

# Mitigation of recirculating and effluent water of land-based, marine finfish aquaculture by integration with seaweed biofiltration

**J.K. Kim<sup>1</sup>, P. Corey<sup>1,2</sup>, B. Prithiviraj<sup>1</sup>, D.J. Garbary<sup>3</sup>, B.C. Blanchard<sup>2</sup>, J. Duston<sup>1</sup>**

<sup>1</sup>Department of Plant and Animal Sciences, Nova Scotia Agricultural College

<sup>2</sup>Scotian Halibut Ltd., Wood's Harbour, NS

<sup>3</sup>Department of Biology, St. Francis Xavier University

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# Land-based aquaculture

- ⦿ A. halibut; RAS
- ⦿ Cost-intensive
  - High costs of operating
  - High costs of waste treatment—N, P
- ⦿ Ammonia nitrogen toxic to fish at low concentrations
  - Normally removed by bacterial biofiltration
- ⦿ N, P responsible for eutrophication



# Seaweed-finfish integration

- ◎ Bioremediation of recirculating water
  - improved fish health; increased carrying capacity of system.
- ◎ Bioremediation of effluent
  - mitigate environmental impacts.
- ◎ Economic diversity
  - broader product base; seaweeds may be used as feed for other organisms.

# Macroalgal species



## ◉ *Palmaria palmata*

- Common name: Dulse
- Wild harvest
- High nutrient value (protein 25% DW)
- Feed for abalone, sea urchins

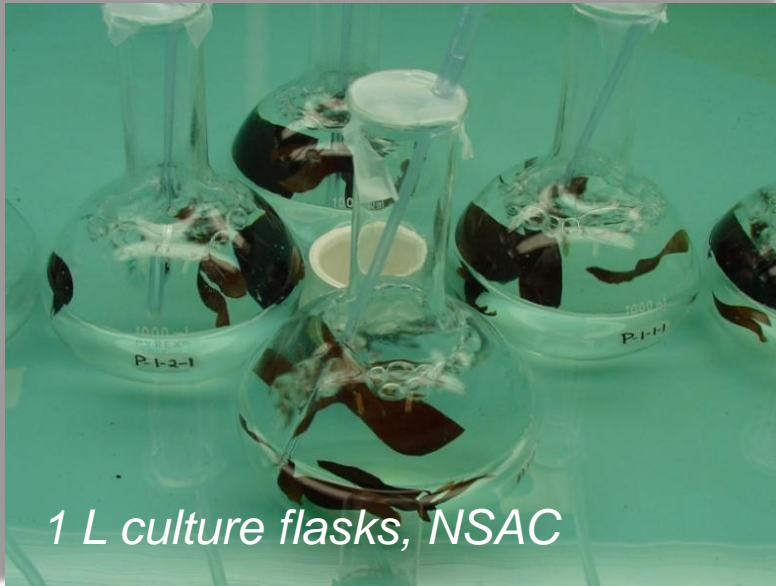


## ◉ *Chondrus crispus*

- Common name: Irish moss
- Wild harvest, aquaculture
  - Carrageenan source
  - Human consumption
- Basin Head strain
  - Unique morphotype, endangered



# Experimental set-up



*1 L culture flasks, NSAC*

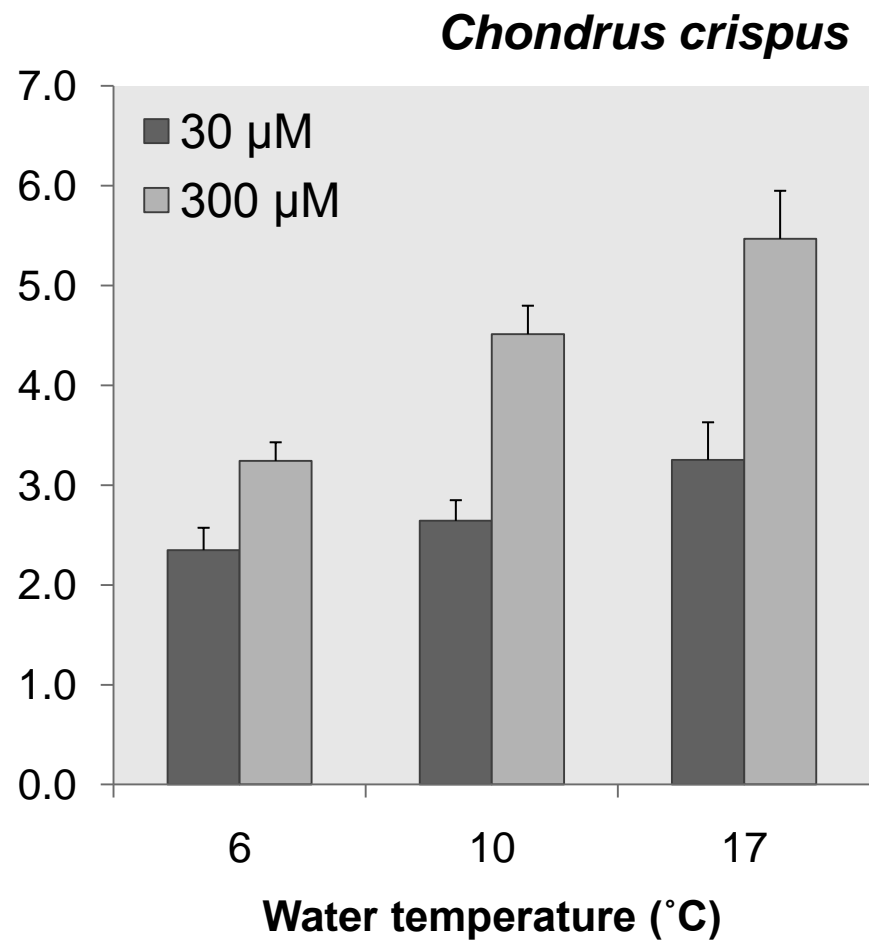
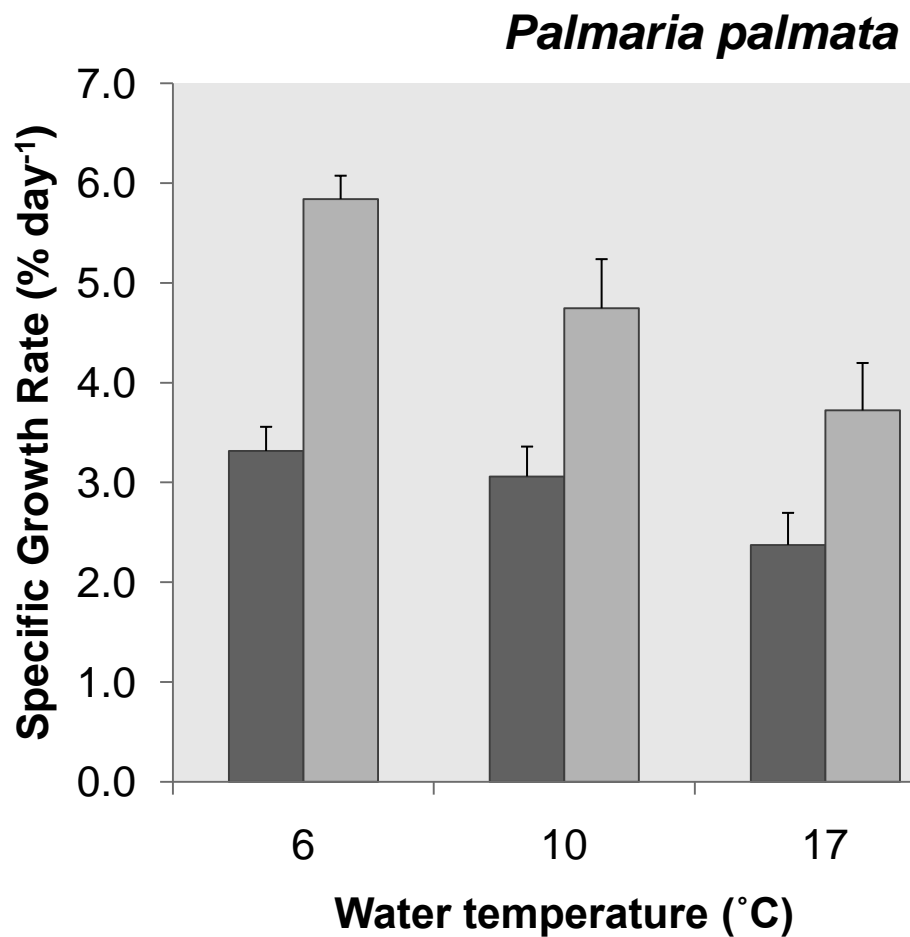


*500 m<sup>3</sup> RAS, Scotian Halibut*



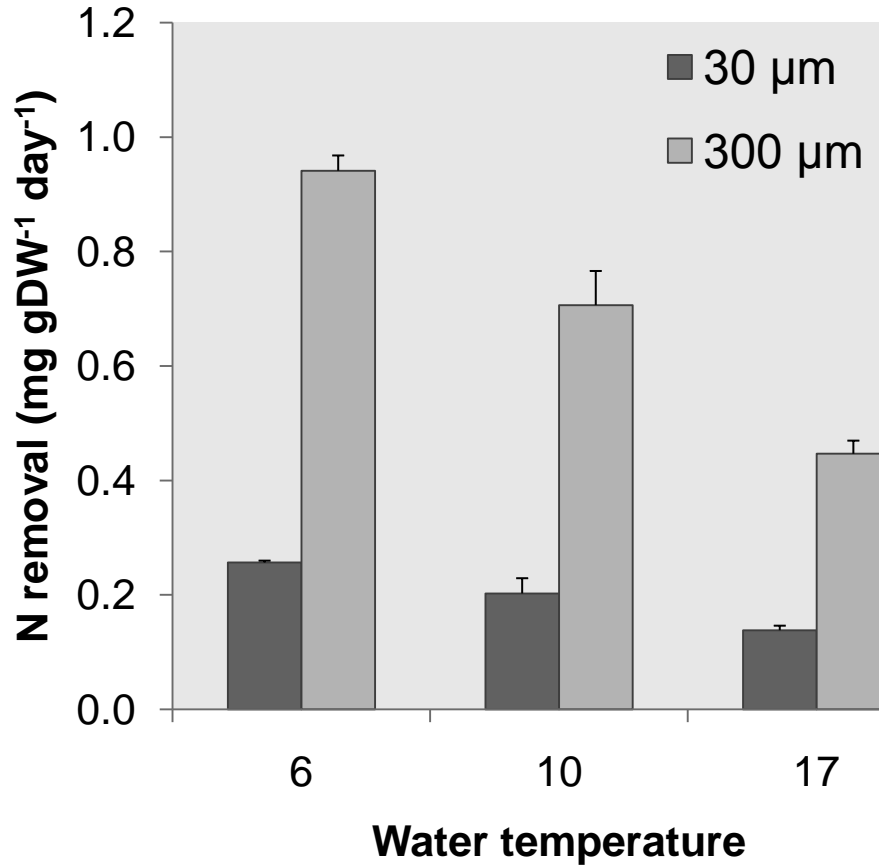
*50 L culture tubs, Scotian Halibut*

Effects of water temperature and nitrate concentration on growth.

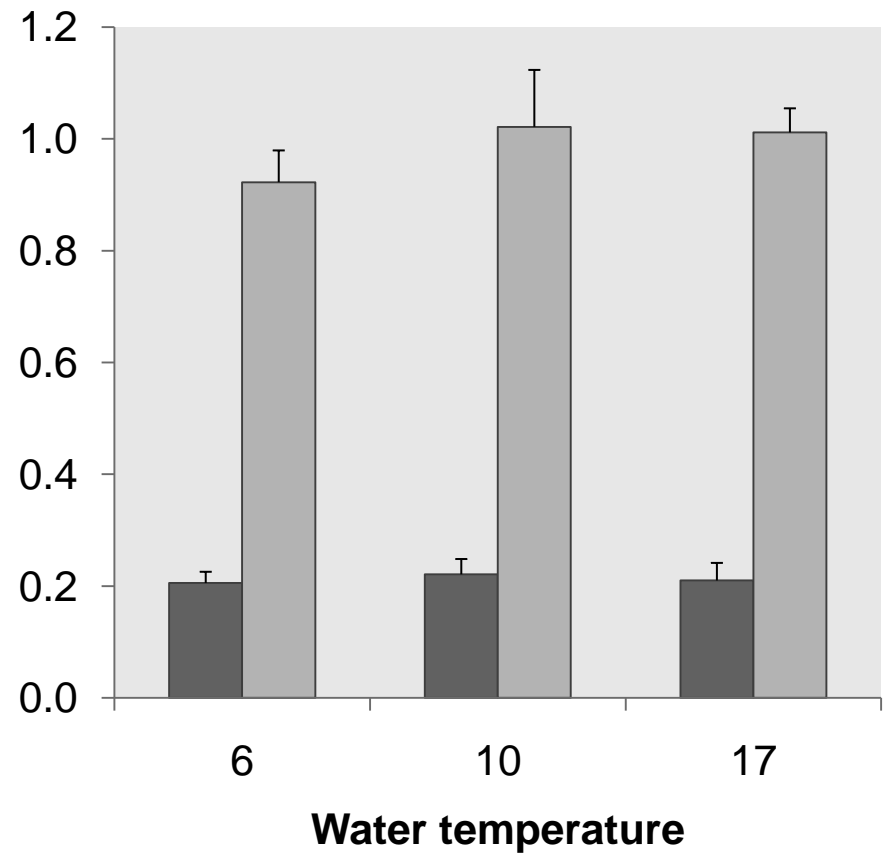


Effects of water temperature and nitrate concentration on nitrogen removal.

*Palmaria palmata*



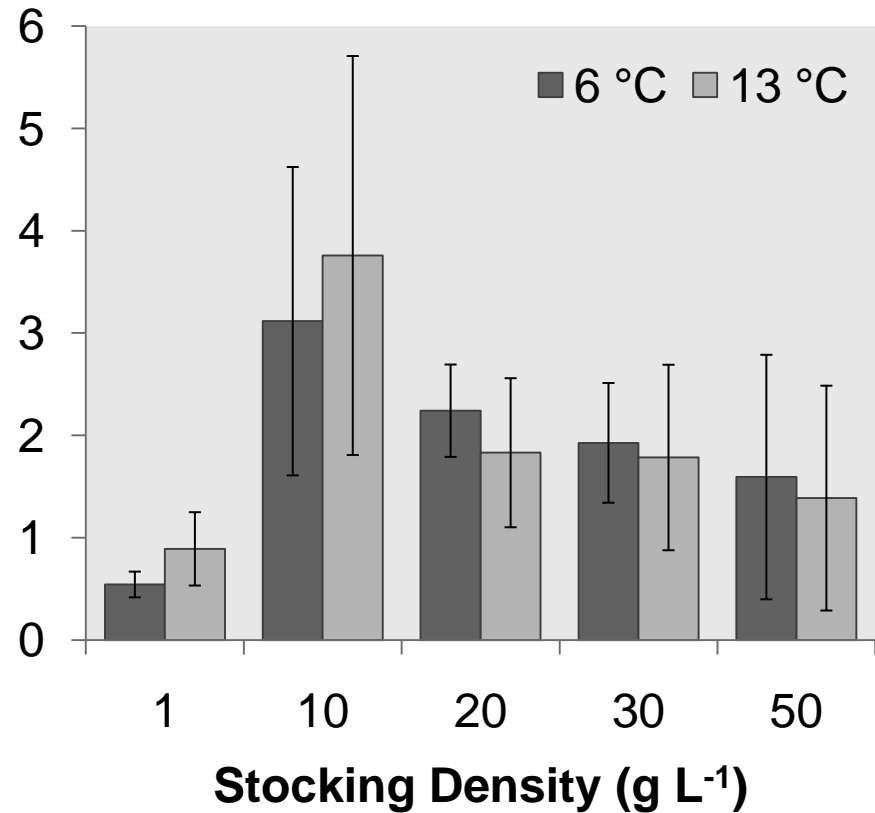
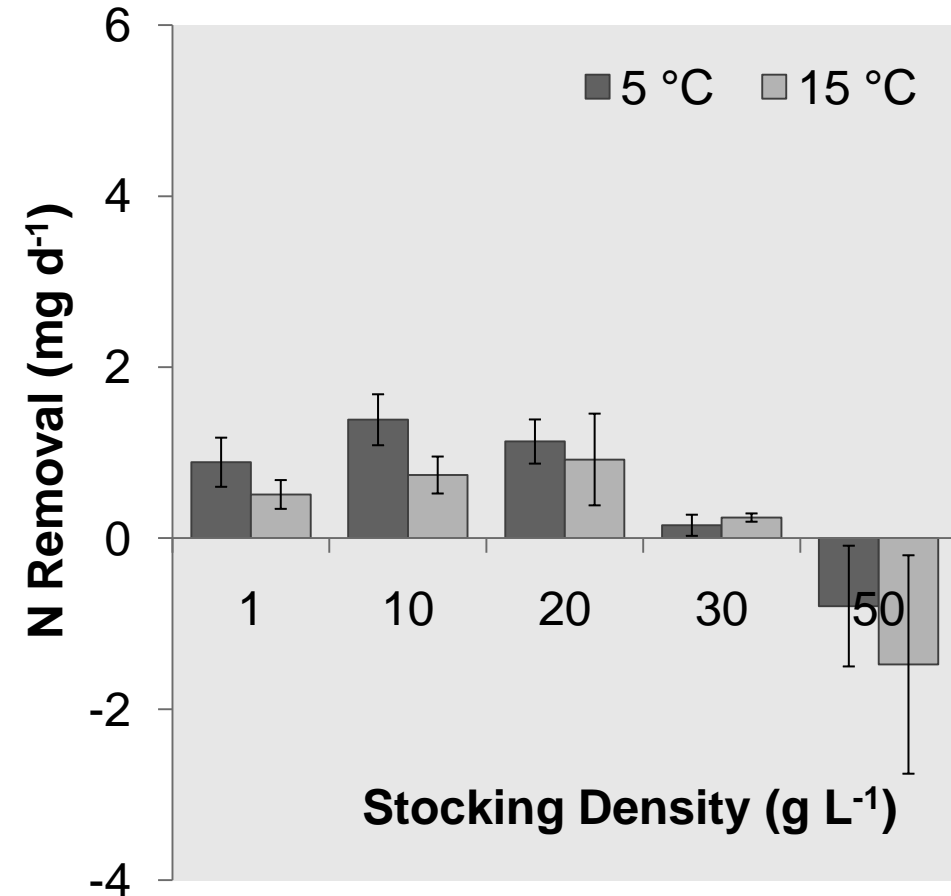
*Chondrus crispus*



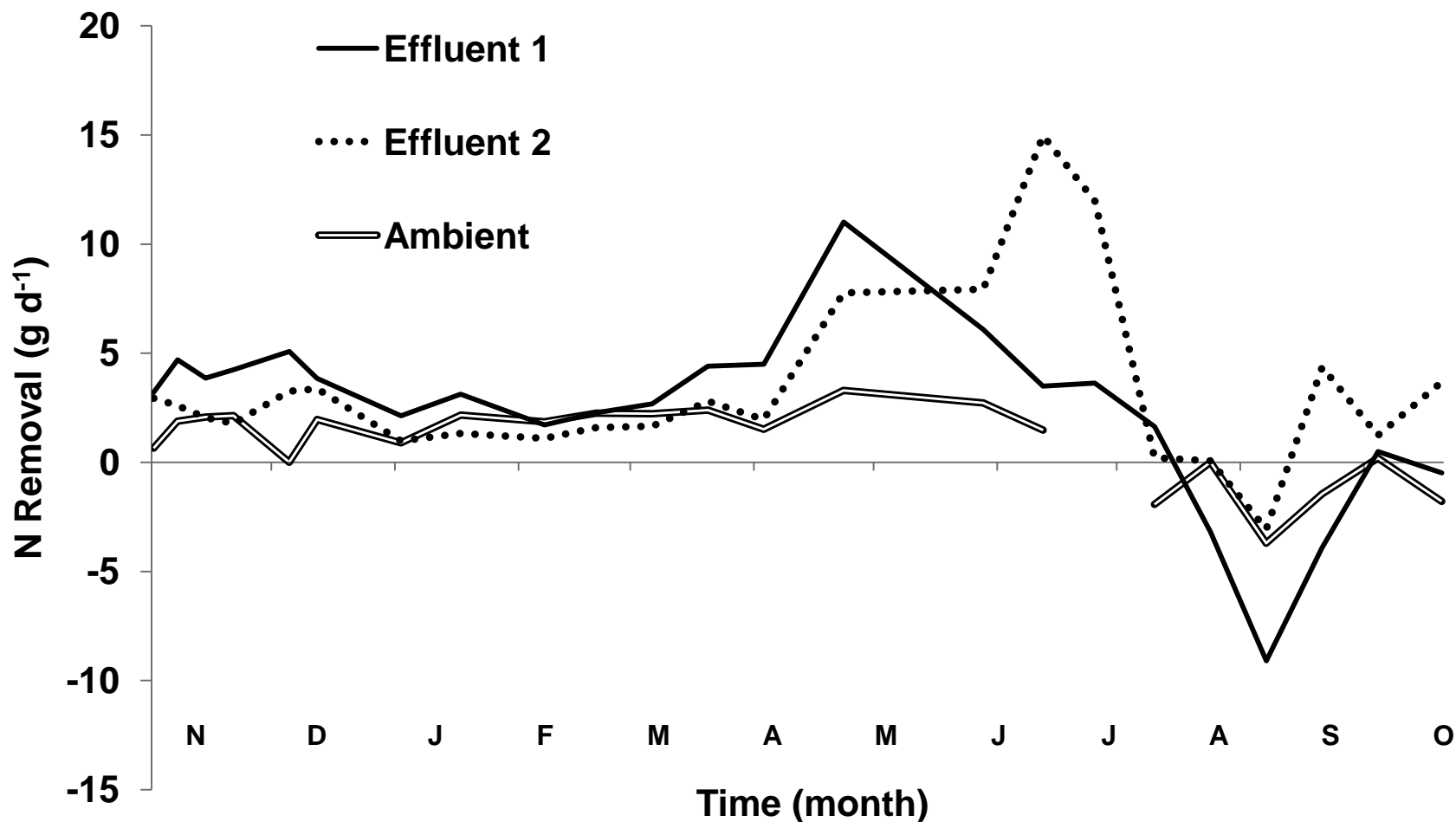
Effects of stocking density on nitrogen removal by two species of red macroalgae in Atlantic halibut aquaculture effluent.

***Palmaria palmata***

***Chondrus crispus***

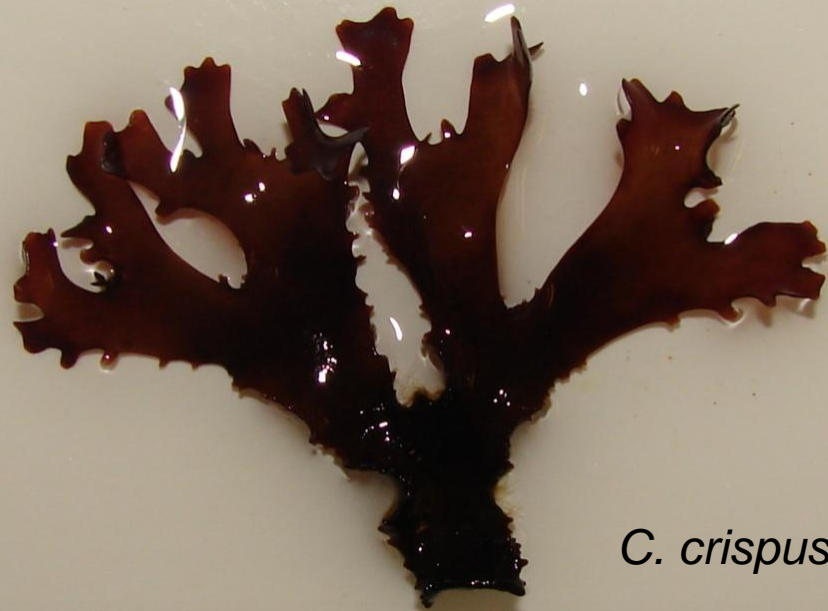


## Nitrogen removal by *Palmaria palmata* in aquaculture effluent and ambient seaweed supply



The initial stocking density was  $3.9 \text{ kg unit}^{-1}$ , and was increased to  $5.3 \text{ kg unit}^{-1}$  in Dec,  $7.3 \text{ kg unit}^{-1}$  in Feb,  $11 \text{ kg unit}^{-1}$  in April and  $13 \text{ kg unit}^{-1}$  in June.

# Morphology



*C. crispus*



*P. palmata*

- Vegetative propagation
  - Healthy plantlets at all margins of *P. palmata* and *C. crispus*
- No need for nursery stage?



# Conclusions

- ⦿ Temperature effects:
  - N removal - *C. crispus* is effective year-round, while *P. palmata* is useful during colder seasons only
- ⦿ Stocking density:
  - N removal optimized at 10 g L<sup>-1</sup>
  - *C. crispus* demonstrated overall superior N removal capacity
- ⦿ Halibut-seaweed integration:
  - Preliminary analysis suggests that algal:fish ratio of 1:1 is required for complete N removal



# Future research

- ⦿ *P. palmata* and *C. crispus* under combined nutrient source
- ⦿ Light saturation at higher stocking densities
- ⦿ *C. crispus* in recirculating aquaculture effluent
- ⦿ Culture of both spp. under ambient light conditions and aquaculture effluent



*Seaweed diversity: Point Prim, Digby County, NS, May 2010*



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People. Discovery. Innovation.

