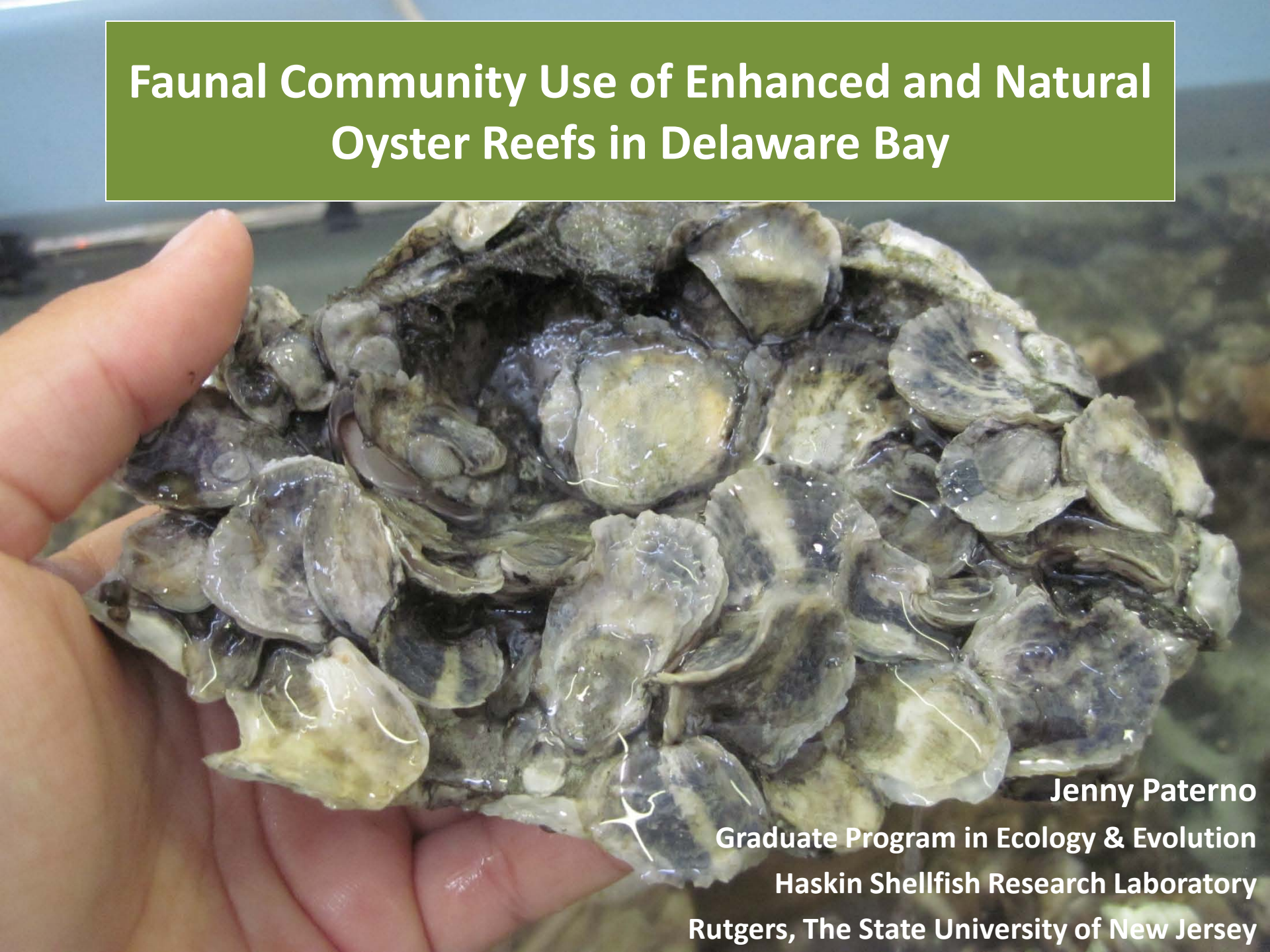
Faunal Community Use of Enhanced and Natural Oyster Reefs in Delaware Bay



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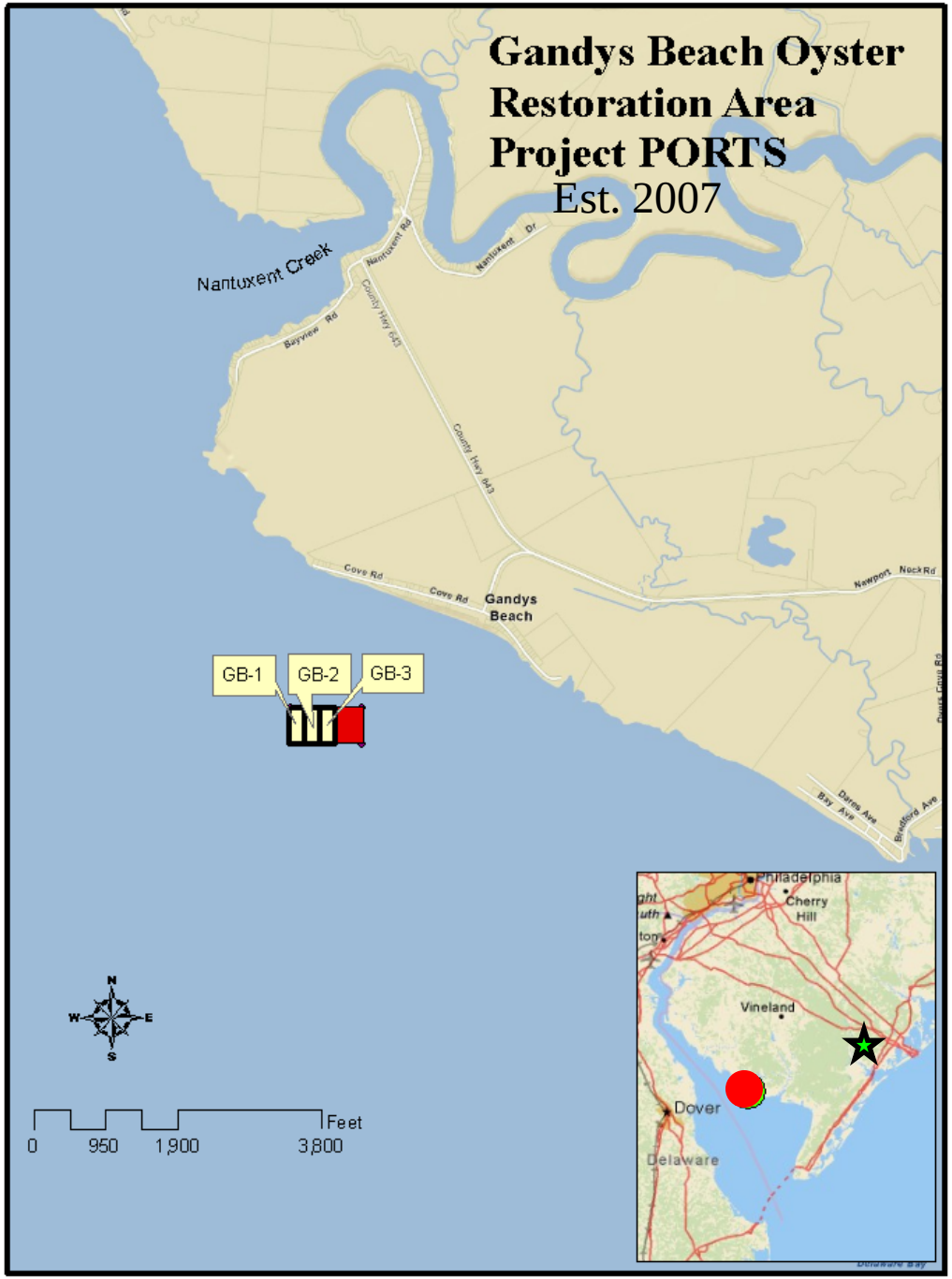
project PORTS

Promoting Oyster Restoration Through Schools

RUTGERS UNIVERSITY



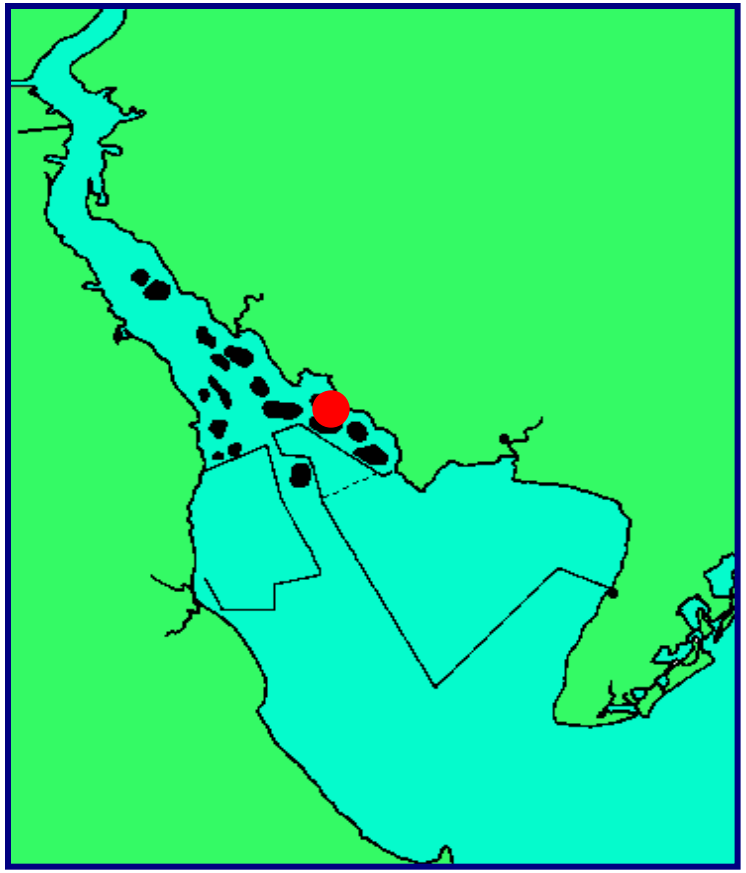


Photo credits: Lisa Calvo

My Question:

Does the Project PORTS enhancement effort alter species abundances and community assemblages relative to unenhanced (natural) bottom?

Hypothesis:

Adding ‘spat on shell’ to sub-tidal bay bottom over time, will result in a faunal community similar to natural oyster reefs.

Objectives for field study:

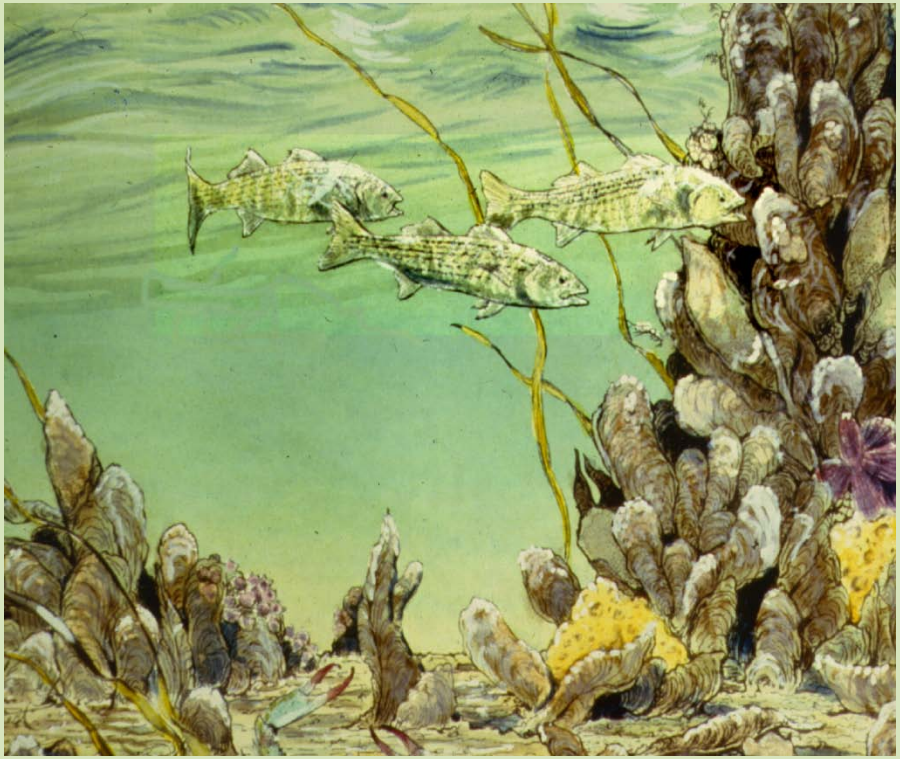


Photo credit: M. Luckenbach, VIMS

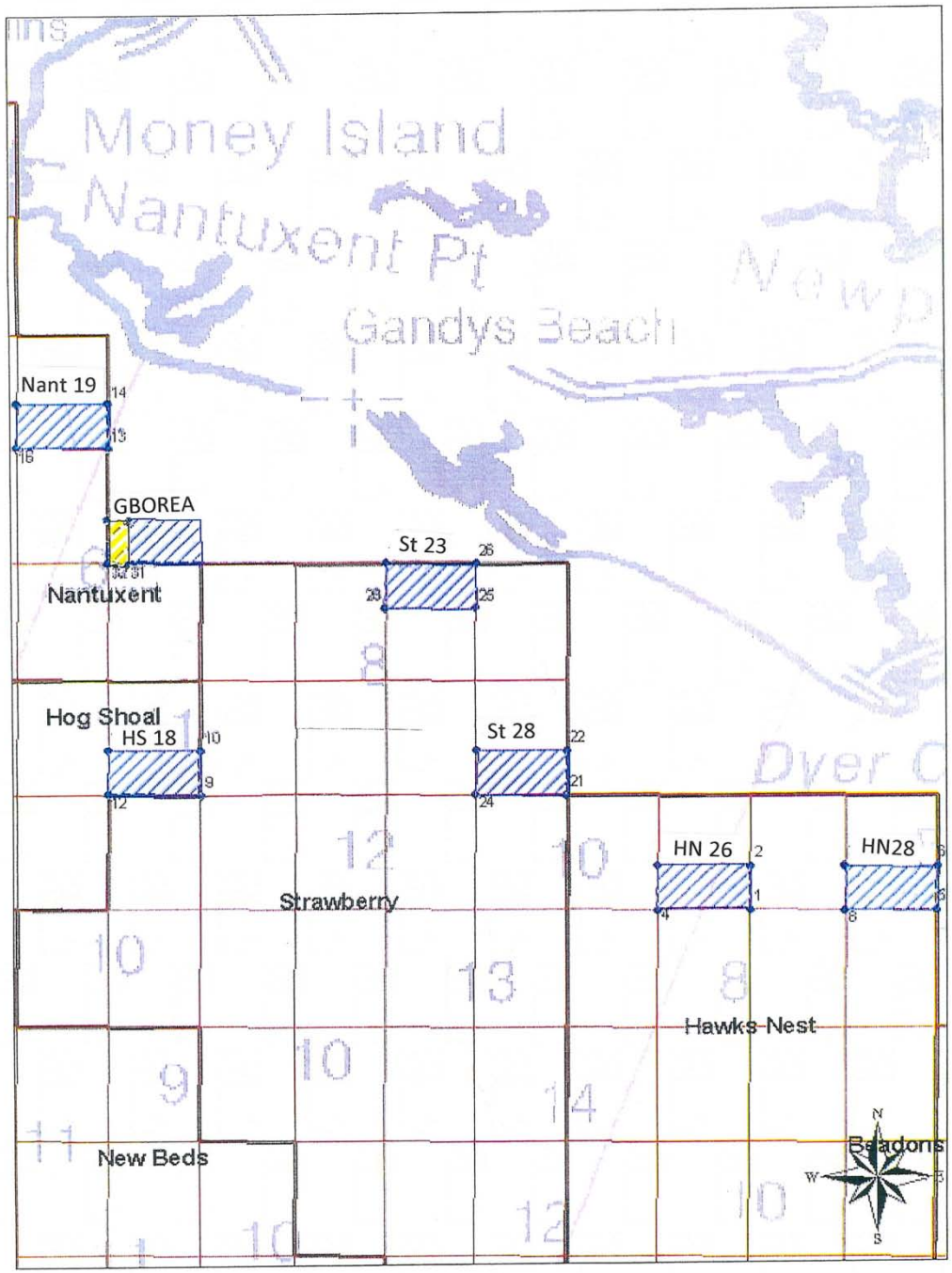
1. sample fishes and invertebrates on a restoration area and nearby unenhanced bottoms

2. compare species assemblages across different bottom types

3. make conclusions about restoration efforts

Each of the 7 study sites are:
300 m x 115 m
34500 m^2
0.0345 km^2
8.5 acres

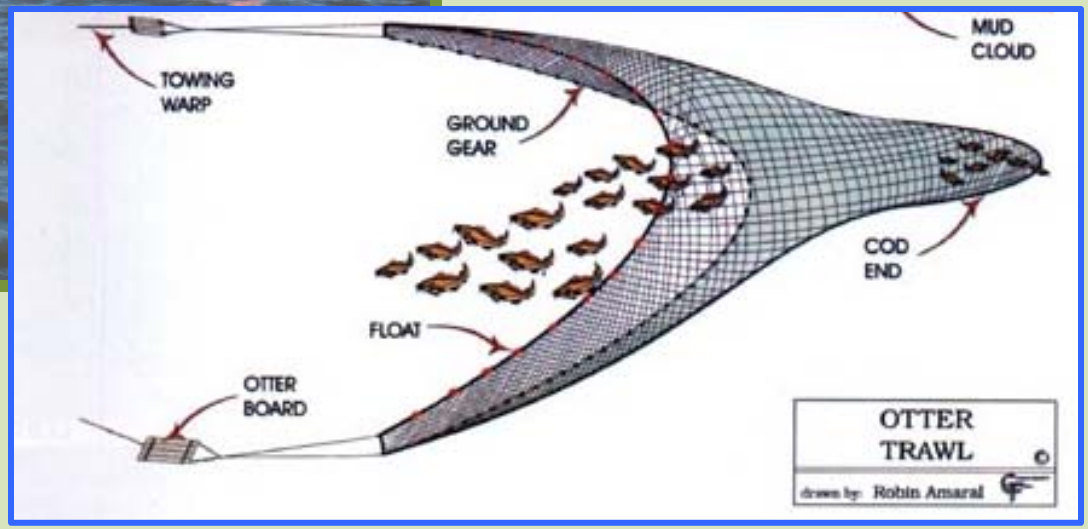
The entire enhancement area :
4.05 hectacre
40469 m^2
0.04 km^2
10 acres



Methods

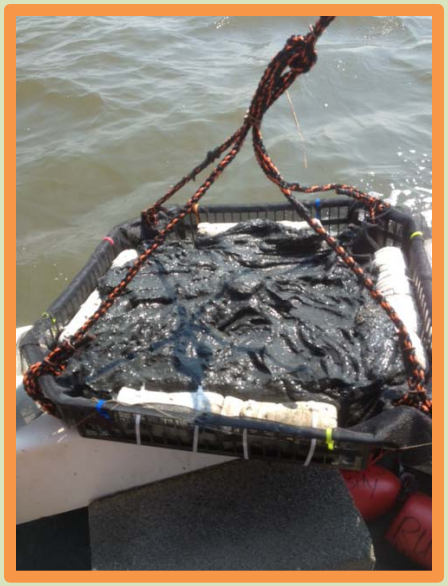
- Otter trawling: transient and resident fishes
  - Twice a month on each site July-November 2013
  - 3 tows per site
  - 30 tows/site over study duration
- Benthic habitat trays: resident fishes and macro-invertebrates
  - 2 trays on each site once a month July-November 2013
  - 1 week soak time
  - 10 trays/site over study duration

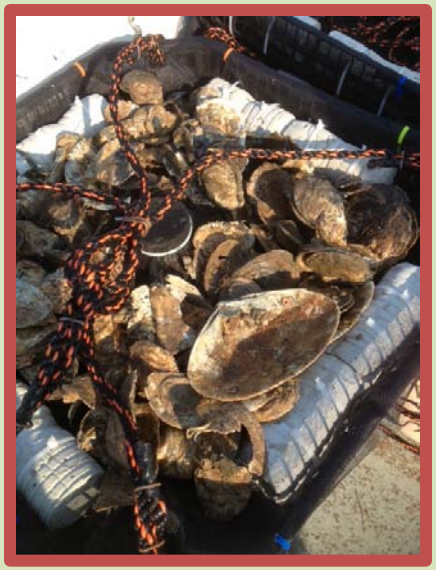
Trawl monitoring



Benthic habitat trays

Dimensions: 60 cm x 60 cm x 10 cm



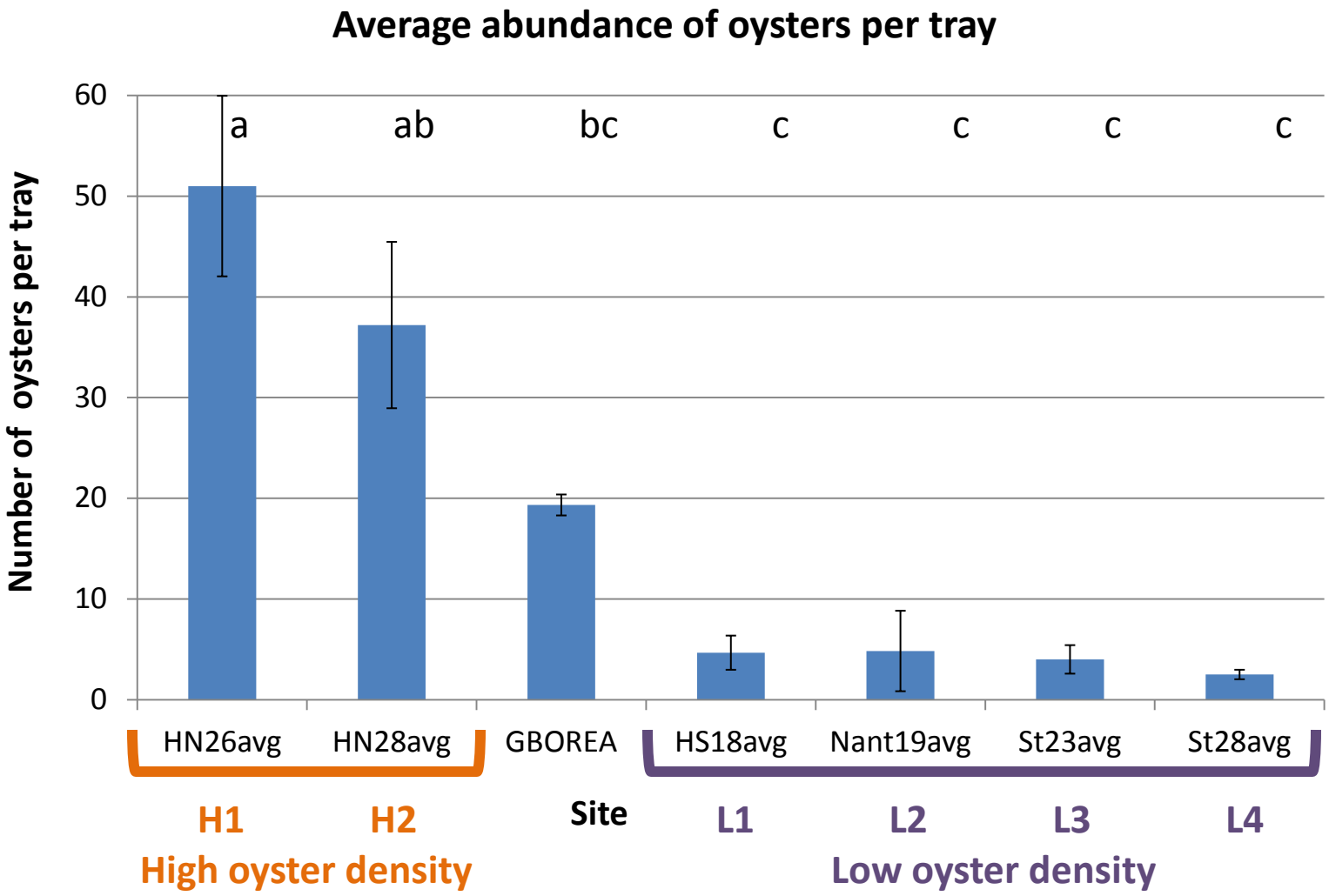



12 quarts (~11.3 liters) of substrate put into each tray - collected using a lined dredge

Collected:

- Faunal information (species, length, weight)
- Benthic habitat information
  - Oyster abundance
  - Box (dead oyster) abundance
  - Cultch, debris (mud, sand, rock) and oyster volume

Bar graph of average count of oysters per tray across all seven sites. Data are means ± 1 SE from trays (0.36 m^2 x 9.5 cm, 11 liters of bottom material)
n= 10 trays per site. Letters denote significant differences P ≤ 0.05, Tukey's HSD



Trawl

A total of 1609 individuals of 30 species were collected in the trawl

Transient species

Species	Common Name	H1	H2	GBOREA	L1	L2	L3	L4	Total
Anchoa mitchili	bay anchovy	52	117	28	176	76	14	24	487
Micropogonias undulatus	Atlantic croaker	22	32	44	75	69	39	21	302
Cynoscion regalis	weakfish	45	41	22	31	43	17	3	202
Trinectes maculatus	hogchoker	3	21	27	15	48	24	16	154
Callinectes sapidus	blue crab	18	18	14	23	23	15	13	124
Morone americana	white perch	21	14	17	5	5	8	3	73
Menticirrhus saxatilis	northern kingfish	1	0	7	11	3	6	0	28
Bairdiella chrysoura	silver perch	9	3	6	0	0	6	1	25
Leiostomus xanthurus	spot	1	6	2	9	2	0	0	20
Pogonias cromis	black drum	4	4	1	3	0	4	0	16
Limulus polyphemus	horseshoe crab	2	2	0	0	0	5	3	12
Paralichthys dentatus	summer flounder	1	3	0	1	3	0	0	8
Chilomycterus schoepfi	striped burrfish	1	2	2	0	1	1	0	7
Centropristis striata	black sea bass	3	3	0	0	0	0	0	6
Alosa pseudoharengus	alewife	0	2	0	1	1	1	0	5
Brevortia tyrannus	Atlantic menhaden	1	1	0	0	1	0	0	3
Morone saxatilis	striped bass	1	0	1	0	0	1	0	3
Ophidion marginatum	striped cusk-eel	0	0	0	1	0	1	0	2
Syngnathus fuscus	northern pipefish	0	0	0	1	0	1	0	2
Prionotus carolinus	northern sea robin	1	0	0	1	0	0	0	2
Peprilus triacanthus	butterfish	0	1	0	1	0	0	0	2
Mustelus canis	smooth dogfish	0	1	0	0	0	0	1	2
Libinia emarginata	spider crab	0	0	0	0	0	0	1	1
Astroscopus guttatus	northern stargazer	0	0	0	0	1	0	0	1
Malaclemys terrapin	diamondback terrapin	0	1	0	0	0	0	0	1
Penaeus aztecus	brown shrimp	0	0	0	0	1	0	0	1
Scophthalmus aquosus	windowpane flounder	0	1	0	0	0	0	0	1
Alosa mediocris	hickory shad	0	0	0	0	1	0	0	1

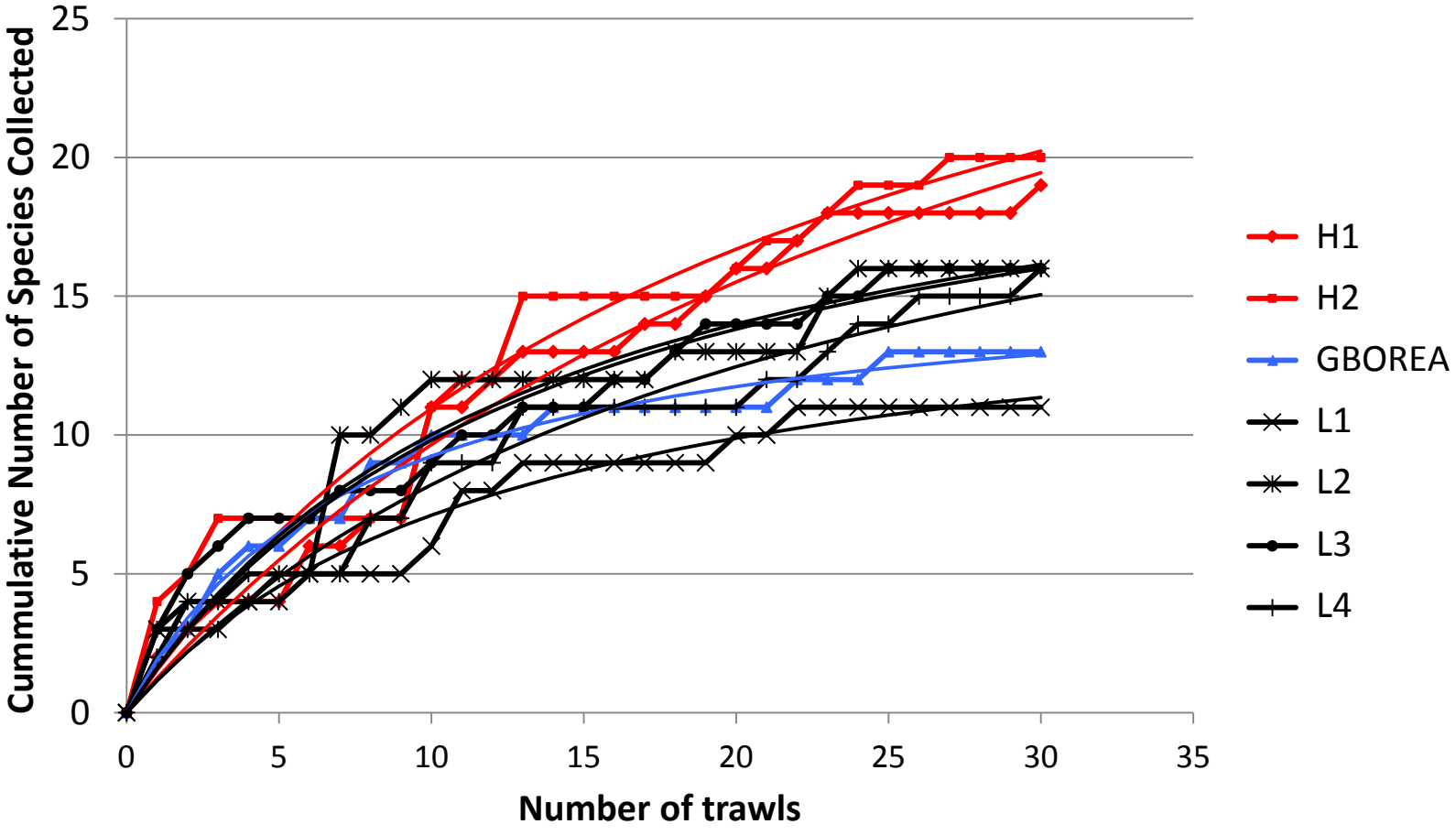
Oyster reef resident species

Species	Common Name	H1	H2	GBOREA	L1	L2	L3	L4	Total
Opsanus tau	oyster toadfish	35	11	24	1	3	13	30	117
Gobiosoma bosci	naked goby	1	0	0	0	0	0	0	1

In summary, abundances of these species were highest on:

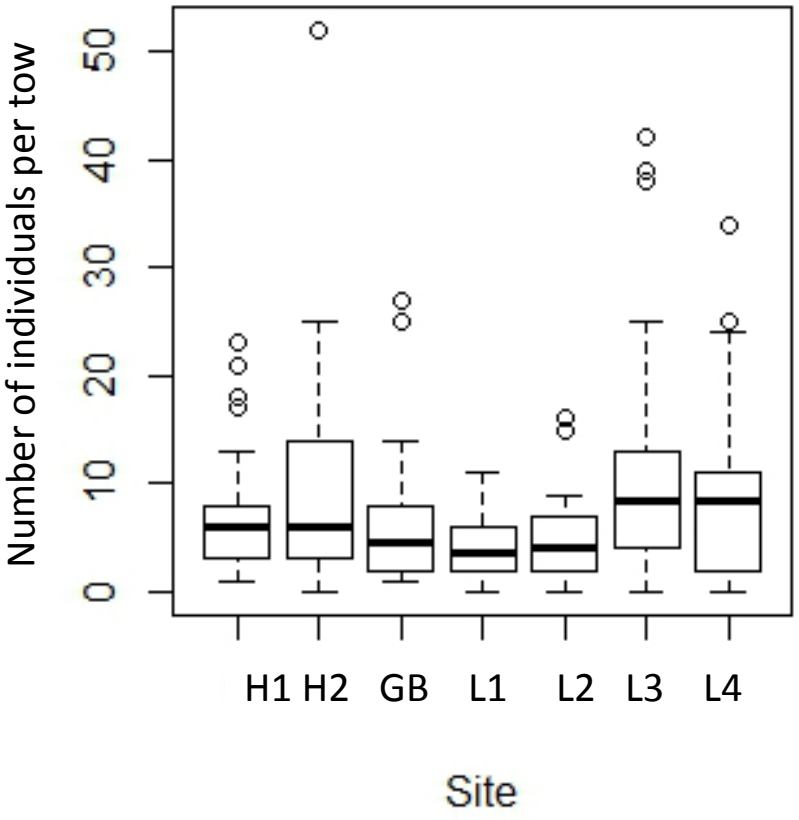
High oyster density	GBOREA	Low oyster density
Pogonias cromis *Morone americana* *Centropristis striata*	*Trinectes maculatus* *Opsanus tau* *Menticirrhus saxatilis* *Chilomycterus schoepfi* *Morone saxatilis*	*Micropogonias undulatus*

Trawl: Species Accumulation Curves

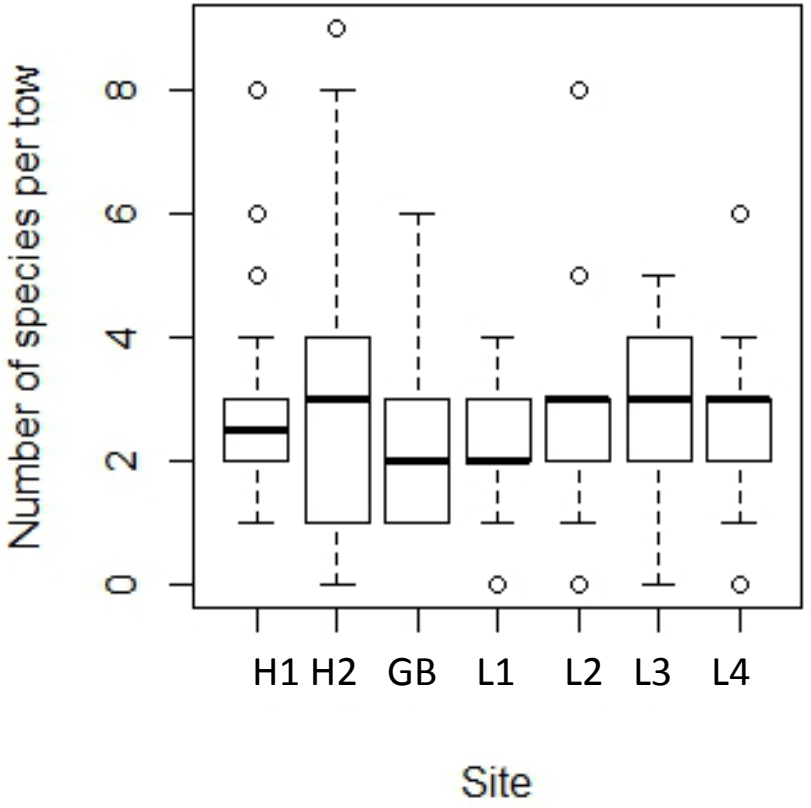


Species accumulation curves of motile fauna for each sampling location. Solid lines are the Michaelis-Menten model curves fit to the data for each site.

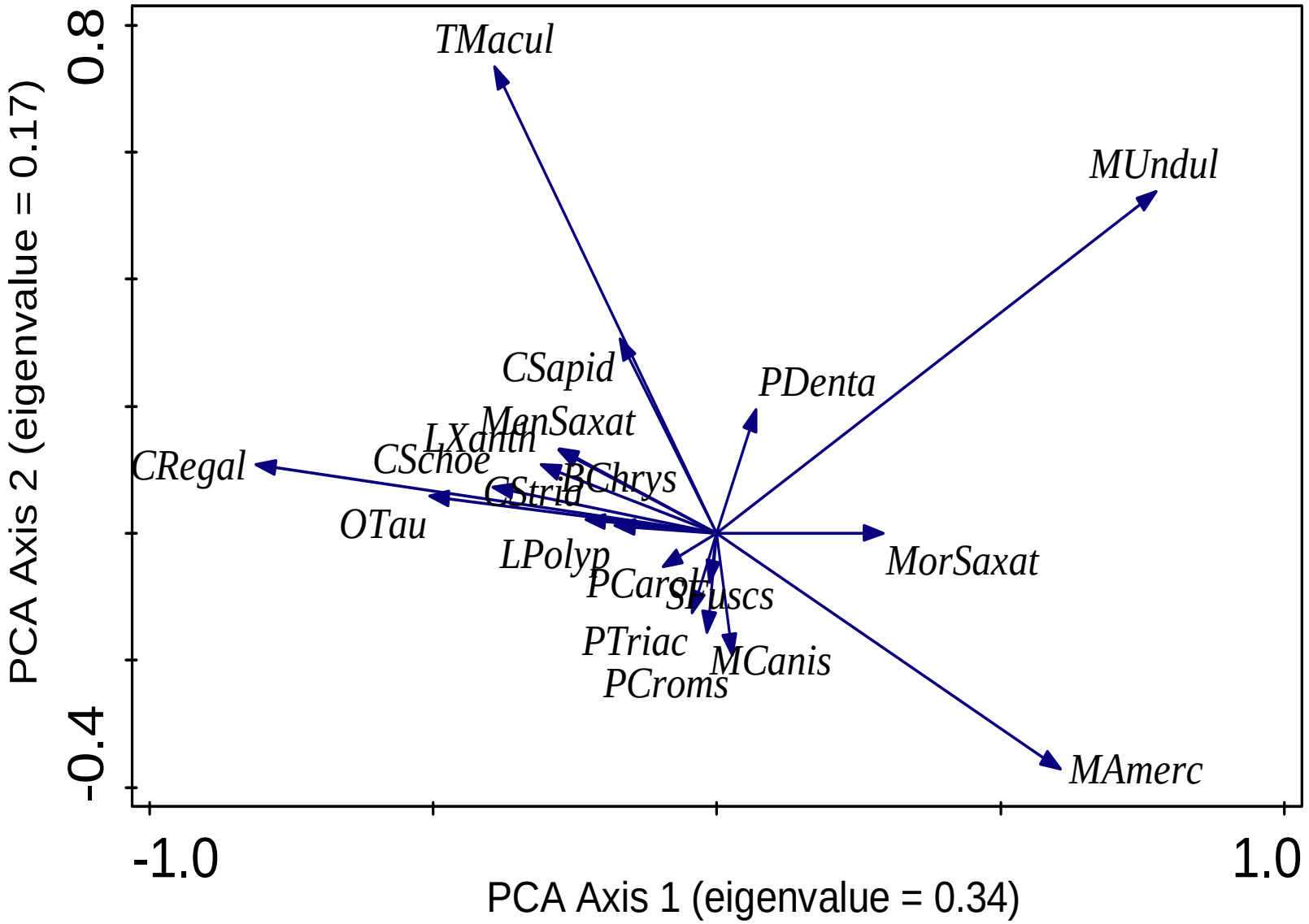
Trawl Abundance

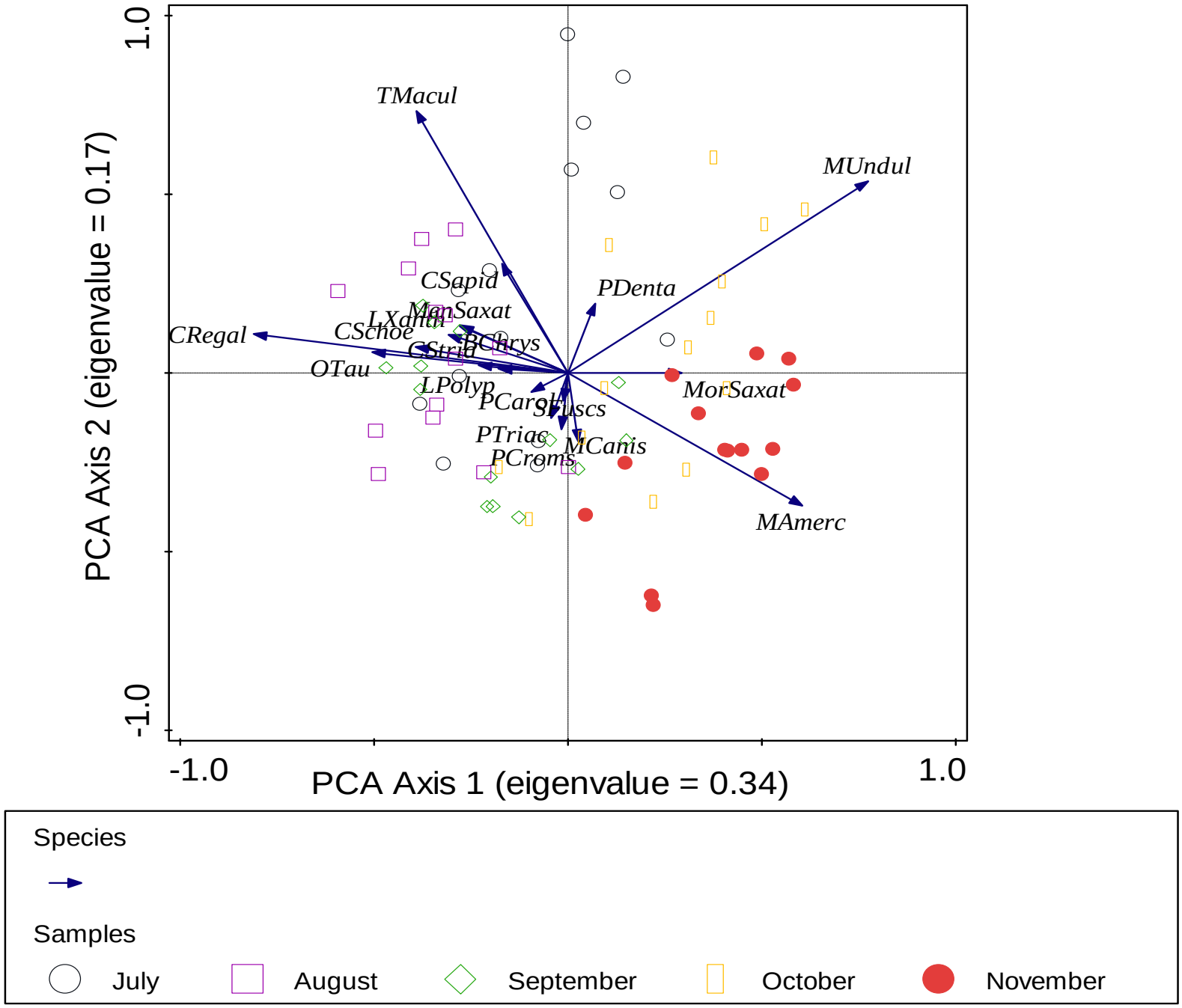


Trawl Species Richness



Principle Component Analysis on selected trawl data (19 species): rare species and those that wouldn't be adequately sampled with an otter trawl were not included




1.0
-1.0
PCA Axis 2 (eigenvalue = 0.17)
-1.0
1.0
PCA Axis 1 (eigenvalue = 0.34)
TMacul
MUndul
PDenta
CSapid
MonSaxat
LXanth
CRegal
CSchoe
BChrys
CStria
OTau
LPolyp
PCarol
SFluscs
PTriac
MCanis
PCroms
MorSaxat
MAmerc
Species
Samples
July
August
September
October
November

Benthic Habitat Trays

2211 individuals of 19 species were collected in the trays

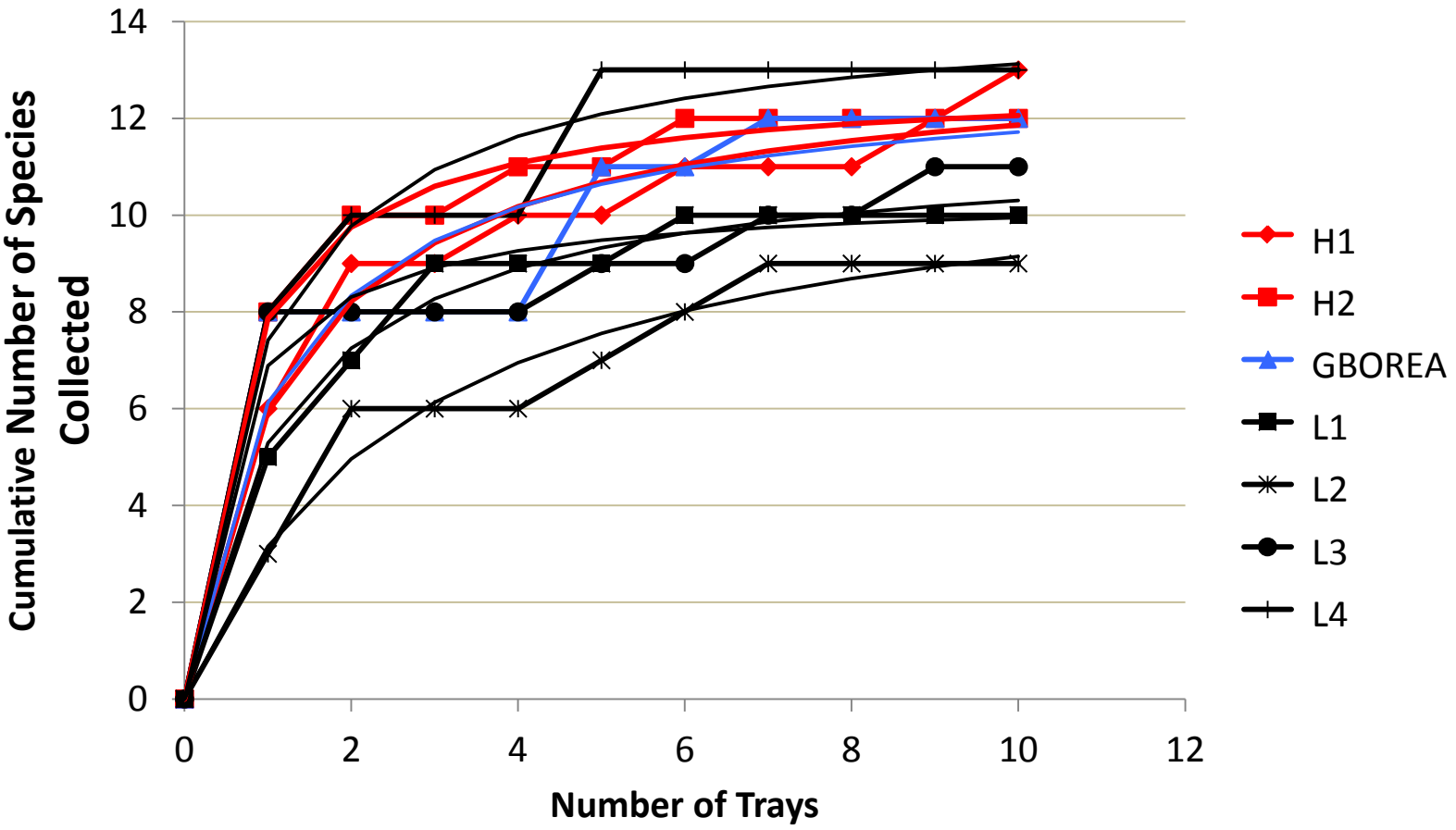
Transient species

Species	Common Name	H1	H2	GBOREA	L1	L2	L3	L4	Total
Ilyanassa obsoleta	eastern mudsnail	21	8	4	57	166	12	53	321
Paleomonetes vulgaris	marsh grass shrimp	34	79	49	32	41	29	18	282
Paleomonetes pugio	daggerblade grass shrimp	4	25	27	7	21	12	15	111
Mulinia literalis	dwarf surf clam	0	0	0	0	3	0	4	7
Pagarus longicarpus	long-clawed hermit crab	0	0	0	4	1	0	0	5
Polinices duplicatus	shark eye moon snail	0	0	2	0	0	0	0	2
Tellina agilis	northern dwarf tellin	0	0	0	0	2	0	0	2
Crangon septemspinosa	sand shrimp	1	0	0	0	0	0	0	1
Anguilla rostata	American eel	0	0	0	0	1	0	0	1

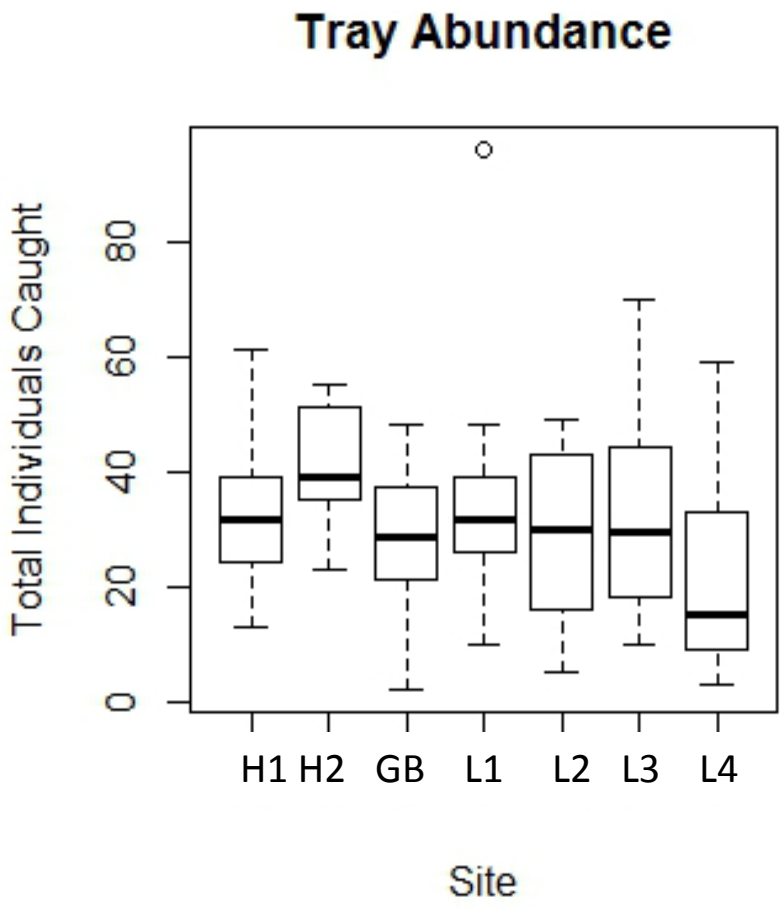
Oyster reef residents

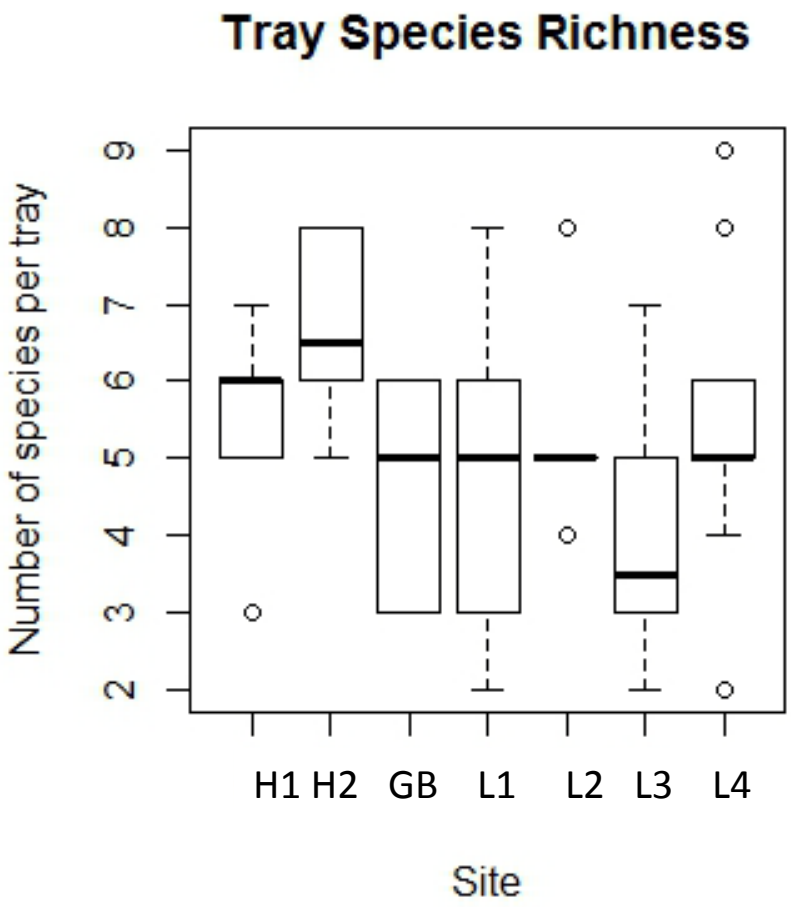
Species	Common Name	H1	H2	GBOREA	L1	L2	L3	L4	Total
Panopeus herbstii	Atlantic mud crab	154	145	128	100	61	82	164	834
Rhithropanopeus harisii	estuarine mud crab	36	40	22	51	8	47	64	268
Panopeus sayi	say mud crab	31	62	18	10	20	21	35	197
Ischadium recurvum	hooked mussel	10	12	31	16	1	5	0	75
Gobiosoma bosci	naked goby	21	24	1	1	6	0	2	55
Geukensia demissa	ribbed mussel	1	1	1	8	0	8	0	19
Crepidula convexa	slipper snail	1	10	2	1	0	0	2	16
Opsanus tau	oyster toadfish	2	4	2	0	2	1	1	12
Urosalpinx cinerea	Atlantic oyster drill	1	0	0	0	0	0	1	2
Eurypanopeus depressus	flat back mud crab	0	1	0	0	0	0	0	1

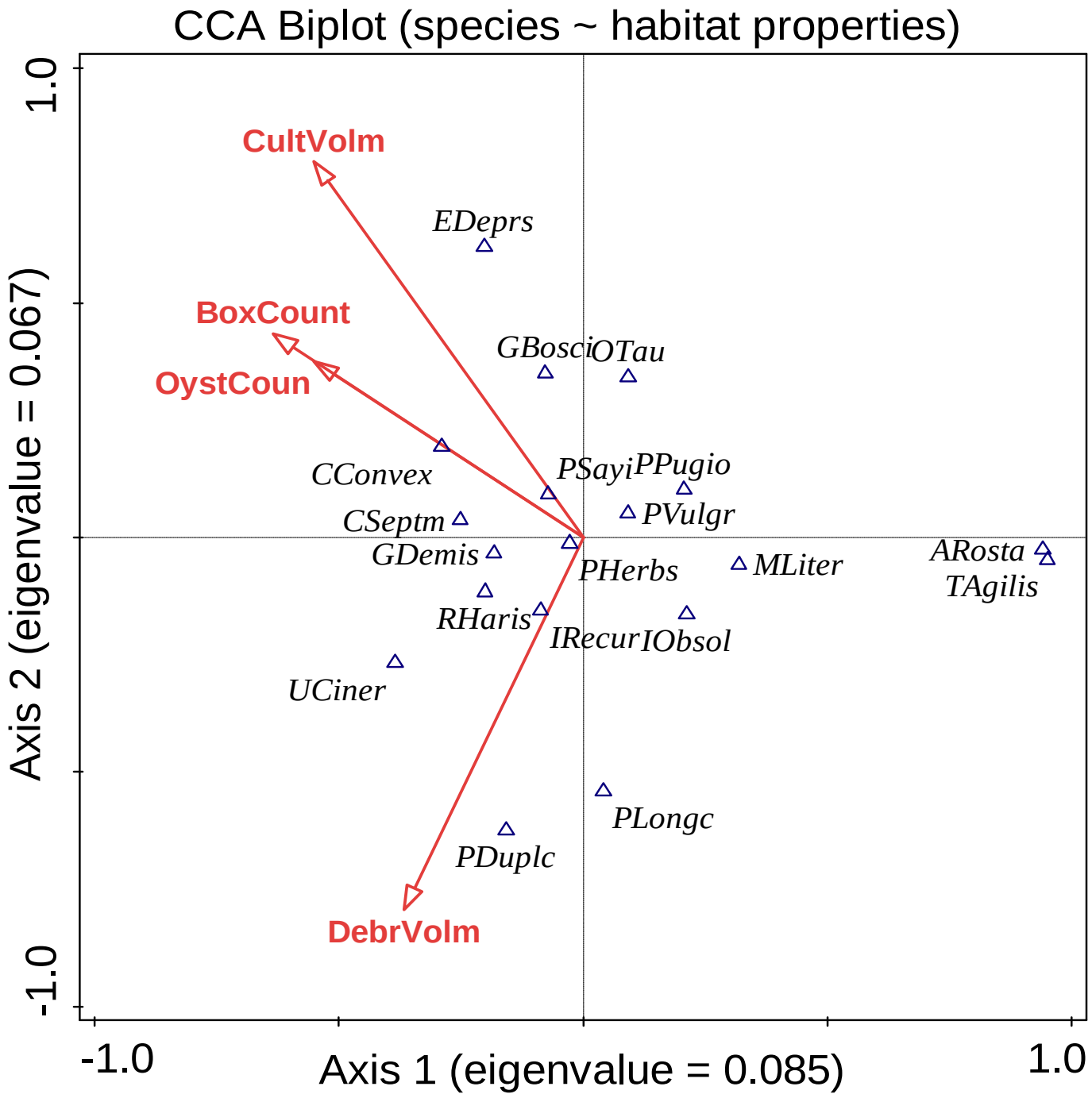
Trays: Species Accumulation Curves



Species accumulation curves of motile fauna for each sampling location. Solid lines are the Michaelis-Menten model curves fit to the data for each site.


Tray Abundance
Total Individuals Caught
0
20
40
60
80
H1
H2
GB
L1
L2
L3
L4
Site


Tray Species Richness
Number of species per tray
2
3
4
5
6
7
8
9
H1
H2
GB
L1
L2
L3
L4
Site



Canonical Correspondence Analysis (CCA) bi-plot of bottom habitat parameters (explanatory variables) and tray catch.

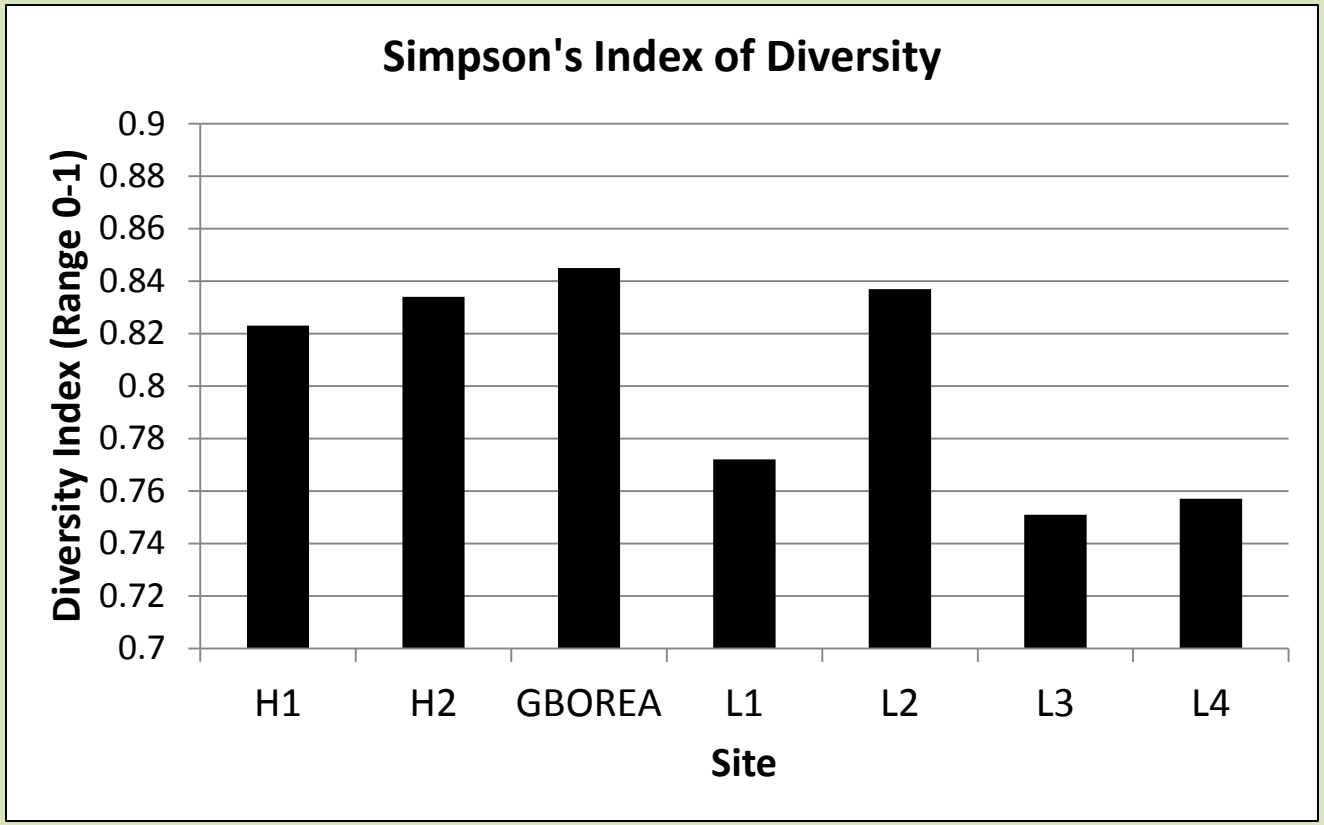
Explanatory variables account for 11.0% of the variation exhibited in catch data. (P<0.005)

Using Simpson's Index of Diversity (SID) equation, indexes were calculated using cumulative trawl data from each of the seven sites.

Excluding *Anchoa mitchili*, the ten most abundant species collected in the trawl were included in the calculations.

The GBOREA exhibited the highest overall diversity index (0.845) of any other site.

More diverse

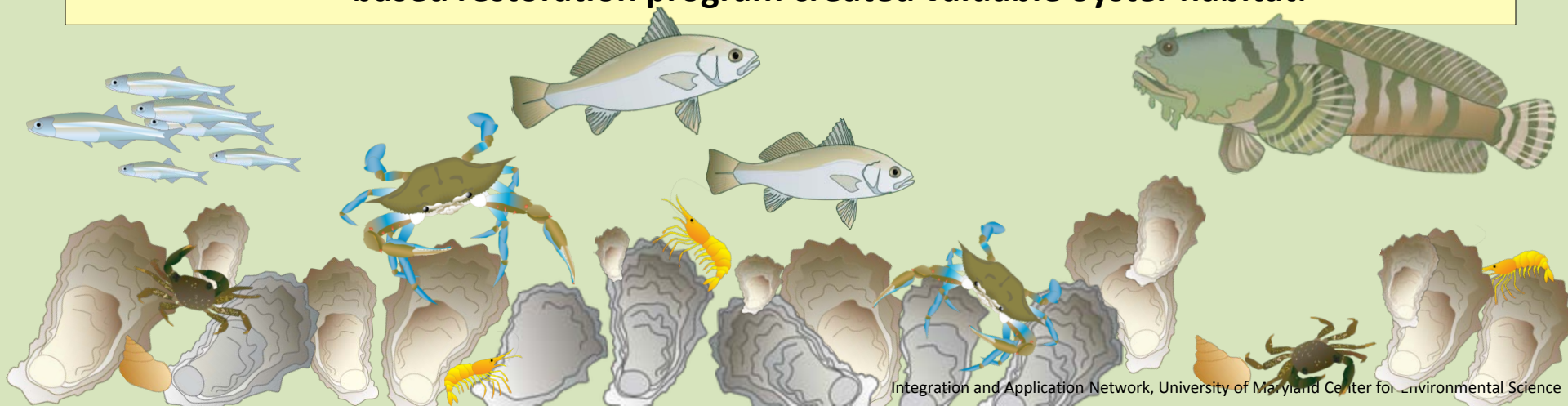


Less diverse

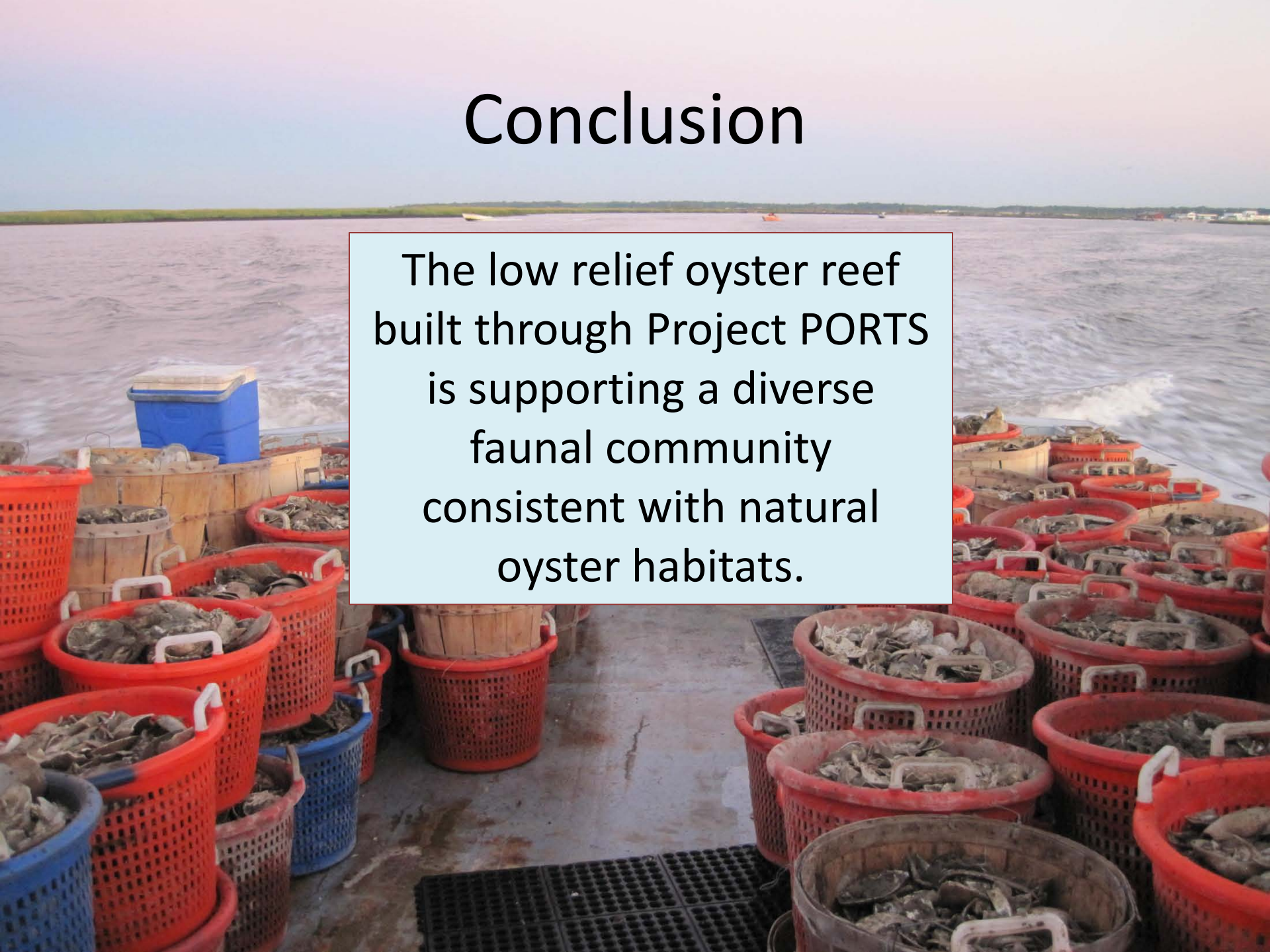
Summary of Results

- Overall, a similar fish and macroinvertebrate community was found across all sites.
- The enhancement site exhibited the greatest cumulative diversity of fish species
- Species richness and total abundance:
  High oyster density reefs > Enhancement area ≥ Low oyster density reefs
- The enhancement area appears to represent a transitional stage between degraded oyster habitat and high oyster density habitat.

In addition to its educational benefits, Project PORTS, a small-scale community based restoration program created valuable oyster habitat.



Conclusion



The low relief oyster reef built through Project PORTS is supporting a diverse faunal community consistent with natural oyster habitats.

Acknowledgements

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Program Coordinator

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