Loss of Eelgrass (*Zostera marina*) Associated With Green Crabs in Maquoit Bay, Maine

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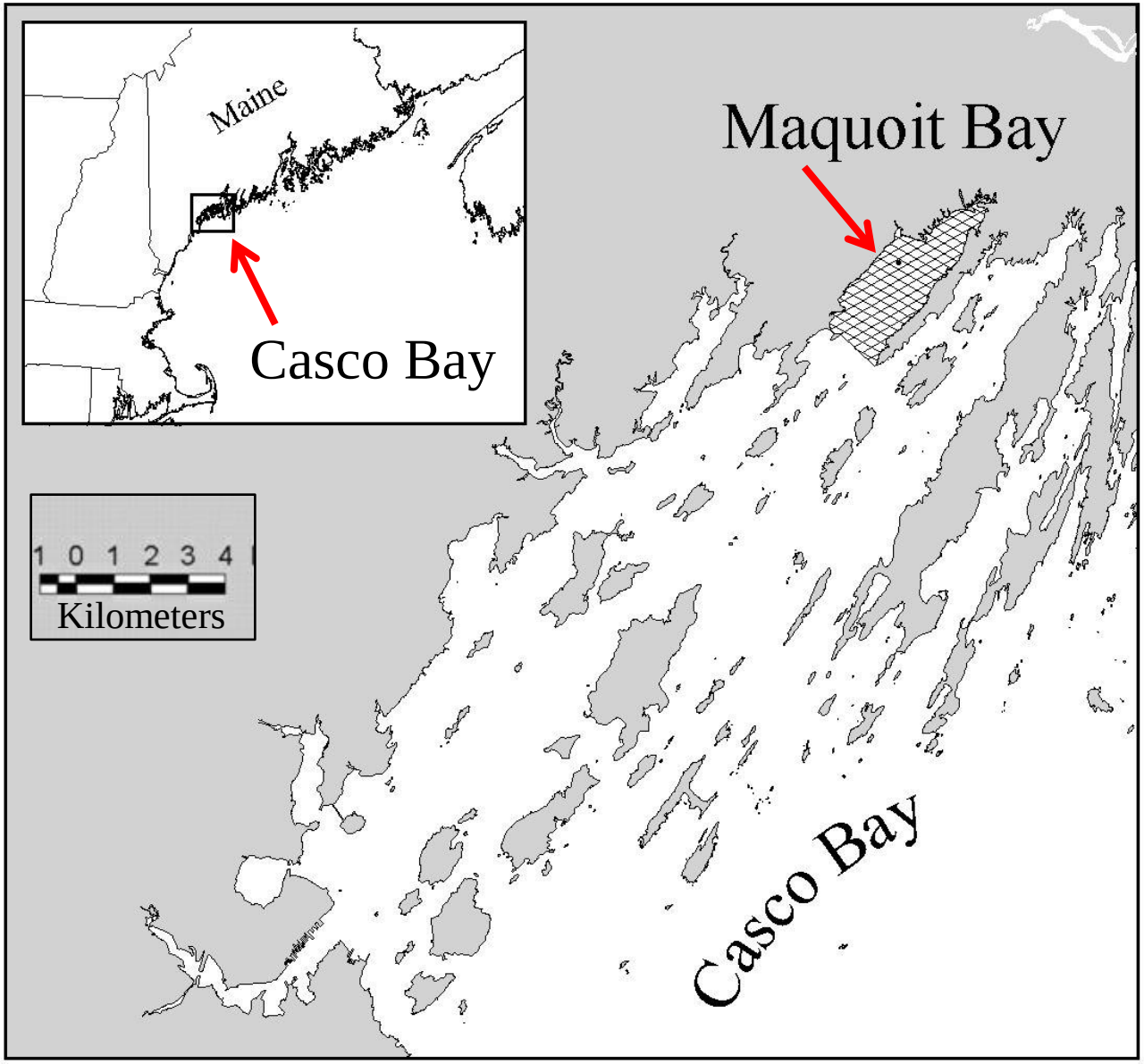

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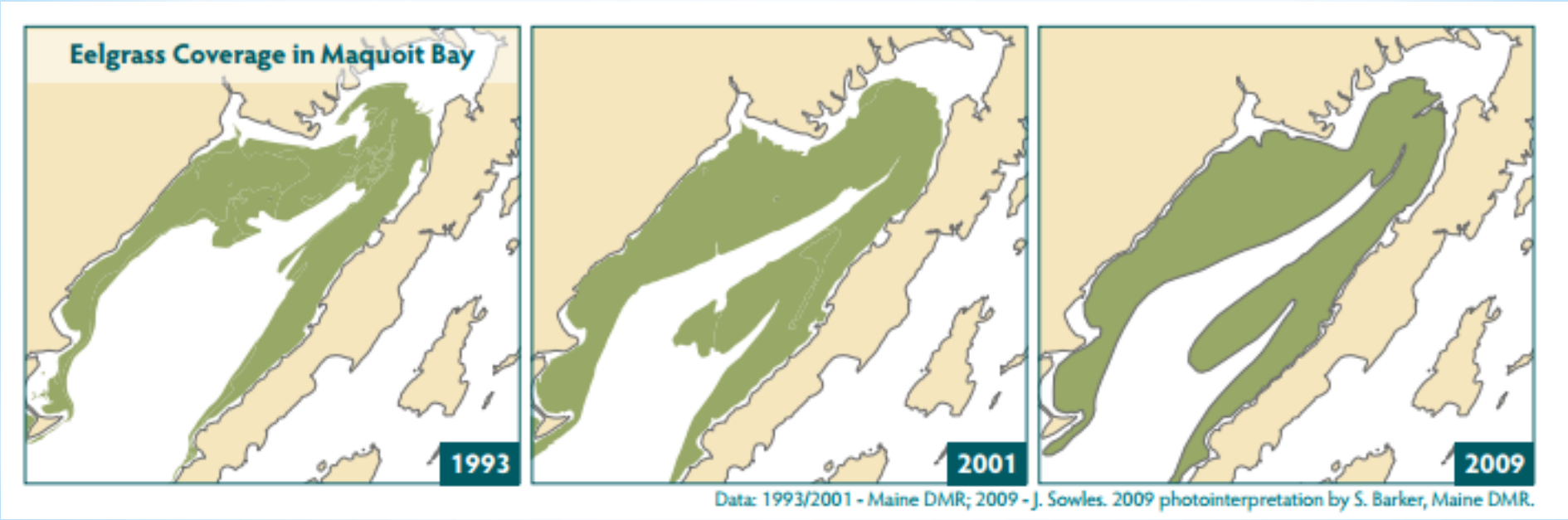
Eelgrass Coverage in Maquoit Bay
1993 - 2009



1993 → Increase → 2001 → No change → 2009

Source: Casco Bay Estuary Partnership – 2010 State of the Bay Report

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Intertidal Flats at Head of Bay

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Intertidal Flats at Head of Bay

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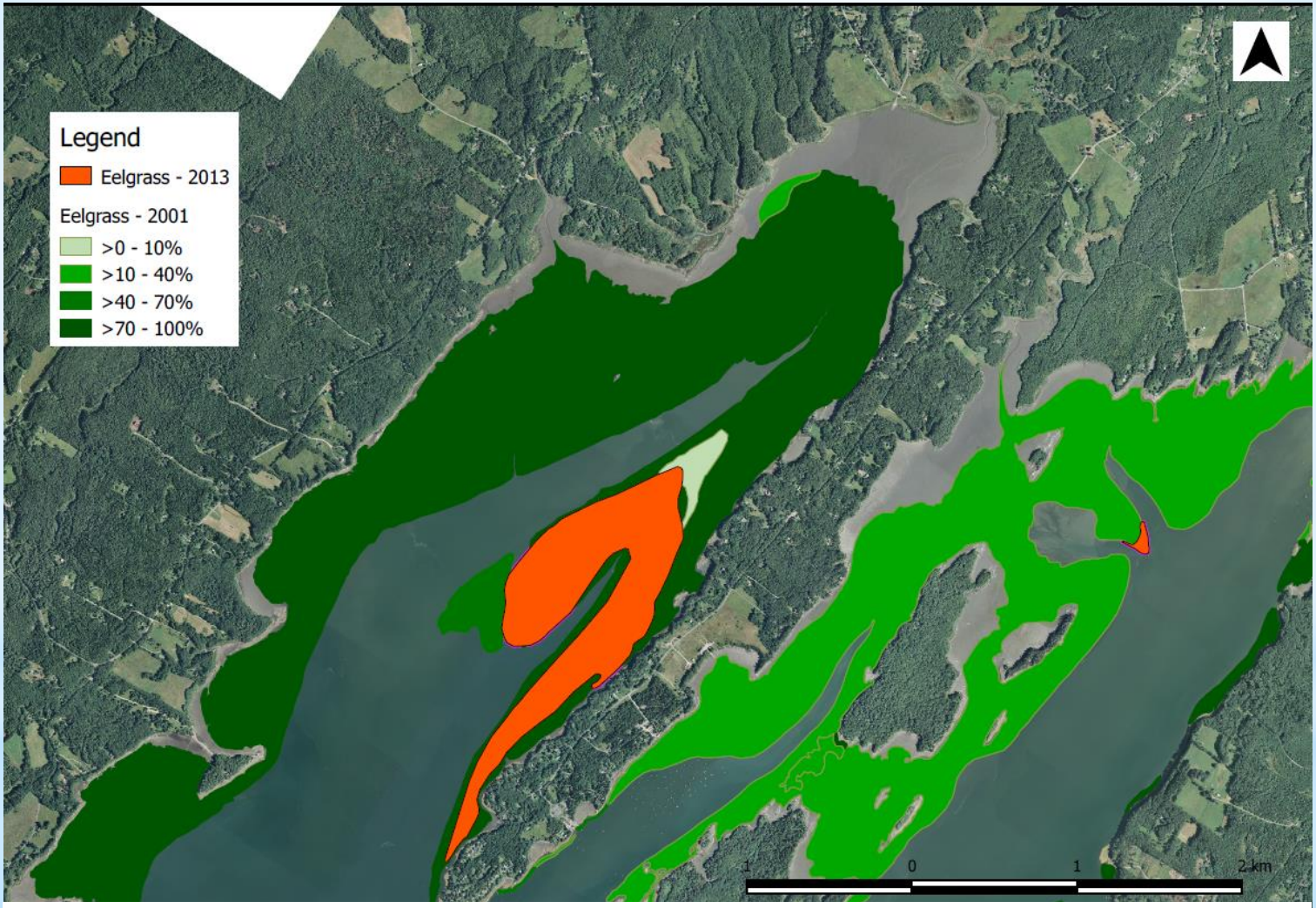
Eelgrass Change Analysis

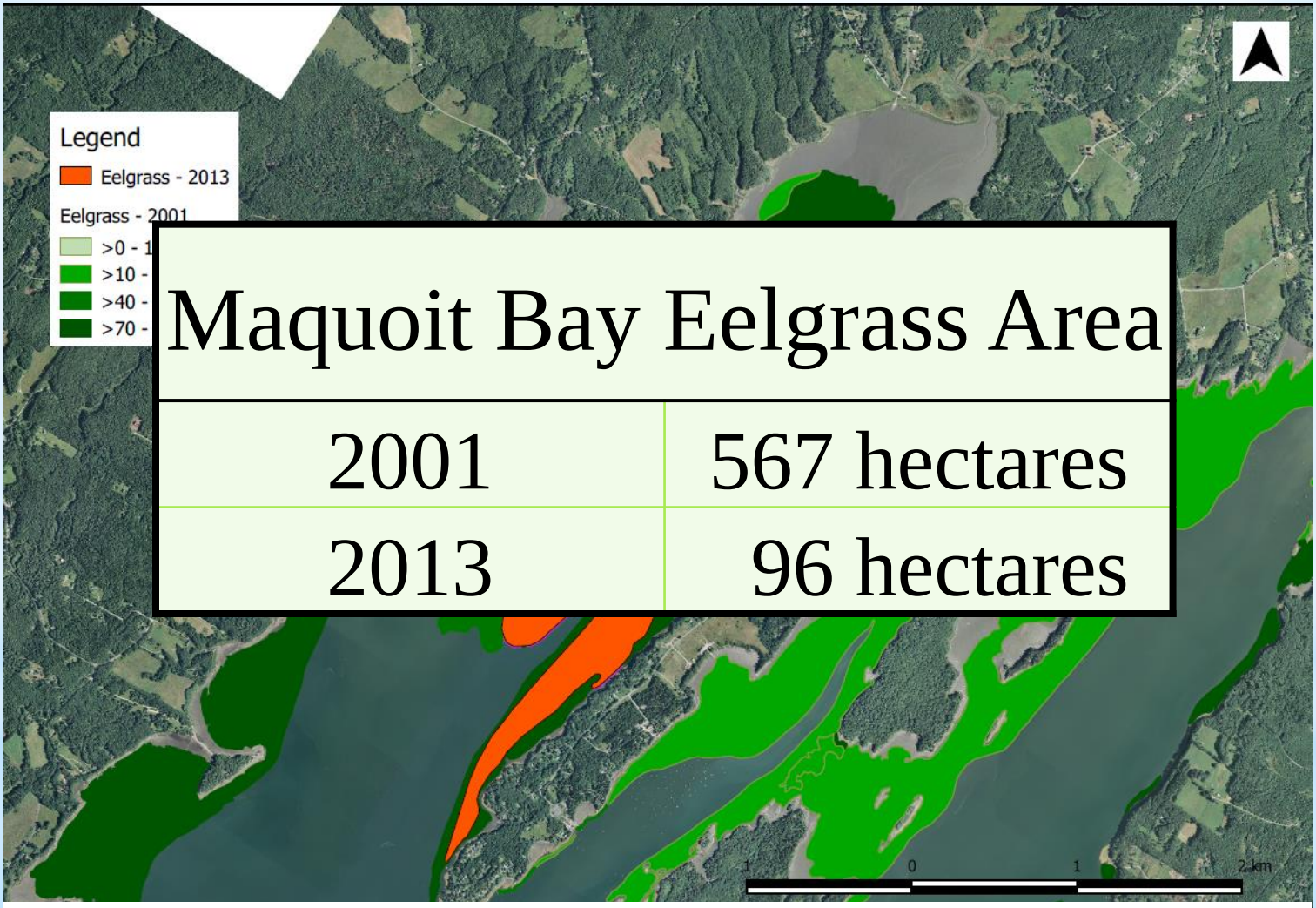
2001 - 2013



Mapping by Seth Barker was funded by Casco Bay Estuary Partnership with field assistance from ME DEP

Eelgrass Change Analysis

2001 - 2013



Maquoit Bay Eelgrass Area	
2001	567 hectares
2013	96 hectares

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Potential Causes of Eelgrass Loss

- Water quality and clarity – light limitation
- Sediment organic enrichment – sulfide toxicity
- Direct human disturbance (dredging, dragging)
- Storms – wind/wave scouring
- Ice scouring
- Increased summer temperature
- Wasting disease
- Toxic pollutants
- Animal disturbance

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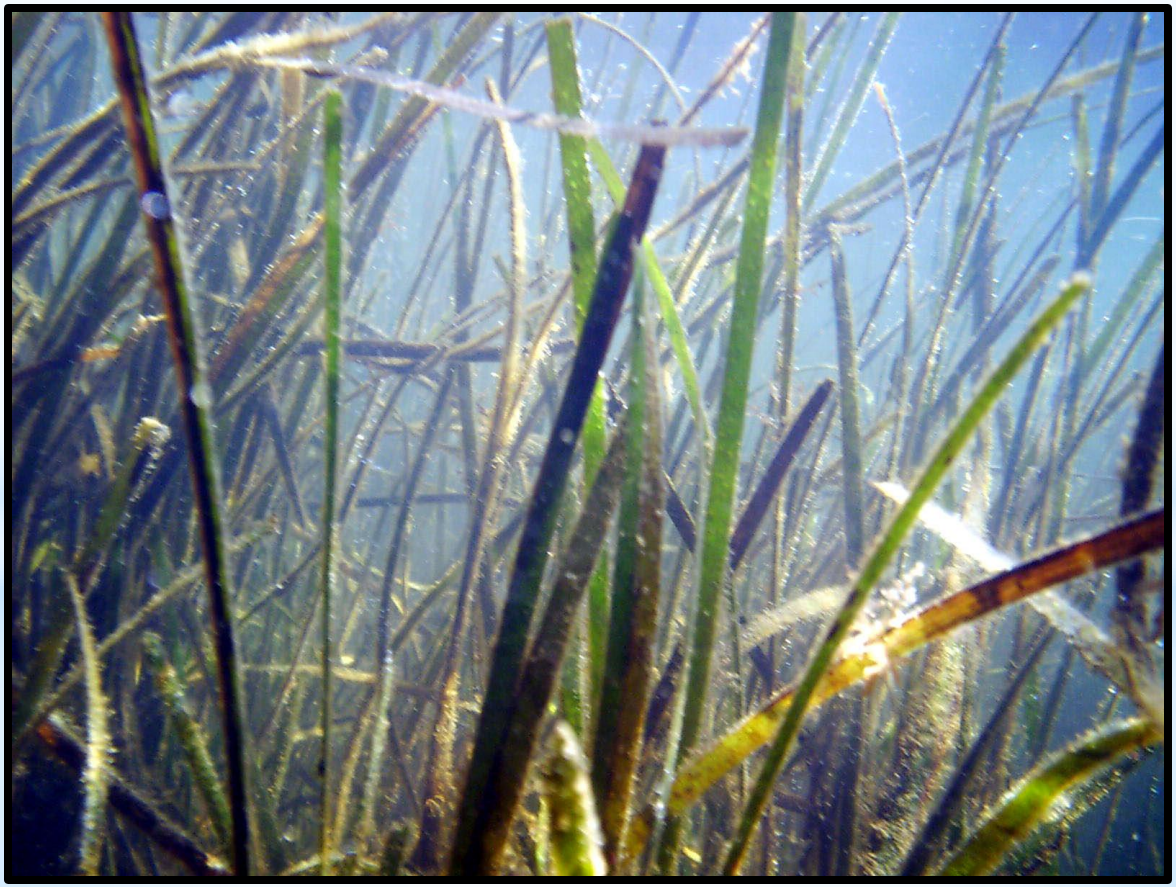
Evidence of Damage by Green Crabs

Shoots collected from shore and floating in Maquoit Bay July 30, 2013

Exclosure Experiment

Are environmental conditions in Maquoit Bay suitable for eelgrass growth in the absence of green crabs?



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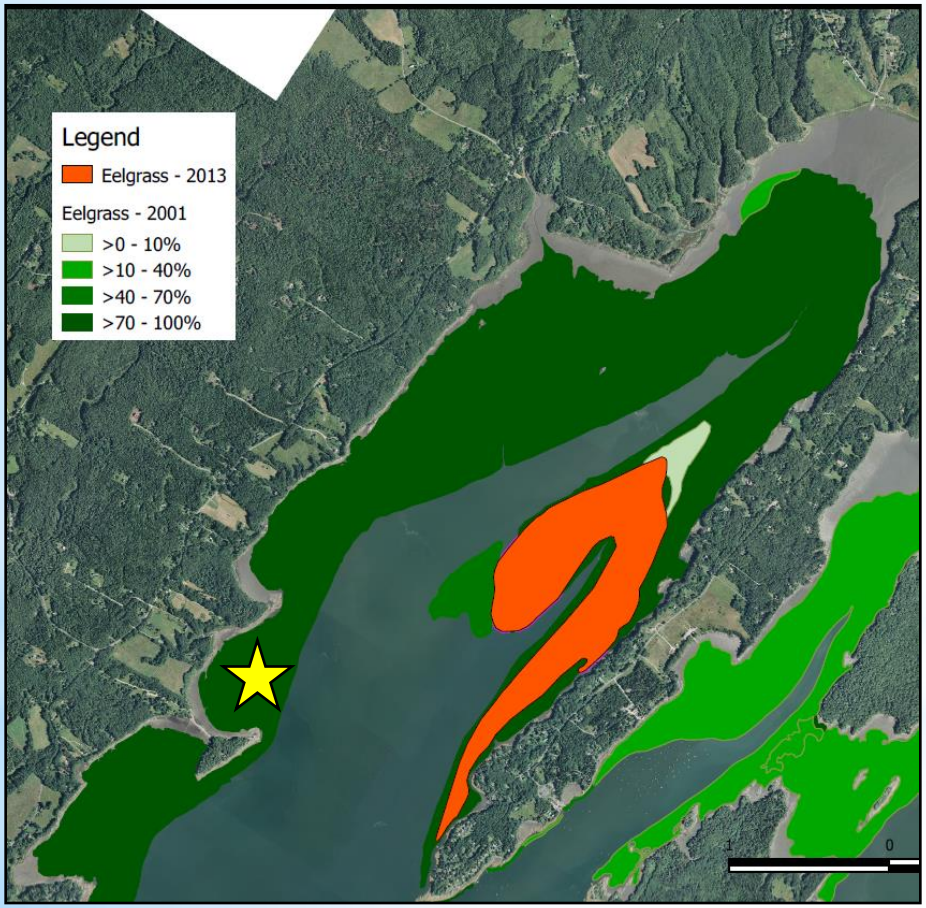
Exclosure Experiment

Location:

Little Flying Point, Freeport, ME



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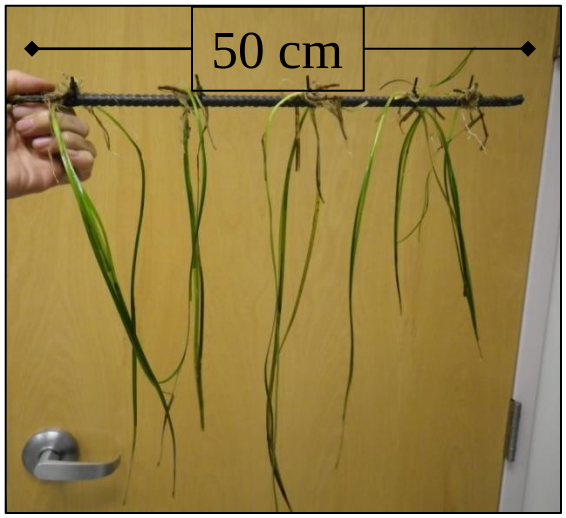
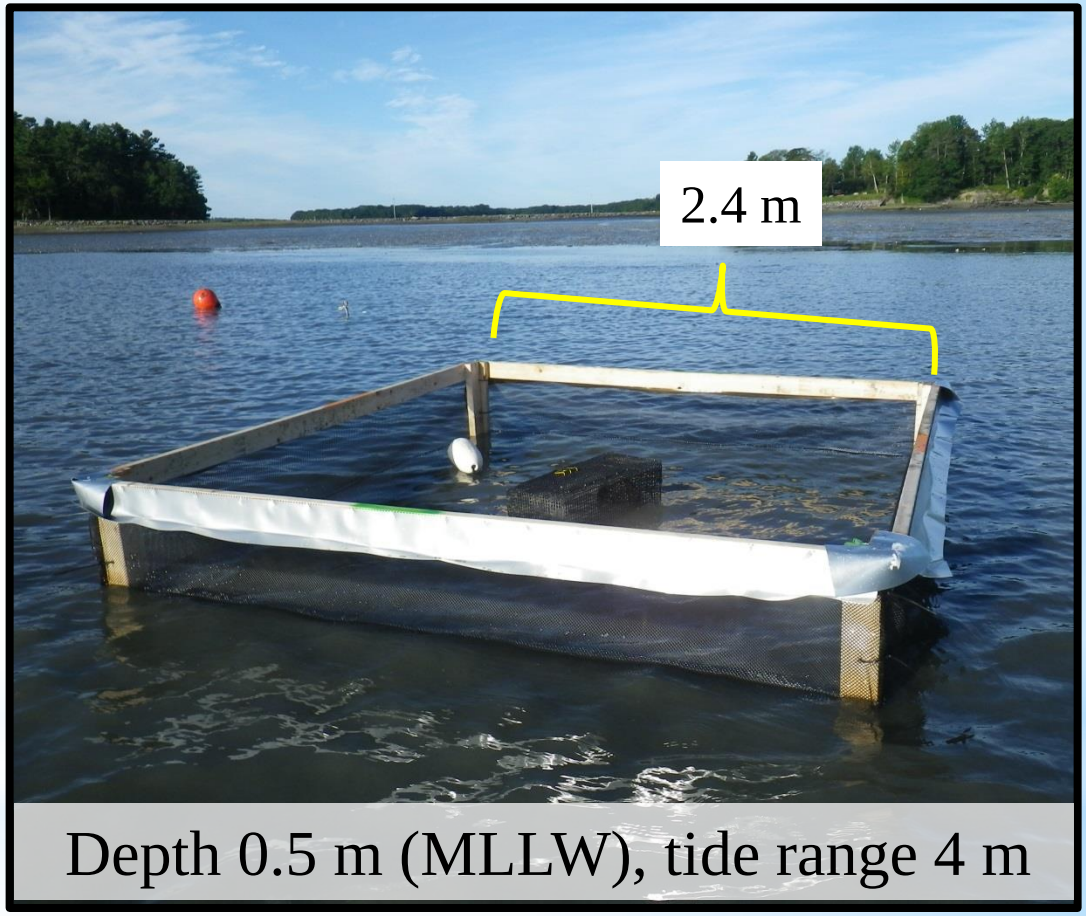
Exclosure Experiment

Design:

Eelgrass transplants

- 3 exclosure sites
- 3 outside sites
- 30 shoots per site





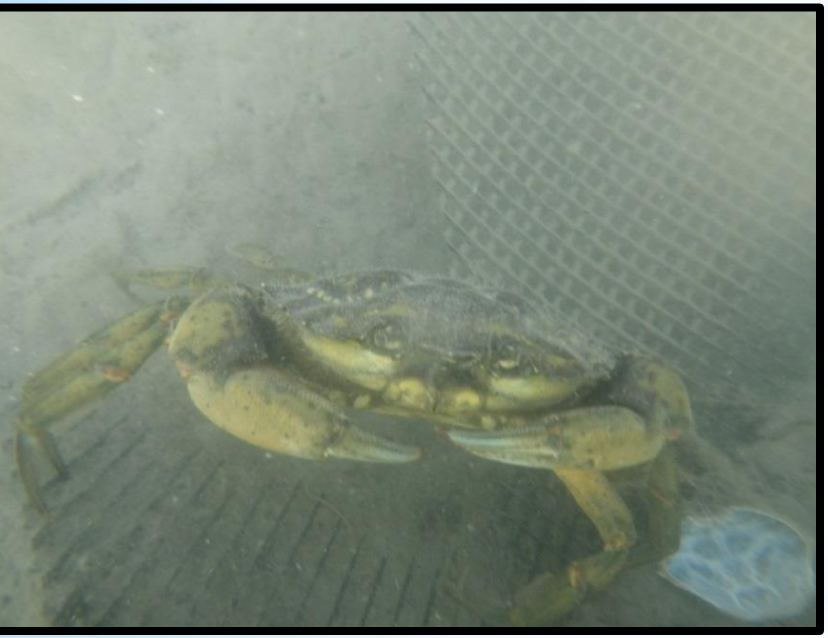
Depth 0.5 m (MLLW), tide range 4 m

26-day growth period, September 5 – October 1, 2013

Measured eelgrass survival and growth, environmental conditions

Exclosure Experiment

Protection from Green Crabs:



Green Crabs Caught in Traps (mean total per trap during interval)		
	Baited before experiment *8/25 - 9/5*	Unbaited during experiment *9/5 - 10/1*
Exclosure	27	17
Outside	242	34

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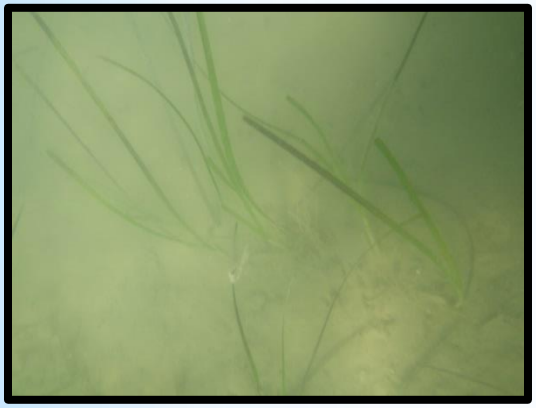
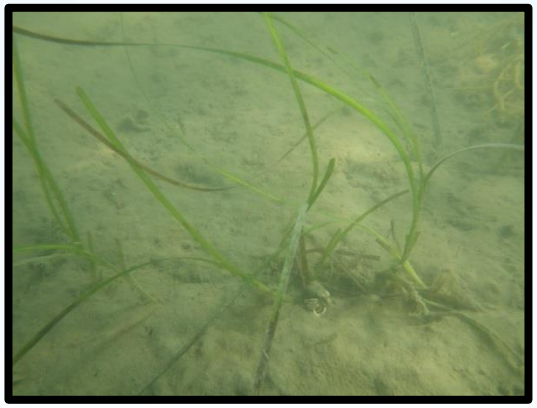
Exclosure Experiment

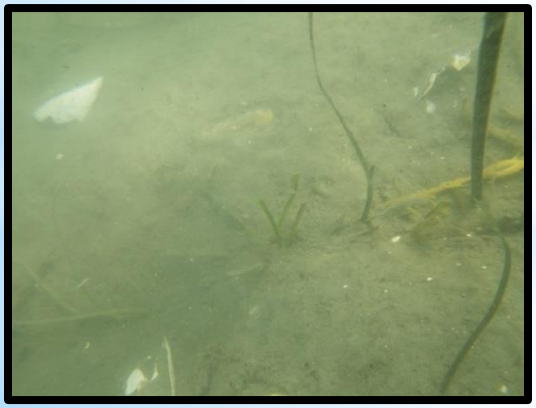
Results: Eelgrass Survival

Exclosures





Outside



Day 10 Day 19 Day 26

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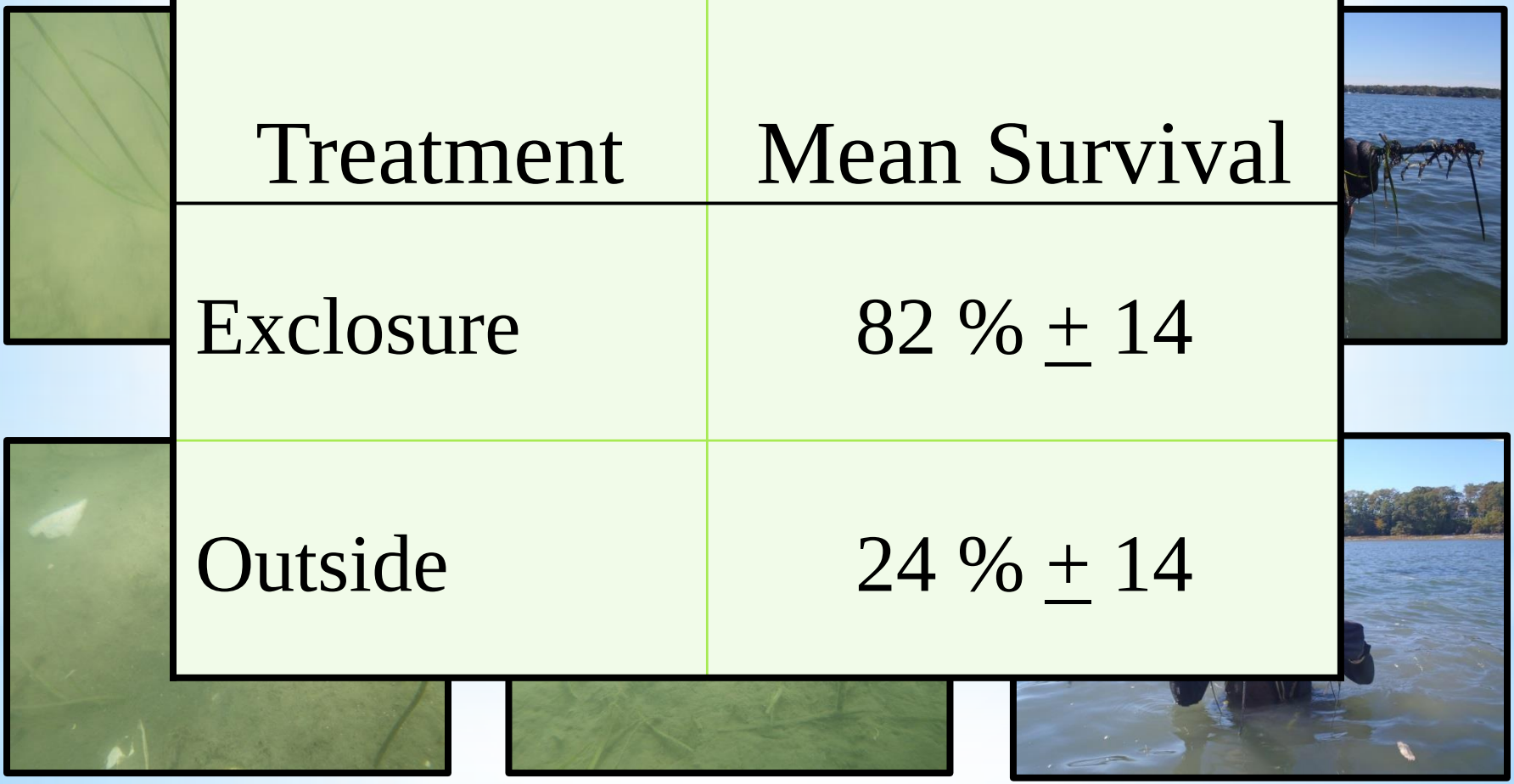
Exclosure Experiment

Results: Eelgrass Survival

Treatment	Mean Survival
Exclosure	82 % ± 14
Outside	24 % ± 14



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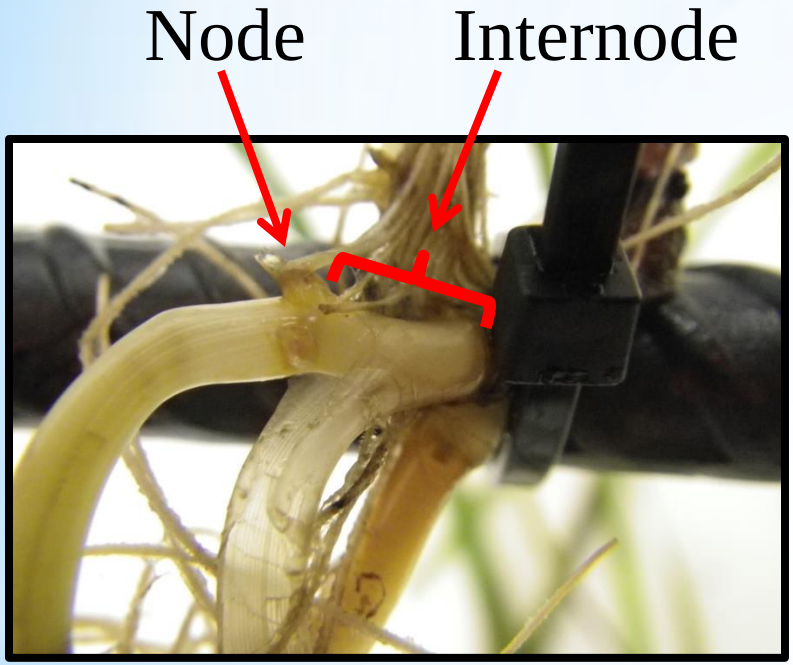
Exclosure Experiment

Results: Eelgrass Growth



N = 57 Undamaged shoots	
New internodes	2.15 ± 0.10

Days Between Formation Of Successive Leaves In September		
Maquoit Bay, ME	14.1 ± 0.8	This study
Fishing Island, NH/ME	12 - 15	Gaeckle and Short (2002)
Waquoit Bay, MA	12 - 15	Hauxwell et al. (2006)

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Exclosure Experiment

Are environmental conditions in Maquoit Bay suitable for eelgrass growth in the absence of green crabs?

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Exclosure Experiment

Results: Sediment Conditions

Year	Site	Organic Content	Source
2013	Exclosure	4.9 % ± 0.04	This study
2013	Outside	4.6 % ± 0.35	This study
2000	Throughout Maquoit Bay	4 - 5 % + 0.3	Neckles et al. 2005

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Potential Causes of Eelgrass Loss

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- ☒ Storms – wind/wave scouring
- ☒ Ice scouring
- ☒ Increased summer temperature
- ☐ Wasting disease
- ☐ Toxic pollutants
- ★ Animal disturbance - green crabs

Conclusions

- Evidence points to green crabs as primary cause of eelgrass loss in Maquoit Bay
- Effects of some other interacting stressors cannot be ruled out
- Restoration possible, but depends on limiting green crab disturbance
- Other eelgrass beds in areas of high green crab densities are at risk
- Factors affecting resiliency of eelgrass beds are in question

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Acknowledgements

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