Friends of Port Mouton Bay
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February/09

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Additional information from Friends of Port Mouton Bay relevant to:

Review of Cumulative Effects Report for Port Mouton Bay, Nova Scotia. DFO Can. Sci. Advis. Sec. Sci. Resp. 2008/015.

Friends of Port Mouton Bay (FPMB) noticed on the DFO website posted on January 13, 2009 a DFO Maritimes Science review of our September 2008 report entitled Cumulative Effects of Two Aquaculture Sites in Port Mouton Bay. We appreciate the attention given to this report, we have made several improvements to the report and we offer some significant background information - combining our knowledge with DFO Science for a resilient, sustainable human-nature interaction in Port Mouton Bay. This note on our additional information accompanies our revised report.

We note that DFO Science was given a tight timeline for response and that the contributors may not have the benefit of first hand knowledge or field experience in Port Mouton Bay or of several other submitted FPMB reports on Port Mouton Bay. FPMB were not directly provided with this response to their report nor notified of the existence of this response on the DFO website. FPMB did not have the opportunity to directly respond to comments or questions raised by the contributors during the preparation of this review. In the meantime we have been advised that DFO is in the process of finalizing its recommendation to approve the proposed aquaculture site with mitigative measures. Our fear is that the opportunity for a clear, widely-shared insight into ecosystem-dynamic responses to human use in Port Mouton Bay is being lost.

We note that DFO's Siting Guidelines for Aquaculture places value on a cooperative approach:

> A cooperative approach, including government, industry and other stakeholders, is preferred for assessing performance characteristics of both new and established management tools and measures of the environmental effects of aquaculture. The cooperative approach should extend to full sharing of the information package necessary to assess the ecosystem effects of the aquaculture facilities in an area.(DFO,2005)

FPMB have also initiated a formal request for an all-stakeholder meeting to facilitate meaningful dialogue and a pooling of information on all of the issues surrounding the proposed aquaculture site at Port Mouton Island.

Ronald H Loucks, Ph.D.

Ruth E. Smith

Science Committee
Friends of Port Mouton Bay

The portions of your review to which we are adding information are copied in black. Our additional information is in green.

REVIEW OF CUMULATIVE EFFECTS REPORT FOR PORT MOUTON, NOVA SCOTIA

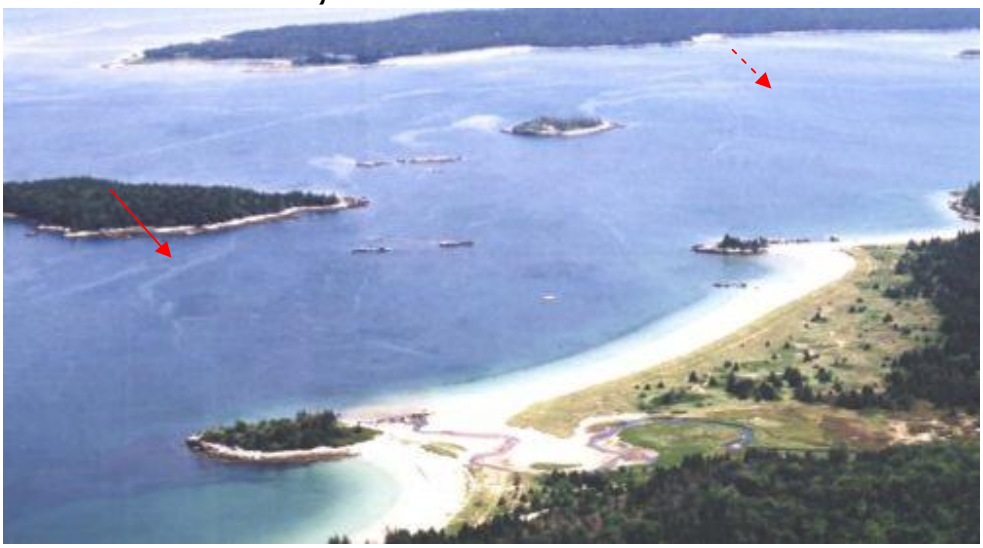

Figure 1 Port Mouton Basin, between Spectacle Island & Port Mouton Island

Context

DFO Maritimes Science was asked by the Maritimes Habitat Protection and Sustainable Development (HPSD) Division to review a document entitled *Cumulative Effects of Two Aquaculture Sites in Port Mouton Bay* (Friends of Port Mouton Bay, 2008) on 18 September, 2008. Given that this report has been submitted to DFO as part of a broader CanadianEnvironmental Assessment process (led by Transport Canada), and since DFO Maritimes Science has provided information and advice on the same Port Mouton aquaculture site proposal previously (DFO, 2007), it was determined that the Maritimes DFO Science review of this document would be conducted using the Science Special Response Process. The document was reviewed internally within DFO Maritimes Science and this response represents the conclusions drawn from the internal review.

Background

The HPSD Division received an application for the establishment of a 29 hectare marine finfish aquaculture site in Port Mouton Bay, Nova Scotia in 2007. Transport Canada is

currently leading an environmental assessment of the proposed site. This and its predecessor application have been in process and of great concern to the residents of Port Mouton Bay since 2002.

DFO Science produced a National Science Advisory Report on Finfish Cage Aquaculture in the Marine Environment in 2005 (DFO, 2005), and DFO Maritimes Science provided information and advice to HPSD on this site application in 2007 (DFO, 2007). This current response is considered to be supplemental to those two previous advisory reports. This report was generated through an internal regional review process under a tight timeline, and it should be considered in that context.

Port Mouton Bay is located in southwestern Nova Scotia (Figure 1). The shoreline is quite rocky typical of the granitic shores found along Nova Scotia in that area but interspersed with several large sand beach areas comprising approximately 30% of the shoreline of the bay. Two of these beaches are classified as protected by Nova Scotia Department of Natural Resources. Travellers rate these as world-class beaches. Much of the population in the area of Port Mouton lives along the coast.

Figure 1. Location of Port Mouton Bay

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Analysis and Responses

The report entitled *Cumulative Effects of Two Aquaculture Sites in Port Mouton Bay* is organized into three parts: (i) nuisance algae, (ii) dissolved oxygen in the waters of Port Mouton Bay, 9 and 10 September 2008, and (iii) surface drifters at proposed aquaculture site near Port Mouton Island.

Nuisance Algae

Research has shown that the presence of nuisance algae can be linked to eutrophication from the run-off of nitrogen from land-use, but the evidence for such a link with aquaculture is presently quite tenuous.

We quote from the DFO Site Guidelines paper:

> Under some circumstances, finfish aquaculture has the potential to alter the trophic status of inlets on far-field scales ……Recently the debate has extended to include the possibility that under some conditions intensive finfish aquaculture may contribute to eutrophication in areas hundreds of metres to as much as a few kilometres from the concentration of culture facilities.…(DFO, 2005)

From the DFO Science Response (2007):

> Dissolved wastes are expected to disperse widely over the area and some interaction between sites might occur…..Although direct causal links have not been established, it is likely that the additional nutrients will be utilized by the macrophyte assemblage and could result in a change in the abundance or diversity of the species present. (DFO, 2007)

A study conducted by the Conservation Council of New Brunswick at Deer Island demonstrated that nuisance algal abundance could reasonably be attributed to increased nutrient load from aquaculture in the area.(Harvey and Milewski, 2007)

There are a number of communities along the eastern seaboard that show increasing densities of opportunistic green and brown seaweeds that are exploiting increased levels of nitrogen. For example, *Pilayella* build up was detected around Lockeport two years ago, as was *Pilayella* build up near Middle River more recently. Large amounts of *Pilayella* and *Ectocarpus* also have been detected in sheltered bays in the Bras d'Or Lakes over the last few years. This is considered a sign of general coastal eutrophication. For Port Mouton, there is insufficient data to show any direct causality between the increase of nuisance algae and the presence of the salmon aquaculture farm.

FPBM(2008a) describes the presence of *Ulva intestinalis* from ocean sources along a beach shoreline adjacent to a continuous source of nutrients – the fish farm at Spectacle Island. These algae were not apparent at this location prior to the existence of the fish farm. The fish plant in Port Mouton located further west is presently operating at a much-reduced capacity. This beach shoreline adjacent to Spectacle Island is not an area of residential, industrial or agricultural activity so that other sources of nutrients are not significant compared to the 10,000 person equivalents of the proposed fish farm (see below)..

Similarly, observations of abundant *Pilayella littoralis* originating in the vicinity of Spectacle Island in 2002 and *progressively* outward to islands in the basin west of Port Mouton Island cannot be associated with any apparent sources from residential, industrial or agricultural activity (Figure 1.1, FPMB 2008a).

Macroalgae are intentionally introduced at some finfish aquaculture sites to utilize dissolved nitrogen wastes as a value-added aquaculture product (Integrated MultiTrophic Aquaculture).

The question that needs to be answered is whether or not the nuisance algae are located close enough to the farms for a cause-effect link to be possible given the dilution and flushing characteristics of the site.

In summary, since other candidate point sources for nutrients in these areas of Port Mouton Bay are negligible or non-existant,, since these algae were not observed prior to the existence of the fish farm and since *Pilayella* first became obvious in the vicinity of the existing fish farm throughout spring, summer and fall which includes the seasons when background ocean nutrient levels are limited, it is reasonable to attribute increased nutrient sources to this aquaculture site.

FPMB have provided considerable evidence in previous reports on limited flushing at the existing and proposed aquaculture sites in Port Mouton Bay. (FPMB, 2008, 2009). We expect that the limited flushing rate in Port Mouton Bay is at the root of the history of habitat degradation in the vicinity of Spectacle Island.

The drifter data provide information only on near-surface flow conditions (not at the full depth of the water column) and many of the results appear to be more closely linked to wind forcing than to the expected tidal-flow directions. Surface drift is expected to transport dissolved nutrients and floatables. FPMB (2008, 2009) describe bottom drifter, water column drogue and recording current meter results for Port Mouton Bay. Bottom drifters were released in the basin in January and February, 2007, and appeared to beach patrols in April, 2007, on the shores of the National Park.

From a scientific standpoint, the evidence to directly link the presence of nuisance algae with aquaculture appears to be lacking. Nuisance algae are routinely pressure-hosed off farm nets at the existing site. However, the potential for aquaculture to contribute to nuisance algae is a topic that may warrant further investigation. For example, stable isotope studies may help to determine the linkage between a potential nutrient source and a macrophyte bloom; however, these pathways should also be put in context of the overall magnitudes of nutrient inputs from a variety of potential sources, including aquaculture, industry, residential developments, and agriculture.
There is no evidence of domestic sewage supporting nuisance algae at these sites. There is no residential housing within 1.8 km of the proposed fish farm. No persons live within 1 km of the existing fish farm. Elevated fecal coliform levels may be associated with nutrient sources from human activity, but there are no shellfish closures in these two fish farm areas (existing and proposed) due to elevated levels of fecal coliforms with the exception of the unofficial shellfish closure around the existing fish farm. The nutrients released by the existing farm at a 200,000 fish stocking capacity are equivalent to 5,000 persons; the proposed expansion would release nutrients equivalent to 10,000 persons (roughly equivalent to the entire population of Queens County) at a stocking capacity of 600,000. FPMB points out that the existing fish farm has the worst environmental record with respect to sediment sulphide concentrations of any in Nova Scotia as shown on the Nova Scotia Fisheries and Aquaculture website. http://www.gov.ns.ca/fish/aquaculture/EMPSummaryReport.pdf.

Dissolved Oxygen

The oxygen data collected for the Port Mouton area is limited, and little of these data are presented in the report under review. We have now included all 23 oxygen profiles in an Appendix to FPMB, 2008a. For example, the vertical profiles, which would be a useful addition, have not been provided. In addition, there is no description of the natural variability in oxygen levels and whether the detected levels fall within, above, or below the natural variance. Late summer is the critical season for oxygen depletion and for an oxygen survey, because of warmer water temperatures and intensive feeding of the salmon in the fish farm with resulting oxygen demand. There was a 'natural mode' of 88 to 104% saturation and the depleted mode of 66 to 79% saturation. Some estimate of natural variance might be gained from the 21 profiles included in the natural mode.

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Results have been presented only for the area of interest and not for any other comparative sites (e.g., control sites). Canadian Council of Fisheries and Aquaculture Ministers (CCFAM) guidelines should be treated in the context that many coastal areas have natural dissolved oxygen levels that are below the CCFAM limits; hence, the impacts of human activities should be considered in the context of deviations from local norms rather than a global threshold.

The scope of human activity at this location is described above – there is little or no residential, industrial or agricultural activity within effective range of the existing fish farm which itself is a huge source of nutrients.

Although oxygen concentration in the sea can be much lower than saturation for a variety of reasons, most invertebrates do not appear to be significantly affected until extremely low concentrations (about 2-3 mg/L or 3-4 mg/L) are reached (Diaz and Rosenberg 1995; Hargrave et al. 2008).

(Diaz and Rosenberg 1995) describe hypoxic levels which "suffocate" marine life. Sub-lethal effects on marine life at hypoxic levels have not been extensively studied. Invertebrates aside, fish including salmon, mackerel and herring require oxygen concentrations higher than the lowest observed levels. In the context of the existing fish farm operating at reduced capacity in September 2008, and the proposed fish farm operating at three times the full capacity of the existing farm, the potential for cumulative effects reducing already depleted oxygen is a reasonable assumption. Even with rotational fallowing, both farm sites will be operating two-thirds of the time.

A more extensive oxygen survey (area, depth and time) would be required before any attempt could be made to link depleted levels with the existing aquaculture activities. Some idea of the organic loading on the bottom would also help interpretation.

From the DFO siting guidelines:

> Dissolved oxygen…..is one of the few options available for monitoring over hard bottoms. It is also useful for predicting and assessing far-field effects in environments where oxygen levels may be a concern. DFO(2005).

The location of depleted oxygen in the water column was over a hard rock and gravel bottom where natural flows occur at high water - 250 m directly downstream of the existing fish farm which was operating at reduced capacity. There was an abundance of algae present to create a sustained oxygen demand at this location.

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Surface Drifters

The drifter data, although somewhat useful on its own, would perhaps be more valuable if it could be put into a more comprehensive context of circulation within the area. Also, as mentioned above, the drifter data provides information only on near-surface flow conditions (not at the full depth of the water column) and many of the results appear to be more closely linked to wind forcing than to the expected tidal-flow

Circulation throughout the water column is addressed in our previous reports on current meter and drogue data (FPMB, 2008) and in our latest report, an analysis of current meter and drogue data from Summer 2008 (FPMB, 2009). Quoting from our report (FPMB 2008a), "Surface drifters were released … to demonstrate pathways of dissolved nutrients and floatable debris from this location."

Comparison of the drifter data with current meter data may help to determine if it is consistent with the currents during comparable wind conditions.
If so then an estimate of the frequency of these conditions could be made, and from this it may be possible to generate the frequency of nutrient flux to the shore. On 7 July 2008, wind speed was 10-30 km/hour at Lunenburg and Yarmouth and the direction was west to northwest, which could have held the drifters against the tide, moving them directly west depending on the time of release.

The Western Head station is 14 km and visible from Port Mouton Bay and reported light winds from the southwest on July 7, 2008, Port Mouton fishermen generally observe that SW winds recorded at Western Head are not consistent with winds in Port Mouton Island basin due to the sheltering influence of land and seabreeze effects.

On July 31, winds at Western Head were also light - 6-7 km/h from the southwest. On August 1, winds were 9-11 km/h from the northeast. A plausible scenario is that July 31 tides positioned the drifters so that winds on August 1 brought them ashore inside Spectacle Island. The DFO windrose statistics for Nova Scotian Shore show east winds occurring for 37 to 88 hours per month in the period March to October. Over the same period, northeast winds occurred for 37 to 66 hours per month. This frequency of occurrence of easterly winds indicates the potential for wastes discharged into the Port Mouton Basin to reach the vicinity of the Spectacle Island fish farm leading to cumulative effects from the two sites.

The dissolved fraction of wastes from aquaculture sites are strongly influenced by current, and considerable dilution and mixing would be expected.

We note that these surface drifters were accompanied for the first nine hours after release by 10 m deep drogues (FPMB, 2009). These drogues demonstrated two features; they drifted toward Spectacle Island, and remained within the basin which over time would lead to recirculation, reloading and build-up of concentration of wastes or their products.

Conclusions

There is nothing in the report entitled *Cumulative Effects of Two Aquaculture Sites in Port Mouton Bay* (Friends of Port Mouton Bay 2008) to suggest that conditions exceed the present aquaculture siting guidelines nor do they contradict the earlier science review (DFO 2007)

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The Cumulative Effects report (FPMB 2008a) focuses on far-field effects in a site-specific situation. The aquaculture siting guidelines (DFO, 2005) state:

> The management tools and approaches currently in use are focused primarily on near-field and site-specific regulatory applications. There may be far-field and cumulative effects, and quantifying and managing them will require new or modified approaches (DFO, 2005).

However, the report does demonstrate the importance of being able to identify direct cause and effect relationships.

The DFO Science Report (DFO, 2007) supports a 'likelihood' framework:

> Dissolved wastes are expected to disperse widely over the area and some interaction between sites might occur…..Although direct causal links have not been established, it is likely that the additional nutrients will be utilized by the macrophyte assemblage and could result in a change in the abundance or diversity of the species present. (DFO, 2007)

This requires a cumulative effects and ecosystem-based approach, i.e., taking natural variation and all coastal activities into consideration - not just aquaculture. These approaches require substantial background information on spatial and temporal patterns for all relevant indicators and processes.

We agree that an ecosystem-based approach is needed. To this end we propose pooling our information on Port Mouton Bay with your specialized knowledge.

Regarding the specifics of nutrient sources, there are no other coastal activities in Port Mouton Bay that discharge nutrients equivalent to 10,000 persons. Other candidate point sources for nutrients in the area of the fish farm sites in Port Mouton Bay are negligible or non-existent.

Contributors

Peter Cranford (primary author) DFO Maritimes Science
Eddy Kennedy (reviewer) DFO Maritimes Science
Tim Milligan (contributor) DFO Maritimes Science
Fred Page (contributor) DFO Maritimes Science
Shawn Robsinson (contributor) DFO Maritimes Science
Herb Vandermeulen (contributor) DFO Maritimes Science
Tana Worcester (editor) DFO Maritimes Science

Approved By

Mike Sinclair
Regional Director, Science
Dartmouth, NS
(902) 426-3490
Date: 13 November 2008

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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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