An Assessment of Habitat Value of Constructed Intertidal Oyster Reefs and Oyster Aquaculture Systems in Delaware Bay, USA

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Oyster Reef Ecology

Oysters build reefs

- create a unique habitat
  - increase biodiversity
  - nursery grounds
  - refuge from predation
  - foraging sites

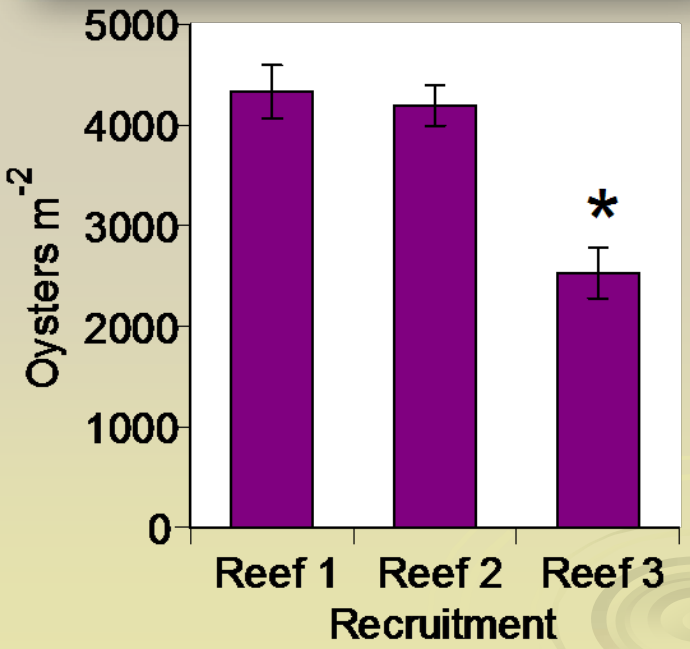
Intertidal Oyster Reefs in Delaware Bay

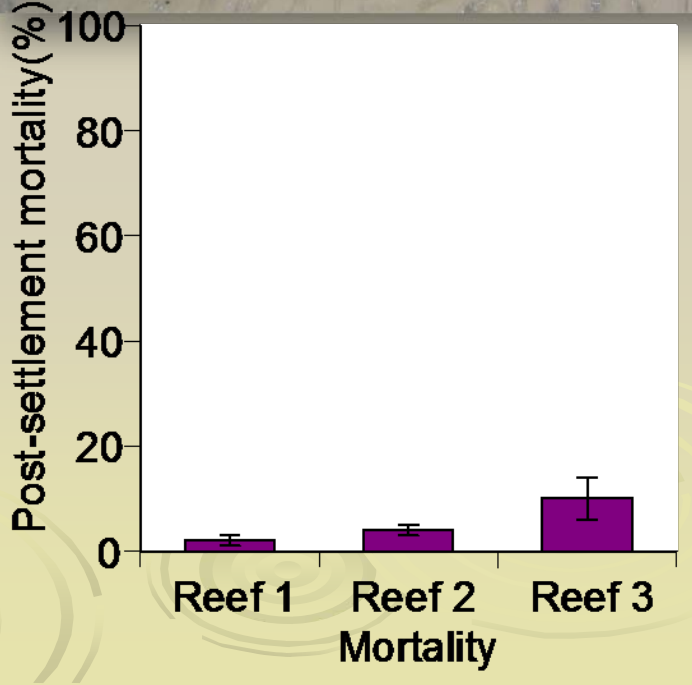
Why Don’t Intertidal Oyster Reefs Persist in Delaware Bay?

Preliminary Study Summer 2006

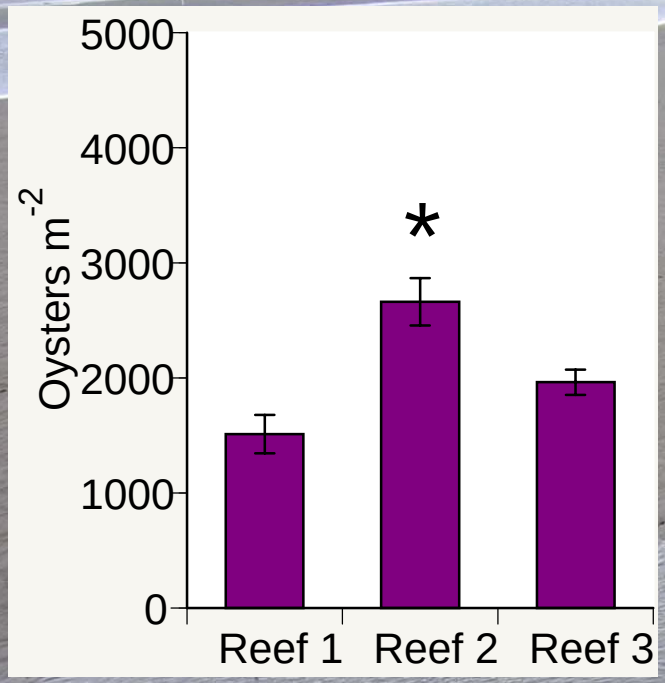
- Three shellbag reefs
  - 1-layer (Reef 1)
  - 2-layer (Reef 2)
  - 3-layer (Reef 3)
- Monitored oyster recruitment & mortality
- Examined reef persistence thru winter

Summer 2006 Oyster Recruitment





Over-Winter Survival 2007



- High mortality on Reef 1 due to sedimentation
- Reef height necessary for reef persistence

What do they attract?

Oyster Aquaculture at Cape Shore

- New activity on the tidal flats
- Rack and bag system creates structure
- Are these structures functionally equivalent to oyster reef habitat?

2007 Habitat Comparisons

- 6 replicate 2-layer shellbag reefs (1.5 m x 3 m)
- 6 control sand plots
- 6 aquaculture racks

Do intertidal reef and aquaculture habitats support increased motile macrofuana diversity, abundance and biomass?

Are constructed shellbag reefs and aquaculture racks comparable habitat for motile fauna?

Motile Fauna Trap Sampling

Treatments:
- Reefs
- Racks
- Sand

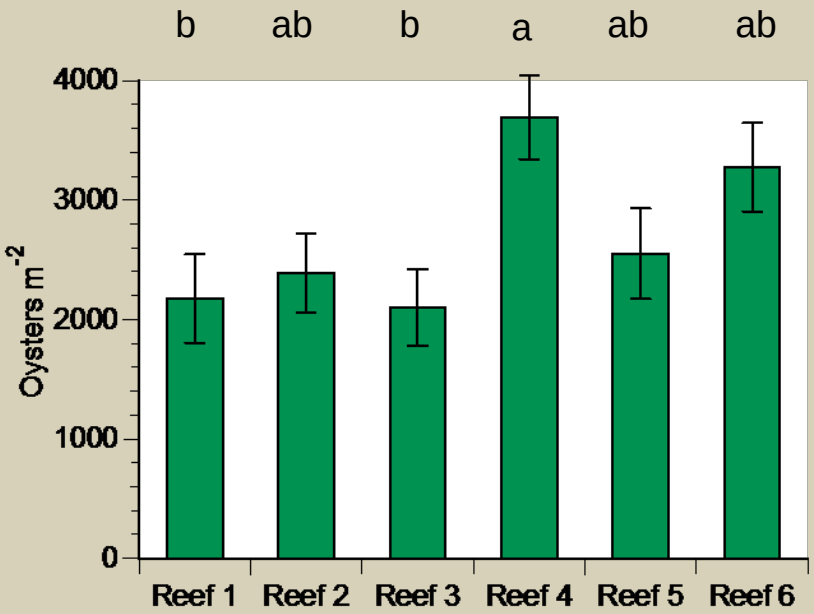
18 eel pots
18 minnow traps
6 crab pots

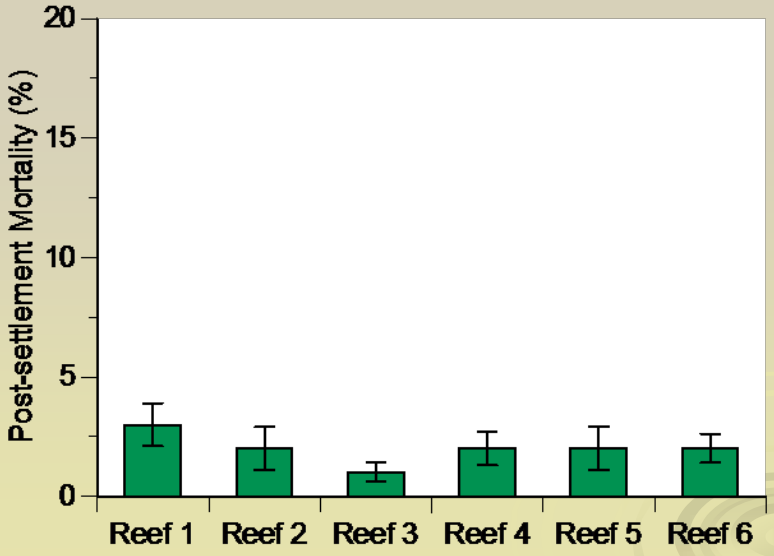
Randomized block design to ensure all sampled simultaneously

39 tides sampled
May to October

Oyster Recruitment & Mortality

16 ten-cm^2 quadrats per reef

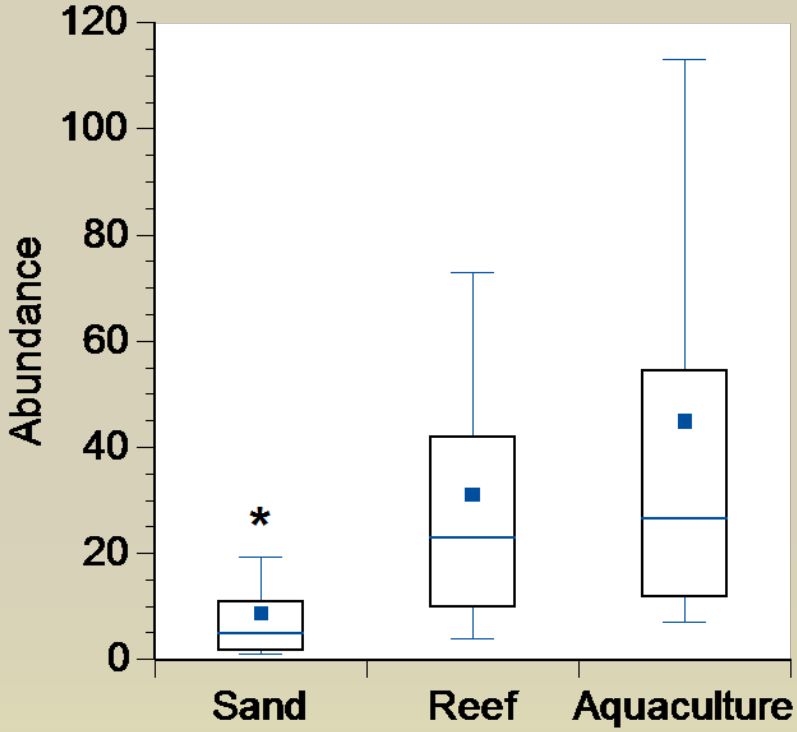


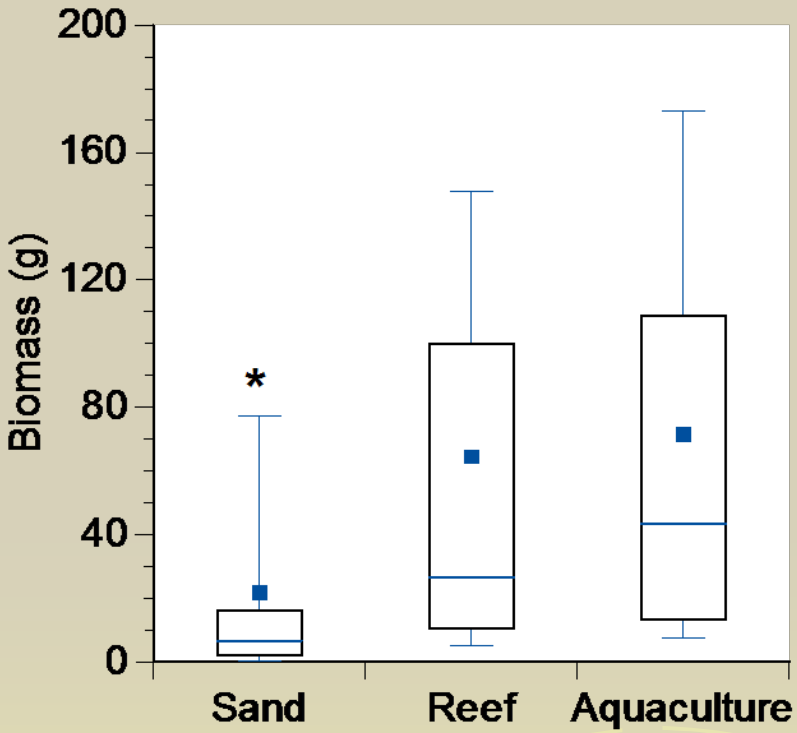


High recruitment
Low early mortality

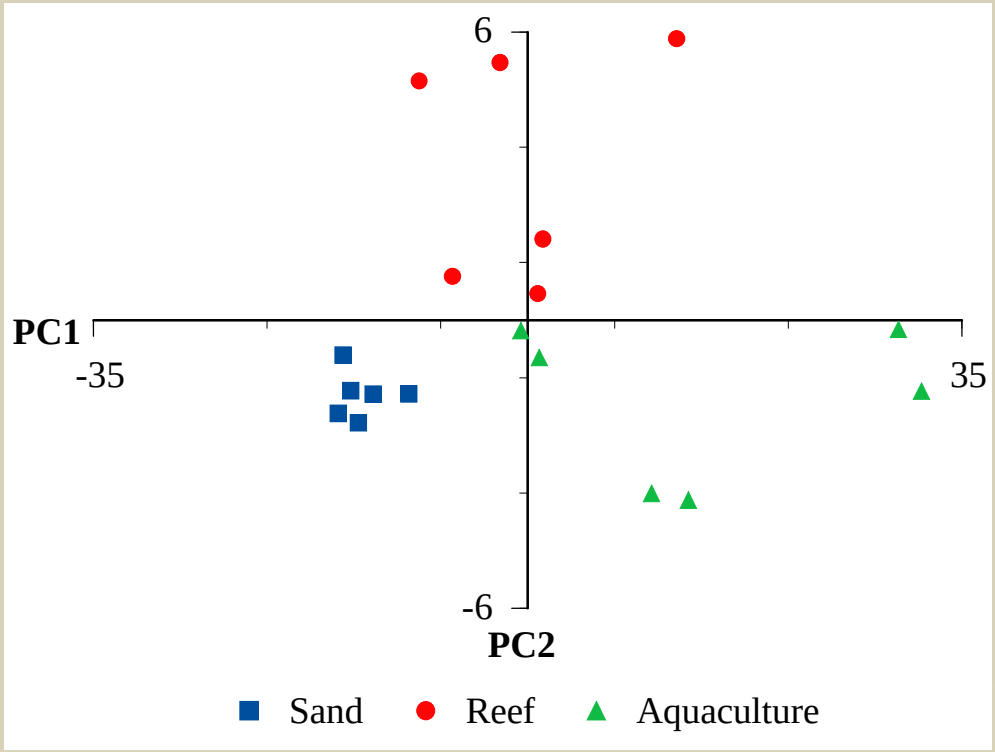
Common Name	Species Name	Sand	Reef	Aquaculture
Grass shrimp	*Palaemonetes pugio*	541	1890	3534
Eastern mud snail	*Nassarius obsoletus*	117	869	840
Longwrist hermit crab	*Pagurus longicarpus*	235	867	658
Blue crab	*Callinectes sapidus*	60	53	58
Sand shrimp	*Crangon septemspinosa*	70	30	33
American eel	*Anguilla rostrata*	2	15	42
Atl horseshoe crab	*Limulus polyphemus*	13	16	1
Silver Perch	*Bairdiella chrysoura*	1	2	17
Estuarine mud crab	*Rhithropanopeus harrisii*	3	12	4
Striped Cusk-eel	*Ophidion marginatum*	5	3	2
Atl silverside	*Menidia menidia*	3	6	7
Flatback mud crab	*Eurypanopeus depressus*	3	10	1
Atl mud crab	*Panopeus herbstii*	2	2	2
Smallmouth flounder	*Etropus microstomus*	3	1	
Striped Bass	*Morone saxatilis*	1	1	
Atl Croaker	*Micropogonias undulatus*	1	3	
Asian shore crab	*Hemigrapsus sanguineus*	1		
Naked goby	*Gobiosoma bosc*		6	5
Oyster toadfish	*Opsanus tau*		2	1
Pinfish	*Lagondon rhomboides*		2	2
Green crab	*Carcinus maenas*		1	1
Summer flounder	*Paralichthys dentatus*		1	1
Black Sea Bass	*Centropristis striata*		1	
Alewife	*Alosa pseudoharengus*			2
Bay anchovy	*Anchoa mitchilli*			2
Gray snapper	*Lutjanus griseus*			1
Spot	*Leiostomus xanthurus*			1
Striped killifish	*Fundulus majalis*			1
Weakfish	*Cynoscion regalis*			1
White Perch	*Morone americana*			1
	Species Richness	**17**	**22**	**25**

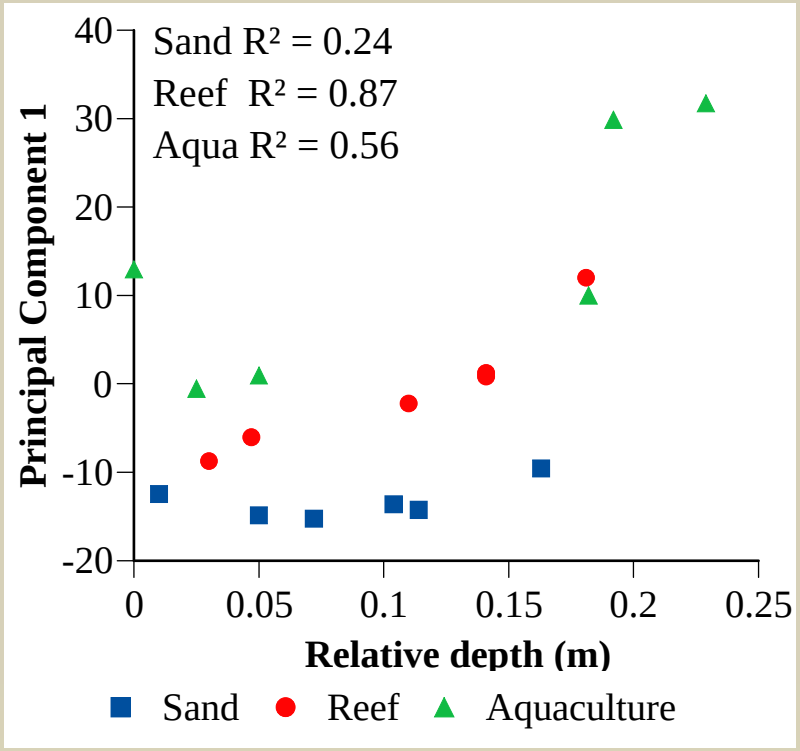
Species Abundance and Biomass





Species Composition PCA





- PCA – 99% of species composition variation
- PC1 – 95%
- Linear regression with PC1 scores and habitat relative depth

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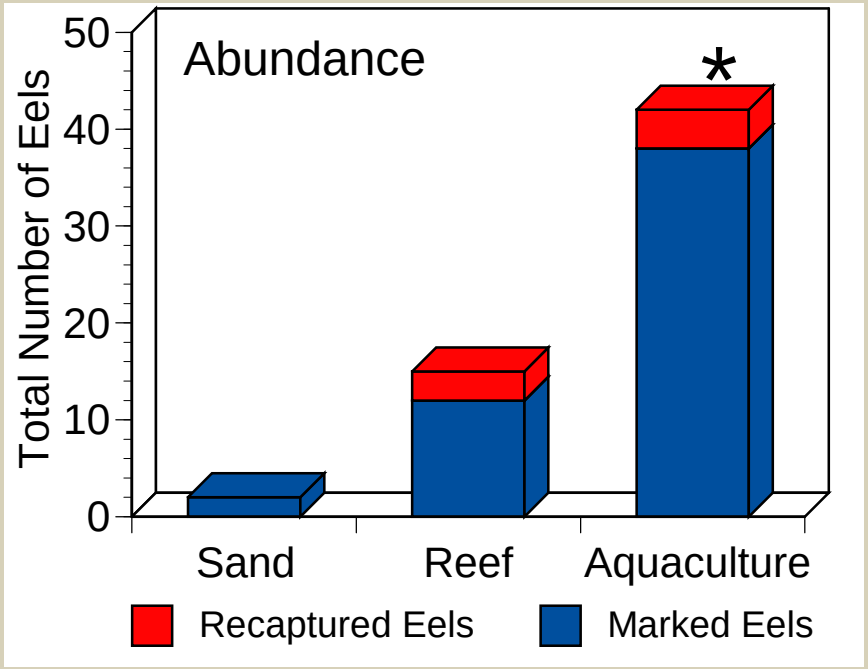
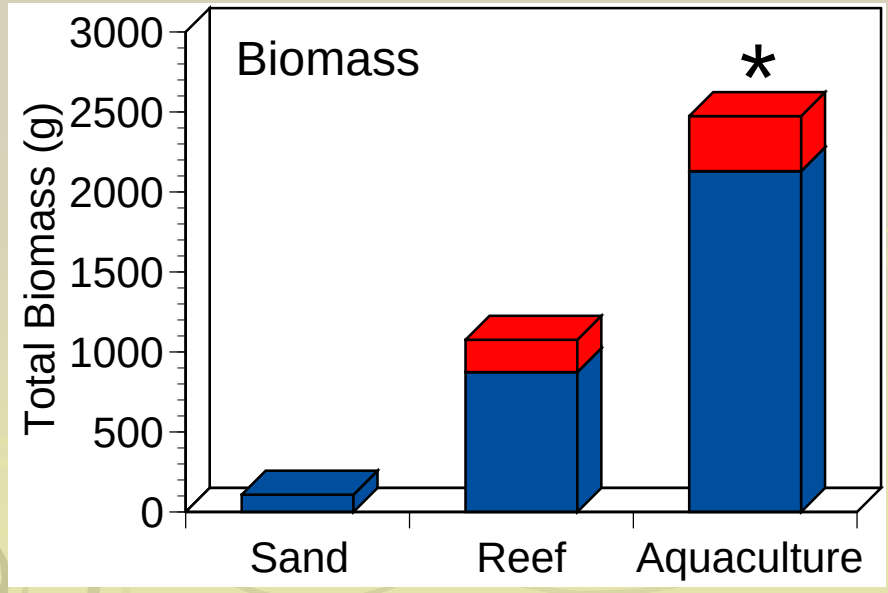
- Important commercial fishery species
- Complex life history
- Yellow-phase eels in estuaries 2-20 years

- **Are American eels a resident species utilizing oyster reefs and aquaculture racks as habitat?**

American Eel Mark-Recapture

- 52 eels marked
  - Aquaculture > Reef > Sand
- 7 eels recaptured
  - 1 recaptured 2x
  - 13% recapture rate
  - no preference
    - n = 4 Aquaculture
    - n = 3 Reef





Conclusions

- Constructed reefs and aquaculture racks support increased species richness, abundance and biomass compared to sand flats.
- Rack and bag oyster culture increased species richness of motile fauna by increasing habitat diversity.
- Oyster aquaculture structures are at least functionally equivalent habitat as intertidal oyster reefs.
- Species composition is influenced by both habitat type and relative depth.
- Mark-recapture results show *Anguilla rostrata* is a resident reef/rack species.

Acknowledgements

Special thanks to:

Greg Debrosse
Fernando Fuentes
Emily Scarpa
Iris Burt
Sean Boyd
Jeff Pydeski
Tom Evans
Emma Green-Beach

And to: James Tweed of Atlantic Capes Fisheries for allowing us to sample on their oyster farm.

Funding:

New Jersey Water Resources Research Institute Graduate Student Grant-in-Aid
The Rutgers University Graduate Program in Ecology and Evolution Academic Excellence Fund
Rutgers University Research Council Grant
Dupont Clear Into the Future Fellowship

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