ASSESSMENT OF THE OCEAN QUAHOG (*ARCTICA ISLANDICA*) STOCK IN SOUTHWEST NEW BRUNSWICK

Arctica islandica
Ocean Quahog

D. Roddick BIO

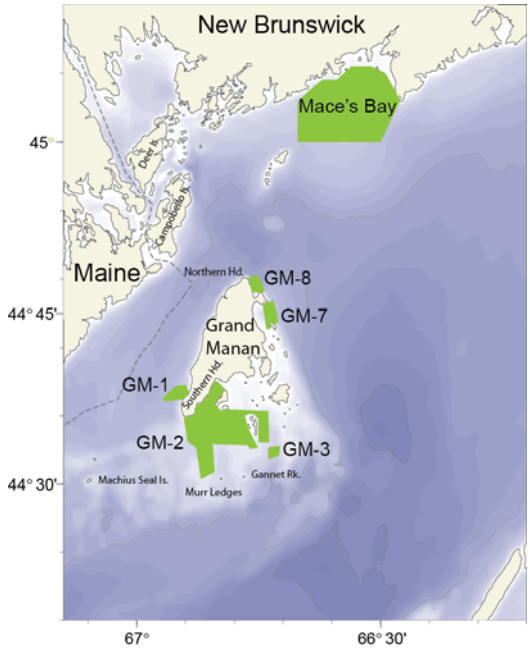

Figure 1. Map of the Southwest New Brunswick Survey Areas (shaded green).

Context:

The presence of Ocean Quahogs in Southwest New Brunswick (SWNB) was noted as far back as the 1800s.

A developing fishery for ocean quahog in SWNB was initiated in 1997. Fishing occurred during 1997-2002, but marketing problems and costs of Canadian Food Inspection Agency (CFIA) inspections (often exceeding the value of the product) hindered development of the fishery.

In 2002, a DFO Regional review of exploratory licences identified the inshore SWNB quahog fishery as one that had been in place for a number of years with no progress, and licenses were not renewed in 2003. In 2004, a process was established to further develop this fishery under the New Emerging Fisheries Policy.

A Joint Project Agreement to conduct survey work for a biomass estimate was signed in 2006 between DFO and the Southwest New Brunswick Quahog Group Inc. A survey (Figure 1) of the Ocean Quahog stock took place in 2006 and 2007. This assessment provides a summary of the survey results and the status of the stock.

This Science Advisory Report was developed during a Maritimes Region Science Advisory Process on 21 October 2011. Additional publications from this meeting will be made available on the Canadian Science Advisory Secretariat (CSAS) website at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

SUMMARY

- This assessment is based on information gathered during two surveys conducted in 2006 (Mace's Bay) and 2007 (Grand Manan) in order to provide stock advice for the developing fishery in Southwest New Brunswick.
- Ocean Quahogs are long lived and slow growing. However, the quahogs in Southwest New Brunswick do not appear to reach the sizes found in the offshore populations.
- Based on the 2006 survey, the biomass estimate of Ocean Quahogs in Mace's Bay is 38,800 t. Based on the 2007 survey, the biomass estimate of Ocean Quahogs in areas surveyed around Grand Manan is 3,920 t.
- A Maritimes Region Expert Opinion recommended a constant harvest strategy based on $F_{0.33M}$. Based on the current biomass and natural mortality estimates, the resulting harvest levels would be 1,537 t for Mace's Bay and 155 t for Grand Manan.
- Size at 50% maturity (38 mm) is close to the current retention size for the commercial gear.
- Survey dredge efficiency is unknown; the assumption of 100% efficiency is a conservative approach.
- By-catch in the survey (using commercial dredges) was low. The majority of the by-catch was other bivalves; no Species at Risk were observed.
- Quahog dredges have an immediate impact on the substrate and benthic organisms, and there continues to be uncertainty about the impact of dredges on overall benthic productivity, especially dry dredges used in areas with mud and clay substrates.

BACKGROUND

Species Biology

The Ocean Quahog (*Arctica islandica*) is generally one of the slowest growing and longest lived commercial species. The harvested beds off the Mid Atlantic States are dominated by animals 40 - 80 years old, with significant numbers over 100. The oldest aged specimen from the Scotian Shelf was 211, while the oldest aged anywhere was 410 years old from Iceland. The oldest observed in St. Mary's Bay was 69 years, and the oldest observed in Mace's Bay was 31 years old.

Ocean Quahogs occur in eastern North America from the Arctic to Cape Hatteras, North Carolina and in Europe from the Arctic to the Bay of Cadiz, Spain. It also occurs in Iceland and the British and Faroes islands. It is most abundant in fine to medium sand bottoms in depths from 4 to 260 m, deeper in the southern part of its range, and has been dredged live from as deep as 482 m.

In the Scotia-Fundy Region of Nova Scotia, it is abundant on Sable and Western banks and the inshore harbours and bays of Southwest Nova Scotia. It is found in Southwest New Brunswick at the mouth of the Bay of Fundy, where it occurs in mud and clay.

Based on U.S. observations, recruitment appears to be variable with infrequent strong year classes. When combined with their longevity, this has led to a U.S. management plan that uses a very low exploitation rate so the strong year classes can carry the fishery through the periods of low recruitment.

Estimates for adult natural mortality range from 0.01 to 0.03 in the offshore. The inshore populations do not have the larger/older quahogs observed offshore, indicating a higher

mortality rate. The current natural mortality estimates for Scotian Shelf quahogs are 0.03 on Sable Bank (offshore) and 0.045 in St. Mary's Bay (inshore).

Fishery

The presence of Ocean Quahogs was known in SWNB back to the 1800s, but there was no directed fishery. A developing fishery for Ocean Quahog in SWNB was initiated in 1997. There were low levels of landings, 32.5 t per year from 1997 – 2002, and 12 t in 2007.

ASSESSMENT

Stock Trends and Current Status

There have been low levels of Ocean Quahog landings from SWNB, and fishing areas have varied, so there are no fishery time series to evaluate. There have been no previous surveys for Ocean Quahog.

This assessment is based on information gathered during two surveys conducted in 2006 (Mace's Bay) and 2007 (Grand Manan) in order to provide stock advice for the developing fishery in SWNB. Figure 2 and 3 show the distribution of biomass from the surveys in Mace's Bay and Grand Manan, respectively. The densities of Ocean Quahogs in Mace's Bay (total area 161 km^2, with average density of 242 g/m^2) were higher than those observed in Grand Manan (total area 99 km^2, with average density of 34 g/m^2) in the areas surveyed.

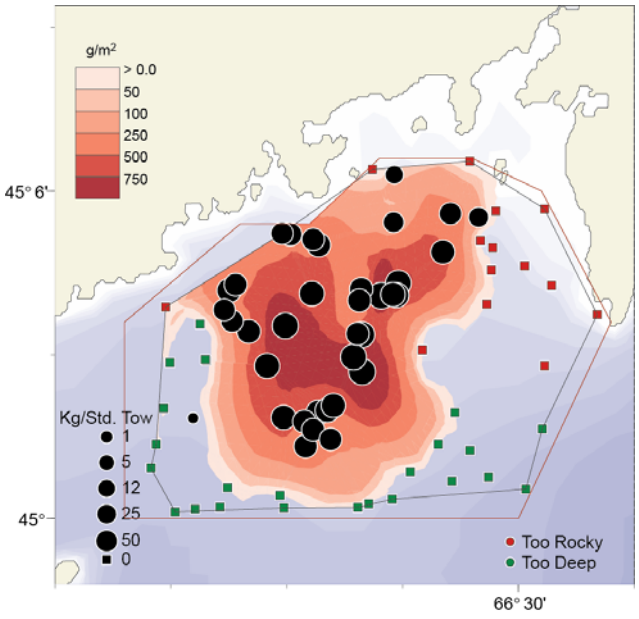

Figure 2. Contour map of the catch for the 2006 Mace's Bay Ocean Quahog survey.

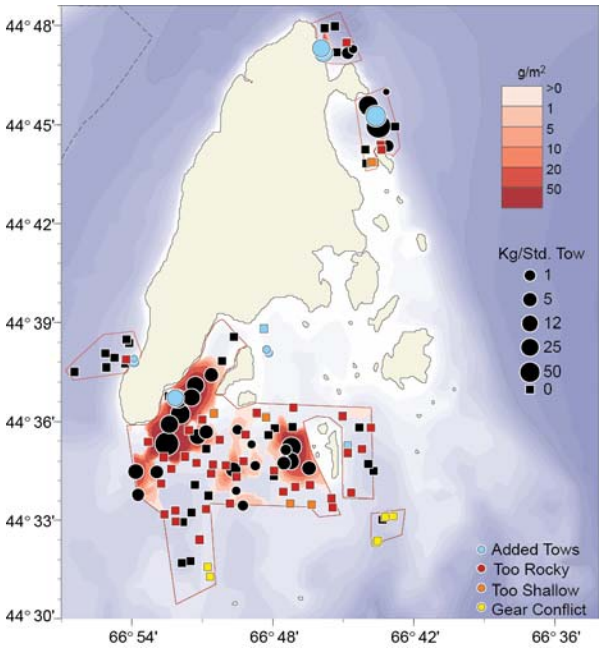

Figure 3. Contour map of the catch for the 2007 Grand Manan Ocean Quahog survey.

Three approaches were used to estimate the biomass of Ocean Quahog in these areas: a random sampling method, kriging, and an inverse distance weighted model. Results of all three approaches were comparable, and only the results of the random sampling method are shown here (Table 1).

Table 1. Biomass estimates for areas surveyed.

	Area km^2	Biomass (t)	CI	Density g/m^2
GM-1	7.4	5.1	±14.6	0.7
GM-2	91.5	2,705	±489.8	29.6
GM-3	2.9	0.0	0.0	0.0
GM-7	7.4	992.1	±162.8	134.1
GM-8	4.9	217.9	±67.7	44.5
Mace's Bay	160.6	38,808.8	±1,437.1	241.6
Total	274.70	42,728.90	2,172.00	155.5

The length frequencies of the survey are presented in Figure 4. The Ocean Quahogs in SWNB do not appear to reach the sizes found in the offshore populations.

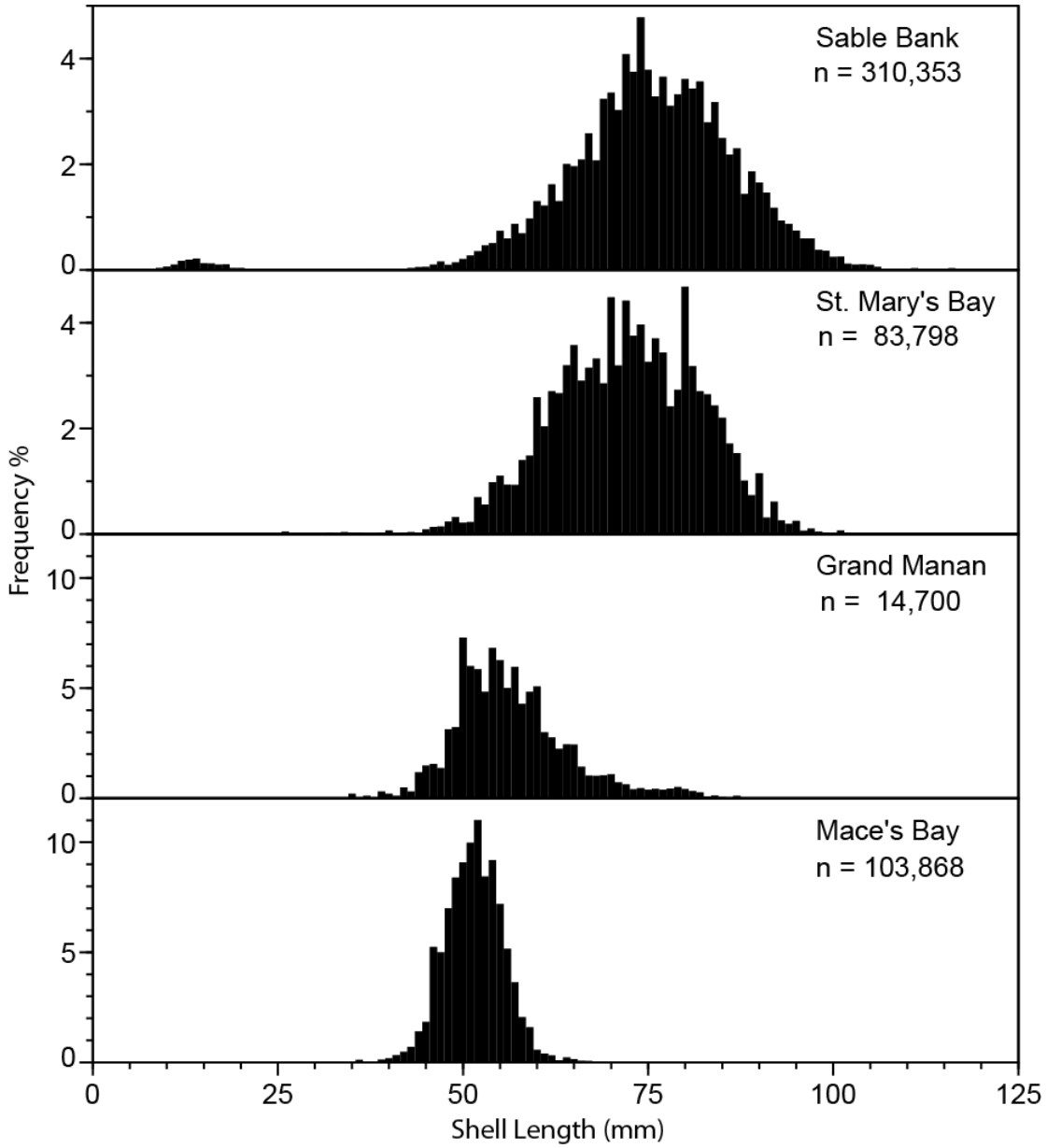

Figure 4. Length frequencies for Ocean Quahog surveys in the Maritimes Region.

A maturity study using samples from Mace's Bay estimated the length of 50% maturity as 37.5 mm (Figure 5). This is close to the estimated size that would fit through the commercial dredge bar spacing (19 mm), which allows capture of quahog over 39 mm (based on the length width regression).

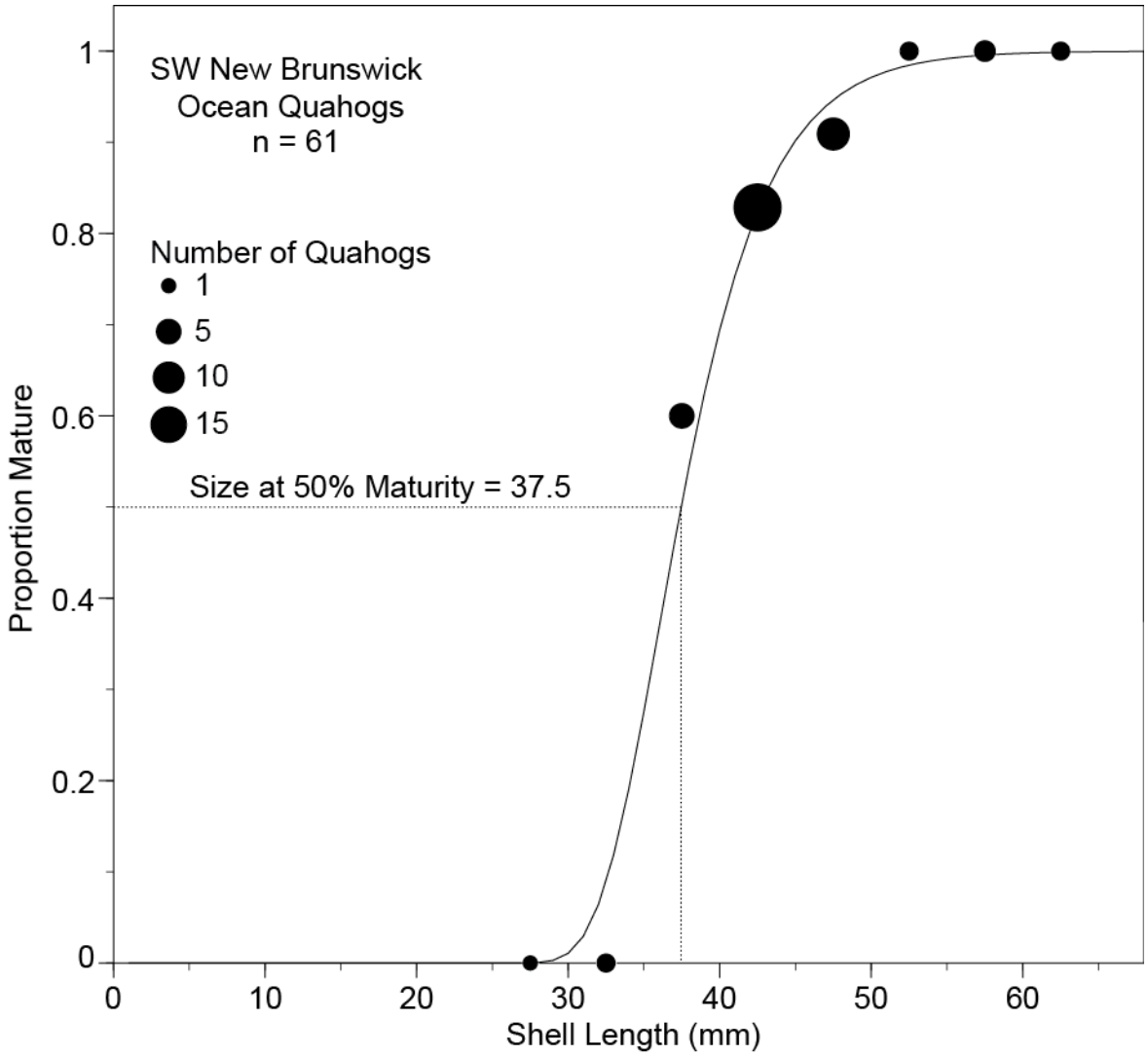

Figure 5. Size at maturity for Ocean Quahogs from Mace's Bay New Brunswick.

The sample used for aging was from Mace's Bay, was small, and was missing larger quahogs. This data may not accurately reflect the age structure of the populations in SWNB. The sampled ages ranged from 10 to 31 years.

Four approaches were used to estimate natural mortality (M) of Ocean Quahog in SWNB. These provided estimates of natural mortality ranging from 0.02 to 0.3. Given the available information, the most appropriate M for these areas was considered to be 0.12, which was based on an approach using maximum age.

Ecosystem Considerations

Habitat

As a developing fishery, the level of effort to date has been low and the footprint of the fishery has been very small.

Dry dredges have an immediate impact on the substrate and benthic organisms because they penetrate the sediment down to the depth the blade is set, remove many large organisms, and cause sedimentation adjacent to the track. Although there are studies of hydraulic dredges on sand substrates, there is little information on the effects of dry dredges on mud and clay substrates. Mud substrates are indicative of low energy environments compared to sand, so disturbance to the substrate will likely last longer than it would in a higher energy area. On Banquereau, hydraulic dredge tracks at 70 m on sandy bottom were still evident in sidescan sonar 10 years after they were made.

By-catch

The Ocean Quahog survey, which used commercial dredges, was held in the propeller wash to remove mud and clay. This also removed most of the small and soft bodied organisms, so there was little by-catch left when the dredge was brought on-board. The remaining by-catch is reported in Table 2.

Table 2. By-catch from the Southwest New Brunswick Ocean Quahog survey in numbers.

Species Name	Common Name	Number
Arctica islandica	Ocean Quahog	11,526
Astarte sp	Astarte clam	146
Molpadia oolitica	Purple sea cucumber	98
Cyclocardia borealis	Northern Cyclocardia	74
Pitar morrhuanus	False Quahog	46
Placopecten magellanicus	Atlantic Sea Scallop	36
Neptunea lyrata decemcostata	Wrinkle Whelk	10
Arabella iricolor	Red segmented worm	6
Colus sp.	Whelk - Colus Sp.	4
Cerianthidae	Tube dwelling anemone	3
Ctenodiscus crispatus	Mud Star	3
Chone infundibuliformis	Smooth tube worm	2
Homarus americanus	Lobster	2
Mytilus sp.	Mussel	2
Actiniaria sp.	Sea anemone	1
Cancer borealis	Jonah Crab	1
Cancer irroratus	Rock Crab	1
Cryptacanthodes maculatus	Wrymouth	1
Cucumaria frondosa	Orange-footed sea cucumber	1
Gastropoda	Snail - Unidentified	1
Laminaria saccharina	Kelp	1
Myxicola sp.	Fan tube worm	1
Pandalus borealis	Northern Shrimp	1
Polychaeta	Polychaete - Unidentified	1
Spionidae	Spionid Worm	1
Total		11,969

The majority of the survey by-catch was other bivalves, *Astarte, Cyclocardia, Pitar and Placopecten* species. The mud dwelling sea cucumber, *Molopadia oolitica,* was another common component. No Species at Risk were observed in the survey by-catch.

Sources of Uncertainty

With the mud and clay substrate in this area, survey gear saturation may have led to an underestimate of catch rates and, thus, biomass.

Survey dredge efficiency is unknown and was assumed to be 100%. The assumption of 100% efficiency is a conservative approach, as it would lead to an underestimate of biomass.

The life-history of this population is not known. It appears to have a shorter lifespan than other populations of Ocean Quahogs. Recruitment patterns are unknown at this time.

Due to a small sample size and a lack of large quahogs in the aged sample, aging results were considered to be of limited use in estimating population age structure and they were not used to estimate natural mortality. The estimate of M (0.12) was based only on the maximum age and is the best approximation given the current information.

CONCLUSIONS AND ADVICE

Based on the 2006 survey, the biomass estimate of Ocean Quahogs in Mace's Bay is 38,800 t. Based on the 2007 survey, the biomass estimate of Ocean Quahogs in areas surveyed around Grand Manan is 3,920 t.

A Maritimes Region Expert Opinion on inshore Ocean Quahogs recommended a target F of 0.33M (DFO 2005). This was supported by an assessment framework (DFO 2007a) and Science Response (DFO 2007b) for Ocean Quahog on Sable Bank and in St. Mary's Bay, which recommended a harvest strategy that used a constant F, suggested that the F should be a function of M, and recommended a TAC around $F_{0.33M}$. This was considered relatively risk-neutral given the biological characteristics of the stock and low probability of regular surveys. There is no basis to recommend an alternate strategy for the Ocean Quahog fishery in SWNB. Based on the current biomass and natural mortality estimates, the resulting harvest levels would be 1,537 t for Mace's Bay and 155 t for Grand Manan (Table 3).

Table 3. Estimated biomass and harvest levels for areas surveyed.

	Biomass (t)	**$B*F_{0.33M}$**
Grand Manan	3,920	155
Maces Bay	38,800	1,537
Total	42,729	1,692

Size at 50% maturity is close to the current retention size for the commercial gear. A strategy that ensures opportunities for spawning prior to capture would decrease the risk of recruitment overfishing.

Ocean Quahogs are long lived and slow growing. If the resource were to be depleted, it may take a long time for stock recovery.

By-catch in the survey (using commercial dredges) was low. The majority of the by-catch was other bivalves; no Species at Risk were observed.

Quahog dredges have an immediate impact on the substrate and benthic organisms, and there continues to be uncertainty about the impact of dredges on overall benthic productivity, especially dry dredges used in areas with mud and clay substrates.

SOURCES OF INFORMATION

This SAR was developed during a Maritimes Region Science Advisory Process on 21 October 2011. Additional publications from this meeting will be made available on the CSAS website at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm

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

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

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2012. Assessment of the Ocean Quahog (*Arctica islandica*) Stock in Southwest New Brunswick. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/069.