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Impacts of Invasive Species on Eelgrass in Eastern Canada

**Northeast Eelgrass Workshop, Portland Maine
February 24, 2009**

**Presented by : Al Hanson, Canadian Wildlife Service, Sackville NB
For the Storm Stranded: Garbary et al and Pelletier et al**



**Destruction of eelgrass in Nova Scotia
by the invasive green crab, (*Carcinus maenus*)**

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The Protagonists



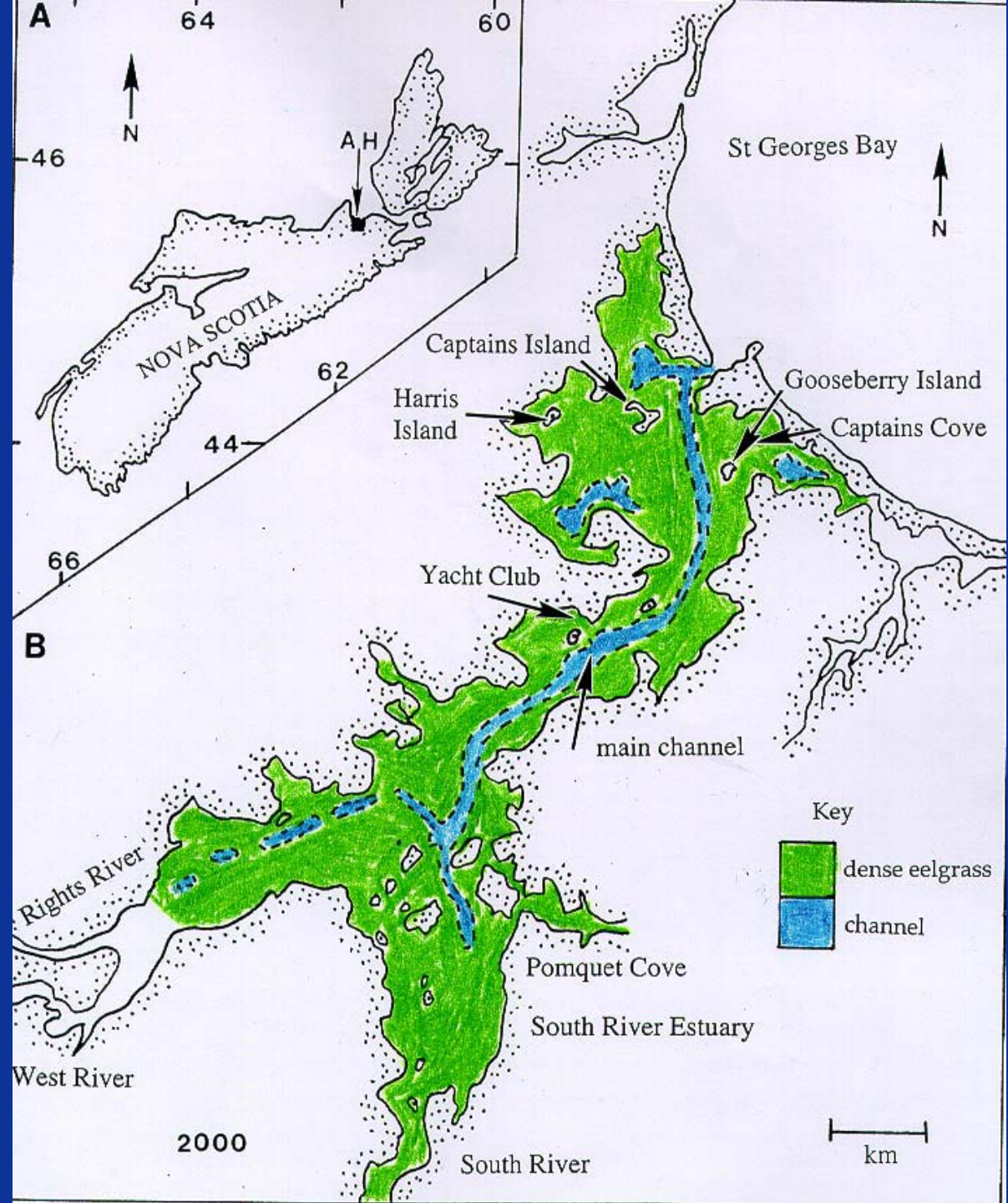
Zostera marina
aka eelgrass

Carcinus maenus
aka green crabs

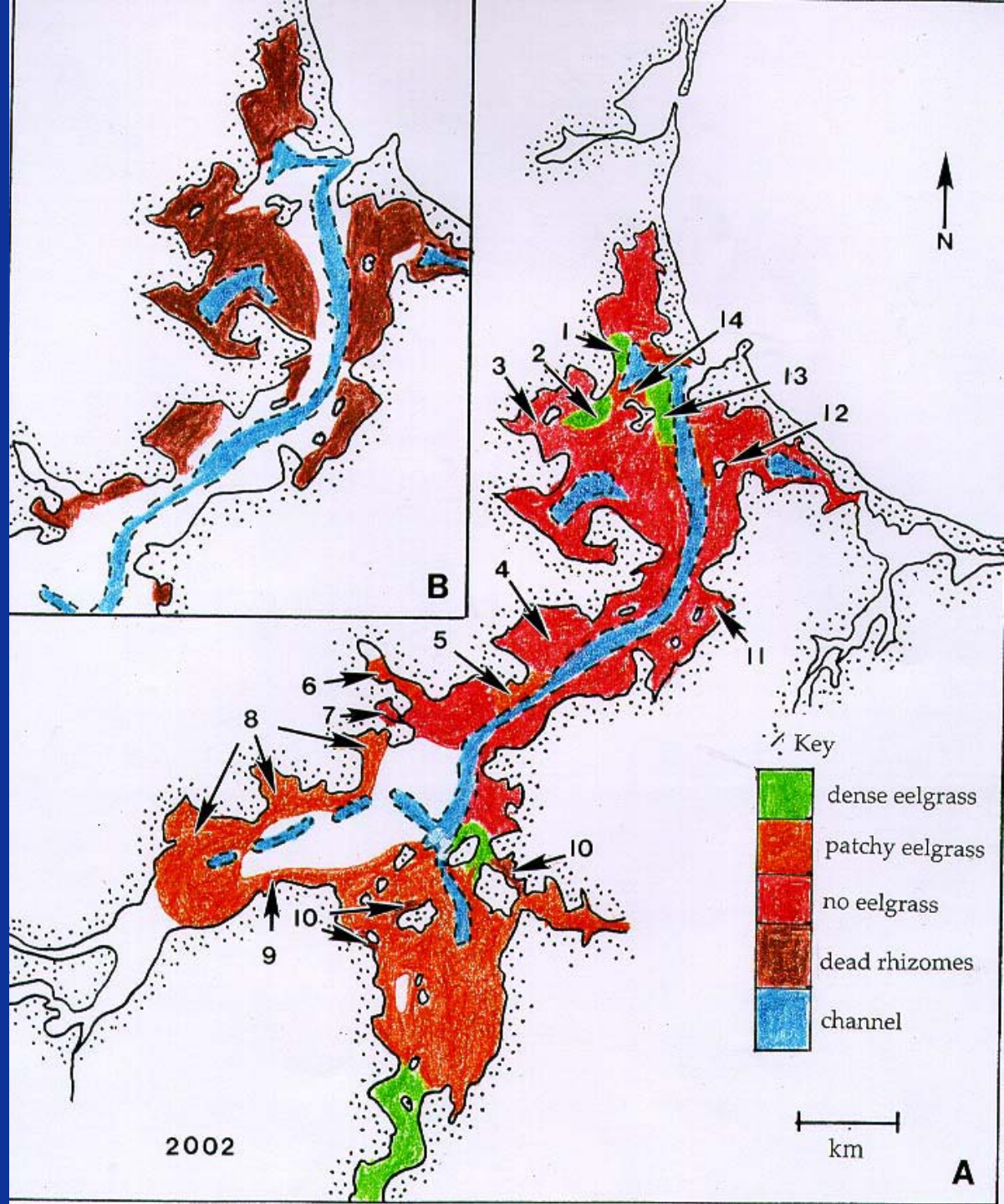


Act 1 - The
Setting

Antigonish
Harbour
Eelgrass beds
1945-2000



Antigonish Harbour Eelgrass 2001



Antigonish Harbour 2000 and 2001

Roots and Rhizomes

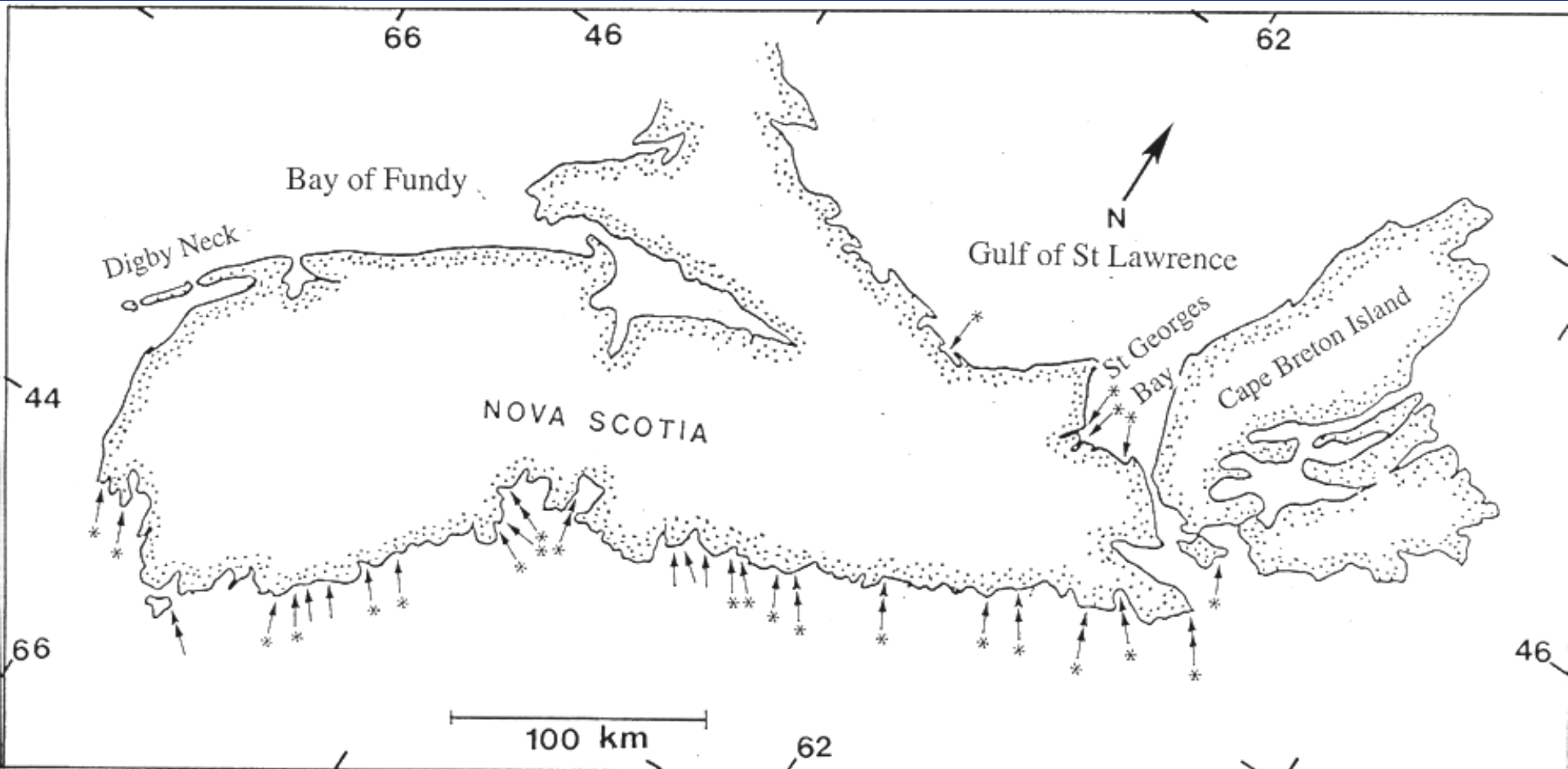
	2000	2001
Total Biomass		
(g m ² ± s.e.)	2133 ± 279	175 ± 42
Living Biomass		
(g m ² ± s.e.)	1505 ± 201	70 ± 27
% Living Biomass	71	41

Act 2 - Nova Scotia

Survey of Harbour Masters

- Can you comment on how extensive the eelgrass beds are or have been (historically) in your harbour?
- Have you noticed any change in eelgrass abundance in recent years?
- Are there any other changes in the biology of the harbour that you or other harbour users have commented upon? Green crabs? *Codium*?

Eelgrass decline and green crabs (*)



Have *Zostera* beds in Nova Scotia declined?

- Within the geographic area that includes all reported sites of eelgrass decline, have a significant number of sites declined?

	Observed	Expected
# sites with decline	31	20
# sites with no decline	9	20

$$\text{Chi}^2 = 11.02 \quad \alpha < .001$$

Conclusion: Major decline in many eelgrass beds has occurred in Nova Scotia

Are Green Crabs associated with Eelgrass decline?

- Considering only the declining beds, is there an association with perceived large numbers or increasing numbers of green crabs?

	Observed	Expected
#sites with green crabs	24	16
# sites with no/few green crabs	7	16

$\text{Chi}^2 = 9.03$ $\alpha < .005$

- Conclusion: Green crabs are associated with eelgrass decline in Nova Scotia.

Without green crabs are eelgrass beds healthy?

- In healthy eelgrass beds, is there as association between absence of green crabs and the lack of decline in eelgrass?

	Observed	Expected
# sites with no green crabs	24	15.5
# sites with green crabs	7	15.5

$\text{Chi}^2 = 7.76$ alpha < .01

- Conclusion:

In sites with healthy eelgrass beds there has been little increase in green crab numbers

Act 3 - Enclosure Experiment Tracadie Harbour



Tracadie Harbour Enclosures

Impacts on *Zostera*

- Loss of shoots
 - $116 \times 4 \times 625 \times 1.2 = 348,000$ shoots or 87,000 shoots per day
- Loss of Biomass
 - $1186 \times 4 \times 625 \times 1.2 = 3558$ kg or 890 kg/day
- Density Changes
 - direct measure = $3.8 \text{ shoots m}^{-2} \text{ d}^{-1}$
 - wrack accumulation = $3.5 \text{ shoots m}^{-2} \text{ d}^{-1}$
 - mark-recapture = $0.9 \text{ shoots m}^{-2} \text{ d}^{-1}$

Tracadie Harbour

Caging Experiment 2002 (seven days)

Cage Condition	# Shoots Lost
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1	no crabs	7
2	no crabs	5
3	crabs	78
4	crabs	48

$\text{Chi}^2 = 94.2$
 $\alpha < 0.001$

4 shoots lost
 $\text{m}^{-2} \text{d}^{-1}$

The victims - Whole shoots lost from bed !



shredded



rhizome



cut

modus operandi - green crab pits



Antigonish Harbour

Loss of eelgrass from the Antigonish Estuary, and concomitant decline in fall staging Canada Geese and Common Goldeneye during 1998-2000 (Seymour *et al.* 2002).



Conclusions

- A major decline occurred in *Zostera marina* in Nova Scotia
- Green crabs (*Carcinus maenus*) are the generalized cause of this decline
- Impacts unclear but a decline of 50% in migrating Canada Geese in one site.
- Negative impact on detritus-based food chains in coastal waters (e.g., lobster?)
- Negative impact on estuarine biodiversity
- Subsequent limited eelgrass recovery was coincident with green crab decline and return of geese.

Acknowledgements

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- DFO

A Disappearing Act? Eelgrass (*Zostera marina*) Decline in Kejimikujik National Park, Nova Scotia

Aimée Pelletier¹, Kristina Benoit¹, Chris McCarthy² and Bill Freedman³

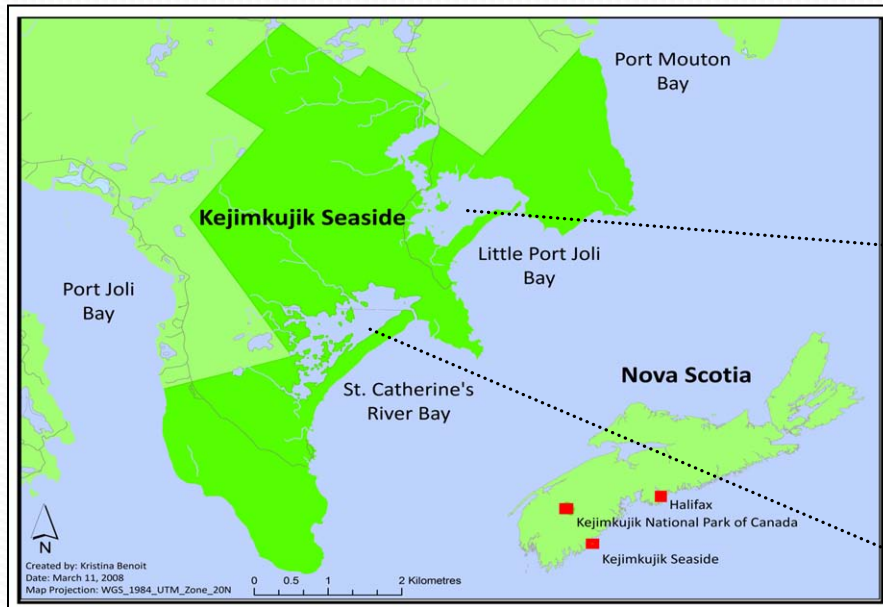
¹School for Resource and Environmental Studies, Dalhousie University

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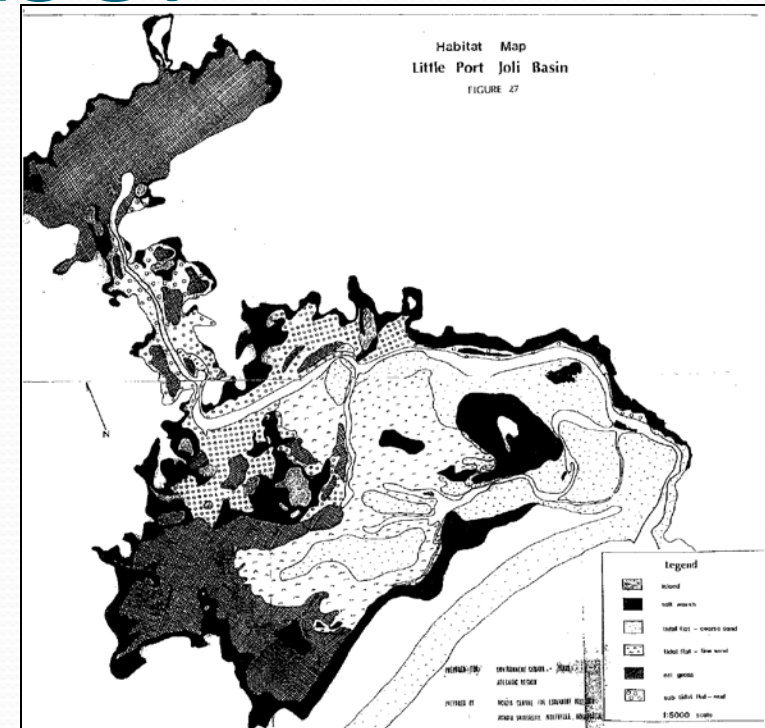
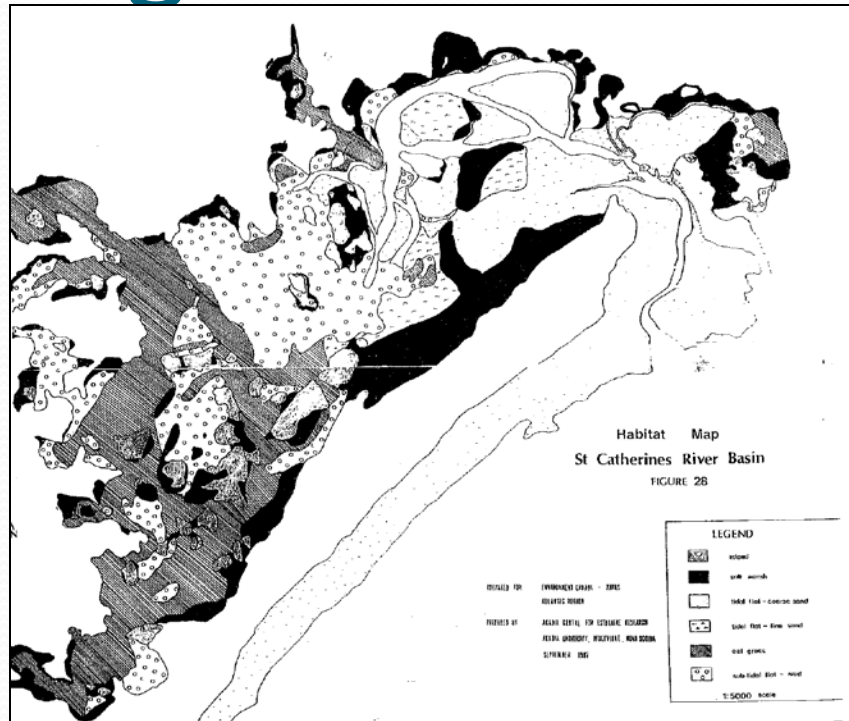
Address for Correspondence: aimée.pelletier@dal.ca

Study Site: Kejimikujik Seaside



- 22 km² coastal property
- Two coastal lagoons:
 - St. Catherine's River Basin (141 ha)
 - Little Port Joli Basin (125 ha)

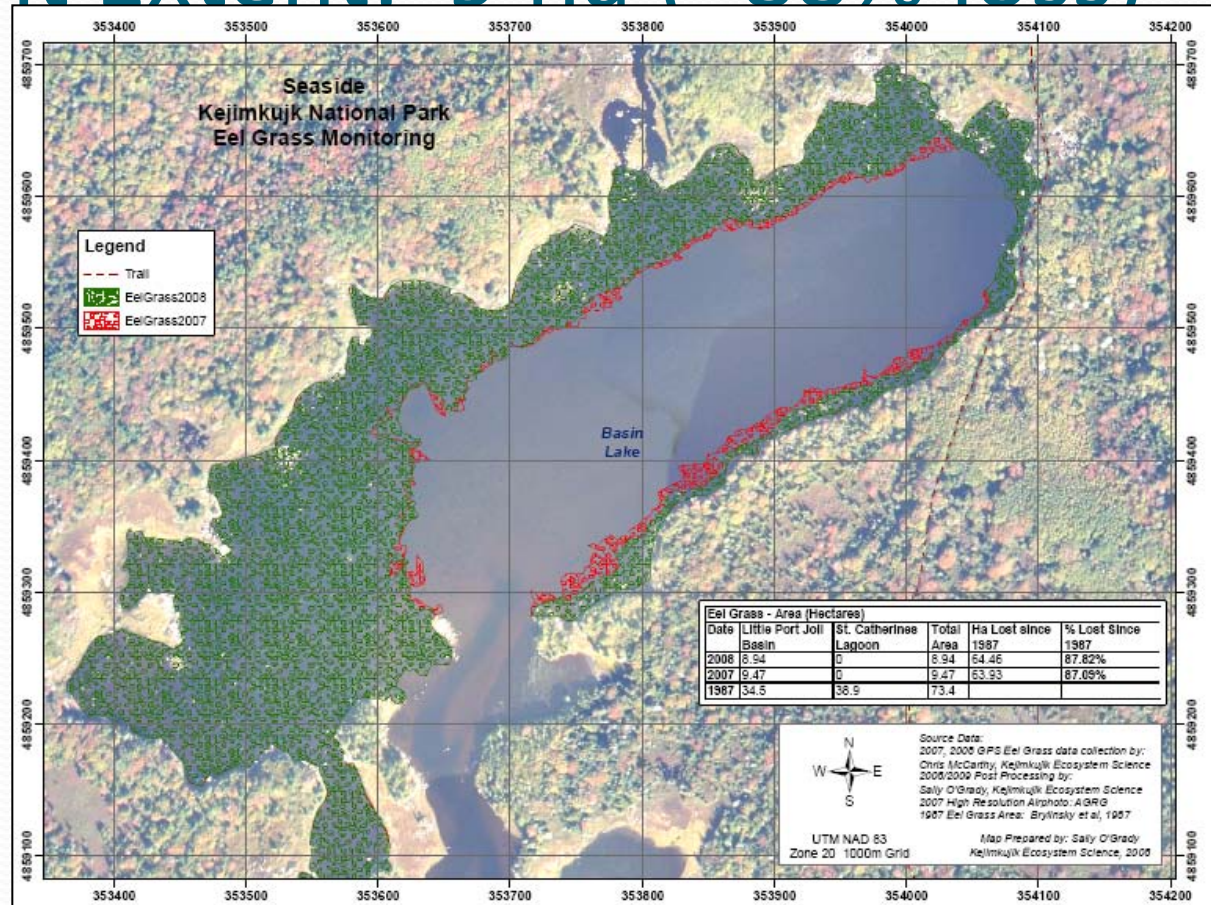
Eelgrass Baseline: 1987



Brylinsky *et al.* 1987

- St. Catherine's River Basin: 37 ha of eelgrass
- Little Port Joli Basin: 35 ha of eelgrass

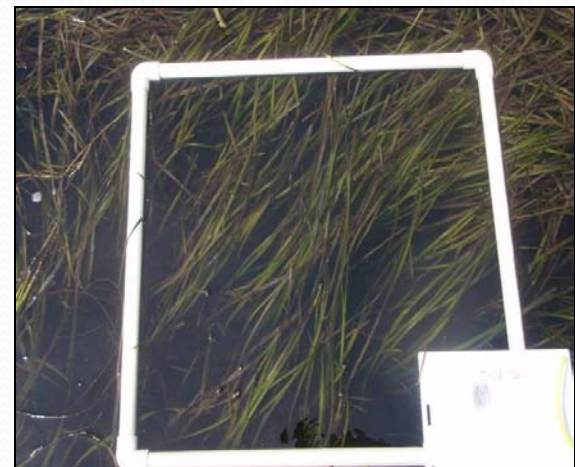
Current Extent: 9 ha (~88% loss)



- Canoe surveys of both lagoons in 2007 and 2008.
- Mapping of bed edge using hand-held GPS on “track”
- Fringing bed in Basin Lake (Little Port Joli Basin) is all that remains.

Current Research

- Eelgrass Condition Monitoring
 - Piloted SeagrassNet methods
- Green Crab Population Estimation
 - Swim transects
 - Mark-Release-Recapture using visual implant elastomer
- Water Quality (bi-monthly, May-September)
 - Nitrate, Phosphate, Ammonia, Silicate
 - CDOM
 - TPM
 - Salinity, DO, pH



Possible Reasons for Loss: Epiphytes

- Epiphyte coverage minimal except some shoots partially covered or knitted together with the invasive golden star tunicate (*Botryllus schlosseri*).
- No signs of eelgrass disease.





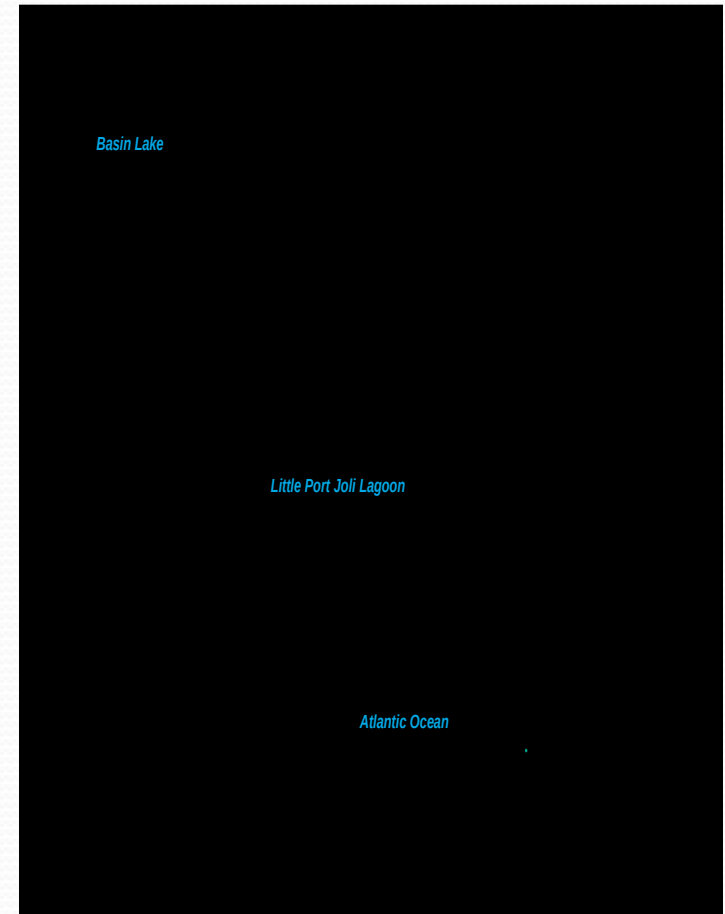
Possible Reasons for Loss: Green Crab Damage

- Swim transects and mark-release-recapture study indicate large number of green crabs in bed.
- Large proportion of whole dislodged plants with signs of green crab damage (shredded or neatly clipped sheaths).



Possible Reasons for Loss: Water Quality

- Water clarity and salinity strongly influenced by episodic precipitation events which increase CDOM concentrations due to large freshwater inputs from surrounding wetlands.
- Moderately enriched in DIN and phosphate with respect to nearby open ocean waters, but not considered a threat.
 - Pristine watershed (no point sources)
 - Natural enrichment due to restricted tidal flushing.



2008 an Odd Year?

- A large precipitation event followed by hot weather and low winds caused rapid senescence and stagnation of the bed in mid-July 2008—a full month earlier than in 2007.
 - Mat of dislodged shoots sat on top of bed and decomposed.



What next?

- Continue eelgrass extent and condition monitoring
- Green crab exclosures in eelgrass bed proposed for 2009
- Large-scale removal of green crabs from Basin Lake proposed for 2009



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