# LANDINGS, LIFECYCLE, AND UTILIZATION OF HABITAT FOR LOBSTER IN THE VICINITY OF TWO PROPOSED FINFISH AQUACULTURE SITES IN ST. MARY'S BAY, NOVA SCOTIA

## Context

On November 24, 2010, Fisheries and Oceans Canada's (DFO) Habitat Protection and Sustainable Development (HSPD) Division, Maritimes Region, requested that DFO Science, Maritimes Region, provide advice regarding lobster landings, lobster lifecycle, and lobster utilization of habitat in the vicinity of two proposed finfish aquaculture sites in St. Mary's Bay, Nova Scotia. The request for advice is in support of HPSD's review of an environmental assessment (EA) of a proposed aquaculture development project pursuant to the *Canadian Environmental Assessment Act*. Specifically, DFO HPSD asked:

> *What are the lobster landings in the vicinity of the proposed finfish aquaculture sites relative to adjacent areas and what lifecycle stages and for what purposes do lobsters utilize the habitat at 45-60 m water depth in the vicinity of the two proposed finfish aquaculture sites?*

Based on the question that was posed, the objectives of the DFO Special Science Response Process (SSRP) are:

1. Identify the lobster landings in the vicinity of the two proposed finfish aquaculture sites relative to adjacent areas in St. Mary's Bay, Nova Scotia; and

2. Identify lobster lifecycle stages in regard to lobster utilization of habitat at 45-60 m water depth in the vicinity of the two proposed finfish aquaculture sites in St. Mary's Bay, Nova Scotia.

The SSRP was based on existing data sources from St. Mary's Bay, which are limited in number and of lower resolution and scale relative to the location and size of the two proposed aquaculture sites. An SSRP was used due to the short deadline for advice of January 15, 2011.

In summary: 1) lobster landings are high in the reporting grid in St. Mary's Bay in which the DEPOMOD area of sensitivity (DAS) resides; 2) planktonic lobster larvae have not been studied in St. Mary's Bay, although they are likely found throughout much of the bay including the DAS; 3) settlement by young-of-year lobsters in the DAS is possible, but is expected to be low compared to shallower, cobble bottoms in St. Mary's Bay; and 4) adolescent and adult lobsters most likely use the DAS at various times of the year. Additional research would be required to more fully address some of the points discussed in this response.

# Background

Fisheries and Oceans Canada HPSD, Maritimes Region, is reviewing an EA for two marine finfish aquaculture sites to be located in St. Mary's Bay, Nova Scotia, to determine if they are likely to result in negative impacts to fish and fish habitat. As part of the federal EA process, DFO may provide advice to Transport Canada regarding any impacts that fall under DFO's mandate. In addition, DFO may provide the Nova Scotia Department of Fisheries and Aquaculture advice on the proposed aquaculture development. Refer to Canadian Environmental Assessment Registry reference number 10-01-55946 for more information regarding the EA of the proposed development project.

One component identified in the DFO HPSD risk assessment of the proposed aquaculture development project and, of major concern expressed in public comments received by DFO, is the risk of the proposed development to the St. Mary's Bay lobster population. The modeling software DEPOMOD has been used by DFO Science to predict the scale (i.e. intensity and extent) of organic enrichment associated with the proposed aquaculture development based on its maximum predicted daily feed rate at the two proposed sites (Figure 1). Based on the results, DFO HPSD is now considering the sensitivity of fish and fish habitat to the predicted organic enrichment and, as a result, requires science advice regarding the abundance, life stages, and use of habitat by lobster in the vicinity of the proposed aquaculture sites.

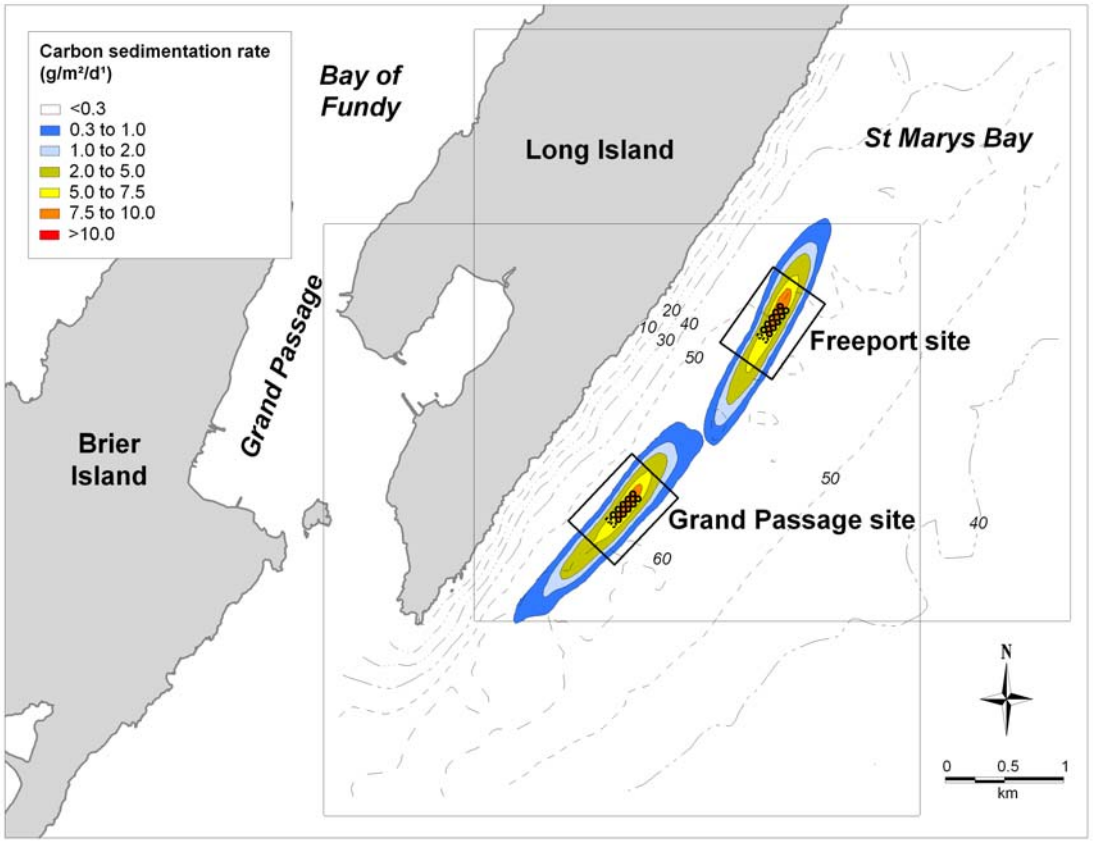


*Figure 1. DEPOMOD predictions for the proposed Freeport and Grand Passage sites in St. Mary's Bay, Nova Scotia, showing predicted extent and intensity of organic enrichment. The predictions assume a maximum daily feed rate of 3600 kg feed cage$^{-1}$ day$^{-1}$ (courtesy: Chang and Losier, DFO Science).*

## Analysis and Response

In this response, the area of sensitivity associated with the proposed aquaculture sites is referred to as the 'DEPOMOD Area of Sensitivity', or DAS. The combined DAS of the two sites is estimated to be less than 2 km$^2$ in size. The exact size of the DAS area is not available.

### Lobster Landings in the Vicinity of the two Proposed Finfish Aquaculture Sites Relative to Adjacent Areas in St. Mary's Bay, Nova Scotia

Landings from the lobster fishery in Lobster Fishing Area (LFA) 34 are derived from mandatory reporting logs completed by commercial fishermen. Fishermen report their daily catch in weight, their daily effort (number of traps hauled), and the location. The locations are reported on the scale of grids outlined in Figure 2. The grids measure 10 minute latitude by 10 minute longitude in size (approximately 18.5 km by 13.3 km), unless interrupted by the coastline. The proposed aquaculture sites fall in Grid 92 in St. Mary's Bay (Figure 2).

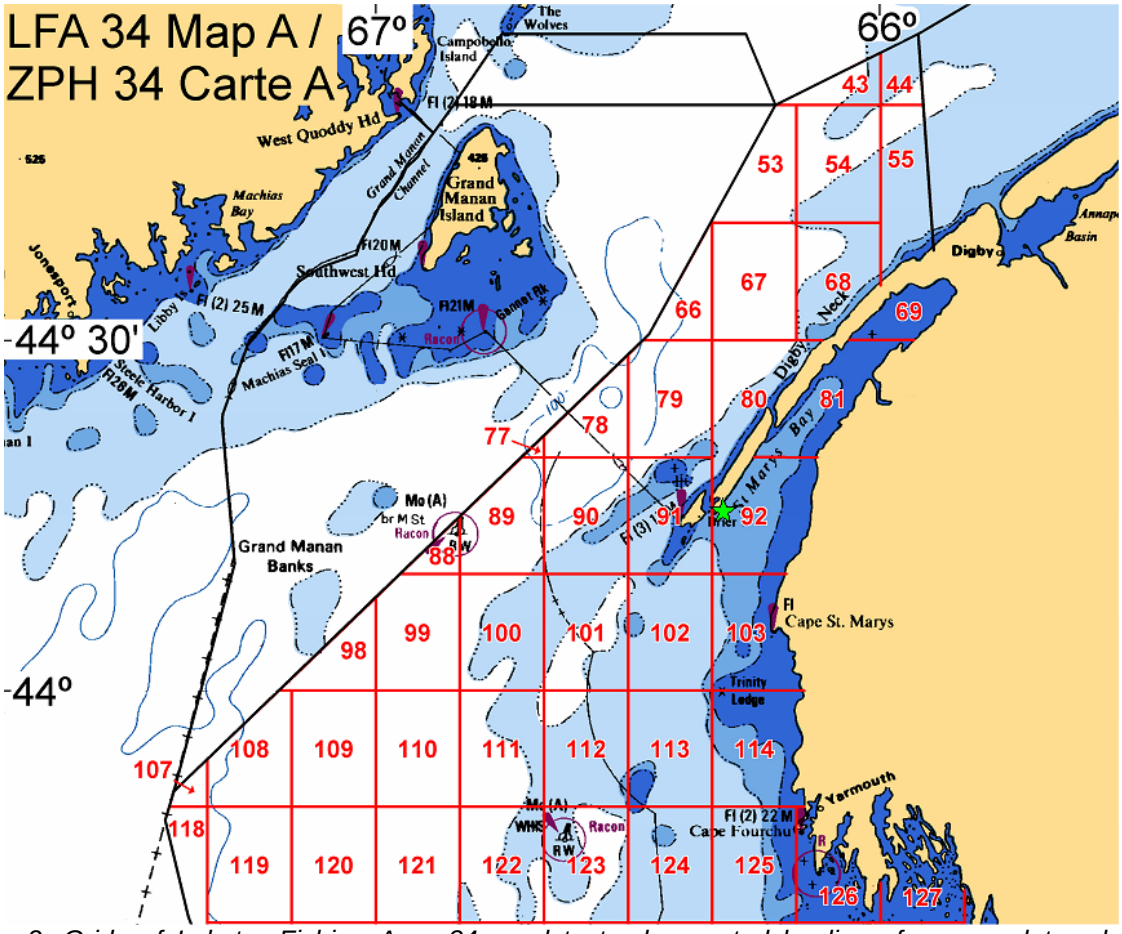


*Figure 2. Grids of Lobster Fishing Area 34 used to track reported landings from mandatory logs of commercial lobster fishermen. Only the northern half of LFA 34 is shown in the figure. The green star indicates the approximate location of the proposed finfish aquaculture sites in St. Mary's Bay. The proposed aquaculture sites reside in Grid 92 of the reporting structure. Other grids of St. Mary's Bay include Grids 69 and 81. Grids 91 and 103 at the mouth of the bay are also noted.*

In St. Mary's Bay, the bulk of landings come from Grid 92. Landings from Grid 92 rank among the highest in LFA 34 (Table 1). Grids 91 and 103 located outside St. Mary's Bay, adjacent to

Grid 92, also have high lobster landings. Grid 92 is estimated to cover approximately 240 $km^2$ in area. Assuming a DAS of 2 $km^2$, the DAS represents less than 1% of the area of Grid 92. This estimate of the DAS, as a proportion of Grid 92, cannot however be used to estimate the proportion of lobster landings of Grid 92 that may come from the DAS, since lobsters are not uniformly distributed about the grid.

*Table 1. Lobster landings in tonnes (t) from mandatory reporting logs. Landings are presented by year (for 2002-2008 calendar years) for Grids 69, 81, and 92 located in St. Mary's Bay and for Grids 91 and 103 located just outside St. Mary's Bay (refer to Figure 2 for grid locations). The rank and proportion of Grid 92 landings relative to LFA 34 are also presented by year. The number of LFA 34 grids fished in 2008 was 148.*

| Year | Landings (t) | | | | | Grid 92 | |
|---|---|---|---|---|---|---|---|
| | 69 | 81 | 91 | 92 | 103 | Rank By Landings in LFA 34 | Proportion of LFA 34 Landings (%) |
| 2002 | 0.1 | 184.1 | 229.6 | 1119.1 | 184.3 | 3 | 6.4 |
| 2003 | 6.6 | 169 | 295 | 988.4 | 216.1 | 3 | 5.5 |
| 2004 | 7.6 | 154.3 | 301.6 | 908.3 | 298 | 3 | 5.4 |
| 2005 | 8.1 | 270.7 | 317.1 | 955.3 | 336 | 3 | 5.2 |
| 2006 | 16.5 | 261.6 | 233.6 | 799.7 | 296.4 | 3 | 4.3 |
| 2007 | 7.2 | 104.9 | 143.8 | 577.5 | 209.3 | 4 | 4.3 |
| 2008 | 10 | 144.5 | 178.7 | 869.9 | 288.1 | 4 | 4.8 |

## Lobster Lifecycle Stages in Regard to Lobster Utilization of Habitat at 45-60 m Water Depth in the Vicinity of the two Proposed Finfish Aquaculture Sites in St. Mary's Bay, Nova Scotia

### Lobster Larvae

There are no published field studies on the distribution and abundance of planktonic lobster larvae in St. Mary's Bay. Based on studies in adjacent areas (e.g. Tremblay and Sharp 1987; Annis et al. 2007), planktonic lobster larvae are likely in the water column from July through to late-September. In most years, the highest abundances would be expected from mid-July to mid-August. Field studies in different areas indicate that the vertical distribution of lobster larvae varies with time of day and larval stage.

A modeling study of Incze et al. (2010) assumed that 'Stage I' lobster larvae are produced all along the coast of southwest Nova Scotia. After simulating the movement of Stage I larvae using a physical transport model, Incze et al. (2010) reported that relative to the area off southwest Nova Scotia east of Saint Mary's Bay, modeled postlarvae were in higher abundance in an area including St. Mary's Bay and much of the Bay of Fundy. It is highly likely that lobster larvae are distributed over a large part of St. Mary's Bay, including the DAS. With the current available data, however, there is no way of determining whether larvae are more or less abundant in the DAS. To determine this, a field study of the seasonal distribution of planktonic lobster larvae would be needed.

## Newly Settled Lobsters

Studies are currently underway by DFO and the Fishermen Scientists Research Society to examine lobster settlement (i.e. the number of young-of-year lobsters per $m^2$ in St. Mary's Bay). To date, only two years of data have been collected and, as such, definitive statements regarding the distribution of lobster settlement in St. Mary's Bay are not possible. In 2010, the lobster settlement collectors closest to the DAS were distributed on the Digby Neck side of the bay beginning approximately 14 km to the northeast of the DAS. Forty collectors were set from a point just north of French Beach Point (opening to Petit Passage) and continuing parallel to the shore at depths of 7-15 m for 6 km to the northeast. Settlement of young-of-year lobsters in these collectors was 5 times higher than 40 collectors set further up the bay on St. Mary's Bay Shoal.

The lobster settlement collectors were all set on hard bottom substrate at water depths less than 20 m. This is shallower than the DAS water depths of 45-60 m. Lobster settlement at the depth of the DAS is possible given appropriate temperatures. For instance, studies in the U.S. Gulf of Maine indicate lobster settlement can occur at water depths of 45-60 m given that water temperatures are greater than 12 $^{o}$C. Settlement at these depths, however, is expected to be lower compared to settlement levels observed at shallower water depths. In St. Mary's Bay, the tides result in well mixed conditions and temperatures typically greater than 12 $^{o}$C, even at water depths of 35-47 m (Table 2). As a result, water temperatures could support lobster settlement at water depths close to the DAS water depths of 45-60 m.

The bottom habitat in the DAS appears to be of low quality for the settlement of lobsters. Bottom video indicates that the bottom type in the DAS consists mainly of soft sediment, with shell debris and the occasional cobble (Kelly Cove Salmon Ltd., 2010). Newly settled lobsters require shelter, which is typically supported by cobble bottom types (Wahle et al. 2009). Based on the available video at the proposed aquaculture sites, the possibility that there are some patches of cobble that would provide shelter for settled lobster can not be eliminated, but the habitat for lobster settlement in the DAS appears to be of low quality.

## Adolescents and Adults

A transition from juvenile, to adolescent, to adult lobsters occurs over a size range of approximately 40 mm carapace length (CL) to 90 mm CL (Lawton and Lavalli, 1995). In 2006 and 2007, DFO underwater video surveys of the sea bottom within 1-4 km of the DAS indicated that the area is used by adolescent and adult lobsters in late summer (Figure 3). The predominant bottom type in the video surveyed areas was sand and mud (Table 2). Although lobsters seen on these transects were not measured, their sizes are estimated to be from 40 mm CL to well over 100 mm CL (this video footage is not effective at detecting small lobsters even if they are present).

Most lobsters observed in the video surveys were adolescents and adults (Table 2). Lobster densities observed in the vicinity of the DAS varied from 0.013 to 0.026 lobsters per $m^{2.}$ These densities are considered to be moderate. To put them in perspective, they are lower than estimates of 0.06 lobsters per $m^2$ in productive shallow habitat of another bay in southwest Nova Scotia in September, but similar to estimates of 0.03 lobsters per $m^2$ for a lobster fishing area at 35-60 m water depth off southwest Nova Scotia (Tremblay et al., 2009).

*Table 2. Abundance of adolescent and adult lobsters estimated from video transects in the vicinity of the DEPOMOD area of sensitivity. Water depths are not corrected for tide stage. The bottom type is characterized by: M=mud; S=sand; G=gravel; and C=cobble. Refer to Figure 3 for transect locations.*

| Transect Number | Survey Date | Mean Water Depth and Range (m) | Bottom Temperature ($^{o}$C) | Pre-dominant Bottom Type | Lobster Count | Estimated Lobster Density (lobsters m$^{-2}$) |
|---|---|---|---|---|---|---|
| 335/336 | Sept. 22, 2006 | 39.5 (35-46) | 13.0 | S,G,C | 22 | 0.026 |
| 376 | Sept. 14, 2007 | 45 (44-45) | 11.5 | S | 11 | 0.013 |
| 413 | Sept. 27, 2006 | 44.5 (42-45) | 12.8 | S,M | 13 | 0.017 |
| 414 | Sept. 27, 2006 | 42.5 (42-43) | 12.8 | S,M | 11 | 0.013 |
| 429 | Sept. 27, 2006 | 47.7 (46-48) | 12.7 | S,M | 19 | 0.026 |

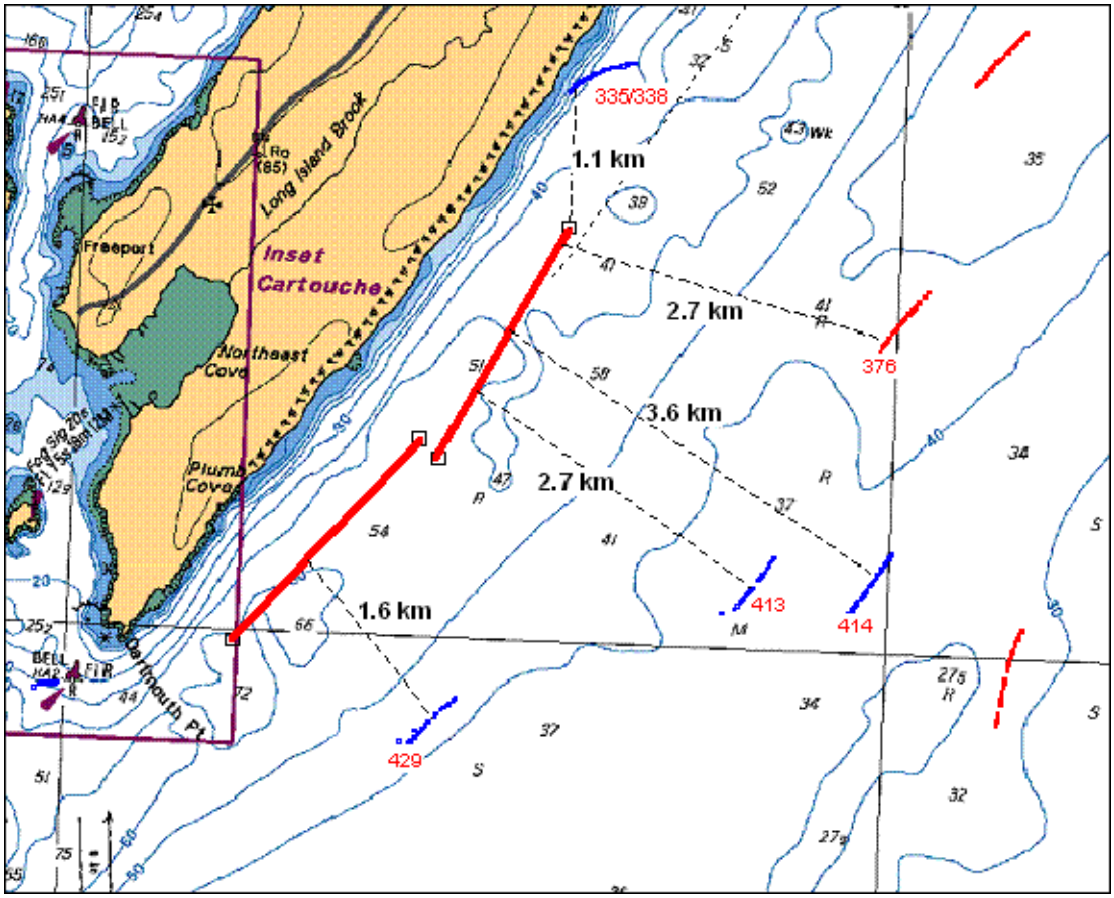


*Figure 3. Map showing the long axes of the DEPOMOD area of sensitivity (DAS) and location of underwater video transects to enumerate lobster undertaken by DFO in 2006 and 2007. The video surveys were not undertaken in association with the proposed aquaculture sites. The DAS axes are represented by the long, thick red lines and the video transects by the short, blue lines (2006 surveys) and red lines (2007 surveys). The black numbers represent the distance in kilometers of the video transects from the DAS. Transect numbers are in red.*

Lobsters observed in the video surveys in the vicinity of the DAS may be foraging or transiting the survey areas. Numerous crabs (e.g. rock crab or Jonah crab) were seen on the video transects, and lobsters could be feeding on these or possibly on bivalves or worms. Lobsters may also simply be passing through the survey areas to reach other foraging areas or to molt or reproduce. In order to determine if the DAS supports higher or lower densities of adolescent and adult lobsters, relative to surrounding areas, studies of abundance at different times of the

year would be required. Understanding how lobsters make use of the habitat in the DAS would require more directed field studies of their feeding behaviour and movement.

## Conclusions

- Lobster landings are high in the reporting grid (Grid 92) in St. Mary's Bay, in which the DEPOMOD area of sensitivity (DAS) resides. The DAS represents less than 1% of the total area of Grid 92. With available data, it is not possible to estimate the proportion of Grid 92 landings that come from the DAS, since lobsters are not uniformly distributed about the bottom.

- Planktonic lobster larvae have not been studied in St. Mary's Bay, although they are likely found throughout much of the bay including the DAS. The importance of the area in the vicinity of the DAS, relative to lobster use of other areas, remains unknown. To better address this question, field studies of the distribution of planktonic larvae would be needed.

- Settlement by young-of-year lobsters in the DAS is possible, but is expected to be low compared to shallower, cobble-bottomed areas in St. Mary's Bay. This is because the sea bottom in the DAS is comprised mainly of soft sediments, while newly settled lobsters require shelter such as that provided by cobbles.

- Adolescent and adult lobsters most likely use the DAS at various times of the year. Underwater video transects on soft-sediment bottoms adjacent to the DAS demonstrated that lobsters are at moderate densities in late summer. Lobsters could use these areas for foraging or as a migration route. To determine the importance of the DAS to adolescent and adult lobsters relative to surrounding areas, further field studies would be required.

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## Contributors

| *Author* | *Affiliation* |
|---|---|
| John Tremblay | DFO Maritimes Science |
| Douglas Pezzack | DFO Maritimes Science |
| Cheryl Denton | DFO Maritimes Science |

## Approved by:

Alain Vézina
Regional Director, Science
Dartmouth, NS
(902) 426-3490

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## This Report is Available from the:

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

Telephone: 902-426-7070
Fax: 902-426-5435
E-Mail: XMARMRAP@mar.dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

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