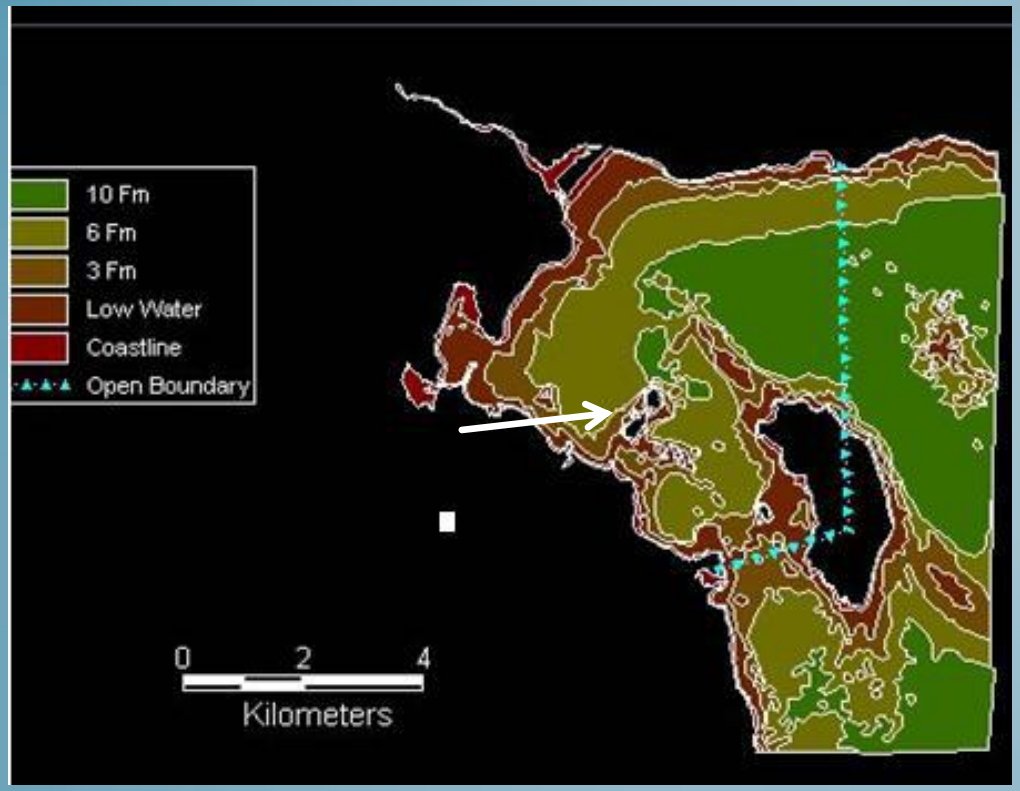
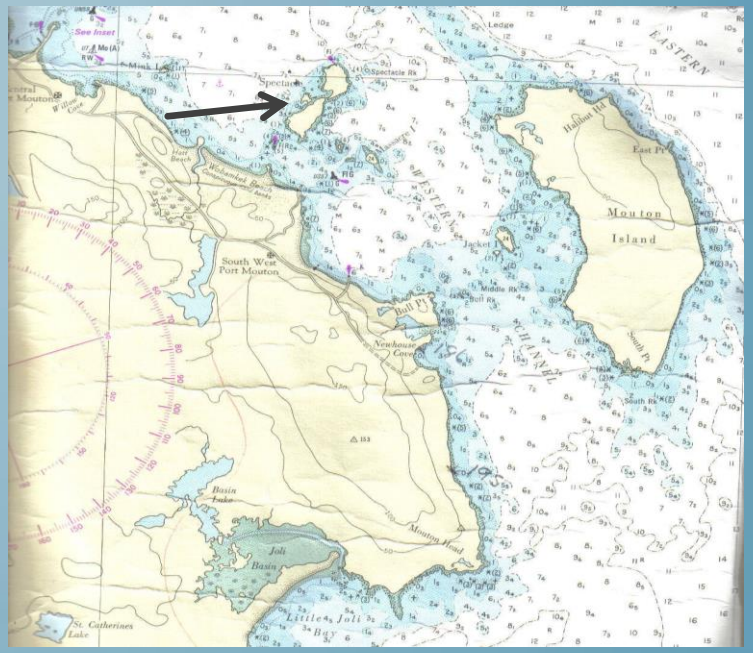
In 2006 Friends of Port Mouton Bay (FPMB) joined together out of concern for the future of the Bay. During the previous 10 years fishermen and others living around the Bay became increasingly concerned about the negative effects of the existing fish farm.

FPMB documented the Local Ecological Knowledge (LEK) of Port Mouton Bay fishermen. Conventional science was used to investigate/validate local knowledge with the full participation of local knowledge holders to form a knowledge partnership.

This presentation focuses on the low-flushing capacity of the Bay and the impacts of the existing fish farm beyond the lease site.

FLUSHING CAPACITY IN PORT MOUTON BAY





DFO, Gregory et al, 1993

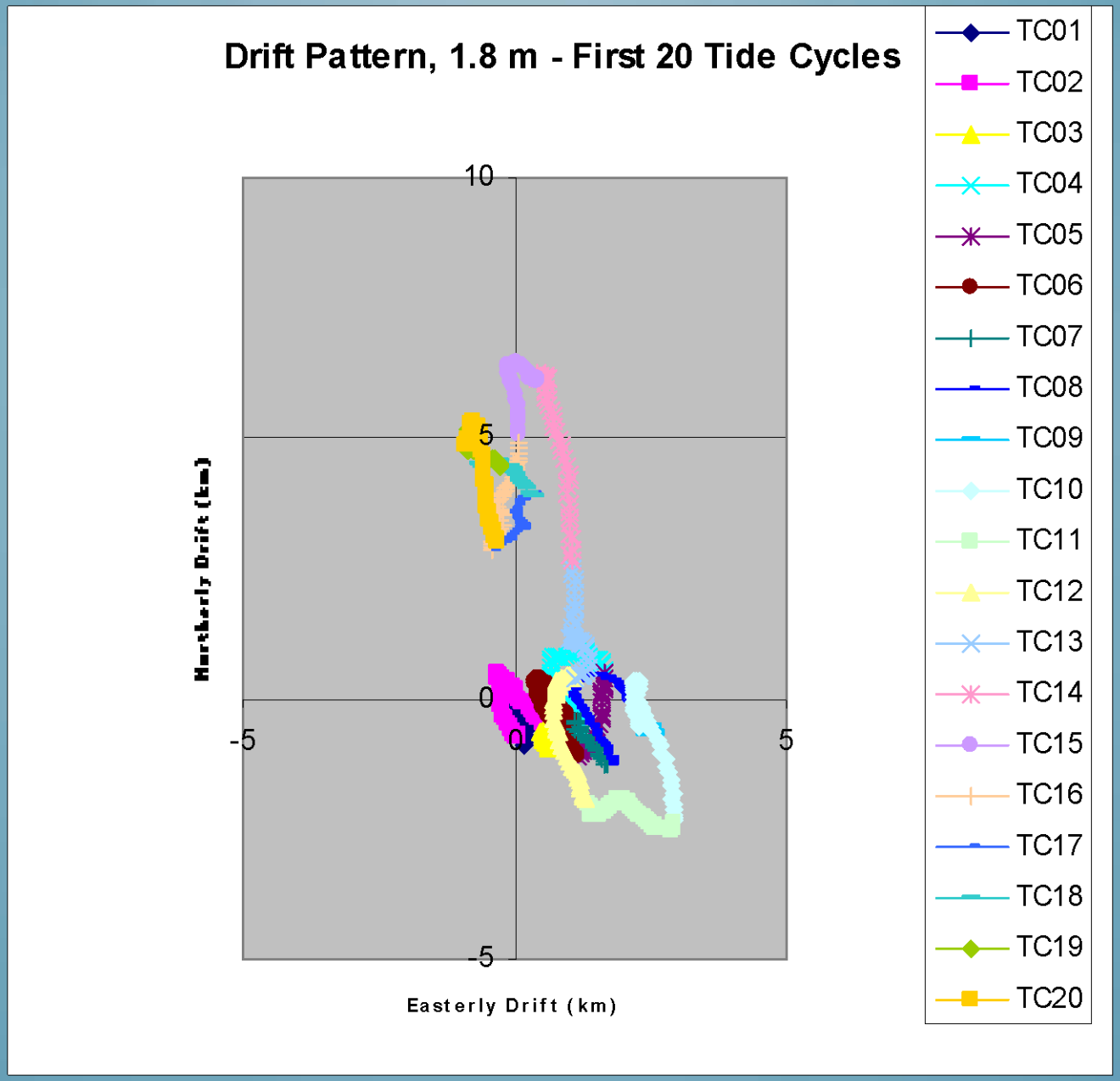
Detailed Bathymetric Map (left) showing shallow depths and enclosed basin (outer harbour) and semi-enclosed basin (inner harbour), the location of fish farm.

TIDAL CURRENT SPEEDS AND CONSERVATIVE FLUSHING TIME*

	Tidal Currents mean / peak (cm/s)	Predicted Flushing Time (hours)
Halifax	3 / 5	155
Port Mouton Bay	2 / 3	112
Jordan Bay	4 / 6	70
Lobster Bay	14 / 22	23
Yarmouth Hbr	10 / 16	16
L'Etang Hbr	22 / 34	15

*DFO, Gregory et al, 1993

Current meter output showing successive recirculation (TC 1 to 12), wind episode (TC 13 to 14) and recirculation (TC 15 to 20) at fish farm, Dec 2006



Current meter:

4.2 cm/s mean speed, winter, 1.6 - 4 m above bottom

3.1 cm/s mean speed, summer, 4 m above bottom

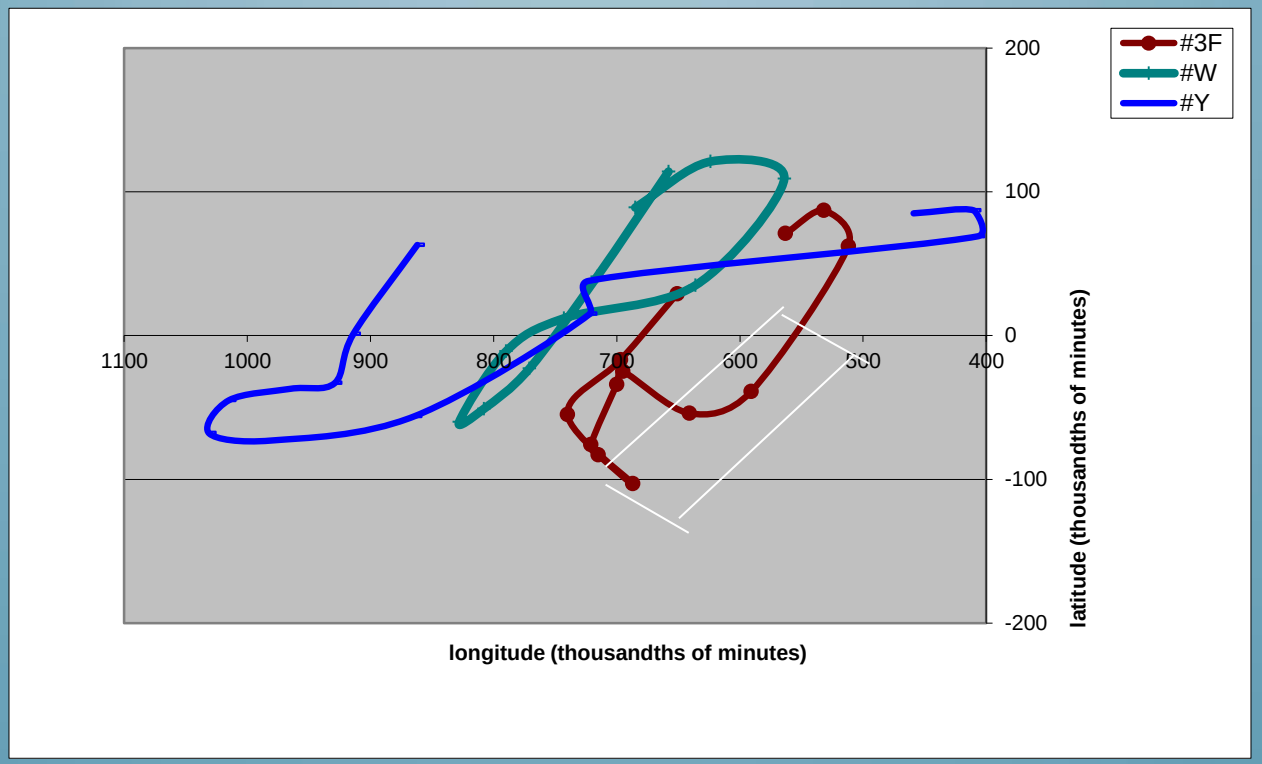
1 cm/s effective speed due to recirculation.

NSDFA Road Map for Aquaculture:

in contrast, optimal/minimal current speeds for salmon >50/10 cm/s

trout >38/-- cm/s

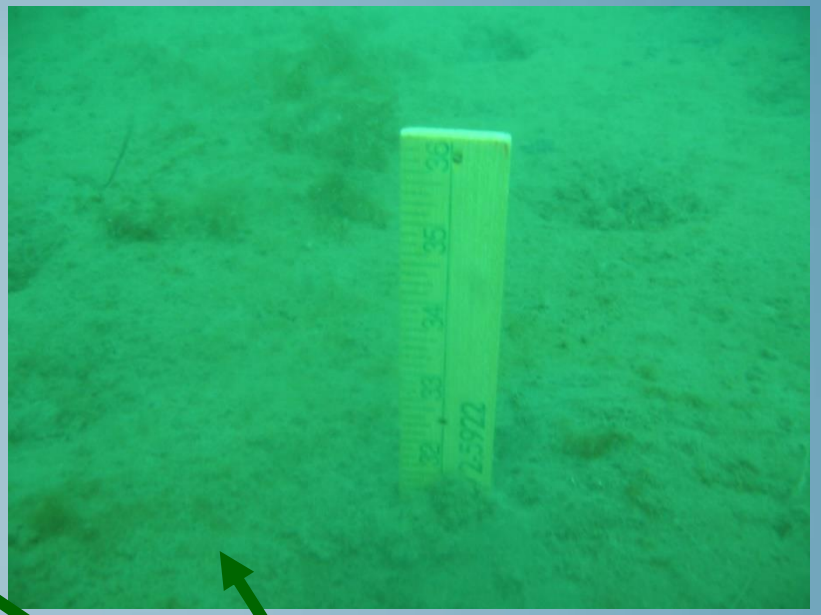
Drogue tracking by fishermen and oceanographer confirmed that currents re-circulate in Port Mouton Bay.

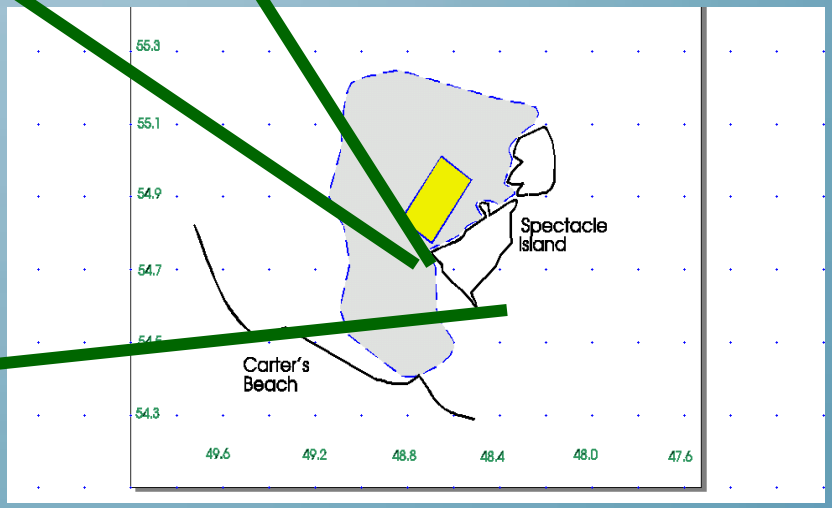


DFO Decision Support System (DSS) Applied to Port Mouton Bay

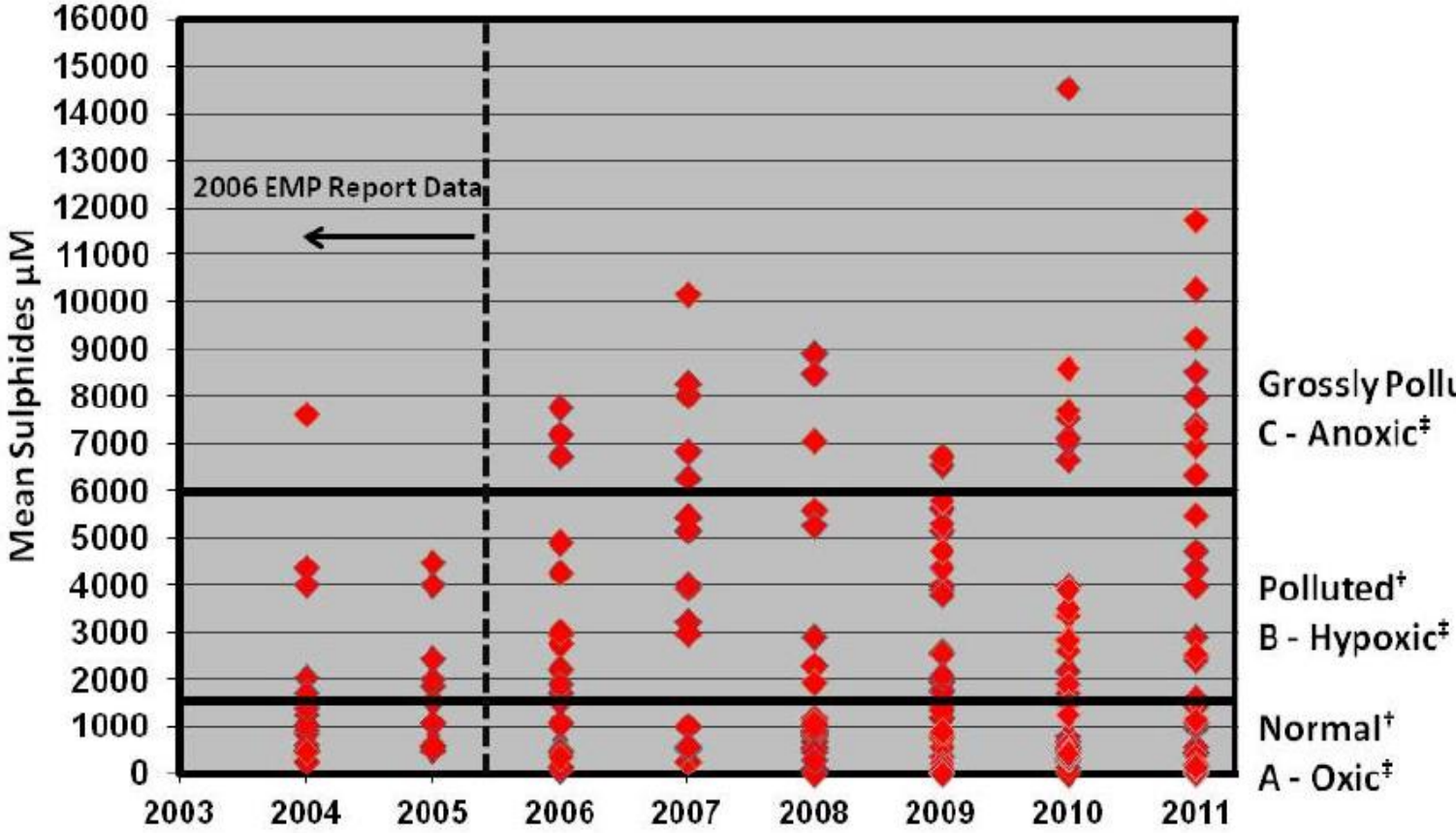
“Shallow depths and low current velocities at both the existing farm and the proposed new lease location combined with the presence of sills that create depositional basins to retain settled organic waste from net pens make both locations in Port Mouton Bay unsuitable for salmon aquaculture.” (Hargrave, 2009)

FIN FISH AQUACULTURE IN PORT MOUTON BAY – FAR FIELD IMPACTS





Settled organic waste (depth 30 to >90 cm) from divers survey. Kelp smothered (left). August 2007



Mean sulphides from results of NS DFA EMP monitoring (2003-2011) for 11 of 16 Nova Scotia open pen fin
leases. Reference sites not included. (Milewski, 2013)

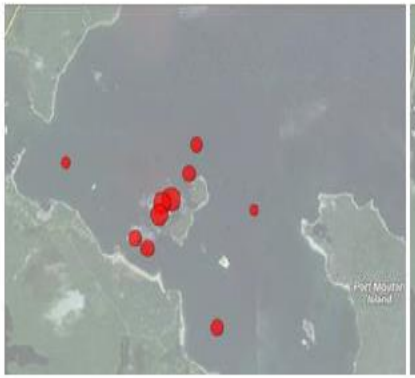
40% of grossly polluted and 39% of polluted sulphide levels occurred at Spectacle Island site, Port Mouton

Sediment Core Images, 2010 after 15 months of fallow.

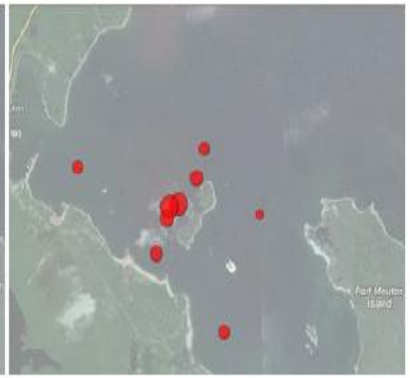
Healthy sediment – upper oxidized layer, 550 m from farm site

Grossly polluted sediment – *Beggiatoa* bacteria layer on surface. *Beggiatoa* can be found in habitats with high levels of H_2S. 100 m from farm site.

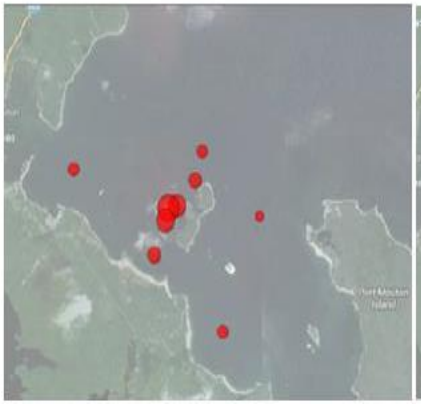
2009



2010



2011

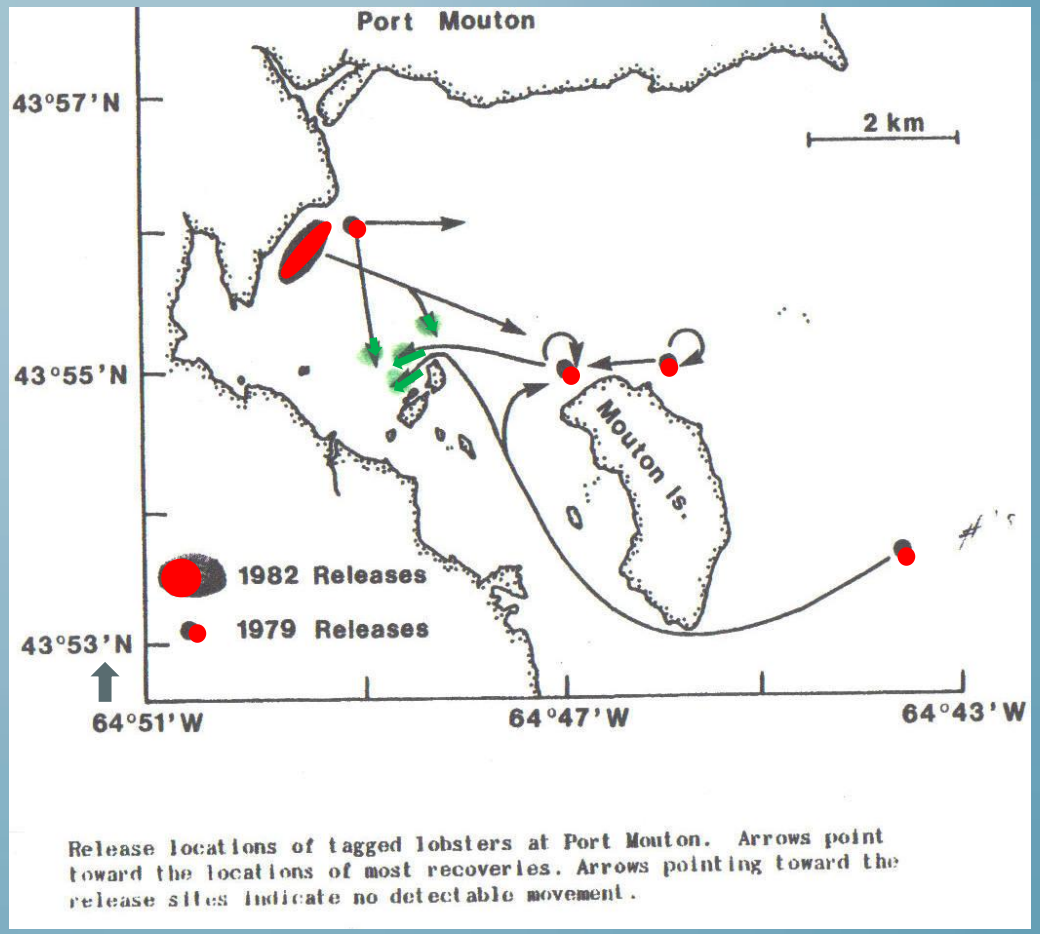


2013

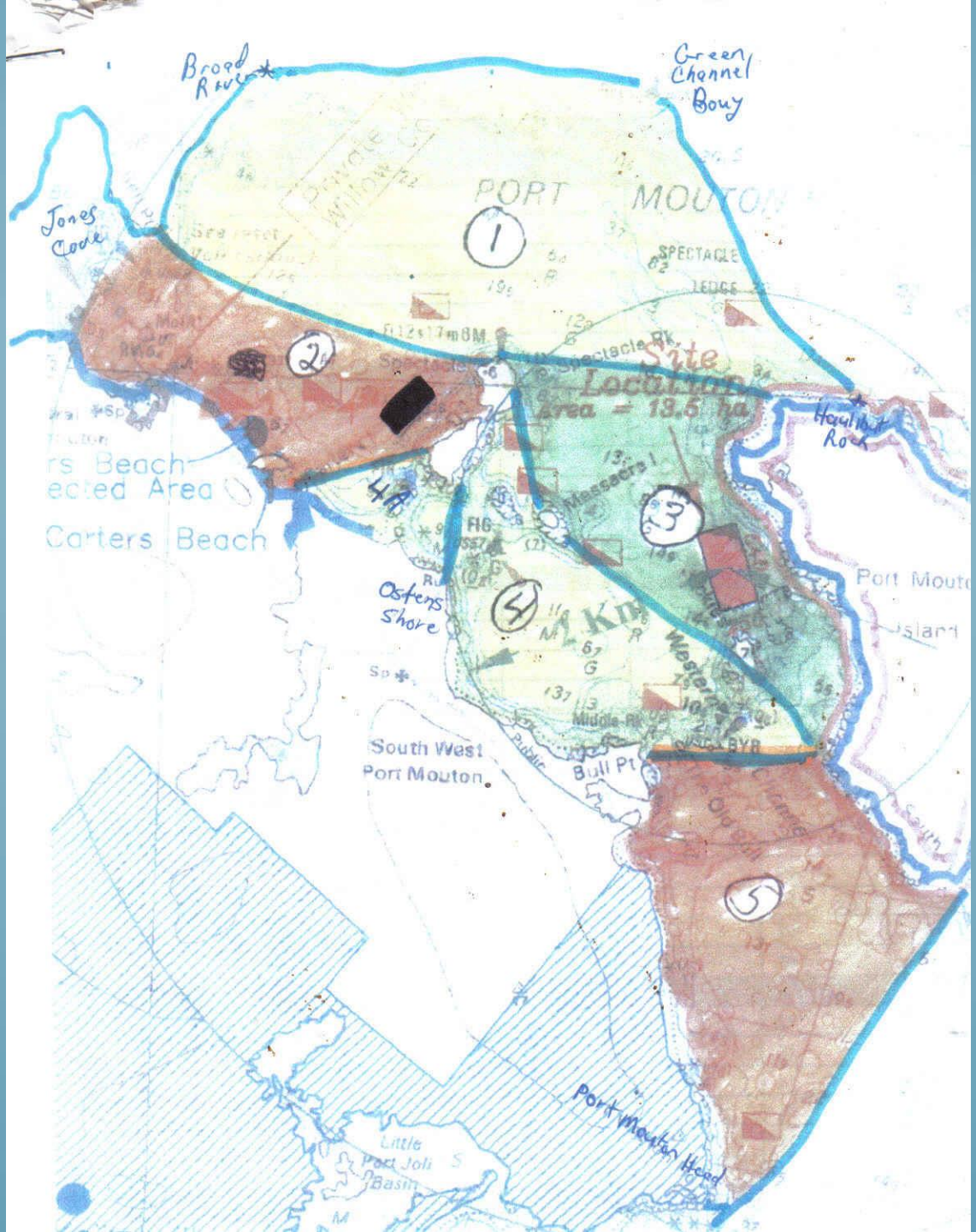
Figure 2. Chart showing concentrations for copper relatively unchanged, 2009-2013, in sediments from Table 1;

Sediment copper levels are above guidelines at farm lease site and are relatively unchanged over the period 2009-2013..

Lobster migration routes, before aquaculture (Miller *et al*, 1989)

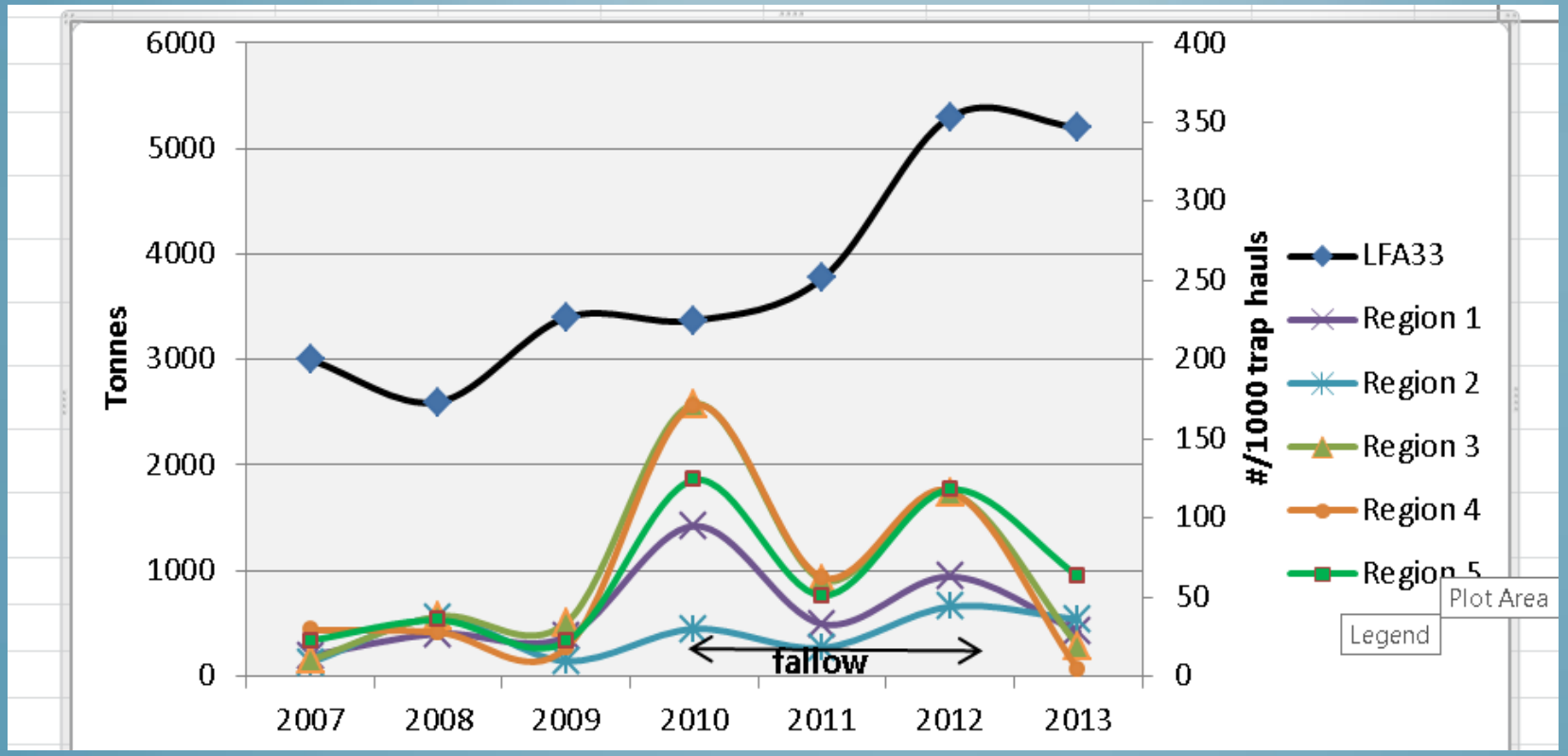


Release locations of tagged lobsters at Port Mouton. Arrows point toward the locations of most recoveries. Arrows pointing toward the release sites indicate no detectable movement.



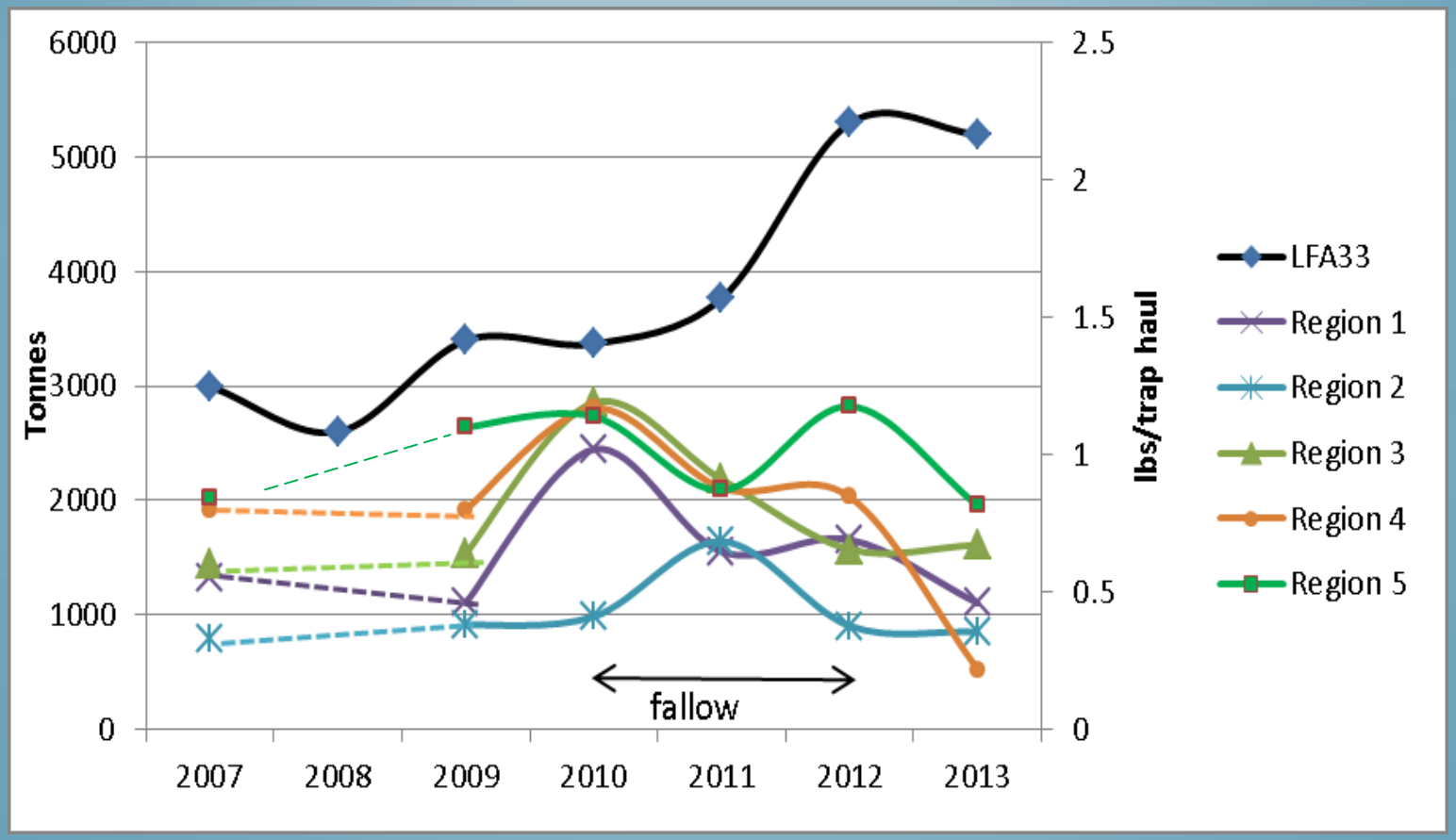
Regions of the Lobster Trap Survey, 2007-13
Region 2 contains farm site.

Seed lobster (#/1000 trap hauls) patterns compared to LFA 33 landings (tonnes), 2007-2013



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

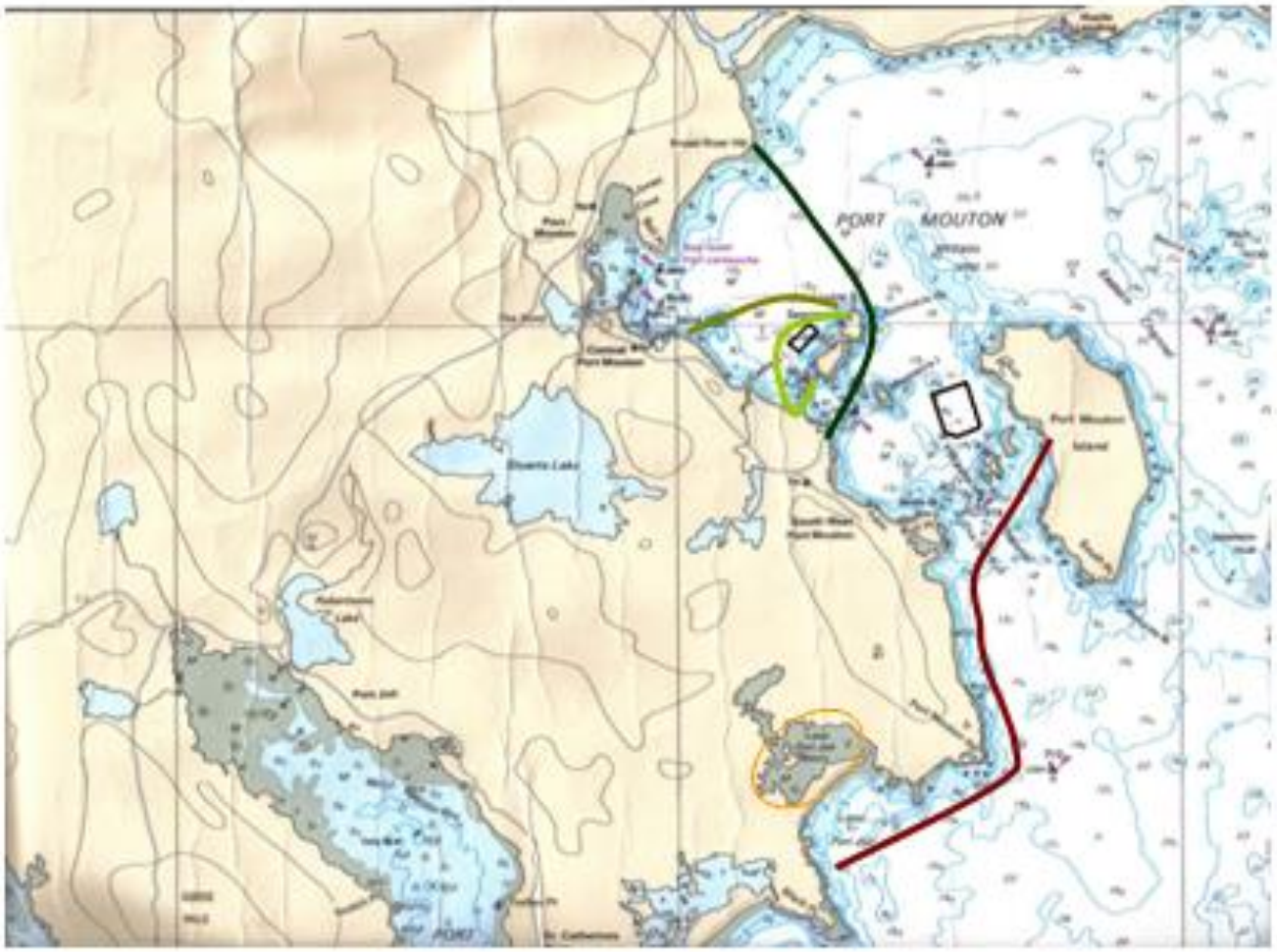
Market lobsters lbs/trap haul patterns compared to LFA 33 landings (tonnes), 2007 – 2013.



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

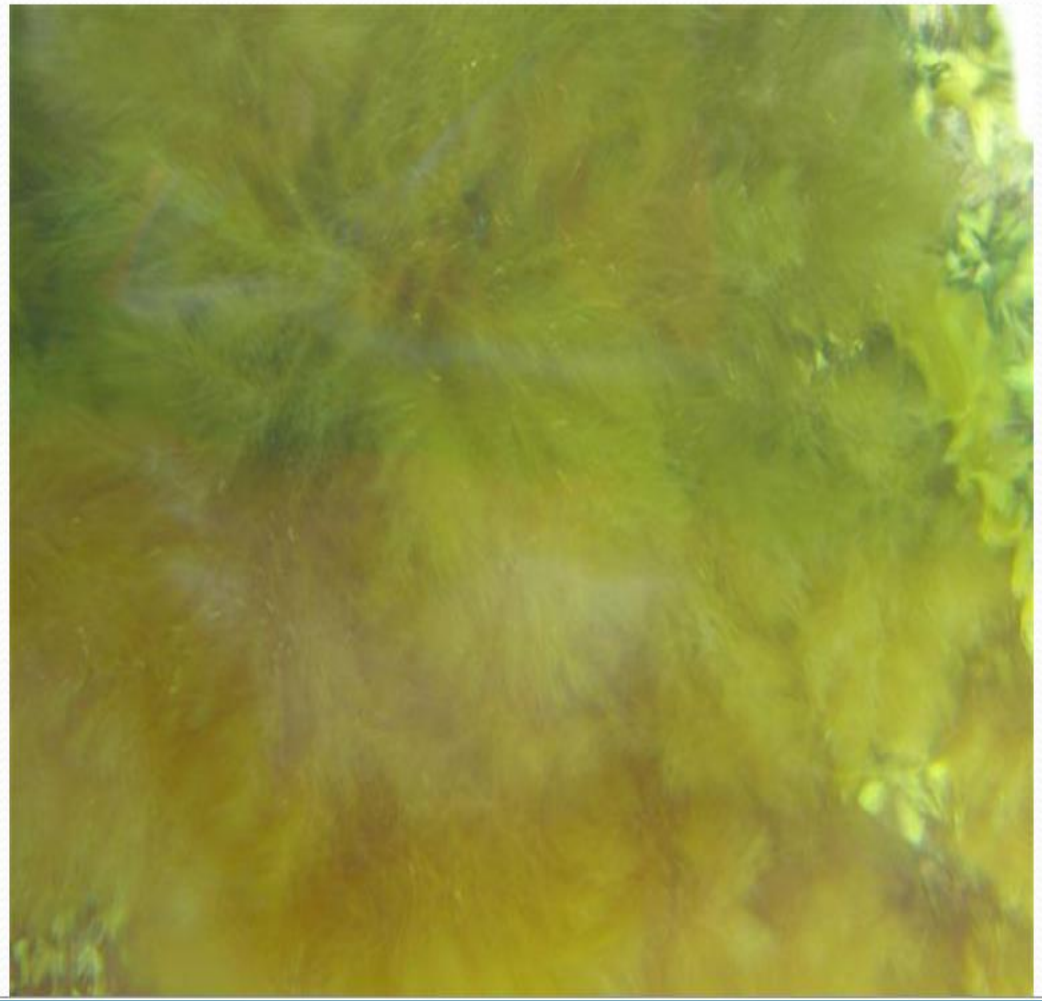
Photo Ron Loucks

Trap hauled approximately 1 km from farm site, showing coating of slime algae after 24 hours exposure, May 19th 2013.



Observations in Port Mouton Bay of progressive spread of abundant nuisance 'slime' algae, *Pilayella littoralis,* from farm site area outward, 2005-2008.

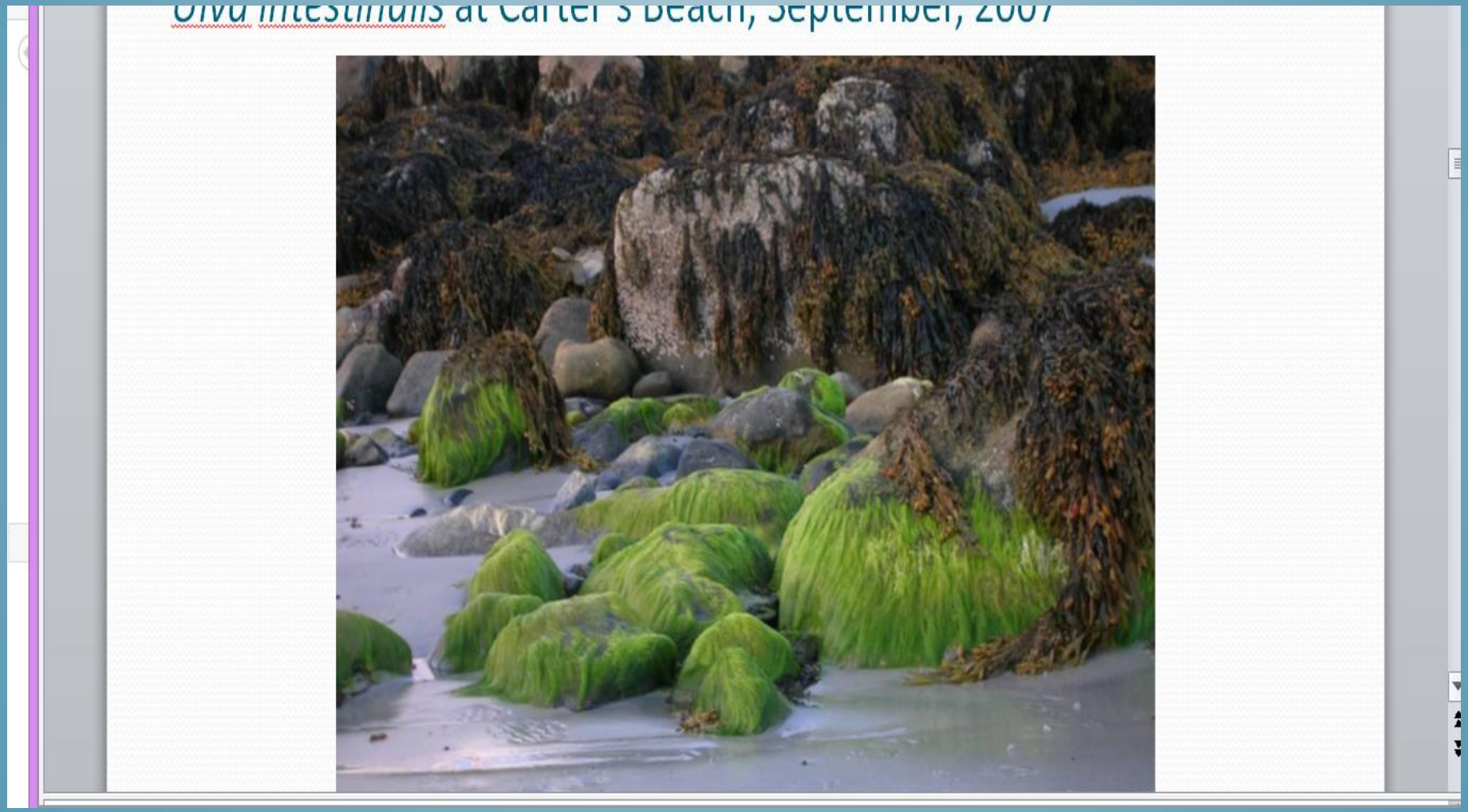
Except for farm site area, nuisance algae disappeared with cessation of feeding in 2009 and reappeared with restocking in 2012.



Pilayella littoralis, nuisance ‘slime’ algae near farm site, June 2008

Mat of slime algae at Carter's/Wobamkek Beach; open–net pens distant

Photo Ruth Smith



Nuisance algae *Ulva intestinalis* at Carter's Beach, September 2007

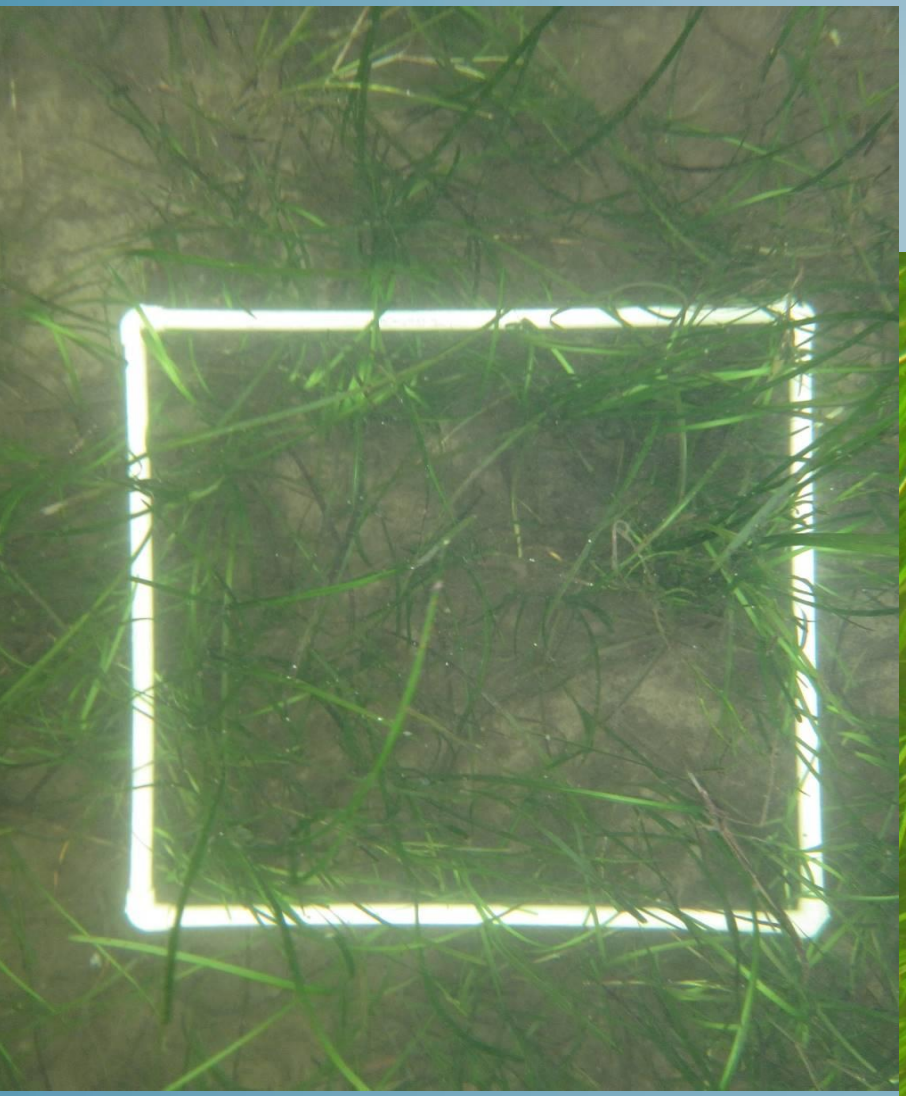
- 300 m from farm site after 26 months fallow

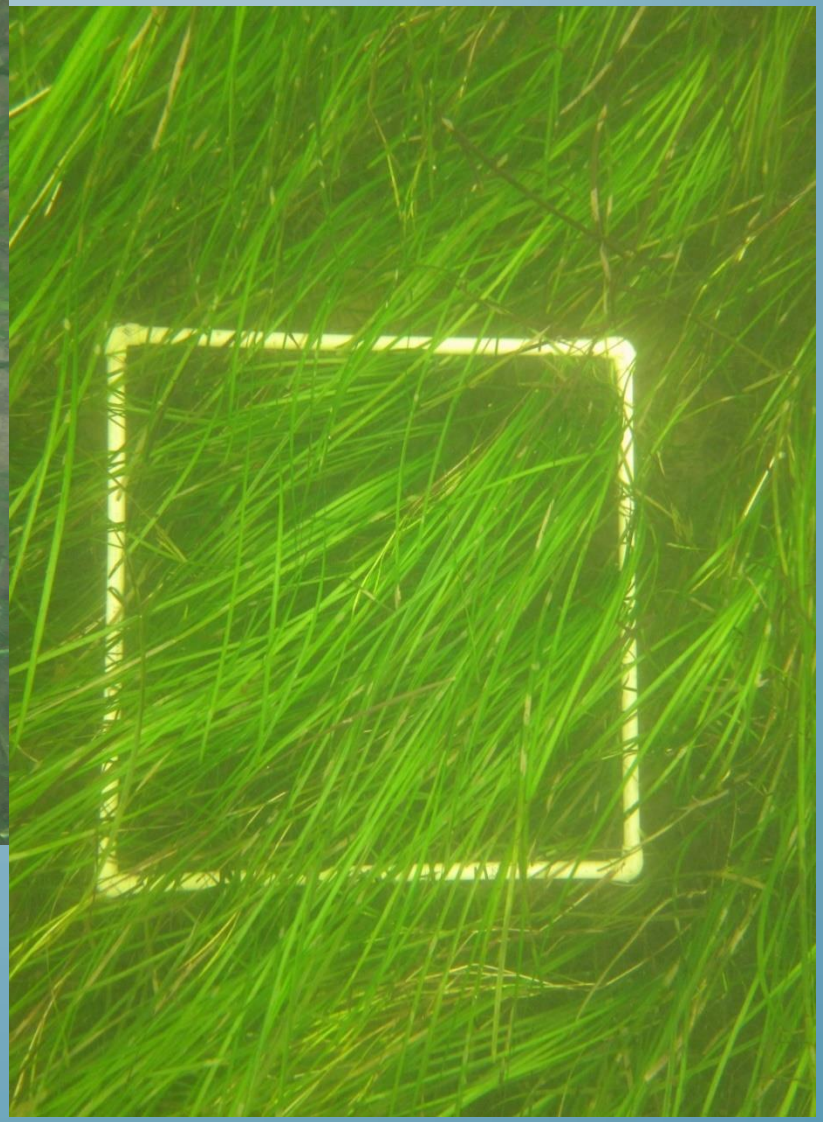
Eelgrass, August 2011

3 km from farm site

Eelgrass October 2013

3 km from lease site





300 m from lease site
15 months after restocking

Far-field impacts previously noted:

- **copper in the sediments,**
- **nuisance algae,**
- **eelgrass and kelp degradation,**
- **lobster habitat degradation.**

Far-field impacts at the sea surface follow.

Pink waste material floating near Spectacle Island, August 5, 2012.

Photo Robert Ross

Pink floating waste from farm site, October 6, 2012

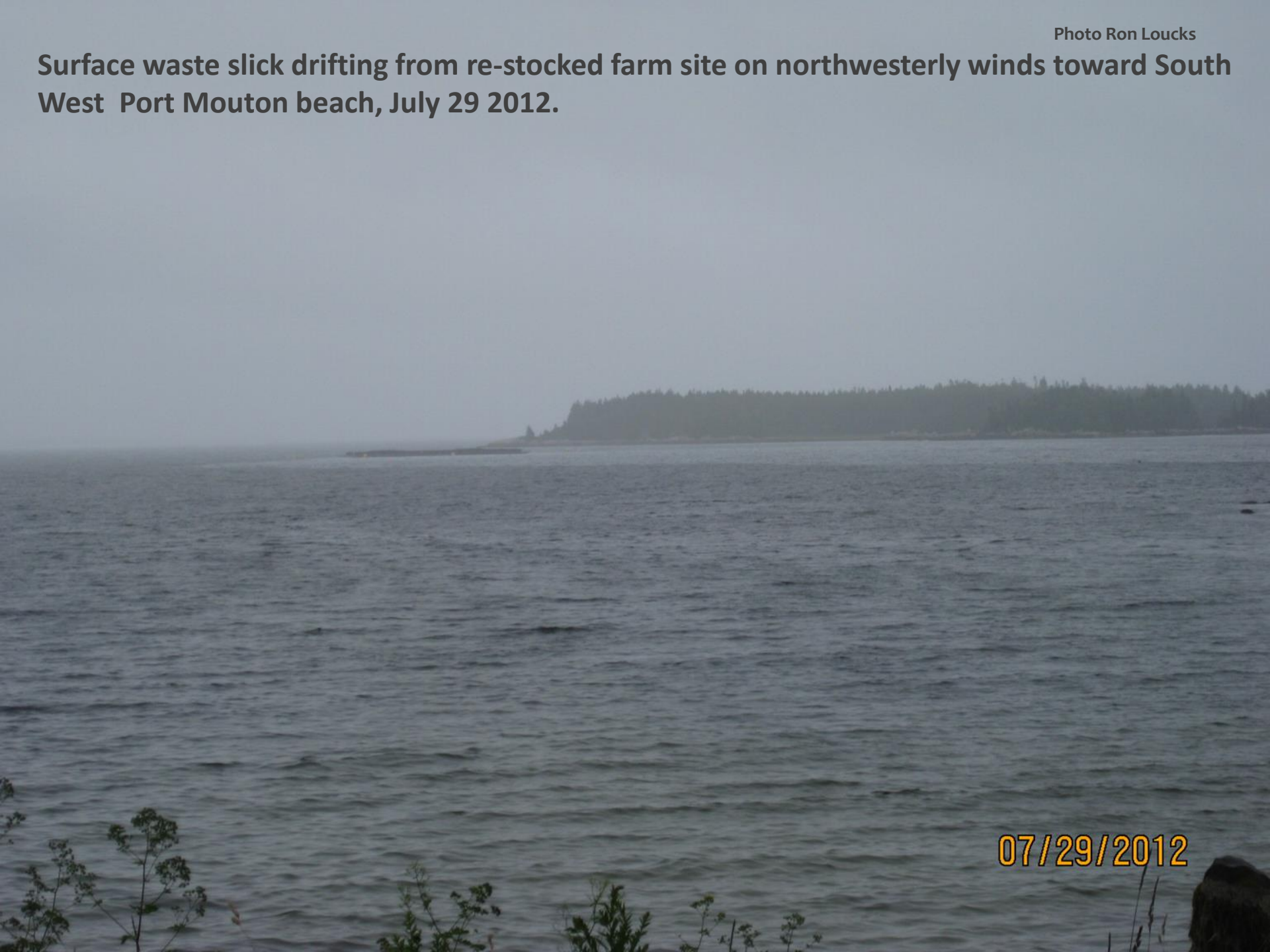
Photo Brian Paul Fisher

Closer view of pink floating waste from farm site October 6, 2012.

Photo Brian Paul Fisher

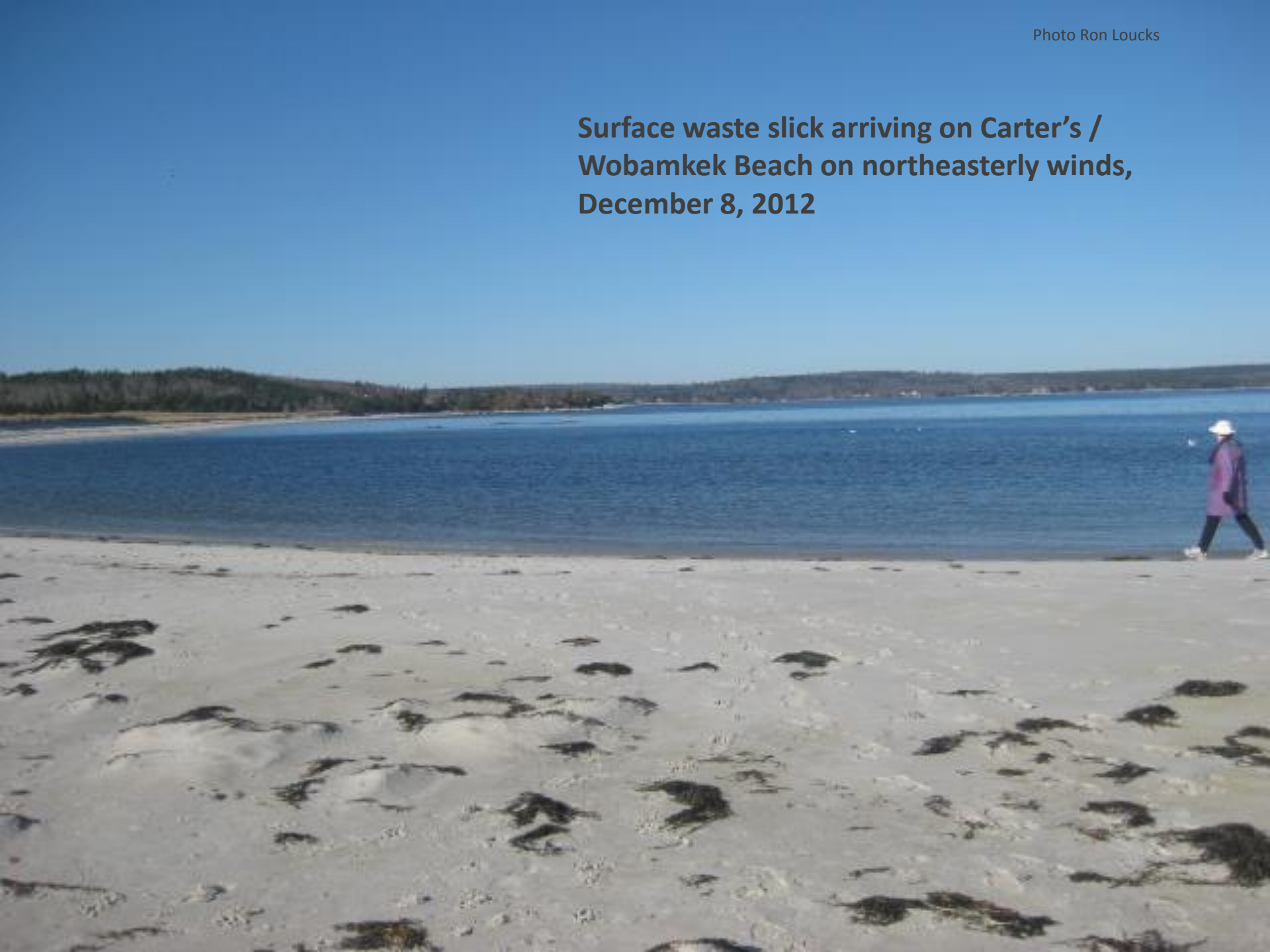
Plume from fish farm which was operating at half capacity. Winds light and tides slack at time of photograph – driving forces of currents at minimum, July 2009. Photo Linda Ross

Photo Ron Loucks



Surface waste slick drifting from re-stocked farm site on northwesterly winds toward South West Port Mouton beach, July 29 2012.

Photo Ron Loucks



Surface waste slick arriving on Carter's / Wobamkek Beach on northeasterly winds, December 8, 2012

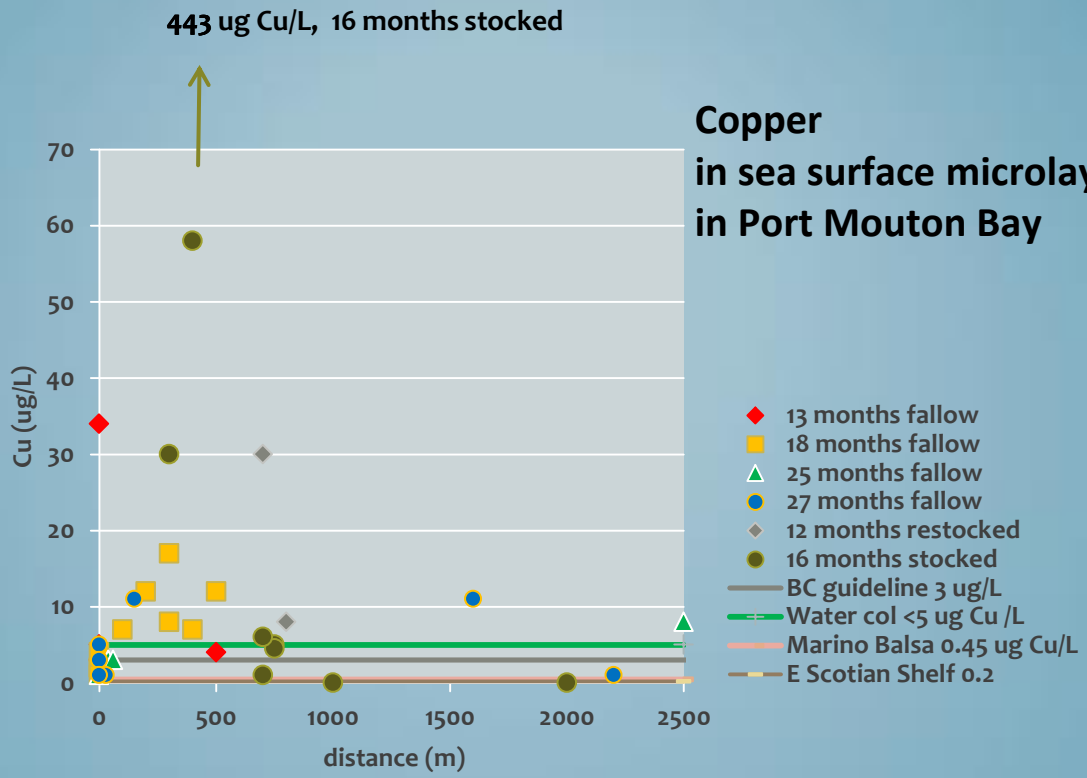
Sea Surface Microlayer

Copper can combine with organic substances to accumulate in the sea surface microlayer at high concentrations – much higher than in the water column.

Stage IV lobster larvae live at the sea surface.

Intertidal shorelines are habitat for juvenile forms of several species; the sea surface microlayer 'paints' shorelines as the tide rises and falls.

Copper levels as high as 147 times greater than the guideline for the protection of marine life were measured near the restocked fish farm in Port Mouton Bay in October 2013.



Copper concentration in the sea surface microlayer and the water column in Port Mouton Bay (fallowed and restocked periods) and for comparison the BC guideline for protection of marine life, a recommended guideline for protection of lobster larvae (Marino Balsa, 2000) and a background level measured on eastern Scotian Shelf.

Updated from:

Loucks, RH, RE Smith, CV Fisher and EB Fisher, 2012. Copper concentration in the sea surface Microlayer near a fallowed open-net fish farm. Marine Pollution Bulletin 64,1970-1973.

Dirty foam, wind-drifted to Summerville Beach Provincial Park, August 13, 2012

Photo Ruth Smith

Dirty foam, wind-drifted to Summerville Beach extending north ~1 km.

August 13, 2012

Photo Ruth Smith

November 18, 2012

Dirty' foam wind-drifted to Summerville Provincial Bark Beach Nov 18, 2012 photo Ron Loucks

Residues in jars filled with Summerville beach foam (above), after foam 'collapsed'.

August 13 and November 18, 2012

Photo Ruth Smith

Waste left by receding tide, Summerville Beach Provincial Park, November 2012

Photo Ron Loucks

- Carter's Beach

- Fine black silt deposits after north east winds and 18 months of fallow
- January 29, 2011

Photo Mary Ediger

‘Dirty’ scum / foam on Carter’s Beach after a period of northeast winds March 10, 2013.

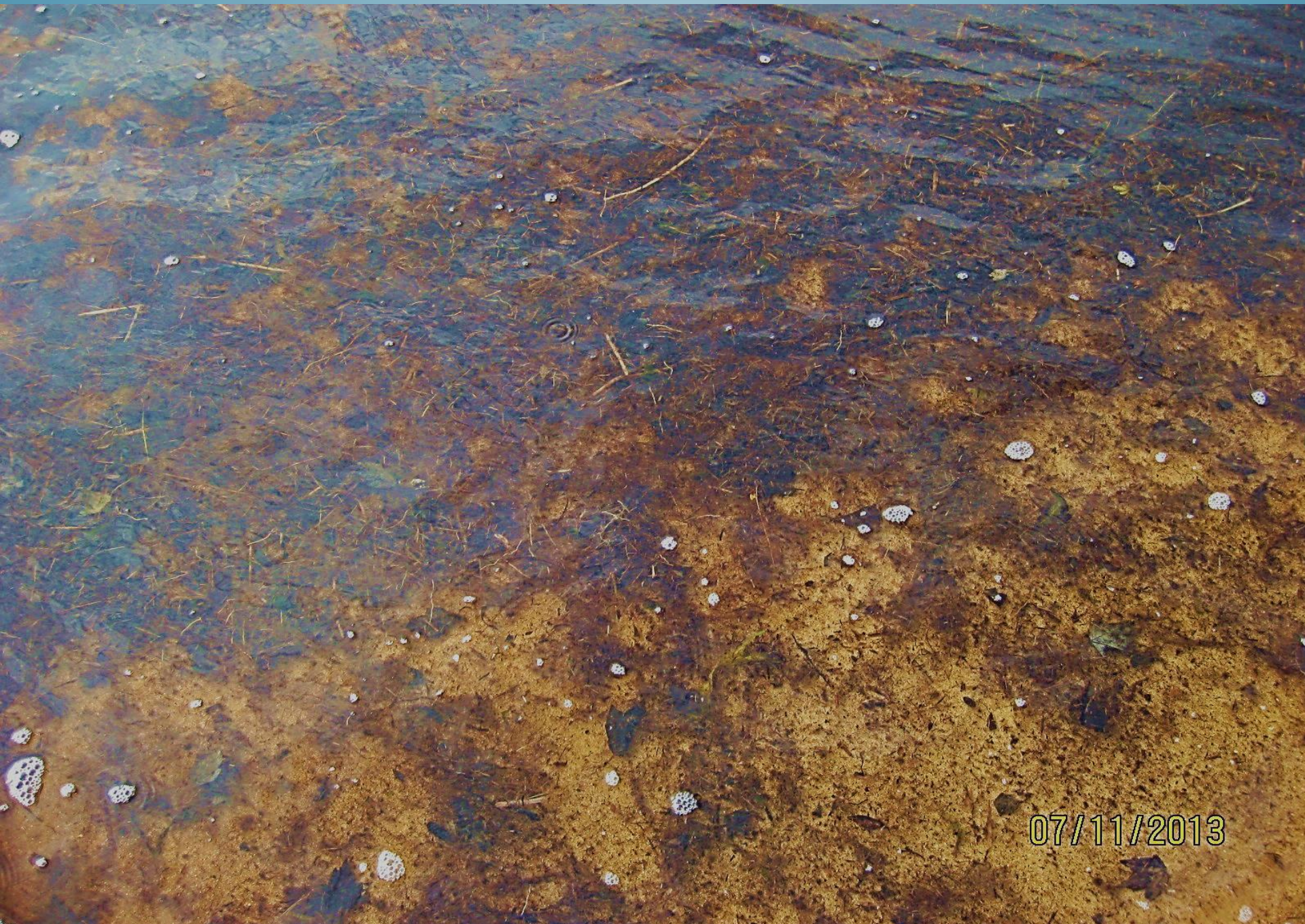
Photo Ruth Smith

Waste in tideline with oily bubbles, Carter's Beach, March 16 or 17, 2013

Photo Brian Fisher

Odorous slime algae, Carter's Beach, July 11, 2013

Photo Ruth Smith



Port Mouton Bay has insufficient flushing capacity for finfish aquaculture.

Over the greater part of the 56 km^2 Bay, existing aquaculture far-field impacts, from bottom sediments to sea surface, on lobster and Irish moss harvest, on ecotourism and on protected beaches, are neither compatible nor acceptable.

www.friendsofportmoutonbay.ca