Oyster Restoration – Quonochontaug Pond, Charlestown RI

COASTAL PONDS MANAGEMENT COMMISSION MEETING

Community Room Charlestown Police Station Charlestown, RI
September 5, 2018 7:30 PM

Eric Schneider, Pat Barrett – RI DEM, Div. Marine Fisheries

Problem: Wild oyster populations are at historic lows, resulting in a significant loss of ecosystem services

- Regional populations are estimated at 15% of historic levels (Beck et al. 2011)
- RI oyster population are estimated at 1% of historic levels (zu Ermgassen et al. 2012) and 10% of mid 1900's (Griffin 2016)

DMF Actions:

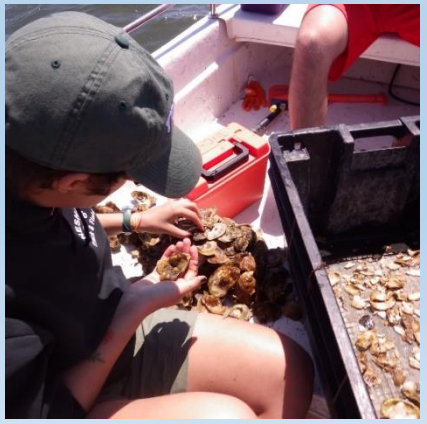
- Restoration and enhancement projects are being conducted to:
  - Restore and enhance oyster spawning stock and ecosystem services, enhance harvest opportunities, and provide outreach and education

- Research is also being conducted aimed at:
  - Evaluating techniques for enhancing habitat for fish, improving restoration techniques, and evaluating the performance of oyster linages in restoration settings

Tonight's presentation contains:

- **Brief Update**: Restoration & Enhancement Projects in Coastal Ponds – Charlestown
  - NRCS EQIP Oyster Restoration – (NRCS, DEM, Aquaculture Industry)
  - Oyster Research – (Northeastern Univ., DEM, Aquaculture Industry)
  - Fish Habitat Enhancement – (TNC, DEM)
  - Shellfish Survey Work – (DEM)

- **Summary of Agenda Item**: Proposed work in Quonnie Sanctuary (CRMC PN: 2018-08-067)



- This is only a limited update on some of the current work in Charlestown
  - A more detailed presentation could be conducted at a future meeting
- Other sources of information:
  - An online recording of a webinar on Shellfish Restoration Efforts in RI is available at: https://youtu.be/eRwg5qWBvoc
  - Presentation from NEERS on FHE available upon request

IMPROVING JUVENILE FISH POPULATIONS BY ENHANCING FISH HABITAT – EVALUATING THE USE OF OYSTER REEFS AS A TOOL TO INCREASE FISH PRODUCTIVITY

New England Estuarine Research Society - Spring Meeting
Sheraton Harborside Hotel, Portsmouth, NH
April 26, 2018

Barrett*, P.D.(1), W.S.K. Helt (2), H.A. Kinney (2), J.H.Grabowski (3), A.R. Hughes (3), and E.G. Schneider (1)

(1)Division of Marine Fisheries, Rhode Island Department of Environmental Management, Jamestown, RI 02835, USA;
(2) The Nature Conservancy, Providence, RI 02906;
(3) Marine Science Center, Northeastern University, Nahant, MA 01908, USA.

The Nature Conservancy
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Northeastern University
Marine Science Center

NRCS EQIP Oyster Reef Restoration Initiative

- Overview
  - Voluntary conservation program that provides financial assistance to agriculture producers (e.g. aquaculturists) to help implement conservation practices that create oyster reefs to improve water quality and associated ecosystem services
- Goal
  - Create sustainable oyster habitats and oyster reefs in sanctuary areas in Rhode Island waters

Photo taken in 2015 of oyster reef constructed in Potter Pond in 2008

RI DEM

USDA NRCS Natural Resources Conservation Service

EQIP Phase I: 2008-2011

- 117 oyster reefs created across 7 water bodies
- Minimal monitoring done post construction
- During 2015-16 DEM monitored all 117 reefs, some twice, using standard methods

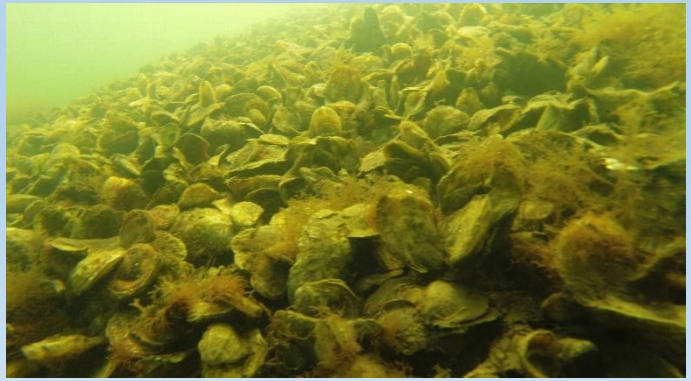
EQIP Phase II: 2015-Present

Changes from previous EQIP work

- Annual monitoring has been incorporated
- Participants are contracted for 5-years
  - 4 years of reef creation (years 1-4), and
  - 4 years of monitoring (years 2-5)
- Project design allows for additional research aspects to be incorporated
  - E.g., Reefs can be manipulated to test for effects of genetic lineage, reef height, directional orientation, seeding density, etc.

EQIP Phase II: 2015-Present

- Represents a true partnership between NRCS, DEM, and the aquaculture community
- Uses Best Available Science
- Adaptive Management
- Incorporates Research into Restoration

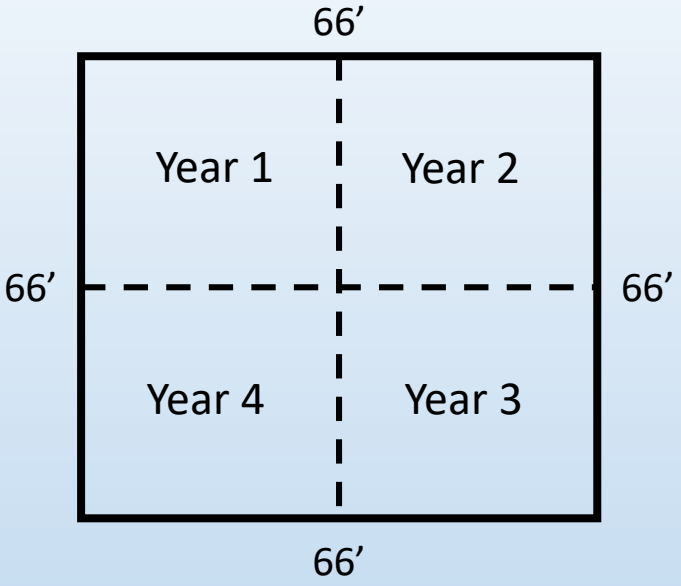


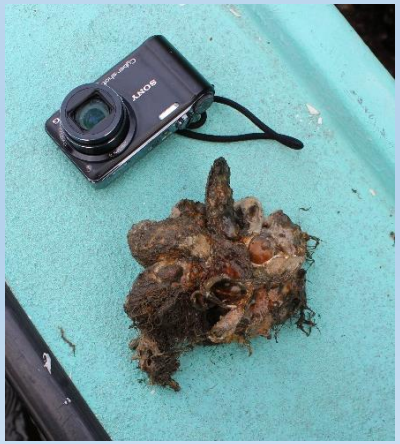
EQIP Phase II: 2015-Present

- Aquaculturists are contracted to restore 0.1 acre plots over 5-years
  - 4 years of construction and monitoring
- Each year, ¼ of the plot is restored
- Quantity of shell & seed on shell oysters deployed
  - $5y^3$ of shell & ~$5y^3$ of seed on shell per year
  - Pre-deployment assessment (estimate of size class, percent alive, projected number of oysters to be deployed)
- Monitoring
  - Conducted by a qualified contractor
  - Reefs are monitored annually,

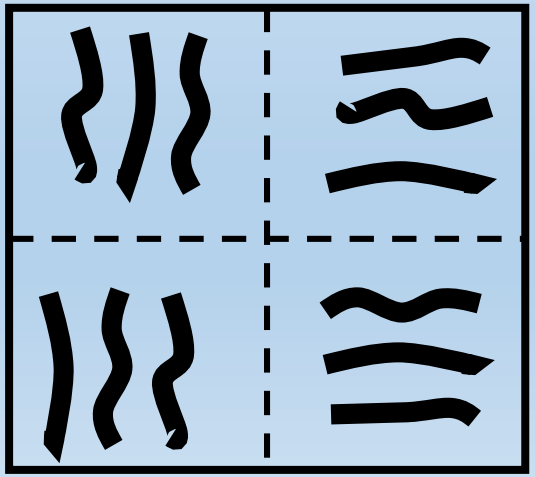
  until 1-year after the last reef has been created

Example 0.1 Acre Plot:





Example 0.1 Acre Plot With Reefs



EQIP Phase II: 2015-Present

- Oyster Monitoring Techniques
  - Conducted during May and October, annually.
  - Oysters are monitored following the Rhode Island Oyster Restoration Minimum Monitoring Metrics and Assessment Protocols (Griffin et al. 2012).
  - Reef size: Measure longest length (N-S) and width (W-E).
  - Oyster density, number alive/dead, algal cover, substrate type, reef height
    - At each reef, a 0.25m^2 quadrat is haphazardly placed six times.
    - Using standard cover practices, the percent cover of macroalgae is estimated, then all algae was brushed away to allow for percent cover estimation of benthic substrate.
    - Reef height was measured at each quadrat and then all oysters and dead shell were excavated from the quadrat.
    - Live oysters were measured and enumerated, as well as any recently dead boxes.
  - All material was then returned to the sampling location so as not to disturb the reef.
  - Pathology: Collect samples from Mid-Aug fall to test for Dermo, MSX, and SSO

EQIP Phase II: 2015-Present

- Approach allows for Research to be incorporated

Examples:

1. Lead by Dr. Randall Hughes, Northeastern Univ. (NEU) in collaboration Dr. Jon Grabowski NEU, DEM, and aquaculturists
   - Collaborate on remote set oyster restoration experiments testing the performance (survival, growth, disease prevalence) of different linages of juvenile oysters alone and in a mixture
   - Potential for smaller-scale experiments manipulating oyster source identity, diversity, and density to look at disease prevalence

2. Lead by DEM
   - Assessing how factors such as reef height, orientation, seeding density affect growth, survival, and recruitment

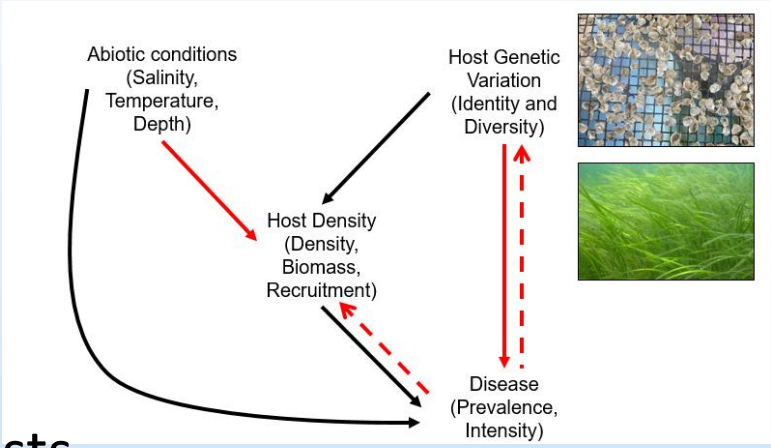
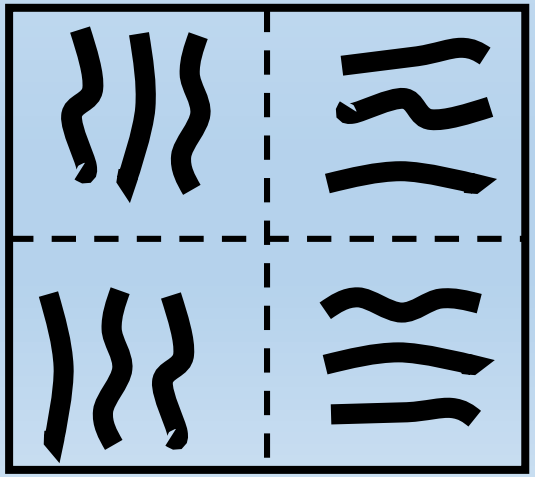


Figure credit: Dr. Randall Hughes, NEU

Example 0.1 Acre Plot With Reefs



FISH HABITAT ENHANCEMENT PROJECT

- **Goal**: Determine if oyster reef construction can be used to improve growth & survival (i.e., productivity) of early-life stages of recreationally important fishes such as black sea bass, tautog, scup, summer flounder, & winter flounder
  - Builds upon previous work in Mid-Atlantic & Gulf of Mexico, evaluating effect in Southern New England

- **Partners:** Cooperative agreement between DEM & TNC
  - Scientific Advisers: Drs. Jon Grabowski and R. Hughes of Northeastern University
    - additional support from RWU
  - US FWS Sport Fish Restoration Program (SFR) funded project

RI DEM
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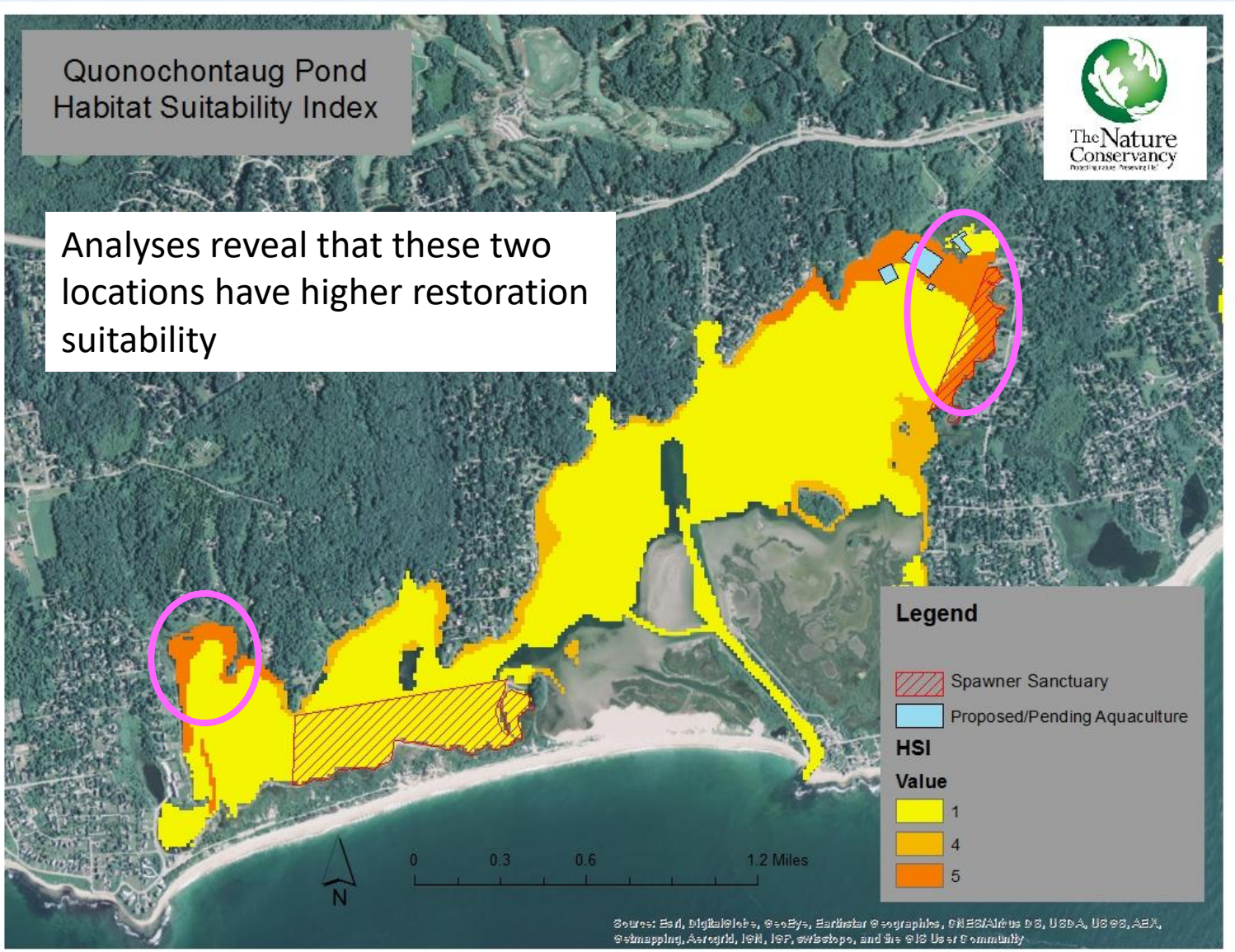
SPORT FISH RESTORATION

FHE 2015-Present

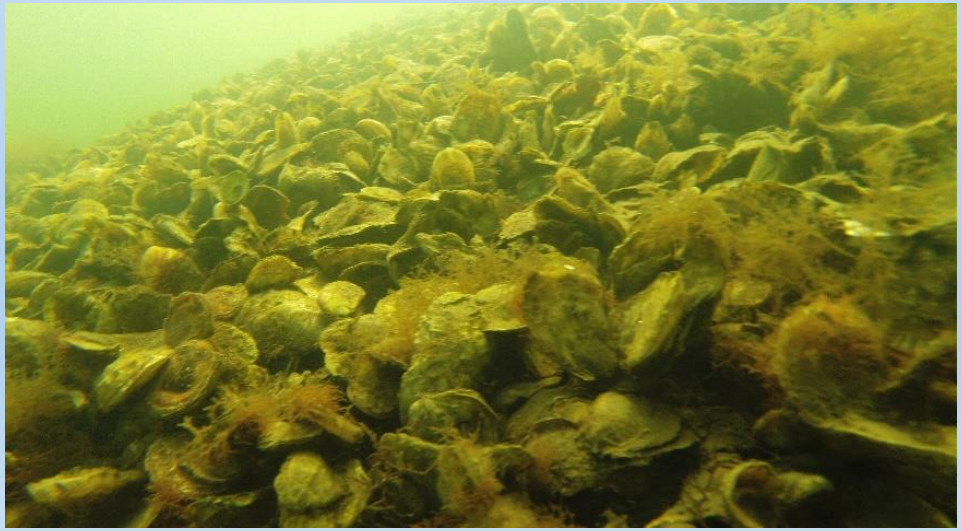
- Objectives
  1. Determine site locations for reef establishment
  2. Create and establish oyster reefs; &
  3. Conduct pre- & post-enhancement surveys to determine if there are changes in fish productivity

FHE 2015-Present

- Site Selection
  - Site suitability analysis used available geospatial and fisheries data
  - Sites were selected to minimize impacts to other known public uses in the pond



FHE 2015-Present



FHE 2015-Present

FHE 2015-Present

- Status
  - Ninigret & Quonnie Ponds
    - Conducted baseline monitoring, constructed reefs, continued post-construction monitoring
  - Pt Judith Pond
    - Selected sites, applied for restoration permits, and plan to begin baseline monitoring in May 2018

FHE 2015-Present

- Design

Ninigret Pond

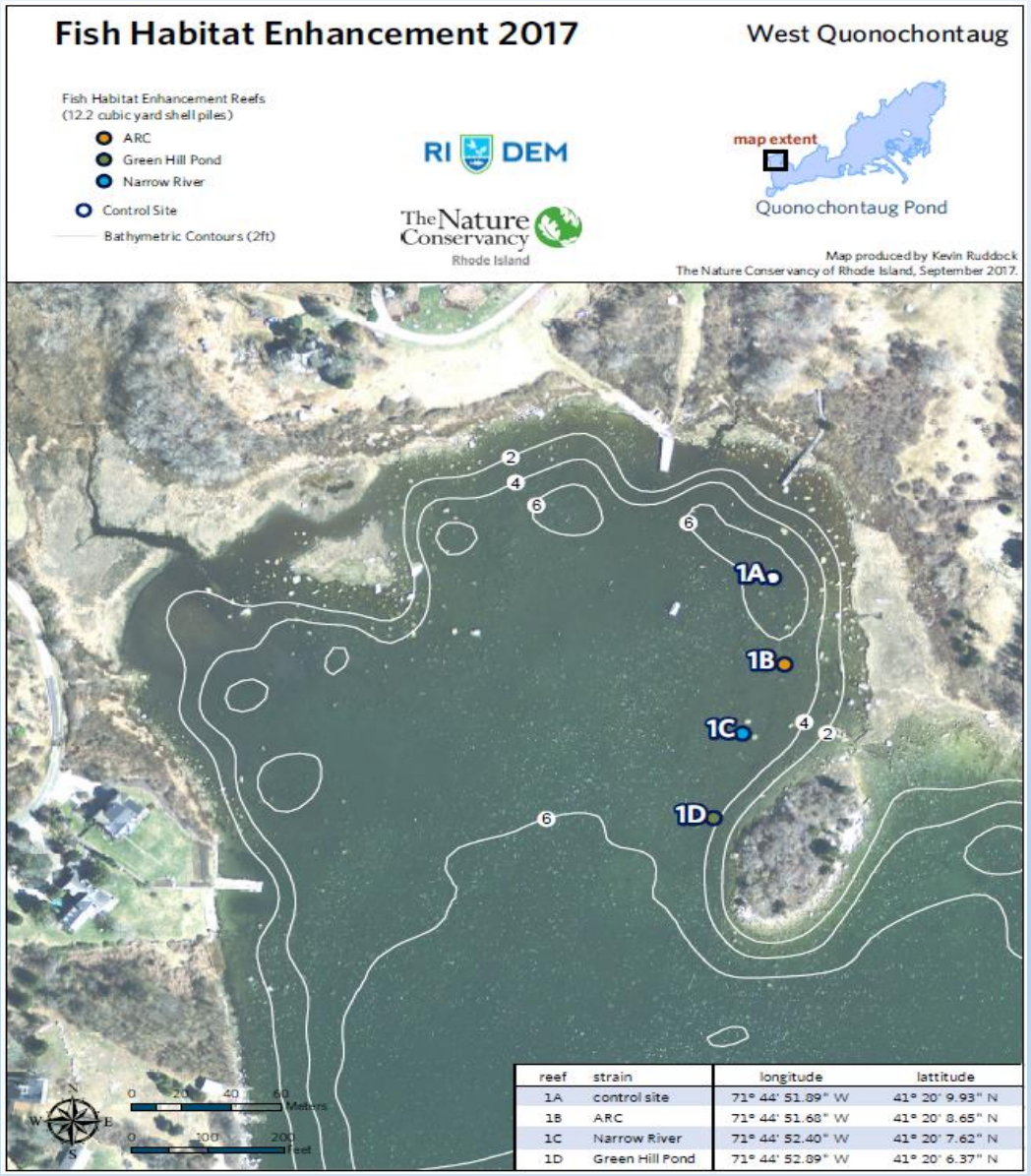
- Experimental Design: BACI
  - 4 replicates
  - 3 treatments:
    - Control
    - Unseeded
    - Seeded
- Construction: October 2015

Quonnie Pond

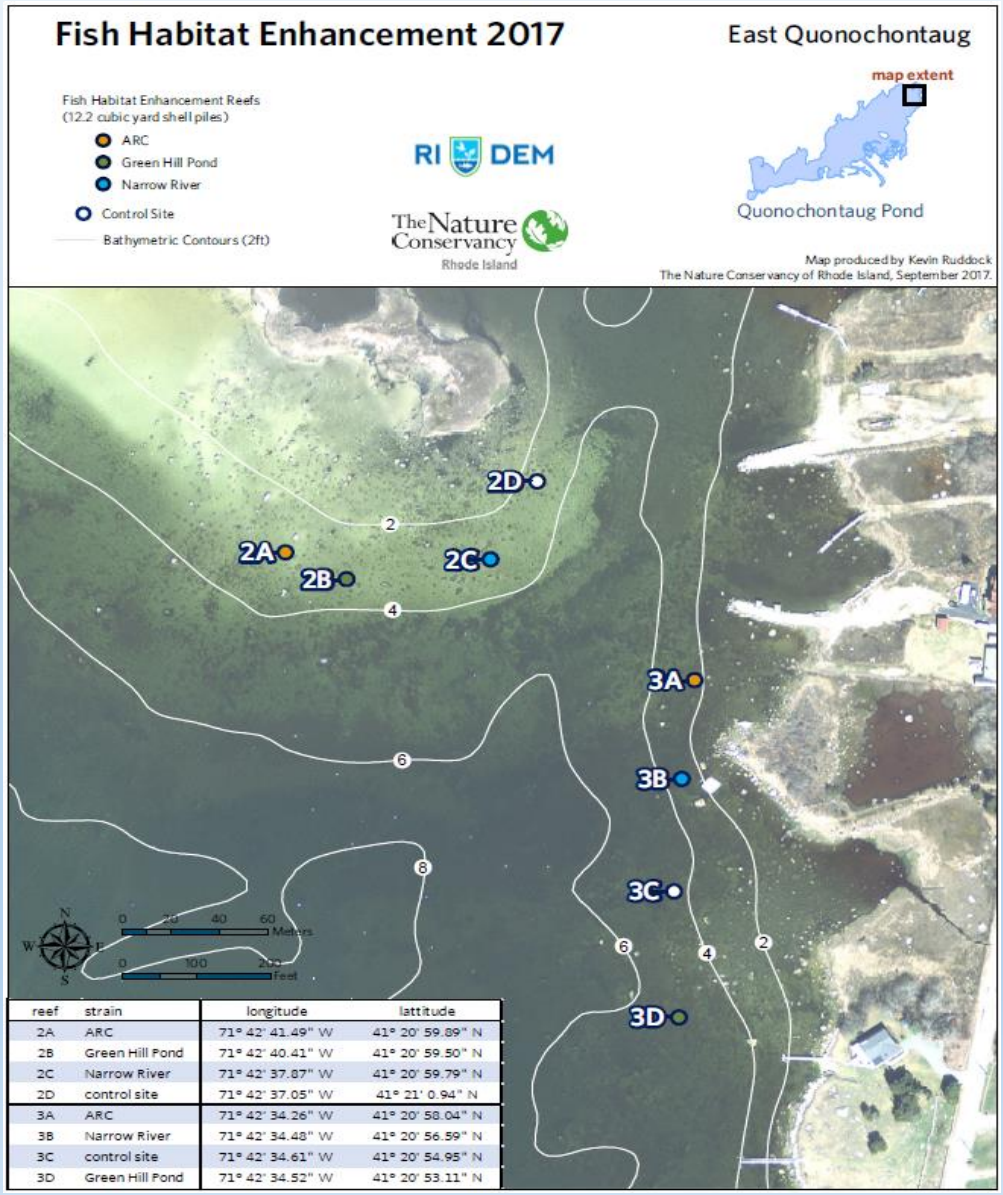
- Experimental Design: BACI
  - 3 replicates
  - 4 treatments:
    - Control
    - Hatchery strain
    - Green Hill strain
    - Narrow River strain
- Construction: May 2017

FHE Ninigret Pond

FHE Quonnie Pond



reef	strain	longitude	lattitude
1A	control site	71° 44' 51.89" W	41° 20' 9.93" N
1B	ARC	71° 44' 51.68" W	41° 20' 8.65" N
1C	Narrow River	71° 44' 52.40" W	41° 20' 7.62" N
1D	Green Hill Pond	71° 44' 52.89" W	41° 20' 6.37" N

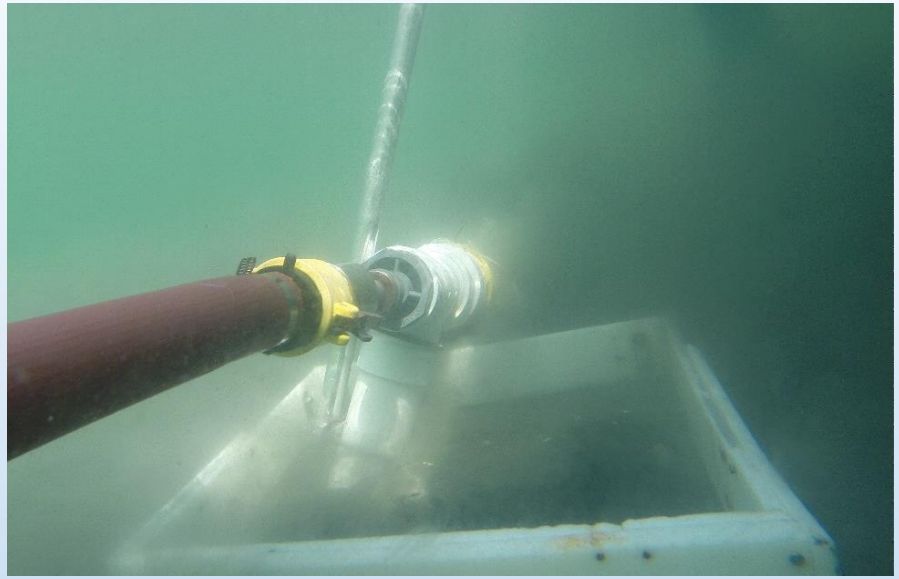


reef	strain	longitude	lattitude
2A	ARC	71° 42' 41.49" W	41° 20' 59.89" N
2B	Green Hill Pond	71° 42' 40.41" W	41° 20' 59.50" N
2C	Narrow River	71° 42' 37.87" W	41° 20' 59.79" N
2D	control site	71° 42' 37.05" W	41° 21' 0.94" N
3A	ARC	71° 42' 34.26" W	41° 20' 58.04" N
3B	Narrow River	71° 42' 34.48" W	41° 20' 56.59" N
3C	control site	71° 42' 34.61" W	41° 20' 54.95" N
3D	Green Hill Pond	71° 42' 34.52" W	41° 20' 53.11" N

FHE Methods

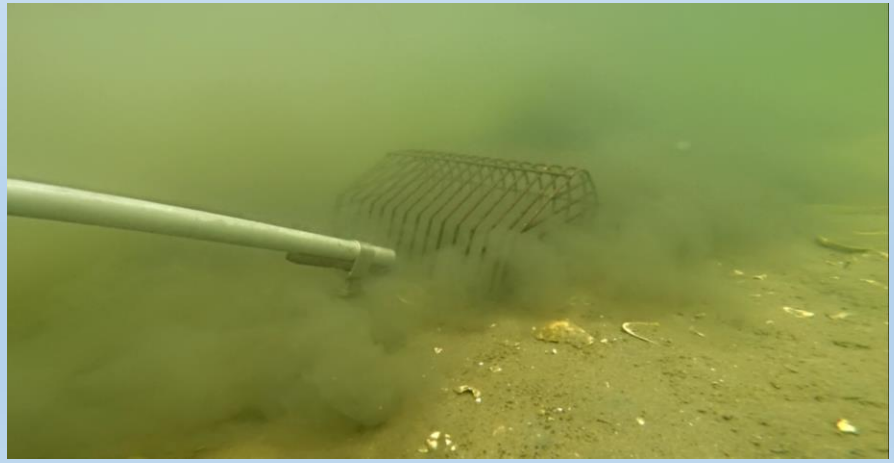
- Oyster
  - Conducted annually (Spring/Fall)
  - Follows RI Oyster Restoration Minimum Monitoring Metrics and Assessment Protocols
- Fish
  - Evaluated pre- & post- reef construction
  - Conducted monthly (May – October)
  - Eel pots, minnow traps, gillnets

Shellfish Surveys - Clam Suck



- **Problem:** DEM lacking critical data in the coastal ponds regarding shellfish resources and spatial data regarding uses, in general.

- **Goal:** Initiate a shellfish survey to assess the standing stock of shellfish

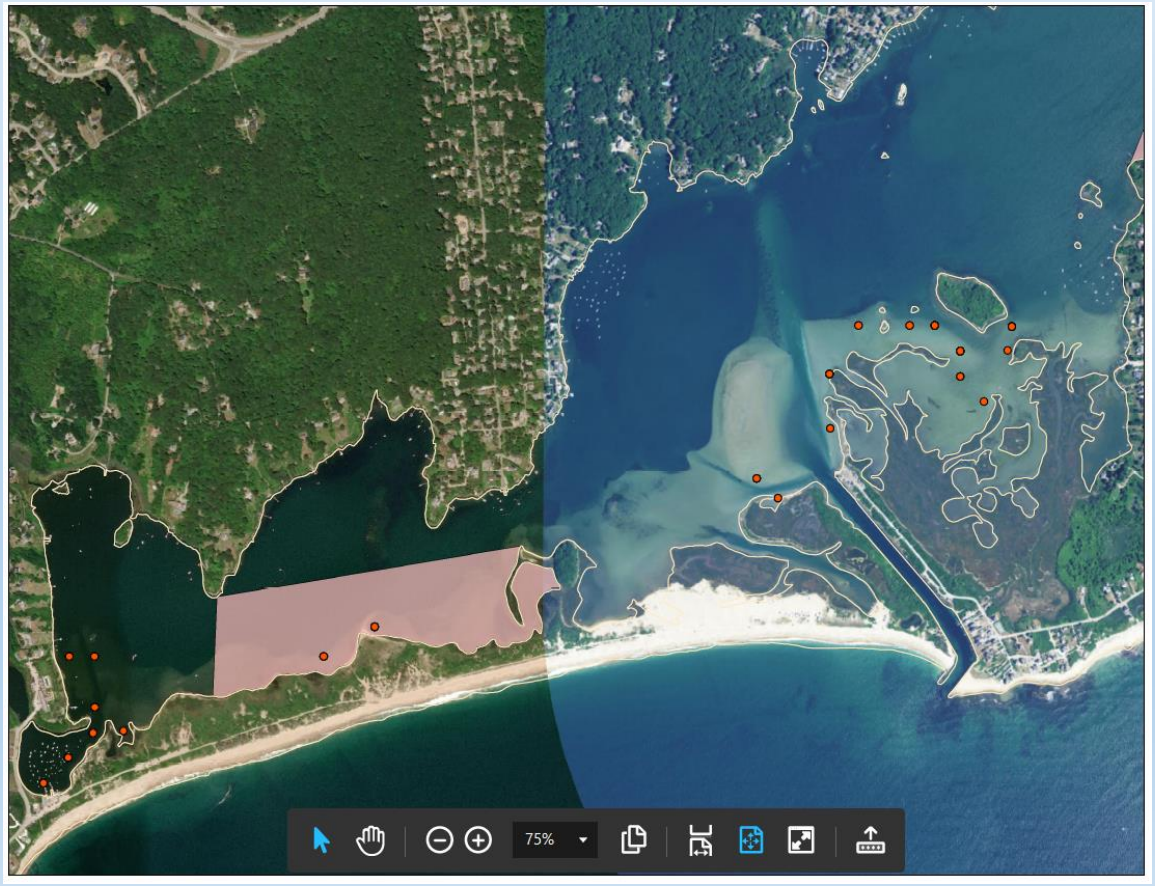


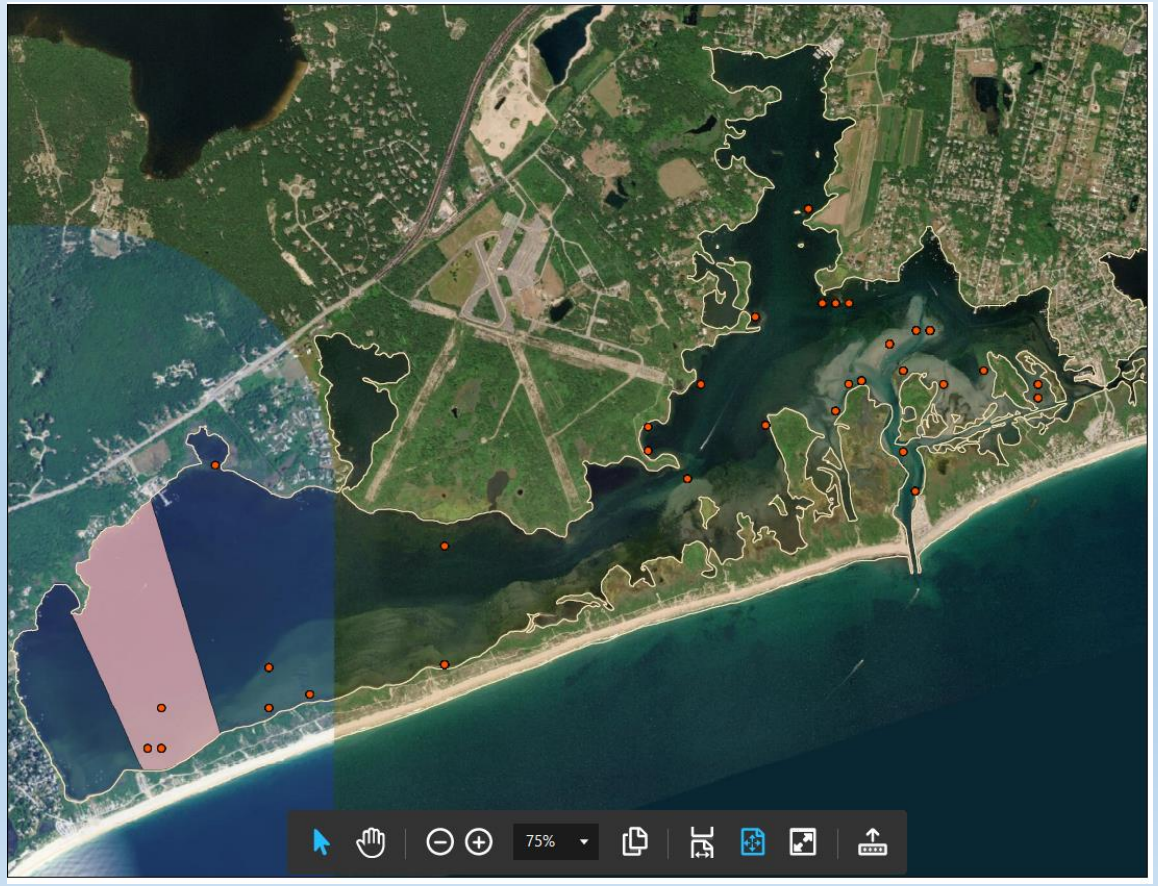
- Shellfish Sampling

  Each sample event consisted of:
  - 1 suction sample ($1m^2$ x 0.5m deep) and
  - 1 bull rake transect (5m)
  - Water quality data using YSI-85
  - All shellfish identified, measured, and counted
  - Other invertebrates and general obs. noted

Shellfish Surveys - Clam Suck

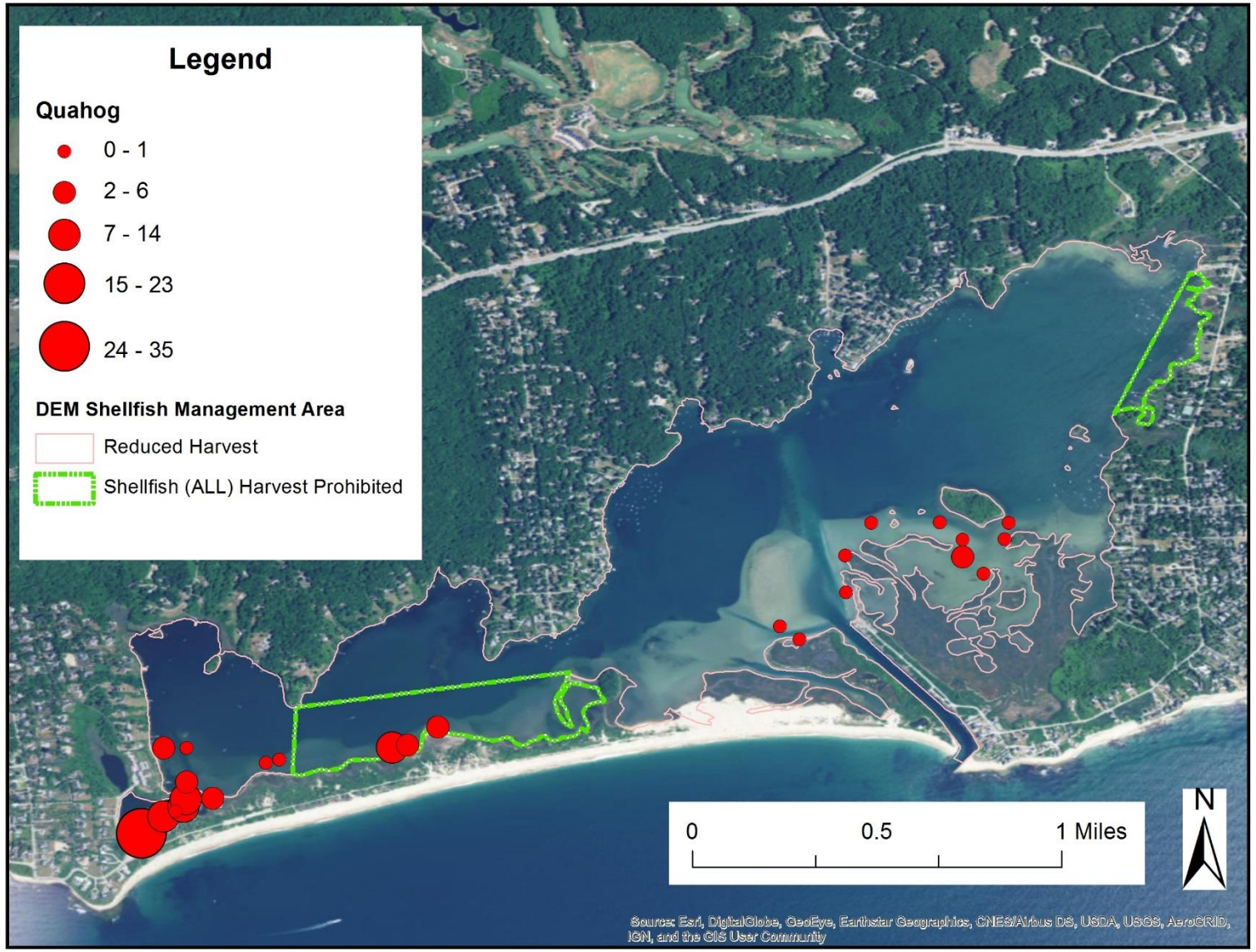
- Shellfish Sampling sites (2016-2018). Work is ongoing.



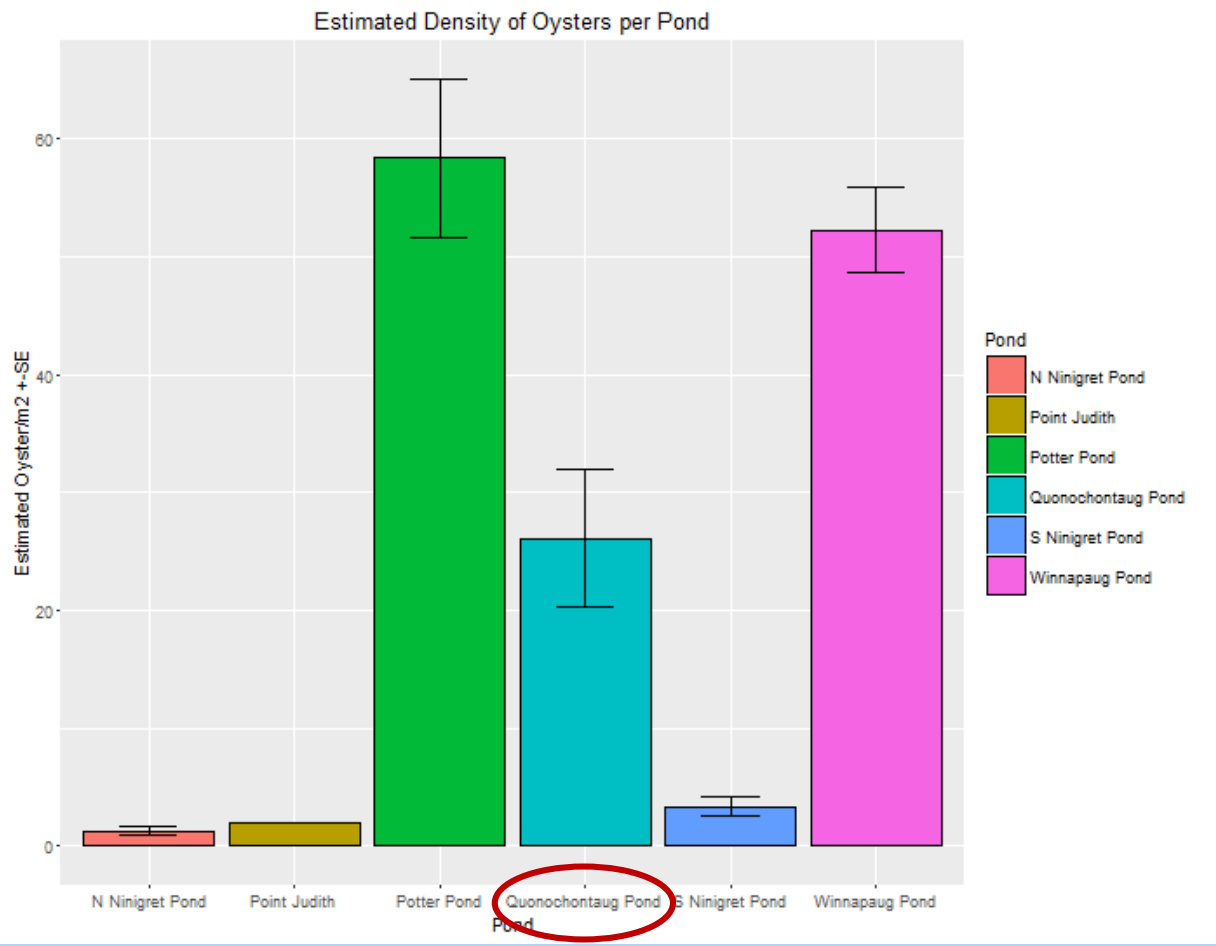


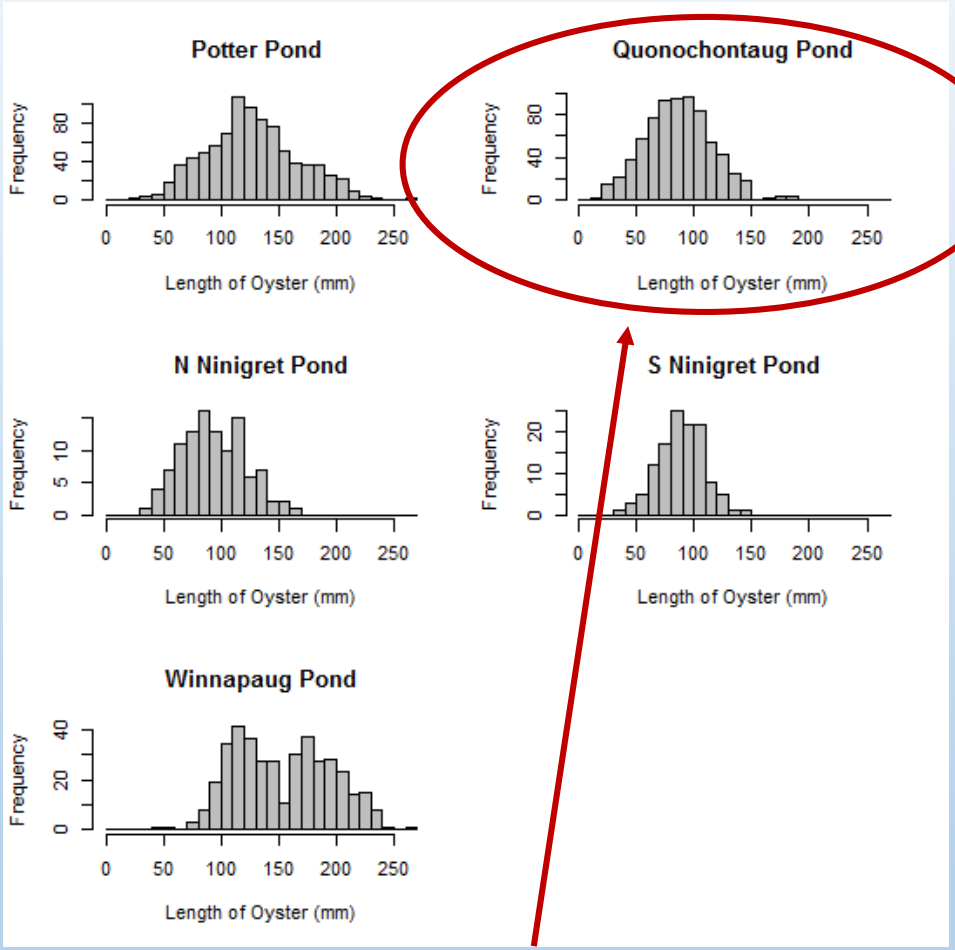
Shellfish Surveys - Clam Suck

- Shellfish Sampling
  - Example of results from 2016
  - Density (No./m^2) of Quahogs by station
  - Additional years of sampling have been conducted, but I didn't have results readily available



EQIP Phase I - DEM Oyster Reef Monitoring Results





Looking across restoration reefs, those in Quonnie showed some of the highest densities, and have densities similar to natural reefs in other Coastal Ponds (natural reefs are not shown in above figure).

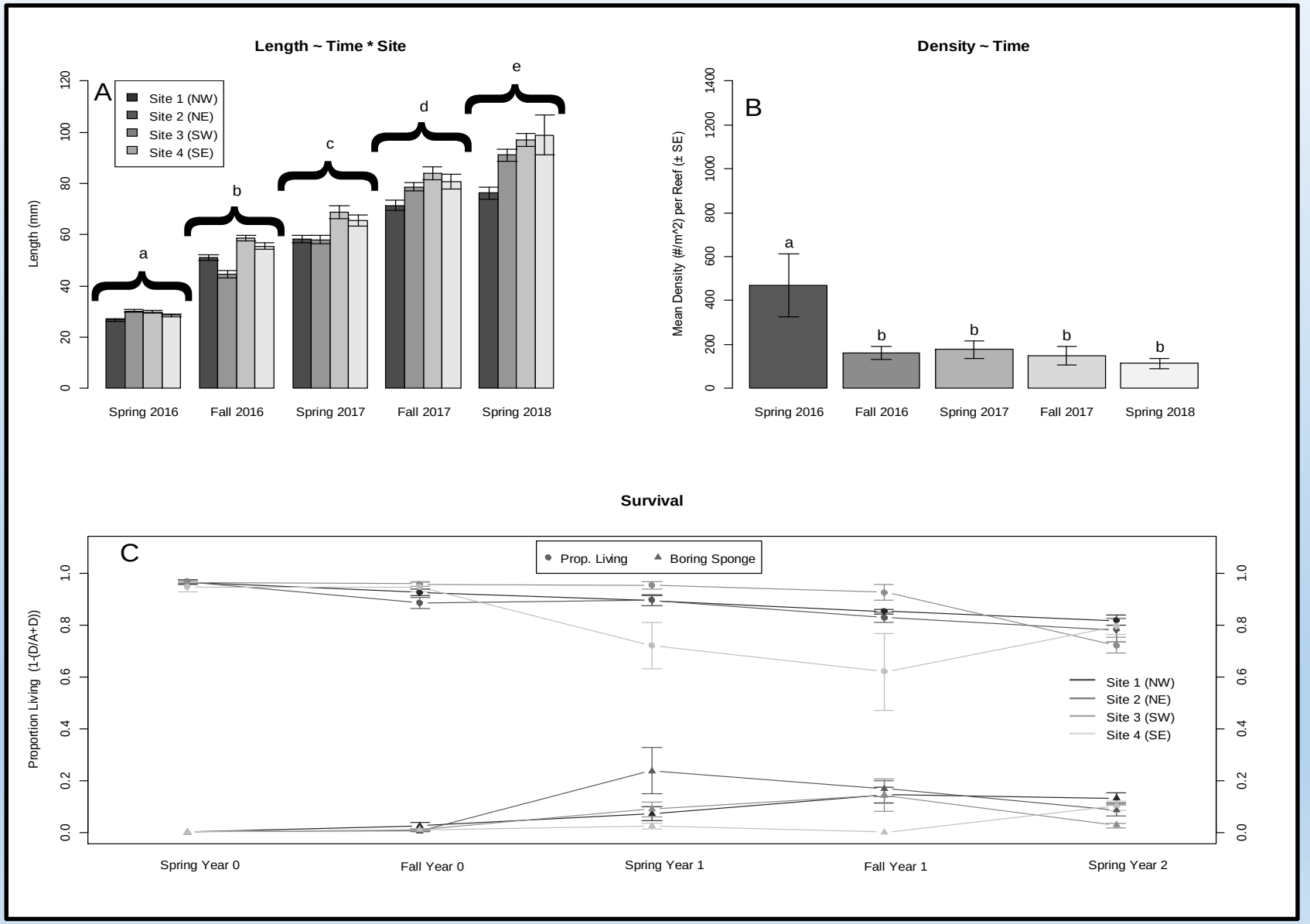
Previous restoration reefs in Quonnie show a broad size distribution suggesting that both spawning and recruitment has occurred in past years. These traits are needed to have self-sustaining populations.

EQIP Phase II: Oyster Reef Monitoring Results (brief)

- Plots in Ninigret showing > 80% survival 1-year post seeding
  - Much improved from previous work, which showed 32% 1 year out (e.g., North Cape, ORGRE; see Griffin 2016).
- Generally similar to FHE survival (see next plots)
- Low levels of recruitment detected in 2016 and 2017 (likely from other sources). Would expect to see recruitment increase in this fall's sampling.

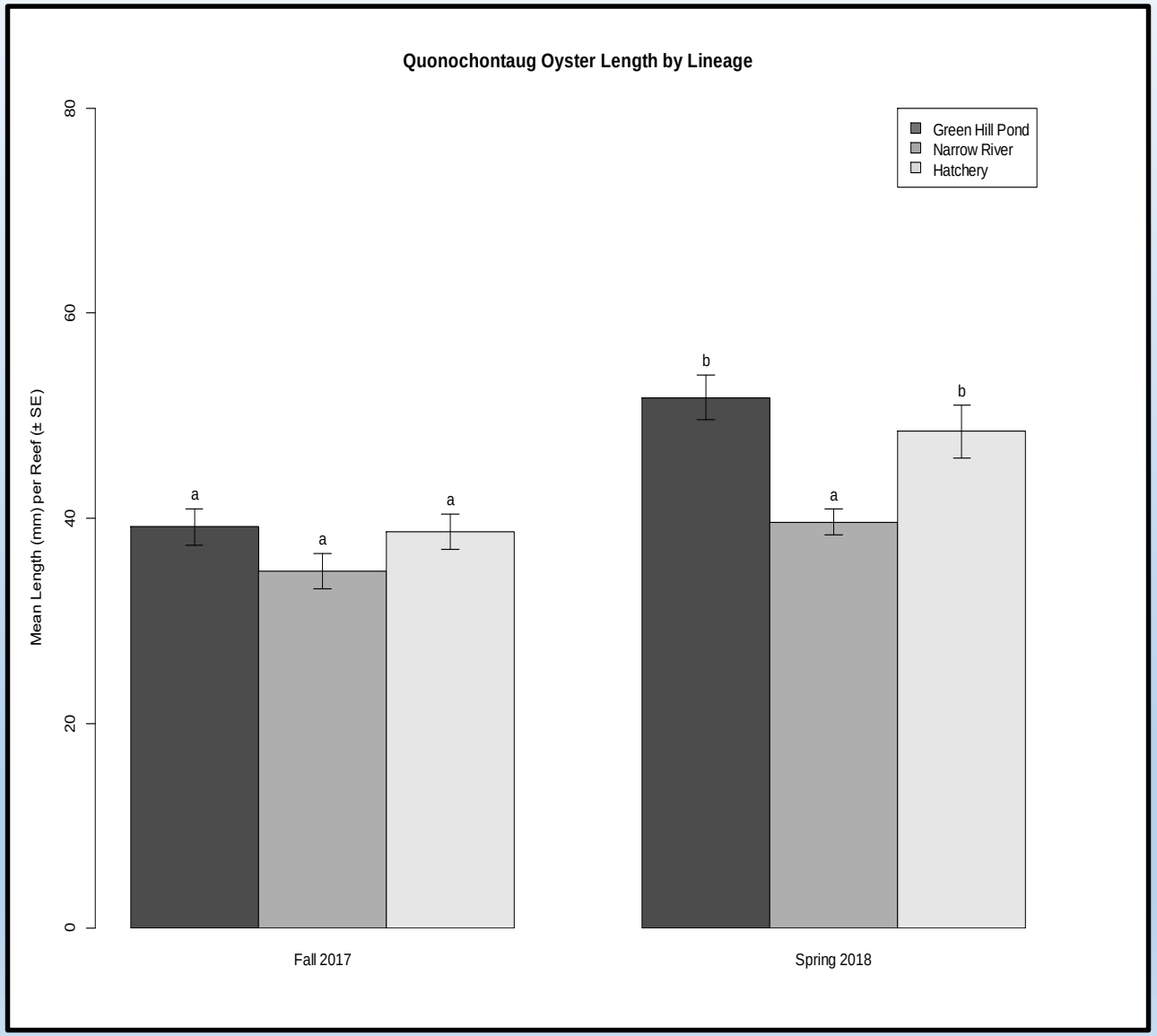
Preliminary Results: FHE – Oysters Ninigret

- Growth has continually increased
- Density leveled off after initial decline, which was expected
- Good survival (>80%) 2.5 years post seeding
  - Prev. work found 55% on average 2.0 years post seeding
- Reefs are intact, no sign of shell loss



Preliminary Results: FHE – Oysters Quonnie

- **Growth increased (Note this is from Oct to May)**
- Density differed by linage and may have leveled off after initial decline, which was expected
- Good survival (>80%)1 year
- Reefs are intact, no sign of shell loss



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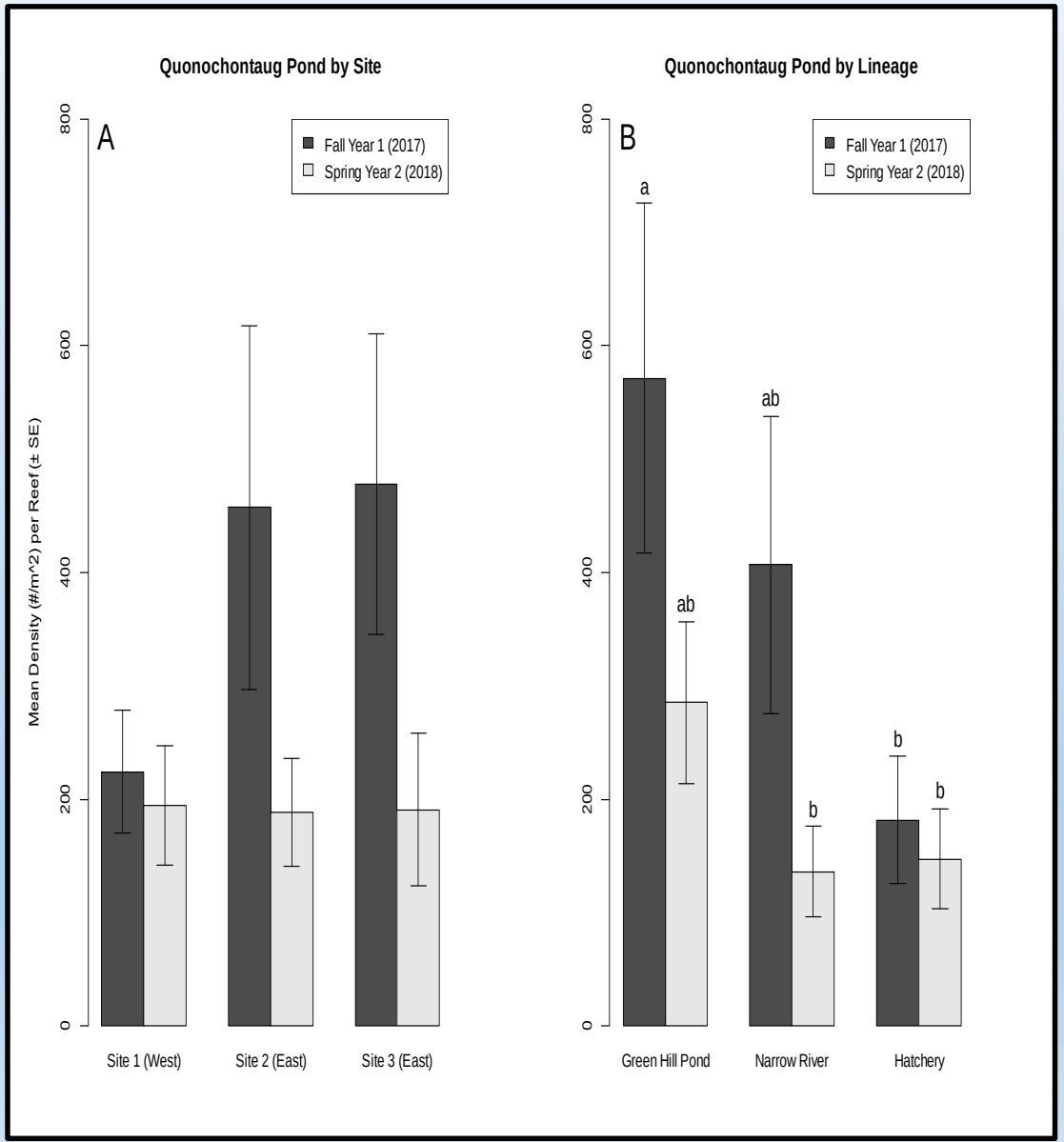

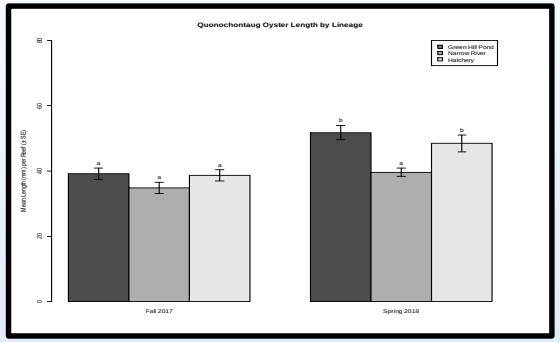

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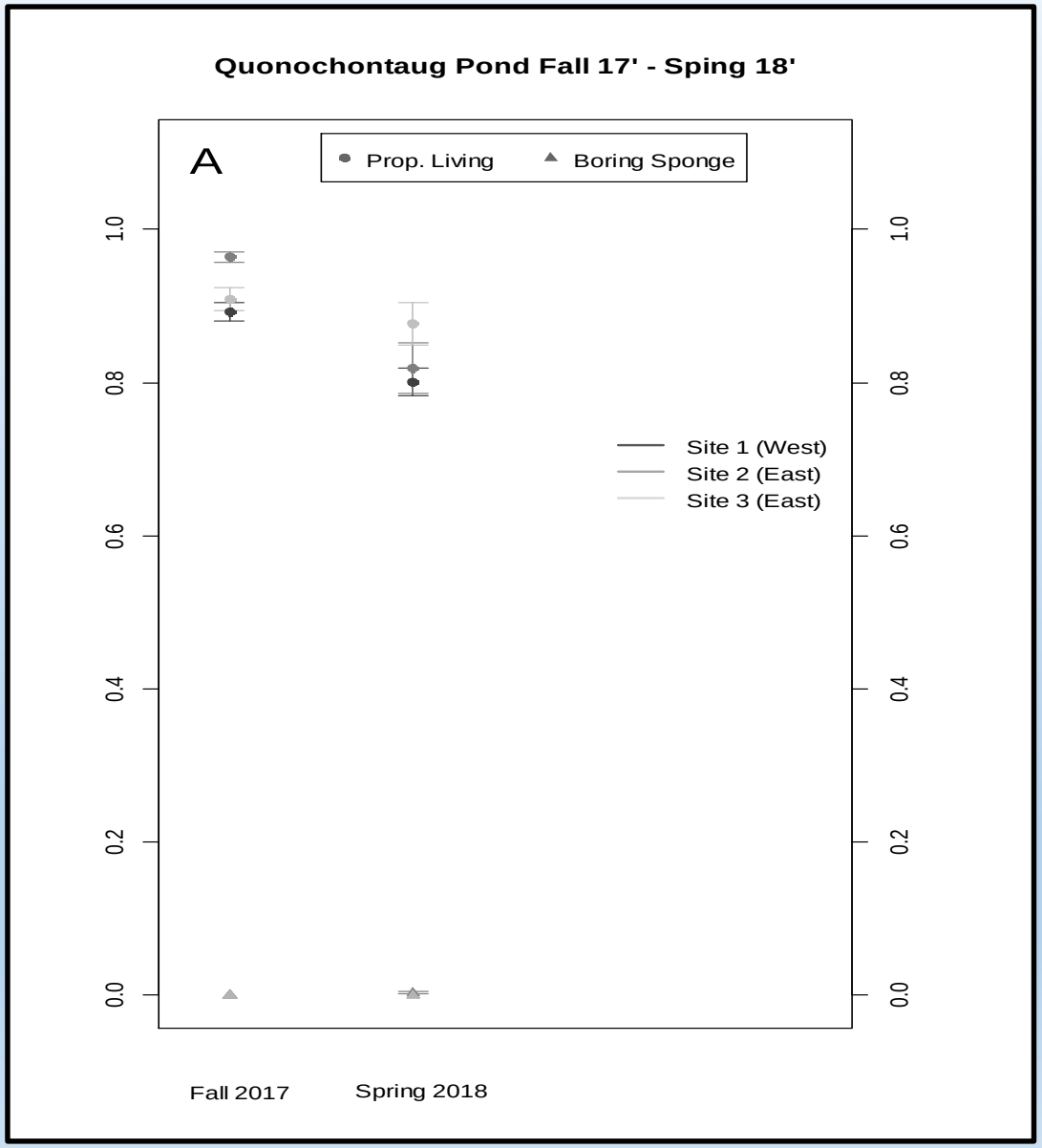
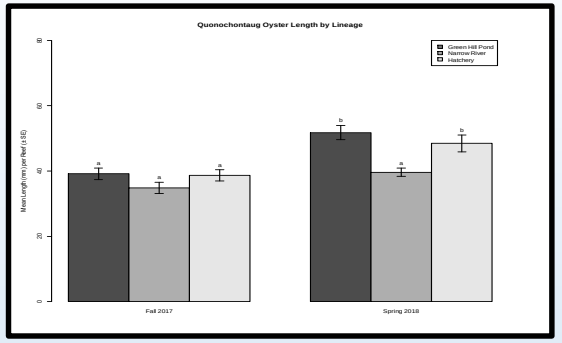
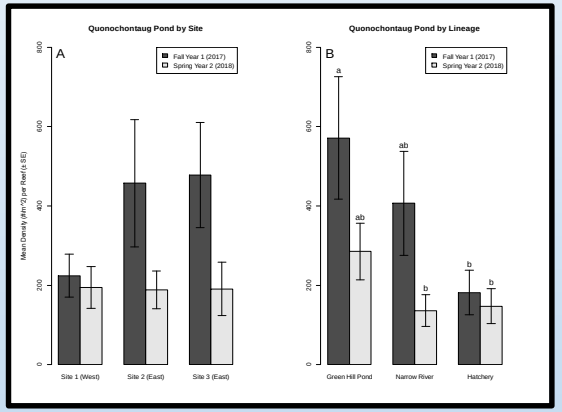




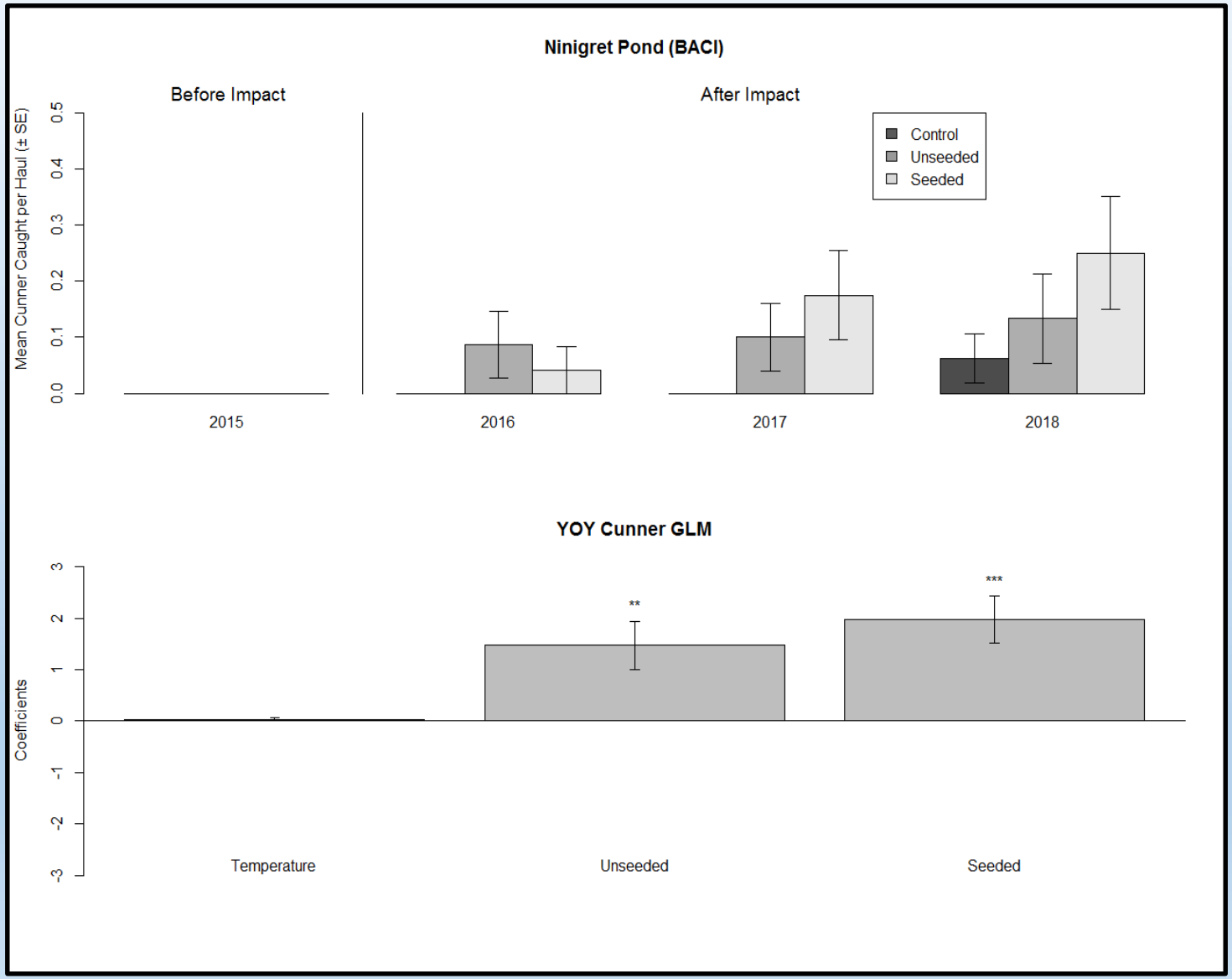


Preliminary Results: FHE – Fish Ninigret

Cunner

- Abundance of YOY cunner increased post reef creation as reefs matured

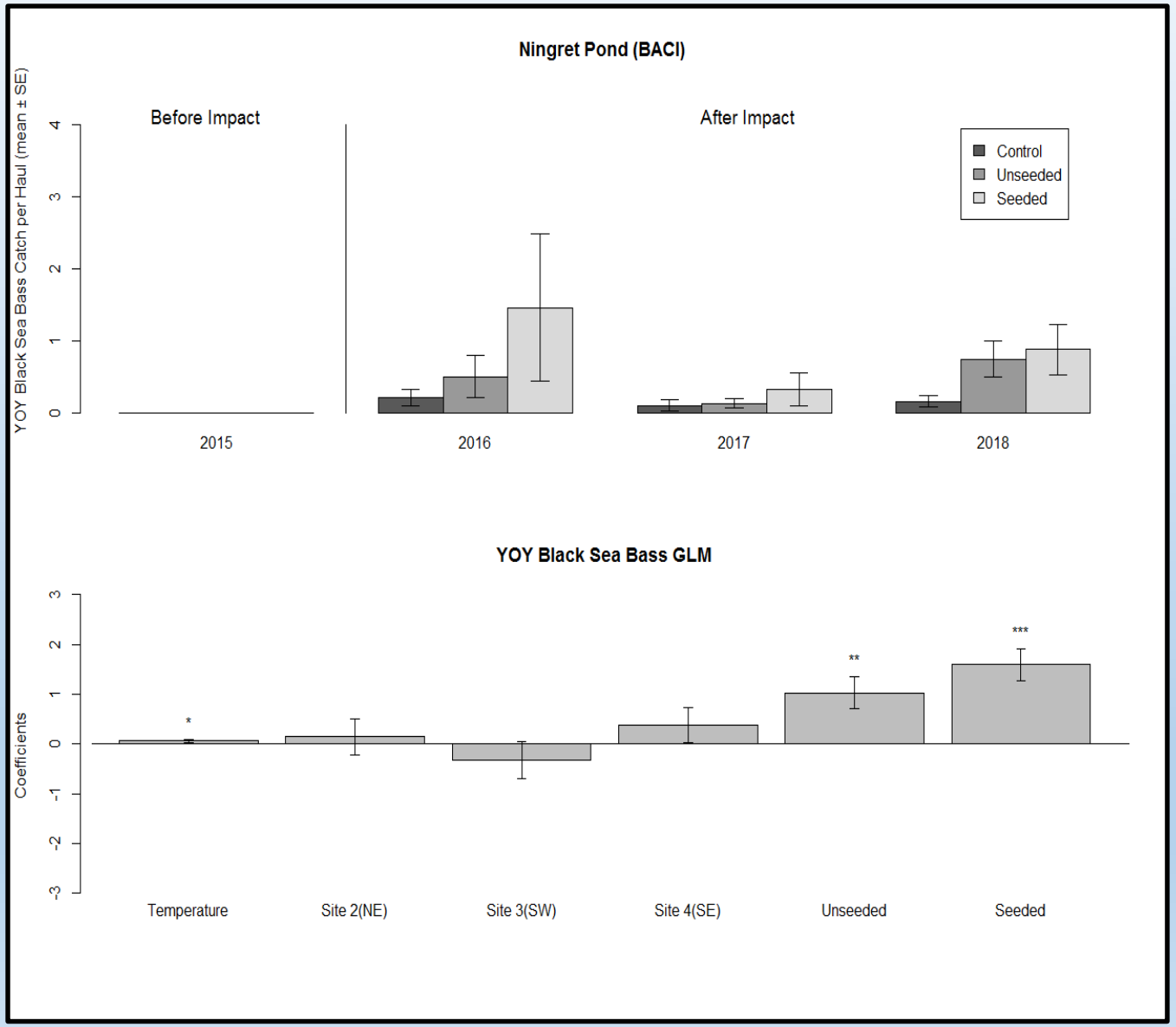
- Both unseeded and seeded reefs show effects;
  - significantly greater abundance on seeded vs. unseeded (**, ***)



Preliminary Results: FHE – Fish Ninigret

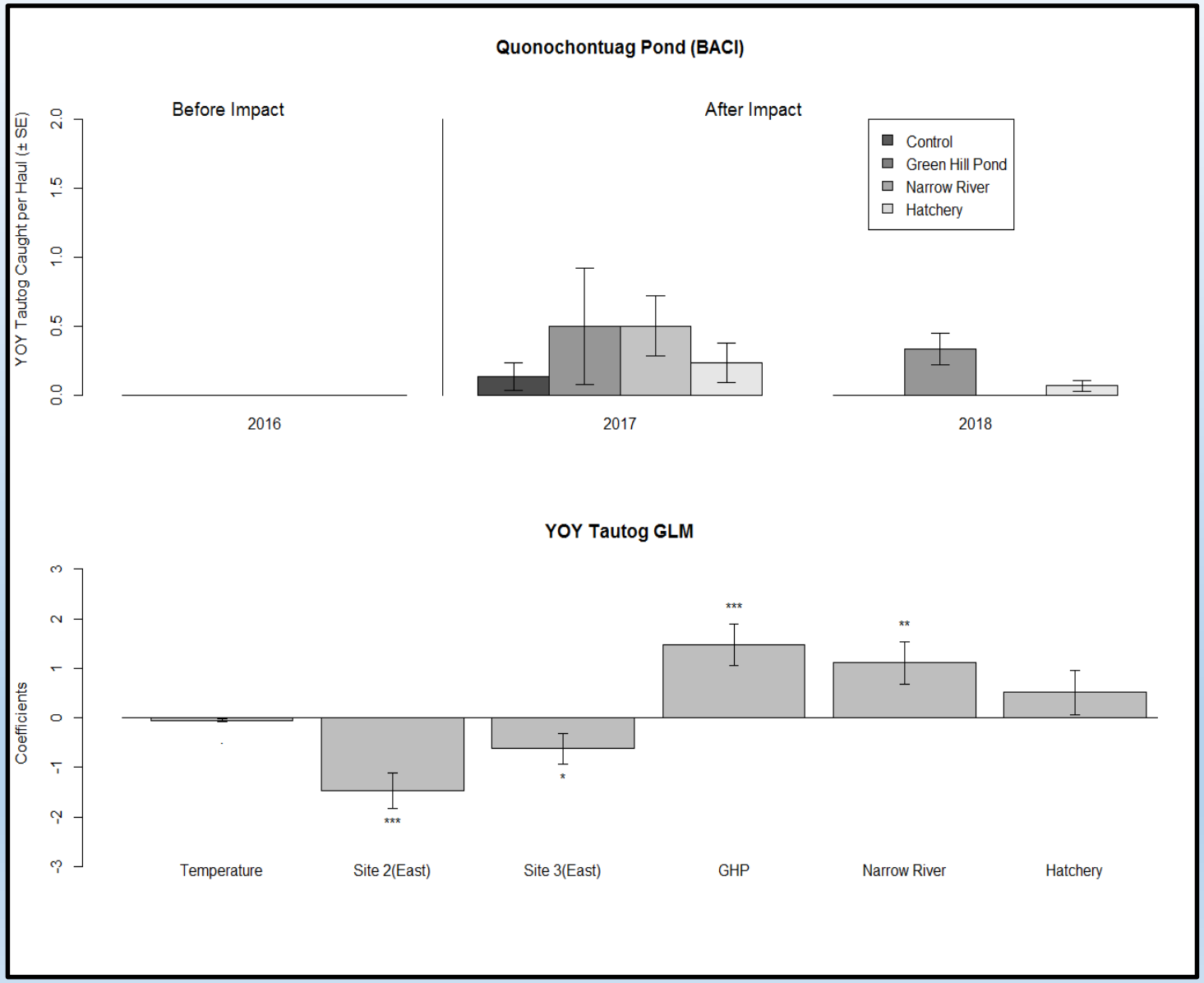
Black seabass

- Abundance of YOY increased post reef creation
- Seeded reefs supported more Black Seabass than unseeded and control plots
- GLM results are relative to first factor, meaning black seabass showed greater abundance:
  - at reefs vs. controls, and
  - at seeded vs. unseeded reefs



Preliminary Results: FHE – Fish Quonnie

- Tautog absent before reef creation, and then found in greater abundance on reefs
  - Reefs positively affecting YOY tautog
- GLM results are relative to first factor, meaning tautog showed > enhancement:
  - at Site 1 compared to 2 & 3
  - On reefs compared to control



Preliminary Results: FHE – Fish Quonnie

- Example of other species caught at FHE sites
- Species observe in higher abundance at sites post enhancement are highlighted in yellow
- Those bolded were specifically increased at reef sites

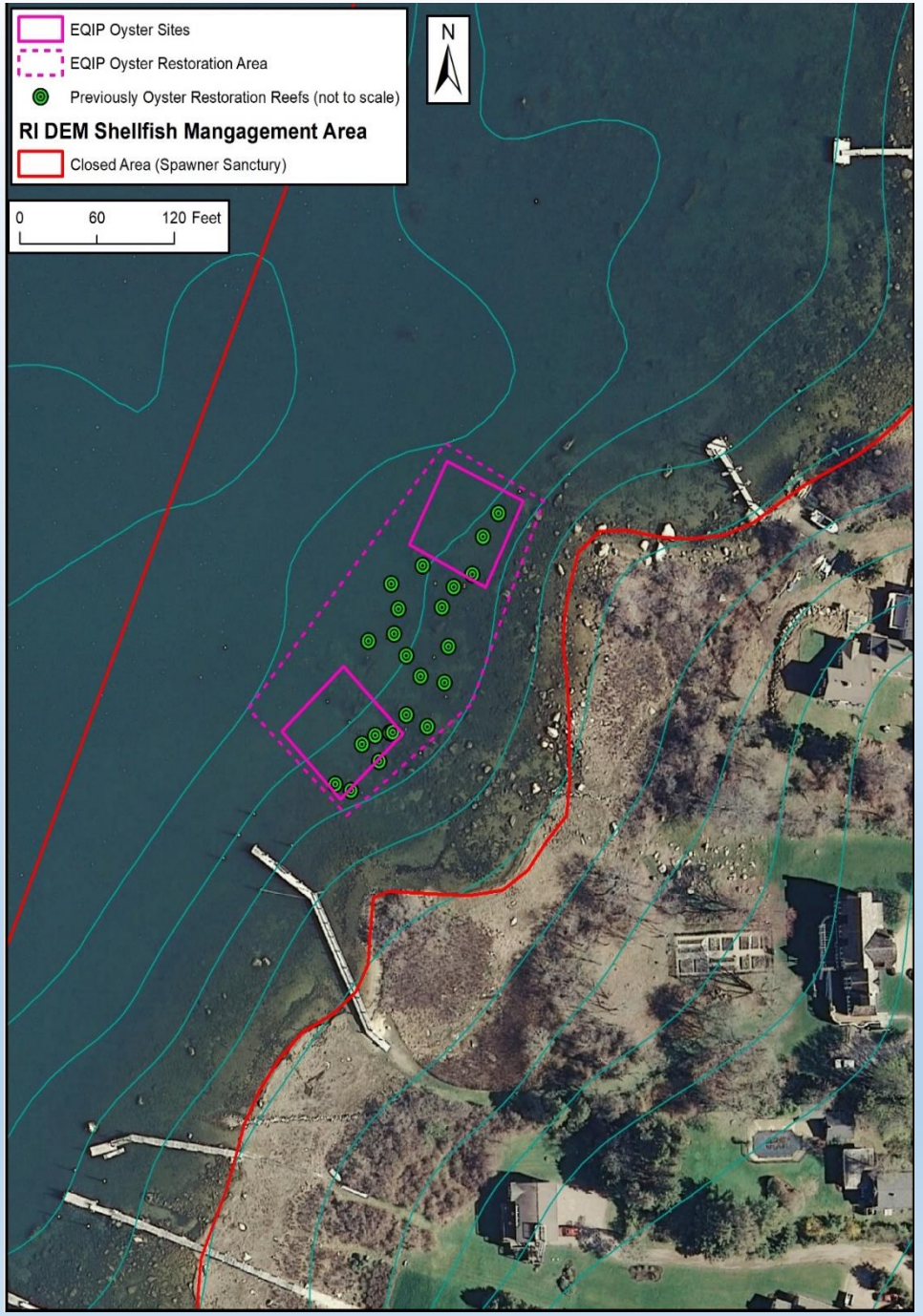
Quonochontaug Pond	2016					2017					Grand
Common Name	Control	ARC	GHP	NR	Total	Control	ARC	GHP	NR	Total	Total
ALEWIFE	0	0	0	0	0	0	0	0	0	0	0
AMBERJACK GREATER	0	0	0	0	0	0	0	0	0	0	0
BASS STRIPED	36	13	17	20	86	33	32	29	31	125	211
BLUE CRAB	10	9	6	5	30	9	4	6	2	21	51
BLUEFISH	12	13	18	14	57	11	4	8	9	32	89
BUTTERFISH	0	0	0	0	0	0	0	0	0	0	0
CRANGON SHRIMP	0	0	0	4	4	51	163	55	71	340	344
CROAKER ATLANTIC	0	1	0	0	1	0	0	0	0	0	1
CUNNER	0	0	1	1	2	4	7	3	7	21	23
EEL AMERICAN	0	0	0	0	0	9	2	3	1	15	15
FLOUNDER SUMMER	0	2	0	0	2	1	0	1	0	2	4
FLOUNDER WINTER	0	0	5	2	7	38	25	15	31	109	116
GOBY NAKED	1	1	0	1	3	1	0	2	1	4	7
GRASS / SHORE SHRIMP	10	15	0	27	52	0	3	0	0	3	55
GREEN CRAB	14	6	4	3	27	6	6	20	11	43	70
HERRING ATLANTIC	1	0	0	0	1	0	0	0	0	0	1
HOGCHOKER	0	0	0	0	0	0	0	0	0	0	0
HORSESHOE CRAB	0	0	0	0	0	4	3	0	0	7	7
KILLIFISH STRIPED	0	0	1	0	1	0	0	0	2	2	3
KINGFISH NORTHERN	1	0	2	0	3	0	0	0	0	0	3
LADY CRAB	9	5	11	5	30	5	3	1	2	11	41
MANTIS SHRIMP	0	3	1	1	5	0	0	1	0	1	6
MENHADEN ATLANTIC	37	18	44	33	132	3	3	8	5	19	151
MUD CRAB	1	1	2	2	6	1	8	0	8	17	23
MULLET STRIPED	1	0	0	0	1	0	0	0	0	0	1
MULLET WHITE	2	5	4	1	12	0	0	0	0	0	12
MUMMICHOG	0	2	1	5	8	0	0	1	3	4	12
NEEDLEFISH ATLANTIC	0	0	2	1	3	1	0	0	0	1	4
PERCH WHITE	0	0	0	2	2	0	0	0	0	0	2
PINFISH	0	0	1	0	1	10	2	2	4	18	19
PIPEFISH NORTHERN	0	1	0	3	4	2	3	0	0	5	9
RAINWATER KILLIFISH	0	0	0	0	0	11	7	25	53	96	96
RIVER HERRING	8	7	7	14	36	20	12	19	12	63	99
ROCK CRAB	0	0	0	0	0	2	1	7	0	10	10
RUDDERFISH BANDED	1	0	0	0	1	0	0	0	0	0	1
SAND TIGER SHARK	0	0	0	1	1	0	0	0	0	0	1
SCULPIN SHORTHORN	0	0	0	0	0	1	0	1	3	5	5
SCULPINS	0	0	0	0	0	2	1	1	0	4	4
SCUP	3	3	6	4	16	2	1	3	0	6	22
SEA BASS BLACK	30	14	10	25	79	32	27	40	45	144	223
SEAROBIN STRIPED	0	0	0	0	0	1	0	0	0	1	1
SENNET NORTHERN	0	0	0	0	0	0	0	0	0	0	0
SILVERSIDE ATLANTIC	3	13	4	1	21	15	12	7	4	38	59
SMOOTH DOGFISH	0	0	0	0	0	0	2	0	2	4	4
SPIDER CRAB	29	40	12	27	108	53	9	12	10	84	192
SPOT	10	12	6	14	42	28	55	23	58	164	206
STICKLEBACK FOURSPINE	0	0	0	0	0	0	5	1	0	6	6
STICKLEBACK THREESPINE	0	0	0	0	0	1	0	0	0	1	1
TAUTOG	0	0	2	0	2	8	8	20	10	46	48
TOADFISH OYSTER	0	0	0	1	1	4	5	7	5	21	22
TOMCOD ATLANTIC	0	0	0	0	0	1	0	1	0	2	2
WEAKFISH	0	1	0	0	1	0	0	0	0	0	1
Grand Total	219	185	167	217	788	370	413	322	390	1495	2283

Any Questions on Results

Proposed work in Quonnie Sanctuary (CRMC PN: 2018-08-067):

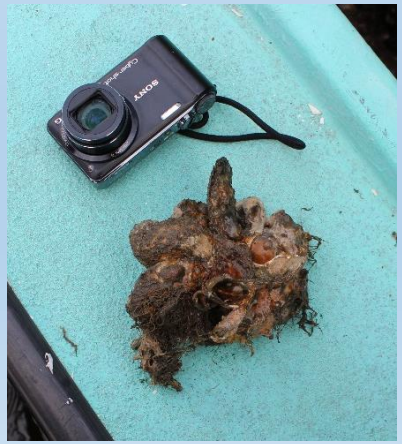
- Goal: Increase spawning stock biomass, aimed at increasing the wild oyster population in Quonochontaug Pond.

- Location: Restoration sites are located in the RI DEM Quonochontaug Pond Shellfish Management Area Eastern Shellfish Spawner Sanctuary, which is closed to the harvest of shellfish.
  - Adjacent to current reefs, rocks, boulders
  - Will not impact or prevent current uses
- Previous oyster restoration at this showed relatively good results. FHE reef preforming well thus far.

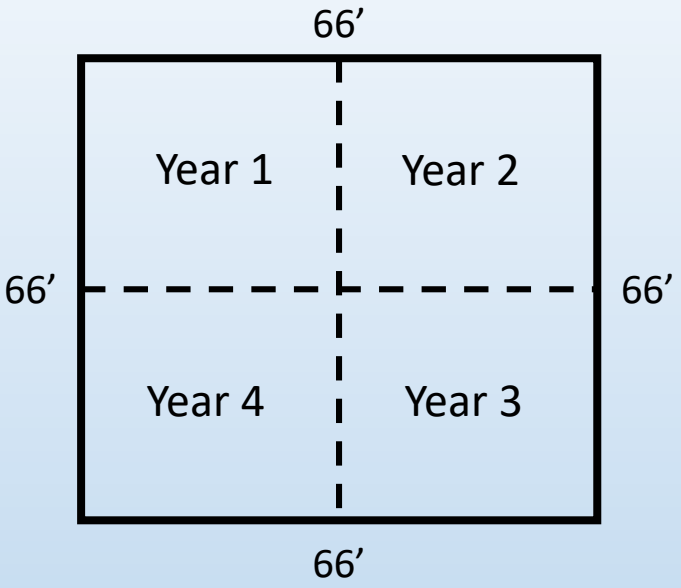


Proposed work in Quonnie Sanctuary (CRMC PN: 2018-08-067):

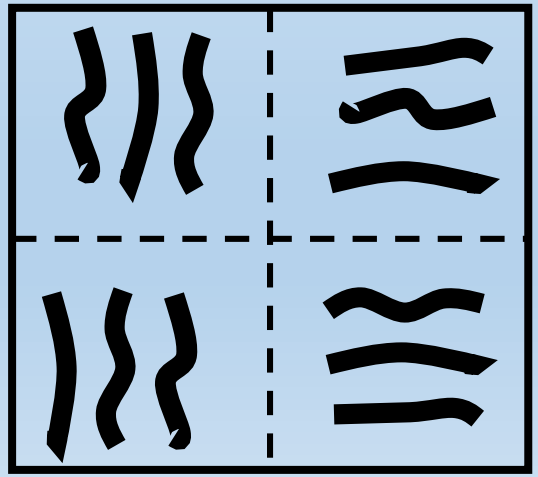
- Work occurs over 5-years
  - 4 years of construction and monitoring
  - Each year, ¼ of the plot is restored
- Quantity of shell & seed on shell oysters deployed
  - 5y^3 of shell & ~5y^3 of seed on shell per year
  - Pre-deployment assessment (estimate of size class, percent alive, projected number of oysters to be deployed)
- Monitoring
  - Conducted by a qualified contractor
  - Reefs are monitored annually,
  - until 1-year after the last reef has been created



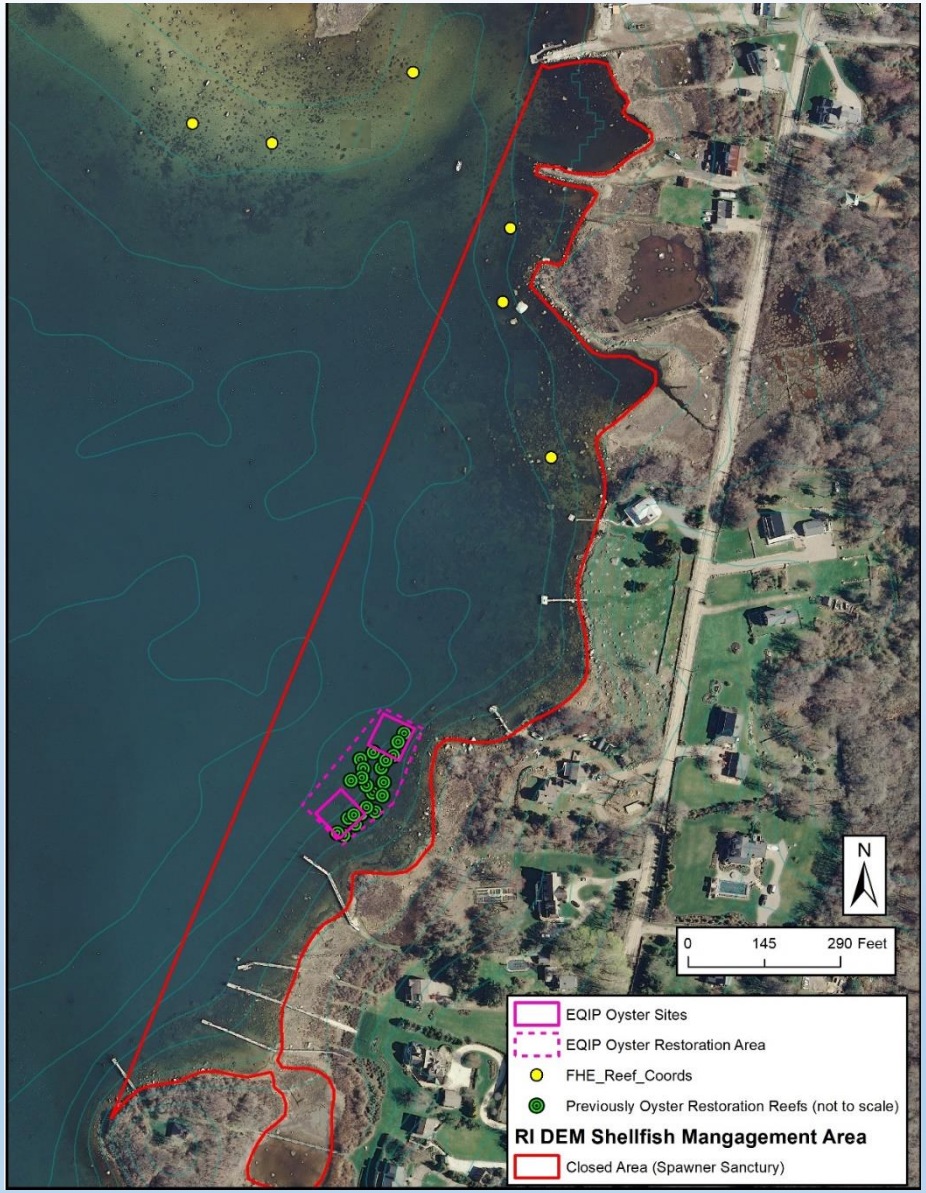
Example 0.1 Acre Plot:



Example 0.1 Acre Plot With Reefs



Any Questions?



Map showing current reefs and proposed restoration sites

Map showing an aerial view (2011 aerial photography) of the oyster restoration area containing current reefs. There is no gear associated with this work. There will be visual change to this area, other than the addition of 8 floats to mark the corner points of the 0.1 acre sites during the project.

Acknowledgments

Rhode Island Aquaculturists Participating in EQIP Oyster Restoration

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Sport Fish Restoration

The Nature Conservancy
Protecting nature. Preserving life.™

Northeastern University
Marine Science Center