Documenting shellfish colonization and fish community assemblage surrounding hybrid living shoreline projects in the Delaware Bay, NJ

Jenny P. Shinn, David Bushek
Haskin Shellfish Research Laboratory, Rutgers University, Port Norris, NJ 08349
Author contact: Jenny.shinn@rutgers.edu

Introduction

The Nature Conservancy's Gandy's Beach Preserve (GBP) includes undeveloped shoreline adjacent to Nantuxent Creek and along the Delaware Bay in Downe Township, New Jersey. Beginning in 2014, a collaborative project lead by USFWS and TNC constructed living shorelines using coir fiber logs, shell bags, and Oyster Castles® to augment the beach and creek shorelines to slow the rate of erosion and create habitat. Fishes and mobile invertebrates were collected from the habitats pre- and post-installation. Oyster recruitment and survival were quantified annually.

Southern facing view of project installation at the Gandy's Beach Preserve at low tide. Emerging oyster castle structures are visible. Drone photo provided by Steve Jacobus, NJDEP

Methods

Fish Community
Nantuxent Creek

- 18.3-meter bagged seine nets (dimensions: 18.3 m long x 1.8 m tall x 3.2 mm sq. mesh)
- Net was set onto stationary poles in block net configuration at high tide enclosing 36 m^2 of intertidal bottom and sampled at low tide
- The paired nets were deployed monthly from Sept-October 2014 and bi-weekly- July–October 2015, 2016 and 2017

Block net surrounding newly constructed structured habitats in Nantuxent Creek at low tide. Image credit: Kurt Cheng, PDE

Fish Community
Gandy's Beach Preserve

- 5.5-meter bag-less seine net (dimensions: 5.5 m long, 1.2 m deep x 3.2 mm sq. mesh)
- Sampled around low tide for a distance of 25 meters (July- Oct.)
- Pre-construction: bi-weekly
  - 3 tows/site/event, 3 site types
- Post-construction: bi-weekly
  - 4 tows/site/day, 2 site types
- Habitats types: (1) Oyster Castle® reefs (2) reference areas without added structure

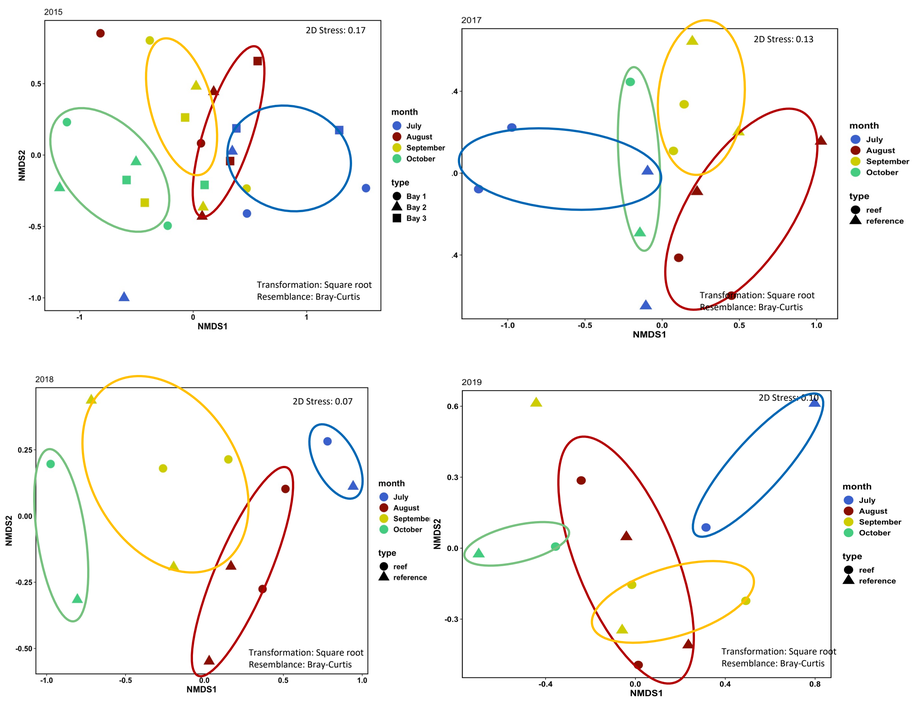
Rutgers team processing seine set haul on the GBP.

Oyster Community

- stratified random sampling design used flexible quadrats: 10 x 10 cm (2016 & 2017) and 25 x 25 cm (2018-present)
- 3 quadrats sampled per structural layer: counted live and dead oysters, measured shell heights of 5 animals, estimated percent cover of other colonizing organisms

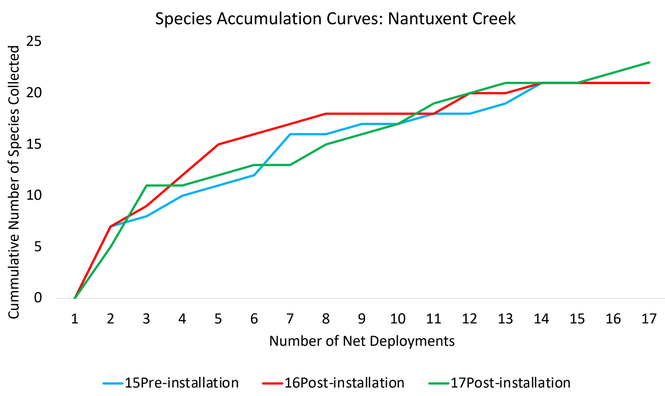
25 x 25 cm flexible quadrat used to quantify oysters recruited to Oysters Castles® in Nantuxent Creek.

Results



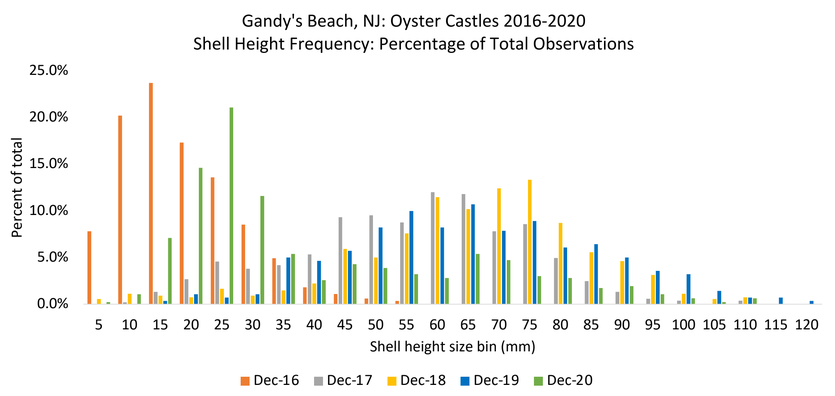
(Above) Non-metric multidimensional scaling (NMDS) plots of GBP nekton community based on pooled seine net tows show significant seasonal relationships in fish communities in 2015, 2017 and 2018, but not habitat type differences in any year (ANOSIM test in the Vegan package in R; p=0.05, 0.007 and 0.0003 , respectively). Ellipses were added for visualization.

(Above) Summer Flounder (*Paralichthys dentatus*), juvenile striped burrfish (*Chilomycterus schoepfi) and* blue crab (*Callinectes sapidus*) collected at the study sites (Below) Species accumulation curves of motile fauna collected in Nantuxent Creek in treatment areas only.



		2016	2017	2018	2019	2020
Nantuxent Creek: Oyster Castles®	**Avg. Density m^2 (SD)**	1720 (327)	1201 (329)	393 (30)	107 (43)	317 (33)
	Total live oysters	124,795	99,303	28,592	7,566	21,928
Gandy's Beach: Oyster Castles®	**Avg. Density m^2 (SD)**	1322 (264)	974 (311)	291 (63)	32 (4)	79 (3)
	Total live oysters	261,802	393,770	202,532	15,198	37,857
Gandy's Beach: Shell bags	**Avg. Density m^2 (SD)**	1156 (557)	824 (387)	204 (63)	36 (15)	185(42)
	Total live oysters	383,750	254,101	64,827	7,781	21,089

(Above) Average oyster density and estimated total number of oysters on the constructed reefs. The totals were calculated by extrapolating oyster densities over the estimated surface area. (Below) Shell height frequencies.



Conclusions

These living shoreline projects are providing habitat for several species of commercial and recreational importance in the Delaware Estuary including; blue crabs, black drum, weakfish, summer flounder, northern kingfish, white perch and black sea bass. Additionally, obligate reef residents; skilletfish, oyster toadfish, and naked gobies were collected near constructed reefs; demonstrating supply of habitat. Species abundances fluctuated seasonally and annually throughout the project duration, but this did not appear to be attributable to the living shorelines themselves. Temporal differences in community composition were stronger than habitat related differences along the GBP. Across sites, oysters are persisting and recruiting to breakwater structures with varying degrees of magnitude. Additionally, ribbed mussels were observed; sometimes at coverage densities of 95%; and likely supply additional structural support and biological filtration capacity to the breakwater reefs. These data indicate that the living shoreline supports a reef community that is indistinguishable from the natural community.

Acknowledgements

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