of the fishery on the ecosystem.

Criteria:

1. The fishery is conducted in a way that maintains natural functional relationships among species and should not lead to trophic cascades or ecosystem state changes.
2. The fishery is conducted in a manner that does not threaten biological diversity at the genetic, species or population levels and avoids or minimises mortality of, or injuries to endangered, threatened or protected species.
3. Where exploited populations are depleted, the fishery will be executed such that recovery and rebuilding is allowed to occur to a specified level within specified time frames, consistent with the precautionary approach and considering the ability of the population to produce long-term potential yields.

² The sequence in which the Principles and Criteria appear does not represent a ranking of their significance, but is rather intended to provide a logical guide to certifiers when assessing a fishery. The criteria by which the MSC Principles will be implemented will be reviewed and revised as appropriate in light of relevant new information, technologies and additional consultations

8.3 Principle 3

The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

The intent of this principle is to ensure that there is an institutional and operational framework for implementing Principles 1 and 2, appropriate to the size and scale of the fishery.

A. Management System Criteria:

1. The fishery shall not be conducted under a controversial unilateral exemption to an international agreement.

The management system shall:

2. Demonstrate clear long-term objectives consistent with MSC Principles and Criteria and contain a consultative process that is transparent and involves all interested and affected parties so as to consider all relevant information, including local knowledge. The impact of fishery management decisions on all those who depend on the fishery for their livelihoods, including, but not confined to subsistence, artisanal, and fishing-dependent communities shall be addressed as part of this process.
3. Be appropriate to the cultural context, scale and intensity of the fishery – reflecting specific objectives, incorporating operational criteria, containing procedures for implementation and a process for monitoring and evaluating performance and acting on findings.
4. Observe the legal and customary rights and long term interests of people dependent on fishing for food and livelihood, in a manner consistent with ecological sustainability.
5. Incorporates an appropriate mechanism for the resolution of disputes arising within the system³.
6. Provide economic and social incentives that contribute to sustainable fishing and shall not operate with subsidies that contribute to unsustainable fishing.
7. Act in a timely and adaptive fashion on the basis of the best available information using a precautionary approach particularly when dealing with scientific uncertainty.
8. Incorporate a research plan – appropriate to the scale and intensity of the fishery – that addresses the information needs of management and provides for the dissemination of research results to all interested parties in a timely fashion.
9. Require that assessments of the biological status of the resource and impacts of the fishery have been and are periodically conducted.
10. Specify measures and strategies that demonstrably control the degree of exploitation of the resource, including, but not limited to:
 - a) setting catch levels that will maintain the target population and ecological community's high productivity relative to its potential productivity, and account for the non-target species (or size, age, sex) captured and landed in association with, or as a consequence of, fishing for target species;

³ Outstanding disputes of substantial magnitude involving a significant number of interests will normally disqualify a fishery from certification.

- b) identifying appropriate fishing methods that minimise adverse impacts on habitat, especially in critical or sensitive zones such as spawning and nursery areas;
 - c) providing for the recovery and rebuilding of depleted fish populations to specified levels within specified time frames;
 - d) mechanisms in place to limit or close fisheries when designated catch limits are reached;
 - e) establishing no-take zones where appropriate.
11. Contains appropriate procedures for effective compliance, monitoring, control, surveillance and enforcement which ensure that established limits to exploitation are not exceeded and specifies corrective actions to be taken in the event that they are.

B. Operational Criteria

Fishing operation shall:

- 12. Make use of fishing gear and practices designed to avoid the capture of non-target species (and non-target size, age, and/or sex of the target species); minimise mortality of this catch where it cannot be avoided, and reduce discards of what cannot be released alive.
- 13. Implement appropriate fishing methods designed to minimise adverse impacts on habitat, especially in critical or sensitive zones such as spawning and nursery areas.
- 14. Not use destructive fishing practices such as fishing with poisons or explosives;
- 15. Minimise operational waste such as lost fishing gear, oil spills, on-board spoilage of catch etc.
- 16. Be conducted in compliance with the fishery management system and all legal and administrative requirements.
- 17. Assist and co-operate with management authorities in the collection of catch, discard, and other information of importance to effective management of the resources and the fishery.

9 BACKGROUND TO THE EVALUATION

9.1 Evaluation Team

Lead Assessor and Project Coordinator: Dr. Rob Blyth-Skyrme

Rob has worked in marine fisheries science, management and policy for 15 years. Prior to becoming a fisheries consultant he was a senior advisor to the UK Government on environmental and fisheries issues and the Deputy Chief Officer for the largest inshore fisheries management organization in England. Rob now runs a marine fisheries and environmental consultancy with offices in the UK and Hawaii and has undertaken all facets of MSC work as a lead assessor and expert team member.

Expert advisor: Dr. Andy Brand

Andy worked for 40 years on the academic staff of the Port Erin Marine Laboratory, Isle of Man, retiring in 2006 as Director of the Laboratory. During this time he developed large, well-funded, research programmes on the biology, ecology, and fisheries of bivalve molluscs and the environmental impact of scallop dredging. He has had extensive fishery management and environmental assessment consultancy experience, including contracts with government departments and industry. He has recent experience as an assessor and reviewer for MSC certifications of scallop, mussel and oyster fisheries in the Irish Sea, Faroes, Denmark, the USA and Canada.

Expert Advisor: John Angel

John worked with the federal Department of Justice before moving to the Department of Fisheries and Oceans as head of legal and regulatory affairs in 1983. His last position in government (1994) was as Regional Director of Fisheries Management for the Scotia-Fundy Region. After ten years as Executive Director of the Canadian Association of Prawn Producers, a trade association representing offshore northern shrimp interests in Eastern Canada, John retired from full time employment but continues to provide consulting services to the fishing industry of Atlantic Canada. He has extensive experience in the development of integrated resource management plans and fishing strategies as well as a background in Canadian fisheries law and is a past member of the Fisheries Resource Conservation Council (FRCC), an independent advisory body to the Minister of Fisheries and Oceans. He has been on several MSC assessment teams as the Principle 3 lead.

9.2 Previous certification evaluations

The fishery has not been previously assessed against the MSC standard.

9.3 Inspections of the Fishery

Inspection of the fishery focused on the practicalities of fishing operations, the mechanisms and effectiveness of management agencies and the scientific assessment of the fisheries. In order to gather information, a meeting was held with scientists and managers from the Department of Fisheries and Oceans, Canada. The key issues discussed are identified in Table 10, below.

Table 10: Key issues discussed at a meeting with the DFO

Name	Affiliation	Date	Key Issues
Wendy Williams Stefan Leslie Carl MacDonald Scott Coffen-Smout Dale Roddick Wade Barney Annette Rumbolt Kent Gilkinson (from 11:15)	DFO DFO DFO DFO DFO DFO DFO	10 th June 2011	<ul style="list-style-type: none"> - Existence of implicit or explicit target and limit reference points - The methodological approach to setting the TAC - MCY compared with MSY - Stock survey frequency - Availability of information on spatfall and pre-recruit strength - Evidence concerning serial depletion of stock - Information on stock density dependent effects on spawning and/or growth - Dredge efficiency - Abundance and ecology of retained and discarded bycatch species - Habitat impacts and recovery - Habitat mapping - Ability of ENGOs to engage with the management process - IFMP drafting process - Internal and external review of the management performance

10 STAKEHOLDER CONSULTATION

Information on the assessment of the Banquereau Arctic surfclam fishery main assessment was made publicly available at the following stages of the assessment:

Date	Purpose	Media
22 nd March 2011	Announcement of assessment	Direct E-mail/letter Notification on MSC website Advertisement in 'The Navigator' magazine.
12 th April 2011	Notification of Assessment Team nominees	Direct E-mail Notification on MSC website
12 th April 2011	Notification of intent to use MSC FAM Standard Assessment Tree	Direct E-mail Notification on MSC website
6 th May 2011	Notification of assessment visit and call for meeting requests	Direct E-mail Notification on MSC website
9 th - 11 th June 2011	Assessment visit	Meetings
29 th November 2011	Notification of Proposed Peer Reviewers	Direct E-mail Notification on MSC website
	Notification of Public Comment Draft Report	Direct E-mail Notification on MSC website
	Notification of Final Report	Direct E-mail Notification on MSC website

10.1 Stakeholder Issues

A total of four stakeholder groups were identified and consulted specifically by Intertek Moody Marine; these were the Sierra Club of Canada, the World Wildlife Fund (WWF), Canada, the Ecology Action Centre (EAC) and Sea Choice. Representatives of those organisations were contacted by e-mail and invited to meet with the team during the site visit. Sea Choice did not respond to the e-mail, while Dr. Winsor of the Sierra Club of Canada sent a letter to the team, outlining their position (included in this report as Section 15.1), and the WWF and the EAC met with the team but also submitted written evidence (included in this report as Section 15.2 and Section 15.3, respectively). The key issues discussed during the meetings with the WWF and the EAC are listed in Table 11, below.

Table 11: Key issues discussed with stakeholders.

Name	Affiliation	Date	Key Issues
Susanna Fuller	Ecology Action Centre	9 th June 2011	<ul style="list-style-type: none"> - Independence of fishery science related to the Arctic surfclam stock assessment - Availability of raw data from stock surveys - Stock survey frequency - Impact of hydraulic dredging on habitats and communities - Desirability of control areas within commercial fishing grounds, closed to dredging - Impacts of prey removal on recovery of clam predators including groundfish - Possible reports of hydraulic fluid leaks from clam fishing vessels - Ability of ENGOs to engage with the management process
Daniela Diz	WWF	10 th June 2011	<ul style="list-style-type: none"> - Impact of dredging on ETP species and their habitats - Existing MPAs and the Canadian MPA designation process - Hydraulic dredge impacts on EBSAs and VMEs - Ability of ENGOs to engage with the management process

11 OBSERVATIONS AND SCORING

11.1 Introduction to scoring methodology

The MSC Principles and Criteria set out the requirements of certified fishery. These Principles and Criteria have been developed into a standard (Fishery Assessment Methodology) assessment tree - Performance Indicators and Scoring Guideposts - by the MSC, which is used in this assessment.

The Performance Indicators (PIs) have been released on the MSC website. In order to make the assessment process as clear and transparent as possible, each PI has three associated Scoring Guideposts (SGs) which identify the level of performance necessary to achieve 100, 80 (a pass score), and 60 scores for each Performance Indicator; 100 represents a theoretically ideal level of performance and 60 a measurable shortfall.

For each Performance Indicators, the performance of the fishery is assessed as a 'score'. In order for the fishery to achieve certification, an overall weighted average score of 80 is necessary for each of the three Principles and no Indicator should score less than 60. As it is not considered possible to allocate precise scores, a scoring interval of five is used in evaluations. As this represents a relatively crude level of scoring, average scores for each Principle are rounded to the nearest whole number.

Weights and scores for the Fishery are presented in the scoring table (Appendix A).

12 LIMIT OF IDENTIFICATION OF LANDINGS FROM THE FISHERY

Traceability of product from the sea to the consumer is vital to ensure that the MSC standard is maintained. There are several aspects to traceability that the MSC require to be evaluated: traceability within the fishery; at-sea processing; at the point of landing; and subsequently the eligibility of product to enter the chain of custody. These requirements are assessed here.

12.1 Traceability within the fishery

Products from the Banquereau Arctic surfclam fishery are 100% processed at-sea. The CSLP vessels engaged in the fishery deliver product only to the CSLP plant in Grand Bank, Newfoundland, after landing in Argentia, Newfoundland. No transshipments are permitted in the fishery, and no other vessels are permitted to retain Arctic surfclams. No instances of these requirements being broken were reported to the assessment team by DFO. There is 100% observer coverage of landings. There are not thought to be any traceability issues that would prevent the demonstration of a secure supply chain for products from the fishery.

It may be noted that the Arctic surfclam vessels operating in this fishery are highly specialised for fishing with hydraulic dredges. As such, there is no possibility of the CSLP vessels using a fishing gear that has not been assessed as part of this Banquereau Arctic surfclam unit of certification (i.e. other than hydraulic dredges).

12.2 At-sea processing

The vessels engaged in the Banquereau Arctic surfclam fishery are equipped with processing and freezing facilities.

The whole animal is blanched and then the tongues (feet) are separated from the mantle material. The tongues are frozen individually and packaged in 16 kg boxes, while the mantles are frozen as a by-product in 7 kg boxes.

12.3 Points of landing

Products are landed only at Argentia, Newfoundland, for further processing at Grand Bank, Newfoundland

12.4 Eligibility to enter chains of custody

The scope of this certification ends at the point of landing. Downstream certification of the product would require appropriate chain-of-custody certification of shore-based storage and handling facilities.

12.5 Target Eligibility date

The Public Comment Draft Report for this fishery was published on April 26th, 2012. The earliest date that can be set for the target eligibility date is therefore October 26th, 2011 (CR 27.6.1.2). This is a logical date in that the client has confirmed that it would provide the most benefit to the fishery from certification.

As the eligibility date for products from the fishery would be before the certification date, Intertek Moody Marine must be confident that the vertical integration and traceability systems in the Clearwater Seafoods Limited Partnership operations allow them to track and clearly identify product landing dates and to separate MSC-eligible from all non-eligible product. Intertek Moody Marine is confident that this is the case.

13 ASSESSMENT RESULTS

The Performance of the Fishery in relation to MSC Principles 1, 2 and 3 is summarised below:

MSC Principle	Fishery Performance
Principle 1: Sustainability of Exploited Stock	Overall : 85.0
Principle 2: Maintenance of Ecosystem	Overall : 91.3
Principle 3: Effective Management System	Overall : 85.6

The fishery attained a score of 80 or more against each of the MSC Principles and did not score less than 60 against any Indicators. It is therefore confirmed that the Banquereau Arctic surfclam fishery is certified according to the Marine Stewardship Council Principles and Criteria for Sustainable Fisheries.

13.1 Conditions and action plan

As a standard requirement of the MSC certification methodology, the fishery shall be subject to (as a minimum) annual surveillance audits. These audits shall be publicised and reports made publicly available.

The fishery attained a score of below 80 against three Performance Indicators. The assessment team has therefore set three Conditions for Continued Certification that the client for certification is required to address. The Conditions are applied to improve performance to at least the 80 level within a period set by the certification body but no longer than the term of the certification.

The client has developed an 'Action Plan' for Meeting the Conditions for Continued Certification; the action plan has been approved by Intertek Moody Marine, and a letter of support has been provided by DFO (See).

The Conditions, associated timescales and relevant Scoring Issue are set out below.

Condition 1	
Reference Points	1.1.2
PI	Limit and target reference points are appropriate for the stock.
SG 60	Generic limit and target reference points are based on justifiable and reasonable practice appropriate for the species category.
SG 80	Reference points are appropriate for the stock and can be estimated. The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity. The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome. For low trophic level species, the target reference point takes into account the ecological role of the stock.
SG 100	Reference points are appropriate for the stock and can be estimated.

	<p>The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity following consideration of relevant <u>precautionary issues</u>.</p> <p>The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome, <u>or a higher level</u>, and takes into account relevant precautionary issues such as the ecological role of the stock with a high degree of certainty.</p>
Score	70
Scoring Rationale	<p>Although there are no analytically determined reference points for this fishery, the management strategy aims to maintain the biomass at the level of B_{MSY}, which is higher than the MSC default target of $0.4B_0$, and is thus an acceptable surrogate target reference point that meets both the third and fourth issues of SG 80. With biomass maintained at or around the virgin biomass level and a very low exploitation rate, no limit reference point has been defined or is implicit within the management strategy, so while the fishery has clearly remained above the MSC default value for an implicit limit reference point of $\frac{1}{2} B_{MSY}$ or 20% of B_0, the lack of any stated threshold at which management action would be taken means that the fishery does not meet the first and second issues of SG 80. The score of 70 requires that a Condition is set.</p>
Condition	<p>The client is required to demonstrate by the 2nd annual audit that:</p> <ul style="list-style-type: none"> • The management system includes a limit reference point that is appropriate for the stock and can be estimated. • The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity. <p>Milestones in achieving this goal are:</p> <p>Year 1 (First surveillance audit)</p> <ul style="list-style-type: none"> • Work with relevant scientists to undertake a review of potential limit reference points.
Client Action Plan	<p>The Client, in conjunction with DFO will, by the 2nd annual audit, identify appropriate limit reference points for the stock that ensure that there is no appreciable risk of impairing reproductive capacity. Progress of this initiative will be presented at the first annual audit.</p>

Condition 2	
Harvest control rules and tools	1.2.2
PI	There are well defined and effective harvest control rules in place.
SG 60	<p>Generally understood harvest control rules are in place that are consistent with the harvest strategy and which act to reduce the exploitation rate as limit reference points are approached.</p> <p>There is some evidence that tools used to implement harvest control rules are appropriate and effective in controlling exploitation.</p>
SG 80	Well defined harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.

	<p>The selection of the harvest control rules takes into account the main uncertainties.</p> <p>Available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules</p>
SG 100	<p>Well defined harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.</p> <p>The design of the harvest control rules take into account a wide range of uncertainties.</p> <p>Evidence clearly shows that the tools in use are effective in achieving the exploitation levels required under the harvest control rules.</p>
Score	70
Scoring Rationale	<p>This fishery is managed on a very precautionary basis, with a low annual exploitation rate and a conservatively set TAC, the uptake of which is closely monitored, so that the stocks are still at, or around, the virgin biomass level after 25 years of fishing. However, there are no analytically determined reference points and there are no well-defined harvest control rules stating under what circumstances action would be triggered to ensure that the exploitation rate is reduced as limit reference points are approached. The fishery does not, therefore, meet the 1st and 2nd of the SC80 scoring issues, although the tools in use (limited licences, conservative TAC) are appropriate and have been effective in maintaining a low exploitation rate so that the 3rd SG80 scoring element is met. The score of 70 requires that a Condition is set.</p>
Condition	<p>The client is required to demonstrate by the 2nd annual audit that:</p> <ul style="list-style-type: none"> Well-defined harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached. The selection of the harvest control rules takes into account the main uncertainties. <p>Milestones in achieving this goal are:</p> <p>Year 1 (First surveillance audit)</p> <ul style="list-style-type: none"> Work with relevant scientists to undertake a review of potential harvest control rules.
Client Action Plan	<p>The Client, in conjunction with DFO, will establish decision rules appropriate to manage the stock that are consistent with the harvest strategy and consider the main uncertainties. An update of this work will be provided at the first surveillance audit.</p>

Condition 3

Consultation, roles and responsibilities	3.1.2
PI	<p>The management system has effective consultation processes that are open to interested and affected parties.</p> <p>The roles and responsibilities of organisations and individuals who are involved</p>

	in the management process are clear and understood by all relevant parties
SG 60	<p>Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are generally understood</p> <p>The management system includes consultation processes that obtain relevant information from the main affected parties, including local knowledge, to inform the management system</p>
SG 80	<p>Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are explicitly defined and well understood for key areas of responsibility and interaction.</p> <p>The management system includes consultation processes that regularly seek and accept relevant information, including local knowledge. The management system demonstrates consideration of the information obtained</p> <p>P.66 in the latest file, attached)</p>
SG 100	<p>Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are explicitly defined and well understood for all areas of responsibility and interaction.</p> <p>The management system includes consultation processes that regularly seek and accept relevant information, including local knowledge. The management system demonstrates consideration of the information and explains how it is used or not used</p> <p>The consultation process provides opportunity and encouragement for all interested and affected parties to be involved, and facilitates their effective engagement.</p>
Score	65
Scoring Rationale	<p>Interested parties have been identified in the advisory process. The functions, structure, purpose and administration of the advisory committee are clearly outlined in the IFMP and well understood. The management system considers all information presented during the consultative process on key elements of the management of the stocks. While the advisory committee process is open to the public and does provide an opportunity for all interested parties to participate, there is no indication that potential interested parties are made aware of meetings. Similarly, minutes of meetings are circulated to committee members but no indication of wider distribution to parties that may be interested in the deliberations of the advisory committee.</p> <p>All the scoring issues of SG 60 are met, as is the first of scoring issue of SG 80. However, as the OCAC has not met on a regular basis (including gaps of several years), it cannot be said that the process regularly seeks and accepts relevant information or that the process provides the opportunity for all interested and affected parties to be involved, as required by the last two of the three scoring issues of SG 80. Nor is there evidence that potential interested parties are aware of advisory meetings being held or of the results of such meetings. A score of 65 is therefore awarded and a condition set.</p>
Condition	<p>The client is required to demonstrate by the 2nd annual audit that the management system includes:</p> <ul style="list-style-type: none"> • Consultation processes that regularly seek and accept relevant information, including local knowledge. • Consideration of the information obtained. • Opportunity for all interested and affected parties to be involved.

	<p>Milestones in achieving this goal are:</p> <p>Year 1 (First surveillance audit)</p> <ul style="list-style-type: none"> • Provide evidence of seeking and accepting relevant information through established consultation processes. • Provide evidence of providing opportunity for interested and affected parties to be involved.
<p>Client Action Plan</p>	<p>The Client, in conjunction with DFO will hold regular OCAC meetings so that relevant information can be obtained, considered, and where appropriate, incorporated into fisheries management. OCAC meetings will be open to the public so that interested and affected parties have an opportunity to be involved. Evidence of this will be provided via OCAC meeting minutes at the first and second year surveillance audits.</p>

13.2 Non-binding recommendations

Two non-binding recommendations, specific to PI 3.1.2 and PI 3.2.1, were made:

Recommendation 1: PI 3.1.2

In order to promote opportunities for all interested and affected parties to be involved, advance notice of the time and place of advisory committee meetings, and the minutes of such meetings, should be posted on the DFO website.

Recommendation 2: PI 3.2.1

In order to ensure that the latest IFMP is available to stakeholders, it should be posted on the DFO website or in some other way made publicly available.

14 APPENDIX A - SCORING TABLE

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

Principle 1 A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.

1.1 Management Outcomes:

1.1.1	Stock Status: The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing	It is <u>likely</u> that the stock is above the point where recruitment would be impaired.	It is <u>highly likely</u> that the stock is above the point where recruitment would be impaired. The stock is at or fluctuating around its target reference point.	There is a <u>high</u> degree of certainty that the stock is above the point where recruitment would be impaired. There is a <u>high degree of certainty</u> that the stock has been fluctuating around its target reference point, or has been above its target reference point, <u>over recent years</u> .
--------------	---	--	--	---

Scoring Comments

For Banquereau, the age of 50% maturity (6.7 – 8.3 years) is well below the age of 50% selectivity (16.5 years), indicating that individual surfclams will be able to spawn about 7 – 10 times before being recruited to the fishery. Although there have been no studies of the relative fecundity of young compared with older surfclams, this should help ensure that recruitment overfishing does not occur (Roddick *et al.* 2007, DFO 2012). Recruitment on Banquereau has been very consistent, with no missed year-classes, but there are stronger pulses of recruitment about 10 years apart and some evidence of spatial variability from year to year. With little historic variability in stock size, no stock-recruitment relationship has been demonstrable, but as a high fecundity, broadcast spawner, a close relationship between stock size and subsequent recruitment is unlikely to occur, except at very low stock densities. Stock surveys of Arctic surfclam undertaken on Banquereau provided biomass estimates of 1,462,097 ± 24,944 t in 2004 and 1,150,585 t in 2010. These estimates of biomass are higher than earlier surveys, while estimates of annual production, albeit approximate, are higher than the removals by the fishery: this suggests that the fishery over 25 years has not had a significant detrimental impact on the stock, which is estimated to be still near the virgin biomass level (Roddick *et al.* 2007). With a conservative TAC, which has not been taken in recent years, fishing effort is very low, with exploitation rates currently of only 1-2% per year. There is, therefore, a high degree of certainty that recruitment overfishing is not occurring. It is also estimated that the age of maximum biomass per recruit occurs close to the age of 50% selectivity so growth overfishing is also unlikely to occur. The evidence of highest fishing effort occurring in areas where the highest biomass had been recorded in surveys provides evidence that serial depletion is not occurring (DFO 2007a).

The Offshore Clam Framework Assessment meeting in 2007 (DFO 2007a, DFO 2007d) agreed that the fishing mortality (F) for the Banquereau fishery should be a function of the natural mortality (M) and recommended a conservative TAC set at around F~MCY (F of 0.33M) (DFO 2007c), based on a strategy of setting a yield that is low enough to be sustainable at all probable biomass levels. However, the *status quo* TAC was maintained because of concerns to maintain a cautious strategy while implementing a constant fishing mortality approach with the current low frequency of surveys. Arctic surfclam is a long-lived and slow growing species, such that the stock would take many years to recover from a high exploitation rate that resulted in a significant stock decline.

The management strategy for offshore clams, set out in the latest IFMP (DFO 2011), states that the TAC is primarily based on harvesting a percentage (the exploitation rate) of

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

an estimate of the harvestable biomass (the fishable biomass $> 75\text{g/m}^2$) which is intended to optimize yield and not expose the resource to risk of over-exploitation.. Thus, a fishing mortality target (F) at Maximum Constant yield (MCY) is estimated to be one-third of natural mortality (M) and F_{MCY} is applied to the harvestable biomass, such that the TAC is set at 2.64% of the harvestable biomass. This mechanism was used for the first time to set the TAC for the Grand Bank Arctic surfclam fishery in 2011 (DFO 2011f) and is one of the options to be considered for the Banquereau fishery in 2012, when it would provide a TAC of 27,592 t (DFO 2012) but this has not been confirmed. The estimated fishing mortality rate at maximum conservation yield (F_{MCY}) would be $F = 0.026$, but a *status quo* TAC of 24,000 t would give a more precautionary exploitation rate of $F = 0.021$.

Setting a conservative TAC at $F \sim \text{MCY}$ (F of $0.33M$) strives to maintain the biomass at the level of B_{MCY} , which is more conservative than the MSC recommendation of B_{MSY} ($=0.4B_0$). B_{MCY} , or the $B_{\text{MSY}/600,00\text{t}}$ that has been in operation since the TAC of 24,000 was introduced in 2004, can be considered to be implicit target reference points, complying with the MSC Policy Advisory (2010b) on implicit reference points, which states “target reference points should be such that the stock is maintained at a level consistent with B_{MSY} or above, or some measure or surrogate with similar intent or outcome.”

With the stock size estimated to be still near the virgin biomass level (Roddick *et al.* 2007), the stock is clearly at or fluctuating around its target reference point.

Score: 100

The fishery complies with SG 60 and SG 80, and there is a high degree of certainty so the first scoring issue of SG100 is met. The lack of any evidence from the surveys of a decline in biomass over time, together with studies indicating that annual production exceeds removals by the fishery, are convincing arguments that the stock is still at or near the virgin biomass levels, so the second scoring issue of SG100 is also met.

Audit Trace References

DFO 2007a, DFO 2007c, DFO 2007d, DFO 2011f, DFO 2012, Roddick *et al.* 2007; MSC 2010b.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

1.1.2	<p>Reference Points: Limit and target reference points are appropriate for the stock.</p>	<p><u>Generic</u> limit and target reference points are based on justifiable and reasonable practice appropriate for the species category.</p>	<p>Reference points are appropriate for the stock and can be estimated.</p> <p>The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity.</p> <p>The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome.</p> <p>For low trophic level species, the target reference point takes into account the ecological role of the stock.</p>	<p>The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity following consideration of relevant <u>precautionary issues</u>.</p> <p>The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome, <u>or a higher level</u>, and takes into account relevant precautionary issues such as the ecological role of the stock with a high degree of certainty.</p>
-------	--	--	---	--

Scoring Comments

There are no analytically determined reference points for this fishery but the use of implicit reference points is clarified in MSC Policy Advisory 12 (2010b), which states, “*target reference points should be such that the stock is maintained at a level consistent with or above, or some measure or surrogate with similar intent or outcome.*” The 2007 Framework Assessment for Banquereau concluded that a fishing strategy that resulted in $F \sim MCY$ (F of 0.33M), was appropriate for the offshore Arctic surfclam offshore fishery, based on the long-lived and slow growing nature of the species (DFO 2010); this has been incorporated into the IFMP and was implemented for the first time in the Grand Bank fishery in 2011 (DFO 2011f). As $M = 0.08$, the $F \sim MCY$ strategy is inherently conservative and precautionary and strives to maintain the biomass at the level of B_{MCY} , which is a higher level than the MSC default target of $0.4B_0$. However, since the TAC of 24,000 was introduced in 2004, the Banquereau fishery has been operating a TAC based on $F_{MSY/600,000t}$, which is an even more conservative fishing strategy than $F \sim MCY$ (F of 0.33M). When arrangements for 2012 are confirmed it appears likely that the fishery will adopt the strategy set out in the IFMP ($F \sim MCY$) but both $F_{MSY/600,000t}$ and $F \sim MCY$ are implicit target reference points that strive to maintain the stock at a level which is more conservative than the MSC default of B_{MSY} .

While there is no explicit limit reference point for this fishery, the need to implement one has recently been noted by the scientific advisors (DFO 2010). However, with the biomass at or around the virgin biomass level (DFO 2007a, Roddick *et al.* 2007, DFO, 2012), and the restriction on fishing effort through the application of a conservative TAC, any decline in biomass will be slow to occur and should be detected in surveys long before it affected reproductive output. Therefore, while a limit reference point would be desirable, it is not currently a priority for this fishery as the fishery is well above the MSC default value of $\frac{1}{2} B_{MSY}$ or 20% of B_0 . In any case, the operational costs of exploiting the offshore Arctic surfclam stocks are such that fishing would be limited for economic reasons long before there is an appreciable risk that recruitment is impaired

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

(DFO 2007a).

The management strategy is therefore consistent with the MSC guidance regarding implicit reference points.

Score: 70

Although there are no analytically determined reference points for this fishery, the management strategy aims to maintain the biomass at the level of B_{MCY} (or $B_{MSY(600,00)}$), which is higher than the MSC default target of $0.4B_0$, and is thus an acceptable surrogate target reference point that meets the third scoring issues of SG 80. As Arctic surfclam is not a low trophic levels species, the fourth scoring issue of SG 80 does not apply. With biomass maintained at or around the virgin biomass level and a very low exploitation rate, no limit reference point has been defined or is implicit within the management strategy, so while the fishery has clearly remained above the MSC default value for an implicit limit reference point of $\frac{1}{2} B_{MSY}$ or 20% of B_0 , the lack of any stated threshold at which management action would be taken means that the fishery does not meet the first and second scoring issues of SG 80. The score of 70 requires that a Condition is set.

Audit Trace References

DFO 2007a, DFO 2010, DFO 2012, MSC 2010b, Roddick *et al.* 2007.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

1.1.3	<p>Stock Rebuilding: Where the stock is depleted, there is evidence of stock rebuilding.</p>	<p>Where stocks are depleted rebuilding strategies which have a <u>reasonable expectation</u> of success are in place.</p> <p>Monitoring is in place to determine whether they are effective in rebuilding the stock within a <u>specified</u> timeframe.</p>	<p>Where stocks are depleted rebuilding strategies are in place.</p> <p>There is <u>evidence</u> that they are rebuilding stocks, or it is highly likely based on simulation modelling or previous performance that they will be able to rebuild the stock within a <u>specified</u> timeframe.</p>	<p>Where stocks are depleted, strategies are <u>demonstrated</u> to be rebuilding stocks continuously and there is strong evidence that rebuilding will be complete within the <u>shortest practicable</u> timeframe.</p>
-------	---	---	---	---

Scoring Comments

The Banquereau Arctic surfclam stocks are not depleted so this PI does not apply.

Score: <n/a

Audit Trace References

--

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

1.2 Harvest Strategy (management)
--

1.2.1	Harvest Strategy: There is a robust and precautionary harvest strategy in place	<p>The harvest strategy is <u>expected</u> to achieve stock management objectives reflected in the target and limit reference points.</p> <p>The harvest strategy is <u>likely</u> to work based on prior experience or plausible argument.</p> <p><u>Monitoring</u> is in place that is expected to determine whether the harvest strategy is working.</p>	<p>The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy <u>work together</u> towards achieving management objectives reflected in the target and limit reference points.</p> <p>The harvest strategy may not have been fully tested but <u>monitoring is in place and evidence</u> exists that it is achieving its objectives.</p>	<p>The harvest strategy is responsive to the state of the stock and is <u>designed</u> to achieve stock management objectives reflected in the target and limit reference points.</p> <p>The performance of the harvest strategy has been <u>fully evaluated</u> and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.</p> <p>The harvest strategy is <u>periodically reviewed and improved</u> as necessary.</p>
--------------	---	---	---	---

Scoring Comments

The Banquereau surfclam fisheries are managed under the Offshore Clams Integrated Fisheries Management Plan (DFO 2011c) that is revised on an annual rolling basis. The IFMP’s primary objective is “to ensure that a biologically and economically sustainable offshore clam fishery continues through the auspices of scientifically-based management plans involving collaborative enforcement, monitoring, and regulatory measures.” An additional stock-specific objective is “to increase certainty that harvesting occurs at an optimum sustainable level to ensure the long-term viability of the resource.” The stock assessment for Banquereau (Roddick *et al.* 2007, DFO 2012), is comprehensive and precautionary as demonstrated by the following:

- Throughout the 2004 stock assessment, the dredge efficiency is assumed to be 1 (when experimental results suggest that efficiency is closer to 0.8),
- Gear-related mortality of non-retained target species is estimated,
- Gear selectivity is such that the age of 50% maturity (6.7 – 8.3 years) is below the age of 50% selectivity (approximately 16.5 years), indicating that the individual surfclams will be able to spawn about 7 – 10 times before recruiting to the fishery,
- Through 100% VMS, 100% DMP, fishing logbooks, and occasional at-sea observers, the catch is accurately recorded and F is reliability estimated.
- Effort is kept low by limited licences (only two vessels now fishing), exploitation rates are very low (1-2% per year of the total biomass), and the TAC has never been reached.
- Annual production probably exceeds removals by the fishery and the stock is still at, or around, the virgin biomass

It has been observed that the areas of greatest effort are still the areas with the highest biomass even after 25 years of fishing, indicating that serial depletion, a concern with fisheries for sedentary species, is not happening in this fishery. The present harvest strategy is having the intended outcome of ensuring sustainable harvest levels and the long-

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

term viability of the resource.

Score: 95

The fishery meets SG 60 and SG 80, and the first and third scoring issues of SG 100 through its precautionary and periodically reviewed harvest strategy. However, while there is evidence that it is achieving its objectives including being clearly able to maintain stocks at target levels, the performance of the harvest strategy has not been fully evaluated so it does not meet the second scoring issue of SG 100. A score of 95 is therefore given.

Audit Trace References

DFO 2007a, DFO 2011c, DFO 2012, Roddick *et al.* 2007.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
1.2.2	<p>Harvest control rules and tools: There are well defined and effective harvest control rules in place</p>	<p><u>Generally understood</u> harvest control rules are in place that are consistent with the harvest strategy and which act to reduce the exploitation rate as limit reference points are approached.</p> <p>There is <u>some evidence</u> that tools used to implement harvest control rules are appropriate and effective in controlling exploitation.</p>	<p><u>Well defined</u> harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.</p> <p>The <u>selection</u> of the harvest control rules takes into account the <u>main</u> uncertainties.</p> <p><u>Available evidence indicates</u> that the tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules</p> <p>The <u>design</u> of the harvest control rules take into account a <u>wide</u> range of uncertainties.</p> <p><u>Evidence clearly shows</u> that the tools in use are effective in achieving the exploitation levels required under the harvest control rules.</p>

Scoring Comments

The annual Arctic surfclam exploitation rate on Banquereau is controlled through limited licences and a TAC. The TAC in recent years has been set at $F_{MSY/(600,000 t)}$, which is below the stated future target level of $F_{MCY} = 0.026$ of the stock biomass that exist in densities $> 75 \text{ g/m}^2$ (= 1 - 2% of the biomass per year). The TAC is set at a very precautionary level because of the long time interval between surveys (4/5 years), taking into account uncertainties with the estimation of biomass, recruitment and gear efficiency. $F_{MSY/600,000t}$ can currently be considered to be an implicit target reference point (TRP), which indicates that $B_{MSY/600,000t}$ is the target biomass. Catches are closely monitored, via 100% VMS, 100% dockside monitoring, fishing logbooks, and occasional at-sea observers, and together these ensure that exploitation will decrease to zero as the TAC is approached. MSC guidance indicates that in the absence of explicit limit reference points (LRP), an appropriately conservative assumption is that LRP is $\frac{1}{2}$ of the target reference point (MSC 2010b). The fishery has been constantly well above this level, and it is generally understood between CSLP and DFO that the stock should be maintained at or close to the virgin biomass level. In addition, the market realities and operational costs of the offshore Arctic surfclam fishery are such that fishing would be limited by economic considerations long before the biology of the resource was at risk. As the stocks on Banquereau do not appear to have deviated significantly from virgin biomass levels over 25 years fishing, it may be concluded that the current TAC has achieved the primary biological objective of the IFMP.

Score: 70

This fishery is managed on a very precautionary basis, with a low annual exploitation rate and a conservatively set TAC, the uptake of which is closely monitored, so that the stock is still at, or around, the virgin biomass level after 25 years of fishing. This has resulted from a generally understood harvest control rule between CSLP and DFO, so meeting the first and second scoring issues of SG 60. However, there are no analytically determined reference points and there are no well-defined harvest control rules stating under what circumstances action would be triggered to ensure that the exploitation rate is reduced as limit reference points are approached. The fishery does not, therefore, meet the first and second scoring issues of SG 80, although the tools in use (limited licences, conservative TAC) are appropriate and have been effective in maintaining a low exploitation rate, so that the third scoring issue of SG 80 is met. The score of 70 requires that a Condition is set.

Audit Trace References

DFO 2006, DFO 2010, DFO 2011c, MSC (2010b).

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>1.2.3</p>	<p>Information / monitoring: Relevant information is collected to support the harvest strategy</p>	<p><u>Some</u> relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.</p> <p>Stock abundance and fishery removals are monitored and at least one indicator is available and monitored with sufficient frequency to support the harvest control rule.</p>	<p><u>Sufficient</u> relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy.</p> <p>Stock abundance and fishery removals are <u>regularly monitored at a level of accuracy and coverage consistent with the harvest control rule</u>, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.</p> <p>There is good information on all other fishery removals from the stock.</p>

Scoring Comments
<p>Information on biomass, stock structure and productivity is collected through occasional (4/5 years) but comprehensive scientific surveys. Size and age structure and relevant biological information, including age at maturity is collected.</p> <p>The fishery is limited to three licenses and up to four vessels only, so fleet composition is very well understood. Other information, including fishing location and fishery removals is collected at high resolution, through excellent catch monitoring, via 100% VMS, 100% DMP, fishing logbooks, and occasional at-sea observers, and no other fisheries remove Arctic surfclam from the relevant areas in significant quantities.</p> <p>A very good range of information on stock structure, stock abundance, productivity, fleet composition and fisheries removals etc is available for this fishery. However, recruitment dynamics are not well understood and, given the importance of the estimate of natural mortality (M) in setting the target fishing mortality and TAC, it is a potential weakness that the fishery managers rely on the simple relationships $Z = 3/T_{max}$, where T_{max} is the lifespan, and $M = Z$ for an unfished stock (Amaratunga and Rowell 1986). This gives a value of $M=0.08$ and this value has been uncritically accepted as the default value for the Banquereau stock (and for the Grand Bank stock), when it is likely that M varies both temporally and spatially. The uncertainties associated with the acceptance of this default value have not been evaluated. Similarly, although incidental mortality has been shown to reduce F_{max} and $F_{0.1}$ the implications of incorporating incidental mortality into the process of setting TACs has not been evaluated.</p>
<p>Score: 90</p>
<p>The fishery meets SG 60 and SG 80, and the information available is sufficiently comprehensive to meet the first scoring issue of SG 100. However, with only infrequent surveys it cannot be said that the information is available at a high frequency (although it is perhaps at a frequency suitable for the stock) and the uncertainties associated with</p>

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

recruitment, incidental mortality and the accepted M value throw some doubts on the robustness of the assessment so the fishery fails to meet the second scoring issue of SG 100.

Audit Trace References

DFO 2007a, DFO 2007d, DFO 2011c, Roddick & Smith 1999, Roddick *et al.* 2007

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>1.2.4</p>	<p>Assessment of stock status: There is an adequate assessment of the stock status</p>	<p>The assessment estimates stock status relative to reference points.</p> <p>The assessment identifies major sources of uncertainty.</p>	<p>The assessment is appropriate for the stock and for the harvest control rule, and is evaluating stock status relative to reference points.</p> <p>The assessment takes uncertainty into account.</p> <p>The assessment of stock status is subject to peer review.</p> <p>The assessment is appropriate for the stock and for the harvest control rule and takes into account the major features relevant to the biology of the species and the nature of the fishery.</p> <p>The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a probabilistic way.</p> <p>The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.</p> <p>The assessment has been <u>internally and externally</u> peer reviewed.</p>

Scoring Comments

The Banquereau Arctic surfclam beds have been surveyed, using efficient gear and the sessile nature of the species means that confidence limits around the biomass estimates are narrow. This assessment of stock status is appropriate for management that is based on setting precautionary TACs that have maintained fishing mortality at a low level. The assessments are conservative because sampling gear is assumed to be fishing at 100% efficiency and the selection of an appropriate target F value and TAC is cautious because of the low frequency of the biomass surveys (every 4/5 years).

Age distribution and density is known, as are the age at maturity, maximum biomass per recruit, and size and age of selectivity by the gear. Incidental mortality has been determined at 15% and while the effect of this has been recognised, it has not been specifically incorporated into the assessment. Other major sources of uncertainty have been identified and are taken into account. The assessment is appropriate for the stock and takes into account the major features relevant to the biology of the species and the nature of the fishery. The assessment is also appropriate for the generally understood harvest control rule, as is referred to under PI 1.2.2. The assessment is subject to extensive internal review during the RAP process, and there was also external peer review in the 2007 Framework process.

Score: 85

The fishery meets SG 60 and SG 80, and the first scoring issue of SG 100 but the other scoring issues are not met. Thus, while some uncertainties are taken into account, these have not been considered in a probabilistic way. The assessment process has not been extensively tested and, although some alternative approaches have been tried, they cannot be said to have been rigorously explored and although there is a good level of internal peer review in the RAP process there is little external input. A score of 85 is therefore awarded.

Audit Trace References

DFO, 2007a, DFO 2007d, DFO 2011c, Roddick & Smith 1999; Roddick *et al.* 2007

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

Principle 2	Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends		
--------------------	---	--	--

2.1	Retained non-target species		
------------	------------------------------------	--	--

2.1.1	<p><i>Status:</i> The fishery does not pose a risk of serious or irreversible harm to the retained species and does not hinder recovery of depleted retained species.</p>	<p>Main retained species are <u>likely</u> to be within biologically based limits or if outside the limits there are <u>measures</u> in place that are <u>expected</u> to ensure that the fishery does not hinder recovery and rebuilding of the depleted species.</p> <p>If the status is poorly known there are measures or practices in place that are expected to result in the fishery not causing the retained species to be outside biologically based limits or hindering recovery.</p>	<p>Main retained species are <u>highly likely</u> to be within biologically based limits, or if outside the limits there is a <u>partial strategy</u> of <u>demonstrably effective</u> management measures in place such that the fishery does not hinder recovery and rebuilding.</p>	<p>There is a <u>high degree of certainty</u> that retained species are within biologically based limits.</p> <p>Target reference points are defined and retained species are at or fluctuating around their target reference points.</p>
--------------	---	---	--	---

Scoring Comments

The catch of species other than Arctic surfclam that may be retained in the Banquereau fishery is limited by licence conditions to northern propellerclam, Greenland cockle, ocean quahog and whelk. Sampling from the 2005 fishery showed that northern propellerclam made up 4% of the catch, but no other retained species made up more than 0.2% of the catch (DFO 2007a). Although the 2005 catch data relied upon for this assessment is relatively old, there is no reason to expect the relative quantities of the catch to have changed significantly and, as such, there are considered to be no 'main' retained species in the Banquereau Arctic surfclam fishery.

Northern propellerclam is a long-lived, slow-growing species, and analysis of commercial catches from Banquereau showed that the population is dominated by old animals up to more than 100 years of age. The species is widely distributed across the northern Atlantic from Cape Cod to Norway, and maturation occurs relatively early at 4.7 years of age or 28.6 mm shell length (Kilada *et al.* 2009). This size is likely to be well below the size of selection in the Arctic surfclam fishery where the bar spacing in the hydraulic dredges is 28mm, because of the selectivity acting across the height of the animals (the smallest shell dimension) rather than the shell length. There is no specific targeting of northern propellerclam on Banquereau or the wider Scotian Shelf, and so it appears highly likely that the fishery has only a minimal impact on this species.

Greenland cockles have been studied relatively little, although they are known to have a circum-polar distribution in the northern hemisphere. It is estimated that this species matures at a minimum size and age of 28 mm and 2.8 years for males, and 37 mm and 3.7 years for females (Kilada *et al.* 2007). This is likely to be well below the size at which they would be selected by the commercial Arctic surfclam fishery, again because of the selectivity acting across the height of the animals rather than the shell length. There is no other fishery for Greenland cockle on Banquereau or the wider Scotian Shelf, and so it appears highly likely that the fishery has only a minimal impact on this species.

Ocean quahogs (0.06% of the 2005 sampled catch) and whelks (0.19% of the 2005 sampled catch) are taken in only tiny amounts in the Banquereau fishery (DFO 2007a). These species are widely distributed in the North Atlantic, and the ocean quahog stock on Sable Bank exceeds 1,300,000 t (DFO 2007a), while whelk is reported to occur in greatest densities at a depth of 15 - 30 m (DFO 2009a), shallower than the depth at which the Arctic surfclam fishery occurs. The offshore Scotian Shelf stock of neither species

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

is subject to targeted fishing (ocean quahog: DFO 2007a, whelk: DFO 2009a), and there is no reason to suspect that the Banquereau Arctic surfclam fishery poses a risk to the stocks of retained species.

Score: 90

The very limited quantities of retained species taken in the fishery, in combination with their widespread distribution and limited removals in this and other fisheries, allow for a high degree of certainty that retained species are within biologically-based limits, and so the fishery meets the first scoring issue of SG 100. However, target reference points are not defined, and so the fishery does not meet the second scoring issue of SG 100. A score of 90 is therefore awarded.

Audit Trace References

DFO 2007a, DFO 2009a, Kilada *et al.* 2007, Kilada *et al.* 2009

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>2.1.2</p>	<p>Management strategy: There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species.</p>	<p>There are <u>measures</u> in place, if necessary, that are expected to maintain the main retained species at levels which are highly likely to be within biologically based limits, or to ensure the fishery does not hinder their recovery and rebuilding.</p> <p>The measures are considered <u>likely</u> to work, based on <u>plausible argument</u> (e.g., general experience, theory or comparison with similar fisheries/species).</p>	<p>There is a <u>partial strategy</u> in place, if necessary that is expected to maintain the main retained species at levels which are highly likely to be within biologically based limits, or to ensure the fishery does not hinder their recovery and rebuilding.</p> <p>There is some <u>objective basis for confidence</u> that the partial strategy will work, based on some information directly about the fishery and/or species involved.</p> <p>There is <u>some evidence</u> that the partial strategy is being <u>implemented successfully</u>.</p>

Scoring Comments

The bar spacing employed in the dredges ensures that northern propellerclam and Greenland cockle are unlikely to be selected for in the Banquereau Arctic surfclam fishery until well after they have matured. Maturity data on ocean quahog suggest that some individuals may be below the age of first maturity when first selected (DFO 2007a), but Banquereau represents marginal habitat for this species, and a much larger stock exists nearby on Sable Bank. Whelks are found in greatest abundance at a shallower depth than that at which the Arctic surfclam fishery occurs on Banquereau (DFO 2009a). These features, including that only a small area ($\approx 1.4\%$) of the bank is fished each year, constitute a partial strategy to manage retained species bycatch. Landed catch data from the fishery, as well as biological data collected during surveys, provide evidence that the catches are being maintained at a low level and the stocks of retained species have not been impacted significantly by the fishery.

Score: 80

There are no main retained species, but in any case the measures in place to manage the Arctic surfclam fishery constitute a partial strategy that is expected to maintain retained species at levels which are highly likely to be within biologically-based limits, so meeting the first scoring issue of SG 80. There is objective basis for confidence that the partial strategy will work, based on evidence from the landings and survey data that show the catches are being maintained at very low levels, and because the age of maturity is well before the animals are likely to be selected for. These data also provide evidence that the partial strategy is being implemented successfully, so meeting the second and third scoring issues of SG 80. A lack of specific objectives pertaining to bycatch levels, and therefore the existence of a specific strategy for managing retained species, prevents the fishery from scoring higher for this performance indicator.

Audit Trace References

DFO 2007a, DFO 2009a

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100	
<p>2.1.3</p>	<p>Information / monitoring: Information on the nature and extent of retained species is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage retained species.</p>	<p><u>Qualitative information</u> is available on the amount of main retained species taken by the fishery.</p> <p>Information is <u>adequate</u> to <u>qualitatively</u> assess outcome status with respect to biologically based limits.</p> <p>Information is adequate to support <u>measures</u> to manage <u>main</u> retained species.</p>	<p><u>Qualitative information</u> and some quantitative information are available on the amount of main retained species taken by the fishery.</p> <p>Information is <u>sufficient</u> to estimate outcome status with respect to biologically based limits.</p> <p>Information is adequate to support a <u>partial strategy</u> to manage <u>main</u> retained species.</p> <p>Sufficient data continue to be collected to detect any increase in risk level (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the strategy).</p>	<p>Accurate and verifiable information is available on the catch of all retained species and the consequences for the status of affected populations.</p> <p>Information is <u>sufficient</u> to <u>quantitatively</u> estimate outcome status with a <u>high degree of certainty</u>.</p> <p>Information is adequate to support a <u>comprehensive strategy</u> to manage retained species, and evaluate with a <u>high degree of certainty</u> whether the strategy is achieving its objective.</p> <p>Monitoring of retained species is conducted in sufficient detail to assess ongoing mortalities to all retained species.</p>

Scoring Comments

The Banquereau Arctic surfclam fishing vessels are monitored continuously with VMS, and dockside monitoring occurs at all landings. There is a licence condition limiting ocean quahog catches to 500 t or 10% of the Arctic surfclam catch, but catches are tiny, and in combination with the absence of a quota for northern propellerclam, Greenland cockle or whelk, this means that there is comprehensive reporting of all retained species catches (i.e. because there is no incentive for under-reporting bycatch levels). However, it is understood that the actual landings data are confidential due to the small number of vessels and single company prosecuting the fishery. Fisheries-independent survey data are, though, available that provide information on bycatch species including retained molluscan shellfish (DFO 2007a). Little or no quantitative analysis has apparently been undertaken on the catch or survey data in order to understand the impacts of the fishery on the retained species, but the information on size at maturity and age structure in the stocks (e.g. Northern propellerclam- Kilada *et al.* 2007, Greenland cockle- Kilada *et al.* 2007), habitat preferences of the different species, as well as the swept area of the fishery, suggest strongly that the Banquereau Arctic surfclam fishery does not pose a risk to stocks of retained species.

Score: 90

The comprehensive VMS and dockside monitoring of the fishery provide accurate and verifiable information on the catches of all retained species, while the broad age structure of the stocks, fishing activity distribution and absence of other fisheries targeting these species or taking large quantities as bycatch on the offshore Scotian Shelf is adequate to understand the consequences for the status of all affected populations, so meeting the first scoring issue of SG 100. Information is also adequate to support a comprehensive strategy to manage these species, and to evaluate with a high degree of certainty if it was achieving its objective, so meeting the third scoring issue of SG 100. The information is sufficient to estimate outcome status with respect to biologically based limits, and to detect an increase in risk level, so meeting the second and fourth scoring issues of SG 80. Overall, the fishery scores 90 for this PI.

Audit Trace References

DFO 2007a, Kilada *et al.* 2007, Kilada *et al.* 2009.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

2.2	Discarded species (also known as “bycatch” or “discards”)		
-----	--	--	--

2.2.1	<p>Status The fishery does not pose a risk of serious or irreversible harm to the bycatch species or species groups and does not hinder recovery of depleted bycatch species or species groups.</p>	<p>Main bycatch species are <u>likely</u> to be within biologically based limits, or if outside such limits there are mitigation <u>measures</u> in place that are <u>expected</u> to ensure that the fishery does not hinder recovery and rebuilding.</p> <p>If the status is poorly known there are measures or practices in place that are expected to result in the fishery not causing the bycatch species to be outside biologically based limits or hindering recovery.</p>	<p>Main bycatch species are <u>highly likely</u> to be within biologically based limits or if outside such limits there is a <u>partial strategy</u> of <u>demonstrably effective</u> mitigation measures in place such that the fishery does not hinder recovery and rebuilding.</p>	<p>There is a <u>high degree of certainty</u> that bycatch species are within biologically based limits.</p>
-------	--	--	---	--

Scoring Comments			
-------------------------	--	--	--

Sampling from the 2005 Banquereau fishery showed that sand dollars, *Echinarachnius parma*, made up just over 5% of the catch. No other bycatch species made up more than 0.5% of the total (DFO 2007a). A survey of the bank also recorded *E. parma* as being the only species that could be considered to be a 'main' bycatch species, but it comprised a higher percentage (12.5%) of the survey catch. These data are not necessarily representative of the commercial fishery, however, as the survey covers a wider area than is fished in the commercial fishery, including marginal habitats for Arctic surfclam, and employs a dredge with a narrower bar spacing that is likely to retain a higher proportion of the animals in the path of the dredge.

While observed catches make up part of the impact of the fishery on bycatch species, there will also be an unobserved fishing mortality of animals located in the path of the dredge that are either swept aside or pass through the dredge bars. This is certainly the case for northern propellerclam as a retained species (Gilkinson *et al.* 2005), but is also highly likely for fragile species such as *E. parma*. However, while the magnitude of post-dredging mortality is not known, Gilkinson *et al.* (2005) reported little or no change in abundance of *E. parma* immediately post experimental dredging. Also, this echinoderm species is very widespread, with a circumpolar distribution in the northern hemisphere (Mooi & Telford 1982).

There is very likely to be some unobserved mortality of the other bycatch species recorded in the fishery data; the greatest catch of any other species was for the Holothuroidea (sea cucumbers), which made up 0.48% of the total. The fish species taken in greatest quantity were thorny skate and seasnail, which accounted for 0.03% of the survey catch and 0.06% of the commercial catch respectively. Although some unobserved mortality of fish species will occur, it is considered that these quantities will be negligible given the very limited quantities taken as bycatch. When considering that only $\approx 1.4\%$ of Banquereau is fished each year, it appears very unlikely that the fishery poses a risk to stocks of bycatch species.

Score: 80			
------------------	--	--	--

The widespread distribution of *E. parma*, evidence of lack of change in the population post-dredging, and limited swept area of the fishery mean that this single main bycatch species is highly likely to be within biologically-based limits, so meeting SG 80. However, lack of a specific assessment of bycatch species against biologically-based limits

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

prevents the fishery from meeting the high degree of certainty required for SG 100.

Audit Trace References

DFO 2007a, Gilkinson *et al.* 2005, Mooi & Telford 1982.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>2.2.2</p> <p>Management strategy: There is a strategy in place for managing bycatch that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to bycatch populations.</p>	<p>There are <u>measures</u> in place, if necessary, which are expected to maintain main bycatch species at levels which are highly likely to be within biologically based limits or to ensure that the fishery does not hinder their recovery.</p> <p>The measures are considered <u>likely</u> to work, based on <u>plausible argument</u> (e.g. general experience, theory or comparison with similar fisheries/species).</p>	<p>There is a <u>partial strategy</u> in place, if necessary, for managing bycatch that is expected to maintain main bycatch species at levels which are highly likely to be within biologically based limits or to ensure that the fishery does not hinder their recovery.</p> <p>There is <u>some objective basis for confidence</u> that the partial strategy will work, based on some information directly about the fishery and/or the species involved.</p> <p>There is <u>some evidence</u> that the partial strategy is being implemented successfully.</p>	<p>There is a <u>strategy</u> in place for managing and minimising bycatch.</p> <p>The strategy is mainly based on information directly about the fishery and/or species involved, and testing supports <u>high confidence</u> that the strategy will work.</p> <p>There is some <u>evidence</u> that the strategy is achieving its objective.</p> <p>There is <u>clear evidence</u> that the strategy is being implemented successfully, and intended changes are occurring.</p>

Scoring Comments

The only main bycatch species in the Banquereau Arctic surfclam fishery is sand dollar, *E. parma* (DFO 2007a). This species is very widely distributed (Mooi & Telford 1982), and is not a target species in any fishery. Additionally, although the levels of unobserved mortality of animals that pass through or are swept aside by the dredge may be significant but are unknown, little or no change in abundance of *E. parma* was reported immediately following experimental dredging (Gilkinson *et al.* 2005). In fact, the dredge design, with a space between the dredge head and the cage, will allow some animals in the path of the dredge to escape before being retained. Most importantly, though, only 1.4% of the bank is fished with dredges each year, ensuring the benthic community is minimally impacted.

The IFMP also contains an objective specifically related to bycatch; this is:

- Minimize incidental mortality of non-target species.

The on-going long-term dredge impacts study on Banquereau (e.g. Gilkinson *et al.* 2005) is being undertaken specifically to address concerns over benthic community impacts.

Score: 95

The characteristics and location of the fishery, in combination with the community present on Banquereau, ensure that bycatch is maintained at low levels; together with the on-going long-term dredge study and the formal objective of the IFMP, these features comprise a strategy for managing and minimising bycatch, so meeting the first scoring issue of SG 100. The strategy is based on information directly about the fishery and species involved, and there is specific evidence from experimental work that supports high confidence that the strategy will work and that it is achieving its objective, so meeting the second and third scoring issues of SG 100. While there is evidence that the strategy is

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

being implemented successfully, it is not clear that changes are intended or are occurring, so meeting the third scoring issue of SG 80. Any unnecessary bycatch must be considered to be unwelcome, but there are generally very low levels of bycatch of most species, while *E. parma*, as the single bycatch species taken in relatively large quantities, is abundant and widely distributed. A score of 95 is awarded for this performance indicator.

Audit Trace References

DFO 2007a, DFO 2011c, Gilkinson *et al.* 2005, Mooi & Telford 1982.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>2.2.3</p> <p><i>Information / monitoring</i> Information on the nature and amount of bycatch is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage bycatch.</p>	<p><u>Qualitative information</u> is available on the amount of main bycatch species affected by the fishery.</p> <p>Information is <u>adequate to broadly understand</u> outcome status with respect to biologically based limits.</p> <p>Information is adequate to support <u>measures</u> to manage bycatch.</p>	<p><u>Qualitative information and some quantitative information</u> are available on the amount of main bycatch species affected by the fishery.</p> <p>Information is sufficient to estimate outcome status with respect to biologically based limits.</p> <p>Information is adequate to support a <u>partial strategy</u> to manage main bycatch species.</p> <p>Sufficient data continue to be collected to detect any increase in risk to main bycatch species (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the strategy).</p>	<p><u>Accurate and verifiable information</u> is available on the amount of all bycatch and the consequences for the status of affected populations.</p> <p>Information is <u>sufficient</u> to quantitatively estimate outcome status with respect to biologically based limits with a <u>high degree of certainty</u>.</p> <p>Information is adequate to support a <u>comprehensive strategy</u> to manage bycatch, and evaluate with a high degree of certainty whether a strategy is achieving its objective.</p> <p>Monitoring of bycatch data is conducted in sufficient detail to assess ongoing mortalities to all bycatch species.</p>

Scoring Comments

Survey and fishery data provide quantitative information on the amount of bycatch taken in the Banquereau Arctic surfclam fishery. The sand dollar, *E. parma*, is the only main bycatch species (DFO 2007a). No formal assessment has been undertaken to determine how or if the fishery impacts this species with respect to biologically-based limits, but information on its widespread distribution (Mooi & Telford 1982), the extent of the fishery, and lack of observed impact on numbers after experimental dredging (Gilkinson *et al.* 2005), is sufficient to determine that the fishery poses no risk to this species. The fishery is also considered to pose no risk to the other bycatch species, based on the very limited quantities taken and annually small spatial extent of the fishery.

Observers are only carried on an average of 1 trip out of 20 per year (CSLP, pers. comm.), but the landed catch and VMS data are comprehensive, providing information on the likely levels of bycatch in the fishery based on relative quantities of catch and area swept; this provides sufficient detail to determine any increase in risk to bycatch species.

Score: 80

Qualitative and some quantitative information is available on the amount of bycatch taken in the fishery, which is sufficient to estimate outcome status with respect to biologically based limits. The fishery therefore meets the first and second scoring issues of SG 80. Information is adequate to support a partial strategy to manage bycatch species, and sufficient data continue to be collected to detect any increase in risk to main bycatch species, so meeting the third and fourth scoring issues of SG 80. In order to score higher, accurate and verifiable information on the amount of all bycatch would need to be collected more frequently and in greater detail aboard the fishing vessels, and

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

the consequences for the status of affected populations, including with respect to biologically based limits, would need to be assessed.

Audit Trace References

DFO 2007a, Gilkinson *et al.* 2005, Mooi & Telford 1982.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

2.3 Endangered, Threatened and Protected (ETP) species
--

<p>2.3.1</p>	<p>Status: The fishery meets national and international requirements for protection of ETP species.</p> <p>The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species.</p>	<p>Known effects of the fishery are <u>likely</u> to be within limits of national and international requirements for protection of ETP species.</p> <p>Known direct effects are <u>unlikely</u> to create <u>unacceptable impacts</u> to ETP species.</p>	<p>The effects of the fishery are known and are <u>highly likely</u> to be within limits of national and international requirements for protection of ETP species.</p> <p>Direct effects are <u>highly unlikely</u> to create <u>unacceptable impacts</u> to ETP species.</p> <p>Indirect effects have been considered and are thought to be unlikely to create unacceptable impacts.</p>	<p>There is a <u>high degree of certainty</u> that the effects of the fishery are within limits of national and international requirements for protection of ETP species.</p> <p>There is a <u>high degree of confidence</u> that there are <u>no significant detrimental effects (direct and indirect)</u> of the fishery on ETP species.</p>
---------------------	--	---	---	--

Scoring Comments

MSC guidance is that species on non-binding lists (e.g. the IUCN Red List) or requirements that are recognised at intergovernmental level (e.g. FAO International Plans of Action) but that are not included in national legislation or binding international agreements etc. shall be assessed under performance indicators covering retained or bycatch species (MSC 2010a). As such, species that are listed by COSEWIC but are not SARA-listed are considered under PI 2.1.1 - PI 2.2.3, and it is only SARA-listed or internationally protected species that are considered to be ETP species under this assessment.

It is very unlikely that any ETP species of seabird, whale, dolphin or turtle will be impacted by the gear directly, and there is no suggestion that the fishery would cause indirect harm to habitats or feeding opportunities for these species; none of these species have been reported in survey or catch data. It is therefore only the SARA-listed northern, spotted and Atlantic wolffish as ETP species that are of potential relevance to the Arctic surfclam fishery. However, while Banquereau is within the potential geographic range of these three wolffish, in all cases, survey and catch data indicate that no direct mortality occurs (DFO 2007a, Roddick *et al.* 2007). Importantly, the distribution of the three wolffish species is focused in deeper water than is fished for Arctic surfclam, while the potential for the fishery to impact spawning sites is very low due to the reported preference for wolffish to spawn in stony or rocky habitats (Kulka *et al.* 2007).

Score: 100

There are no reports of ETP species being taken in the Grand Bank Arctic surfclam fishery, and there is a high degree of certainty that the effects of the fishery are within limits of national and international requirements for protection of ETP species (i.e. for wolffish, as specified by Kulka *et al.* 2007), and there is a high degree of confidence that there are no significant detrimental direct or indirect effects of the fishery on ETP species. All the scoring issues are therefore met and a score of 100 is awarded to the fishery.

Audit Trace References

DFO 2007a, Kulka *et al.* 2007, Roddick *et al.* 2007.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>2.3.2</p>	<p>Management strategy The fishery has in place precautionary management strategies designed to:</p> <ul style="list-style-type: none"> - meet national and international requirements; - ensure the fishery does not pose a risk of serious or irreversible harm to ETP species; - ensure the fishery does not hinder recovery of ETP species; and - minimise mortality of ETP species. 	<p>There are <u>measures</u> in place that minimise mortality, and are expected to be highly likely to achieve national and international requirements for the protection of ETP species.</p> <p>The measures are <u>considered likely</u> to work, based on <u>plausible argument</u> (eg general experience, theory or comparison with similar fisheries/species).</p>	<p>There is a <u>strategy</u> in place for managing the fishery's impact on ETP species, including measures to minimise mortality, that is designed to be highly likely to achieve national and international requirements for the protection of ETP species.</p> <p>There is an <u>objective basis for confidence</u> that the strategy will work, based on <u>information</u> directly about the fishery and/or the species involved.</p> <p>There is <u>evidence</u> that the strategy is being implemented successfully.</p> <p>There is a <u>comprehensive strategy</u> in place for managing the fishery's impact on ETP species, including measures to minimise mortality, that is designed to achieve <u>above</u> national and international requirements for the protection of ETP species.</p> <p>The strategy is mainly based on information directly about the fishery and/or species involved, and a <u>quantitative analysis</u> supports <u>high confidence</u> that the strategy will work.</p> <p>There is <u>clear evidence</u> that the strategy is being implemented successfully, and intended changes are occurring. There is evidence that the strategy is achieving its objective.</p>

Scoring Comments
<p>The hydraulic dredge gear employed in the Arctic surfclam fishery has a very low and narrow mouth opening, such that the potential for large ETP species, such as whales or turtles, to be impacted appears to be almost non-existent. There is no reason to suspect that ETP seabirds are impacted in any way by the fishery. Also, the gear can only be operated efficiently on well-sorted sandy sediments; in order to ensure the gear is only used on suitable sediments, the vessels are equipped with Roxanne seabed discrimination systems (CSLP, pers. comm.). As such, and because the Arctic surfclam fishery occurs in shallower waters than the main areas of wolffish abundance, while wolffish also prefer to spawn in rocky substrates (Kulka <i>et al.</i> 2007), the potential for the fishery to impact wolffish or their habitat is very limited. Survey and catch data support these assertions (DFO 2007a). These features of the fishery can be regarded as a strategy for managing the fishery's impact on ETP species.</p> <p>The IFMP requires that the offshore clam fishery participants take all feasible measures to minimize the impact on listed species and their residences, and that the survival or recovery of listed species will not be jeopardized. The Species at Risk Act (2002) also requires that <i>A. denticulatus</i> or <i>A. minor</i> captured while fishing must be returned to the place from which they were taken, and where they are alive, in a manner that causes them the least harm.</p>
<p>Score: 80</p>
<p>Features of the fishery can be considered to be a strategy for managing its potential impact on ETP species that is designed to be highly likely to achieve national and international requirements, and so the fishery meets the first scoring issue of SG 80. There is an objective basis for confidence that the strategy will work, based on information directly about the fishery and on the species involved. Data from the fishery provides evidence that the strategy is being implemented successfully, such that the fishery meets the second and third scoring issues of SG 80. It is not considered that the strategy is designed to achieve above national and international requirements, and no quantitative analysis has been undertaken, so preventing the fishery from meeting the first and second scoring issues of SG 100, while a greater level of observer coverage would be required in order to meet the final scoring issue of SG 100.</p>
<p>Audit Trace References</p>
<p>DFO 2007a, DFO 2011c, Kulka <i>et al.</i> 2007.</p>

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>2.3.3 <i>Information / monitoring</i> Relevant information is collected to support the management of fishery impacts on ETP species, including:</p> <ul style="list-style-type: none"> - information for the development of the management strategy; - information to assess the effectiveness of the management strategy; and - information to determine the outcome status of ETP species. 	<p>Information is <u>adequate</u> to <u>broadly understand</u> the impact of the fishery on ETP species.</p> <p>Information is adequate to support <u>measures</u> to manage the impacts on ETP species</p> <p><u>Information</u> is sufficient to <u>qualitatively</u> estimate the fishery related mortality of ETP species.</p>	<p>Information is <u>sufficient</u> to determine whether the fishery may be a threat to protection and recovery of the ETP species, and if so, to measure trends and support a <u>full strategy</u> to manage impacts.</p> <p><u>Sufficient data</u> are available to allow fishery related mortality and the impact of fishing to be <u>quantitatively</u> estimated for ETP species.</p>	<p>Information is <u>sufficient</u> to <u>quantitatively</u> estimate outcome status with a high degree of certainty.</p> <p>Information is adequate to support a <u>comprehensive strategy</u> to manage impacts, minimize mortality and injury of ETP species, and evaluate with a high degree of certainty whether a strategy is achieving its objectives.</p> <p><u>Accurate and verifiable information</u> is available on the magnitude of all impacts, mortalities and injuries and the consequences for the status of ETP species</p>

Scoring Comments

The CSLP vessels engaged in the Banquereau Arctic surfclam fishery are monitored 100% of the time with VMS, logging each vessel's location and speed. Northern, spotted and Atlantic wolffish are the species that appear to be at greatest risk from the fishery as their ranges overlap with the fishery (Kulka *et al.* 2007). However, information on habitat preferences suggest that all three wolffish prefer deeper water than is targeted by the fishery, and that they prefer rockier bottoms for spawning than is targeted. Also, the available survey and fishery catch data show an absence of wolffish in Arctic surfclam catches from Banquereau (DFO 2007a), and no wolffish were reported in surveys of fishery catches from the Grand Bank from 2004 - 2009 (DFO 2010). These data provide confidence that the fishery does not pose a direct or indirect threat to the protection or recovery of ETP species.

Score: 85

Information is sufficient to determine that the fishery is not a threat to the protection and recovery of ETP species, so meeting the first scoring issue of SG 80. Information on fishing location, habitat preference for the three wolffish species, gear type and substrate limitations of the gear, as well as catch and survey data, is adequate to support a comprehensive strategy to manage impacts (even if one is not in place), and to evaluate with a high degree of certainty whether the strategy was achieving its objectives, so meeting the second scoring issue of SG 100. Greater amounts of accurate and verifiable information from the commercial fishery, for example through an increased level of observer coverage, that also allowed the qualitative estimation of outcome status with a high degree of certainty, would be required for the fishery to achieve a higher score.

Audit Trace References

DFO 2007a, DFO 2010, Kulka *et al.* 2007.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

2.4	Habitat		
-----	----------------	--	--

2.4.1	<i>Status</i> The fishery does not cause serious or irreversible harm to habitat structure, considered on a regional or bioregional basis, and function.	The fishery is <u>unlikely</u> to reduce habitat structure and function to a point where there would be serious or irreversible harm.	The fishery is <u>highly unlikely</u> to reduce habitat structure and function to a point where there would be serious or irreversible harm.	There is <u>evidence</u> that the fishery is highly unlikely to reduce habitat structure and function to a point where there would be serious or irreversible harm.
-------	--	---	--	---

Scoring Comments			
-------------------------	--	--	--

Hydraulic dredges can only be used effectively in sandy sediments, and Arctic surfclams are found in relatively shallow depths of less than 110 m. The commercially exploited Arctic surfclam beds are found in depths of ≤ 70 m. Available data suggest that the bottom habitats of Banquereau at such depths are impacted by wave and tidal disturbance, and that the surface sediments are likely to be mobilised at frequent intervals (Kostylev 2004, Stanley *et al.* 1972).

An experimental dredge impact study was started on Banquereau in 1998, and repeat surveys have been undertaken to assess recovery. The survey area is 70-80 m depth, such that habitat recovery might be expected to be as slow as is ever likely to occur on the commercial beds (i.e. deep areas are likely to recover slower than shallow areas as natural perturbation is lessened at deeper depths). Although dredging produces pronounced tracks through fluidising and digging through the sediment at depths of up to 20 cm, visual evidence of the tracks had disappeared in the experimental site after one year (Gilkinson *et al.* 2005). Preliminary results indicated that side-scan sonar was barely able to detect dredge tracks after 10 years (DFO pers. comm.). This contrasts with evidence from a site at 40 m depth on Sable Bank, where 6 of 12 dredge tracks were reported to be undetectable after just one year (DFO 2010). This recovery time is not inconsistent with the high level of exposure (Kostylev 2004) and well-sorted sand habitat (Stanley *et al.* 1972) of Banquereau.

An important consideration for this PI is the MSC's interpretation of the words 'serious' and 'irreversible' in relation to harm. It is stated: "*Serious harm relates to gross change in habitat types or abundances, and disruption of the role of the habitats. Irreversibility relates to changes that are expected to take much longer to recover than the dynamics in unfished situations would imply (e.g. some sort of regime change is implied from which recovery may not automatically occur) ... The full extent of the habitats shall be considered in assessing the status of habitats and the impacts of fishing, and not just the part of the habitats that overlap with the fishery.*" (MSC 2010a).

Although some habitat disturbance clearly occurs through the use of hydraulic dredges, the area covered by the tracks is small in comparison to the area of the bank at 10,900 square km. Since 1986, on Banquereau, approximately 2,220 square km have been swept, but this figure takes no account of repeated dredging of any site, or of any overlap of tows, which certainly occurs. The average annual area swept during the period 2002 - 2006 was approximately 140 square km, representing 1.4% of the known surfclam habitat on Banquereau; this figure also takes no account of repeated dredging of any site or of overlap of tows (DFO 2007a). As such, these figures represent the worst-case scenario. However, after a fallow period of approximately 10 years, the fishery has returned to areas that were previously found to support high Arctic surfclam biomass, suggesting that some sites will be fished more frequently and intensively than others, thereby limiting the geographic range of impact (CSLP, pers. comm.).

Score: 100

Specific work undertaken to determine the impact of the Arctic surfclam fishery on the seabed habitat of Banquereau provides evidence that the fishery is highly unlikely to reduce habitat structure and function to a point where there would be a serious or irreversible harm. As such, the fishery scores full marks for this performance indicator.

Audit Trace References

DFO 2007a, DFO 2010, Gilkinson *et al.* 2005, Kostylev 2004, MSC 2010a, Stanley *et al.* 1972.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>2.4.2</p> <p>Management Strategy</p> <p>There is a strategy in place that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to habitat types.</p>	<p>There are <u>measures</u> in place, if necessary, that are expected to achieve the Habitat Outcome 80 level of performance.</p> <p>The measures are considered <u>likely</u> to work, based on plausible argument (e.g. general experience, theory or comparison with similar fisheries/habitats).</p>	<p>There is a <u>partial strategy</u> in place, if necessary, that is expected to achieve the Habitat Outcome 80 level of performance or above.</p> <p>There is some <u>objective basis for confidence</u> that the partial strategy will work, based on information directly about the fishery and/or habitats involved.</p> <p>There is <u>some evidence</u> that the partial strategy is being implemented successfully.</p>	<p>There is a <u>strategy</u> in place for managing the impact of the fishery on habitat types.</p> <p>The strategy is mainly based on information directly about the fishery and/or habitats involved, and testing supports high confidence that the strategy will work.</p> <p>There is <u>clear evidence</u> that the strategy is being implemented successfully, and intended changes are occurring. There is some evidence that the strategy is achieving its objective.</p>

Scoring Comments

Hydraulic dredging can only be undertaken in sandy sediments, and the fishery takes place in relatively shallow water of less than 70 m depth that is subject to levels of natural perturbation. The surficial sediments of Banquereau are well or very well mixed sand (Kostylev 2004, Stanley *et al.* 1972), and the fishing vessels utilise Roxanne ground discrimination gear to ensure the dredges are used in areas that are appropriate for Arctic surfclams (CSLP, pers. comm.). Further, the assessment team was informed that CSLP had recently undertaken a detailed, multibeam bathymetric survey of Banquereau, allowing fishing sites to be targeted with high precision, and that fishing areas are left fallow for approximately 10 years before being fished again (CSLP, pers. comm.). Data from the multibeam survey are not available for publication, however, as they are proprietary and valuable.

The IFMP contains objectives specifically related to coral habitats; these are:

- Prevent significant adverse alteration of coral communities in the Stone Fence area,
- Prevent significant adverse alteration of coral communities on the Scotian Shelf and Slope Initiative.

Experimental dredge impact work on Banquereau has provided data showing recovery of the seabed habitat within about 10 years, although this is likely to be a worst case scenario, and recovery has been shown to be faster at shallower depths on Sable Bank (Gilkinson *et al.* 2005). It is important that the annual swept area of the fishery is restricted in part by the TAC; while the TAC is set at the current level, the area of Banquereau that is fished is highly unlikely to increase significantly from its current mean level of approximately 1.4% of the area of surfclam habitat. Any significant increase to the TAC, and the potential for that to result in significantly increased impact on habitats, would be assessed through the regular surveillance audit process.

Score: 100

In the context of the experimental work that has been undertaken to determine the impact of the fishery on Banquereau habitats, the various features of the fishery that limit the extent and duration of any effects, including the TAC and leaving fished areas fallow for 10 years, can be considered to constitute a strategy for managing the impact of the fishery on Banquereau habitats, such that the fishery meets the first scoring issue of SG 100. The strategy is based on information directly about the fishery, and experimental work from Banquereau provides confidence that the strategy will work and is being implemented successfully. As such, the fishery meets the second and third scoring issues of SG 100, and scores full marks for this performance indicator.

Audit Trace References

Gilkinson *et al.* 2005, Kostylev 2004, Stanley *et al.* 1972)

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>2.4.3</p> <p>Information / monitoring Information is adequate to determine the risk posed to habitat types by the fishery and the effectiveness of the strategy to manage impacts on habitat types.</p>	<p>There is a basic understanding of the types and distribution of main habitats in the area of the fishery.</p> <p>Information is adequate to broadly understand the nature of the main impacts of gear use on the main habitats, including spatial overlap of habitat with fishing gear</p>	<p>The nature, distribution and vulnerability of all main habitat types in the fishery area are known at a level of detail relevant to the scale and intensity of the fishery.</p> <p>Sufficient data are available to allow the nature of the impacts of the fishery on habitat types to be identified and there is reliable information on the spatial extent of interaction, and the timing and location of use of the fishing gear.</p> <p>Sufficient data continue to be collected to detect any increase in risk to habitat (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the measures).</p>	<p>The distribution of habitat types is known over their range, with particular attention to the occurrence of vulnerable habitat types.</p> <p>Changes in habitat distributions over time are measured.</p> <p>The physical impacts of the gear on the habitat types have been quantified fully.</p>

Scoring Comments

Hydraulic dredges can only be used in sandy sediments. Clearwater Seafood's vessels are equipped with Roxanne ground discrimination equipment and are able to target appropriate habitats (CSLP, pers. comm.). Habitat types on the Scotian Shelf have been mapped at a relatively coarse, but still relevant, level, showing that the surficial sediments are composed of well or very well mixed sand (Kostylev 2004, Stanley *et al.* 1972). It is also understood that CSLP has undertaken a multi-beam bathymetric survey of Banquereau; while these data are not publicly available, mapping the bank in detail further helps fishermen to target Arctic surfclams while limiting any impacts. Comprehensive data on the distribution of the fishery is available through the 100% VMS coverage, and these show that the fishery has covered an average of only 1.4% of the Arctic surfclam habitat on Banquereau each year (DFO 2007a). An ongoing benthic impacts study has provided specific, locally collected data to inform managers and participants in the fishery on the effects on, and recovery rates of, the Banquereau habitat, such that the dredge tracks had all but disappeared after approximately 10 years (Gilkinson *et al.* 2005).

Score: 95

The distribution of habitat types is known, and particular attention is paid to vulnerable habitat types (i.e. avoidance of coral communities). The physical impacts of the gear on habitat types have also been quantified fully, so meeting the first and third scoring issues of SG 100. However, while sufficient data are certainly available to allow the fishery to meet the second scoring issue of SG 80, there is no ongoing work to determine if any changes in habitat type are occurring over time as a result of the fishery that would allow the fishery to meet the second scoring issue of SG 100. As such, and although the habitat types on Banquereau appear highly unlikely to change, the fishery can score no more than 95 for this performance indicator.

Audit Trace References

Gilkinson *et al.* 2005, Kostylev 2004, Stanley *et al.* 1972, DFO 2007a.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

2.5	Ecosystem		
-----	------------------	--	--

2.5.1	<p><i>Status</i> The fishery does not cause serious or irreversible harm to the key elements of ecosystem structure and function.</p>	<p>The fishery is <u>unlikely</u> to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.</p>	<p>The fishery is <u>highly unlikely</u> to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.</p>	<p>There is <u>evidence</u> that the fishery is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.</p>
-------	---	---	--	---

Scoring Comments			
-------------------------	--	--	--

Because of the nature of hydraulic dredging as a towed, bottom-fishing activity, the impact of the fishery is focused on the seabed, and there are no known impacts on the pelagic environment. Sedimentation is a possible pelagic factor, but this is unlikely to be a significant or long-lasting factor given the well or very well sorted surficial sand sediments (Stanley *et al.* 1972) and moderate tidal influence (Kostylev 2004) across Banquereau. Although the Eastern Scotian Shelf was previously dominated by large demersal fish species (Zwanenburg 2000), the timelines of the groundfish collapse and the commencement of the Arctic surfclam fishery suggest that the Arctic surfclam fishery cannot be implicated in the collapse, or in the failure of those species to recover. It may also be noted that the Arctic surfclam fishery was screened-out (i.e. it was not considered to be an impacting activity) in a DFO analysis of all activities potentially impacting spawning cod on the Grand Bank (DFO 2009f). It is considered that there is no reason why a similar conclusion should not be drawn for Banquereau. Furthermore, the very limited quantities of fish bycatch recorded from surveys and commercial catches on Banquereau, and likely very limited quantities of unobserved mortality of fish species, constitute a negligible impact from the fishery.

Part of Banquereau (the Eastern Shoal) was selected with Misaine Bank as a candidate Area of Interest for a new MPA on the Eastern Scotian Shelf, together with two other candidate Areas of Interest. Following consultation in 2009 (DFO 2009g), only St. Anns Bank was taken forward. As part of the ESSIM Initiative, the Eastern Shoal and Banquereau were also listed as a possible EBSA, primarily for their abundance of infaunal animals, including bivalves. It is understood that the ESSIM Initiative has not progressed beyond the proposal stage, however, and that other areas were more favoured for designation as EBSAs (Doherty & Horsman 2007).

Hydraulic dredges, as used in the Arctic surfclam fishery, have a relatively small footprint but dig deeply into sediments and therefore have the potential to effect change in benthic communities. However, the fishery is prosecuted at water depths shallower than 70 m on Banquereau, where natural disturbance will impact the seabed. As such, the benthic community is likely to be somewhat resistant to perturbation from fishing (Jennings & Kaiser 1998).

A dredge impact study was started on Banquereau in 1998. Results showed that benthic species abundance and biomass immediately reduced by approximately 40% on average across the experimental plots. After two years, only four polychaete species still showed decreased abundance with the pre-dredging state, but a number of species had dramatically increased in abundance, including the tube dwelling polychaetes *Euchone papillosa* and *Spiophanes bombyx*, as well as the brittlestar *Ophiura sarsi*, although the latter species is likely to have been due to immigration rather than larval recruitment. Results until 2005 concluded that the disturbed community was still in the colonizing phase (Gilkinson *et al.* 2005), while the results from the repeat survey in 2008 are still being written-up (DFO, pers. comm.). After two years, the Arctic surfclam and other targeted bivalve species were still greatly reduced in abundance, having sustained reductions in biomass of up to 67%. Preliminary analysis suggested there were few juvenile clams found in the grab samples after ten years (DFO, pers. comm.). However, while a lack of recruitment at this timescale could be a concern, episodic and patchy recruitment is to be expected in Arctic surfclam (Roddick *et al.* 2007). Also, the fishery has returned to previously productive areas on Banquereau after 10 years to find that new

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

recruitment to the fishery had occurred (CSLP, pers. comm.).

Clams including Arctic surfclam may be important bioturbators on Banquereau, such that very high removal levels may be significant for community composition (Gilkinson *et al.* 2005). The Arctic surfclam fishery does not work an area to exhaustion, however, as the economics of the fishery require that the vessels move on before that point. In addition, the gear cannot be worked with very high accuracy, and so unfished patches will be present even in ground that is intensively prosecuted. As such, it is highly unlikely that serious or irreversible harm would occur.

Score: 100

The results of experimental work undertaken on Banquereau show that the fishery is highly unlikely to disrupt key elements underlying ecosystem structure and function to the point there would be serious or irreversible harm. As such, the fishery scores full marks for this performance indicator.

Audit Trace References

Doherty & Horsman 2007, Gilkinson *et al.* 2005, Jennings & Kaiser 1998, Roddick *et al.* 2007, Stanley *et al.* 2007, Zwanenburg 2000.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>2.5.2</p> <p>Management strategy There are measures in place to ensure the fishery does not pose a risk of serious or irreversible harm to ecosystem structure and function.</p>	<p>There are <u>measures</u> in place, if necessary, that take into account potential impacts of the fishery on key elements of the ecosystem.</p> <p>The measures are considered likely to work, based on <u>plausible argument</u> (eg, general experience, theory or comparison with similar fisheries/ ecosystems).</p>	<p>There is a <u>partial strategy</u> in place, if necessary, that takes into account available information and is expected to restrain impacts of the fishery on the ecosystem so as to achieve the Ecosystem Outcome 80 level of performance.</p> <p>The partial strategy is considered likely to work, based on <u>plausible argument</u> (eg, general experience, theory or comparison with similar fisheries/ ecosystems).</p> <p>There is <u>some evidence</u> that the measures comprising the partial strategy are being implemented successfully.</p>	<p>There is a <u>strategy</u> that consists of a <u>plan</u>, containing measures to address all main impacts of the fishery on the ecosystem, and at least some of these measures are in place. The plan and measures are based on well-understood functional relationships between the fishery and the Components and elements of the ecosystem.</p> <p>This plan provides for development of a full strategy that restrains impacts on the ecosystem to ensure the fishery does not cause serious or irreversible harm.</p> <p>The measures are considered likely to work based on <u>prior experience</u>, plausible argument or <u>information</u> directly from the fishery/ecosystems involved.</p> <p>There is <u>evidence</u> that the measures are being implemented successfully.</p>

Scoring Comments
<p>Canada's Oceans Act (1997) requires consideration of the impacts of all human activities on the respective ecosystem, while the 2002 Oceans Strategy requires stakeholders and regulators to work together to decide how best to manage designated geographic areas of the ocean. The ESSIM Initiative is the integrated management program covering Banquereau that is intended to deliver those commitments. The IFMP contains various specific elements focused on ensuring the fishery poses no threat to ecosystem structure and function; these are:</p> <ul style="list-style-type: none"> • Prevent significant adverse alteration of coral communities in the Stone Fence area, • Prevent significant adverse alteration of benthic communities in The Gully MPA, • Prevent significant adverse alteration of coral communities on the Scotian Shelf and Slope Initiative. <p>The IFMP also includes the overarching objectives for ecosystem-based management that are accepted through the ESSIM Initiative (DFO 2011c):</p> <ul style="list-style-type: none"> • The sustainability of human ocean resources, and • The conservation of species and habitats, including those other ecosystem components that may not be utilized by humans.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

The objectives laid out in the IFMP are functionally transformed into a strategy through a combination of the precautionary TAC for Arctic surfclam and work undertaken to determine and manage the impact of the dredges on the Banquereau habitat and associated community (DFO 2011c). On this latter point, hydraulic dredges can only be used efficiently in well-mixed sandy sediments, which is targeted through the use of Roxanne equipment aboard the fishing vessels (CSLP pers. comm.). The fishery then occurs in a small area of the bank in any given year, in relatively shallow water that is subject to natural perturbation, and away from vulnerable components such as The Gully and deeper coral communities of the Stone Fence (DFO 2011c). Given the slightly deeper depth of the study site, results of the long-term study on Banquereau suggest that habitats within the fishing area will recover within approximately 10 years, while recovery of the benthic community, other than the targeted bivalve species, will take at least two years (Gilkinson *et al.* 2005). The fishery routinely leaves areas fallow for approximately 10 years before returning to fish, in order to support recovery of the target species (CSLP pers. comm.). Enforcement of the Arctic surfclam TAC works to ensure the sustainable management of the Arctic surfclams and the other species of large, bioturbating bivalves.

Score: 95

There is a partial strategy in place to manage the main impacts of the fishery on the ecosystem, and information has been collected to help understand the functional relationships between the fishery and the components and elements of the ecosystem, so meeting the first scoring issue of SG 80. The IFMP has incorporated the available evidence to restrain impacts to ensure the fishery does not cause serious or irreversible harm, and evidence and plausible argument suggest the measures are likely to work, so meeting the second and third scoring issues of SG 100. The 100% VMS and dockside monitoring provide evidence that the measures are being implemented successfully. The fishery therefore meets three of the four requirements of the SG100, and scores 95.

Audit Trace References

Oceans Act 1997, Oceans Strategy 2002, DFO 2011c, Gilkinson *et al.* 2005.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>2.5.3</p> <p>Information / monitoring There is adequate knowledge of the impacts of the fishery on the ecosystem.</p>	<p>Information is adequate to <u>identify</u> the key elements of the ecosystem (e.g. trophic structure and function, community composition, productivity pattern and biodiversity).</p> <p>Main impacts of the fishery on these key ecosystem elements can be inferred from existing information, but <u>have not been investigated in detail</u>.</p>	<p>Information is adequate to <u>broadly understand</u> the key elements of the ecosystem.</p> <p>Main impacts of the fishery on these key ecosystem elements can be inferred from existing information, but <u>may not have been investigated in detail</u>.</p> <p>The main functions of the Components (i.e. target, Bycatch, Retained and ETP species and Habitats) in the ecosystem are <u>known</u>.</p> <p>Sufficient information is available on the impacts of the fishery on these Components to allow some of the main consequences for the ecosystem to be inferred.</p> <p>Sufficient data continue to be collected to detect any increase in risk level (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the measures).</p>	<p>Main <u>interactions</u> between the fishery and these ecosystem elements can be inferred from existing information, and <u>have been investigated</u>.</p> <p>The impacts of the fishery on target, Bycatch, Retained and ETP species and Habitats are identified and the main functions of these Components in the ecosystem are <u>understood</u>.</p> <p>Sufficient information is available on the impacts of the fishery on the Components <u>and elements</u> to allow the main consequences for the ecosystem to be inferred.</p> <p>Information is sufficient to support the development of strategies to manage ecosystem impacts.</p>

Scoring Comments
<p>Because of the nature of hydraulic dredging as a towed, bottom-fishing activity, the impact of the fishery is focused on the seabed, and there are no known impacts on the pelagic environment.</p> <p>The importance of the various areas and elements of the Scotian Shelf ecosystem were reviewed through the ESSIM Initiative, and the Eastern Shoal and Banquereau were listed in the group of possible EBSAs to be taken forward, primarily for their abundance of infaunal animals, including bivalves (Doherty & Horsman 2007). Experimental data are available, showing that recovery of the majority of the community after dredging takes at least several years at impacted sites, and that the targeted bivalve species can take much longer (Gilkinson <i>et al.</i> 2005). However, data are also available showing that the fishery covers only a small percentage of the bank each year, and that vessels move on well before an area is comprehensively swept by the gear (Roddick & Smith 1999). This means that there will be areas of unimpacted ground in even heavily fished areas from where the community can start the recovery process through emigration (Kaiser <i>et al.</i> 2002; Roddick <i>et al.</i> 2007), and also means that the role of large clam species as</p>

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

bioturbators will not be eliminated from an area. Individuals of large fish species are expected to move out of the way of the narrow and slow-moving dredge gear, and this is reflected in the extremely low levels of fish bycatch recorded from the Banquereau survey (Roddick *et al.* 2007) or fishery (DFO 2007a). There may be a small amount of unobserved mortality of fish species, but the quantities of observed fish bycatch mean that this mortality is highly unlikely to be anything other than negligible.

Vessels are monitored 100% of the time with VMS, while landings from the fishery are monitored 100% at the dock. There is only very limited observer coverage in the fishery, however. The long-term benthic impacts study will provide valuable data to understand long-term impacts on habitats and recovery rates.

Score: 100

Information is sufficient to broadly understand the main elements of the Banquereau ecosystem, the main interactions between these elements and the fishery have been investigated, and the main functions of the components of the ecosystem are identified and understood, so meeting the first, second and third scoring issues of SG 100. Sufficient information is available on the impacts of the fishery on retained, bycatch, ETP species and the habitats to allow the main consequences for the ecosystem to be inferred, satisfying the fourth scoring issue of SG 100. It is also considered that the information is sufficient to support the development of strategies to manage ecosystem impacts, and so the fishery therefore scores full marks for this PI.

Audit Trace References

DFO 2007a, Doherty & Horsman 2007, Gilkinson *et al.* 2005, Kaiser *et al.* 2002, Kostylev 2004, Roddick & Smith 1999, Roddick *et al.* 2007.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

Principle 3	The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable
--------------------	---

3.1	Governance and Policy
------------	------------------------------

3.1.1	<p>Legal and/or customary framework The management system exists within an appropriate and effective legal and/or customary framework which ensures that it:</p> <ul style="list-style-type: none"> - Is capable of delivering sustainable fisheries in accordance with MSC Principles 1 and 2; - Observes the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood; and - Incorporates an appropriate dispute resolution framework. 	<p>The management system is generally consistent with local, national or international laws or standards that are aimed at achieving sustainable fisheries in accordance with MSC Principles 1 and 2.</p> <p>The management system incorporates or is subject by law to a <u>mechanism</u> for the resolution of legal disputes arising within the system.</p> <p>Although the management authority or fishery may be subject to continuing court challenges, it is not indicating a disrespect or defiance of the law by repeatedly violating the same law or regulation necessary for the sustainability for the fishery.</p> <p>The management system has a mechanism to <u>generally respect</u> the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.</p>	<p>The management system is generally consistent with local, national or international laws or standards that are aimed at achieving sustainable fisheries in accordance with MSC Principles 1 and 2.</p> <p>The management system incorporates or is subject by law to a <u>transparent mechanism</u> for the resolution of legal disputes which is <u>considered to be effective</u> in dealing with most issues and that is appropriate to the context of the fishery.</p> <p>The management system or fishery is attempting to comply in a timely fashion with binding judicial decisions arising from any legal challenges.</p> <p>The management system has a mechanism to <u>observe</u> the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.</p>	<p>The management system incorporates or is subject by law to a <u>transparent mechanism</u> for the resolution of legal disputes that is appropriate to the context of the fishery and has been <u>tested and proven to be effective</u>.</p> <p>The management system or fishery acts proactively to avoid legal disputes or rapidly implements binding judicial decisions arising from legal challenges.</p> <p>The management system has a mechanism to <u>formally commit</u> to the legal rights created explicitly or established by custom on people dependent on fishing for food and livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.</p>
--------------	--	---	--	---

Scoring Comments Canadian fisheries management has a well-established legislative and policy framework. As noted Section 6.1 above, the federal government has jurisdiction for seacoast and inland fisheries in Canada, and it has enacted several pieces of legislation that govern fisheries, the most important of which is the Fisheries Act. That Act grants authority for fisheries management to the Minister of Fisheries and Oceans as well as providing the power to enact regulations governing a wide variety of management measures of which
--

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

the Atlantic Fishery Regulations, 1985, and the Fishery (General) Regulations (1985) are the main legal instruments governing the fishery. Management measures are developed under the authority of the Act and the regulations and ministerial powers are delegated to officials of the DFO. All areas of management responsibilities and roles are clearly defined within the department and fishery management programs are delivered in an organized and controlled manner. There is an elaborate sanction and penalty structure in the Act and regulations; as well as a ticketing and court based program for the resolution of legal disputes. Government legislation and policy ensures the protection of aboriginal rights although there is no current participation in the offshore clam fishery by aboriginal people.

Several policy initiatives have been developed to guide decision-making in the management of fisheries in Canada, three of which are important for this assessment. The “Policy Framework for the Management of Fisheries on Canada’s Atlantic Coast” (DFO 2004) envisions robust fisheries that include all stakeholders and which are biologically and economically sustainable. The “Sustainable Fisheries Framework” requires the incorporation of the precautionary and ecosystem approaches into fisheries management decisions (DFO 2009c). Finally, the “Aboriginal Fisheries Strategy” which is aimed at ensuring that aboriginal entitlements are respected in the development of stable fisheries management regimes for aboriginal peoples (DFO 1992).

Legal disputes respecting fishing are adjudicated quickly and fairly in a public forum through the Canadian judicial process and have been shown to be effective. For example, disputes regarding aboriginal fishing rights have been fairly resolved (R.v Sparrow, R.v Marshall) and have led to current legislation and policy that ensures the protection of aboriginal rights. While there is currently no aboriginal presence in the offshore clam fishery, the IFMP requires that First Nations representatives be advised of meetings and can attend at their discretion (DFO 2011c). The legal and policy framework has been otherwise tested on several occasions in such areas as licencing (Saulnier v The Royal Bank), fishing rights and allocation practices {Larocque v. Canada (Minister of Fisheries and Oceans)} and through numerous prosecutions in an open and transparent process. The system has quickly reacted to implement binding legal decisions.

Many disputes, legal and otherwise, are avoided through a proactive co-management advisory process and frequent communication between the regulator and the fishery participants.

All management regimes described are consistent with the United Nations Convention on the Law of the Sea (UN 1982) as well as with the main principles of the 1995 Food and Agriculture Organisation Code of Conduct for Responsible Fishing (FAO 1995).

Score: 100

The Canadian management system contains a legal and customary framework of legislation and policy guidelines that ensure consistency with national and international laws and standards aimed at achieving sustainable fisheries. The Canadian system for the settlement of legal disputes is fair and transparent, has been tested and proven to be effective. The system seeks to avoid disputes and respect legal and customary rights of participants through legislation and policy. The management system has been tested and proven to be effective. All scoring issues of SG 100 are met.

Audit Trace References

DFO 1992; DFO 2004, DFO 2009c, DFO 2011c, FAO 1995, Fisheries Act 1985, Territorial Sea Geographic Co-ordinates (Area 7) Order 1985, UN 1982.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>3.1.2 Consultation, roles and responsibilities The management system has effective consultation processes that are open to interested and affected parties.</p> <p>The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties.</p>	<p>Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are <u>generally understood</u>.</p> <p>The management system includes consultation processes that <u>obtain relevant information</u> from the main affected parties, including local knowledge, to inform the management system.</p>	<p>Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are <u>explicitly defined and well understood for key areas</u> of responsibility and interaction.</p> <p>The management system includes consultation processes that <u>regularly seek and accept</u> relevant information, including local knowledge. The management system demonstrates consideration of the information obtained.</p> <p>The consultation process <u>provides opportunity</u> for all interested and affected parties to be involved.</p>	<p>Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are <u>explicitly defined and well understood for all areas</u> of responsibility and interaction.</p> <p>The management system includes consultation processes that <u>regularly seek and accept</u> relevant information, including local knowledge. The management system demonstrates consideration of the information and <u>explains how it is used or not used</u>.</p> <p>The consultation process <u>provides opportunity and encouragement</u> for all interested and affected parties to be involved, and <u>facilitates</u> their effective engagement.</p>

Scoring Comments
<p>The Offshore Clam Advisory Committee (OCAC) is the major consultative mechanism for the fishery. Sitting members of the committee include the single licence holder, the regulator (DFO), representatives of the processing sector, First Nations representatives as they wish, representatives of the Provinces of Nova Scotia and Newfoundland and Labrador, and other stakeholders and interested parties. Meetings of the advisory committee are open to the public, and minutes show that interested parties are able to participate. Formal terms of reference outline the structure and purpose of the committee, its administration and membership. The defined purpose of the committee is to provide input and advice to the DFO on the conservation, protection and management of the offshore clam resource. The committee serves as an open and public consultation forum on all issues affecting the offshore clam fishery on Canada's Atlantic coast. The roles and responsibilities of participants are well understood. Information is presented at the meetings of the committee where harvest levels and management measures are considered and recommendations to the regulator are formulated. Local knowledge and input is considered. The management system demonstrates consideration of the information obtained. The terms of reference for the committee require that it meet at least once a year or as otherwise called by the chair (DFO 2011c). The frequency of meetings has not been regular in past years, although that has improved with meetings having been held in 2009, 2010 and 2011. Minutes of meetings are kept, and circulated to members of the committee.</p> <p>A second committee called the Offshore Clam Management Board (OCMB) is charged with the responsibility to oversee and direct the implementation of the management plan. This committee is composed of two representatives each of the two licence holding companies (both wholly owned by the client) and four representatives of DFO, two each from science and management. The OCMB is co-chaired by an industry member and DFO staff person. The functions and responsibilities of the board are clearly outlined. The terms of reference call for the Board to meet at least once per year and as often as it deems fit, but as with the OCAC, meetings have not been annual. Minutes are kept and circulated to members.</p>

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

Score: 65

Interested parties have been identified in the advisory process. The functions, structure, purpose and administration of the advisory committee are clearly outlined in the IFMP and well understood. The management system considers all information presented during the consultative process on key elements of the management of the stocks. The advisory committee process is open to the public and interested parties may register to receive notice of meetings and minutes. There is no provision to make the minutes more publically available to parties that may be interested in the deliberations of the advisory committee but who are not part of the advisory process.

All the scoring issues of SG 60 are met, as is the first of scoring issue of SG 80. However, as the OCAC has not met on a regular basis (including gaps of several years), it cannot be said that the process regularly seeks and accepts relevant information or that the process provides the opportunity for all interested and affected parties to be involved, as required by the last two of the three scoring issues of SG 80. Nor is there a mechanism to inform interested parties who are not already part of the advisory process of upcoming meetings or of the results of such meetings. A score of 65 is therefore awarded and a condition set.

Audit Trace References

DFO 2011c; Minutes of Meetings of OCAC 2001, 2009, 2010; Minutes of OCMB 2004, 2007, 2010; pers knowledge of DFO.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

3.1.3	<p>Long term objectives The management policy has clear long-term objectives to guide decision-making that are consistent with MSC Principles and Criteria, and incorporates the precautionary approach.</p>	<p>Long-term objectives to guide decision-making, consistent with MSC Principles and Criteria and the precautionary approach, are <u>implicit</u> within management policy.</p>	<p><u>Clear</u> long-term objectives that guide decision-making, consistent with MSC Principles and Criteria and the precautionary approach, are <u>explicit</u> within management policy.</p>	<p><u>Clear</u> long-term objectives that guide decision-making, consistent with MSC Principles and Criteria and the precautionary approach, are <u>explicit</u> within <u>and required by</u> management policy.</p>
-------	---	---	--	---

Scoring Comments

Canadian fisheries management has a hierarchy of broad policy measures beginning with a solid legislative foundation through the Fisheries Act (1985) and several sets of associated regulations (see 6.4 above). From that legal framework flows an elaborate outline of policy goals, objectives, processes and procedures the most relevant of which are:

Four overarching objectives for fisheries management are outlined in the Atlantic Fisheries Policy Framework - conservation and sustainable use of marine resources and habitat; self-reliant fisheries contributing to the well-being of coastal communities; shared stewardship involving participants in fisheries management decision-making processes and a stable and transparent access and allocation approach through a rules-based process (DFO 2004).

The precautionary and ecosystem approaches are required to be incorporated into all fishery management decisions while protecting biodiversity and fisheries habitat by virtue of the “Sustainable Fisheries Framework” (DFO 2009c).

The “Policy to Manage the Impacts of Fishing on Sensitive Benthic Areas” requires the mitigation of the impacts of fishing on sensitive benthic areas or avoidance of impacts of fishing that are likely to cause serious or irreversible harm to sensitive marine habitat, communities and species (DFO 2009d).

Requirements and procedures for new fisheries are outlined in “The Emerging Species Policy” . A cornerstone of the policy is the establishment of a scientific base with which stock responses to new fishing pressures can be assessed (DFO 2008b).

The Aboriginal Fisheries Strategy was developed to implement the Supreme Court of Canada decision that aboriginal people have a right to fish for food, social and ceremonial purposes, a right that takes priority, after conservation, over other users of the resource. The policy seeks to provide stability where DFO manages the fishery and where land claims settlements have not already put a fisheries management regime in place (DFO 1992).

These broad policy guidelines are implemented through fisheries specific objectives that are outlined in species management plans.

Score: 100

All scoring issues of SG 100 are met, there being a clear and explicit legislative and policy framework that guides decision-making in a manner consistent with the MSC Principles and Criteria, including the explicit outline and adoption of the precautionary approach that is required for all fisheries.

Audit Trace References

DFO 1992, DFO 2004, DFO 2008b, DFO 2009c, DFO 2009d, DFO 2010b, Fisheries Act 1985;

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100	
<p>3.1.4</p>	<p>Incentives for sustainable fishing The management system provides economic and social incentives for sustainable fishing and does not operate with subsidies that contribute to unsustainable fishing.</p>	<p>The management system provides for incentives that are consistent with achieving the outcomes expressed by MSC Principles 1 and 2.</p>	<p>The management system provides for incentives that are consistent with achieving the outcomes expressed by MSC Principles 1 and 2, and seeks to ensure that perverse incentives do not arise.</p>	<p>The management system provides for incentives that are consistent with achieving the outcomes expressed by MSC Principles 1 and 2, and <u>explicitly considers</u> incentives in a <u>regular review</u> of management policy or procedures to ensure that they do not contribute to unsustainable fishing practices.</p>

Scoring Comments

The individual quota system of fishing provides a quasi property right to the three licence holders. Such stability and security of access provide strong economic incentives to harvest for the long-term, maximize value and not volume, and minimize negative impacts on the stock and its ecosystem. A sense of stewardship is evident in the attitude of the licence holders, through their participation in the advisory process and in their voluntary involvement in research activities. For example, due to the intrusive nature of the fishing gear, the client has joined with DFO to conduct a multi-year collaborative research program to assess the impact of the gear on the bottom habitat and localized organisms. These studies have led to several peer reviewed scientific papers that outline the impacts for the short and long term. The client also participates in abundance surveys with the regulator to gather and analyse data for determining harvest strategies

There is also a detailed legislative penalty structure with significant financial penalties to deter negative behaviour.

Score: 80

The Enterprise Allocation approach to fishing encourages good practices and avoids overharvesting and waste. The client and its Captains take part in surveys, trials and gather information for assessments, while there are neither negative incentives nor subsidies in the fishery. The fishery therefore meets SG 80. As it was not evident that the management system explicitly considered incentives in a regular review of management policy or procedures to ensure that they do not contribute to unsustainable fishing practices, the requirements of SG 100 are not met.

Audit Trace References

DFO 2011c, Joint Project Agreements (CSLP - DFO), Minutes of the OCAC and OCMB, pers. knowledge DFO

1	SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
---	------------------	----------------------	----------------------	-----------------------

3.2	Fishery- specific management system			
-----	--	--	--	--

3.2.1	Fishery-specific objectives The fishery has clear, specific objectives designed to achieve the outcomes expressed by MSC's Principles 1 and 2.	<u>Objectives</u> , which are broadly consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are <u>implicit</u> within the fishery's management system.	<u>Short and long term objectives</u> , which are consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are <u>explicit</u> within the fishery's management system.	<u>Well defined and measurable short and long term objectives</u> , which are demonstrably consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are <u>explicit</u> within the fishery's management system.
-------	--	---	---	--

Scoring Comments				
-------------------------	--	--	--	--

Several major fishery-specific objectives are outlined in the IFMP (DFO 2011c):

- Ensure a biologically and economically sustainable offshore clam fishery
- Develop scientifically-based management plans
- Implement collaborative enforcement, monitoring and regulatory measures
- Foster cooperation between the licence holders and DFO to establish management measures that minimize the impacts of harvesting on the habitat

The IFMP goes on to identify management issues and approaches to achieve these objectives.

The IFMP also outlines ecosystem-based management thrusts to maintain the sustainability of ocean resources and the conservation of species and habitats, including those other ecosystem components that may not be utilized by humans. Objectives to achieve these goals include:

- Maintain areas of fishery disturbance to within identified limits (well-sorted sand bottoms) to preserve the diversity of benthic communities
- Prevent significant adverse alteration of coral communities on the Scotian Shelf and Slope by confining the fishery to waters shallower than those in which coral thrives.
- Prevent significant adverse alteration of benthic communities in the Gully Marine Protected Area (MPA) by maintaining safe distances from the area while harvesting offshore clams
- Minimize incidental mortality of non-target species
- Prevent the impact of human activity on spawning and breeding components by leaving 40-50% of the bottom of commercially fished areas undredged

Score: 80				
------------------	--	--	--	--

Short and long term objectives are explicit in sections 4 and 5 of the IFMP and are consistent with achieving the outcomes of Principles 1 and 2 supporting a score of 80. The fishery does not meet SG 100 as it cannot be said that the long and short term objectives are operationally defined in such a way that the performance against the objective can be measured as required by the FAM (section 8.3.3).

Audit Trace References				
-------------------------------	--	--	--	--

DFO 2011c

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>3.2.2 Decision-making processes The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives.</p>	<p>There are <u>informal</u> decision-making processes that result in measures and strategies to achieve the fishery-specific objectives.</p> <p>Decision-making processes respond to <u>serious issues</u> identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take <u>some</u> account of the wider implications of decisions.</p>	<p>There are <u>established</u> decision-making processes that result in measures and strategies to achieve the fishery-specific objectives.</p> <p>Decision-making processes respond to <u>serious and other important issues</u> identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.</p> <p>Decision-making processes use the precautionary approach and are based on best available information.</p> <p><u>Explanations</u> are provided for any actions or lack of action associated with findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.</p>	<p>Decision-making processes respond to <u>all issues</u> identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.</p> <p><u>Formal reporting</u> to all interested stakeholders describes how the management system responded to findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.</p>

Scoring Comments

The Offshore Clam Advisory Committee (OCAC) serves as the forum for the discussion of issues on the management and development of the offshore clam fishery providing advice and recommendations to DFO. The decision making process is set out in the IFMP under Purpose and Administration (DFO 2011c). The committee reviews all available information including scientific advice and provides input for the content of the annual management plan, including but not limited to advice on the TAC, regulatory, conservation, compliance and licencing issues. Advice is analyzed by the DFO after which decisions are made and incorporated into the IFMP.

The Minister of DFO is the final decision maker with regard to access, allocations and TACs. Scientific stock status reports are published and made available on DFO websites and information and minutes are distributed to all stakeholders of the Advisory Committee. Management measures are distributed to all harvesters through licence conditions and through Notice to Harvesters bulletins via marine radio. The Offshore Clam Management Board composed of the regulator and the single licence holder deals with day-to-day management of the fishery.

The precautionary approach is required for all fisheries as a matter of policy as outlined in the “Sustainable Fisheries Framework.” (DFO 2009c). An example of precautionary decision-making in this fishery is the setting of TACs based on a fishing mortality rate well below the rate of natural mortality.

Score: 80

There is a well-established decision making process that follows the precautionary approach based on the best available information and that has produced measures and strategies to achieve the fishery objectives. Explanations for action or lack thereof are circulated to stakeholders, directly at OCAC meetings and in scientific reports through

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
---------------------------	-----------------------------	-----------------------------	------------------------------

the Canadian Science Advisory Secretariat (CSAS) system, thereby meeting all scoring issues of SG 80.

None of the scoring issues of SG 100 are met as the decision-making processes has not yet responded to all issues that have been identified in relevant research and monitoring. Nor is there a formal reporting process to all stakeholders.

Audit Trace References

Canadian Science Advisory Reports, DFO 2009c, DFO 2011c.

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>3.2.3 Compliance and enforcement Monitoring, control and surveillance mechanisms ensure the fishery's management measures are enforced and complied with.</p>	<p>Monitoring, control and surveillance <u>mechanisms</u> exist, are implemented in the fishery under assessment and there is a reasonable expectation that they are effective.</p> <p>Sanctions to deal with non-compliance exist and there is some evidence that they are applied.</p> <p>Fishers are <u>generally thought</u> to comply with the management system for the fishery under assessment, including, when required, providing information of importance to the effective management of the fishery.</p>	<p>A monitoring, control and surveillance <u>system</u> has been implemented in the fishery under assessment and has demonstrated an ability to enforce relevant management measures, strategies and/or rules.</p> <p>Sanctions to deal with non-compliance exist, <u>are consistently applied</u> and thought to provide effective deterrence.</p> <p><u>Some evidence exists</u> to demonstrate fishers comply with the management system under assessment, including, when required, providing information of importance to the effective management of the fishery.</p> <p>There is no evidence of systematic non-compliance.</p>	<p>A <u>comprehensive</u> monitoring, control and surveillance system has been implemented in the fishery under assessment and has demonstrated a consistent ability to enforce relevant management measures, strategies and/or rules.</p> <p>Sanctions to deal with non-compliance exist, are consistently applied and <u>demonstrably</u> provide effective deterrence.</p> <p>There is a <u>high degree of confidence</u> that fishers comply with the management system under assessment, including, providing information of importance to the effective management of the fishery.</p>

Scoring Comments
<p>DFO reports that there have been no violations in the offshore clam fishery for the past 5 years (DFO pers. comm.).</p> <p>There is a comprehensive monitoring and surveillance system in place that covers the area of operation of the offshore clam fishery. Vessels are issued a licence containing an extensive list of conditions that is to be on board the vessel at all times for the information of the Captain and crew. Measures such as VMS, hail-in requirement, catch and information reporting, aircraft surveillance, at-sea boardings and 100% dockside weighing of catch ensure good coverage of the fishery. There are one to two observer trips each year in this fishery. A ticket and court-based sanction framework is outlined in the Fisheries Act and regulations with court based prosecution for serious offences through the Canadian Criminal Code (1985). Upon conviction maximum penalties of \$500,000 and up to two years in jail may be imposed along with forfeiture of catch and equipment at the discretion of the court.</p>
<p>Score: 95</p>
<p>The Canadian monitoring, control and surveillance system in place for the offshore clam fishery is conducted by well-trained, professional fishery officers. The coverage is broad and varied consisting of at-sea and dockside components and has been shown to be effective in enforcing the requirements and rules of the fishery. Offenders are pursued and the sanctions under the Fisheries Act are strong deterrents. The offshore clam fleet has not had any serious compliance issues. There is evidence that fishers comply with the management system and provide necessary information through logbooks, VMS and the dockside-monitoring program. However, the low level of observer coverage makes it difficult to conclude that there is a high level of confidence of compliance with the management scheme. There is no evidence of systematic non-compliance. All but the third</p>

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

element of the 100 score are met for a score of 95.

Audit Trace References

Criminal Code 1985, DFO 2011a; DFO 2011c; Fisheries Act 1985

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
--------------------	----------------------	----------------------	-----------------------

3.2.4	<p>Research plan The fishery has a research plan that addresses the information needs of management.</p>	<p><u>Research</u> is undertaken, as required, to achieve the objectives consistent with MSC's Principles 1 and 2.</p> <p>Research results are <u>available</u> to interested parties.</p>	<p>A <u>research plan</u> provides the management system with a strategic approach to research and <u>reliable and timely information</u> sufficient to achieve the objectives consistent with MSC's Principles 1 and 2.</p> <p>Research results are <u>disseminated</u> to all interested parties in a <u>timely</u> fashion.</p>	<p>A <u>comprehensive research plan</u> provides the management system with a coherent and strategic approach to research across P1, P2 and P3, and <u>reliable and timely information</u> sufficient to achieve the objectives consistent with MSC's Principles 1 and 2.</p> <p>Research <u>plan</u> and results are <u>disseminated</u> to all interested parties in a <u>timely</u> fashion and are <u>widely and publicly available</u>.</p>
-------	---	--	--	--

Scoring Comments

Estimating stock biomass, recruitment levels and determining habitat impacts caused by hydraulic dredging are the principle challenges in the fishery. The IFMP outlines several research programs aimed at these challenges:

- Stock assessments are based on periodic surveys with updates based on analysis of data from commercial fishery and sampling data. The results of the surveys and analysis are subject to peer review at Regional Advisory Process meetings. The target frequency for the surveys is a 5-year cycle in each of the fishing areas. Sable Island Bank was surveyed in 2003 and Banquereau Bank in 2004 and 2010. All surveys are conducted through Joint Project Agreements (JPA) between the client and DFO.
- Resource studies have been ongoing since the 1980s with data indicating that clams reach an age of 40 years or more and size ranges for commercial purposes have been identified between 10-15 years old, well above the age of maturity. With regular recruitment it has been determined that an area may need to be left for 10-15 years before it could be re-harvested.
- With respect to the impact of the hydraulic dredge on the habitat, a multi-year collaborative research program on Banquereau Bank (conditions on the Grand Bank have been determined to be comparable) was begun in 1998 by DFO Science, the Geological Survey of Canada Atlantic and the licence holders. An experimental impact area was identified and dredged in 1998 and repeat surveys have been undertaken to assess recovery. Two DFO reports and three peer-reviewed scientific papers describing the results of the studies have been released. The studies have indicated that the habitat is capable of recovery over a reasonable time period.

Score: 90

The three major focuses of research are identified in section 2.5 of the IFMP and a strategic approach has been developed to address those areas. The scientific approach provides reliable and timely information sufficient to achieve the objectives of Principles 1 and 2.

The research plan is strategic (for example in aiming to research the biology and abundance of retained bycatch species with a view to establishing quota limits), and results are circulated to all interested parties and the public in a timely fashion, either directly to stakeholders, at advisory committee meetings or via the CSAS system on the DFO website. Both elements of SG 80 are met, along with the second scoring issue of SG 100. A score of 90 is therefore awarded. The score would have been higher if the research went beyond the immediate short term needs of management to the creation of a strategic body of research relevant to long term needs as required by the FAM (section 8.3.15) for a 100 score.

Audit Trace References

DFO 2011c, Gilkinson *et al.* 2003, Gilkinson *et al.* 2005 and Gilkinson *et al.* 2011 (in review), Pers. knowledge of DFO

1 SCORING CRITERIA	SCORING GUIDEPOST 60	SCORING GUIDEPOST 80	SCORING GUIDEPOST 100
<p>3.2.5 Monitoring and management performance evaluation There is a system for monitoring and evaluating the performance of the fishery-specific management system against its objectives.</p> <p>There is effective and timely review of the fishery-specific management system.</p>	<p>The fishery has in place mechanisms to evaluate <u>some</u> parts of the management system and is subject to <u>occasional internal</u> review.</p>	<p>The fishery has in place mechanisms to evaluate <u>key</u> parts of the management system and is subject to <u>regular internal</u> and <u>occasional external</u> review.</p>	<p>The fishery has in place mechanisms to evaluate <u>all</u> parts of the management system and is subject to <u>regular internal</u> and <u>external</u> review.</p>

Scoring Comments
<p>A general review to evaluate key parts of the management system is conducted at annual OCAC advisory committee deliberations meetings, attended by the licence holders, the regulator (DFO), representatives of the processing sector, First Nations representatives (as they wish), representatives of the Provinces of Nova Scotia and Newfoundland and Labrador, and other stakeholders and interested parties (DFO 2011c).</p>
<p>DFO is in the process of developing a “ Fishery Checklist”- an internal diagnostic tool containing more than a 100 questions designed to assess a fishery's status against necessary elements of a sustainable fishery, which will be assist in reviewing the fishery against objectives.</p>
<p>With respect to external review, the Canadian Auditor General (AG) has the authority to review the fisheries management regime on an ad-hoc basis and has done so with respect to Atlantic shellfish and the protection of fish habitat (e.g. OAGC 1999, OAGC 2009). Also, Fisheries and Oceans committees from the Parliament and Senate of Canada occasionally conduct reviews of specific issues in the fishery, including the appearance of the Minister or officials of DFO and the industry as witnesses to the review.</p>
<p>Score: 80</p>
<p>The annual advisory committee reviews the key parts of the management system and there is occasional external review of the management system through the AG of Canada and parliamentary committees, thereby meeting SG 80. The score on this indicator would have been higher if there was a regular review mechanism for the review of all parts of the management system against its objectives and if there was a provision for regular external review.</p>
<p>Audit Trace References</p>
<p>DFO 2011c, OAGC 1999, OAGC 2000, OAGC 2004, OAGC 2008, OAGC 2009.</p>

15 APPENDIX B - STAKEHOLDER EVIDENCE FOR SITE VISIT

15.1 Letter from the Sierra Club of Canada, received on the 9th June, 2011.

Rob Blyth-Skyrme
Banquereau and Grand Banks Arctic surf clam
Marine Stewardship Council Assessment

June 9, 2011

Dear Rob Blyth-Skyrme:

We write regarding the Banquereau and Grand Banks Arctic Surf Clam Assessment for Marine Stewardship Council certification. We view this assessment in the context of the history of commercial fisheries on Banquereau Bank and the Grand Bank over the past six decades and the position of the aforementioned surf clam fishery in relation to those other fisheries. Similarly we consider the historical context of commercial fisheries management policies and practices as followed by the Canadian Department of Fisheries and Oceans and the role they play in fostering renewability and sustainability as a coastal state in the North-west Atlantic.

It is our understanding that the Surf Clam fishery commenced in the late 1980s early 1990s just prior to the collapse of longstanding commercial groundfish fisheries such as cod and haddock. Those fisheries and others collapsed because of decades of overfishing – an outcome of both international and domestic unsustainable fisheries management practices. While other countries have taken steps to learn from these mistakes and adjust their fishery management policies accordingly, Canada, in our view, has not.

Despite almost two decades of moratoria on fishing for groundfish and other species Canadian fisheries management policy remains entrenched in managing each species individually while refusing to acknowledge the role of ecosystems in supporting healthy oceans and commercial fisheries. While there is much discussion about “ecosystem management” and identifying and closing “vulnerable marine ecosystems,” little has been accomplished to realize such precautionary practices. Similarly Canadian fisheries management continues to ignore the negative effects of technological changes in fishing technologies. Rarely have the devastating negative effects of destructive fishing methods and technologies been examined and seldom addressed. According to official departmental policy “No fishing gear is inherently destructive.” This despite the numerous studies and practical examples from various jurisdictions which show otherwise.

It is our understanding that the Arctic surf clam fishery involves towing large sleds across the ocean floor resulting in major disturbances of benthic habitat. The targeted species – Surf clams - are known to have long life cycles and are slow to reproduce. From our reading of the information available on their habitat it seems little is known of their roles within the ocean or ecosystem food webs and the effects their removal will have on recovery of the food web and the top predators contained within.

Similarly little is known about the affected marine environments both in terms of the environmental damage already to the benthic habitats and their roles for supporting recovery of the ocean food web and restoration of the ocean's health. Consequently we are very nervous about this and other assessments of fisheries which employ proven destructive technologies which, from numerous past experiences, we know will continue the environmental degradation of valuable marine habitats.

In that context we would encourage adopting the precautionary approach as outlined in the November 2006 United Nations General Assembly Protocol on Sustainable Fisheries and not certify this fishery as sustainable. Many of our members who reside in the Atlantic region have witnessed far too much destruction over the years to recommend otherwise.

Sincerely,

Fred Winsor PhD. (North-west Atlantic fisheries history)

Conservation Chair
Atlantic Canada Chapter
Sierra Club Canada
St. John's, Newfoundland

15.2 Information from the World Wildlife Fund, Canada, received on 17th June, 2011.

I would like to suggest the documents listed below for the consideration of the assessment team. The documents listed below address some of our concerns in regards to habitat and benthic ecosystem impacts associated to the gear utilized in this fishery. We are also concerned with the location where the fishery takes place as part of the Banquereau, and the Grand Banks' Southeast Shoal have been considered Ecologically and Biologically Significant Areas (EBSAs) by DFO and by scientific documents.

Relevant Documents:

A) On corals (including sea pens) and sponges from the area:

Kenchington, E.C., Lirette, C., Cogswell, A.A., Archambault, A., Archambault, P., Benoit, H., Bernier, D., Brodie, B., Fuller, S., Gilkinson, K., Levesque, M., Power, D., Siferd, T., Treble, M., & V. Wareham, 2010. Delineating Coral and Sponge Concentrations in the Biogeographic Regions of the East Coast of Canada Using Spatial Analyses. DFO Canadian Scientific Advisory Secretariat Research Document 2010/041. iv + 207 pp.

B) On trawling impact publications from the Grand Bank and Banquereau Bank:

DFO, 2006. Impacts of Trawl Gears and Scallop Dredges on Benthic Habitats, Populations and Communities. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/025.

Gilkinson, K., 2008, Reliability of Abundance Estimates of the Propellerclam (*Cyrtodaria siliqua*) derived from their burrow openings: A case Study from Banquereau, Eastern Canada. *Journal of Shellfish Research*, vol. 27 (2): 289-295.

Gilkinson, K.D., Gordon Jr., D.C., Macisaac, K.G., McKeown, D.L., Kenchington, E.L.R., Bourbonnais, C. & P. Vass, 2005. Immediate impacts and recovery trajectories of macrofaunal communities following hydraulic clam dredging on Banquereau, Eastern Canada. *ICES Journal of Marine Science* 62: 925-947.

Gordon, Jr., D.C., Gilkinson, K.D., Kenchington, E.L.R., Kenchington, C., Bourbonnais, K.G., Macisaac, K.G., McKeown, D. L. W. P. Vass, 2004. Summary of the Grand Banks otter trawling experiment (1993-1995): Effects on benthic habitat and macrobenthic communities. *Proceedings of the Symposium on Effects of Fishing Activities on Benthic Habitats: Linking Geology, Biology, Socioeconomics and Management*, American Fisheries Society Special Publication 41:411-424.

Gilkinson, K.D., Gordon Jr., D.C., McKeown, D., Kenchington, E.L.R., Macisaac, K.G., Bourbonnais, C. & P. Vass, 2004. Impacts of hydraulic clam dredging on populations of soft corals (Anthozoa: Alcyonacea) on Banquereau, eastern Canada. *Proceedings of the Symposium on Effects of Fishing Activities on Benthic Habitats: Linking Geology, Biology, Socioeconomics and Management*, American Fisheries Society Special Publication 41: 383-390.

Gilkinson, K.D., Fader, G.B.J., Gordon Jr., D.C., Charron, R., McKeown, D., Roddick, D., Kenchington, E.L.R., Macisaac, K., Bourbonnais, C., Vass, P. & Q. Liu, 2003. Immediate and longer-term impacts of hydraulic clam dredging on an offshore sandy seabed: effects on physical habitat and processes of recovery. *Continental Shelf Research* 23:1315-1336.

Kenchington, E., Prena, J., Gilkinson, K.D., Gordon Jr., D.C., Macisaac, K., Bourbonnais, C., Schwinghamer, P.J., Rowell, T.W., McKeown, D.L. & W.P. Vass, 2001. Effects of experimental otter trawling on the Grand Banks of Newfoundland. *Canadian Journal of Fisheries and Aquatic Sciences* 58:1043-1057.

C) As this fishery on the Grand Banks extends beyond Canadian Exclusive Economic Zone, please find below reference to an important report prepared by the Northwest Atlantic Fisheries Organization (NAFO) Working Group on Ecosystem Approach to Fisheries Management, specifically on Vulnerable Marine Ecosystems (VMEs) present in the NAFO area, including the Southeast Shoal:

NAFO SCS Doc. 08/10, Report of the NAFO Scientific Council Working Group on Ecosystem Approach to

The report identifies the Grand Banks' Southeast Shoal as a potential VME due to its unique characteristics, as follows:

“Defined as the shallowest area on the southeastern Grand Banks, the Southeast Shoal is a candidate VME in the NRA, as identified by its “topographical features known to support vulnerable species, communities, or habitats”.

The area's physical characteristics make it unique on the Grand Banks. It was the last area of the Grand Banks above sea level prior to the last glacial period, and as past beach habitat, it supports two possible relict bivalve populations, such as the wedge clam (*Mesoderma deauratum*) (Hutcheson and Steward, 1994). On the Grand Banks, the Southeast Shoal is also the only known offshore area for the spawning of 3NO capelin, a population that is at a low level and under moratorium. The area is important habitat for several other species under moratorium or at risk, including cod, American plaice, and striped wolffish. Characteristics, such as capelin spawning beds, flatfish (yellowtail flounder and American plaice) nurseries, and occurrence of long-lived bivalve populations, are a consequence of the physical characteristics and related habitat.

Maintaining the shallow, sandy habitat is important and one would not want to significantly alter the spawning and nursery areas. It is an area of high productivity and biodiversity, and is an important feeding area for several marine mammals, including humpback whales, as well as for various seabirds. It has been identified by Canada as part of an Ecologically and Biologically Significant Area (EBSA) on the southern Grand Bank. Although the area is shallow and much of the bottom is comprised of sand, the SE Shoal would still qualify under several of the criteria suggested in the FAO Guidelines for VMEs.”⁴

In this context, it is also important to note relevant commitments undertaken by Canada under United Nations General Assembly resolutions on sustainable fisheries, namely, UNGA resolutions 61/105 (2006) and 64/72 (2009) to avoid and minimize significant adverse impacts of bottom fishing activities on vulnerable marine ecosystems. Relevant provisions of the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas⁵ should also be taken into account in the assessment of the fishery impacts, particularly, Paragraphs: 42, which defines VMEs; 47, which establishes criteria for impact assessments; and 63, on management and conservation tools that should be put in place to protect VMEs, such as fisheries closures and reducing or refraining from expanding the level or spatial extent of effort of vessels involved in deep-sea fisheries.

Even though the FAO Guidelines focus on deep-sea fisheries occurring in areas beyond national jurisdiction, its paragraph 10 encourages States to apply relevant provisions within areas of national jurisdiction. Furthermore, as the fishery in question also takes place in areas beyond Canadian EEZ, the standards adopted by the FAO Guidelines should be observed in the whole fishing footprint area. This is justifiable in the context of the United Nations Convention on the Law of the Sea (UNCLOS) and its implementing Agreement – the Fish Stocks Agreement (UNFSA), which Canada is also a contracting party. In accordance to UNCLOS, Canada has the duty to protect and preserve the marine environment and shall take measures to “protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species and other forms of marine life”⁶ within and beyond areas of national jurisdiction.

The Fish Stocks Agreement provides for the duty of states to, *inter alia*, apply the precautionary approach, assess the impacts of fishing not only on straddling and highly migratory target stocks, but also on species belonging to the same ecosystem or associated with or dependent upon the target stocks, and to protect marine biodiversity.⁷

D) On habitat impacts:

DFO, Maritime Provinces, “Expert Opinion on Clearwater/Deep Sea Clam Ocean Quahog Development Proposal”, Expert Opinion 2002/03 (21 January 2003).

⁴ NAFO SCS Doc. 08/10, Report of the NAFO Scientific Council Working Group on Ecosystem Approach to Fisheries Management (WGEAFM), 2008, Serial No. N5511.

⁵ FAO, International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (Rome: FAO, 2009).

⁶ United Nations Convention on the Law of the Sea [UNCLOS], Article 194 (5).

⁷ UN Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks [UNFSA], Art. 5.

It is important to note that even though the Expert Opinion cited above refers to quahog fishery, the assessment of key habitat impacts undertaken in that document would also apply to the proposed Arctic surfclam fishery since the same gear type is being used on a similar bottom type (K. Gilkenson, pers. comm.). The Expert Opinion notes that:

“There will be substantial immediate impacts on habitat that will change seabed topography. Furrows will be excavated, sediment will be suspended and redeposited, and there will be a reduction in habitat structural complexity. However, it is expected that habitat should recover in several years, with the exception of the re-establishment of large mollusc burrows that will take on the order of 10-20 years or more.”⁸

In addition, it was noted in this study that there are still uncertainties regarding the effects of hydraulic dredging on spawning grounds. The study observes that “There is a possibility that hydraulic dredging might affect fish spawning but the risk can not be assessed at this time.”⁹ Therefore the effects of this fishery on the endangered Atlantic cod spawning grounds on the Grand Banks’ Southeast Shoal, as well as on other important habitat for threatened species, such as winter skate in the Banquereau should be further assessed.

E) On EBSAs:

DFO, 2007. Placentia Bay-Grand Banks Large Ocean Management Area Conservation Objectives. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/042.

This Science Advisory Report (2007/042) states that the Southeast Shoal and Tail of the Banks (area east of 51°W and south of 45°N, extending to the edge of Grand Bank) is an area that requires the highest priority conservation objectives in the Placentia Bay-Grand Banks Large Ocean Management Area (PBGB-LOMA). This report identified the Southeast Shoal and Tail of the Banks as an ecologically or biologically significant area (EBSA). It is noteworthy that the EBSA criteria developed by Canada conforms to the Convention on Biological Diversity’s EBSA criteria¹⁰ as adopted by the ninth CBD Conference of Parties (COP 9), decision IX/20, Annex I (<http://www.cbd.int/doc/decisions/cop-09/cop-09-dec-20-en.pdf>).

Due to the ecological importance of the Southeast Shoal, the CSAS report 2007/042 concluded that conservation objectives for the area must “[e]nsure that the features listed below are not altered and/or disrupted by human activities to the point they can no longer be considered a unique feature and/or fulfill the ecological function that initially triggered their identification as significant in the area:

- Area of highest overall benthic biomass on the Grand Banks
- Unique offshore capelin spawning
- Unique yellowtail nursery
- Unique shallow, sandy habitat with glacial history
- Cetacean aggregation and feeding
- Seabird aggregation and feeding
- American plaice (nursery habitat)
- Atlantic cod spawning
- Reproduction and survival of striped wolfish
- Unique relict populations of blue mussels and wedge clams”¹¹

Therefore, it is important to ensure, through comprehensive assessments, that the fishery in question does not represent a threat to any of the features listed above. It should be noted that possible increased harvest capacity in the

⁸ DFO, Maritime Provinces, “Expert Opinion on Clearwater/Deep Sea Clam Ocean Quahog Development Proposal”, Expert Opinion 2002/03 (21 January 2003), at 2.

⁹ *Ibid.*, at 27.

¹⁰ EBSAs “are geographically or oceanographically discrete areas that provide important services to one or more species/populations of an ecosystem or to the ecosystem as a whole, compared to other surround areas or areas of similar ecological characteristics, or otherwise meet the criteria as identified in Annex I to the decision IX/20”. The criteria include characteristics such as: uniqueness or rarity; special importance for life history stages of species; importance for threatened, endangered or declining species and /or habitats; vulnerability, fragility, sensitivity or slow recovery; biological productivity; biological diversity; and naturalness”.

area can lead to further impacts.

As for the Scotian Shelf, the Banquereau and Eastern Shoal were identified as EBSAs by DFO¹² primarily due to its unique characteristics and fitness consequences.¹³ The Eastern Shoal (which is located partially on the Banquereau) was further considered as an Area of Interest¹⁴ (AOI) candidate. The area was selected as an AOI candidate due to its ecological and biological importance. As noted by DFO:

“Eastern Shoal appears to be particularly significant for winter skate, which is considered “threatened” by COSEWIC. The area is also important for cod, considered of “special concern” by COSEWIC. Atlantic, northern and spotted wolffishes (all listed under the SARA) also occur in this area.

Winter skate – The abundance of winter skate on the Eastern Scotian Shelf is estimated to have declined by more than 90% since the early 1970s and is now at a historically low level. Certain life history characteristics of this species make it vulnerable to exploitation and limit its ability to recover. Scientific surveys since 1970 indicate that the Eastern Shoal portion of Banquereau is a very important habitat for this species.

Atlantic cod – The Laurentian Channel component of this candidate AOI is an important overwintering habitat for the Sydney Bight and southern Gulf of St. Lawrence populations of Atlantic cod. Southern Gulf of St. Lawrence cod are thought to be at high risk of local extinction. Protecting this important mixing area may benefit both of these severely depleted populations. Cod was also once abundant on Eastern Shoal.

Wolffishes – This candidate AOI includes important habitat for the Atlantic wolffish, a large, solitary, nest-building benthic fish that has declined significantly since the 1970s. Northern and spotted wolffishes have also been found in this area. All three of these predator species are long lived and slow to mature, making them vulnerable and slow to recover from human disturbances.”¹⁵

In addition, I would also like to concur with the concerns expressed by the Ecology Action Centre in an email to the assessment team dated 09 June 2011, particularly in regards to: the absence of independent and comprehensive impacts assessment, apart from a few DFO scientists assessments; absence of trophic level assessments; hydraulic fluid associated concerns; the need for closed areas; and concerns over potential increases in the harvesting capacity in the respective areas.

¹² P. Doherty and T. Horsman. 2007. Ecologically and Biologically Significant Areas of the Scotian Shelf and Environs: A Compilation of Scientific Expert Opinion. Can. Tech. Rep. Fish. Aquat. Sci. 2774: 57 + xii pp.

¹³ Ibid, at 7.

¹⁴ First step towards the establishment of an *Oceans Act* marine protected area.

¹⁵ DFO, Marine Protected Areas on the Eastern Scotian Shelf, Selecting the next Area of Interest, 2009 Consultation Booklet, at 12-13. See also, DFO, 2011., At Risk Species, State of the Scotian Shelf Report, online: < <http://coinatlantic.ca/docs/species-at-risk.pdf>>

15.3 Information from the Ecology Action Centre, received on 17th June, 2011.

We have been discussing our involvement in this fishery at EAC, and we do have major concerns that this fishery has even made it past pre-assessment given the destructive nature of the fishing gear and the maximum age of the target species.

- The hydraulic clam dredge has a high catch efficiency and completely destroys the seafloor, in some cases down to 18 inches. This disrupts numerous ecosystem processes, breaks the benthic food web as well as vastly changes any benthic pelagic coupling.
- To date, the fishery has been limited by a lack of harvesting capacity by Clearwater. Should harvesting capacity increase whether through new entrants to the fishery or through new vessels, the intensity and frequency of this fishery will certainly become unsustainable particularly given the amount of time needed for the target species to recruit to the fishery.
- We are also concerned that there is no fishery independent science being conducted on this fishery, and all science is done in conjunction with the fishery, with the exception of some impact studies completed by DFO. This not only limits the questions that can be asked during a research survey but it also severely limits the access to data. Despite the existence of enterprise allocations, this resource, and all fisheries resources in Canada, remain in the public domain.
- We are also concerned that we end up putting a significant amount of time into MSC stakeholder processes, and have yet to see meaningful conditions placed on fisheries that used destructive fishing gear. We are not sure we want to be engaged in the certification of the status quo - and in many cases MSC certification of Atlantic Canadian Fisheries has largely undermined much of our conservation work and is leading to consumer confusion given the level of public concern about fishing gear impacts on habitat and bycatch species. We can discuss this further this afternoon.

I know you are meeting with DFO this morning, and I am cognizant of the capacity of DFO scientists and managers to actually implement conditions and meet assessment timelines. There are some very specific issues relating to the fishery that should be included in discussions with DFO, particularly considering the current survey cycle. Previous survey analysis have showed considerable serial depletion of surf clams on the Scotian Shelf, particularly after "virgin" populations have been fished.

Aside from the bottom habitat disturbance issues, we suggest that a proper sensitivity analysis (along the lines of a real Management Strategy Evaluation) of the effect of a 4 (or is it 5?) year survey cycle on assessment advice. In other words, how much does a non-annual survey influence assessment uncertainty relative to other sources of uncertainty? It may not be that big a problem because of the very late age at recruitment to the fishery and the presumed very low M (natural mortality) for the target species, but this should be verified. This idea was only discussed superficially at the Framework Assessment meetings in 2007. Since that meeting there have been a few new methods developed to estimate sustainable yields for long-lived species (eg. MacCall. 2009. ICES J Mar Sci 66:2267-2271) it would be worthwhile exploring their utility for providing TAC advice in this kind of fishery - where a more traditional time-series based population model cannot be used due to the sparsity of survey data and strong biases in the CPUE data. As well, the low M should be examined in terms of historical predator populations - both groundfish and walrus used to prey quite heavily on clam populations on the Scotian Shelf. The Southeast Shoal of the Grand Banks is also a uniquely productive ecosystem. How does the removal of these shellfish affect potential recovery of groundfish (we don't expect the walrus to come back!). The current stock assessment framework does not include any trophic level analysis, and this is something that should be examined, particularly if the TAC is to increase or if there are new entrants to the fishery.

We also suggest that you ask for data on the amount of hydraulic fluid that is being used and what is being done to ensure proper disposal and that this is not being released into the marine environment. This is an issue that has been raised by fisheries observers.

To summarize, we do not feel that there is any grounds for the hydraulic clam fishery to be certified - and even if there were any indications that such a fishing method (which quite frankly can be equated to the use of dynamite in a sandy environment), there are significant improvements that need to be made to this fishery, including the addition of closed areas that are not fished - ever - to ensure that there is a control area to measure impacts and to ensure that some level

of ecosystem integrity is maintained. Clearwater has the ability to do this and should be willing to set aside no fish areas, given that it is already rotationally harvesting.

We can discuss further this afternoon.

All the best,

Susanna Fuller
Marine Conservation Coordinator
Ecology Action Centre



P.O. Box 1035
Dartmouth, NS
B2Y 4T3

DEC 12 2011

Ms. Christine Penney
Director of Corporate Affairs
757 Bedford Highway
Bedford, Nova Scotia
B4A 3Z7

Re: Fisheries and Oceans Canada Support for Marine Stewardship Council Action Plan

Dear Ms. Penney,

This letter is to advise you that Fisheries and Oceans Canada Maritimes Region (DFO) agrees to support the Action Plan you have drafted for the Banquereau Bank Arctic Surf Clam fishery, with the caveat that DFO's contributions will be limited to actions that align with DFO annual work plan activities.

We expect that in the coming months, a more detailed Action work plan will define timelines and accountabilities that touch on areas of DFO authority. Please note that this work plan will be reviewed on an annual basis to assess its alignment to DFO's annual plans and priorities. As a result additional internal review will be required in advance of DFO commencing activities to support the Action Plan.

I would like to take this opportunity to applaud Clearwater Seafoods Limited Partnership for its on-going commitment to a sustainable fishery and I wish you all the best in your effort to become Marine Stewardship Council certified.

Yours sincerely,

A handwritten signature in black ink that reads "Faith G. Scattolon".

Faith G. Scattolon
Regional Director-General
Maritimes Region

17 APPENDIX D – PEER REVIEW 1

Overall Opinion

<i>Has the assessment team arrived at an appropriate conclusion based on the evidence presented in the assessment report?</i>	Yes/No P1 – no P2, P3 - generally	Conformity Assessment Body Response
<p><u>Justification:</u> Some comments to consider on P3. P2 is generally good but please consider MSC definitions of “strategy” and “partial strategy”. On P1, the fact that the reference points, harvest strategy, and harvest control rules are not explicit in the IFMP makes me question whether the relevant PIs achieve the MSC minimum standard.</p>		<p>The assessment team has addressed specific comments as they appear below.</p>

If included

<i>Do you think the condition(s) raised are appropriately written to achieve the SG80 outcome within the specified timeframe?</i>	Yes/No Yes	Conformity Assessment Body Response
<p><u>Justification:</u> They are written in line with the MSC standard and timelines are appropriate. However there may be some additional conditions needed, based on my review.</p>		<p>The assessment team has addressed specific comments as they appear below.</p>

:

<i>Do you think the client action plan is sufficient to close the conditions raised?</i>	Yes/No Yes with one comment	Conformity Assessment Body Response
<p><u>Justification:</u> Fine as written for Conditions 1 and 2 For Condition 3 I suggest adding “which conform to MSC requirements” after “to manage the stock” – as written it appears that the requirement to reduce exploitation rate as LRP is approached is not included.</p>		<p>This comment refers to Condition 2, rather than to Condition 3.</p> <p>The text of Condition 2 provides no doubt that the requirement of MSC certification is that the exploitation rate is reduced as the limit reference point is approached. The text “which conforms to MSC requirements” is considered to be self-evident and its inclusion is therefore unnecessary. Any annual surveillance assessment team will certainly consider how any proposed harvest control rule conforms to MSC requirements in assessing whether this condition has been met.</p>

For reports using the Risk-Based Framework please follow [the link](#).
For reports assessing enhanced fisheries please follow [the link](#).

General Comments on the Assessment Report (optional)

The report was generally well documented, well argued and well written.

Some comments on introductory sections:

References. The Roddick et al 2010 Working Paper is now published as CSAS Research Document 2011/052.

IMM Ltd.: Thank you- this is noted and the reference checked and changed.

Section 5.1 (Management Unit), para 1 line 7. Surveys have not really been on a “rotating” basis but have

occurred periodically over a 15 year period.

IMM Ltd.: The comment is noted and the sentence has been modified to read ‘several times’.

Section 5.2.3 Biomass and abundance. Tables 4 and 5 give a different area surveyed for Banquereau – why? and which is right?

IMM Ltd.: There is no explanation for this in the reference documents. A note has been added to the report at Section 5.2.3 saying that it is presumed that the difference is due to changes in the boundary definition of the survey between the publication of the two reports.

Section 5.2.4, Figure 9. What is the source of the “population” information? was it derived somehow from the “sample” information?

IMM Ltd.: Figure 9 and the related section 5.2.4 refer to ‘survey’ information rather than to ‘population’ information. Length data taken during the surveys were used to recreate a survey age distribution based on the sample age data that were collected later in laboratory aging. This is standard fisheries biology methodology and is described in the section.

Section 5.2.5 Assessment methods. Para 1, last sentence. I would say sources of uncertainty are “described” not “addressed” which implies something has been done to take account of each. The TAC is selected based on a cautious approach because of the multiple uncertainties.

IMM Ltd.: Agreed- a change has been made in the report.

Section 5.2.5 para 3. Is this whole analysis from Roddick 2007? I presume. That is not clear from the citation. I would cite this publication after first sentence if so.

IMM Ltd.: Yes, the analysis is from Roddick *et al* 2007, and so the citation has been moved up in the paragraph.

Section 5.2.5 para 4-5. See separate sheet on MCY – this approach needs to be described as the publication cited is not widely available. It is not clear from the description what the principle behind MCY is, separate from the calculations and analyses used to determine TACs in the fishery.

IMM Ltd.: Agreed. The relevant sections have been amended to include more information on MCY and some readily available references are included.

Section 5.2.8. Recruitment. Interesting analysis. It is good to see that recruitment under no exploitation has been fairly regular. However in other long-lived molluscs (eg geoducks), recruitment may be rare under exploitation – this is one of the big uncertainties in harvesting this population, as the team recognizes.

IMM Ltd.: This comment is noted and agreed.

Section 5.2.11 Stock status. Probably a quibble, but I would say “status based on last assessment is good” rather than “current status is good” because last assessment was in 2007 and last survey was 2004.

IMM Ltd.: This comment is noted. The text has been changed to include the 2010 survey, the results of which are now available.

Section 5.3 Management advice. Para 1. DFO should be strongly encouraged to post the IFMP on their web site – the management plan on the site quite old.

IMM Ltd.: Noted- a recommendation has been made in the reports at Section 5.3..

Section 7.1 Ecosystem characteristics. First line: “westernmost” should be “easternmost”.

IMM Ltd.: Thank you- quite correct!

Table 7 (and others if I have not flagged these). Should indicate source in the caption.

IMM Ltd.: These have been checked and citations inserted as appropriate.

Performance Indicator Review

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.1.1	Yes – although I would note in addition that evidence indicates no serial depletion	Yes	N/A	<p>The rationale is generally well described. The second paragraph in the “Scoring Comments” is not really relevant. Stating that biomass is higher than previous surveys (para 1 line 6) gives the misleading impression that abundance has increased, which is not necessarily the case – phrase not needed, I suggest deleting.</p> <p>Statement that only two boats fishing ensures low fishing effort (para 1 line 8) is not relevant, fishing mortality is regulated by the TAC – delete.</p> <p>Science Advisory Report provides evidence that there has not been serial depletion – this is important.</p>	<p>The Scoring Comments have been modified to take into account information from the 2010 survey that has recently been published. The second paragraph describes the TAC setting approach, which relates to the fishing pressure that the stock is subjected to. These factors are considered relevant in the context of stock status.</p> <p>The text has been modified to include reference to the 2010 survey</p> <p>The reference to only two boats fishing has been deleted and the role of the TAC in controlling effort highlighted.</p> <p>Thank you- a note indicating that there is evidence that serial depletion is not occurring has been inserted.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.1.2	No – the report does not mention that RPs are not referenced in the IFMP	No for LRP Probably not for TRP	Question whether fishery meets 60 for LRP	<p>Three issues:</p> <ul style="list-style-type: none"> - reference points are not referred to in the IFMP or available management documents - rationale behind MCY is not well explained, so can't confirm that this approach is equivalent to a target reference point - strictly speaking, the fishery does not meet 60 for LRP as there is no mention whatsoever of a LRP in the IFMP or other documentation <p>See separate sheet</p>	<p>The use of implicit reference points is allowed within the MSC Standard (Certification Requirements, Section CB 2.3.2.1- MSC 2011). The assessment team considers that the absence of explicit mention of reference points in the IFMP does not, in itself, preclude the fishery from achieving a minimum score for this PI since there is documented evidence of the use of an acceptable proxy for the TRP in the management process. The rationale for MCY has now been detailed more fully.</p> <p>It is considered that the management strategy aims to achieve B_{MCY} as a target reference point. There is no LRP but the stock is clearly well above the point at which recruitment would be impaired, and above the default LRP as suggested by the MSC (Certification Requirements, Section CB 2.3.3.1- MSC 2011).</p>
1.1.3				N/A, stock not depleted	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.1	No – the report does not mention that the harvest strategy is not described in the IFMP	No	N/A (no condition set)	<p>The harvest strategy described in the certification report based on MCY (application of a low exploitation rate to estimated biomass) is nowhere referred to in the IFMP. It is probably an appropriate strategy but I question whether this lack of documented commitment to a strategy meets MSC requirements.</p> <p>If the strategy was properly documented, I think the score is generally OK although I question whether element 2 in the 100 (fully evaluated) and also element 3 (periodically reviewed and improved) are met, so would consider a score around 85-90.</p> <p>The text should identify the elements of the harvesting strategy and also address the various points of SG60, 80 etc – for example “responsive to the state of the stock” since survey frequency is relatively low.</p>	The harvest strategy based on MCY is described in detail in the latest IFMP (DFO 2011c). It was used for the first time for Grand Bank in 2011 but is yet to be implemented for Banquereau, which has continued to retain an even more conservative TAC.
1.2.2	No – report does not mention that HCRs not referenced in IFMP	No	Yes	<p>1. As above, the harvest control rule(s) are not referenced in the IFMP so I question whether this meets the MSC standard. An HCR to be used on an ongoing basis is not clearly outlined in the “Scoring Comments” either, although there is a description of recent practice.</p> <p>2. As the draft report indicates, no HCR “which act to reduce exploitation rate” as LRP is approached is in place – there is only a fixed F applied to biomass estimates. Accordingly I question whether SG 60 is met. The wording of the condition would allow the fishery to meet the MSC standard.</p>	<p>The harvest control rules are described in the latest IFMP (DFO 2011c).</p> <p>The assessment team consider that since the fishery has been maintained at around an implicit target reference point and the stocks are well above the MSC default value for an implicit limit reference point of $\frac{1}{2} B_{MSY}$ or 20% of B_0, this fishery is not in danger and meets the minimum MSC standard requirement. We consider that the lack of an explicit limit reference point is best dealt with by imposing a Condition.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.3	Generally, see comments	Not sure	N/A	<p>This is generally good.</p> <p>It would be important here to explicitly say why the relatively low survey frequency is OK – I think it is, given the stock and fishery dynamics, but saying “it is perhaps at a frequency suitable for the stock” in the Scoring Justification is not convincing for the MSC standard.</p> <p>What has been the observer coverage?</p> <p>The fishery clearly meets 80 but the justification that it meets element 1 of the 100 should be stronger – it is true that information is pretty good, but the time series is relatively short and stock-recruitment dynamics under exploitation are not well known, compared to other exploited stocks.</p>	<p>The low frequency of surveys is not ideal but is a question of available resources and is taken into account by setting conservative TACs. The implications of this are considered in scoring other PIs – e.g. 1.2.3.</p> <p>This comment has been noted and the text has been modified</p>
1.2.4	Yes	No	N/A	<p>I question how it meets element 2 of 100 (“a probabilistic way”), element 3 (“tested” and “alternative hypotheses”) and the “externally reviewed” part of element 4 – the framework has been externally reviewed but not the assessment per se, according to the draft report.</p>	<p>Agreed. The text has been modified and the score lowered from 95 to 85.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.1.1	Mostly – see comment	Yes	N/A	The “Scoring Comments” need to explain clearly how a bar spacing of 28 mm is OK for animals maturing at 28-29 mm (propellerclam, male cockle). I am assuming that this is because selection operates on shell height as much as shell width. Otherwise - OK	Dredge selectivity on bivalves in the Arctic surfclam fishery is primarily associated with shell height rather than shell length as this is the smallest shell dimension. For example, see the size-frequency distribution of Arctic surfclams taken in the 2006-2009 survey of Grand Bank (Figure 18, Roddick <i>et al.</i> 2011). A note to this effect has been included in the report. Thank you, a note has been made on the lack of any main retained species in the report.
2.1.2	Yes	Yes	N/A	Since there are no “main” bycatch species, the “if necessary” provision of the 80 SG can also be invoked, however, it is good to give the information here and it clearly supports the score.	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.1.3	Generally – see comment	See comments – please consider	N/A	<p>No information on actual landings of retained species is available in the reports. We only have some survey and observer information. Is this available and would it further improve the information base? Without it, I question whether “accurate and verifiable” information on catch is available. This would also help address element 4 in SG 8 (detect increased risk). “Broad age structure of the stocks” (scoring justification line 2) – can a citation be provided? Generally this seems OK although I am not totally convinced that information justifies a score above 80.</p>	<p>The landings data are understood to be confidential due to the very small number of vessels and the single company prosecuting the fishery. This is a standard DFO practice as described in Hillier <i>et al.</i> 2007 (Hillier, C.J., Gueret, D., Butterfield, S., & N. Pellegrin 2007. Fish harvesting activities within the proposed Gwaii Haanas National Marine Conservation Area. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2803: vii+ 65 pp.). Nevertheless, the data are collected and are available for management.</p> <p>In combination with information on the bycatch profile of the fishery, the assessment team considers that the data on the swept area of the fishery do suggest strongly that the fishery does not pose a risk to stocks of retained species.</p> <p>Broad age structure of the stocks- Kilada <i>et al.</i> 2009 provide information on the northern propellerclam stock on Banquereau, while Kilada <i>et al.</i> 2007 provide information on the Greenland cockle on Banquereau and Grand Bank, with the sample animals collected from the Arctic surfclam fishery. Although not comprehensive, these data are considered adequate to provide descriptive information on age structure of the stocks.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.2.1	Yes	Yes	N/A	Should note in scoring justification that there are no other "main" bycatch species. I believe that "non-catch" mortality (animals killed but not found in the bycatch) is best dealt with in the 2.5 series. It could stay here, as long as it is dealt with, but non-catch mortality by definition is not a bycatch issue. The evidence for a small footprint of the fishery relative to the distribution of impacted species is good to support the argument for a generally low non-catch impact.	A comment has been added noting that <i>E.parma</i> is the single main bycatch species. The MSC Guidance is that bycatch species should be interpreted as species in the catch that are not retained and that are discarded as well as those that die because of unobserved fishing mortality. However, the issue of unobserved mortality is now referred to in the PIs covering 2.2 (bycatch) and 2.5 (ecosystem).

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.2.2	Yes	No	N/A	<p>The arrangements and very general objectives described do not meet the MSC definition of a “strategy” (FAM 7.1.22). A “strategy” would explicitly state what is being done to reduce bycatch, why, and what would be done if things get worse. They are at the limit of meeting a “partial strategy” (FAM 7.1.23) which implies awareness of the need to change if necessary, but I think 80 is justified because of the very low bycatch and obviously low impact on the only “main” bycatch species (which barely makes it as a “main” species).</p> <p>The first 3 objectives listed are better dealt with in 2.4 or 2.5 as they are almost never seen in the bycatch.</p>	<p>This comment on ‘strategy’ versus ‘partial strategy’ is not accepted. The MSC defines a strategy as “<i>a cohesive and strategic arrangement which may comprise one or more measures, an understanding of how it/they work to achieve an outcome and which should be designed to manage impact on that Component specifically. A strategy needs to be appropriate to the scale, intensity and cultural context of the fishery.... A strategy should contain mechanisms for the modification fishing practices in the light of the identification of unacceptable impacts.</i>” The assessment team believes that the work undertaken to understand impacts has shown that the specific arrangements in the fishery (bar spacing, limited area impacted annually by the fishery) will work to manage and minimise impacts. The arrangements are appropriate to the scale of the fishery, and further modifications could be introduced through the IFMP if further issues were identified.</p> <p>Following consideration of this comment, the first three objectives have been deleted from PI 2.2.2, and added as objectives to PIs 2.4 (habitat) and 2.5 (ecosystem).</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.2.3	Generally – see comments	Yes	N/A	“the landed catch” (scoring comments para 2 line 1) is not of use for discarded species. “Sufficient data to detect increase in risk” (element 4 of SG 80) – given the low observer coverage, this fishery is at the limit for this. The small footprint compared to total benthic habitat gives confidence that risk is low.	The reference to landed catch is considered to be relevant in the context of bycatch, on the assumption that the two are related. For example, if it is assumed that all things are proportionate, it may be presumed that if the landed catch was to double, the bycatch would also double.
2.3.1	Yes	Yes	N/A	Note in scoring comments that there has been no recorded bycatch of any listed species.	Thank you, a comment to this effect has been made in the report.
2.3.2	Yes	Yes	N/A	Agree with draft	
2.3.3	Yes	Yes	N/A	Agree with draft	
2.4.1	Mostly but see comment	Yes	N/A	Section would be stronger if it started with a para that this is a habitat subject to a relatively high level of natural disturbance (see introduction section 7). Fishery impacts are generally of less concern in these high-energy habitats. I don't think citation of the MSC standard is needed in the scoring comments – this should be relatively well known and has been properly applied here. However no problem leaving it in.	Thank you- the first paragraph has been adjusted slightly to highlight the wave and tidal regime on Banquereau, and the conclusion that the well-sorted surface sediments are likely to be mobilised at frequent intervals. Although unusual, it was considered in this case that the MSC guidance would usefully direct readers on the thinking behind the scoring comments on impacts, and on the subsequent score.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.4.2	Yes	No	N/A	<p>This does not meet the FAM definition of a "strategy" (7.1.22) so cannot make 100. I would question whether it makes the definition of a "partial strategy" (FAM 7.1.23) which would imply some recognition that there is a potential problem and a "cohesive arrangement" to deal with it. On this basis I question whether it makes the 80. It definitely makes 60.</p> <p>Gilkinson et al 2005 state that industry leaves harvested areas "fallow" for 10 years before re-harvesting – although the rationale is to allow the target species to recover, this probably is a strategy with positive impacts for habitats and ecosystems. Is this strategy still in place?</p>	<p>The comment on 'strategy' is not accepted. It is considered that the arrangements do constitute a strategy on the basis that the experimental work on Banquereau was specifically targeted at understanding the impacts of the fishery on the seabed and benthic species- the results indicated that recovery of those features should occur comparatively quickly, and certainly within a timeframe that is compatible with the fishery impacts.</p> <p>It is understood that the 10 year fallowing period is still in effect.</p>
2.4.3	Yes	Yes	N/A	<p>The standard for 100 requires "particular attention to the occurrence of vulnerable habitat types" – these have been pretty well mapped on the eastern Scotian Shelf (and the fishery does not go into them) so the argument for a high score is further justified.</p>	<p>Thank you- a note of the avoidance of vulnerable habitat types has been included. The score has not changed as a result.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.5.1	Generally, but could be more effectively organised (see comments)	Yes	N/A	<p>This section is hard to write. It is useful to first identify the ecosystem issues to be addressed, then address them one by one. "Key" elements should also be identified at the start (MSC FAM 7.6.5).</p> <p>In this case, non-catch impacts on biodiversity, effect of removing target species on food webs or bioturbation, etc., would be among the potential ecosystem impacts.</p> <p>Gilkinson et al 2005 (near the end of the paper) provide a good description of the possible structuring role of large clams in benthic ecosystems – their removal could impact ecosystem structure and function. Although uncertainties about just how important this role is are high, this issue should be mentioned and addressed.</p> <p>I think the small footprint of the fishery relative to the extent of benthic ecosystems is a good argument for the scoring – however it should be recognized that hydraulic dredges do have a significant impact on benthic communities where they operate – see Gilkinson et al 2005.</p> <p>The fact that this area was identified as a candidate EBSA (see 2.5.3) needs to be addressed. My understanding is that the candidates were never formalised, and that this area only qualified on one of 5 criteria.</p>	<p>The authors have approached the ecosystem section by excluding some potential ecosystem impacts (sedimentation and other pelagic impacts, and impacts on demersal fish species), before focusing on the seabed, which is where impacts might be expected.</p> <p>The role of clams as bioturbators is discussed.</p> <p>The report discusses the EBSA designation, and a note is now included in this PI. A mention of the Area of Interest process is also included.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.5.2	Yes	No	N/A	As with habitat, the situation does not meet the definition of a "strategy" (MSC) or a "partial strategy". These require some explicit recognition in the IFMP or other documentation of a need for action. It meets the 60 with no problem. The 10-year "fallow" strategy, if still in place (see 2.4.2) would support ecosystem rebuilding.	The comment on strategy versus partial strategy is accepted, and a change made to the report. The other scoring issues of SG100 are, though, considered to have been met. The fishery has undertaken a thorough review of the impacts on benthic habitats and communities through work undertaken on Banquereau, and no long term or serious impacts have been detected. In combination with the limited range of water depth and habitat type in which the gear can be worked, and the very small footprint of the fishery, this is considered to provide for the development of a full strategy that restrains impacts on the ecosystem to ensure the fishery does not cause serious or irreversible harm (SG100, scoring issue 2); the measures are considered likely to work based on plausible argument involving the results from Banquereau (SG100, scoring issue 3), and there is evidence from VMS data that the measures (the limited fishery area) are being implemented (SG100, scoring issue 4). If the fishery extended over a large area, took large quantities of bycatch or had removed a high percentage of the stock then a much more involved strategy would be required, but this is not the case. The score has been revised to 95.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.5.3	Mostly but see suggestions – could be better organized	No	N/A	<p>This section would benefit from organisation by potential impact and element (see 2.5.1). It is currently difficult to fit the information to the standard.</p> <p>The fact that it was identified as a candidate EBSA needs to be addressed. The text needs to focus more on information available.</p> <p>Some potentially useful additional references are provided on separate sheet.</p>	<p>As for comments related to PI 2.5.1, the comments on style are noted.</p> <p>The candidate EBSA designation confers no special status to the site. The site was also not taken forward as an Area of Interest following a consultation in 2009. These were dealt with under PI 2.5.1. The additional references were examined, thank you, but not used. The section was instead rewritten to focus more on data availability.</p>
				A general comment on P3 – the Canadian system is generally well known in relation to the MSC standard and this draft is generally consistent with other certification reports (but see comments)	
3.1.1	Yes	Yes	N/A	Agree with draft	
3.1.2	Yes	Yes	Yes	Are stakeholders invited to, or advised of, meetings of the management bodies to which they can participate? If the meetings are simply “open” but not advised, opportunities to participate are even more restricted than indicated.	The assessment team understands that the DFO maintains a list of stakeholders who have expressed an interest in the OCAC, and that those stakeholders are contacted prior to OCAC meetings. In order to promote this approach, a recommendation has been made that advance notice of the time and place of advisory committee meetings, and the minutes of such meetings, should be circulated to all interested parties on request or posted on the DFO website.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
3.1.3	Yes	Yes	N/A	Agree with draft	
3.1.4	Yes	Yes	N/A	Agree with draft	
3.2.1	Yes	Yes	N/A	Agree with draft	
3.2.2	Yes	Yes	N/A	Agree with draft although last sentence in scoring comments should probably be something like: An example of precautionary decision-making in this fishery is the setting of TACs based on a fishing mortality rate well below the rate of natural mortality.	The suggested wording has been accepted.
3.2.3	Generally but see comment	Yes	N/A	The initial statement that there have been very few violations raises more questions than it answers – for what, when? this may not be known in detail but it would be good to give a few examples and a rough estimate of how many over what time period.	DFO has now advised that there have been no violations in the offshore clam fishery for the past 5 years. A comment to this effect has been placed in the report.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
3.2.4	Yes	No	N/A	<p>I don't think the situation described meets the MSC definition of a "research plan" as per FAM 8.3.13. We have a list of possible projects in the IFMP and an indication that which ones get funded will be decided later. I don't see the "strategic approach" to addressing priorities in the IFMP.</p> <p>Accordingly I am not convinced that it meets element 1 of SG 80.</p> <p>Yes there has been some good research. Reliable, timely, disseminated – OK.</p>	<p>DFO has identified stock biomass estimates, recruitment and bottom disturbance as the major issues in the fishery. The research and studies conducted are focused on those issues and were accordingly judged to be strategic in that they are pro-active, anticipatory and identify gaps in knowledge driven by management needs that are relevant to the scale and intensity of the fishery and the issues requiring research as required by the FAM.</p>
3.2.5	Yes	Yes	N/A	Agree with draft	

18 APPENDIX E - PEER REVIEW 2

Overall Opinion

Has the assessment team arrived at an appropriate conclusion based on the evidence presented in the assessment report?	Yes/No YES	Conformity Assessment Body Response
<p><u>Justification:</u> While the overall conclusion that the fisheries on both Banquereau (BB) and Grand Bank (GB) are certifiable with Conditions, is appropriate, there are some issues that need to be addressed including possible additional conditions.</p>		<p>The assessment team has responded to specific points made by the reviewer in the table below.</p>

If included:

Do you think the condition(s) raised are appropriately written to achieve the SG80 outcome within the specified timeframe?	Yes/No NO	Conformity Assessment Body Response
<p><u>Justification:</u> While generally satisfactory, for both the Banquereau and Grand Bank documents more detail regarding the limit reference point in Condition for 1.1.2 should have been included. Based on the 2nd bullet of the condition ("The limit reference point is set above ...") it appears that the reference point is in relation to biomass. This should actually be 'exploitable' biomass and should be explicitly stated.</p> <p>For Conditions associated with both PI 1.1.2, there should be a requirement that the limit reference point be included in the Harvest control Rules to be developed within 1.2.2, and there should be a requirement for the limit reference point and the Harvest Control Rules to be included in an updated IFMP (perhaps by the 3rd annual audit) so as to ensure their active application in the fishery so as to ensure an ongoing meeting of the SG80 guideposts.</p> <p>With regard to the Condition associated with 3.1.2, it is stated in the scoring rationale " The advisory committee process is open to the public and provides an opportunity for all interested parties to participate." However, the assessment text (page 40 – Banquereau; page 42 – Grand Bank) states that although meetings of the OCAC are open to the public, "only members of the committee are permitted to address the agenda unless specifically allowed by the chair." This is considered to potentially limit the "opportunity for all interested and affected parties to be involved" (3rd bullet of Condition (both reports)) and as such should be specifically considered in development of the Condition.</p>		<p>This comment, and several below, highlight the importance of carefully defining biomass terms. The term 'exploitable biomass' is not clear but seems to imply that portion of the stock that is economic to harvest, which is not what is required in the context of managing and conserving the stock. The IFMP uses the term 'harvestable biomass (fishable biomass >75g/m²)', which is clearly defined, appropriate for managing the stock and is not dependent on the vagaries of market conditions and the economics of exploitation. More details of the limit reference point are not necessary in Condition 1 since it states that they must be 'appropriate for the stock'</p> <p>The limit reference point will be included in the Harvest Control Rules since Condition 2 requires 'that the exploitation rate is reduced as limit reference points are approached'. Once operational, new harvest control rules would be expected to be included in management documents.</p> <p>The text "only members of the committee are permitted to address the agenda unless specifically allowed by the chair." has been removed from the document. This is not listed in the terms of reference for the OCAC as provided in the latest IFMP (DFO 2011c). The assessment team can also find no other reference to it, and it unfairly infers that members of the public are prevented from speaking at OCAC meetings. In fact, OCAC minutes show that interested parties are allowed to contribute to meetings, and, in any case, a responsibility of the Chair at any meeting is to manage the participation of those attending in an orderly manner, as doubtless occurs at OCAC meetings. The text of the Condition has not been modified.</p>

Do you think the client action plan is sufficient to close the conditions raised?	Yes/No YES	Conformity Assessment Body Response
<p><u>Justification:</u> The Action Plans, as stated, are adequate to address the Conditions as stated but will require modification depending on</p>		<p>Based on the answers provided to other points made in this review, the assessment team does not feel it is necessary or appropriate to adjust the text of the three Conditions.</p>

adjustments made in relation to the Condition issues noted above as well as any additional or modified conditions arising from the peer review comments.

For reports using the Risk-Based Framework please follow the link.

For reports assessing enhanced fisheries please follow the link.

General Comments on the Assessment Report (optional)

Overall, both assessment documents (Banquereau and Grand Bank) are well structured with generally adequate information provided so as to allow for evaluation against the PI Guideposts. There are, however, some issues that should be addressed as indicated in the Any Other Comments Section below. Some are quite minor while some are considered to be critically important as they could have potential important impacts regarding scoring of a number of PIs.

It is recommended that the assessment team examine the issues raised in the Any Other Comments Section before reviewing the specific PI scoring comments.

Performance Indicator Review

Please complete the table below for each Performance Indicator which are listed in the Conformity Assessment Body's Public Certification Draft Report.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
Example:1.1.2	No	No	NA	<i>The certifier gave a score of 80 for this PI. The 80 scoring guidepost asks for a target reference point that is consistent with maintaining the stock at Bmsy or above, however the target reference point given for this fishery is Bpa, with no indication of how this is consistent with a Bmsy level.</i>	
1.1.1	Yes	Yes	NA	<p>A score of 100 was assigned and this is considered appropriate. However, the Scoring Comments need to be redone taking remarks in the Any Other Comments Section below pertaining to the F~MSY approach including the calculation of the various Fs in both documents. The "convincing arguments" that the stock is still at or near the virgin biomass level should be included in the Scoring Comments.</p> <p>For BB, the Scoring Comments state "This would have allowed an increase in the TAC to 38,599 t" This is incorrect based on the IFMP criterion of 75g/m³ density.</p>	<p>The assessment team has responded to the comments in the 'any other comments' section below.</p> <p>The report has deleted the reference to a tonnage figure on the basis of the ongoing management discussions and uncertainty over the TAC that will be set in future.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.1.2	No	No	No (see Overall Opinion comments above)	<p>The Scoring Comments suggest that only two vessels prosecuting the fishery is a "restriction" on fishing effort. The only restriction is the TAC (and market conditions) since more vessels could easily be licenced by DFO at any time.</p> <p>The Scoring Comments suggest that the fishery would detect a decline in biomass but since the vessels move from location to location and only return to previously fished grounds every 10 years or so, systematic declines would not be detected far enough in advance to ensure no impeding of reproductive output.</p> <p>While the F-MCY approach is more conservative than the MSC recommendation of MSY, it's application is inappropriate (see Any Other Comments Section below) and as such, the 3rd scoring criterion of SG 80 is not met. As such, an additional Condition should be developed that requires the target to be in relation to exploitable biomass rather than commercial viability.</p>	<p>While it is accepted that other vessels (up to a maximum of two) could be engaged in the fishery, albeit at considerable cost to CSLP, the point that it is the TAC that ultimately restricts effort is also accepted, although the TAC has not been taken in recent years A change has been made to the assessment documents.</p> <p>This point is also accepted- a change has been made to the assessment documents noting that a significant reduction in biomass should be detected by <u>surveys</u> before reproductive output was affected. .</p> <p>The comment is partially addressed in the 'Any other comments' section below'. The assessment team does not agree that an additional condition is required, as there is already considerable precaution set in to the management approach (assuming the survey gear is 100% efficient, fishing vessels moving on before an area is fished to exhaustion). Further, as noted by the peer reviewer, the economic situation may change and more or less of the stock may be exploitable in future, rendering the results of an analysis based on 'exploitable biomass' difficult to interpret.</p>
1.1.3	Yes	Yes	NA	Nothing further to add.	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.1	YES	YES	NA	<p>It would be helpful, in the Scoring Comments for both BB and GB, to include the specifics regarding the age at 50% maturity and the age at 50% selectivity so as to clearly demonstrate the number of years of spawning before recruitment to the fishery.</p> <p>The 5th bullet of the Scoring Comments suggests exploitation rates of 1-2% per year but these need to be re-estimated based on RV exploitable biomass rather than RV total biomass.</p>	<p>The Grand Bank report under PI 1.2.1 now notes the age at 50% maturity (5.3 years) and the age at 50% selectivity (22.9 years). The Banquereau report under PI 1.2.1 now notes the age at 50% maturity (6.7 – 8.3 years) and the age at 50% selectivity (approximately 16.5 years).</p> <p>The text has been modified to read “(1-2% of the research vessel total biomass per year)”.</p>
1.2.2	No	No	No (see Overall Opinion comments above).	<p>As described in the Any Other Comments Section, there are problems with the application of the reference exploitation levels that need to be addressed. The Scoring Comments need to be modified to take the issues raised into account. Additional Condition(s) need to be considered in relation to these issues.</p> <p>Since it is questionable whether the application is correct, it is incorrect to state that the fishery is "managed on a very precautionary basis..." or that the TAC is "conservatively set"</p> <p>Since there are no well defined Harvest Control Rules, it cannot be said that the 3rd element of SG80 is met. Scores of 65 are more appropriate for both fisheries.</p>	<p>Extensive comments have been included in the 'Any other comments' section on this area. The TAC-setting approach since 2004 has been based on $F_{MSY}/600,000t$, which is more conservative than the $F \sim MCY = 0.33M$, which is now the recommended management strategy for the offshore clam fisheries as laid out in the 2011 IFMP. This, in turn, is more conservative than the default MSC approach of using F_{MSY}. As such, the assessment team considers that an extra condition is not required, and a rescoring of the fishery from 70 is not required.</p> <p>The assessment team considers that the management approach is very precautionary and that the TAC is conservatively set. The maintenance of the stock at a level that approximates the virgin biomass level confirms that this is the case.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.3	No	No	NA	<p>It is not well demonstrated that "A comprehensive range of information on ... stock abundance and productivity ... is available as is required to meet the first element of SG100. For Banquereau there have only been 3 surveys over a span of 23 years and there are a number of reasons cited as to why the 3 surveys are not directly comparable. For GB there has only been 1 survey and it was conducted over a 3-year span. Questions were raised as to the appropriateness of combining the information due to differences in the surveys. As such, while a good variety of information is available, there are considerable uncertainties such that information cannot be considered "comprehensive".</p> <p>Since there has only been 1 survey of the GB area, it cannot be stated that the stock abundance is "regularly monitored" as is required in element 2 of SG80. It has not been demonstrated for either stock that indicators are monitored with "sufficient frequency" to support the harvest control rule.</p> <p>A score of no higher than 80 is warranted for Banquereau while a score of 70 is warranted for Grand Bank thus necessitating a development of a Condition pertaining to research surveys.</p>	<p>The Grand Bank was surveyed in 1996-1997 as well as 2006-2009. The first survey results were never formally published because of the demise of the scientist in charge at that time (CSAS res doc 2011/052). The exploitable resource was, though, estimated at 504,000 t at that time (IFMP), which is comparable with the 548,763 t estimated at >75 g/m² in the 2006-09 survey (2010 GB SAR). In the context of the broad range of information available, the low exploitation level of the fishery and very limited fished area, the assessment team considers that the information available is comprehensive.</p> <p>The text has been modified slightly in 1.2.3. to reflect that the stock has been surveyed twice, although only very basic data are available on the first survey.</p> <p>The assessment team continues to believe that the fisheries should be awarded scores of 90 for this PI.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.4	No	No	NA	<p>The assessment does not fully take uncertainty into account. There are measurable uncertainties surrounding the biomass estimates but these are not considered when developing the recommended TAC. There are also uncertainties related to M but there was no apparent consideration of these in the derivation of the 2.64% exploitation target. There are also a number of uncertainties associated with the use of point estimates that have not been considered. That the 3 surveys on Banquereau are considered to not be directly comparable attests to this. The meeting described in DFO (2007b) was sponsored by DFO and attended by only 2 non-DFO persons. This cannot be considered as an external peer review (see for comparison PI 3.2.5). This especially so when the lack of agreement on the 0.33 value is considered but was used subsequently regardless. As such, the 4th element of SG100 has not been met. Uncertainty has not been considered in a probabilistic way and thus Element 2 of SG100 has not been met. The Scoring Comments suggest that incidental mortality has been considered in the assessment. It has been recognized but not specifically considered. The generic MCY equation ($MCY = xF_{0.1}B_0$) allows for M to be substituted for $F_{0.1}$ and this (0.08) is (fortuitously) close to $F_{0.1}$ for Banquereau (0.07) when incidental mortality is included. However, incidental mortality was not explicitly considered in the derivation of the quota recommendations. A score no higher than 85 is warranted for both areas.</p>	<p>Some of these points have already been discussed and taken into account in the allocation of scores in other PIs. Thus the uncertainties associated with M have been dealt with in 1.2.3, while the need for caution in setting the TAC because of the low frequency of surveys has been noted in several places. Both the scoring comments and the text have been modified to clarify the situation regarding incidental mortality but this was one of the factors contributing to a lower score for 1.2.3.</p> <p>The assessment team notes the concerns regarding the RAP process but consider that this provides very good opportunities for detailed consideration of the scientific and management issues but a consensus cannot always be expected.</p> <p>We agree that the 2nd and 4th elements of SG100 are not fully met and have reduced the score accordingly.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.1.1	Yes	Yes	NA	Nothing further to add.	
2.1.2	Yes	No	NA	It is not considered that the 3 rd Element of SG100 has been met as there is no comprehensive strategy to manage retained species and so it is unknown if there is adequate information available to support any such strategy or to evaluate how effective it might be.	
2.1.3	Yes	Yes	NA	Nothing further to add.	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.2.1	Yes	Yes	NA	Somewhere in 2.2 consideration should be given to unaccounted mortality of fish species due to water pressure from the nozzles (see Any Other Comments Section below) but since it is not measured, it cannot be determined if this would constitute a "main" bycatch or not. If the fish are small, they may not since the 5% is based on weight but the numbers might be significant nonetheless.	Bycatch data show that the fish species taken in greatest quantities on Banquereau were thorny skate (0.03% of the survey catch [13.8 kg out of 52,114 kg]) and seasnail <i>Liparis</i> sp. (0.06% of the commercial catch [0.5 kg out of 841 kg]), while on Grand Bank the fish species taken most frequently was sand lance (0.06% of the survey catch [14.4 kg out of 25,882 kg] and 0.09% of the commercial catch [1.4 kg out of 1,663 kg]); these quantities are negligible. It may be noted that the survey gear has a smaller bar spacing (23 – 28 mm) than commercial gear (28 – 32 mm), and so may be expected to retain greater quantities of small fish than the commercial gear; however, the quantities recorded are still tiny. Although it is inevitable that a quantity of unobserved mortality of fish species will occur, it is considered highly unlikely that those numbers would be significant, given the very low actual bycatch. A comment to this effect has been noted in the both assessment reports.
2.2.2	Yes	Yes	NA	Nothing further to add.	
2.2.3	Yes	Yes	NA	Nothing further to add.	
2.3.1	Yes	Yes	NA	Nothing further to add.	
2.3.2	Yes	Yes	NA	Nothing further to add.	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.3.3	Yes	Yes	NA	Nothing further to add.	This has now been corrected.
2.4.1	Yes	Yes	NA	Gordon <i>et al.</i> 2002 is not included in the Audit Trace References	
2.4.2	Yes	Yes	NA	Nothing further to add.	
2.4.3	Yes	Yes	NA	Nothing further to add.	
2.5.1	Yes	Yes	NA	Consideration should be given here to the possible impact (unmeasured mortality) on juvenile commercial fish as well as small non-commercial species as suggested in the Any Other Comments Section below.	As noted against the peer review comments for PI 2.2.1, the amounts of fish bycatch are negligible, and the potential quantities of unobserved mortality are therefore also likely to be tiny. A comment to this effect has been added to the text for PI 2.5.1.
2.5.2	Yes	Yes	NA	Nothing further to add.	
2.5.3	Yes	Yes	NA	The Scoring Comments should be modified to include consideration of smaller fish species as well as juveniles.	Again, as noted against the peer review comments for PI 2.2.1, the amounts of fish bycatch are negligible, and the potential quantities of unobserved mortality are therefore also likely to be tiny. A comment to this effect has been added to the text for PI 2.5.1.
3.1.1	Yes	Yes	NA	Nothing further to add.	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
3.1.2	Yes	Yes	No (see Overall Opinion comments above)	<p>The Scoring Comments indicate that the committee (OCAC) serves as an "open and public consultation" but non-members are only permitted to address agenda items with permission of the Chair. The assessment team should consider this as a shortcoming that should be addressed through an additional or modified Condition.</p> <p>Minutes are kept but are only available to committee members. This too should be addressed with an additional or modified Condition.</p>	<p>As noted earlier, the text <i>"only members of the committee are permitted to address the agenda unless specifically allowed by the chair."</i> has been removed from the document. This is not listed in the terms of reference for the OCAC as provided in the latest IFMP (DFO 2011c). The assessment team can find no other reference to it, and it unfairly infers that members of the public are prevented from speaking at OCAC meetings. In fact, a responsibility of the Chair at any meeting is to manage the participation of those attending in an orderly manner, as doubtless occurs at OCAC meetings.</p> <p>A recommendation has been made in the report that the minutes should be placed on the DFO website or made available upon request to DFO.</p>
3.1.3	No	No	NA	<p>Since all of the policies, frameworks, etc. in place can be over-ridden as a result on the considerable ministerial discretion afforded via the Fisheries Act, the "and required by" part of SG100 is not met. A score of 90-95 is more appropriate for both fisheries.</p>	<p>The Fishery Assessment Methodology notes that the focus of this Performance Indicator is the use or otherwise of the precautionary approach within the policy context. It goes on to say that the PI is not concerned with the operational implementation of the PA within the day-to-day management of the fishery itself but is more about the "high or broad management policy context." The team does not consider a possible ministerial "over-ride" of any particular decision or policy guideline an impediment to a 100 score on this PI.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
3.1.4	Yes	Yes	NA	Nothing further to add.	
3.2.1	Yes	Yes	NA	Nothing further to add.	
3.2.2	Yes	Yes	NA	Nothing further to add.	
3.2.3	No	No	NA	In PI 2.3.2 and 2.3.3 it was noted that the last scoring element of SG100 had not been met due to the low observer coverage. Here too a higher level of observer coverage would be needed to support the perspective that "a high degree of confidence that the fishers..." as is required under Element 3 of SG100. A score of 95 would be more appropriate for both fisheries.	The team notes the comment and agrees that the third element of the 100 score is not met. The score has been reduced to 95 and the text has been amended accordingly in both the Grand Bank and Banquereau fishery assessment reports.
3.2.4	Yes	Yes	NA	The Scoring Comments suggest that "Recruitment studies have been going on since the 1980s..." but there are no details of this provided in Section 5.2.8 of either document. Additional information to support this statement should be included.	Research has been undertaken on the Arctic surfclam resource of Grand Bank and Banquereau since the inception of the fishery in the 1980s (IFMP 2011). A change from 'recruitment studies to 'resource' studies has been made in the assessment documents.
3.2.5	Yes	Yes	NA	It should be noted that the FRCC has been disbanded and the text modified accordingly.	The reference to the FRCC has been deleted.

Any Other Comments

Comments	Conformity Assessment Body Response
<p>In all instances, the province of Newfoundland should be Newfoundland and Labrador. Similarly, the DFO Region is Newfoundland and Labrador rather than Newfoundland.</p> <p>The citations in the text including the Audit Trace References should be carefully checked so as to ensure they are all included in the "Other Information Sources". For example, Taggart <i>et al.</i> (1994) is cited in the Grand Bank (GB) document but not included in the bibliography (Taggart, C. T., J. Anderson, C. Bishop, E. Colbourne, J. Hutchings, G. Lilly, J. Morgan, E. Murphy, R. Myers, G. Rose, and P. Shelton. 1994. Overview of cod stocks, biology, and environment in the Northwest Atlantic region of Newfoundland, with emphasis on northern cod. Cod and Climate Changes. ICES Marine Sciences Symposium, 198: 140-157). There are references made to e.g., DFO, pers. comm. but it is unclear whether the information was obtained during the site visit meetings or speaking with a specific individual at DFO. These should be clarified.</p> <p>In the Grand Bank document (page 26) SeaScan is credited to Sonavision Ltd., but it should be credited to Seatronics Ltd.</p> <p>"Broadhead" wolffish is more commonly referred to as "northern" wolffish when speaking of it in the context of SARA and this practice should be followed in the documents so as to eliminate any possible confusion.</p> <p>On page 49 of the Banquereau document it is suggested that the groundfish collapse on Scotian Shelf was due, in part, to foreign fishing fleets. This is incorrect as there were no foreign fleets fishing in the area (except some fishing for silver hake by the USSR). This is only an issue for the Grand Banks. On page 51 of the Grand Bank document it refers to a moratorium in 1993. This is incorrect. A moratorium was placed on northern cod in July, 1992 and the other GB closures began in 1994. In that same section of the GB document, it is stated that the catch of northern cod was >1 million t in 1968. This estimate is for cod in all of 2GHJ3KLMNPs. Northern cod is the stock in NAFO divisions 2J3KL only and the reported landings in that year were 810,014 t (http://www.dfo-mpo.gc.ca/CSAS/Csas/publications/resdocs-docrech/2010/2010_103_e.pdf). Also on page 51 of the GB document it suggests that haddock was one of the dominant species prior to the collapses in the late 1980s. This is incorrect. The haddock stock collapsed back in the 1960s and has never recovered since. It has been suggested that the haddock niche was taken over by yellowtail flounder. Prior to the collapse, the stocks that dominated were cod, American plaice, yellowtail flounder, witch flounder and redfish.</p>	<p>The text has been modified where appropriate, although it may be noted that the IFMP is entitled "Offshore Clam IFMP for Maritimes and Newfoundland Regions", and so this has not been changed where the IFMP is referred to.</p> <p>The citations have been checked and it is thought that they have now all been included in the bibliography, including the Taggart <i>et al.</i> 1994 reference.</p> <p>All the (DFO pers. com.) references refer to comments made during the site visit meeting. Such comments have been made non-attributable by design.</p> <p>This has been corrected.</p> <p>This has been changed.</p> <p>The reference to foreign fishing fleets in the Banquereau document has been removed.</p> <p>The date of the moratorium has been corrected, and the references and data made specific to northern cod.</p> <p>The reference to haddock has been removed and other species included.</p> <p>The ACON software package calculated biomass by contouring (interpolating) the data within defined boundaries and between survey locations using an inverse distance formula. Essentially, the package creates new point biomass data within the survey grid using the real</p>

In both documents, it states that "simple statistics were used... while ACON..." to derive biomass estimates but no further details are provided. More detail is necessary regarding both the "simple statistics" used as well as ACON especially since ACON does not provide confidence intervals. For example, Roddick *et al.* (2007) provide details.

All tables and figures should be checked carefully (both documents) so as to ensure that the proper sources have been identified.

In both documents, it is stated that the surveys are considered to "provide good estimates of fishable biomass..." Neither DFO (2010) nor Roddick *et al.* (2007) cited in the Banquereau (B) document make such a statement. The Roddick *et al.* (2010) document (draft) could not be checked. It is also unclear what 'fishable' biomass actually refers to. Since the selectivities are different for the commercial and research gears, it presumably does not refer to 'exploitable' biomass but is 'total' biomass. This should be clarified.

Maximum Constant Yield (MCY) figures prominently in both assessments. It would be better if some additional information associated with this could be provided within the document rather than just referencing the Ministry of Fisheries (2007) document in a footnote. The inclusion of a short appendix would be helpful in this regard.

The re-ordering of the sub-sections of 5.2 (Assessments and Stock Status) should be considered for both documents so as to improve the information flow. It is suggested that the re-ordering be as; 5.2.1 (stocks), 5.2.2 (catch), 5.2.3 (RV biomass/abundance), 5.2.4 (RV sizes), 5.2.8 (recruitment), 5.2.9 (M), 5.2.5 (assessment models), 5.2.7 (F), 5.2.10 (incidental M (should this actually be incidental F since it results from fishing?)), 5.2.11 (stock status), 5.2.6 (BRPs).

There are a number of issues surrounding the MCY approach that could potentially impact a number of PIs, especially those associated with Principle 1. As such, an overall discussion of the concerns is provided here and references made to this section as appropriate when considering the scoring of each PI.

It is stated in both documents that the application of F-MCY and specifically $F=0.33M$ was determined to be appropriate as per DFO (2007a). That was not the case. The referenced document actually makes reference to a 2005 Expert Opinion document (DFO, 2005. Expert Opinion on the Rationale for Harvest Advice on Ocean Quahogs (*Arctica islandica*). DFO Maritimes Region Expert Opinion 2005/04). The EO document is in the very grey literature and could not be located through searching Google or the DFO web site. The rationale for selecting 0.33 was apparently that it was considered to approximate 2/3 MSY but it is unclear if this

survey data to create an estimate of overall biomass. This is now described in the assessment reports.

The sources have now been cited in the legends for all tables and figures..

The Roddick 2007 report cited state that the estimate of natural mortality (M) of 0.08 was considered reasonable / appropriate. There is no comment on the estimation of fishable biomass. The assessment reports have been modified by deleting this statement. This section has now been amended considerably to include the 2010 survey assessment (DFO, 2012), which does not provide reliable biomass estimates.

Agreed. The relevant sections have been amended to include more information on MCY and some better, more readily available, references are included

This comment is noted but it is considered that the information flow is acceptable, and consistent with a large number of other assessment reports that have followed a similar outline.

The assessment team has responded to specific comments as they appear in the text below.

While the exact process for adopting a particular TAC appears slightly different between different DFO documents, the Grand Bank SAR (DFO 2010) states: "*The Framework* (DFO 2007d) recommended a constant F approach; A science Response to clarify the advice (DFO 2007c) stated that as F approaches 0.5 M, increased stock risk could be expected. As a result, the Banquereau assessment adopted $F_{mcy} = 0.33M$ as an appropriate F. This was considered a relatively risk-neutral point given the survey frequency and biological characteristics of the stock." It is considered that the assessment documents accurately reflect this official DFO publication.

document was subject to any peer review at all. Another reference (DFO, 2007d) in both BB and GB documents specifically states "It was agreed that the fishing mortality, F , should be a function, a , of natural mortality, M . Agreement was **NOT** reached on a specific level of a ." (bold and capitals inserted by reviewer). "A value of $a=1.0$ ($F=M$) was considered the upper limit and the current level ($a=0.25$) was considered to be at the low end. Other potential values were 0.33 (MCY approach) and 0.5 (MSY approach)." Nonetheless, a value of 0.33 has been subsequently applied (e.g., DFO (2007c)) although specific rationale for this is unclear.

All of the above is not to say that the selection of $F \sim$ MCY or $a=0.33$ is inappropriate but to indicate that its selection was not as clear cut as the BB and GB assessment documents under review suggest, and perhaps most importantly, not necessarily supported during any peer review. As such, there are possibly more uncertainties surrounding the application of a $2.64\%B_{RV}$ protocol than have been considered when scoring against PI Guideposts. Overall, it is important for the assessment team to thoroughly examine all associated documentation and develop a chronology of development of the 0.33 application for inclusion as an appendix to both assessment documents and for consideration during any PI scoring re-evaluations.

In addition to questions concerning the development of the specifics of the $F \sim$ MCY strategy, there are also questions surrounding its application. In the Banquereau document (page 32) and the Grand Bank document (page 32) it states "TAC ... is based on harvesting a percentage (the exploitation rate) of the estimated harvestable biomass (i.e. the biomass > 75 g/m²), which is intended to optimize yield and not expose the resource to risk of over-exploitation." For GB, the TAC was revised down to 14,756 t (DFO, 2011d) specifically based on this. However, for B, the available documentation (DFO 2007a, c) suggests that the 2.64% exploitation was applied to the total RV biomass (38,599 t is 2.64 % of 1,462,097 t) although the IFMP (2011c) does indicate the application of 2.64% to the harvestable biomass (>75 g/m³). The BB document (page 32-33, 36) goes on to indicate that the current TAC of 24,000 t represents a fishing mortality (actually exploitation rate since is ratio of C/B) of 0.0164 and the current average catch would give an F of 0.012, again both estimates using total RV (2004) biomass. In the GB document (page 33) the estimates of F (0.016 for TAC and 0.006 for average catches) again are based on total RV biomass rather than the biomass corresponding to the 75 g/m³ criterion. These require clarification and correction as appropriate.

A more generic question pertains to the validity of the use of the 75 g/m³ criterion in the first place. Both documents (page 32) make reference to the "estimated harvestable biomass (i.e. the biomass >75 g/m³ ...". This "harvestable biomass" is actually the total RV biomass associated with an economically viable density for the fishery and as such it is an economics-based criterion rather than one based on any

Roddick et al 2007 indeed states that $F = 0.33M$ was recommended for inshore ocean quahogs. However, this decision is not specifically referred to or even inferred in the consideration of the adoption of $F = 0.33 M$ for Arctic surfclams.

The assessment team agrees that the use of $F \sim$ MCY or $a=0.33$ is appropriate. The text of the report has been modified to reflect the somewhat unclear process by which the Banquereau TAC was derived and the $F \sim$ MCY or $a=0.33$ figure was adopted and is now incorporated in the 2011 IFMP.

The Banquereau and Grand Bank documents have relied on the Science Advisory Reports and the IFMP. The IFMP, Section 1.8 (Management style) states: '*The TAC is primarily based on harvesting a percentage (exploitation rate) of an estimate of the harvestable biomass (fishable biomass > 75 g/m²) and is intended to optimize yield and not expose the resource to risk of over-exploitation. A fishing mortality (F) target at Maximum Constant Yield (MCY) is estimated to be one-third of natural mortality (M). F_{mcy} is applied to the harvestable biomass, such that the TAC is set at 2.64% of the harvestable biomass.*

MCY calculation and uses the full biomass rather than the economically exploitable biomass, this figure is not currently used in management. The actual TAC of 24,000 t was established in 2004 through two methods (Roddick *et al.* 2007); the first was MSY-based and used the model $MSY = 0.5 MB_0$, (B_0 = virgin biomass, M estimated by $M=3/T_{max}$, where T_{max} is the maximum age corresponding to the 95 percentile for the distribution of ages in the population). However, it was recognized that this approach made some assumptions, especially that of equilibrium conditions, that probably do not hold. Furthermore, the estimates were based on very limited data. As a result, the estimate of MSY was probably not very accurate. The second method assumed biomass was a finite resource, and made no assumptions about natural mortality, growth or recruitment. The level of exploitation (TAC) that would enable the estimated 600,000 t resource to last 10, 20 or 25 years was simply calculated as 60,000 t, 30,000 t or 24,000 t. The most precautionary level of exploitation was chosen as 25 years/24,000 t. While both these approaches have considerable limitations, the approach was precautionary and it is apparent that the stock was maintained at high levels. For Banquereau, the fishery has so far retained the *status quo* TAC of 24,000t but with the MCY approach now written into the IFMP as the recommended fishing strategy, and implemented for the first time in the Grand Bank fishery in 2011, the assessment team understands that it may be adopted for the Banquereau fishery in 2012. However, with changes to the gear and assessment methods used for the 2010 Banquereau survey, the most recent fishable biomass estimates are considered to be unreliable

biological/conservation rationales.

This approach could lead to significant problems. For example, if the same overall biomass existed in each area under assessment, but the fishery area and the area within which the biomass was located was much smaller such that the density throughout the area was all $>75 \text{ g/m}^3$, then that alone would result in a higher TAC. Any change in markets that resulted in an increase or decrease of the threshold economically viable density could result in a decrease or increase in the TAC without any change in the biomass.

Additionally, the 75 g/m^3 density evaluations based on RV data includes both pre-recruit (to the fishery) as well as recruited (to the fishery) sizes. It is possible, that some of these densities may be made up of pre-recruit sizes mainly or only. This too points to potential problems with this approach.

In determining a TAC, an exploitation rate should be applied to the exploitable portion of the total biomass or abundance only (that is, that portion of the RV biomass that is available to the commercial gear). The Ministry of Fisheries (2007) document specifically refers to B_0 as being an estimate of the "virgin recruited biomass" (page 27) in the calculation of MCY; in other words, the "recruited" or exploitable portion of the overall biomass. The correct approach for Arctic surfclam in both BB and GB is to apply the formula $\text{MCY} = 0.33\text{MB}_{\text{RV}}$ to only the exploitable portion of the total RV biomass and this should be reflected in the IFMP. Adequate biological information is collected during the research surveys and selectivity ogives are available for both the GB and BB fisheries such that RV based exploitable biomass can be estimated. The assessment team should have considered this during scoring of various PIs.

The 2007 Ministry of Fisheries document defines $\text{MCY} = xF_{0.1}B_0$ but indicates that in the absence of information on $F_{0.1}$, the use of M is acceptable. In both documents (Figure 12), $F_{0.1}$ that specifically accounts for 15% incidental mortality of clams passing through the dredge is shown to be 0.07. While this is close to $M=0.08$, it's specific use should be considered to as to explicitly account for the incidental mortality in establishing TACs.

Section 7 deals with Ecosystem considerations and provides supporting information for the scoring of the PIs under Principle 2. Under sub-section 7.2 of both documents there is consideration of both retained and discarded species. There is reference to unobserved mortality (e.g., Gilkinson *et al.* 2005) for invertebrates. On page 48 (GB) and page 44 (BB) there is reference to fish escaping from the dredge so not being by-caught. However, nowhere is there consideration of possible unobserved mortality of small non-commercial fish or juvenile commercial fish species caused by water pressure from the nozzles. While this may or may not be a significant issue, it is

(DFO 2012). These issues are now better described in the assessment report.

Stock density on the ground is clearly a major factor in determining how much is or can be physically removed from each bank in a profitable manner. The Banquereau stock is concentrated into areas of higher density (only 152,000 t (11%) of the stock is in a density of $< 100 \text{ g/m}^2$) than the Grand Bank stock (almost 570,000 t (51%) of the stock is in a density of $< 75 \text{ g/m}^2$), but Arctic surfclam are slow growing, and are essentially immobile once settled. As such, the density or distribution is unlikely to change significantly within a short period. It is considered that the science and management are appropriate for the fishery

The problem with pre-recruits is taken into account in the latest Banquereau report (DFO, 2012) where the survey biomass is corrected for the selectivity of the dredges

The assessment team has, indeed, considered this point, but DFO 2007d states: "*It was noted that the survey measures fishable biomass as it is using commercial gear.*" The fishable biomass is therefore considered to be the same as the survey biomass, and the assessment report has therefore not been modified as a result of this comment. However, in the most recent DFO report for Banquereau (DFO 2012) this problem with pre-recruits is taken into account as the survey biomass is corrected for the selectivity of the dredges.

The assessment team agrees that incidental mortality is important and should be considered in the setting of TACs. This is an interesting idea but since $F_{0.1}$ (with 15% incidental mortality) is close to M it makes little practical difference which is used and the fishery managers have, in any case, always stressed the need for caution and opted for TACs well below MCY (0.33MB_0). However, the text of 1.2.3 has been amended to stress the need to consider incidental mortality in the setting of TACs.

As noted against the specific comments for PI 2.2.1, it is considered that the very low levels of bycatch recorded in both survey and commercial catches will result in negligible impacts on fish species. It is also highly unlikely that any unobserved mortality would result in anything other than negligible impacts, given the level of observed bycatch. Comments to this effect have been made in the scoring comments for PI 2.2.1, PI 2.5.2 and PI 2.5.3.

important that the assessment team consider the matter as part of the assessments and scoring. This could be important with regard to overall ecosystem function. Also, it is indicated (page 52 – GB; page 49 – BB) that the surfclam fishery is highly unlikely to be retarding the recovery of groundfish species or the ecosystem more generally through critically reducing the abundance of prey items." This may be the case but questions such as 'is it possible that unaccounted mortality of juvenile groundfish could be impeding recovery?' could be posed.

19 APPENDIX F - STAKEHOLDER COMMENTS

19.1 Letter from WWF International, dated 25th May 2012.



WWF International
Avenue du Mont-Blanc
1196 Gland
Switzerland
Tel: +41 22 364 9111
Direct: +41 22 364 9502
Mobile: +41 76 214 7211
kbilo@wwfint.org
www.panda.org

Rob Blyth-Skyrme
Intertek Moody Marine
Merlin House, Stanier Way
The Wyvern Business Park
Derby. DE21 6BF
rob@ichthysmarine.com

Re: Comments to the Public Comment Draft Reports for the Grand Bank and Banquereau Arctic surf clam fishery assessments

Dear Dr Blyth-Skyrme,

WWF actively engages as a stakeholder in a number of MSC fishery assessments to improve fisheries sustainability.

WWF has carefully considered the Public Comment Draft Report for the Grand Bank and Banquereau Arctic surf clam fishery assessments. We are concerned that the draft reports do not adequately assess principle 2 and more specifically the impact of the fishery on habitat structure and function. As the majority of the Arctic surf clam fishery occurs within defined ecologically and biologically significant areas (EBSA) and it is the first hydraulic dredge fishery in the world recommended to be MSC certified, this precedent-setting certification is of concern to WWF.

We were surprised by the high scores for both fisheries on the habitat performance indicators considering the potentially severe effect of hydraulic dredging on seabed habitat. Given the limited knowledge on recovery trajectories and the severe damage to the seabed following hydraulic dredging, we urge the assessment team to reconsider their assessment of the habitat component.

IMM Comment: The assessment team scored the fishery against the MSC Standard according to the information available, which we consider is credible and covers many of the major areas of interest to the assessment process. We do not agree that knowledge is particularly limited, as specific work has been undertaken to understand the effects of hydraulic dredging in Arctic surfclam habitat on Banquereau. We agree that the scores for Principle 2 in particular were high, but the team considers that, despite the potential impact of the gear, the scientific understanding of the fishery and its overall low impact (at the scale of the region or bioregion) on the specific habitats of the Grand Bank and Banquereau justifies those scores, with the work undertaken on Banquereau allowing that fishery to score a little higher for P2 than in the Grand Bank fishery. More comments are provided on specific points below.

2.4.1 Status The fishery does not cause serious or irreversible harm to habitat structure considered on a regional or bioregional basis, and function

Surprisingly, the assessment team concludes that there is evidence that the fishery is highly unlikely to reduce habitat structure and function to a point where there would be serious or irreversible harm (SG100). The assessment team argues that the footprint of the fisheries is small as hydraulic dredging

is undertaken in sandy sediments subject to natural perturbation (storms) and the fisheries annually cover a small area of the available surf clam habitat.

IMM Comment: The assessment team considers that the score is justified for both the Grand Bank and Banquereau Arctic surfclam fisheries. As stated in the reports, the MSC defines ‘serious and irreversible’ as “*Serious harm relates to gross change in habitat types or abundances, and disruption of the role of the habitats. Irreversibility relates to changes that are expected to take much longer to recover than the dynamics in unfished situations would imply (e.g. some sort of regime change is implied from which recovery may not automatically occur) ... The full extent of the habitats shall be considered in assessing the status of habitats and the impacts of fishing, and not just the part of the habitats that overlap with the fishery*”. Further, the Guidance to the Certification Requirements states: “*Examples of serious or irreversible harm include local or global extinction, serious recruitment overfishing, habitat loss on scales that have widespread detrimental consequences for the ecosystem services provided by the habitat (e.g. gross change in species composition of dependent species), and loss of resilience resulting in trophic cascades, fishery mediated regime shifts, etc.*”.

The MSC’s definition of ‘serious and irreversible’ is critical in assessing the impact of the Arctic surfclam fishery on habitat, as are the habitat type, the likelihood of natural perturbation (tidal disturbance, as well as wave disturbance), and the annual swept area of the fisheries in question (mean annual swept area of the Grand Bank and Banquereau fisheries to date are 0.1% and 1.4%, respectively, although these figures do not consider any repeated dredging over the same sites, nor all of the shallow bank habitat of the same or similar type within the region or bioregion). These factors combine to mean that the assessment team considered there to be “*evidence that the fishery is highly unlikely to reduce habitat structure and function to a point where there would be serious or irreversible harm*”, so meeting the SG 100.

However, the factory freezer vessels used in this fishery work at depths between 50 and 80 m (Gilkinson 2005). Natural perturbation at this depth is less and recovery at this depth is slow. Also the impact of a storm on the seabed is significantly different from the impact of hydraulic clam dredging on habitat and benthic communities. Hydraulic dredging liquefies the seabed to a depth of up to 30 cm and reduces the abundance, biomass and diversity of benthos (Gilkinson et al 2005).

IMM Comment: Natural disturbance at commercial Arctic surfclam depths is very likely to be less (than at shallower depths), as inferred from comparison of the results of studies at 80 m depth on Banquereau and 40 m depth on Sable Bank (as reported in this assessment report), but natural disturbance may nevertheless still occur on the very exposed offshore banks in question, including through tidal action. In fact, enormous volumes of material can be mobilised by physical processes, and communities in exposed sites tend to be defined by and adapted to perturbation. The evidence from specific studies on Banquereau is that the visual evidence of hydraulic dredge tracks had disappeared within one year from a site at 80 m depth (as deep as Arctic surfclam beds are commercially targeted, with most beds being in the 50 – 70 m range). Although the same experimental tracks were still barely detectable with side-scan sonar after 10 years, the team contends that, in combination with the very limited swept areas of both fisheries, this cannot be considered to represent ‘serious or irreversible harm’ (as defined by the MSC) to the habitat structure and function of these exposed, soft-sediment sites.

The footprint of hydraulic dredges may be relatively small (in terms of area covered), but hydraulic clam dredges produce the most severe effects on seabed habitat of any gear¹⁶. The assessment team is tasked to assess the risk that the clam fisheries cause serious or irreversible harm to habitat structure and function. Risk is, broadly speaking, the product of consequence and probability. Given that the fisheries sweep 0.4% of the available Arctic surf clam habitat annually, the probability of serious or irreversible harm may be reasonably low. However, the consequence/impact of hydraulic dredging is significant.

IMM Comment: The assessment team agrees that the potential risk to some habitats from hydraulic

¹⁶ Gilkinson, K.D. et al (2005). Immediate impacts and recovery trajectories of macro faunal communities following hydraulic clam dredging on Manquereau, eastern Canada. ICES Journal of Marine Science, V 62, pp. 925-947.

dredging is considerable. However, evidence from the disturbance study on Banquereau is that surf clam habitat (i.e. well-mixed sand) is not particularly sensitive to disturbance (in comparison to, say, cold water coral reefs or deep and sheltered muddy sites), while the annual swept area of the fisheries is very small. As such, we have assessed the risk of ‘serious or irreversible harm’ posed by the Arctic surfclam fishery to relevant habitats on a regional or bioregional scale to be very low.

Also, the MSC standard does not require an assessment of the cumulative impact of (other) fisheries on the Arctic surf clam habitat. Currently two of four vessels prosecute the fishery in both areas. If the intensity and frequency of the fisheries increase the probability of serious harm will also increase. It is important to note that in accordance with the Science Advisory (CSAS) Report 2007/042¹⁷ the Southeast Shoal and Tail of the Banks area (east of 51oW and south of 45oN, extending to the edge of Grand Bank) requires the highest priority conservation objectives in the Placentia Bay-Grand Banks Large Ocean Management Area (PBGB-LOMA). This report identified the Southeast Shoal and Tail of the Banks as an ecologically or biologically significant area (EBSA). It is noteworthy that the EBSA criteria developed by Canada conforms to the Convention on Biological Diversity’s (CBD) EBSA criteria¹⁸ as adopted by the ninth CBD Conference of Parties (COP 9), decision IX/20, Annex I (<http://www.cbd.int/doc/decisions/cop-09/cop-09-dec-20-en.pdf>).

IMM Comment: It is correct that other fisheries may impact the habitats of Banquereau and Grand Bank, but we would again comment that Arctic surfclam habitat is not very sensitive to fishing impacts in comparison to deeper or more sheltered areas and the swept areas of both fisheries are small, while the status of the long-lived Arctic surfclam populations (i.e. probably near to the virgin biomass level on both banks) also strongly suggests that the fisheries are not causing serious or irreversible harm to habitats.

In regards to the impact of the Arctic surfclam fisheries, it is possible that the number of vessels can be doubled from the present 2 to a total of 4 on the basis of the available licenses, but the total intensity of the fishery is ultimately limited by the TAC set rather than the number of vessels fishing. In recent years, the fishery has focused more on Banquereau, where the TAC has been largely taken, while only limited amounts of surfclam have been taken on the Grand Bank. If both fisheries are certified, and if the TACs were raised significantly during the course of their certifications, then the risk posed to habitats by the fisheries would be reassessed during the course of surveillance audits.

Due to the ecological importance of the Southeast Shoal, the CSAS report 2007/042 concluded that conservation objectives for the area must “ensure that the features listed below are not altered and/or disrupted by human activities to the point they can no longer be considered a unique feature and/or fulfill the ecological function that initially triggered their identification as significant in the area:

- Area of highest overall benthic biomass on the Grand Banks
- Unique offshore capelin spawning
- Unique yellowtail nursery
- Unique shallow, sandy habitat with glacial history
- Cetacean aggregation and feeding
- Seabird aggregation and feeding
- American plaice (nursery habitat)
- Atlantic cod spawning
- Reproduction and survival of striped wolffish
- Unique relict populations of blue mussels and wedge clams¹⁹

¹⁷ DFO, 2007. Placentia Bay-Grand Banks Large Ocean Management Area Conservation Objectives. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/042.

¹⁸ EBSAs “are geographically or oceanographically discrete areas that provide important services to one or more species / populations of an ecosystem or to the ecosystem as a whole, compared to other surround areas or areas of similar ecological characteristics, or otherwise meet the criteria as identified in Annex I to the decision IX/20”. The criteria include characteristics such as: uniqueness or rarity; special importance for life history stages of species; importance for threatened, endangered or declining species and /or habitats; vulnerability, fragility, sensitivity or slow recovery; biological productivity; biological diversity; and naturalness”.

¹⁹ DFO, 2007, supra note 17.

The Grand Banks Assessment report (Intertek Moody Marine, Ref: 82351/v3) refers to the EBSA classification, noting that ‘there is no guidance as to whether the present ecosystem should be protected or whether the aim should be to restore an ecosystem from a point in history’ (pp. 54). It is important to note that in accordance to Decision X/29 of the UN Convention on Biological Diversity (CBD), noted that the application of the EBSA criteria presents a tool towards the implementation of ecosystem approaches through the identification of areas and features of the marine environment that are important for conservation and sustainable use of marine and coastal biodiversity. Besides, it also noted that areas that meet the EBSA criteria may require enhanced conservation and management measures, which can be achieved through a variety of means, including marine protected areas and impact assessments.

IMM Comment: The assessment team contends that the comment ‘*there is no guidance on whether the present ecosystem should be protected, or whether the aim should be to restore an ecosystem from a point in history*’ is still valid in the context of aiming to implement an ecosystem approach to conservation and sustainable use. And, while areas that meet the EBSA criteria may require enhanced conservation at some point, to our knowledge there is no such requirement for specific management to be in place at the present time. However, if the fisheries are certified and if such management was introduced during the course of the certification, then those changes would need to be considered during future surveillance audits. However, it is noteworthy that, as reported in the Grand Bank assessment report, the fishery was screened-out (i.e. it was not considered to be an impacting activity) in a DFO analysis of all activities potentially impacting spawning cod in the Southeast Shoal and Tail of the Banks EBSA (DFO 2009f), while the quantities of the other EBSA-listed species in bycatch and scientific survey data are either tiny or completely absent.

With respect to vulnerable marine ecosystems (VMEs), the Grand Banks Assessment Report did not address VME concerns as part of its P2 considerations. In fact, it states that ‘no specific work has been undertaken to determine the impact of the Arctic surf clam fishery on the seabed habitat of Grand Bank’ (pp. 95). It has been highlighted in a previous WWF communication letter that the Northwest Atlantic Fisheries Organization (NAFO) has been undertaking research to identify VMEs in its regulatory area, including on the Grand Banks. In 2008, NAFO’s Scientific Council Working Group on Ecosystem Approach to Fisheries Management identified the Southeast Shoal and adjacent Shelf Edge/Canyons as VMEs (NAFO SCS Doc. 08/10). Paragraph 119 (a) of the United Nations resolution 64/72 establishes that flag states can only undertake bottom fishing activities after impact assessments have been conducted in accordance with the criteria established by the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (FAO Guidelines).

IMM Comment: This information is specific to the Grand Bank Arctic surfclam fishery assessment report.

In view of these developments of international law, undertaking comprehensive impact assessments should be a P2 condition for this certification to ensure that the Grand Bank Arctic Surf Clam Fishery does not impact ecologically or biologically significant areas and vulnerable marine ecosystems (as defined by Paragraph 42 of the FAO Guidelines). Due to the characteristics of the fishing method in the area (bottom fishing), and in accordance with generally accepted standards under international law, WWF recommends that these impact assessments follow the criteria established by Paragraph 47 of the FAO Guidelines. Under the FAO criteria, impact assessments should address, inter alia:

IMM Comment: This information is specific to the Grand Bank Arctic surfclam fishery assessment report.

- “i. Type(s) of fishing conducted or contemplated, including vessels and gear types, fishing areas, target and potential bycatch species, fishing effort levels and duration of fishing (harvesting plan);
- ii. best available scientific and technical information on the current state of fishery resources and baseline information on the ecosystems, habitats and communities in the fishing area, against which future changes are to be compared;
- iii. identification, description and mapping of VMEs known or likely to occur in the fishing area;
- iv. data and methods used to identify, describe and assess the impacts of the activity, the identification

of gaps in knowledge, and an evaluation of uncertainties in the information presented in the assessment;

v. identification, description and evaluation of the occurrence, scale and duration of likely impacts, including cumulative impacts of activities covered by the assessment on VMEs and low-productivity fishery resources in the fishing area;

vi. risk assessment of likely impacts by the fishing operations to determine which impacts are likely to be significant adverse impacts, particularly impacts on VMEs and low-productivity fishery resources;²⁰ and;

vii. the proposed mitigation and management measures to be used to prevent significant adverse impacts on VMEs and ensure long-term conservation and sustainable utilization of low-productivity fishery resources, and the measures to be used to monitor effects of the fishing operations.”²¹

It is important to note that the FAO Guidelines can also be implemented in marine areas within national jurisdiction (Paragraph 10). In fact, the United Nations General Assembly resolution 66/68 (2011) noted the “adoption by coastal States of conservation measures regarding their continental shelf to address the impacts of bottom fishing on vulnerable marine ecosystems, as well as their efforts to ensure compliance with those measures” (Para. 124). Giving a 100 score to habitat status in the absence of a comprehensive prior impact assessment is contrary to the Precautionary Approach. In this context, it is important to highlight that in a recent Advisory Opinion of the International Tribunal for the Law of the Sea, the chamber recognized “a trend towards making this approach part of customary international law” (ITLOS, Case 17, Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area, 2011) and therefore legally binding.

IMM Comment: The team was unable to find any evidence that the assessment approach listed above is currently a requirement in Canadian national waters. If the fisheries are certified and new measures were introduced, though, then such measures would be considered during the surveillance audit process.

2.4.2 Management Strategy There is a strategy in place that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to habitat types
Grand Bank: 80, Banquereau: 100

The fisheries leave harvested areas fallow for 10 years before re-harvesting to allow the target species to recover. The assessment team considers the fallowing period a strategy to manage habitat impacts, but a strategy should be designed to manage impact on the habitat component specifically (GCB3.3.1.b). A habitat strategy should at least comprise protection and avoidance of the identified EBSA.

IMM Comment: The assessment reports have been modified to take account of the fact that the TAC setting process limits the potential for the fisheries to impact significantly larger areas of habitat than are currently being fished. However, it may be noted that the MSC defines a comprehensive strategy (i.e. at the SG 100 level) as “a complete and tested strategy made up of linked monitoring, analyses, and management measures and responses”, but that to meet the requirement at SG100 “this may simply comprise a statement of intent about continuing to have no impact and ongoing monitoring to ensure that no impact occurs”. While there is no such statement in this case, it is considered that the work undertaken on Banquereau specifically to determine the impact of the Arctic surfclam fishery, together with setting the TAC at a level which limits the swept area of the fishery and the 10-year fallowing period, is sufficient to justify the high marks for these fisheries in the context of efforts undertaken to understand the impacts and ensure they are within acceptable limits (with the Banquereau work allowing the Banquereau fishery to score higher than the Grand Bank fishery). The reference to the EBSA is specific to the Grand Bank fishery.

2.4.3 Information/monitoring Information is adequate to determine the risk posed to habitat types by

²⁰ For a risk-management framework model see K. Martin-Smith, “A Risk-Management Framework for Avoiding Significant Adverse Impacts of Bottom Fishing Gear on Vulnerable Marine Ecosystems”, (2009) 16 CCAMLR Science 177-193.

²¹ FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas, Rome, 2009. Para. 47.

the fishery and the effectiveness of the strategy to manage impacts on habitat types

Not much is known about the environmental impacts of hydraulic clam dredging even though this technology has been in use in the Northwest Atlantic since the 1940s (Gilkinson et al 2005). Even less is known about the impacts of hydraulic clam dredging on benthic communities in deeper offshore areas. A score of 80 and 95 does not reflect this limited knowledge on impacts and recovery trajectories.

IMM Comment: As a potentially impacting activity, hydraulic dredging has not been much studied in comparison to some other fishing gears (e.g. otter trawling, long-lining). However, this is to a large extent related to the much more common use of such gears than hydraulic dredging in commercial fisheries. And, although not well studied in general, the work that was undertaken on Banquereau, specifically to understand the effects of this specific fishery on Arctic surfclam habitats, has been very useful in providing relevant information. In fact, it is somewhat unusual that the assessment team has been able in this case to review the results of an impact study that is specific to the fishery in assessment and the habitats in which it operates- for many fisheries, the effects have to be inferred from studies of similar fisheries that occur in similar habitats. With this in mind, it is pertinent to highlight that the IFMP (DFO 2007) states “*As a result of this ten year study [on Banquereau], the effects of hydraulic clam dredging are now better understood compared with many other gear typed used throughout the Canadian fisheries.*”. The higher score for Banquereau reflects the better information on habitats which is available from Banquereau in comparison to Grand Bank.

2.5.1 Ecosystem status There is a strategy in place that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to habitat types
Grand Bank: 90; Banquereau: 100

The Banquereau Assessment report (Intertek Moody Marine, Ref. 82351/v3) acknowledges that part of the Banquereau was selected as an EBSA and a candidate Area of Interest for a new MPA, but it states that the ESSIM initiative has not progressed beyond the proposal stage and that “other areas were more favoured for designation of EBSAs” (pp.93). It is important to note, however, that a new initiative is taking place on the Scotian Shelf, the Scotian Shelf bioregional MPA network planning, in accordance with the National Framework for Canada’s Network of Marine Protected Areas (adopted in September 2011). Under the National Framework, one of the criteria for selecting the design of the network is the EBSA criteria. Even if the Banquereau is not included in the MPA network design, it would be recommended that a comprehensive impact assessment is undertaken to ensure adequate conservation of marine biodiversity (see comments on section 2.4.1 above).

IMM Comment: The fishery can only be scored on the basis of the management framework that is in place at the time of the assessment. In what we believe is an absence of any specific management requirements regarding EBSAs or possible future EBSAs, the assessment team believes that both the Banquereau and Grand Bank fisheries are appropriately scored (noting that, in any case, there is credible evidence that the fisheries do not significantly impact EBSA-listed species or occur within the VME). However, if the fisheries are certified, then the implications of any new measures being introduced during the course of the certifications would be assessed during the normal audit process.

As for the Grand Banks, see comments under section 2.4.1 above.

The Arctic clam fisheries are the first hydraulic dredge fisheries to be recommended for certification. The conclusions of these clam assessments are thus not harmonized with other hydraulic dredge fisheries. However, it would be informative to review the evaluation, scoring and particularly conditions of already certified trawl and dredge fisheries. Several examples of already certified trawl and dredge fisheries in the region are provided in the table below. All of the certified fisheries score lower on the habitat criteria than the clam fisheries in assessment, while the impact of hydraulic dredge on habitat is more severe.

	Grand Bank, Newfoundland Hydraulic dredge	Banquereau, Scotian Shelf Hydraulic dredge	Eastern Canada offshore scallop Dredge	OCI Grand Bank yellowtail flounder Trawl	Canadian offshore northern shrimp Trawl	Scotian shelf shrimp Trawl
Average P2	87.7	91.3	83	81	82	84
2.4.1	100	100	75 (pre FAM)	80	60	60
2.4.2	80	100		80	60	80
2.4.3	80	95		70	70	70

IMM Comment: In response to the points made above, the assessment team contends that the swept area of the Arctic surfclam fishery and the habitat types encountered must be taken in to account in any assessment of ‘severity’, and, that when compared against the other fisheries mentioned, we cannot agree with the view that the impact of the hydraulic dredge fishery is more severe than other certified fisheries. In fact, the low annual swept area of the Arctic surfclam fisheries, as a fraction of the regional or bioregional area covered by the habitats, together with the knowledge of effects of this fishery as provided through a specific study (not available in the other fisheries cited in the above table), justify the higher scores awarded.

The assessment team also does not believe that the fact that the Banquereau and Grand Bank fisheries are the first hydraulic dredge fisheries to pursue MSC-certification is a reason to score the fisheries down. With regard to the mention of a precedent being set in the first paragraph of the WWF comments, this is to some extent true in that the assessment team clearly believe that it is possible to certify the Grand Bank and Banquereau hydraulic dredge fisheries (albeit, with some conditions of certification), but we do not believe that we have set a precedent that hydraulic dredge fisheries should be scored highly- the scores recommended here are on the basis of the understanding of these specific fisheries and their impacts. With regards to harmonisation with other fisheries, though, MSC guidance is that harmonisation is specific to overlapping fisheries (i.e. two or more fisheries assessing some, or all, of the same aspects of MSC Principles 1, 2 and/or 3 within their respective units of certification), rather than on the basis of the gear type alone. As such, should other hydraulic dredge fisheries in different areas and targeting different species seek certification then those fisheries would need to be scored on the basis of the knowledge of their impacts, rather than on how the Banquereau and Grand Bank fisheries are scored.

In conclusion, the assessment of Principle 2 and the assessment of the habitat PIs specifically are not precautionary or adequate and do not reflect the intent of Principle 2, which is to encourage the management of fisheries from an ecosystem perspective under a system designed to assess and restrain the impacts of the fishery on the ecosystem. We look forward to a more precautionary assessment of Principle 2.

IMM Comment: The overall focus of Principle 2 is “*Fishing operations should be managed to maintain the structure, productivity, function and diversity of the ecosystem on which the fishery depends.*”, while the term ‘restrain’ is used specifically with regard to the ecosystem management component, PI 2.5.2, where at the SG 100 level the wording is “*This plan provides for development of a full strategy that restrains impacts on the ecosystem to ensure the fishery does not cause serious or irreversible harm.*” We believe that the management does indeed prevent serious or irreversible harm, as defined in the MSC Standard, from occurring, and have scored the Banquereau fishery accordingly, while information is not as specific to the Grand Bank fishery and so a score of 80 was given for PI 2.5.2 there.

Thank you for the opportunity to provide comments.

Sincerely,

Bettina Saier



Bettina Saier
Director Oceans
WWF-Canada
+1 902 4821105
bsaier@wwfcanada.org

Daniel Suddaby
Smart Fishing Initiative
+44 207 211 53 95
daniel.suddaby@wwf.panda.org

19.2 Letter from the MSC, undated.



Marine House
1 Snow Hill
London EC1A 2DH
United Kingdom
Tel: +44 (0)20 7246 8900
Fax: +44 (0)20 7246 8901

SUBJECT: MSC Review and Report on Compliance with the scheme requirements

Dear Rob Blyth-Skyrme

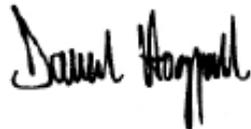
Please find below the results of our partial review of compliance with scheme requirements.

CAB	Intertek Moody Marine
Lead Auditor	Rob Blyth-Skyrme
Fishery Name	Clearwater Seafoods Banquereau and Grand Bank Arctic Surf Clam Hydraulic Dredge Fishery
Document Reviewed	Public Comment Draft Report Posted

Ref	Type	Page	Requirement	Reference	Details
TO.391	Major	51/56	CR-V1.1-27.12.1.2	The possibility of vessels fishing outside the unit of certification.	It is mentioned in the report that "Although it is possible for Arctic surfclams to be taken by gears other than hydraulic dredges (for example, in groundfish trawls), the quantities taken will inevitably be extremely small and essentially inconsequential." The report does not provide a detailed explanation of how these clams are handled (i.e. discarded or processed, etc.) once caught
TO.392	Major		CR-V1.1-27.12.1.3	The CAB shall determine if the systems of tracking and tracing in the fishery are sufficient to make sure all fish and fish products identified and sold as certified by the fishery originate from the certified fishery. The CAB shall consider the following points and their associated risk for the integrity of certified products. The opportunity of substitution of certified with non-certified fish prior or at landing.	As per TO.0391

www.msc.org				Marine Stewardship Council	
TO.390	Major	59/64	CR-V1.1-27.6.3	The CAB shall document the rationale for the target eligibility date and include an assessment regarding how the assessed risks to the traceability system in the fishery are adequately addressed by the applicant to give confidence in this date.	The rationale for the target eligibility date is not given in the report.
TO.393	Guidance	59/64	CR-V1.1-27.12.1	The CAB shall determine if the systems of tracking and tracing in the fishery are sufficient to make sure all fish and fish products identified and sold as certified by the fishery originate from the certified fishery. The CAB shall consider the following points and their associated risk for the integrity of certified products.	The traceability section of the report does not clarify whether there are traceability systems in place during onboard processing to segregate any Arctic surfclams caught by other methods (e.g. in groundfish trawls) as referenced in the report (pg 51 for Clearwater and pg 56 for Grandbanks report)
TO.394					

This report is provided for action by the CAB and ASI in order to improve consistency with the MSC scheme requirements; MSC does not review all work products submitted by Conformity Assessment Bodies and this review should not be considered a checking service. If any clarification is required, please contact Jodi Bostrom on +44 (0)20 7246 8934 for more information.



Best regards,
 Dan Hoggarth
 Fisheries Oversight Director
 Marine Stewardship Council

cc: Accreditation Services International

IMM Comments in response to the MSC:

TO 391: A note has been added to the report in Section 13.1, Traceability within the fishery, to make it clear that the Arctic surfclam vessels operating in this fishery are highly specialised for fishing with hydraulic dredges. As such, unless modified (at considerable expense), there is no possibility of these vessels using a fishing gear other than the assessed hydraulic dredge to catch Arctic surfclams. The text of Section 8 has also been modified to better reflect the fishery's situation.

TO 392: Trans-shipment is banned within the Arctic surfclam fishery, and no instances of this requirement being broken were reported to the assessment team by DFO. No other fishing vessels are permitted to retain Arctic surfclam. A comment has also been added in Section 13.1 to note that landings are 100% monitored. In combination with the features of the fishery as noted against To 391, the assessment team is confident that *“systems of tracking and tracing in the fishery are sufficient to make sure all fish and fish products identified and sold as certified by the fishery originate from the certified fishery.”* (CR 27.12.1).

TO 393: The MSC allows for the TED for a fishery to be *“Any date prior to the certification of the fishery up to a maximum of six months prior to the publication of the most recent Public Comment Draft Report. This date should be linked to: c. Any other logical date with regard to the applicant fishery.”* (CR 27.6.1.2).

In this case, the Public Comment Draft Reports for both fisheries were published on April 26th, 2012. The earliest TED that can be set is therefore October 26th, 2011, and this is a logical date in that the client has confirmed that it would provide the most benefit to the fishery from certification. A note to this effect has been included at Section 13.5 of this report.

TO 394: It is the assessment team's contention that the answers as provided to TO 391 and TO 392 apply to and satisfy this query also.

20 APPENDIX G - REGISTERED COMPANIES / VESSELS WITHIN THE UOC

Upon certification, the following would be eligible to sell MSC certified product

- Clearwater Seafoods Limited Partnership.

21 APPENDIX H - DETERMINATION OF SURVEILLANCE LEVEL

After each certification, surveillance and re-certification assessment, the certification body shall determine the level at which subsequent surveillance of the fishery shall be undertaken. A surveillance audit may be conducted as either an “on-site” or “offsite audit”. This is determined by using criteria set out by the MSC:

Criteria	Surveillance Score	Banquereau Surfclam
1. Default Assessment Tree		
Yes	0	0
No	2	-
2. Number of Conditions		
Zero Conditions	0	-
1-5 Conditions	1	1
>5 Conditions	2	-
3. Principle Level Scores		
≥ 85	0	0
<85	2	-
4. Conditions on outcome PIs?		
Yes	2	0
No	0	0
Total		1

The Banquereau surfclam fishery receives a total surveillance score of 1.

Using the table below, the surveillance score is used to determine the surveillance level appropriate to the fishery:

Surveillance score	Surveillance level	Years after certification or re-certification				
		Year 1	Year 2	Year 3	Year 4	
2 or more	Normal surveillance	On-site surveillance audit	On-site surveillance audit	On-site surveillance audit	On-site surveillance audit & recertification visit	
1	Remote surveillance	Option 1	Off-site surveillance audit	On-site surveillance audit	Off-site surveillance audit	On-site surveillance audit & recertification visit
		Option 2	On-site surveillance audit	Off-site surveillance audit	On-site surveillance audit	
0	Reduced surveillance	Review new information	On-site surveillance audit	Review new information	On-site surveillance audit & recertification visit	

The Banquereau surfclam fishery will be eligible for remote surveillance audits. The first surveillance announcement will indicate whether the first surveillance audit will be an on-site or an off-site surveillance audit.