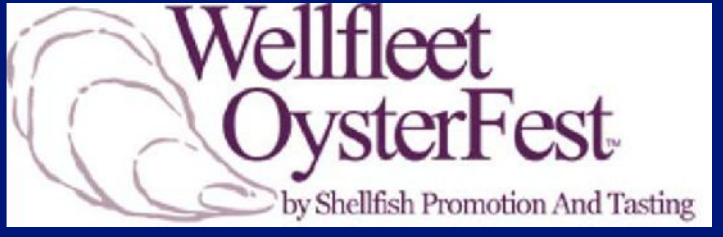
Wellfleet Comprehensive Wastewater Committee

Integrated Oyster Reef and Salt Marsh Restoration as an MEP Compliance Strategy



Wellfleet Green Infrastructure Goals

- Protect and enhance the Wellfleet Harbor ecosystem now → think 1600's function
- Adaptive approach to nutrient management
- Identify low-cost, sustainable approaches
- Use best marine science focusing on
  - Integrated ecosystems
  - oyster reef restoration
  - salt marsh restoration

Program Elements

1. Oyster Propagation Project (2 acres) Wellfleet/UMass Boston/USDA/SPAT/MOP/Provincetown Center/Env. Partners
2. Oysterfest Shell Recycling NOAA/SPAT
3. Seaclam Cultch Program Wellfleet/USDA/MOP/SPAT
4. Townwide Shell Recycling DPW/Transfer Station Collection
5. Salt Marsh Restoration
   - Mayo Creek (20 acres)
   - Herring River (890 acres)
6. Composting toilets for marina nutrient removal
7. Traditional Needs Assessment
8. Townwide GIS Septic/Well Database

Feasibility

- 30 years of science documents the nitrogen removal capacities of oysters and salt marshes
- Biodiversity of oyster reefs and salt marshes:
  - “habitat today → fish tomorrow”
  - Buffers shoreline erosion and ocean acidification
- Similar projects have been on-going in TX, NC, FL, Chesapeake Bay for over 15 years

Results in Maryland

MD: Governor O'Malley's Oyster Restoration and Aquaculture Development Plan 2009.

1. increased Maryland's network of oyster sanctuaries from 9 percent to 24 percent;
2. increased leased areas for oyster aquaculture and streamlined the permitting process;
3. established a $2.2 million financial assistance program for aquaculture interests; and
4. maintained 76 percent of the Bay's remaining habitat for targeted, sustainable, and scientifically managed public oyster fishery.

- Since implementation:
  - 28 new oyster farming leases have been approved on about 650 acres.
  - 52 lease applications covering 620 acres are currently being processed
  - MSX and Dermo have fallen to lowest levels ever recorded
  - Highest SPAT survival rates since 1985
  - Overall biomass up 44%
  - $7.5 Million committed for 2013

http://www.oysterrecovery.org/Content/Content/1/Documents/2012_October3_PressRelease_2012 Oyster Planting Season Results.pdf

Outreach Effort

- Cape Cod Commission and DEP Staff
- Wellfleet Forum
- Shellfish Advisory Board/Planning Board/FinCom/ConsCom/Natural Resources Advisory
- Harbor Master/Health Department/Shellfish Department/DPW
- Board of Selectmen
- Cape Cod National Seashore
- Division of Marine Fisheries
- Non-Resident Taxpayer's Association
- WOMR/WHAT Theatre/Preservation Hall/LCAT/Newspapers
- Oysterfest

Results – Oyster Efforts

- 5 million new oysters in study area & 40% nitrogen reduction
- 50 million oysters from cultch programs' 1,200 tons of shell
- 3 billion gallons of added water filtration per day
- Pilot projects show start-up costs are minimal and maintenance is low (under $15/lb of N removed)
- Anecdotal:
  - Huge influx of shrimp, tunicates, quahogs, crabs, snails, invertebrates, small fish
  - Significant reduction in mud level
  - Return of menhaden
  - Paired diamond back turtles foraging, heavy turtle use

Results – Oyster Efforts

Awards:

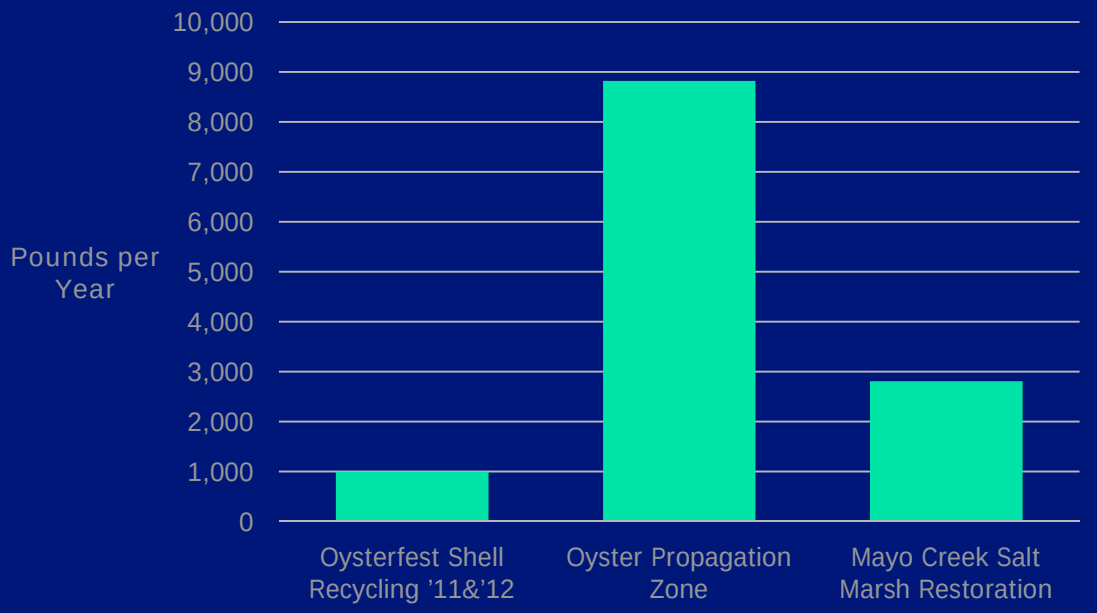
- Mass Recycle – Municipal Innovation

  November 2012

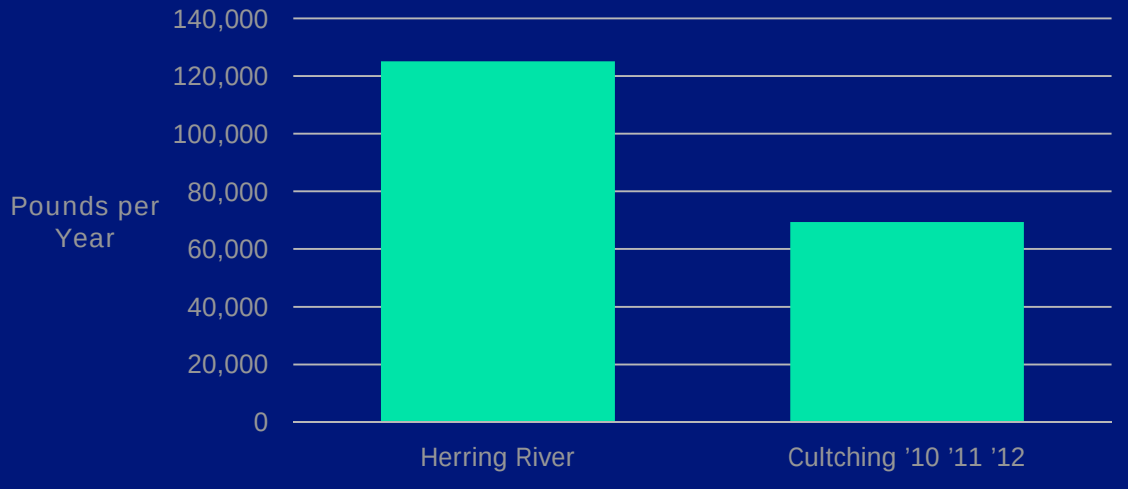
- American Council of Engineering Companies – Engineering Excellence Award

  March 2013

Nitrogen Removal
Smaller Scale Projects



Nitrogen Removal
Larger Scale Projects



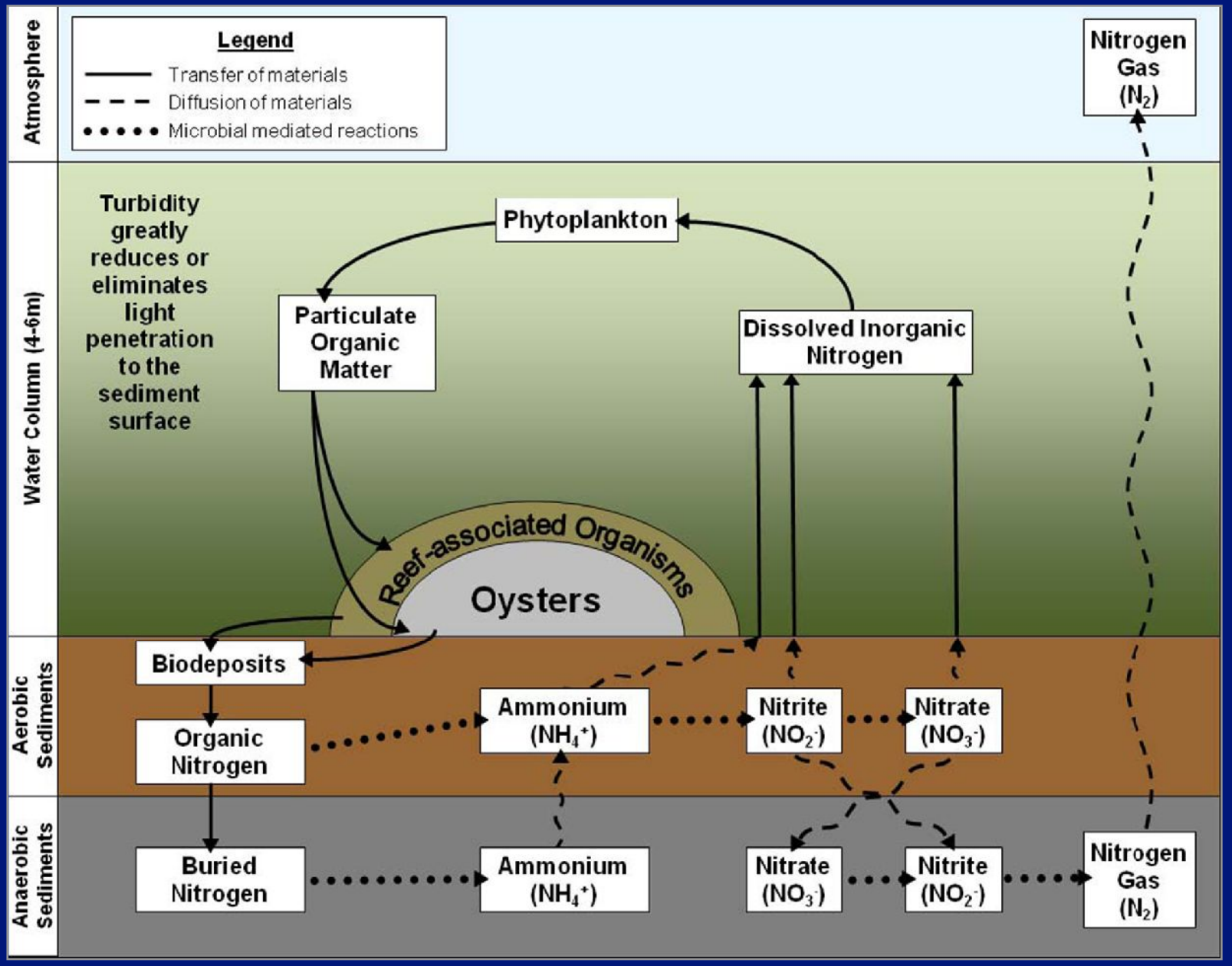
Program Costs and Number of Human Nitrogen Equivalents Removed per Year

	$/lb Nitrogen Removed[1,2,3]		People Equivalents[3]
1. Town Sea Clam Cultching ’10 ’11 ’12	$ 0.75	($50,000)	8,013
2. Mayo Creek Salt Marsh Restoration	$ 1.78	($100,000)	336
3. Oysterfest Shell Recycling ’11&’12	$ 2.01	($2,000)	119
4. Oyster Propagation Zone	$ 5.67	($50,000)	1,055
5. Herring River Salt Marsh Restoration	$23.98	($60 million)	14,963
6. Baker Field Bathrooms	$93.68	($324,000)	28
7. Sewering options (Cape Cod Commission)	$500-$1,000	($60 million)	450(CD Sewer)

1. Costs only; economic benefits dwarf costs in most cases;
2. Merrill/Cornwell 2002 Role of Oligohaline Marshes in Estuarine Nutrient Cycling
3. M Rice “Environmental Impacts of Shellfish Aquaculture: Filter feeding to Control Eutrophication”

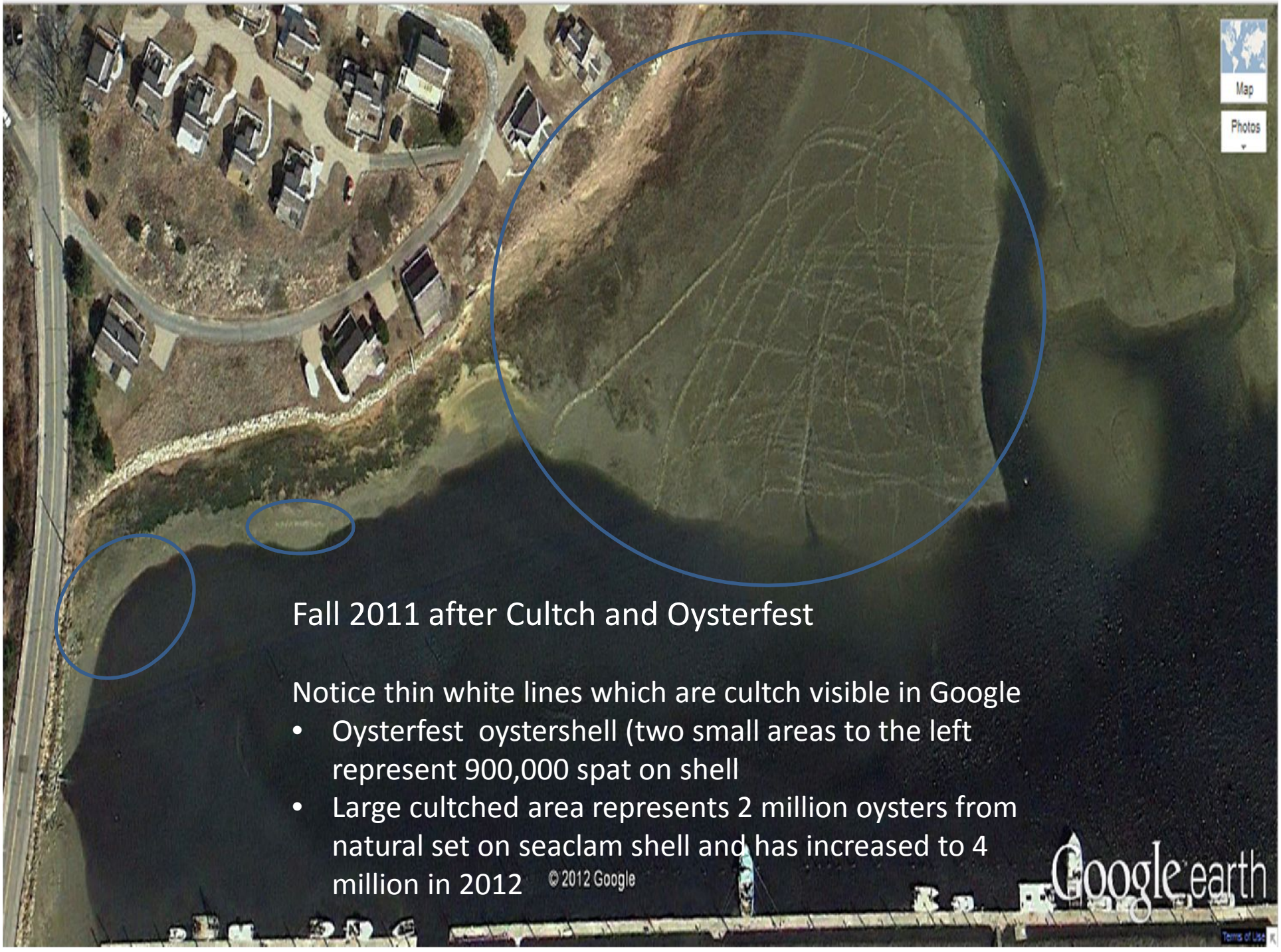
Nitrogen cycling on oyster reefs

Denitrification, after Kellogg



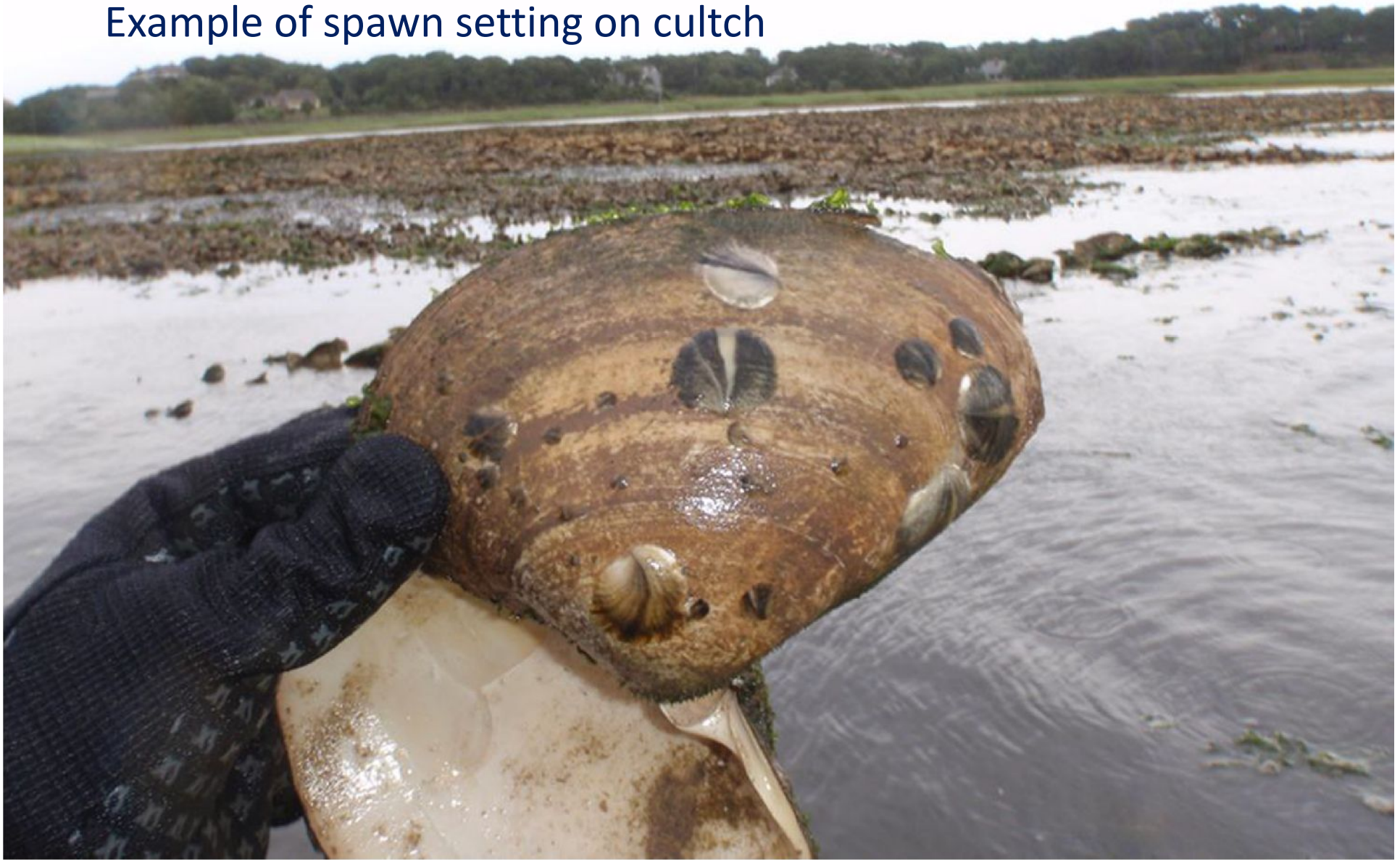
Wellfleet Harbor Oyster Propagation Study Area

Site visit May 24, 2011 9 am


Map
Photos
Fall 2011 after Cultch and Oysterfest
Notice thin white lines which are cultch visible in Google
• Oysterfest oystershell (two small areas to the left represent 900,000 spat on shell
• Large cultched area represents 2 million oysters from natural set on seaclam shell and has increased to 4 million in 2012
© 2012 Google
Google earth
Terms of Use

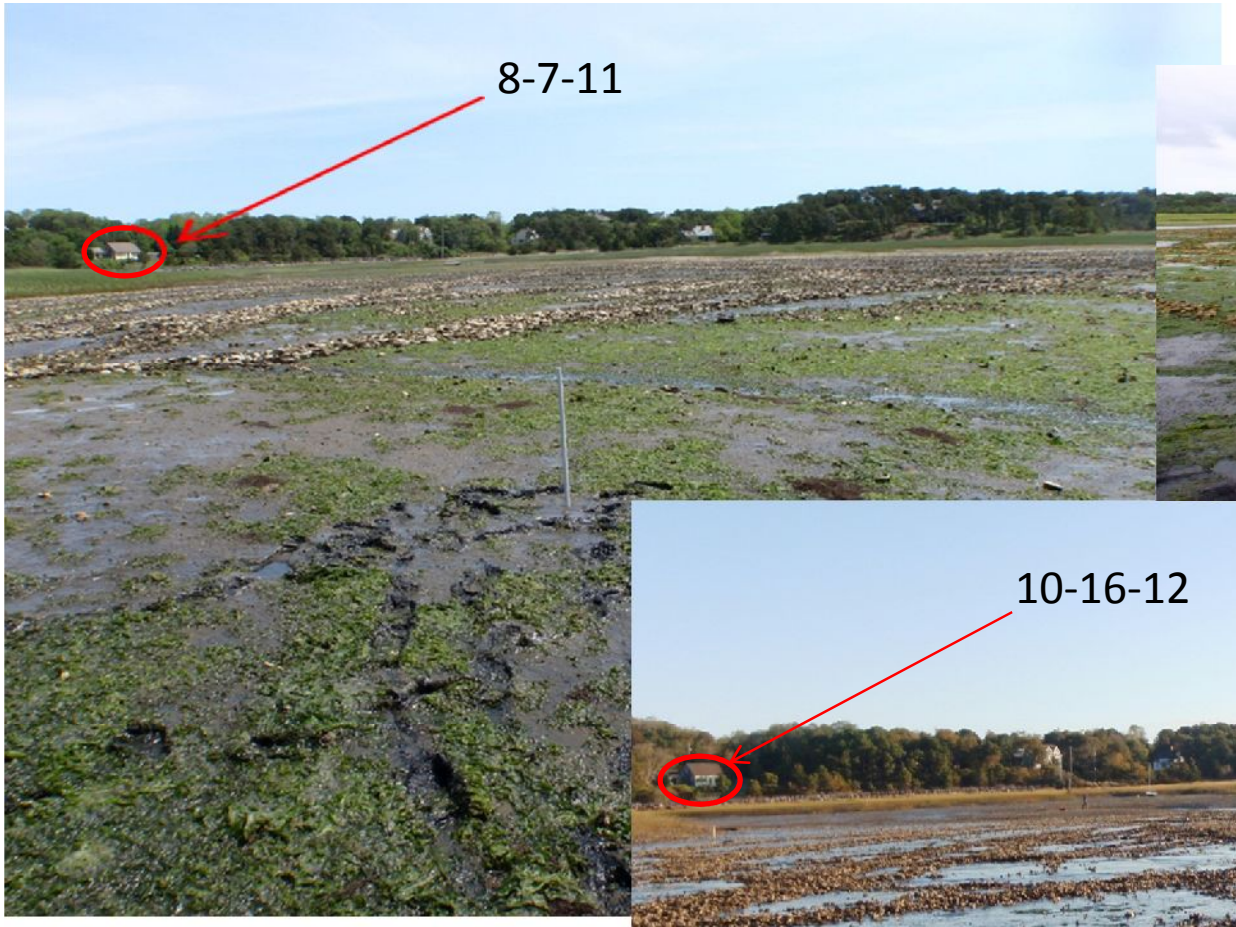

Site visit July 16, 2011 9 am
After initial cultch before receiving “set”

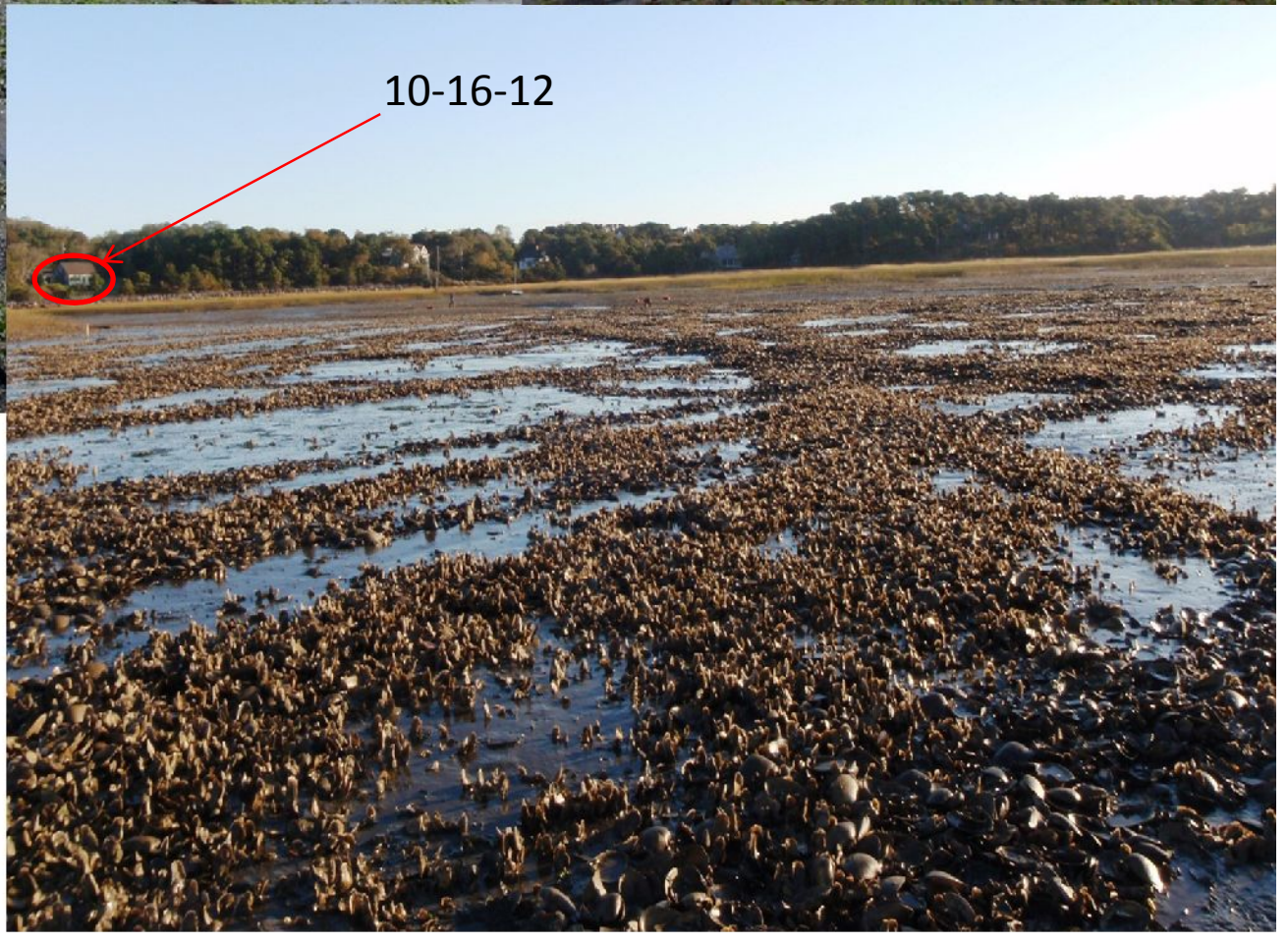
Site visit August 2011 after 1 month
Example of spawn setting on cultch




Site visit September 2011 showing
Even more set and good initial growth

Site visit October 17, 2012 8 am
Showing significant 1 yr growth and another summer “set”





Oyster reef restoration in
Duck Creek,
Wellfleet Harbor
Images: A. Frankic

Why Recycle Shells?

Oyster, Clam, Mussel, Scallop only

Next generation of oysters will attach to this shell

Water Quality oysters consume algae filtering 50 gal/day

Critical Habitat for other fish “habitat today … fish tomorrow”

Erosion control oysters form natural breakwaters that protect shoreline

Saving Money $$$$ no cost for out of Town disposal

Wellfleet Oysterfest 2012

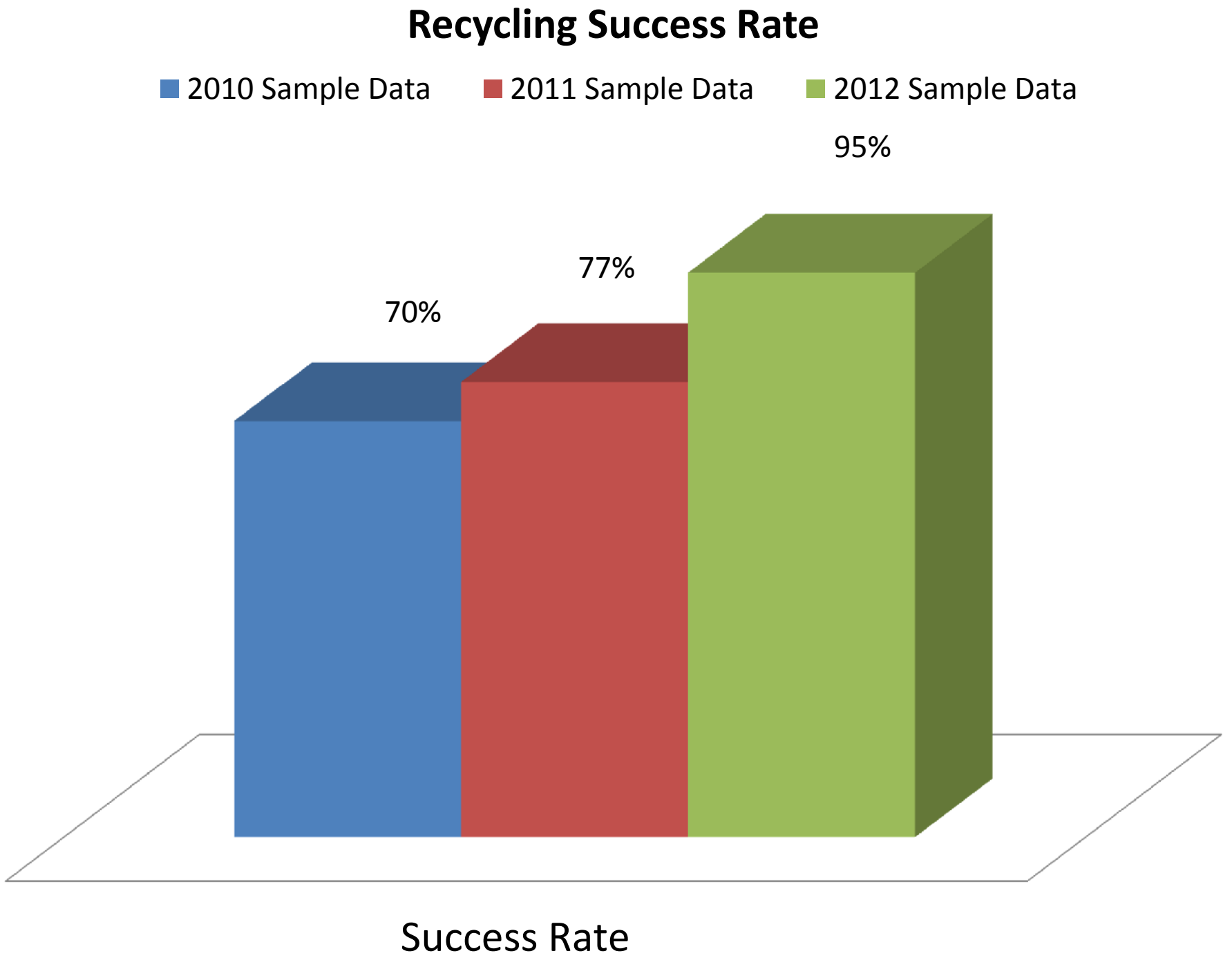
- 25,000 visitors
- 100,000 oysters served
- 5.2 tons of shell recycled (NOAA Sponsored)
- 43% removed from 12.1 ton solid waste stream
- For every oyster eaten 6 were returned to the water or 577,448 oysters saved!

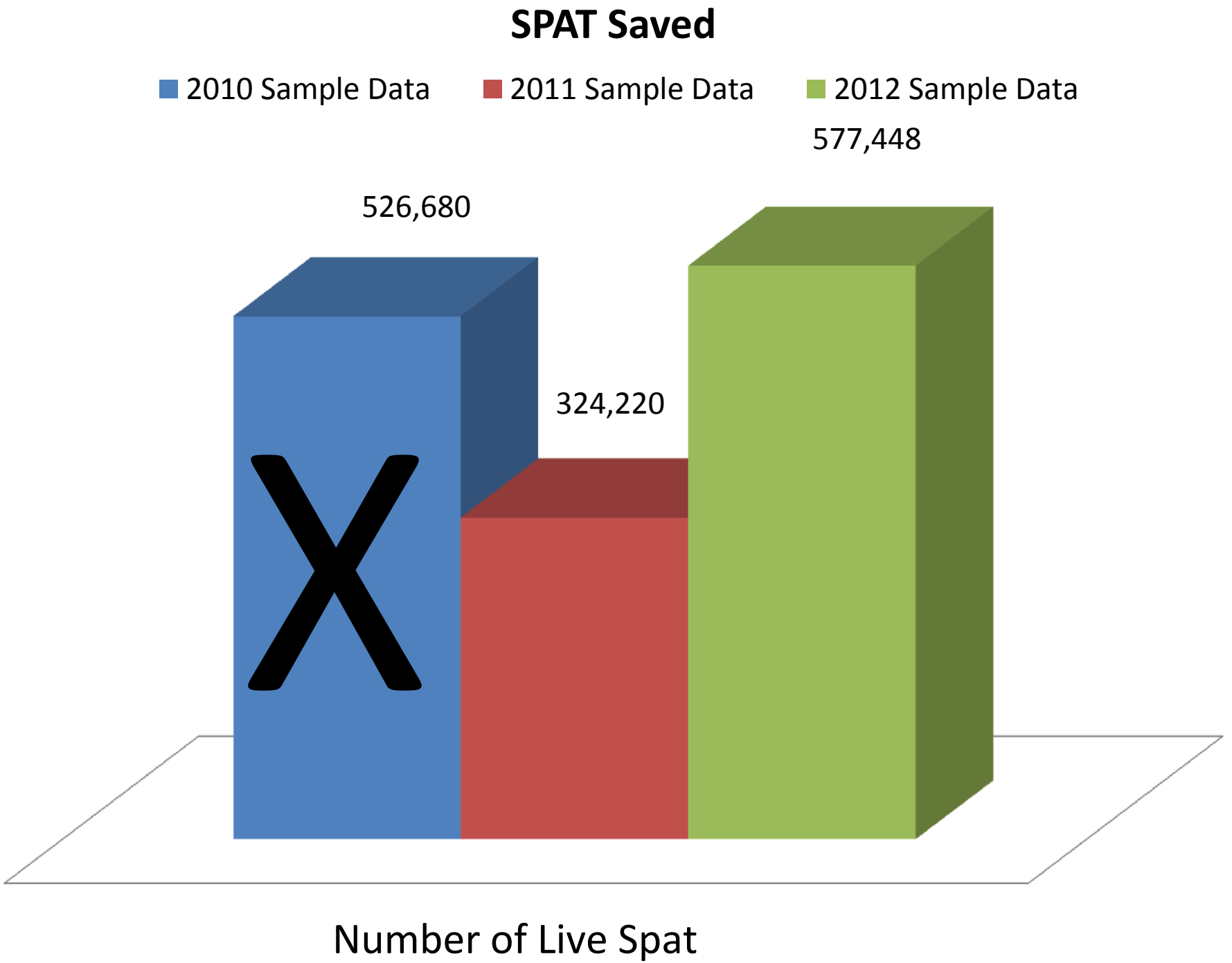
- 3 yr total= 15 tons of shell/ 900,000 SPAT


Oysterfest Shell Collection 2011


Oysterfest Shell Collection 2012
YSTER SHELLS & CLA
NO TRASH
IN THIS CO
This contai


Oysterfest October 15, 2012
Can you find the 14 spat on this one oyster shell?


Recycling Success Rate
2010 Sample Data
2011 Sample Data
2012 Sample Data
70%
77%
95%
Success Rate


SPAT Saved
2010 Sample Data
2011 Sample Data
2012 Sample Data
526,680
324,220
577,448
X
Number of Live Spat


Oysterfest Shell Return 2011
Ginny Lu
WELLFLEET, MA

Shellfish Constable Andy Koch with cultch spreader enroute to dropoff oysterfest shells

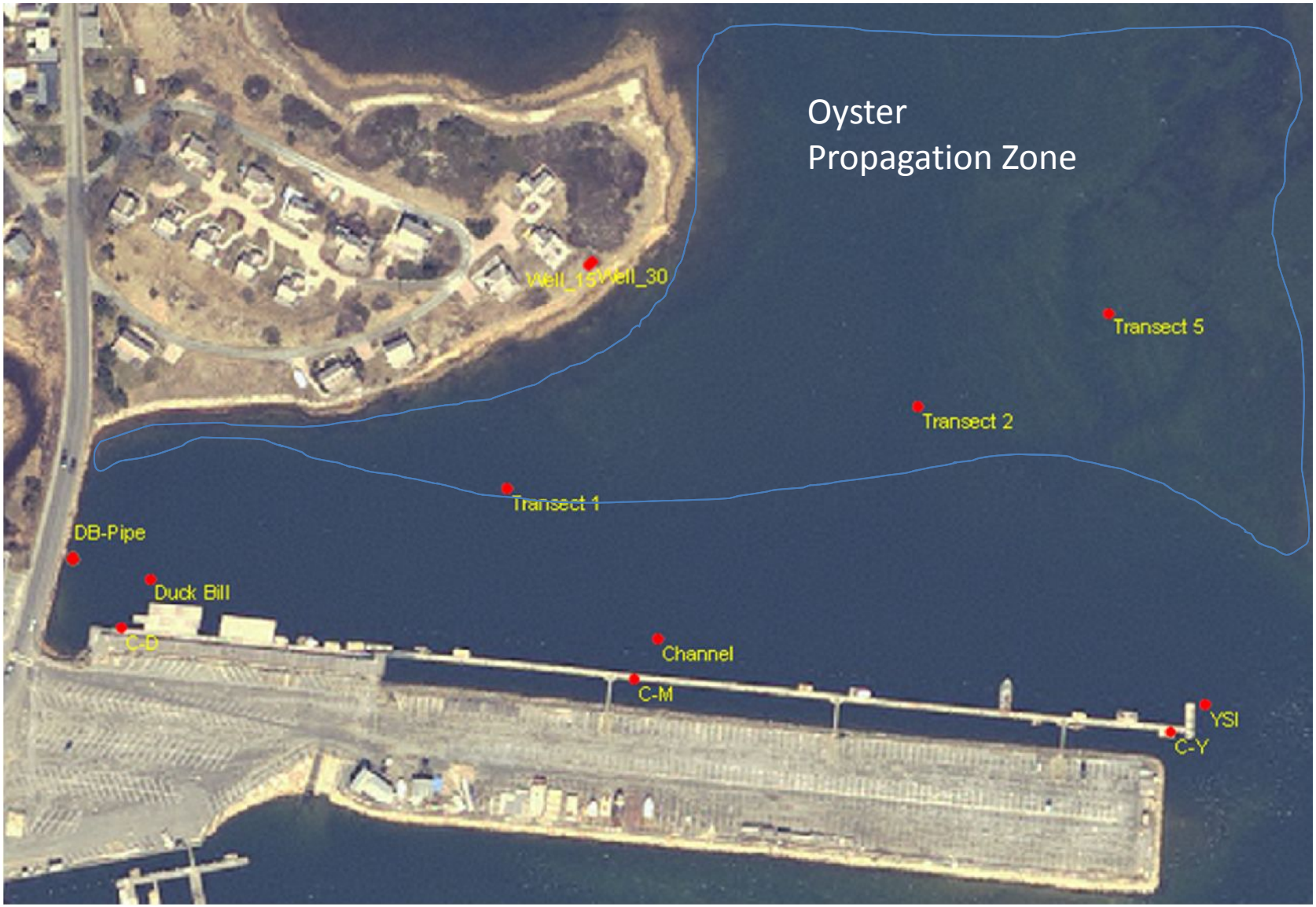

2 year olds attached to cultch
otherwise not possible due to pure sand bottom


Griffins Island Rd
Duck Harbor Rd
Hopkins
Long Pond
Great Pond
A
Wellfleet
Kendrick Ave
Chequessett Neck Rd
Cove Rd
Old County Rd
6
South
Wellfleet
Indian Neck Rd
Drummer
Cove
Old Wharf Rd
Loagy Bay
D St
Audubon Bird
Sanctuary
Wellfleet
Harbor
Silver Spring
Harbor
Cultch Target Zones
Propagation Sanctuaries

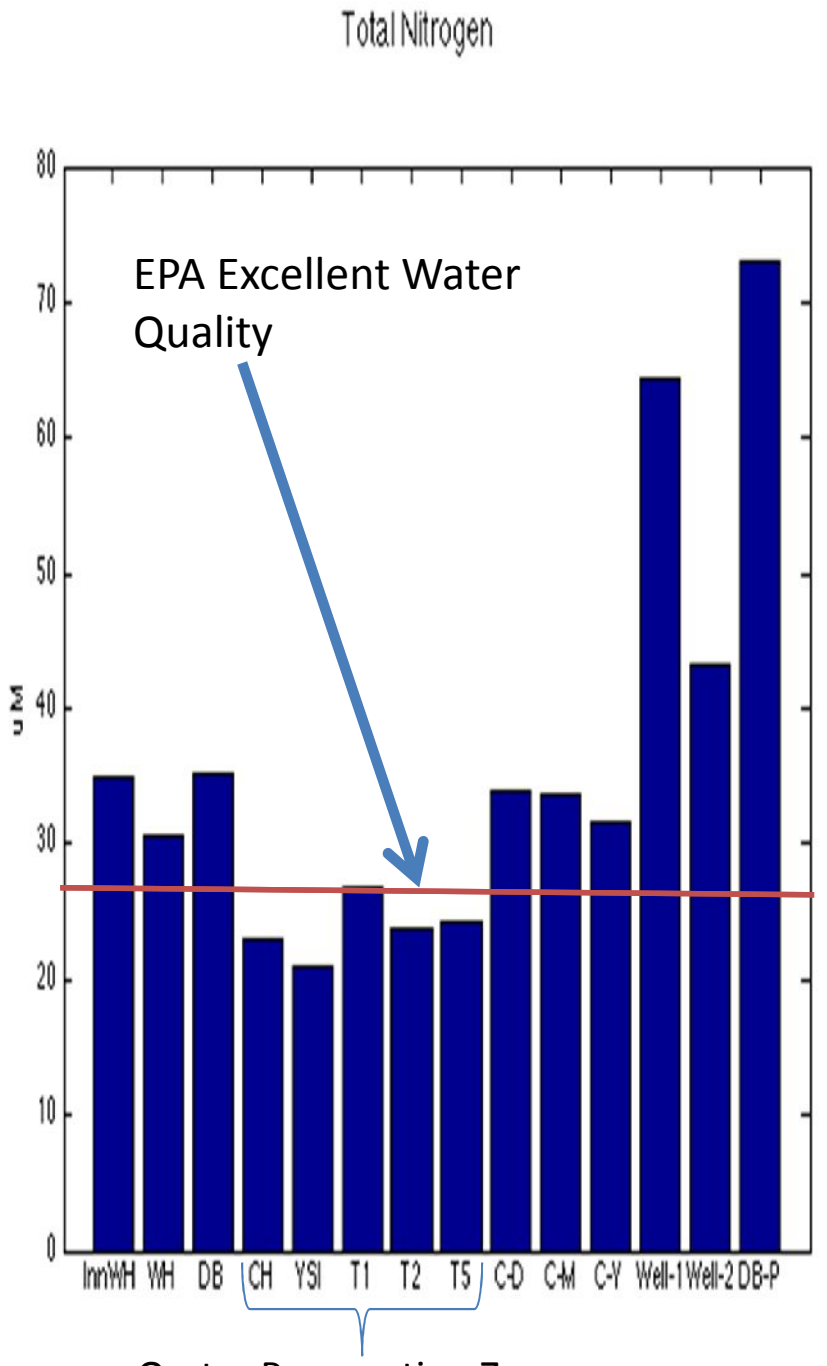
Wellfleet Oyster Propagation Project

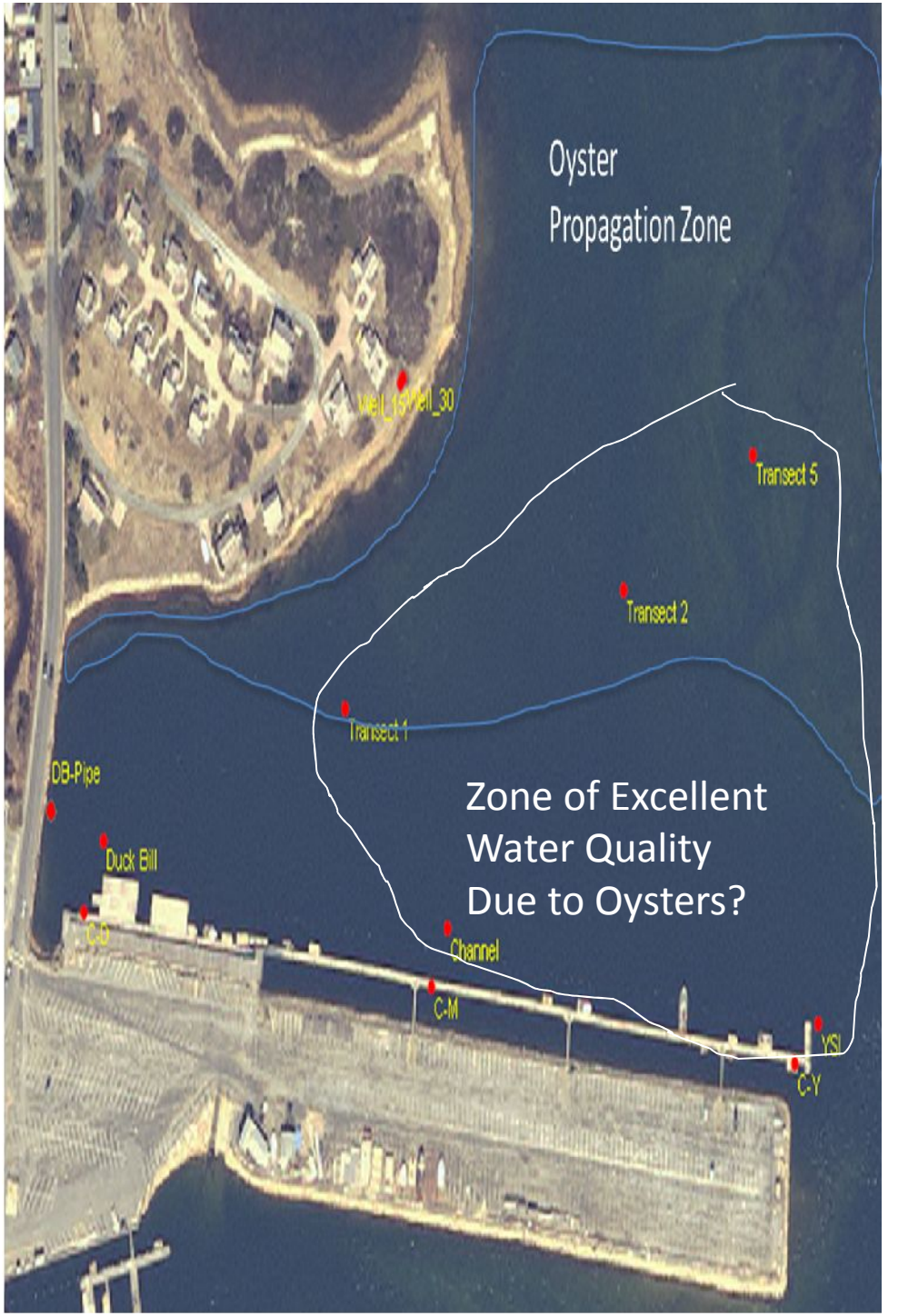
Water Quality Monitoring

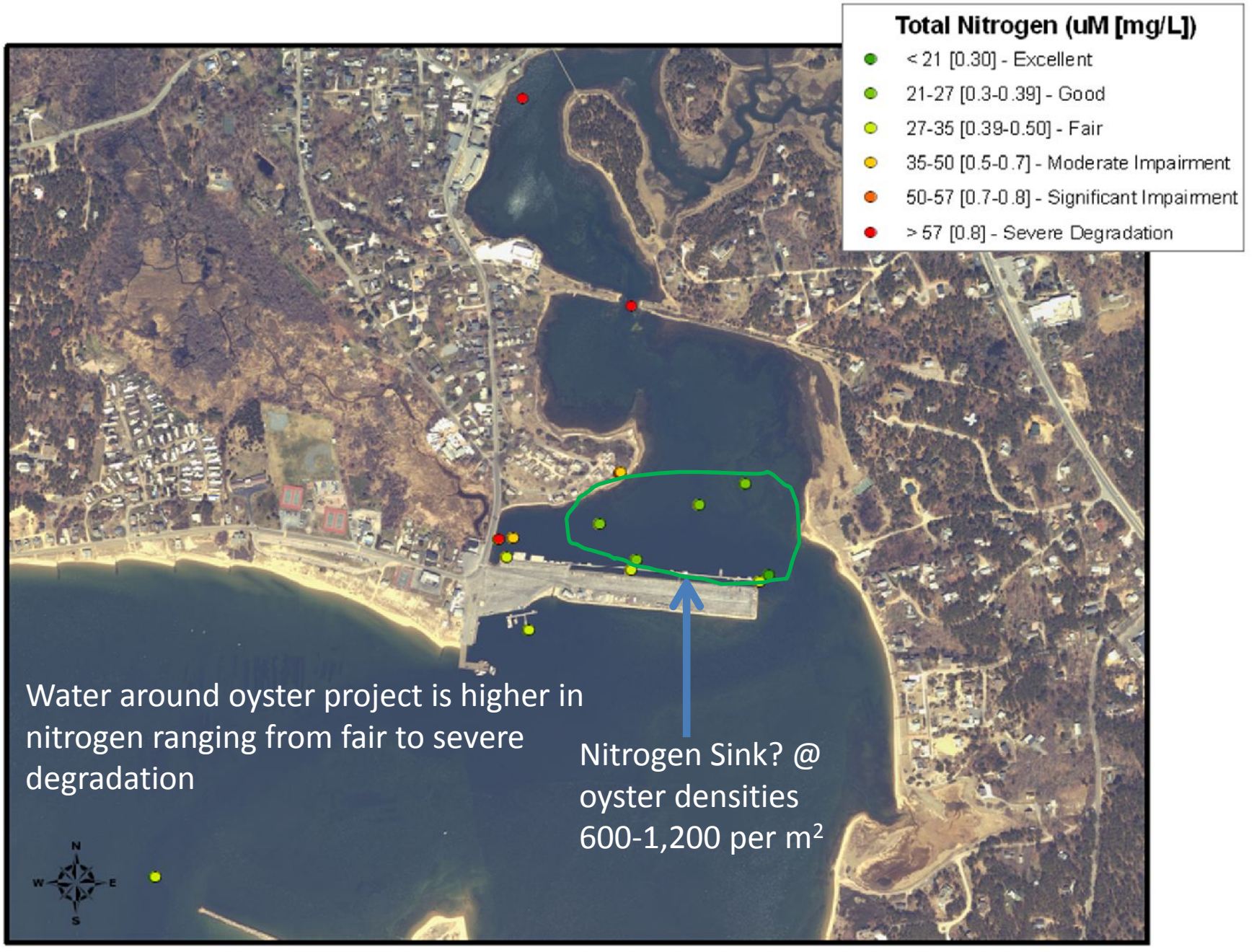
Provincetown Center for Coastal Studies


Oyster
Propagation Zone
Well_15
Well_30
Transect 5
Transect 2
Transect 1
DB-Pipe
Duck Bill
C-D
Channel
C-M
YSI
C-Y

Water Sampling Grid (not shown are 2 points further north in Duck Creek)


Total Nitrogen
EPA Excellent Water Quality
uM
80
70
60
50
40
30
20
10
0
InnWH
WH
DB
CH
YSI
T1
T2
T5
C-D
C-M
C-Y
Well-1
Well-2
DB-P
Oyster Propagation Zone


Oyster Propagation Zone
Well_15
Well_30
Transect 5
Transect 2
Transect 1
DB-Pipe
Duck Bill
C-D
Channel
C-M
YSI
C-Y
Zone of Excellent Water Quality Due to Oysters?


Total Nitrogen (uM [mg/L])
< 21 [0.30] - Excellent
21-27 [0.3-0.39] - Good
27-35 [0.39-0.50] - Fair
35-50 [0.5-0.7] - Moderate Impairment
50-57 [0.7-0.8] - Significant Impairment
> 57 [0.8] - Severe Degradation
Water around oyster project is higher in nitrogen ranging from fair to severe degradation
Nitrogen Sink? @ oyster densities 600-1,200 per m2
N
W
E
S