An Ecosystem Approach to Living Shoreline Project Design: Restoration of Penniman Spit, York River*

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* Funded by Chesapeake Bay Trust

Objectives

Objective 1: Develop a shovel-ready living shoreline restoration plan and monitoring protocols.

Deliverable 1. Literature review of design applications and effectiveness

-emphasis on design features that optimize oyster restoration and ecosystem benefits over the long term, which most reviews have not distinguished from short-term effects

Deliverable 2. Description of chosen site and rationale for methodology based on physical characteristics of site

-use structures that have been proven to succeed in marsh/shoreline protection under high-energy conditions

-use structures that have been proven to succeed in oyster restoration and placed in locations benefitting York River oyster restoration

-involve public landowners

-include elements that enhance the ecosystem, especially those addressing CBP outcomes for blue crab, fish habitat, oyster, wetlands (i.e., salt marshes), and climate resiliency

-be transferable to other York River sites and in the Bay

-serve as a demonstration project visible to the general public

-(i) site analysis, (ii) pre-construction monitoring, (iii) permit approval and legal compliance

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Location: Penniman Spit, York River

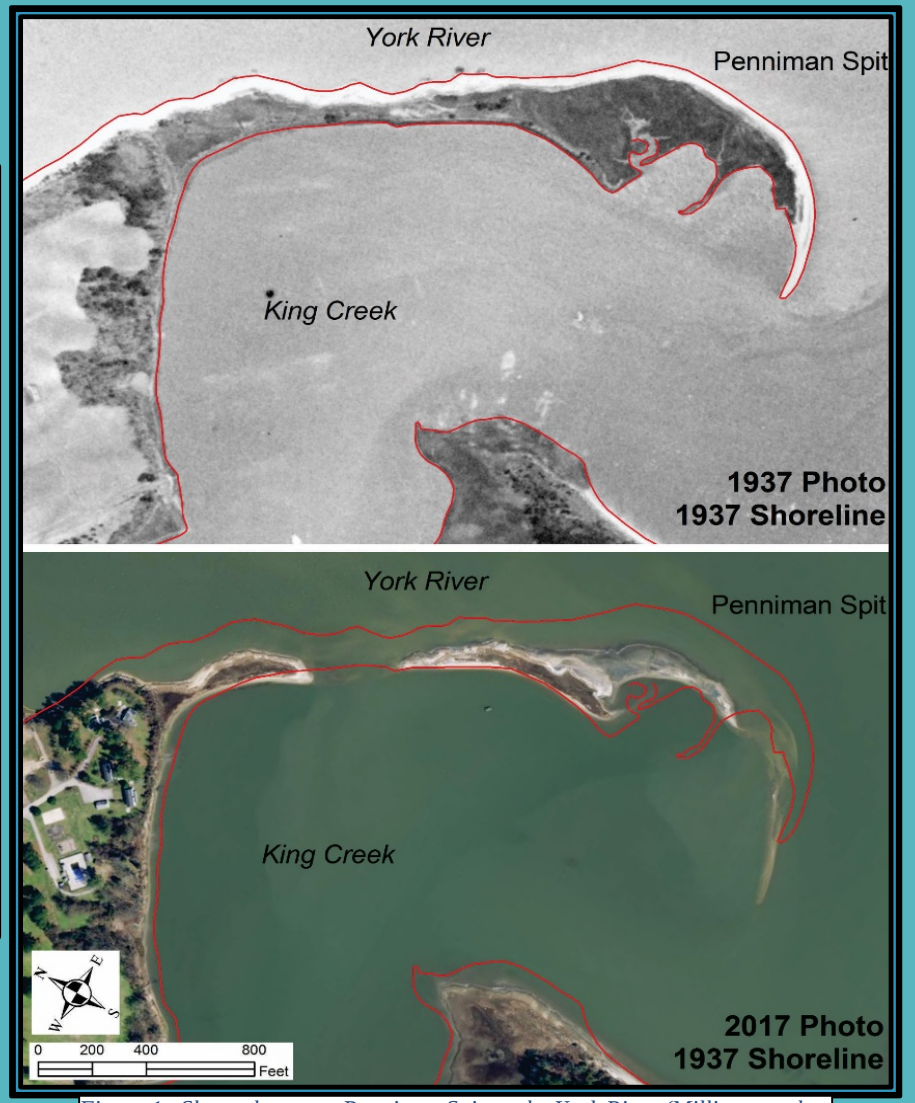
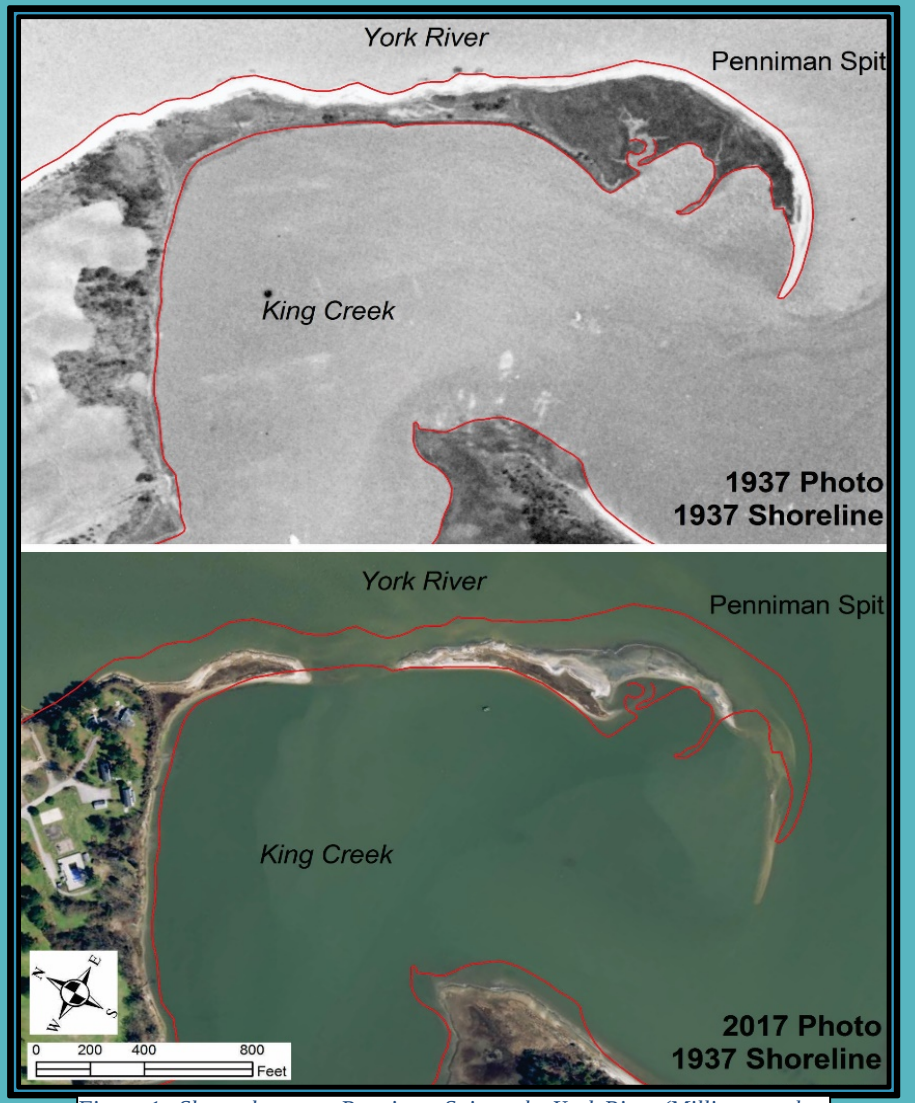


Figure 1. Shore change at Penniman Spit on the York River (Milligan et al., 2010; Milligan et al., 2018).

Ecological Changes: Penniman Spit, York River

- Salt marsh/shoreline erosion under high wave energy conditions and sea level rise
- Loss of protection for lower energy, productive ecotone--inner cove and creek systems
- Loss of nursery habitat for blue crab, white shrimp, and finfish
- Loss of trophic subsidies from marsh, cove and creek residents (e.g. clams, mummichogs, silversides, crabs, shrimp) to higher trophic levels
- Loss of oyster reefs and habitat important for ecosystem and tourism



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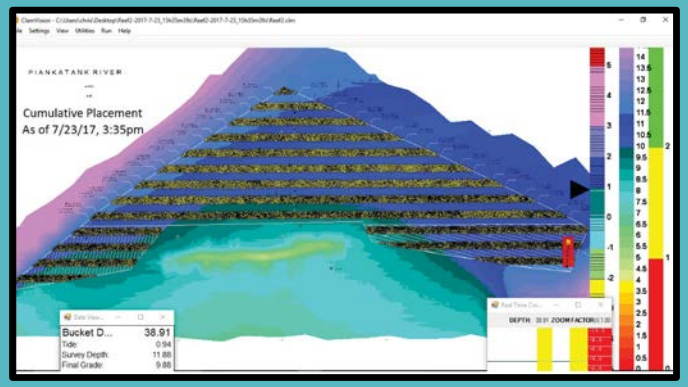
Structures effective for shoreline protection

Figure 2. Draft oyster reef sill system for Penniman Spit.

Structures effective in oyster restoration

Figure 3. Oysters colonizing appropriately-sized granite on the sill below Mean High Water.



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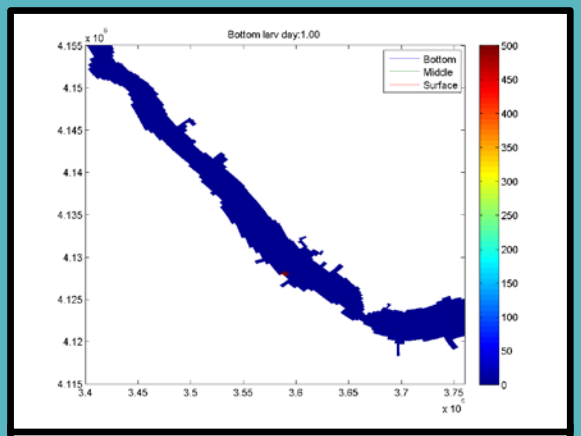
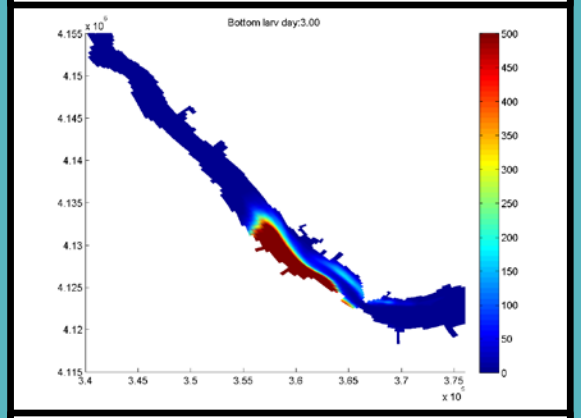
Structures benefitting oyster restoration in York River

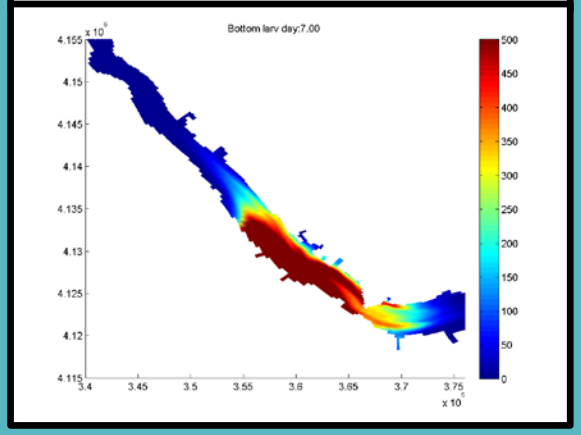
Day 1



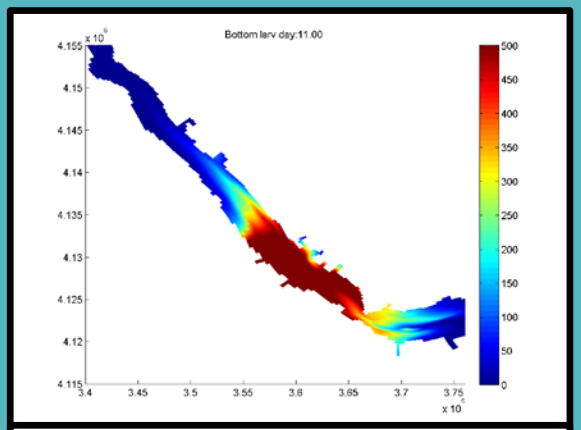
Day 3



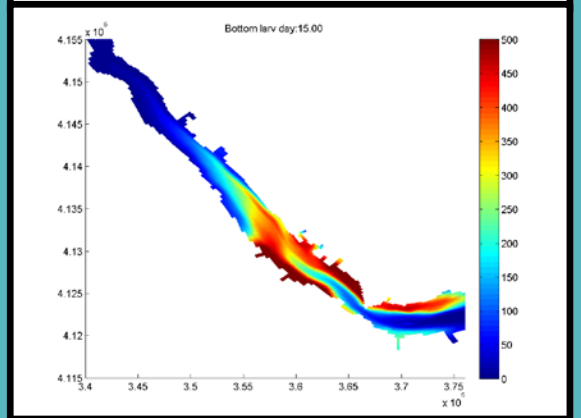
Day 7



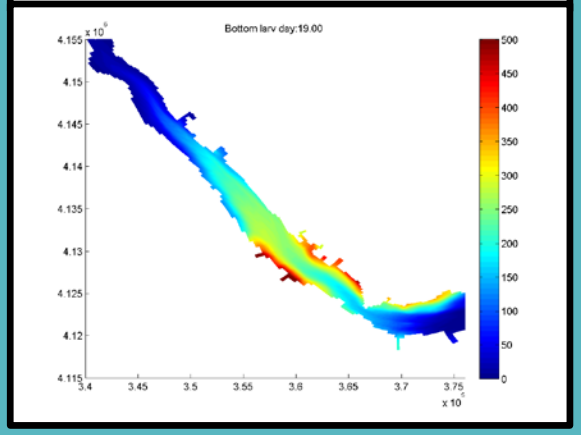
Day 11



Day 15



Day 19



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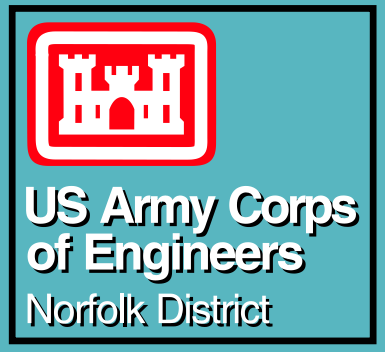
Partnerships/Funding



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Enhance ecosystem and climate resiliency; demonstration project

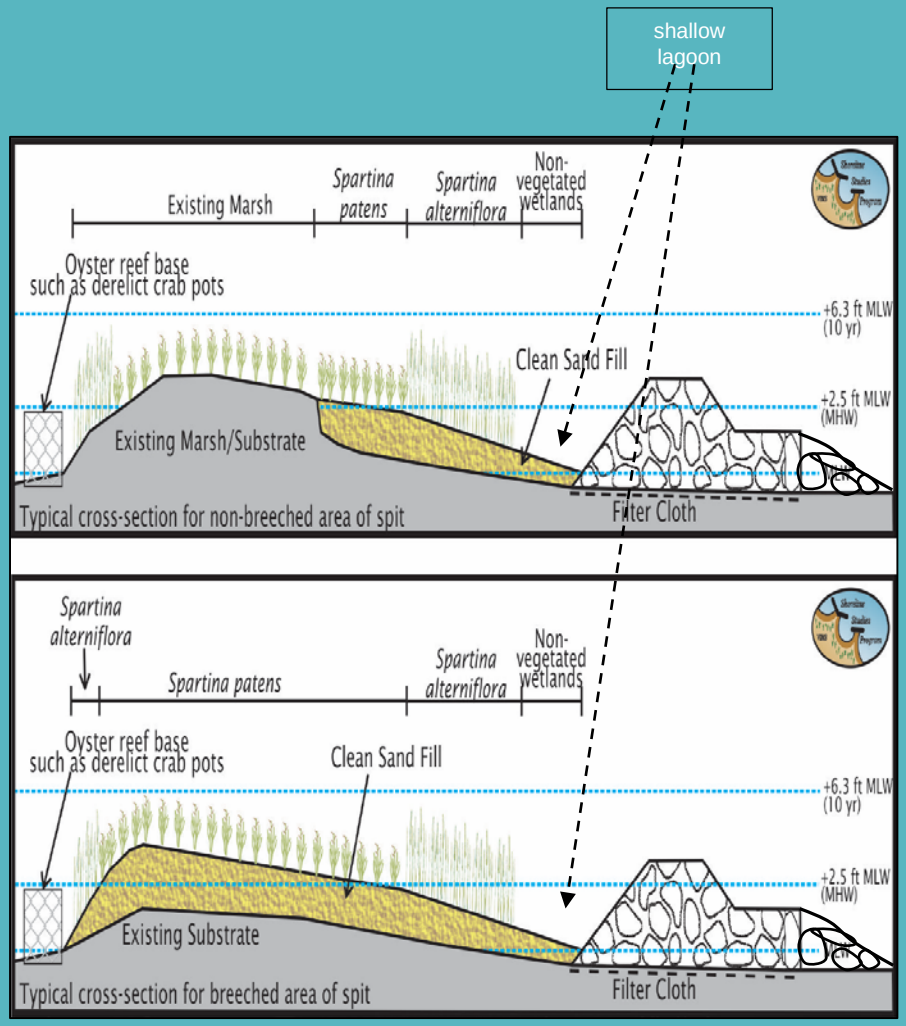

Figure 7. Draft schematic of a living shoreline applicable to Penniman Spit and various locations throughout the York River and Chesapeake Bay. The right side of the sill faces the river, and the rocks will be rearranged such that there is a slowly grading slope to provide shallow-water habitat for juvenile fish and crabs, as indicated by the additional (blue) rock substrate near present Mean Low Water (MLW).

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BACI DESIGN; PRE-CONSTRUCTION MONITORING

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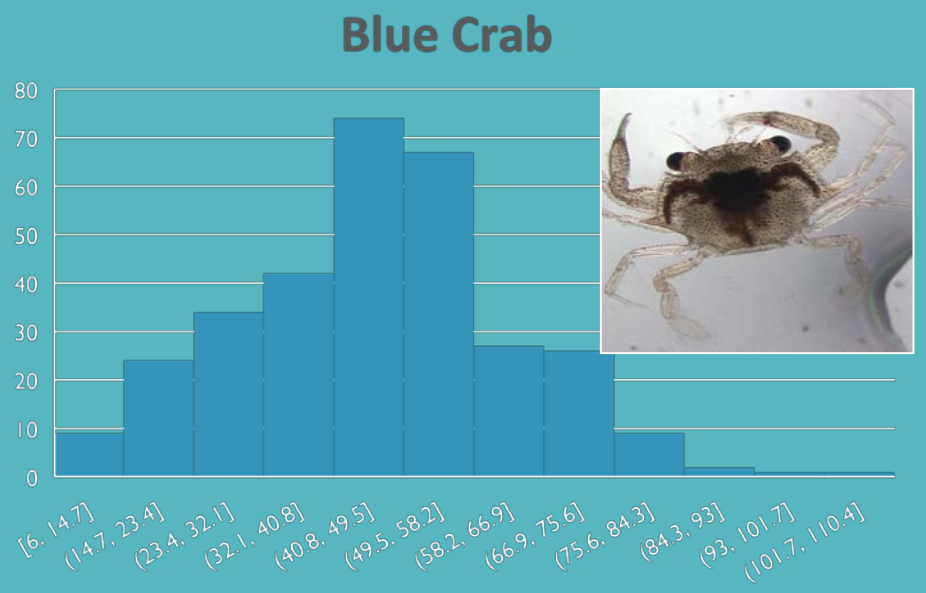
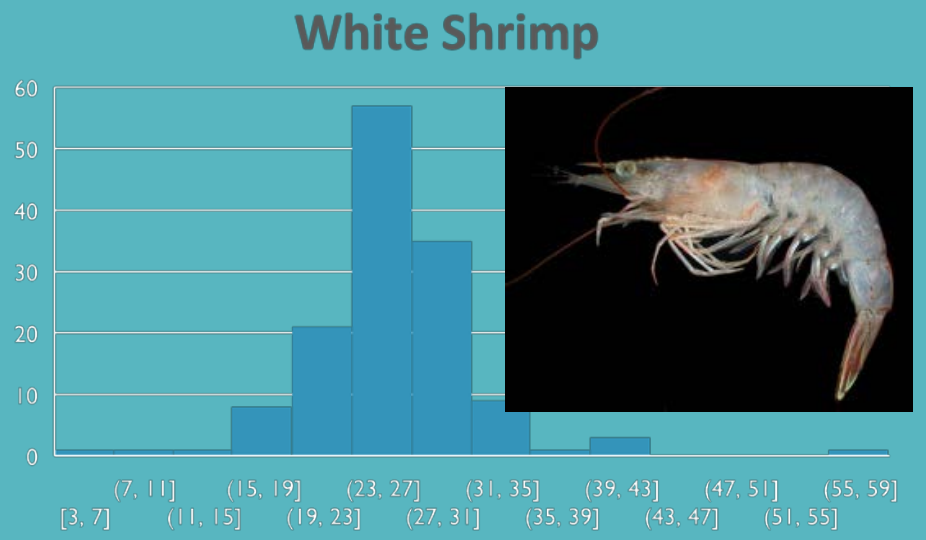
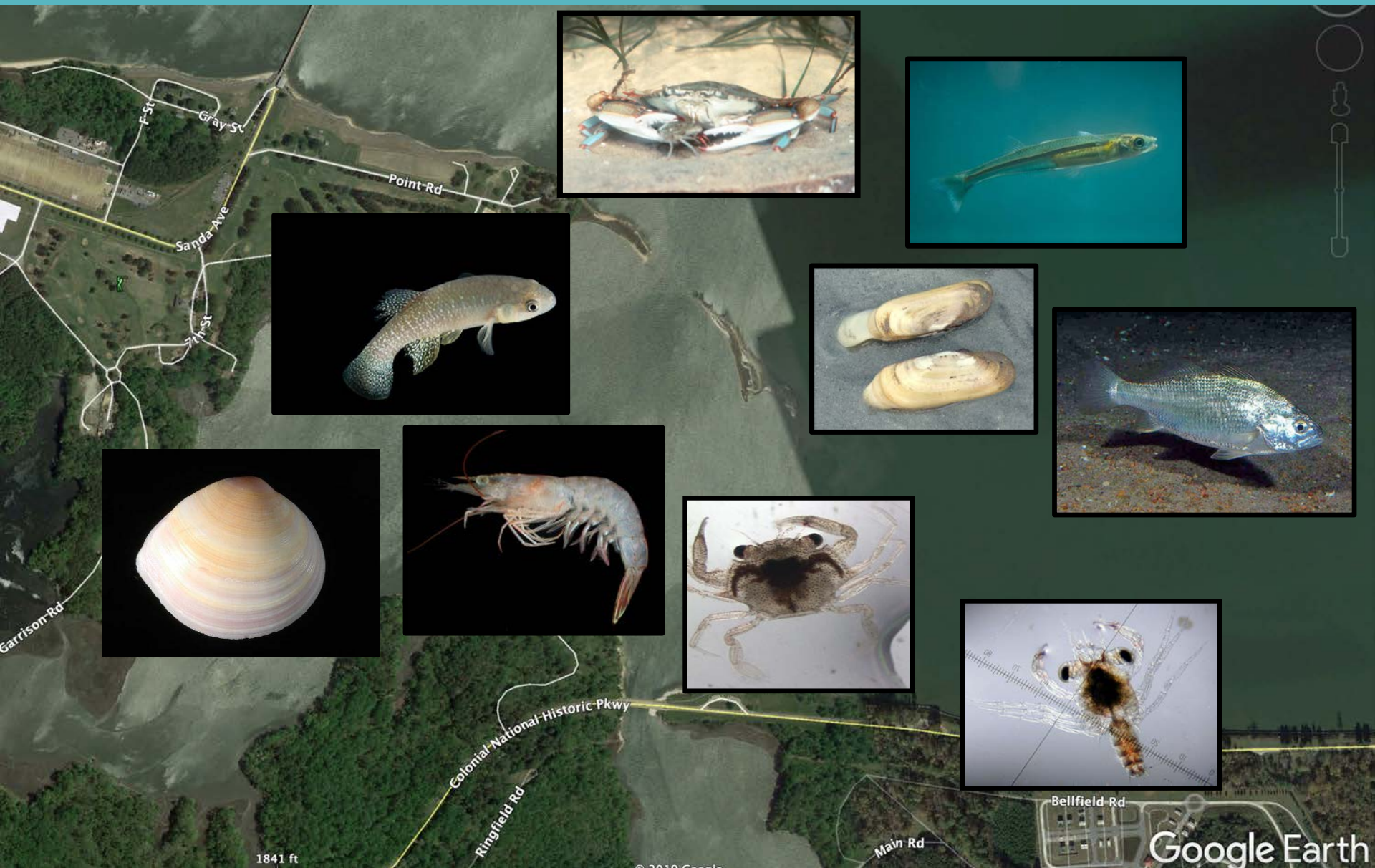
Seines	Abundance	Benthic Suctions	Abundance
Atlantic silverside	1624	Spionids	2400
mummichog	986	*G. gemma*	2155
striped killifish	943	*M. lateralis*	1664
blue crab	327	*I. recurvum*	1318
bay anchovy	176	*P. pholadiformis*	1109
white shrimp	139	*L. balthica*	1082
croaker	74	*L. culveri*	1036
silver perch	23	*O. fusiformis*	1009
kingfish	17	Nemerteans	991
pipefish	13	*C. plana*	873
northern kingfish	9	Sabellid worms	782
white perch	8	*P. gouldi*	764
naked goby	8	*T. plebeius*	709
tongue fish	6	Capitellids	682
spade fish	5	Un. Amphipod	627
skilletfish	4	*G. dibranchiata*	573
mud crabs	4	*G. demissa*	464
spot	3	*Leitoscoloplos*	464
seahorse	2	Phonronids	464
sheepshead	2	*L. setiferus*	464
speckled trout	1	*A. mitchelli*	436
		L. medusa	436
		N. schmitz	355
		S. oculatus	355
		tunicate	355
		N. succinea	273
		D. cuprea	273
		G. bosci	245
		C. sapidus	164
		P. vibex	109
		U. affinis	27





BACI DESIGN; PRE-CONSTRUCTION MONITORING OF AN ECOTONE



Moving Forward

- Implementation
- Monitoring
- Adaptive management
- Funding
- Public support
- Federal support
- State support