Evaluating ecosystem services at a subtidal oyster restoration site in Barnegat Bay, NJ

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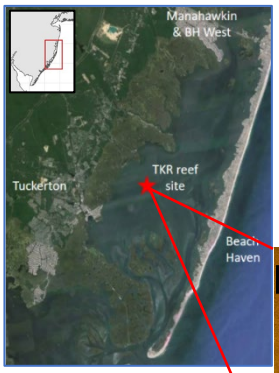
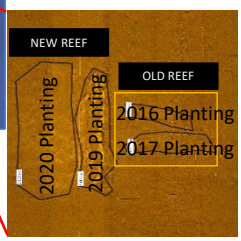
Background

The Tuckerton Reef was established in 2016 as the first-ever oyster restoration effort in the Barnegat Bay-Little Egg Harbor area. Oyster plantings have occurred from 2016-2021 using disease-resistant spat-on-shell planted on bay bottom. Substrates have included whelk, clam and recycled oyster shell. From 2019-2020 this site was monitored for oyster success metrics[1] and ecosystem services after more than doubling the reef footprint. Oyster biomass was related to filtration capacity for each year-class of oysters using water monitoring data. Habitat creation was determined through fish trap comparisons from the reef and a non-reef site. This research evaluates the environmental contributions of this restoration project to the Barnegat Bay ecosystem.

Site Information



- Lower Barnegat Bay/Little Egg Harbor area
- Subtidal shell beds cover approximately 1.1 acres of 2-acre site
- "Old" Reef: created in 2016 & 2017
- "New" Reef: Remote set oysters planted in 2019 and 2020



Reef Footprint
Old Reef: 1,040 m^2
New-2019: 1,151 m^2
New-2020: 2,255 m^2

Ecosystem Services Monitoring

	Oyster Populations	Water Quality	Habitat Value
OBJECTIVE	Increase oyster population	Increase filtration capacity and nitrogen removal	Increase habitat for fish and invertebrates
METRICS	Oyster density (> 10 m^2), Oyster size	Temperature, Salinity, DO, TSS with oyster metrics	Species abundance and richness
METHODS	Surveys, Counts, Measurements (size, biomass)	Water quality loggers (HOBOs, YSI), TSS	Mesh traps, substrate baskets
FREQUENCY	2 x year (Spring and Fall)	Seasonal – monthly throughout May - Oct	3 x year (June – Sept)
ANALYSIS	Change in counts over time, histogram of sizes	Filtration rate calculations and nitrogen removal estimates	Compare abundances on and off reef

Art from Integration and Application Network (ian.umces.edu/media-library)

Oyster Populations: New plantings (1-2 years old) maintained threshold density for ecosystem services, old reef (3-4 years old) fell below 10 m^{-2} despite having largest sizes.

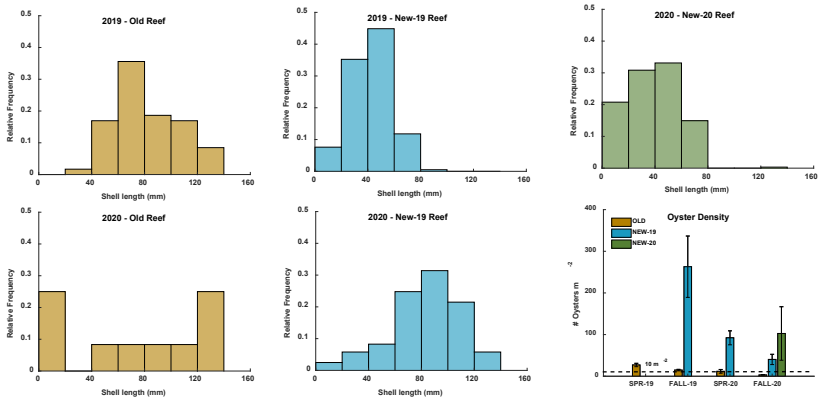


Figure 1. Oyster size structure from fall monitoring events and density for each cohort from each sampling period.

Filtration Capacity: Temperature, turbidity drive monthly filtration rates in this system. Older areas of reef maintained filtration despite density loss.

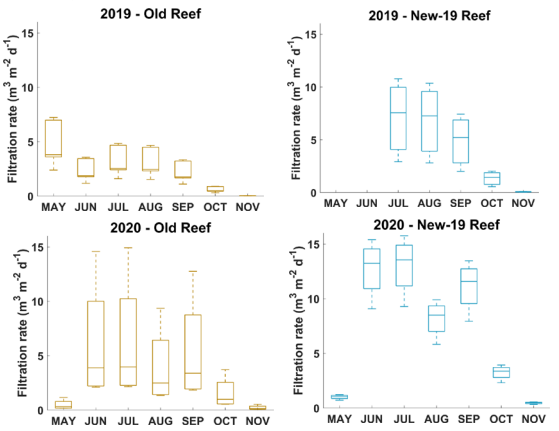


Figure 2. Monthly estimated filtration rates[2] for each reef cohort in 2019 and 2020 and adjusted for oyster density.

Seasonal Nitrogen Removal (kg), May-November

SITE	2019	2020
OLD REEF	0.34	0.26
NEW-19	0.29	0.60
NEW-20	--	0.20

Habitat Value: More richness and abundance of nekton found on reef sites – but age of reef may matter.

Fish seem to prefer reef areas to mud bottom – with lower abundances on older areas of reef but high richness. No significant differences were found with sample date and reef site for all metrics.

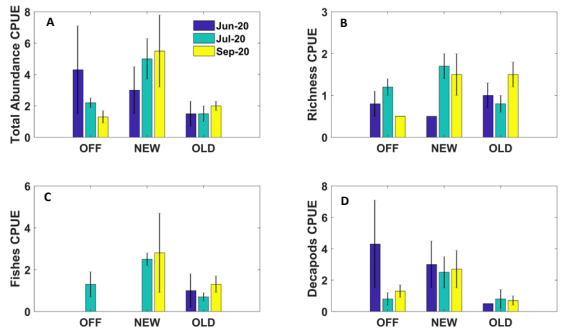


Figure 3. Mean of nekton community metrics adjusted for deployment time (CPUE) for three months in 2020 for each reef location and a mud-bottom control.

Table 1. Combined, adjusted trap totals for 2019 and 2020.

RICHNESS	2019	2020
OFF	6	6
OLD REEF	10	9
NEW REEF	--	7

ABUND.	2019	2020
OFF	18	23.5
OLD REEF	27	15
NEW REEF	--	40.5

Overall, 40-60% increase in species and individuals on the reef

References:

[1]Universal metrics:
Baggett, L.P. *et al.* (2015) *Restor. Ecol.*, 23(6): 737-745.

[2]Filtration and N-removal models:
Fulford, R.S. et al. (2007) *Mar. Ecol. Prog. Ser.*, 336: 43-61.
Grizzle et al. (2008) *Estur. Coasts,* 31: 1208-1220.

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More info: