Port Mouton Bay Lobster Trap Survey 2007-2013

Summary

Port Mouton Bay fishermen's local ecological knowledge and experience led them to conclude that lobsters will avoid an area they sense to be fouled.

This knowledge is investigated via participatory research in annual lobster trap surveys by fishermen and scientists beginning in May 2007, completed to 2013 and expected to continue. In the three years during the fallowing of the fish farm (2010-2012), lobster catches generally improved in all areas of the bay except in the proximity of the fish farm, in spite of year-to-year variation in bottom water temperatures and weather conditions. This pattern is most obvious with seed-bearing female lobsters. This improvement reversed in 2013 after the fish farm had been re-stocked with rainbow trout in June, 2012.

LFA33 landings trend upward during 2007 - 2013. Patterns indicate that Port Mouton Bay catch rates respond more strongly to fish farm feed/fallow regimes than to LFA33 aggregated landings.

In 2011 and 2012 other ecosystem-based indicators – kelp, eelgrass and Irish moss, mackerel, scallops and rock crab - exhibited some recovery in Port Mouton Bay. In 2013, kelp, eelgrass and Irish Moss exhibited reversal.

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Background

Fishermen of Port Mouton Bay were reporting that they had abandoned historical lobster fishing 'territories' within the inner bay because of very low catches. This trend had developed since 1995 during the presence of the fish farm. These 'territories' had previously been prime lobster fishing ground and a lobster spawning and moulting area.

Lobster trap surveys conducted by DFO have demonstrated that the inner harbour of Port Mouton Bay historically has been a destination for lobster migration. In 1946-7 (unpublished records in DFO files) and in 1979 and 1982 (Miller et al., 1989), surveys showed that a significant portion of tagged lobsters released within and outside of inner Port Mouton Bay were recovered in the vicinity of the current fish farm site (see green arrow heads, Figure 1 below).

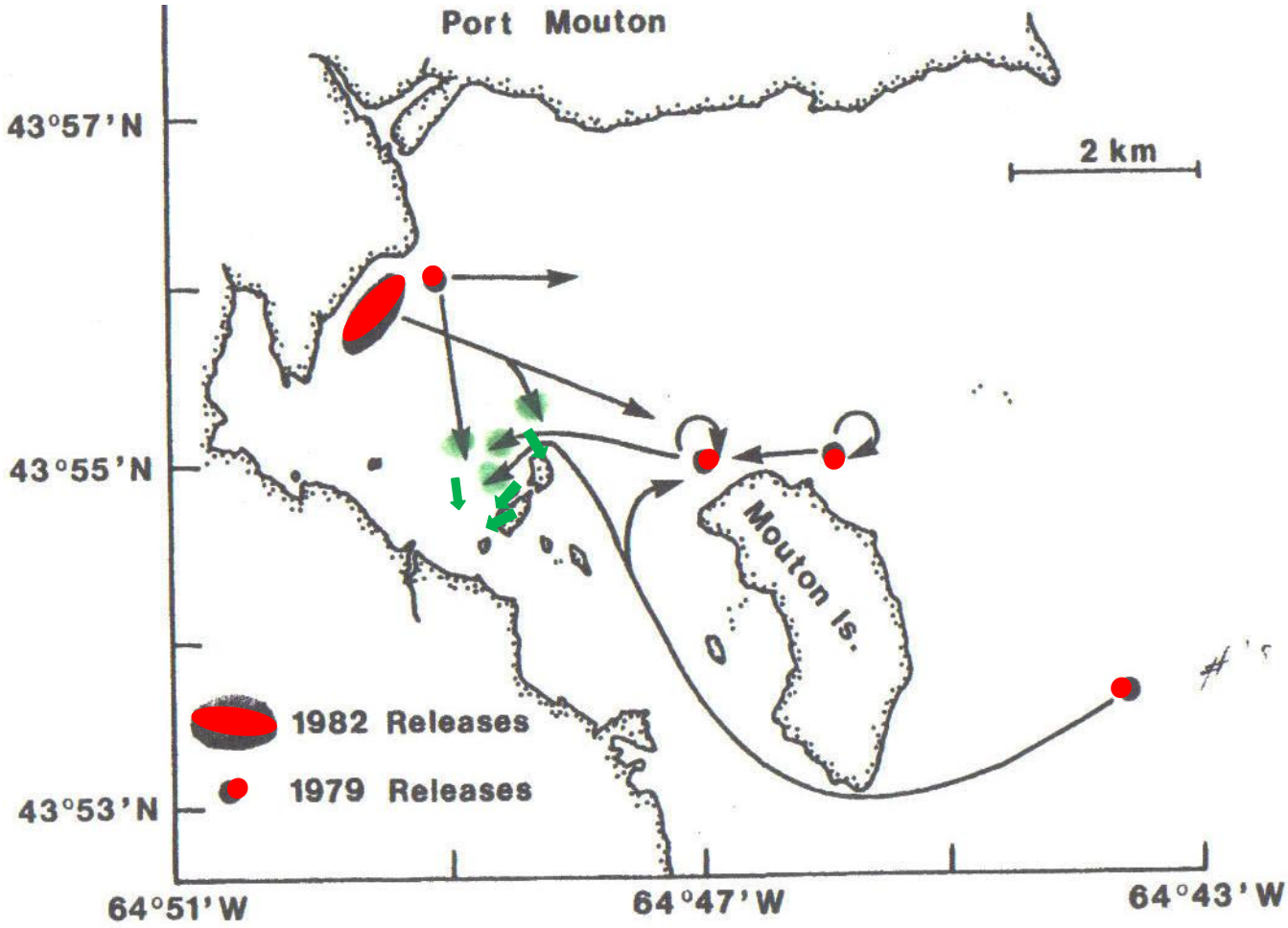

Figure 1. Movement of tagged/released/recovered lobsters in 1979 and 1982. Lobsters were released at red locations and recovered near Spectacle Island (green locations) and Port Mouton Island (Miller *et al*, 1989).

Trap Survey Methods

A lobster trap survey was initiated by Port Mouton Bay fishermen during the last two weeks of the lobster season in May of 2007 and repeated in the following years of 2008, 2009, 2010, 2011, 2012 and 2013. It is expected to continue. This survey involves recording in which of the five Bay regions each trap haul took place, and the lobster yields of that trap haul – whether markets or seed-bearing females. Trap locations and lobster yields in five contiguous areas in the bay (Figure 2) provide the average catch-per unit-effort (pounds of market lobster per trap-haul) and average numbers of seed lobsters (numbers per 1000 trap hauls) for each region. The 2008 survey reported numbers of seed lobster only. Records of market lobsters were reinstated after 2008.

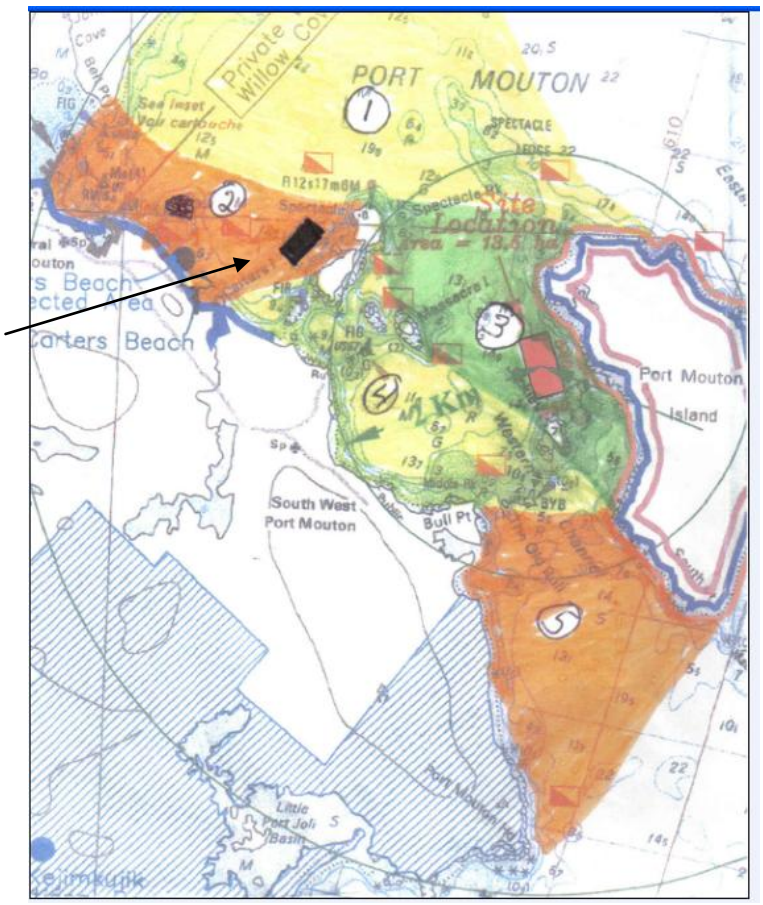

Figure 2. Map showing regions of Port Mouton Bay assigned to lobster catch regions. The Spectacle Island fish farm is the black rectangle in Region 2.

Regions were chosen on the basis of fishermen's traditional fishing territories with which individual fishermen were most familiar. The number of boats participating in the survey and the total number of trap hauls in each year are shown in Table 1. Fishermen report their data to scientist members of FPMB for analysis on an individual and confidential basis. Poor weather conditions were a contributing factor to the lower number of trap hauls in 2011 and 2013. The average number of days lost to weather conditions per fishing boat during the two-week survey period was slightly less in 2013 (2.4 days) than in 2011 (2.6 days).

Table 1. Number of boats and number of trap hauls for the 14-day period in late May in each year of survey

Year	# Boats	# Hauls
2007	7	5779
2008	12	5,238
2009	15	10,230
2010	14	13,045
2011	12	11,597
2012	13	11,717
2013	11	8,558

Results

Bottom temperature data in Port Mouton Bay from a temperature recorder provided by the Fishermen and Scientist Research Society (FSRS) placed in a trap in Region 4 showed higher temperatures for the May 17-31 survey period in 2010 than in 2008 or 2009 and more variable temperatures in 2012. The temperature recorder failed in 2011 but unofficial reports indicate lower temperature records for May in that year. 2013 temperatures were comparable to 2010 until temperatures dropped in days 11 to 14 of the survey.

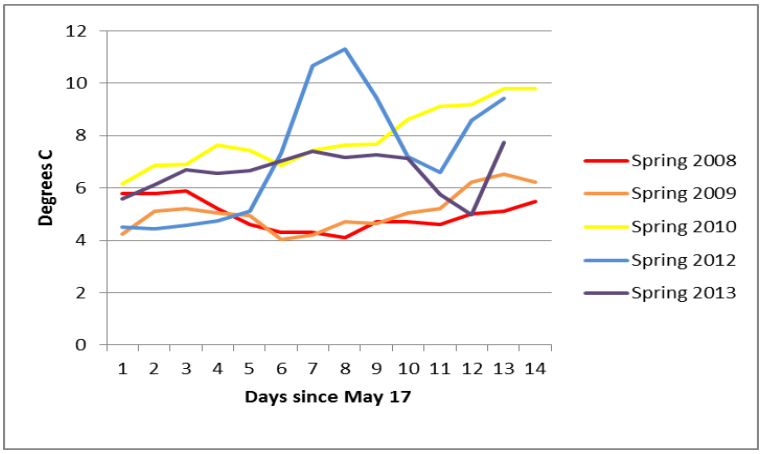

Figure 3. Bottom temperature in Port Mouton Bay in survey period (last two weeks of May); 2008 and 2009 before fish farm fallow, 2010 and 2012 during fallow, 2013 one-year after re-stocking of fish farm.

Region 2 includes the fin-fish aquaculture site west of Spectacle Island which was fallowed from late July 2009 (cessation of fish feeding July 20, 2009) to June, 2012, at which time it was restocked. Historically, in the period before the fish farm existed, Region 2 had been a prime lobster fishing ground.

The 2007-2009 period of open net pen aquaculture before fallowing and the 2013 period after restocking of the fish farm shows low catches of seed lobsters per unit effort (CPUE) in all regions (figure 4). In the fallow period (2010-2012), seed-bearing lobsters increased noticeably in all regions except Region 2, regardless of bottom temperatures and weather conditions (Figure 5). In 2010 when temperatures were consistently more favorable, numbers of seed lobsters increased strongly everywhere except in Region 2. Figure 6 shows the entire 2007 – 2013 series of seed lobster catches/releases per unit effort over the Port Mouton Bay regions for comparison of stocked (2007, 2008, 2009, 2013) and fallowed years, (2010, 2011, 2012).

The pattern of catch-per-unit (CPUE)-effort for market lobsters throughout the period 2007 to 2013 indicated generally lower CPUE in Region 2 than in other regions of the Bay. Region 2 Lobsters were caught in peripheral areas of that region and not near the fish farm. In 2013, after re-stocking, market lobster numbers were again depressed in Region 2 as well as in adjacent Regions 1 and 4 (Figures 7, 8 and 9).

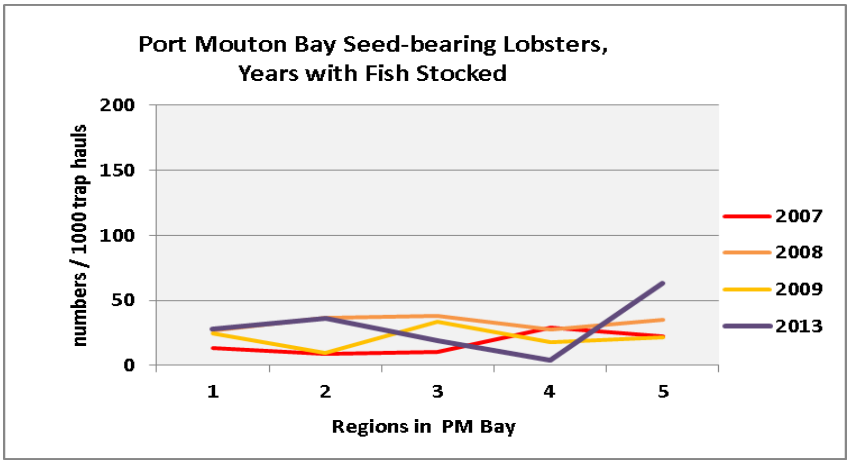

Figure 4 . Catch rates of seed lobsters in years when aquaculture was practised, including 2013 one year after aquaculture was resumed.

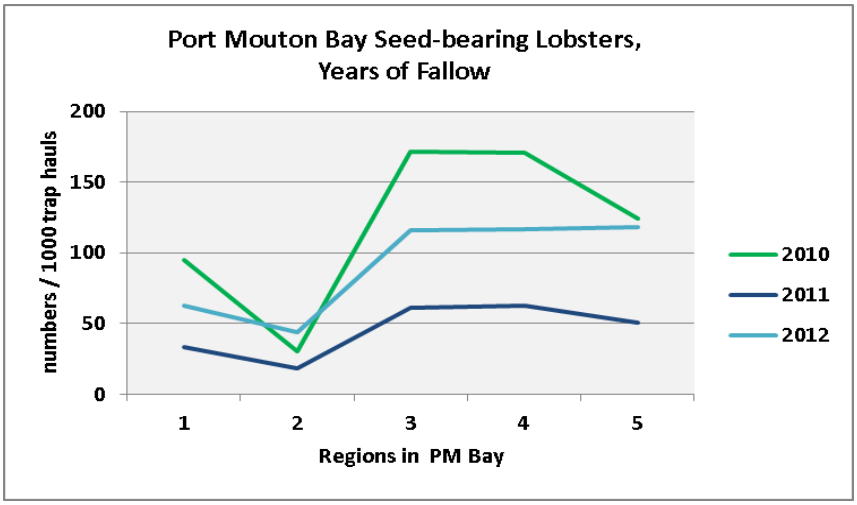

Figure 5. Catch rates of seed lobsters showed a tendency toward recovery in years of fallow, except in Region 2 which contains the fish farm.

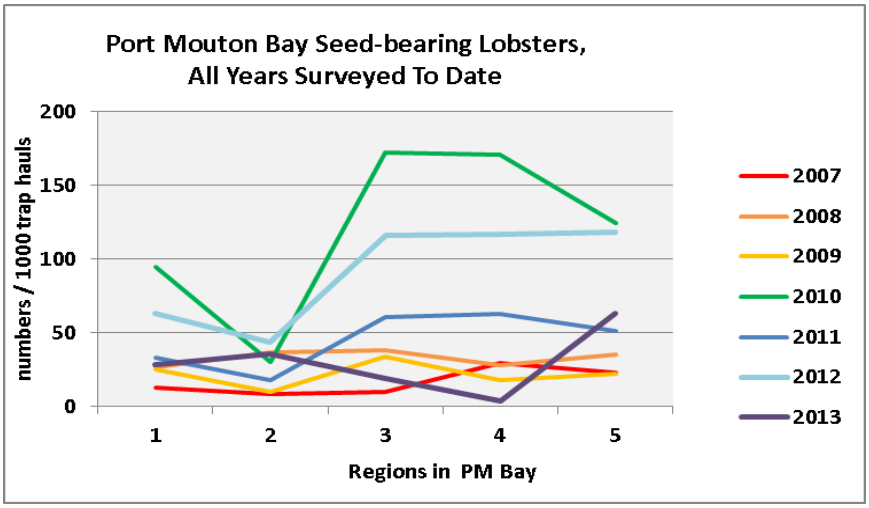

Figure 6. Number of seed lobsters per 1000 trap hauls annually in the last two weeks of May for seven years in the five regions of Port Mouton Bay.

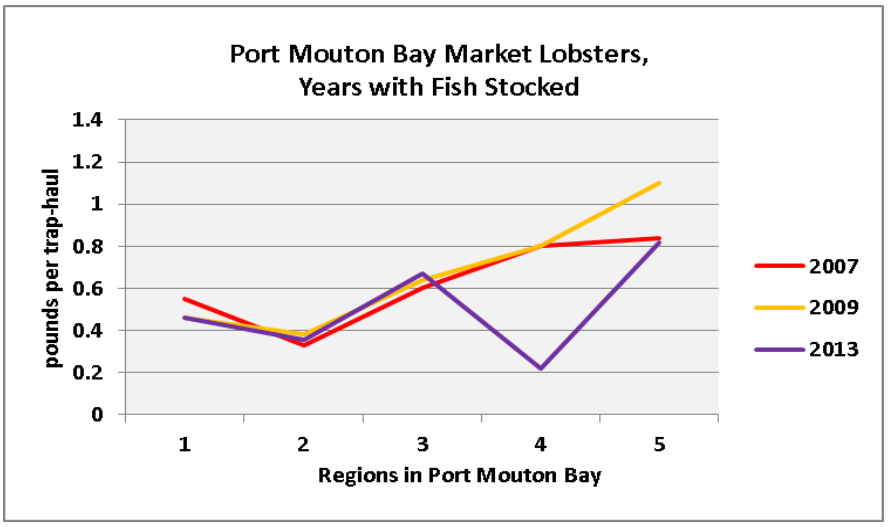

Figure 7. Catch rates (CPUE's), market lobsters, with the farm operating.

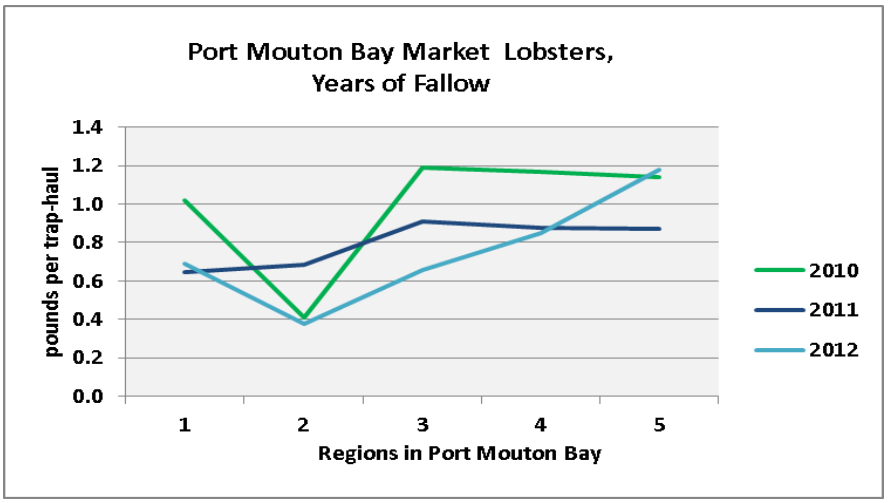

Figure 8. Catch rates (CPUE's), market lobsters, with the farm in fallow

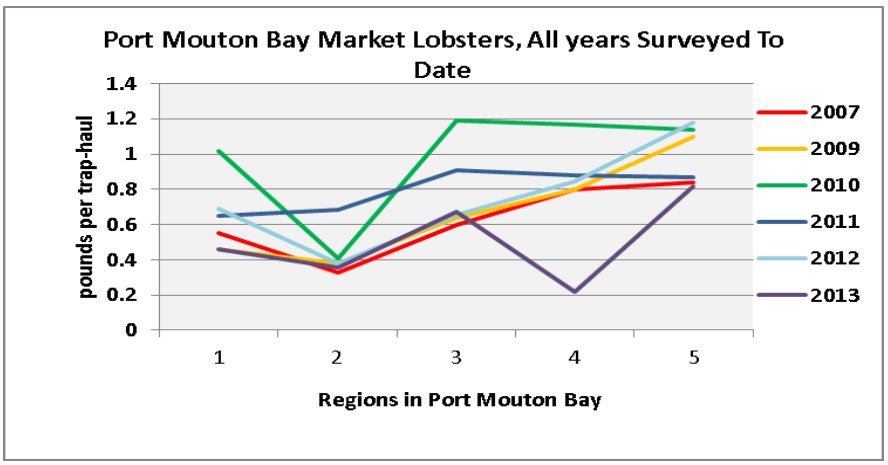

Figure 9. Catch rates (CPUE's) annually in the last two weeks of May for six years in the five regions of Port Mouton Bay.

Discussion

Catch per Unit Effort (catch rate)

Catch-per-unit-effort (CPUE) evidence is appropriate in this case where the target species (lobster) and the fleet efficiency have not changed throughout the survey period.

Because fishers move to maximize their catch, CPUE data are expected to show bias to averages larger than randomly sampled averages (Walters, 2003). The bias produces conservative results for low CPUE episodes. CPUE's, fisher evidence, can be useful in monitoring changes in fisheries (Maunder et al, 2006). In Port Mouton Bay, available information was increased by two ecosystem transitions as tracked by CPUE's – at the beginning and at the end of a fallow period of three years followed by restocking the aquaculture site. The scale of displacement of lobsters is indicated by this CPUE evidence

Potential displacement factors

Factors potentially contributing to absence of lobsters near the active fish farm and beyond are:

- Absence of prey (e.g. rock crab)
- Foul smell (lobsters have keen sense of smell)
- Nephaloid layer of easily disturbed fine waste sediment (which irritates gills of lobster)
- Nuisance algae due to nutrient overload (lobsters don't enter traps fouled with 'slime' algae)
- Barren sea floor (absence of refuge in eelgrass or kelp)

Fishermen reported catching lobsters at distance from the fish farm site around the periphery of Region 2, but traps set closer to the fish farm site in 2010 and 2011 were soon removed due to negligible catches, black foul-smelling mud on traps and fouling of traps with nuisance algae (R. Broome, A. Bush, R. Lawson, M. Roy, D. Roy, pers. comm.). In 2013, lobster traps were reported covered with nuisance 'slime' algae in Region 4 near Massacre Island approximately 1 km from the fish farm (R. Broome, R. Lawson, pers.comm.) (Figure 10).

The introduction of open-net-pen finfish aquaculture introduced a large nutrient supply rate into what is naturally a low-nutrient ecosystem (Worm and Lotze, 2006) with concomitant shift from perennial algae – kelp and Irish Moss - to annual, nuisance, filamentous algae.

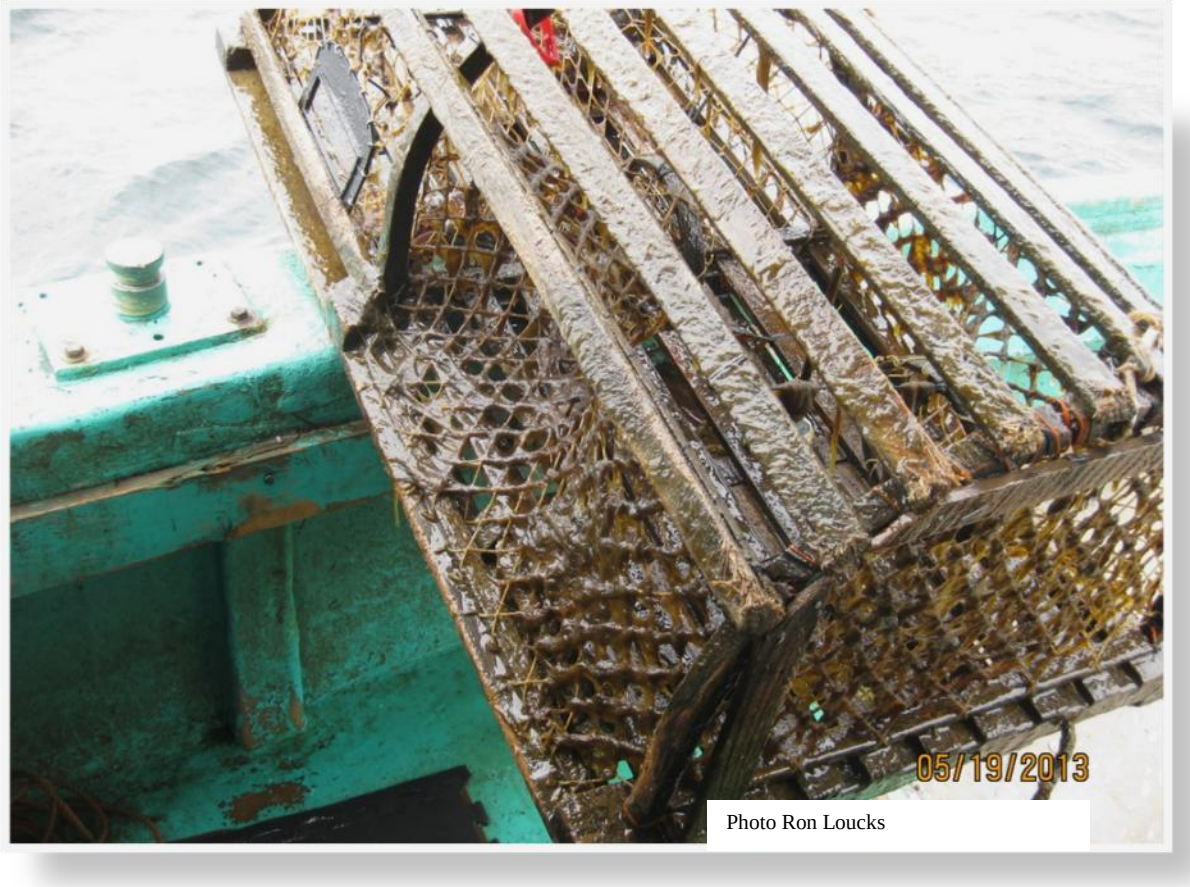

Figure 10. Lobster trap covered with 'slime' – filamentous, nuisance algae after trap was set over 24 hours in Region 4, approximately 1 km from the fish farm.

Rate of recovery in three years of fallow

Fishermen reported in 2010, the first year of fallow, that the extent of degraded lobster habitat – the 'dead zone', appeared to be shrinking as evidenced by the fact that for the first year in many years lobster fishing took place within the larger Port Mouton Bay area for the entire season. In 2011-12, also fallowed, fishermen reported that conditions continued to improve around the boundaries of the degraded zone although no regions within the bay had returned to their original productive state.

The higher numbers of seed lobsters in 2010 and 2012, in regions except Region 2, support the local ecological knowledge of fishermen that Port Mouton Bay is a lobster spawning, and moulting area to which seed lobsters migrate to discharge eggs and moult.

This Port Mouton Bay survey pattern is corroborated by observations of lobster fisherman in South West New Brunswick that within two years of a fin fish aquaculture operation being established, berried female lobsters abandoned the area, that all lobster numbers generally decrease after two years of aquaculture operation, and that female lobsters returned when aquaculture was discontinued in an area, (Wiber et al. 2011, 2012).

Comparison with the pattern of LFA 33

DFO Lobster Fishing Area 33 (LFA 33) is a large area (~ 1600 km^2) for which lobster landings statistics are published. LFA 33 landings for 2007 – 2010 were taken from Tremblay *et al (*2011), and for 2011 – 2013, were derived from landed value and average price per pound in DFO Maritimes Region Economic Update (2013). The LFA 33 landings in recent years have shown a strong upward trend. The suggestion is often made that increased landings in in LFA 33 in recent years prove that aquaculture has had no adverse effects on lobster CPUE's. The upward trend of aggregated LFA 33 landings can be assumed to integrate large scale influences. For comparison the Port Mouton Bay CPUE results are converted from spatial series (Figures 4 to 9) to time series (Figures 11 and 12). The Port Mouton Bay (56 km^2) survey CPUE results are from a much smaller area and show a different pattern locally. The two patterns are compared in Figures 11 (seed lobsters) and 12 (market lobsters).

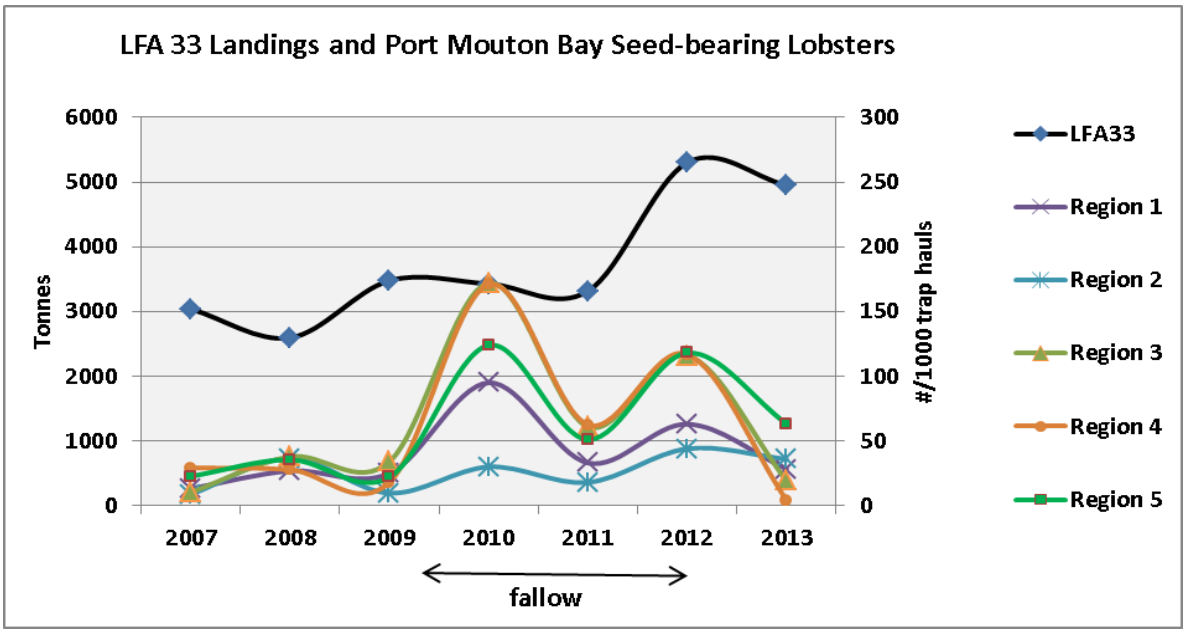

Figure 11

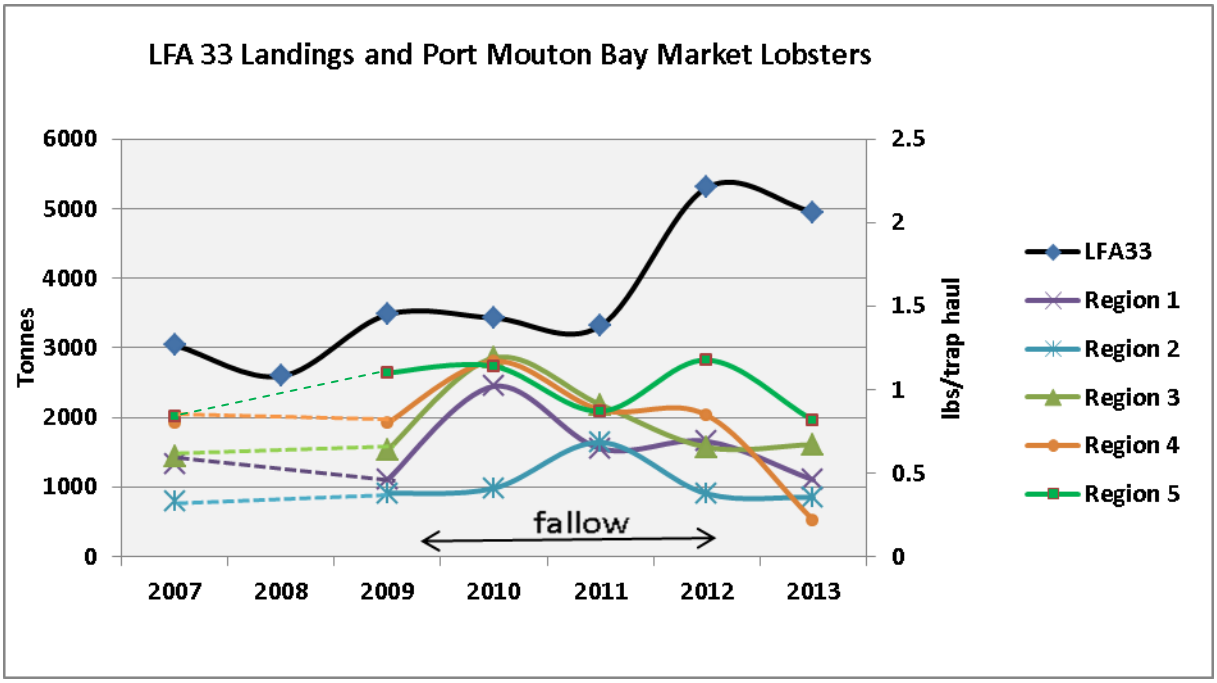

Figure 12

Figures 11 and 12. Time series of LFA33 Lobster Landings in comparison with time series of Port Mouton Bay Seed and Market Lobster CPUE's, 2007 - 2013.

LFA 33 landings are generally trending upward with time; Port Mouton Bay's Region 2, which contains the fish farm, has low catch rates in all years for both market and seed-bearing lobsters.

Catch rates in regions other than Region 2 increase in 2010 – the first of three years of fallow - while LFA33 landings are approximately level. The improvement in Port Mouton Bay generally continues through 2012 except for a decrease in 2011 associated with poor weather conditions. Catch rates in 2013, when the fish farm resumed feeding operations, drop significantly while LFA33 landings continue at a high level.

The Port Mouton Bay pattern of results does not match the upward trend shown for LFA 33. The evidence in Figures 11 and 12 indicates that Port Mouton Bay catch rates respond more strongly to fish farm feeding/fallow regime shifts than to LFA33 aggregated landings. Impact of aquaculture is indicated throughout the Bay at considerable distance beyond Region 2.

Conclusions

During the three-year fish farm fallow (2010-2012), lobster catches generally increased in all areas of the bay except in the proximity of the fish farm, regardless of year-to-year variation in bottom water temperatures and weather conditions. This pattern is most obvious with seed-bearing female lobsters. This partial recovery reversed in 2013 after the fish farm was re-stocked with rainbow trout in June, 2012.

The Port Mouton Bay pattern of catch rates does not match the upward trend for LFA 33. Port Mouton Bay catch rates respond more strongly to fish farm feeding/fallow regime shifts than to LFA33 aggregated landings. Impacts of aquaculture in the bay are indicated at considerable distance beyond the fish farm location.

Other Ecosystem-based Indicators

Kelp

In spring 2010, fishermen reported flourishing beds of kelp which were previously smothered with sediment in Region. 4. In 2013 these kelp beds disappeared, replaced by nuisance algae. Kelp forms important refuge habitat for lobster**.** (R. Broome, B. Fisher, pers. comm.)

Irish Moss Harvest

Irish moss harvesters reported flourishing beds of Irish moss during the first week of July 2010 in areas some 400 to 500 m distant from the fish farm site (near Spectacle Light and in Region 4). This had not been the case in many years. The Irish moss contained juvenile lobster, scallop and crabs – indicating a nursery habitat (T. Leslie, E. Fisher, pers. comm.). In 2013, moss harvesters reported that beds of Irish moss were covered with nuisance 'slime' algae near Spectacle Island and the overall harvest of Irish moss within Port Mouton Bay was greatly diminished from previous years.

Eelgrass

After many years, eelgrass was visible in Spectacle Harbour approximately 400 m from the farm site in the summer of 2010 after one year of fallow. In June of 2011, eelgrass at the same location was approximately one-third as high as healthy beds of eelgrass at Jackie's Island - near Port Mouton Island (C. Fisher, pers. comm.). Eelgrass beds were measured in Port Mouton Bay by divers in August 2011 and 2012 and October 2013. http://www.friendsofportmoutonbay.ca/news.html

Since eelgrass is associated with life stages of 50% of marine species, it has recently been recognized as an Ecologically Significant Species (DFO, 2009), and is referred to as the 'coastal canary'.

Mackerel
Historically, mackerel have been abundant in Port Mouton Bay and are fished for food and bait. Mackerel avoided the bay during years of aquaculture but reappeared in 2010, are appearing more abundant in 2011 and 2012 and are now appearing in the inner bay in 2011-13, but not in the proximity of the fish farm (B. Fisher, pers. comm.).

Scallops
The recreational scallop fishery in inner Port Mouton Bay disappeared during the active period of the salmon farm and showed some recovery in summer 2011.

Crab
Rock crab are traditionally fished for lobster bait. A few rock crabs caught near the fish farm site in 2010 were discolored dark brown. No rock crabs were reported caught there during the lobster season of spring 2011, but were first sighted in Spectacle Harbour (400 m from fish farm site) in July 2011 and were caught near Summerville beach in 2011 for the first time in many years (R. Swim, pers. comm.).

Nuisance Algae
Nuisance ('slime') algae which spread within the entire bay during operation of the fish farm persisted in 2011 and 2012 near the farm site at the south-western end of Spectacle Island (R. Broome, B. Fisher, pers. comm) and re-appeared in 2013 at distance from the fish farm.

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