

# Sea-cage aquaculture impacts market and berried lobster (*Homarus americanus*) catches

I. Milewski<sup>1,\*</sup>, R. H. Loucks<sup>2</sup>, B. Fisher<sup>3</sup>, R. E. Smith<sup>2</sup>, J. S. P. McCain<sup>1</sup>, H. K. Lotze<sup>1</sup>

<sup>1</sup>Department of Biology, Dalhousie University, Halifax, Nova Scotia B3H 4R2, Canada

<sup>2</sup>RH Loucks Oceanology Ltd., Halifax, Nova Scotia B3M 1L3, Canada

<sup>3</sup>Port Mouton, Nova Scotia B0T 1T0, Canada



# Background

- Port Mouton Bay is an historically important habitat for lobsters, supporting generations of fishers
- Within 2-3 year from the start of fish farming operations in the Bay, fishers observed declines in catches
- Lobster fishers in New Brunswick have also reported declines but no data has been collected



# Port Mouton Fish Farm

- first fish farm appeared in 1995
- 2007-2009 stocked with Atlantic Salmon
- followed 2009 -2012
- 2012-2014 stocked with rainbow trout
- 2015-2017 followed

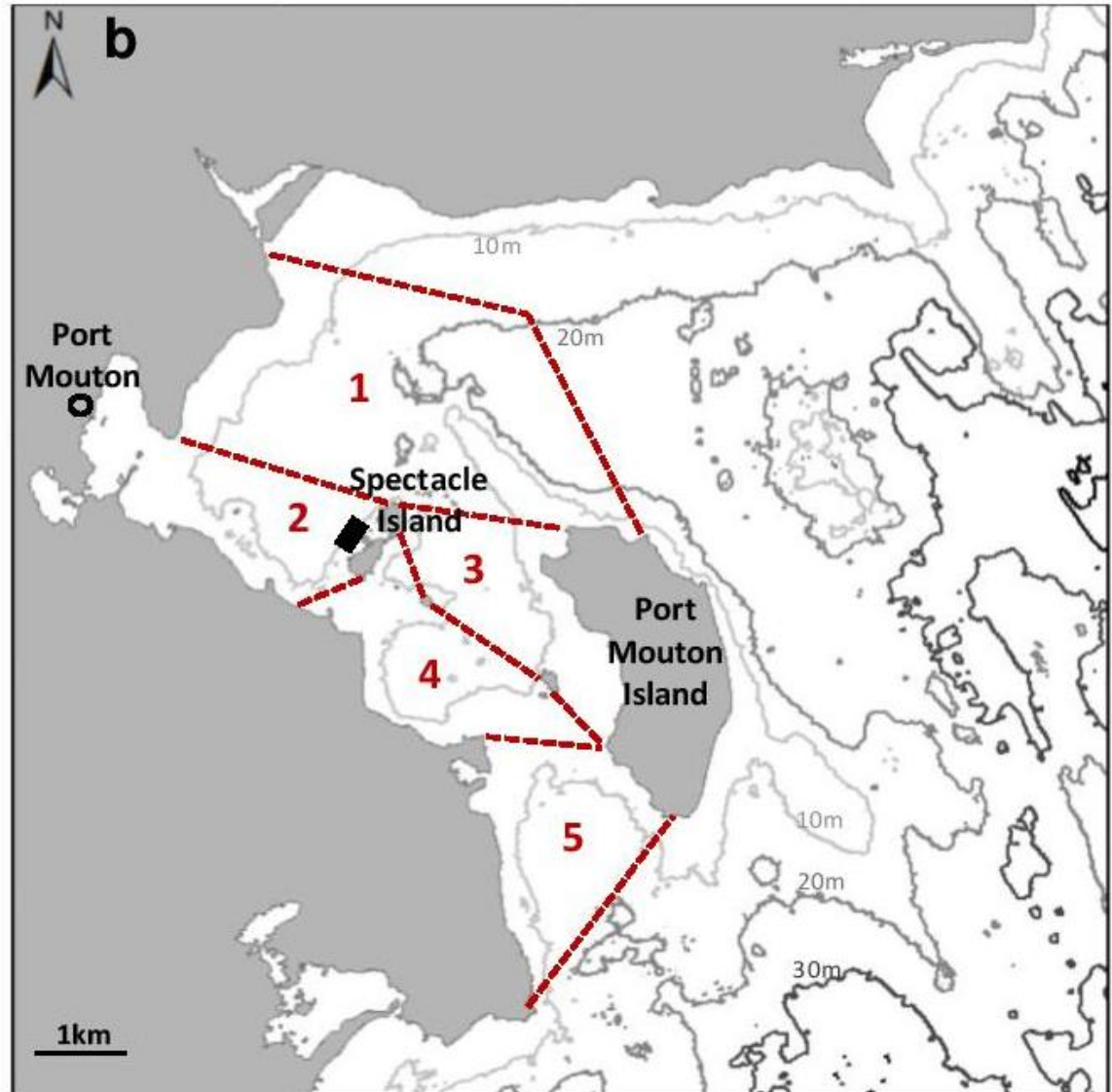


# How did we do our study?

- recruited up to 15 boats and ~30 fishers
- fishers divided inner Port Mouton Bay into five traditional fishing regions
- catches of market lobsters and berried female counts reported for the last two weeks of May beginning in 2007 to 2017
- Fishermen and Scientists Research Society provided bottom temperature loggers; Society retrieves data and provides daily mean temperatures
- catches and counts were standardized by effort

# Fishing Regions

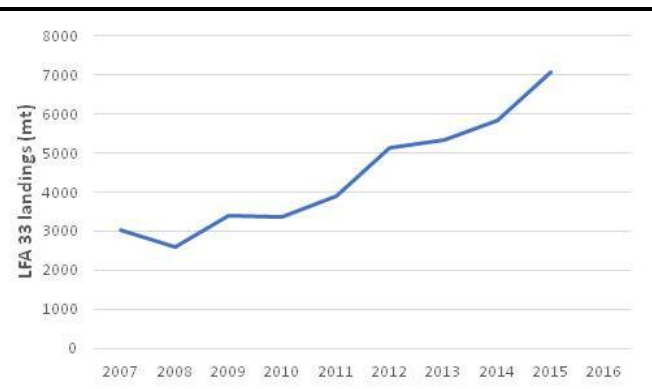
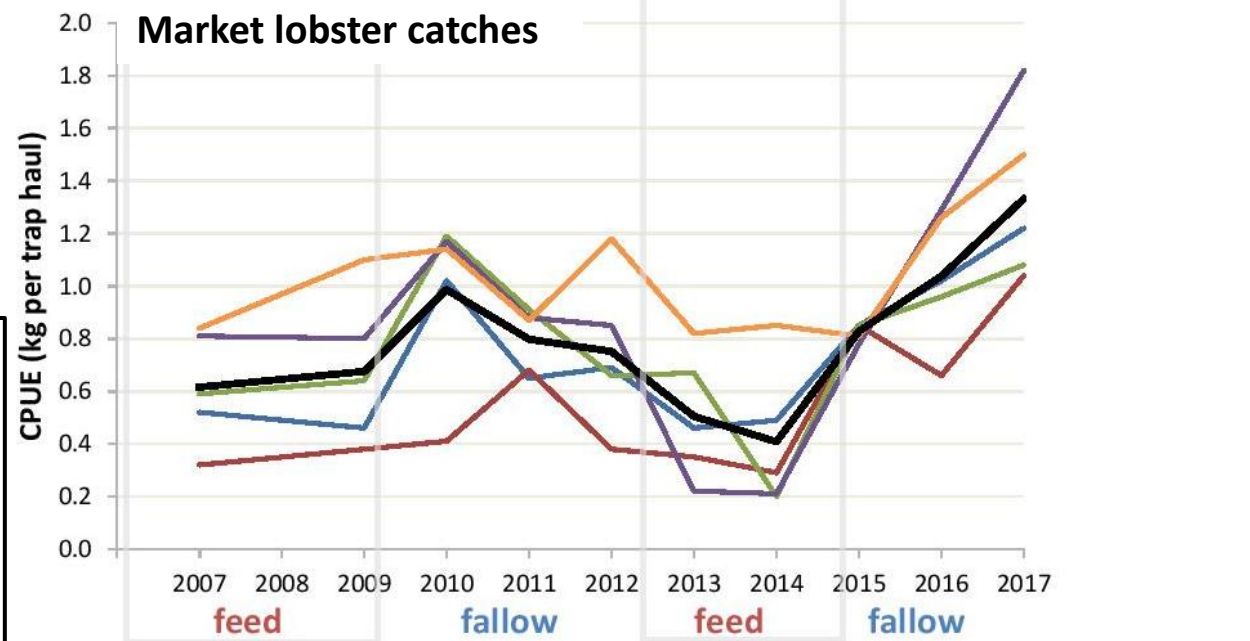
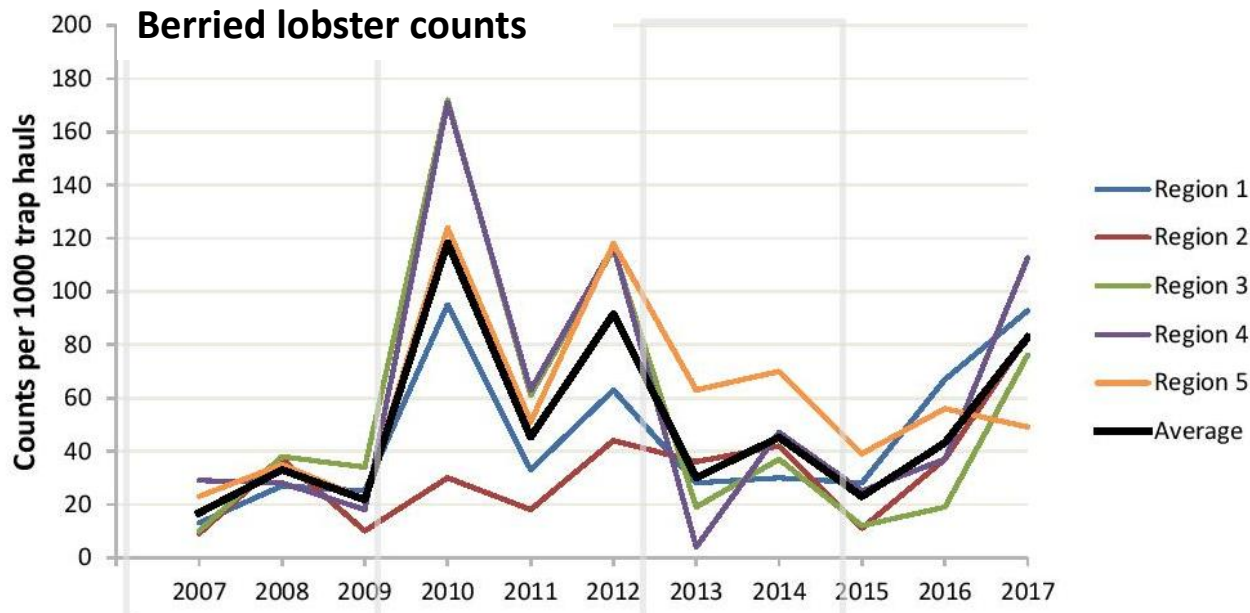
- cover an area of 26 km<sup>2</sup>
- fish farm located in fishing Region 2
- all fishing regions have same amount of suitable lobster habitat (gravel, mud, sand, rocky ledges)
- water depths range from 4-16 m in each fishing region



# Results

- market lobster catches and berried counts fluctuated in Port Mouton Bay between 2007-2017

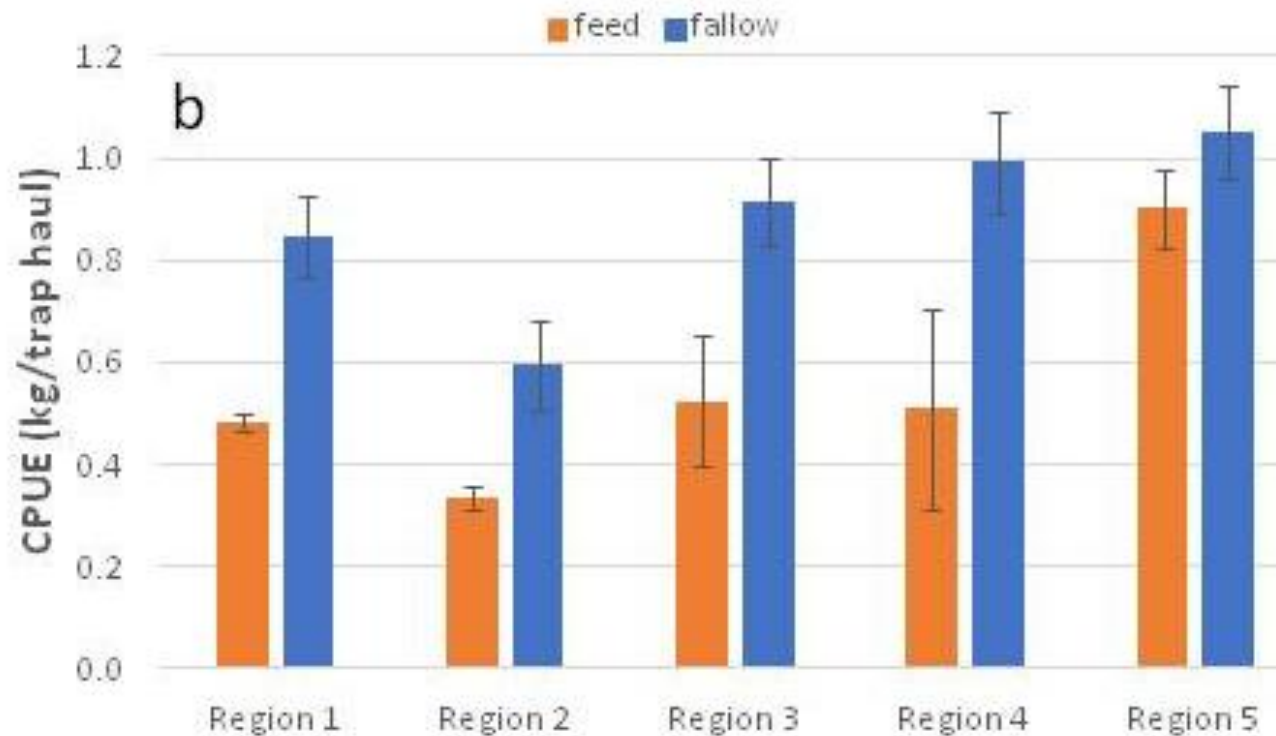
- market lobster catches in LFA 33 increased between 2007-2017



# Results:

## Market Lobster

- CPUE significantly ( $p < .01$ ) higher during fallow ( $0.96 \pm 0.09$  SE) vs feed ( $0.55 \pm 0.06$  SE) period
- 42% average drop in catch between fallow vs feed periods
- Catches in Region 2 remained low during fallow periods vs other Regions
- Catches in Region 5, furthest from the fish farm decline during feed periods but were higher than other Regions



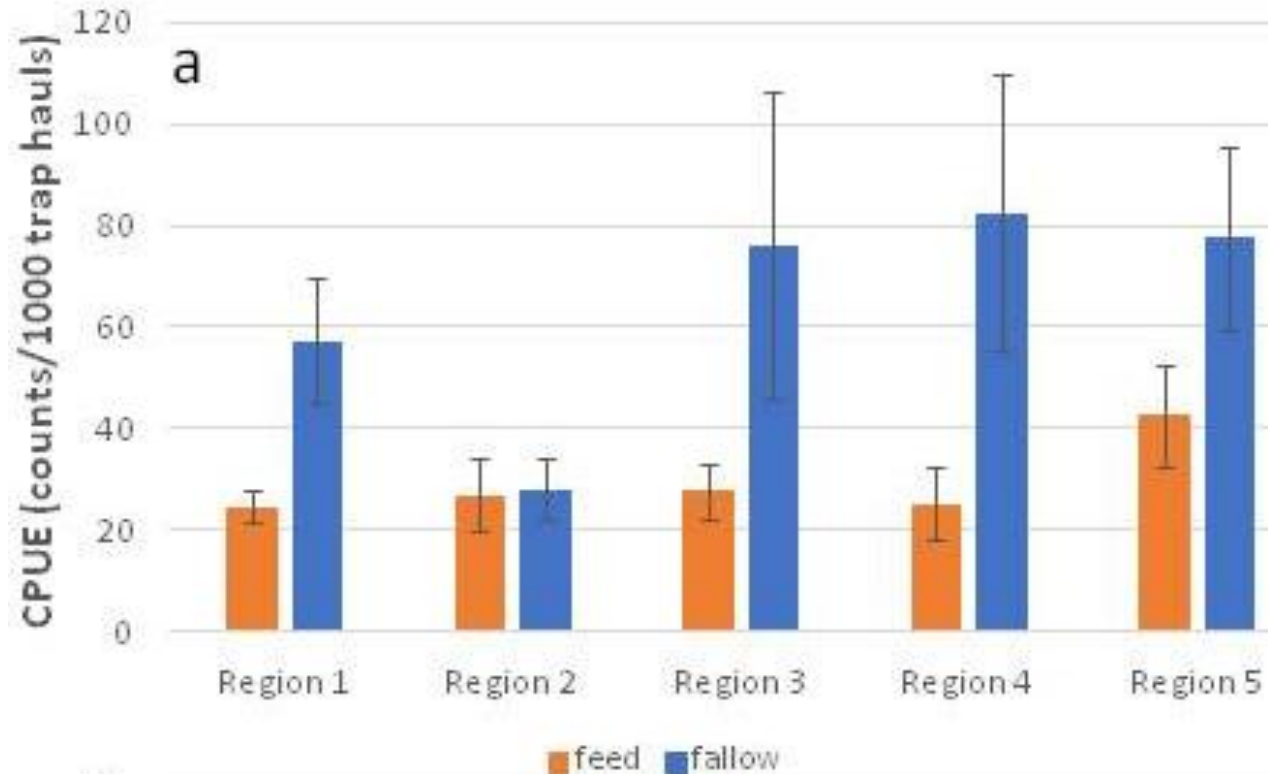
# Results:

## Berried Lobster

- Counts significantly ( $p < 0.001$ ) higher during fallow ( $64.3 \pm 14.7$ ) vs feed ( $29.4 \pm 4.9$ ) periods

- 56 % average drop in counts between fallow and feed periods

- Counts in Region 2 remained low during fallow periods compared to other Regions

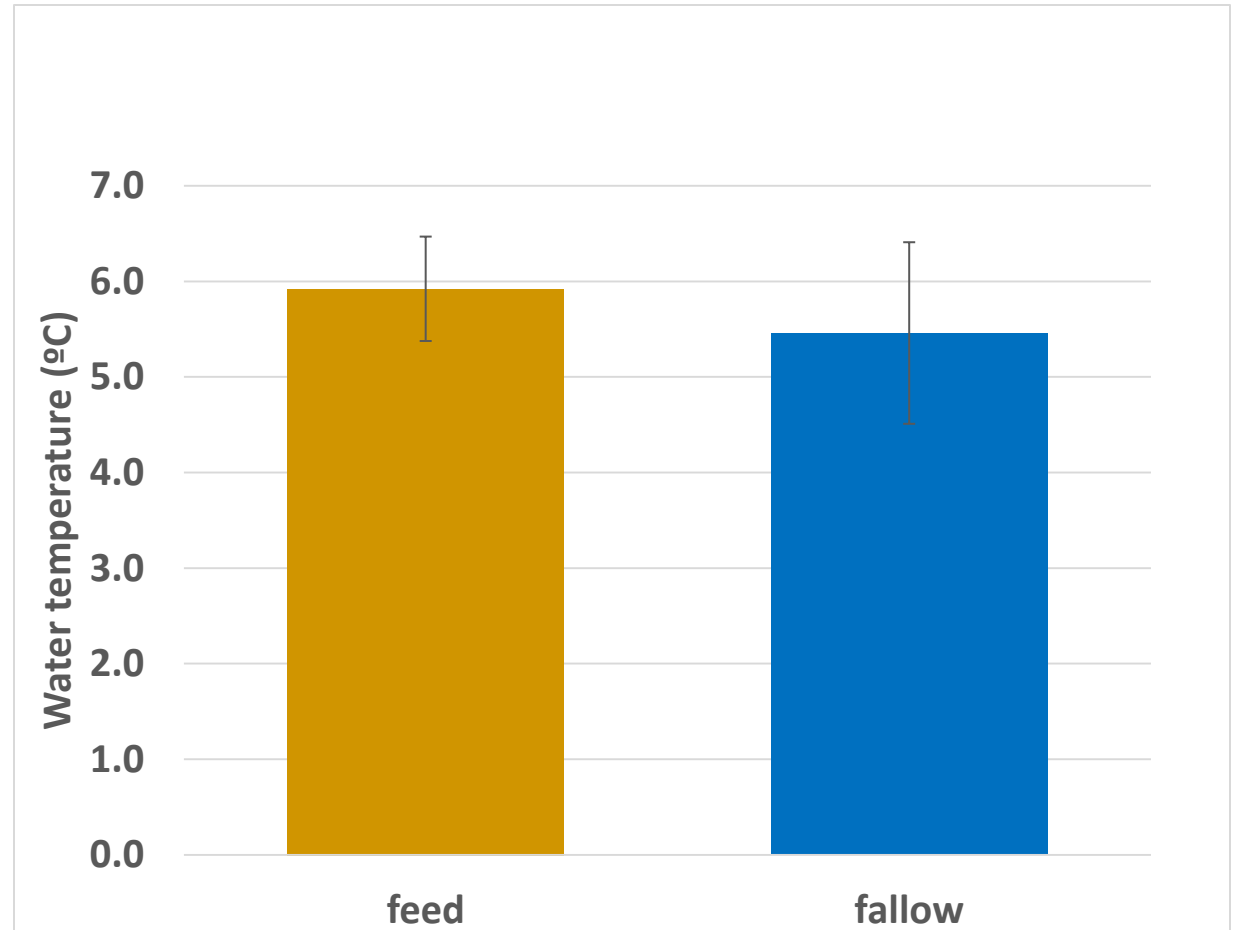




# Results:

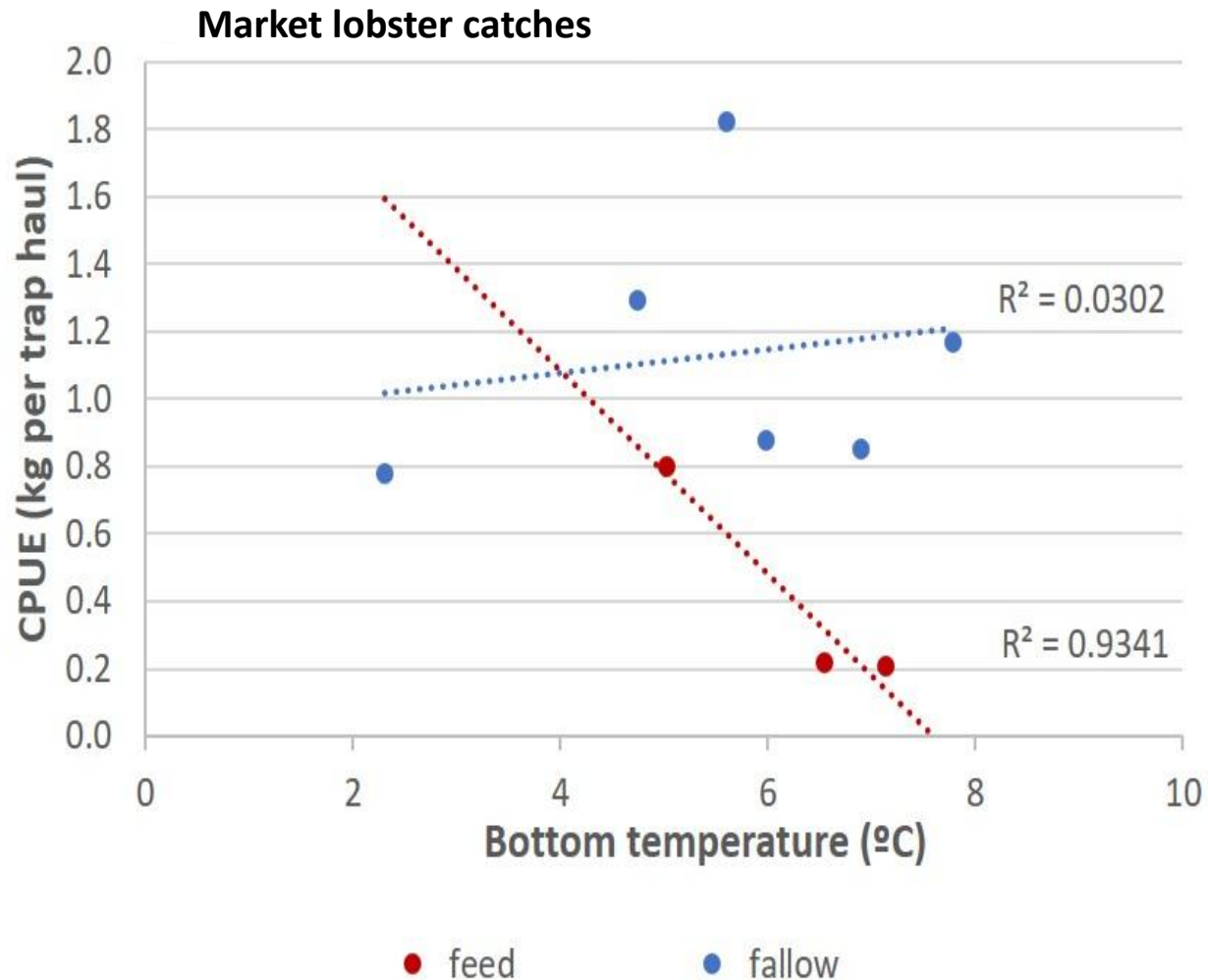
## Bottom Temperature

- **Bottom water temperatures during the study period (2007-2017, last two weeks of May) were not significantly different during feed and fallow periods**



# Results: Temperature effects on market lobster

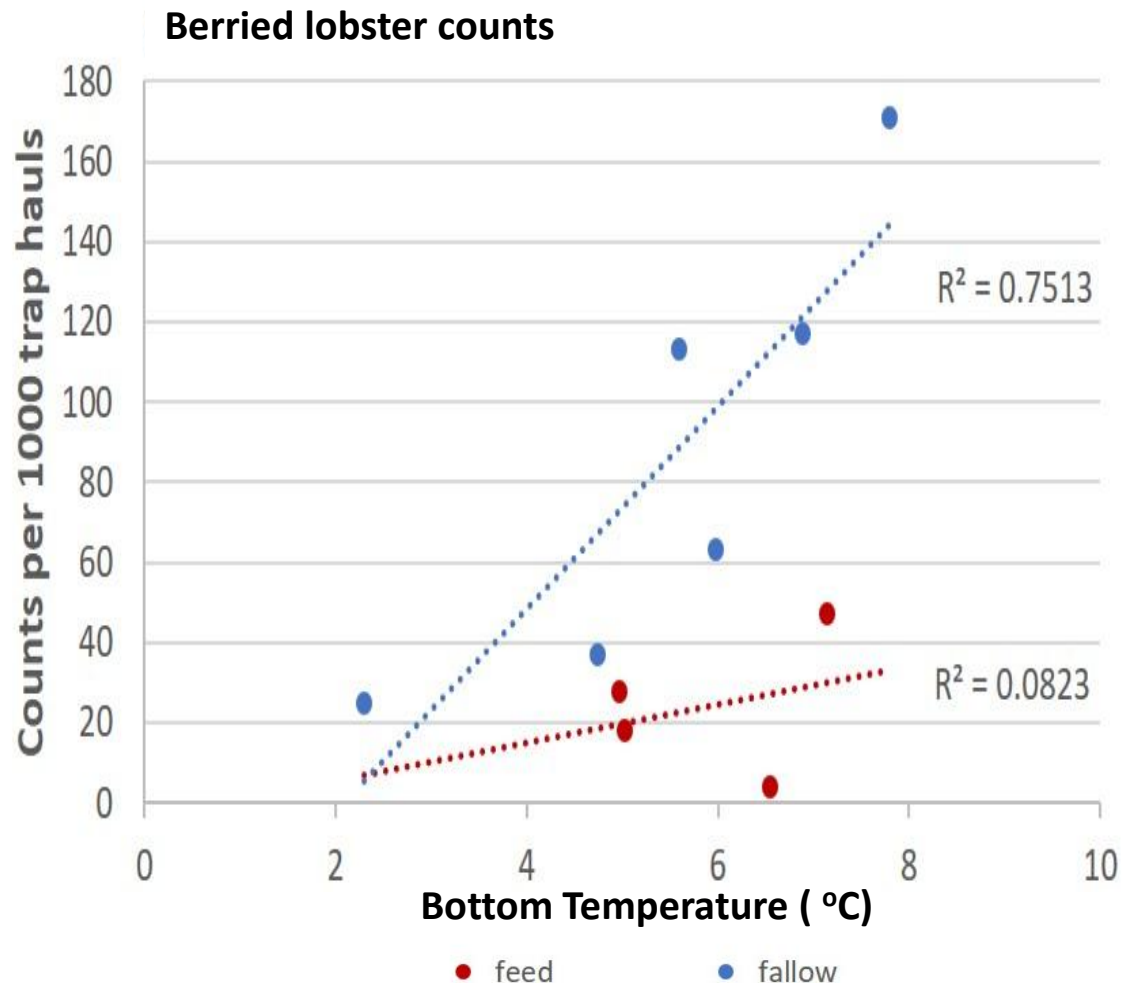
- Catch rates unaffected by increases in temperature during fallow periods
- Catch rates decline as temperature increase during fish farm feed periods
- Data suggests the negative effects of aquaculture override the temperature effects



# Results:

## Temperature effects on berried lobster

- Counts increased as temperature increases during fallow periods
- Counts only slightly increased when temperature increase during feed periods
- Data suggests the negative effects of aquaculture override the temperature effects



# Other factors affecting lobster catches

- Moulting
- Wind
- Fishing effort
- Odour plumes and turbidity

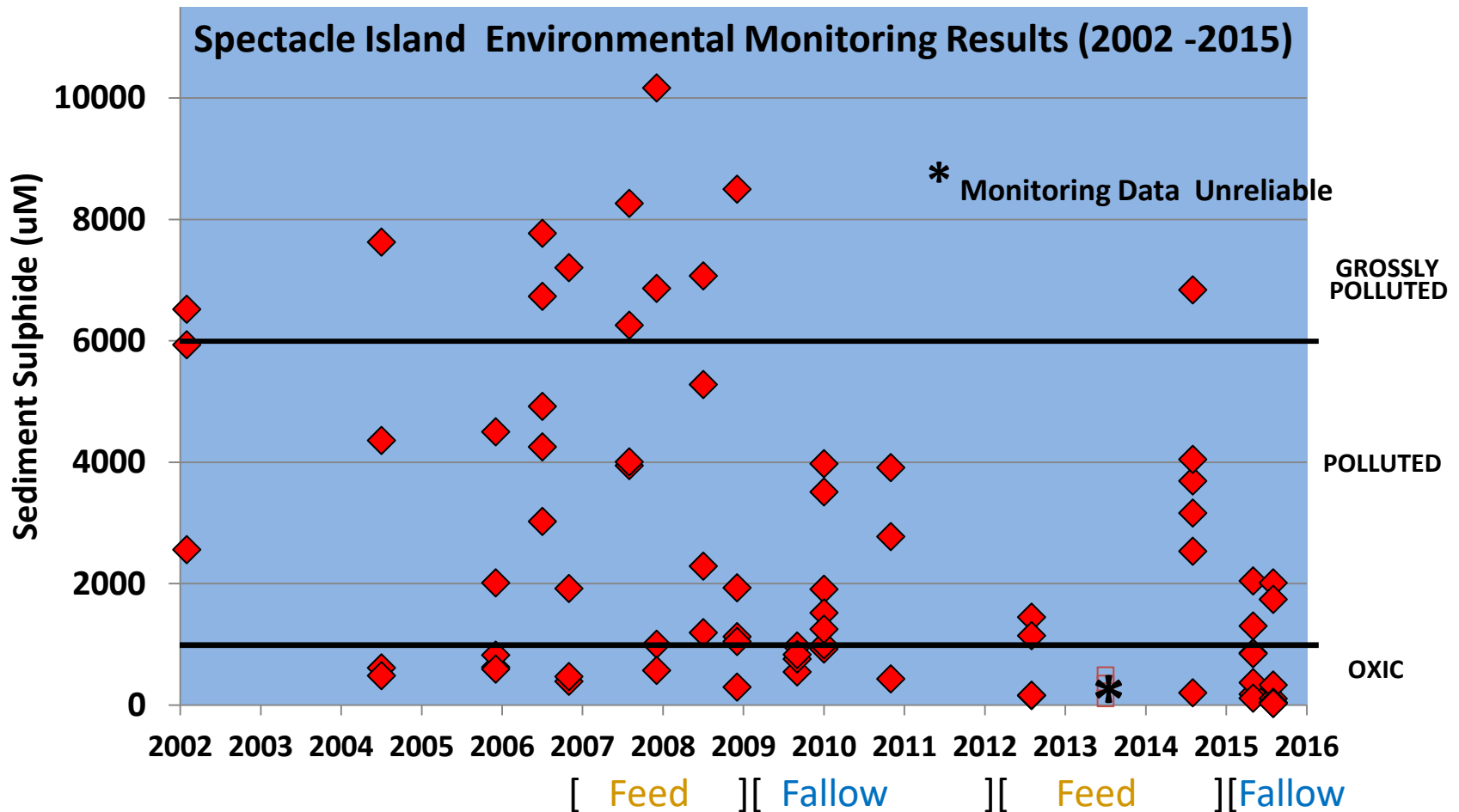


# Lobster and Habitat Quality

- Lobster “sniff” the odour seascape with their antennules and chemoreceptors found on their legs
- Odours are used to locate food, find mates, detect predators and avoid environmental stresses
- Sulphides and ammonium have toxic and behavioural effects on adults and other lobster life stages
  - In laboratory studies, 50% of lobsters die within 3.3 days in low oxygen, low sulphides (5.5  $\mu\text{M}$ ) and ammonium (17  $\mu\text{M}$ ) conditions (Draxler et al. 2005)
- Berried lobster are very sensitive to odours and temperature
  - Berried lobster show retreat behaviour at 50  $\mu\text{M}$  sulphide (Butterworth et al. 2004); at 500  $\mu\text{M}$  and regular oxygen conditions, 50% of lobster died in 22.5 hr

# Fish Farm Waste : Feces and Feed

- ~400,000 rainbow trout = ~ 760 mt /yr
- Fecal and feed waste production = ~ 130 mt/yr



# Fish Farm Waste : Nitrogen Pollution

- Farm dissolved nitrogen (N) waste ~ 30 mt/yr
- Farm represents an ~ 14% increase in total dissolved N to Port Mouton Bay
- dispersion potential of N by currents is ~10-11 km

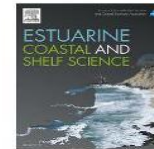
Estuarine, Coastal and Shelf Science 205 (2018) 46–57



Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: [www.elsevier.com/locate/ecss](http://www.elsevier.com/locate/ecss)



Estimating nitrogen loading and far-field dispersal potential from background sources and coastal finfish aquaculture: A simple framework and case study in Atlantic Canada



R. McIver <sup>a,\*</sup>, I. Milewski <sup>b</sup>, R. Loucks <sup>c</sup>, R. Smith <sup>c</sup>

<sup>a</sup> Department of Biology, Dalhousie University, 1355 Oxford Street, P.O. Box 15000, Halifax, Nova Scotia B3H 4R2, Canada

<sup>b</sup> 254 Douglasfield Road, Miramichi, New Brunswick E3B 4S5, Canada

<sup>c</sup> 24 Clayton Park Drive, Halifax, Nova Scotia B3M 1L3, Canada

## ARTICLE INFO

Article history:  
Received 30 January 2017

## ABSTRACT

Far-field nutrient impacts associated with finfish aquaculture have been identified as a topic of concern for regulators, managers, scientists, and the public for over two decades but disentangling aquaculture

# Effects of N Pollution

- Decrease in water quality
- Increase in epiphyte growth on eelgrass
- Increase in benthic algae
- Increase in nuisance or “slime” algae





# Conclusions

- Lobster catches and counts significantly declined during feed compared to fallow periods
- Differences in catch and counts during feed and fallow periods are not driven by temperature
- Berried lobsters appear more sensitive to aquaculture and temperature effects than market lobsters
- Odours and water quality changes are likely reasons for changes in catch rates
- Protection and conservation of key lobster/shellfish habitat critical in the face of multiple environmental stressors

# Thank You

- Lobster fishers of Port Mouton Bay
- Friends of Port Mouton Bay
- Fishermen and Scientist Research Society
- Canada Ocean Partnership