NEERS SPRING 2012 MEETING

April 12 – 14, 2012

John Carver Inn, Plymouth, Massachusetts

Hosted By

Massachusetts Bays Program and Saquish Scientific

Local organizers: Sara Grady and John Brawley

Patrons

Normandeau, The Nature Conservancy, Woods Hole Sea Grant, YSI

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MEETING PROGRAM

All events at the John Carver Inn unless noted otherwise

All oral sessions are in the John Carver Room

Thursday, April 12th

12:00 – 1:00 pm	Meeting registration (Boardroom)
1:00 – 5:00 pm	Symposium: Shellfish Aquaculture, Restoration, and Conservation
5:00 – 6:00 pm	Meeting Registration (Boardroom)
5:00 – 7:00 pm	Welcoming Social (Winslow Room)
7:00 pm – 8:30 pm	Executive Committee Meeting (Boardroom)

Friday, April 13th

7:00 – 8:00 am	Meeting registration (Boardroom)
8:00 – 9:45 am	Oral presentations: Nitrogen – Pathways and Processes
10:05 am – 12:05 pm	Oral presentations: Nutrients/Bacteria/Biogeochemical Signatures
12:05 pm – 1:05 pm	Lunch on your own in Plymouth
1:05 pm – 2:45 pm	Oral presentations: Coastal Vegetated Communities I
3:00 pm – 4:20 pm	Oral presentations: Estuarine Fauna
4:20 pm – 5:00 pm	NEERS Business Meeting (John Carver Room)
5:00 pm – 6:00 pm	Poster presentations (Winslow Room)
6:00 pm – 7:00 pm	Social and poster viewing (Winslow Room)
7:00 pm – 9:00 pm	NEERS Awards Banquet (John Carver Room)
9:00 pm - ??	Music and dancing at T-Bones Road House (22 Main Street)

Saturday, April 14th

8:00 – 10:00 am	Oral presentations: Coastal Vegetated Communities II
10:20 am – 12:20 pm	Oral presentations: Estuarine Assessment and Management
12:45 pm	Field trip departure

Thursday, April 12th

SPECIAL SYMPOSIUM:
The Ecological, Economic, and Social Benefits of Shellfish Aquaculture, Restoration, and Conservation in New England Estuaries

Chair: John Brawley
* Presenter

1:00 Welcome and Introduction – John Brawley
Saquish Scientific LLC, Duxbury, MA

1:10 Macfarlane, Sandra
Coastal Resource Specialists, Orleans, MA
SOCIAL ASPECTS OF SHELLFISH AQUACULTURE AND RESTORATION PROGRAMS

1:30 Kite-Powell, Hauke
Woods Hole Oceanographic Institution, Woods Hole, MA
ECONOMIC CONSIDERATIONS IN SHELLFISH AQUACULTURE AND NUTRIENT MANAGEMENT IN NE COASTAL PONDS

1:50 Gregory, Shore
Island Creek Oysters, Duxbury, MA
SOCIAL AND ECONOMIC IMPLICATIONS OF OYSTER AQUACULTURE ACROSS LOCAL, REGIONAL, AND GLOBAL SCALES

2:10 Karney, Richard C.
Martha's Vineyard Shellfish Group, Inc., Oak Bluffs, MA
THE BENEFITS OF SHELLFISH AQUACULTURE TO THE ECONOMIC, ECOLOGICAL, AND SOCIAL INTEGRITY OF MARTHA'S VINEYARD

2:30 Leavitt*, Dale, S. Patterson, T. Scott, and M. Griffin
Ctr. for Economic and Environmental Development, Roger Williams Univ., Bristol, RI
THE TOWN POND RESTORATION - THEY DUG THE HOLE, NOW WHAT DO WE DO?

2:50 BREAK

3:10 Buttner, Joseph K.
Northeastern Massachusetts Aquaculture Center, Cat Cove Marine Laboratory and Dept. of Biology, Salem State University, Salem, MA
SOFTSHELL CLAM (MYA ARENARIA) RESTORATION AND ENHANCEMENT EFFORTS

3:30 Gomez-Chiarri, Marta
Dept. of Fisheries, Animal and Veterinary Science, Univ. of Rhode Island, Kingston, RI
DISEASE RESISTANCE IN OYSTERS: FROM FIELD EVALUATION TO ELUCIDATION OF MECHANISMS

3:50 Green* Mark A.[1], L. Hubacz[1], J. Salisbury[2], and G. Waldbusser[3]
[1]Division of Natural Sciences, Saint Joseph's College of Maine, ME
[2]Ocean Processes Analysis Lab, University of New Hampshire, NH
[3]Oregon State University, College of Earth, Ocean, and Atmospheric Sciences, OR
ACIDIFICATION OF THE COASTAL OCEAN: EVALUATING THE IMPACTS OF SEDIMENT CORROSIVITY ON BIVALVES

4:10 Hancock*, Boze[1] and L. zuErmgassen[2]
[1]Global Marine Team, The Nature Conservancy, URI Narragansett Bay Campus, RI
[2]Dept. of Zoology, University of Cambridge, Cambridge, UK
SETTING GOALS FOR OYSTER REEF RESTORATION BASED ON ECOSYSTEM SERVICES

4:30 Panel Discussion

5:00 **NEERS WELCOMING SOCIAL** (Winslow Room)

7:00 Dinner on your own in Plymouth

Friday, April 13th

8:00 Welcome and Introductory Remarks – Steve Hale, NEERS President

Nitrogen: Pathways and Processes

Chair: Steve Hale
* Presenter; **(K)** Ketchum Prize candidate for best graduate student presentation,
(R) Rankin Prize candidate for best undergraduate student presentation

8:05 Deacutis*, Christopher F.[1], H. Stoffel[2], S. Brown[3], and B. Jenkins[3]
[1]Narragansett Bay Estuary Program, URI Coastal Institute, Narragansett, RI
[2]URI GSO, Narragansett, RI; [3]Cell&Molecular Biology, URI, Kingston, RI
HYPOXIA IN NARRAGANSETT BAY: A DRIVER FOR A HIDDEN NITROGEN POSITIVE FEEDBACK LOOP? PART I: HYPOXIC CONDITIONS IN THE BAY

8:25 **(K)** Brown*, Shelley M.[1], A. Jones[1], A. L. Ehrlich[1], C. Deacutis[3] and B. D. Jenkins[1,2]
[1]Dept. of Cell and Molecular Biology, Univ. of Rhode Island, Kingston, RI
[2]Graduate School of Oceanography, Univ. of Rhode Island, Narragansett, RI
[3]Narragansett Bay Estuary Program, URI Coastal Institute, Narragansett, RI
HYPOXIA IN NARRAGANSETT BAY: A DRIVER FOR A HIDDEN NITROGEN POSITIVE FEEDBACK LOOP? PART II: THE GENETIC EVIDENCE

8:45 **(K)** Heffner*, Leanna R.[1], T. Murphey[2], and S.W. Nixon[1]
[1]Graduate School of Oceanography, and [2]Dept. of Natural Resources Science, University of Rhode Island, RI
EXAMINING THE RESPONSE OF NITROGEN-FIXATION AND DENITRIFICATION TO NUTRIENT ENRICHMENT IN SALT MARSHES OF NARRAGANSETT BAY, RI

9:05 **(K)** Brin*, Lindsay D.[1,2], J. J. Rich[1], A. E. Giblin[2]
[1]Dept. of Ecology and Evolutionary Biology, Brown University, Providence, RI
[2]Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA
NITROGEN LOSS PATHWAYS IN COASTAL AND SHELF SEDIMENTS: DEFINING CONTROLS IN NEW ENGLAND AS A MODEL SYSTEM

9:25 **(R)** Johnson, Hansen D.
Dept. of Biology, Bates College, Lewiston, ME
RESOURCE LIMITATION AFFECTS HETEROCYST FORMATION AND PRODUCTIVITY IN NITROGEN-FIXING CYANOBACTERIA

9:45 **BREAK**

Nutrient and Bacterial Dynamics

Chair: Steve Hale
* Presenter; **(K)** Ketchum Prize candidate for best graduate student presentation,
(R) Rankin Prize candidate for best undergraduate student presentation

10:05 **(K)** Krumholz*, Jason S.[1], C. A. Oviatt[1], and L. M. Smith[2]
[1]University of Rhode Island Graduate School of Oceanography, Narragansett, RI
[2]Your Ocean Consulting LLC, Knoxville TN
INVESTIGATING THE IMPACT OF ADVANCED WASTEWATER TREATMENT ON NUTRIENT DYNAMICS IN NARRAGANSETT BAY, RI

10:25 **(R)** Spillane*, Tyler and S. Zeeman
University of New England, Biddeford, ME
BACTERIA IN THE SACO RIVER

10:45 **(K)** Watka*, Lauren[1], N. Chu[2], A. L. Rhyne[3], and H. M. Leslie[1,2]
[1]Center for Environmental Studies, Brown University, Providence, RI
[2]Dept. of Ecology and Evolutionary Biology, Brown University, Providence, RI
[3]Roger Williams University, Dept. of Biology and Marine Biology, Bristol, RI
INFLUENCE OF PHYTOPLANKTON ABUNDANCE AND GUILD MEMBERSHIP ON ROCKY INTERTIDAL SPECIES PERFORMANCE AND NITROGEN FLUX

Biogeochemical Signatures

11:05 **(R)** Olesnavage, Kathryn M. and C. Chryssostomidis
Dept. of Mechanical Engineering, Mass. Institute of Technology, Cambridge, MA
THE DESIGN AND TESTING OF A PROCEDURE TO LOCATE FRESH SUBMARINE GROUNDWATER DISCHARGE IN CYPRUS

11:25 **(K)** Salacup*, Jeff M., T. D. Herbert, and W. L. Prell
Geological Sciences Dept., Brown University, Providence, RI
RECONSTRUCTING PAST SEA SURFACE TEMPERATURES IN NARRAGANSETT BAY USING THE UK'37 SST PROXY: FROM VALIDATION TO APPLICATION

11:45 **(R)** Brooks*, Ashley, W. Ambrose, and W. Locke
Dept. of Biology, Bates College, Lewiston, ME
THE GROWTH RATES OF THE SURF CLAM, SPISULA SOLIDISSIMA, FROM THE MID-ATLANTIC BIGHT FOR OVER 66 YEARS

12:05 – 1:05 LUNCH

Coastal Vegetated Communities I

Chair: Sara Grady
* Presenter; **(K)** Ketchum Prize candidate for best graduate student presentation,
(R) Rankin Prize candidate for best undergraduate student presentation

1:05 **(K)** Simon*, Matthew, S. Travis, and G. Zogg
Dept. of Biology, University of New England, Biddeford, ME
ATLANTIC COAST SALT MARSH RESPONSE TO SEA LEVEL RISE: EFFECTS ON SEDIMENT MICROBIAL DECOMPOSITION

1:25 **(R)** Ivens-Duran*, Morgan[1], S. S. Corman[1,2], and H. M. Leslie[1,3]
[1]Dept. of Ecology and Evolutionary Biology, Brown University, Providence RI
[2]Marine Biological Laboratory, Woods Hole, MA
[3]Center for Environmental Studies, Brown University, Providence RI
ENVIRONMENTAL DRIVERS OF *SPARTINA ALTERNIFLORA* FLOWERING PATTERNS

1:45 **(R)** Barry*, Colin H. and B. J. Johnson
Dept. of Geology, Bates College, ME
A HYDROGEOLOGIC STUDY OF A DITCHPLUGGED SALT MARSH IN PHIPPSBURG, MAINE

2:05 **(K)** Bayley*, Holly K.[1,3], F. T. Short[1], A. S. Klein[2], D. M. Burdick[1], and G. E. Moore[2]
Depts. of [1]Natural Resources and Environment., Jackson Estuarine Lab. and
[2]Biological Science, Univ. of New Hampshire, Durham, NH
[3]National Park Service, Cape Cod National Seashore, Wellfleet, MA
EELGRASS (*ZOSTERA MARINA* L.) FROM GENETICALLY DIFFERENTIATED POPULATIONS RESPONDS DIFFERENTLY TO LOW LIGHT AND HIGH SEDIMENT ORGANIC CONTENT

2:25 **(K)** Norton*, Ashley R.[1,2], A. C. Trembanis[1], M. Borrelli[2], and T. L. Brown[2,3]
[1]Dept of Geological Sciences, Univ. of Delaware, Newark, DE
[2]Provincetown Center for Coastal Studies, Provincetown, MA
[3]Environmental, Earth and Ocean Sciences, UMass-Boston, Boston, MA
ESTIMATING THE DISTRIBUTION, CANOPY HEIGHT AND CANOPY VOLUME OF EELGRASS BEDS (*ZOSTERA MARINA*) IN EASTERN CAPE COD BAY, MA USING AN INTERFEROMETRIC SONAR SYSTEM

2:45 **BREAK**

Estuarine Fauna

Chair: Pam Morgan
* Presenter; **(K)** Ketchum Prize candidate for best graduate student presentation,
(R) Rankin Prize candidate for best undergraduate student presentation

3:00 **(K)** Bloodsworth*, Kylie H.[1], C. E. Tilburg[1], P. O. Yund[1], and C. E. Epifanio[2]
[1]Dept. of Marine Sciences, University of New England, Biddeford, ME
[2]College of Earth, Ocean, and Environment, University of Delaware, Lewes, DE
RIVER PLUME DYNAMICS INFLUENCE THE DISTRIBUTION OF DECAPOD AND BIVALVE LARVAE WITHIN SACO BAY, ME

3:20 **(K)** Hanlon*, Elizabeth[1], D. P. Cheney[1], and J. M. Logan[2]
[1]Biology Dept. and Marine Science Center, Northeastern University, Boston, MA
[2]Massachusetts Division of Marine Fisheries, New Bedford, MA
DIETARY CONNECTIONS BETWEEN FUNDULUS HETEROCLITUS AND A PCB-CONTAMINATED ULVA BLOOM IN NEW BEDFORD HARBOR

3:40 **(R)** Smith*, Kayla M. and J. A. Sulikowski
Marine Science Dept., University of New England, Biddeford, ME
EVALUATING THE SACO BAY ESTUARY SYSTEM AS A NURSERY GROUND FOR COMMERCIALLY VALUABLE AND ECOLOGICALLY IMPORTANT FISH SPECIES

4:00 **(K)** Schillaci*, Christopher[1,2], G. Bettencourt[2], J. Kennedy[2], and T. Shields[2]
[1]Dept. of Natural Resources and the Environ., Univ. of New Hampshire, Durham, NH
[2]Massachusetts Division of Marine Fisheries, Gloucester, MA
BOSTON HARBOR SOFTSHELL CLAM *(MYA ARENARIA)* ENHANCEMENT AND OUTREACH

4:20 Business meeting

5:00 **POSTER SESSION**
Poster titles are listed at the end of the program

6:00 Social and Poster Viewing

7:00 Awards Banquet

Dessert Slide Show by Marshall Pregnall, Vassar College, Poughkeepsie, NY:
IN THE WAKE OF DRAKE, COOK AND DARWIN:
EXPLORING COASTAL PATAGONIA AT THE END OF THE AMERICAS

Presentation of Awards for Best Student Papers

9:00 Music and dancing T-Bones Road House (22 Main Street)

Saturday, April 14th

Coastal Vegetated Communities II

Chair: John Brawley
* Presenter

8:00 Young, Alan M.
Biology Dept., Salem State University, Salem, MA
A COMPARATIVE STUDY OF *PHRAGMITES* CONTROL MEASURES

8:20 Burdick*, David[1,2], G. Moore[1,3], C. Peter[1] and R. Buchsbaum[4]
[1]Jackson Estuarine Laboratory; [2]Dept. of Natural Resources and the Environment; [3]Dept. of Biological Sciences, UNH, Durham, NH
[4]Massachusetts Audubon, Wenham, MA
NATIVE PLANT COMMUNITIES OF THE GREAT MARSH AND INVASION BY *PHRAGMITES AUSTRALIS*

8:40 Rogers*, Catherine J. and T. A. Randall
Environ. Resources, U.S. Army Corps of Engineers, New England District, Concord, MA
COMPARING AND CONTRASTING TWO INTERTIDAL MUDFLAT MITIGATION PROJECTS IN RUMNEY MARSH, SAUGUS, MASSACHUSETTS.

9:00 Elmer, Wade H.
Dept. of Plant Pathology and Ecology, The CT Agric. Experiment Sta., New Haven, CT
DISEASE AND DROUGHT INDUCED STRESS OF *SPARTINA ALTERNIFLORA* INCREASES HERBIVORY BY MARSH CRABS

9:20 Moore*, Gregg E.[1], W. F. Nichols[2], N. Ritter, and C. R. Peter[1]
[1]Dept. of Biol. Sci. and Jackson Estuarine Lab., UNH, Durham, NH
[2]NH Natural Heritage Bureau, Division of Forests & Lands – DRED, Concord, NH
A UNIQUE COASTAL SALT POND MARSH SYSTEM AT ODIORNE POINT STATE PARK, RYE, NEW HAMPSHIRE

9:40 Short*, Frederick T.[1], H. K. Bayley[1], A. S. Klein[2], D. M. Burdick[1], and G. E. Moore[2]
Depts. of [1]Natural Resources and the Environment, Jackson Estuarine Lab. and [2]Biological Sci., Univ. of New Hampshire, Durham, NH
THE ROLE OF GENETICS IN EELGRASS POPULATION RESILIENCE IN SOUTHERN NEW ENGLAND AND NEW YORK

10:00 BREAK

Estuarine Assessment and Management

Chair: John Brawley
* Presenter

10:20 Trench*, Elaine C. T. and J. R. Mullaney
U.S. Geological Survey, East Hartford, CT
STATUS AND TRENDS OF NUTRIENTS IN STREAMS OF THE NORTHEASTERN UNITED STATES, 1975-2003

10:40 Stacey*, Paul E.[1], T. Haze[2], and I. Raffa[2]
[1]Great Bay National Estuarine Res. Reserve, NH Fish & Game Dept., Durham, NH
[2]Bur. of Water Prot. & Land Reuse, CT Dept. of Energy and Environ. Prot., Hartford, CT
CONNECTICUT'S NITROGEN CREDIT EXCHANGE - A COLLABORATIVE EFFORT TO ATTAIN NITROGEN REDUCTION GOALS FOR LONG ISLAND SOUND CELEBRATES 10 YEARS OF PROGRESS

11:00 Dettmann*, Edward H. and H. A. Walker
USEPA, NHEERL, Atlantic Ecology Division, Narragansett, RI
A SYSTEMS-BASED APPROACH TO INTEGRATED NUTRIENT MANAGEMENT IN NARRAGANSETT BAY AND ITS WATERSHED

11:20 Kachmar*, Jon and C. Shetterly
The Nature Conservancy, Boston, MA
CONSERVING AND RESTORING NEARSHORE COASTAL HABITATS IN MASSACHUSETTS: ENABLING CONDITIONS FOR SEAGRASS AND WILD SHELLFISH COMMUNITIES

11:40 Koo*, Kyung-Ah, E. Davenport, and C. S. Hopkinson
Dept. of Marine Sciences, University of Georgia, Athens, GA
EUTROPHICATION: EFFECTIVENESS OF *MYA ARENARIA* IN CONTROLLING PHYTOPLANKTON POPULATION IN PLUM ISLAND ESTUARY, MA

12:00 Harris*, Jennifer H. and K. Ono
Dept. of Marine Science, University of New England, ME
TWO- AND THREE-DIMENSIONAL PHOTOGRAMMETRIC MASS ESTIMATION TECHNIQUES FOR TWO PHOCID SPECIES: *HALICHOERUS GRYPUS* AND *PHOCA VITULINA CONCOLOR*

12:20 Closing words

12:30 Adjourn

12:45 Field trip departure – see web site for details

POSTER PRESENTATIONS

* Presenter; **(D)** Dean Prize candidate for best graduate student poster; **(W)** Warren Prize candidate for best undergraduate student poster; **§** High School Student

(W) Black, Bridgette E.
Center for Environmental Studies, Brown University
INCORPORATING ECOSYSTEM SERVICES INTO MARINE MANAGEMENT FRAMEWORKS IN THE NORTHEAST REGION

Browne, James P.
Dept. of Conservation and Waterways, Town of Hempstead, NY, and
Dept. of Ecology and Evolution, Stony Brook University, NY
AN ANALYSIS OF SALT MARSH EDGE LOSS OVER 81 YEARS IN HEMPSTEAD BAY, LONG ISLAND, NEW YORK

Buchsbaum, Robert B. Massachusetts Audubon Society, Wenham, MA
CHANGES OVER TIME IN BIRD POPULATIONS IN THE PLUM ISLAND SOUND ESTUARY, MASSACHUSETTS: A PRELIMINARY ASSESSMENT

(W) Chebot*, Benjamin B.[1], W. G. Ambrose[2], W. L. Locke[2], and B. J. Bourque[3]
Depts. of [1]Environmental Studies, [2]Biology, and [3]Anthropology, Bates College, Lewiston, ME
ANNUAL TIMING OF GROWTH LINE DEPOSITION AND COMPARATIVE GROWTH ANALYSIS OF MODERN AND ARCHAIC *MYA ARENARIA* FROM THE PEONOBSCOT BAY REGION, MAINE

Costa, Amy S.
Provincetown Center for Coastal Studies, Provincetown, MA
ANALYZING TRENDS IN WATER QUALITY TO ASSESS THE HEALTH OF CAPE COD BAY

Durant*, Daisy, and K. B. Raposa
Narragansett Bay National Estuarine Research Reserve, Prudence Island, RI
PRELIMINARY RESULTS FROM BENTHIC INFAUNAL MONITORING AT THE NARRAGANSETT BAY NATIONAL ESTUARINE RESEARCH RESERVE ON PRUDENCE ISLAND, RHODE ISLAND.

(W) Ennis*, Rosmin S., J. Krumholz, and C. Oviatt
University of Rhode Island, Narragansett, RI
NUTRIENT INPUT FROM WASTEWATER TREATMENT FACILITIES IN THE NARRAGANSETT BAY WATERSHED, 2000 – 2010

Francoeur, L.[1], Alexandra Kanonik*[2], R. L. Burke[3] and G. W. Frame[4]
[1]The Port Authority of NY & NJ, JFK International Airport, Jamaica, NY
[2]Town of Hempstead Department of Conservation and Waterways, Point Lookout, NY [3]Dept. of Biology, Hofstra University, Hempstead, NY

[4]Nat. Resources Management Division, Gateway National Recreation Area, Staten Island, NY
WHY DID TERRAPINS CROSS THE RUNWAY? THE MYSTERIOUS TURTLE INVASION OF JFK AIRPORT

Grady*, Sara P.[1], M. Kearns[2], and S. Woods[2]
[1]Massachusetts Bays Program South Shore/N. & S. Rivers Watershed Assn., Norwell, MA
[2]N. & S. Rivers Watershed Assn., Norwell, MA
BALANCING ECOLOGICAL AND MUNICIPAL WATER DEMAND IN A SOUTHEASTERN MASSACHUSETTS COASTAL STREAM

(D) Hill, Troy D.
School of Forestry and Environmental Studies, Yale University, New Haven, CT
SEDIMENT FLUX BETWEEN AN URBAN SALT MARSH AND LONG ISLAND SOUND

Johnson*, Beverly J.[1], C. A. Harris[1], W. G. Ambrose, Jr.[1], B. J. Bourque[1], R. S. Steneck[2], P. T. Dostie[1], and W. L. Lock, V.[1]
[1]Bates College, Lewiston, ME; [2]Darling Marine Center, University of Maine, Walpole, ME
STABLE ISOTOPIC ANALYSES OF ARCHAEOLOGICAL FISH BONES REVEAL A SIGNIFICANT SHIFT IN NEARSHORE ECOSYSTEMS AFTER EUROPEAN SETTLEMENT, PENOBSCOT BAY, GULF OF MAINE

(W) Johnston*, Amy E., W. A. Ambrose, and W. Locke
Dept. of Biology, Bates College, Lewiston, ME
GROWTH RATE AND SHELL ANALYSIS OF *PATELLA VULGATA* (THE COMMON LIMPET) FROM THE SANDWICK SOUTH SITE, UNST, SHETLAND ISLANDS, UK

(W) Kingston*, Ryan[1], S. Travis[2], and G. Zogg[2]
Depts. of [1]Environmental Studies and [2]Biology, University of New England, ME
THE EFFECTS OF GENOTYPIC DIVERSITY ON *SPARTINA ALTERNIFLORA* RESPONSE TO SEA LEVEL RISE AND NUTRIENT LOADING

(W) Leporacci*, Nicole[1], L. Fields[2], and S. Nixon[2]
[1]University of Rhode Island, Kingston, RI
[2]Graduate School of Oceanography, Narragansett, RI
SEDIMENT CHLOROPHYLL *A* AND ORGANIC MATTER CONTENT ALONG THE RHODE ISLAND COAST

(W) Lesneski*, Kathryn, W. Prell, and D. Murray
Brown University Dept. of Geological Sciences. Providence, RI
A SPATIAL AND TEMPORAL ANALYSIS OF LEAD IN NARRAGANSETT BAY SINCE 1850

§ Luciani*, Caroline R., C. A. Baker, M. F. Buckley, T. L. DeRosa, J. A. Hernandez, E. L. Hillis, R. Matta, A. R. Novak, C. C. Smith, Q. Xu, and Sr. M. J. Paolella
Sacred Heart Academy, Hamden, CT.
THE COMPARATIVE STUDY OF ACTIN AND MYOSIN GENES IN *MOLGULA MANHATTENSIS*, *STYELA CLAVA*, AND *LIMULUS POLYPHEMUS*: IMPLICATION ON MITOCHONDRIAL DNA MAINTENANCE

McKinney*, Richard A.[1] and K. B. Raposa[2]

[1]US EPA, ORD, NHEERL, Atlantic Ecology Division, Narragansett, RI
[2]Narragansett Bay National Estuarine Research Reserve, Prudence Island, RI
FACTORS INFLUENCING EXPANDED USE OF URBAN ESTUARINE HABITATS BY FORAGING WADING BIRDS

Morgan*, Pamela A. and R. Tamulonis
Dept. of Environmental Studies, University of New England, Biddeford, ME
PLANT COMMUNITY STRUCTURE OF TIDAL WETLANDS IN THE SACO RIVER ESTUARY, MAINE

(W) Murphy*, Theresa[1], L. R. Heffner[2], and S. W. Nixon[2]
[1]Dept. of Natural Resources Science and [2]Graduate School of Oceanography, University of Rhode Island, RI
EFFECTS OF LIGHT INTENSITY AND EUTROPHICATION ON AUTOTROPHIC NITROGEN-FIXATION IN NARRAGANSETT BAY, RHODE ISLAND SALT MARSHES

Neckles*, Hilary A.[1], B. J. Johnson[2], B. S. Kopp[1,3], and H. K. Bayley[4]
[1]USGS Patuxent Wildlife Research Center, Augusta, ME
[2]Dept. of Geology, Bates College, Lewiston, ME; [3]Kimball Union Academy, Meriden, NH
[4]NPS Cape Cod National Seashore, Wellfleet, MA.
LONG-TERM VARIATION IN δ^{15}N OF EELGRASS IN PLEASANT BAY, MASSACHUSETTS, SURROUNDING FORMATION OF A NEW INLET

Nelson*, Michaeline B. and J. J. Rich
Dept. of Ecology and Evolutionary Biology, Brown University, Providence, RI
INFLUENCE OF ORGANIC CARBON AVAILABILITY ON THE NITROGEN CYCLE IN SEDIMENT FROM RHODE ISLAND COASTAL WATERS

(D) Nichols*, Owen C.
School for Marine Science and Technology, UMass - Dartmouth, Fairhaven, MA and Provincetown Center for Coastal Studies, Provincetown, MA
LONGFIN INSHORE SQUID (*LOLIGO PEALEII*) PARALARVAL DISTRIBUTIONAL ECOLOGY: DATA GAPS AND NOVEL FIELD STUDIES

Nightingale*, Meghan[1], W. J. Berry[1], S. E. Reinert[2], S. M. Lussier[1], F. C. Golet[3]
[1]U.S. EPA, Narragansett, RI [2] Barrington, RI [3] Univ. Rhode Island, Kingston, RI
POPULATION STATUS OF THE SEASIDE SPARROW IN RHODE ISLAND: A 25-YEAR ASSESSMENT

Scharf*, Tina M.[1],J. P. Browne[1], and J. E. Ciappetta[2]
[1]Dept. of Conservation and Waterways, Town of Hempstead
[2]Triumvirate Environmental
TRENDS IN SALT MARSH POND AND PANNE EXTENT OVER AN 81 YEAR PERIOD IN HEMPSTEAD BAY, LONG ISLAND, NY

(W) Short*, Meghan I.[1], D. S. Johnson[2], and L. A. Deegan[2]
[1]Brown University, Providence, RI
[2]Marine Biological Laboratory, Woods Hole, MA
NUTRIENT EFFECTS ON SPARTINA PATENS DECOMPOSITION DYNAMICS IN A

(W) Sonshine*, Elizabeth, B. Johnson, and P. Dostie
Dept. of Geology, Bates College, Lewiston, ME.
THE CHARACTERIZATION OF ORGANIC CARBON IN SEDIMENTARY CORE FROM *ZOSTERA MARINA* BEDS, MAQUOIT BAY, GULF OF MAINE

Srisamart*, Saya, W. G. Ambrose, B. J. Bourque, and W. L. V. Locke
Bates College, Lewiston, ME
SEASONALITY OF DRINKING PLACE BROOK SITE, VINALHAVEN, ME, BASED ON MARGIN ANALYSIS OF ARCHAEOLOGICAL MICROGADUS TOMCOD OTOLITHS

Watson*, Elizabeth B., and C. Wigand
U.S. EPA, ORD-NHEERL, Atlantic Ecology Division, Narragansett, RI
INUNDATION EFFECTS ON GROWTH AND DECOMPOSITION OF TWO TIDAL MARSH PLANT SPECIES, *SPARTINA ALTERNIFLORA* AND *TYPHA ANGUSTIFOLIA*

(W) Zera*, Kristy[1], W. Ambrose[1], B. Johnson[2], W. Locke[1], B. Bourque[3], and P. Dostie[2]
Depts. of [1]Biology, [2]Geology, and [3]Anthropology, Bates College, Lewiston, ME
A COMPARISON OF THE δ13C STABLE ISOTOPES AND TRACE MINERAL CONCENTRATIONS OF MODERN AND ARCHAEOLOGICAL *MYA ARENARIA* SHELLS FROM THE TURNER FARM MIDDEN AND NEARBY MUDLFATS ON NORTH HAVEN ISLAND, PENOBSCOT BAY, MAINE

§ Zueva*, Xenia D., K. E. Arnone, E. H. Bailey, C. J. Donohue, M. K. Ferraro, A. L. Grammatico, A. V. Marren, A. M. Onofrio, E. R. Roth, and Sr. M. J. Paolella
Sacred Heart Academy, Hamden, CT
EVOLUTION OF THE ACTIN GENE: COMPARING DNA SEQUENCES OF *LIMULUS POLYPHEMUS* AND *ARGOPECTEN IRRADIANS* AND THE IMPLICATION IN MITOCHONDRIAL FUNCTION

ABSTRACTS

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A HYDROGEOLOGIC STUDY OF A DITCHPLUGGED SALT MARSH IN PHIPPSBURG, MAINE
The “grid ditching” of salt marshes is a 200 year old practice of marsh management that results in an effective drainage of the marsh and overall loss of pool habitat on the marsh surface. Recent restoration projects designed to remediate the effects of grid ditching on Sprague Marsh, located in Phippsburg, Maine, were initiated by the United States Fish and Wildlife Service in 2002, where eleven ditchplugs were installed in the southern end of the marsh. The focus of this study is to monitor and compare the hydrogeology in natural systems versus ditchplugged systems to determine if the restoration is adversely affecting natural processes in the marsh. Fifteen monitoring wells were installed in the southeastern section of the marsh, six in the northern alcove (ditched) and nine in the southern alcove (ditchplugged), to enable monitoring of water level, conductivity and temperature over several days. Land cover information, soil salinities, monitoring well stratigraphy, and slug test information was also gathered to aid in evaluating the existing hydrologic conditions. Preliminary results from the southern alcove indicate higher water table levels behind the ditchplug through several tidal cycles. Land cover information supports this finding by indicating increased low marsh environments, likely caused by the higher water table. The well monitoring experiment indicates affected hydrologic flow due to the installation of the ditchplug. Further evaluation of the monitoring data will allow for more accurate understanding of hydrologic conditions in both study areas.

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EELGRASS (*ZOSTERA MARINA* L.) FROM GENETICALLY DIFFERENTIATED POPULATIONS RESPONDS DIFFERENTLY TO LOW LIGHT AND HIGH SEDIMENT ORGANIC CONTENT
The role eelgrass genetics plays in productivity and the expression of morphological characteristics under changing environmental conditions is poorly understood and important to consider for conservation and management. This study used neutral genetic markers to assess the genetic diversity and relatedness of 35 eelgrass beds along the coast of southern New England and New York. We selected ten genetically differentiated populations from a range of environmental conditions, for mesocosm experiments where light availability and sediment organic content were manipulated. Ramets from each population were transplanted into flow-through seawater outdoor mesocosm common-gardens and subjected to two light (100 and 50% ambient) and sediment organic content (1 and 8%) treatments simultaneously in a full factorial experiment. Measurements of shoot productivity for the different eelgrass populations were taken for three months following the start of the treatments in June 2011. Ramet survival and morphology were measured at the end of the study. Overall, productivity and survival were inhibited and morphology was altered by the stress treatments, but these responses differed significantly among populations. To further test differences in resilience among populations, eelgrass from the populations exhibiting the best survival and productivity were transplanted into a restoration site. Like the mesocosms, survival and productivity varied among populations. Variation in survival, productivity and morphology among the populations, in the mesocosm and field experiments, will be useful for identifying populations that are more resilient to a changing environment and potentially more suitable as donor stock for restoration.

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INCORPORATING ECOSYSTEM SERVICES INTO MARINE MANAGEMENT FRAMEWORKS IN THE NORTHEAST REGION
Ecosystem-Based Management (EBM) emphasizes the protection of ecosystem structure, functioning and key processes while integrating ecological, social, economic, and institutional perspectives, recognizing their strong interdependences. This management structure has become increasingly utilized in the last decade. Likewise, the term *ecosystem services* has been proliferating through regional, national, and global-scale conversations referring to EBM. This term is particularly useful in bringing a social dimension to the increasingly spatial affair of management. This study focuses on the services of food

provision, recreation, and sense of place provided by Narragansett Bay and Rhode Island Sound to the state of Rhode Island and surrounding communities. While these three do not define the entirety of the benefits provided by the estuary and coasts, they highlight what have been deemed the most important and immediately vulnerable services due to recent and ongoing environmental concerns such as development and climate change. These services can be assessed and valued using multiple methods including qualitative and quantitative analysis, as well as dynamic and detailed models. Ultimately, understanding, defining, measuring, and monitoring ecosystem services in Rhode Island can help to improve and extend EBM in the Ocean State.

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RIVER PLUME DYNAMICS INFLUENCE THE DISTRIBUTION OF DECAPOD AND BIVALVE LARVAE WITHIN SACO BAY, ME

Many marine invertebrates undergo a pelagic larval stage near the inner-shelf regions where larvae experience strong flow fields. Larval behavior can interact with flow fields to determine dispersal trajectories. In the Gulf of Maine, buoyancy driven flow from the Saco River potentially influences the distribution and transport of invertebrate larvae. The Saco River generates a 'surface advected' plume of no more than 1-2m depth. Decapod larvae are expected to exhibit relatively sophisticated behavior around river plumes, while bivalve larvae, are thought to behave more like passive particles. My research investigated the hydrodynamic features of the Saco River plume and explored how larval behavior may alter the distribution of larvae of bivalves and three species of crustacean in and around that plume. Two designated regions encompassing the plume and its offshore edge were sampled two depths to assess spatial and temporal variation in the horizontal and vertical distribution of larvae. I conducted hydrographic surveys (via CTD casts) and larval sampling (via plankton tows) under both ebb and flood conditions. Larvae were identified visually and counted. Densities were calculated from raw counts and measured tow volumes. Densities of larvae of all three decapod species exhibited stronger spatial patterns than bivalve larvae. Horizontal and vertical distributions varied among species and larval stages. All decapods species had the ability to move outside or below the plume, with the exception of *Carcinus maenas* stage I zoeae. These results may generate predictions for the distribution of larvae of other taxa with similar behavior patterns.

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NITROGEN LOSS PATHWAYS IN COASTAL AND SHELF SEDIMENTS: DEFINING CONTROLS IN NEW ENGLAND AS A MODEL SYSTEM

In coastal and marine ecosystems, fixed nitrogen (N) is essential to growth, but detrimental when in excess, and its availability depends on the balance of N sources and sinks. Nitrogen is removed from aquatic systems by sedimentary denitrification and anammox (anaerobic ammonium oxidation), which thus directly affect the distribution of N available for biological processes. We have yet to fully constrain the relationships between these N removal processes and their controlling environmental factors. To explore natural variation in marine sediment N removal rates, controls, and relative importance, we measured oxygen, nitrate, and ammonium profiles in intact cores, and potential denitrification and anammox rates in slurried sediments, from seven southern New England sites that span a range of water column depths (5-76 m). Process rates, calculated oxygen fluxes (a proxy for organic matter availability), and nutrient profiles varied spatially and seasonally. Process rates are in the range of reported values, and are dependent on environmental factors. Denitrification was significantly correlated with temperature and oxygen flux. Anammox was negatively correlated with oxygen flux, but positively correlated with denitrification in sites where anammox occurred. The percent of N_2 production by anammox (relative anammox) was significantly correlated with sediment porewater nitrate, and negatively correlated with oxygen flux. In multiple regression analyses using our rates and those from the literature, temperature was positively correlated with denitrification and negatively correlated with relative anammox, which further emphasizes the importance of temperature in controlling nitrate removal processes.

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THE GROWTH RATES OF THE SURF CLAM, SPISULA SOLIDISSIMA, FROM THE MID-ATLANTIC BIGHT FOR OVER 66 YEARS
Surf clams, Spisula solidissima, were used as proxies for marine climate change and their growth correlated with temperature off the New Jersey coast, and the Atlantic Multidecadal Oscillation (AMO). A chronology that spans from the 1940s to 2011 was constructed using an ontogenetically adjusted growth index (SGI) to examine inter-annual variations in growth. Spisula were collected from 1974-1977 off the coast of New Jersey, inshore and offshore (depth >30m) and then inshore again in 2011. Growth rates of Spisula were determined by cross-sectioning shells along the line of maximum growth and measuring exit lines. Growth performance (phi) of Spisula showed offshore clams collected from 1974-1977 grew 18.2% more than inshore individuals collected at the same time and 21% more than those collected in 2011. Inshore clams showed no difference with the clams collected in 2011. AMO accounted for 18% of inter-annual variation in the SGI. Analyzing other environmental parameters may further explain variation in inter-annual growth.

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HYPOXIA IN NARRAGANSETT BAY: A DRIVER FOR A HIDDEN NITROGEN POSITIVE FEEDBACK LOOP? PART II: THE GENETIC EVIDENCE
Estuarine sediments harbor metabolically versatile bacteria whose activities can influence the cycle of nutrients on global scales. Microbial communities that drive nitrogen (N) cycling are extremely diverse making it difficult to identify the functional groups and elucidate controls on their activity. Sediments from the estuary Narragansett Bay (RI) were recently shown to exhibit a seasonal switch in N cycling with high rates of net N_2 fixation. To target the microbes driving this process, we are following the expression of functional genes for N fixation (*nifH*). Organisms expressing the *nifH* gene in Bay sediments are relatives of anaerobic bacteria that can reduce sulfur and sulfate compounds. Upper areas of the Bay exhibit seasonal hypoxia due to the nutrient loading, so we wanted to determine the impact of changing oxygen profiles spatially and temporally on these anaerobic N fixers. Following the microbes related to sulfur reducers we have detected the highest *nifH* expression during hypoxia near a wastewater treatment plant; not an N limited site. We hypothesize that N fixation in these bacteria is potentially insensitive to combined N. These bacteria may directly inhibit coupled nitrification-denitrification as they evolve H_2S from the reduction of sulfur compounds which is toxic to key enzymes in nitrification. This unanticipated feedback thus could expand the niche for sulfur and sulfate reducers to thrive. Field measurements of gene expression may provide insight into how these microbes react to fluctuating oxygen conditions and their contribution to inputs of N in the environment.

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AN ANALYSIS OF SALT MARSH EDGE LOSS OVER 81 YEARS IN HEMPSTEAD BAY, LONG ISLAND, NEW YORK
Salt marshes on Long Island have lost about 50% of their area during the 20th century, mostly due to dredging and fill projects. Before marsh protection programs were instituted in the 1970s, about 45 Ha/y were lost from the Town of Hempstead marshlands, and these marshes are continuing to lose area at a rate of 6.5 to 10 Ha/y. This study used GIS to measure the change at numerous points on the edges of Hempstead Bay marshlands and associated the rates of marsh change at the selected points with conditions at those locations. Statistical comparisons with local variations and trends in several parameters can provide insight into the drivers of both gain and continued loss. The highest rates of loss were found along man-made edges that were cut in the first half of the 20th century as well as natural meander streams. Boat traffic was weakly detected by comparing the edge changes during the first and second halves of the 20th century and by correlations between the distance from the marsh to high traffic channels edge loss. Borrow pits are a potential sediment trap, yet their proximity to marsh edges showed a

weak effect and only near boat channels. The impact of wind driven waves was significant along edges not affected by stronger impacts from the cut edges and heavily trafficked boat channels. The general trend is attributed to insufficient sediment to support the recovery from natural and minor anthropogenic damage in the presence of sea-level rise. Anthropogenic damages were from historical events and were localized, including a significant effect from man-made edges and marginally significant effects from boat traffic and nearby borrow pits.

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CHANGES OVER TIME IN BIRD POPULATIONS IN THE PLUM ISLAND SOUND ESTUARY, MASSACHUSETTS: A PRELIMINARY ASSESSMENT.
Because they are highly mobile and migratory, the presence of birds in a region is a reflection of both local and global trends. We have been using historical records and current surveys to examine the current status and trends over time of birds in the Plum Island Estuary (PIE) and surrounding watersheds. Drivers of these ongoing changes include changes in land use, climate, and global shifts in populations and ranges. Data sources include field notes from Ludlow Griscom, Massachusetts State Ornithologist from 1930s to the 1950s, breeding bird surveys from the Parker River National Wildlife Refuge and Mass Audubon, data from the recently completed Breeding Bird Atlas project, shorebird surveys from the PIE Long Term Ecological Research program and the annual Christmas Count. Some trends in the estuary are similar to regional trends: increases in mallards, Canada geese, ospreys, and willets. Shrubland birds in the surrounding uplands have declined in response to reforestation. Regional declines in American black ducks and snowy egrets, two species of conservation concern, are not reflected in counts at PIE. Saltmarsh sparrow numbers also appear to be stable. The future of this obligate salt marsh species is clouded by uncertainty about how marshes will respond to sea level rise. LIDAR data indicates that saltmarsh sparrow numbers reaches a maximum at a narrow elevation range in the marsh - between 1.4-1.5 m above mean sea level. Future studies will focus on how anticipated sea level rise scenarios will affect saltmarsh sparrows, snowy egrets, and other species of estuarine birds.

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NATIVE PLANT COMMUNITIES OF THE GREAT MARSH AND INVASION BY *PHRAGMITES AUSTRALIS*
The exotic invasive variety of common reed (*Phragmites australis*), is threatening the integrity of the Great Marsh by spreading rapidly and displacing native plants. A study was conducted in cooperation with Mass Bays Program, USFWS and the Great Marsh Partnership to determine key factors that contribute to its success within one of the most ecologically significant salt marshes in New England. We found salinity was the strongest and most significant factor favoring *Phragmites* expansion in the marsh. To the south of Pine Island, high marsh soils averaged 20.0 ppt salinity and was dominated by five plants typical of salt marshes, but to the north soil salinity averaged slightly less, 16.7 ppt, and the plant community contained over 20 species. Our results suggest that the entire northern portion of the marsh may be vulnerable to further *Phragmites* spread if no management actions are taken. Fortunately, the management actions currently in place (i.e., selective herbicide spraying) appear to be working as a short-term approach that is helping to buy time until a more comprehensive management approach can be developed. In fact, sprayed areas are re-vegetating with a diverse, native population of salt marsh plants with little to no re-growth of *Phragmites* in the majority of sites examined. A mosaic of salinity, micro-elevation and surficial hydrologic conditions appear to play a role in the invasion. New research to integrate fine-scale mapping of salinity and elevation with hydrologic modeling would allow development of new approaches to large-scale management.

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SOFTSHELL CLAM (MYA ARENARIA) RESTORATION AND ENHANCEMENT EFFORTS
Since the Northeastern Massachusetts Aquaculture Center (NEMAC) housed at the Cat Cove Marine Laboratory (CCML) officially opened in 1999 over 26 million juvenile softshell clams have been

produced and stocked in tidal waters. CCML personnel have worked with nearly three dozen Massachusetts Towns providing clams, equipment, and advice. What initiated as a Massachusetts effort to restore and enhance depleted populations has expanded to become a regional activity as clams have been provided to interested parties in Connecticut, New York and in the near future Rhode Island. Technical assistance has been provided to communities and individuals interested in restoration and/or enhancement of softshell clams, from Chesapeake Bay to the Canadian Maritimes. Protocols to culture softshell clams have been defined and disseminated through three fact sheets that are accessible and down-loadable from the Northeaster Regional Aquaculture Center website (http://www.nrac.umd.edu). Most culture techniques are equally applicable to public and private aquaculture. Through collaborative efforts with growers, municipalities and state agencies, NEMAC has helped perpetuate fishing traditions and working waterfronts by facilitating the sustainable culture of softshell clams. The resultant aquaculture industry, public or private, produces a quality product locally. Jobs and income are generated, while nutrients (e.g., nitrogen, phosphorous, particulates) are removed and carbon sequestered from the environment. Softshell clams originally viewed as a New England curiosity and cuisine are increasingly embraced as an ecologically sound complement to other bivalve culture and an important component to maintenance of water quality in coastal waters.

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ANNUAL TIMING OF GROWTH LINE DEPOSITION AND COMPARATIVE GROWTH ANALYSIS OF MODERN AND ARCHAIC *MYA ARENARIA* FROM THE PEONOBSCOT BAY REGION, MAINE

Correlative analyses of modern *Mya arenaria* growth rates with environmental data have shed light on the growth rates of archaic *M. arenaria* and historic environmental conditions. Growth rates were determined by using the annually deposited growth lines in chondrophores of shells as annual markers. The first objective was to determine the timing of growth line deposition. This was accomplished by near-monthly sampling of *M. arenaria* from Maquoit Bay, Maine. I found that 85.7% of the individuals begin their slowed growth period by mid-August, and the transition into relatively fast growth probably occurs in March-April. I then compared growth patterns of modern clams from five sites from North Haven Island, Penobscot Bay, with shells from the nearby Turner Farm shell midden. *M. arenaria* from 3600 years BP experienced significantly greater growth rates (13%) than modern clams, but were insignificant when compared with individuals from the other midden horizons. Spatial variation in growth is currently being assessed at four other modern sites. This project provides another lens with which to view Maine's environmental history and further determine the time of harvest for the archaic clams.

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ANALYZING TRENDS IN WATER QUALITY TO ASSESS THE HEALTH OF CAPE COD BAY

Cape Cod Bay is a dynamic environment. It undergoes natural as well as human-induced change. This variability occurs on many different scales - geographic, seasonal and inter-annual. The Cape Cod Bay Monitoring Program (CCBMP) at the Provincetown Center for Coastal Studies (PCCS) focuses on the health of Cape Cod Bay and has been tracking changes in water quality and related indicators of ecosystem health since 2006. Using a Seasonal Kendall Trend Analysis test, a subset of the variables that are monitored for water quality were analyzed to address changes in the overall health of the Cape Cod Bay ecosystem. Analysis of 5 years of these data found that there are areas of improving or stable quality but there are also hot spots of degrading quality. Of the 54 stations analyzed, water quality improved at 30 stations over this 5-year period, did not change at 3 stations, and has declined at 21 stations. Most of the degradation is occurring in the nearshore and inshore waters sampled throughout the Bay.

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HYPOXIA IN NARRAGANSETT BAY: A DRIVER FOR A HIDDEN NITROGEN POSITIVE FEEDBACK LOOP ? PART I: HYPOXIC CONDITIONS IN THE BAY

Significant monitoring of oxygen distribution has been maintained in Narragansett Bay RI over the last decade. Results have shown repetitive patterns of episodic summer hypoxia centered on specific problem areas receiving significant nitrogen loads, possibly exacerbated by local hydrodynamics. Hypoxia extent and severity increases with increased summer freshwater riverflow (June-Sept.). Such hypoxic events still recur, even with a slight decrease (~ 30%) Tot DIN load from initial tertiary treatment efforts at several Wastewater Treatment Facilities. Full denitrification limits (3-5 mg/L TN) are projected to bring about a 50% decrease to DIN loads from all major WWTFs releasing to or just upstream of the Bay by 2014. Recent unusual findings of N fixation in Bay sediments have been interpreted as an oligotrophication signal due to loss of organic material to the sediments by loss of the winter-spring bloom. Some have interpreted this as a forewarning of inadequate nutrient sources for secondary productivity in the lower Bay following such treatments. We will provide an alternative hypothesis using several lines of evidence that suggest such N fixation results may be directly linked to severe hypoxic conditions, perhaps due to changes in benthic microbial community processes under these conditions. This would generate a positive nitrogen feedback loop that adds to the source of excess N in eutrophic systems, exacerbating the negative impacts of excess nitrogen loads to some marine systems. A separate presentation will provide strong genetic evidence that this hypothesis appears to be correct. We will discuss further research and management questions that need to be addressed if this hypothesis is correct.

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A SYSTEMS-BASED APPROACH TO INTEGRATED NUTRIENT MANAGEMENT IN NARRAGANSETT BAY AND ITS WATERSHED

EPA's Office of Research and Development is embarking on a project to develop and demonstrate a systems-based management approach that will achieve more integrated and effective management of nutrients in southern New England. The geographic focus of this multi-year research project is Narragansett Bay, its watershed and airshed. Our goal is to better inform governance decisions at municipal to national scales that affect changes in air quality, land use, and water quality in this watershed and estuary. Decision options range from shifts in national policy and regulations related to air and water quality, to non-regulatory decisions and land use planning at municipal scales. We will employ historical and newly-collected data, information, and decision support tools such as models, GIS server applications, and web-based "knowledge delivery" services. The research will take into account ongoing efforts to reduce nutrient loading to water resources in this system, including tertiary treatment of wastewater in Massachusetts and Rhode Island, storm water controls, and benefits and trade-offs of changes in land use and land cover and green and grey infrastructure. We are collaborating with local and regional decision makers, land use planners, NGOs, and other stakeholders to identify specific concerns and decision support needs, so stakeholders can better evaluate policy and management options at a range of scales. The conceptual approach and decision support tools will be designed to be adaptable for use in other watershed management contexts. This project will contribute to a more holistic approach for nutrient management, and help achieve more sustainable solutions for water resources in southern New England.

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PRELIMINARY RESULTS FROM BENTHIC INFAUNAL MONITORING AT THE NARRAGANSETT BAY NATIONAL ESTUARINE RESEARCH RESERVE ON PRUDENCE ISLAND, RHODE ISLAND.

Benthic macrofaunal (> 500 µm) communities and sediments at three water quality monitoring stations at the Narragansett Bay National Estuarine Research Reserve on Prudence Island, RI, were sampled seasonally during 2010. The water quality monitoring stations represent three different habitat types: salt

marsh, shallow cove, and open Bay waters. Community metrics such as composition, species richness, diversity, evenness, and density were analyzed across stations for winter samples only. Collectively, 1 anthozoan species, 7 species of polychaetes, 7 species of arthropods, and 10 species of mollusks were identified across the three sampling sites. Other groups present included nematodes, copepods, oligochaetes, ostracods, and amphipods. Benthic infaunal community composition was significantly different ($p=0.004$, ANOSIM) among the three stations/habitat types. Multidimensional scaling analysis (MDS) also identified three distinct infaunal groups, further supporting the notion that benthic macrofauna composition differs among habitat types. Overall, an average (± SD) of 9 (± 1.0) species/groups were found at the salt marsh, 10 (± 4.5) at the shallow cove, and 13 (± 3.2) at the open Bay water site. Among habitats, diversity (J') was high and evenness (H') was low. Macrofaunal densities among sites were highest at the shallow cove station compared to the other sites. Sediment composition at all three stations was dominated by sand and mud; organic content was approximated 20%. Subsequent analysis of community metrics and sediments of the 2010 spring, summer and fall samples will help elucidate seasonal trends in community parameters of benthic infauna around Prudence Island.

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DISEASE AND DROUGHT INDUCED STRESS OF *SPARTINA ALTERNIFLORA* INCREASES HERBIVORY BY MARSH CRABS

Recovery from dieback of *Spartina alterniflora* (SA) has been hindered by the herbivorous, nocturnal marsh crab, *Sesarma reticulatum*. Plant stress may increase herbivory. Adult marsh crabs were collected and reared in captivity in six 0.5 x 0.4 x 0.4 m bins containing clumps of marsh peat and filled 8 cm deep with marsh water (five crabs/bin). Greenhouse grown SA were exposed to drought or flooding and either inoculated with the pathogen *Fusarium palustre* or left un-inoculated. Control plants received normal irrigation and were inoculated or not inoculated. Pairwise combinations of SA plants were set into the bins and photographed periodically over a 1-2 day period. Visual estimates of herbivory were made two individuals, averaged, and analyzed over time for an integrated estimate of consumption. Herbivory was greatest in declining order: drought-stressed plants (inoculated or non-inoculated); inoculated, normal plants; non-inoculated, normal plants; then flooded plants that were either inoculated or non-inoculated. Plants exposed to the same treatments and transplanted into a crab-infested SVD site (Madison, CT) were similarly consumed over a 3 day interval in the same order. Since stressed SA tissue has higher levels of dimethylsulfoxide (DMSO) than healthy SA, we drenched healthy SA with DMSO (20 µm) to determine if it increased herbivory. Consumption was significantly greater in the first 4 hr on DMSO-treated plants than controls. These findings suggest that plant stress, whether disease- or drought-stressed, may increase the attractiveness of SA to herbivory by marsh crabs and that DMSO might function as a chemo-attractant.

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NUTRIENT INPUT FROM WASTEWATER TREATMENT FACILITIES IN THE NARRAGANSETT BAY WATERSHED, 2000 – 2010

Wastewater treatment facilities (WWTF) have been the primary source of nitrogen and phosphorus into Narragansett Bay for many years. Recently upgrades to 10 facilities in the watershed have been completed in the first stage of a project with the overall goal of reducing nitrogen and phosphorus loading to the Bay from WWTF by 50%. Annual and seasonal loads of total nitrogen, ammonium, nitrite, nitrate, and total phosphorus were calculated for 10 upgraded and 8 non-upgraded facilities over the last decade from concentration and flow data using Beale's unbiased ratio estimator. As expected, the majority of those facilities showed a reduction in nitrogen and/or phosphorus when compared to their load prior to upgrade and to facilities which have not upgraded. The Bucklin Point facility exhibits the most dramatic decreases, with consistent year-round total nitrogen reduction of about 50%. The Worcester and Woonsocket facilities on the Blackstone River also had large total nitrogen reductions. The North Attleboro facility showed large total phosphorus reductions. All facilities on the Pawtuxet River (Cranston, Warwick, and West Warwick) had large reductions in total phosphorus load, but total nitrogen load reductions were impacted by extensive flooding in 2010. When these facilities are re-examined

without the flood year, their total nitrogen reductions improve. Overall, the upgraded facilities are indeed reducing their total nitrogen and total phosphorus loads to Narragansett Bay. However, the majority of these facilities discharge into tributary rivers rather than the Bay which makes estimating the full effect on the Bay more difficult to determine.

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WHY DID TERRAPINS CROSS THE RUNWAY? THE MYSTERIOUS TURTLE INVASION OF JFK AIRPORT
On June 30-31 2011 domestic and international news agencies once again carried stories about diamondback terrapins (*Malaclemys terrapin*) causing departure delays at John F. Kennedy International Airport, one of the busiest airports in the world. A similar event occurred in summer 2009. These stories were generally presented as sympathetic and amusing filler pieces in which tiny turtles with amorous intent brought a major travel hub to a stop. JFK Airport is located within New York City on the eastern edge of Jamaica Bay. Airport construction was started in 1942, eventually covering 2000 ha of cord grass salt marsh with solid fill and destroying considerable amounts of terrapin habitat. Nevertheless, a large terrapin population persists, likely in excess of >10,000 individuals, probably in nearby JoCo Marsh. Most Jamaica Bay salt marshes are eroding for a variety of reasons, but JoCo Marsh appears to be stable. Only female terrapins come on land, and only for nesting forays. Terrapins have been reported on JFK runways annually since 2000, as far back as records exist. A small number are killed each year. However, a dramatic increase in runway crossings began in 2009. We plan to determine whether this increase was due to a surge in recruitment, movement of individuals from other parts of the bay, a change in nesting behavior, or increased detection by airport personnel. Efforts are also underway to prevent terrapin access to runways; these include development of new nesting areas and barriers that will meet FAA requirements.

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DISEASE RESISTANCE IN OYSTERS: FROM FIELD EVALUATION TO ELUCIDATION OF MECHANISMS
One of the most important strategies to manage disease in wild, restored, and cultured populations of shellfish is to encourage the development of disease resistance. The East Coast Shellfish Breeding Consortium is a group of institutions working on the development of shellfish strains with improved performance. Due to the significant impact of infectious diseases on wild and cultured populations of the eastern oyster, the program has mainly focused on the development of fast-growing strains that are resistant to diseases like Multinucleated Sphere X (MSX), Dermo, and Juvenile Oyster Disease (JOD). We have been involved in testing the performance of some of these strains in Rhode Island farms, developing experimental challenge models for the evaluation of disease resistance in the laboratory, and using genomic and genetics tools to identify mechanisms of disease resistance in oysters. We have also determined the impact of changing environmental conditions, such as hypoxia, on the performance of selected oyster strains. Improved knowledge on the molecular mechanisms of disease resistance will aid in future breeding efforts for shellfish aquaculture, as well as help identify and promote disease resistance in wild and restored oyster populations.

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BALANCING ECOLOGICAL AND MUNICIPAL WATER DEMAND IN A SOUTHEASTERN MASSACHUSETTS COASTAL STREAM
The Town of Scituate in SE Massachusetts obtains drinking water from surface and groundwater sources within the First Herring Brook and its watershed. In the summer the brook often runs dry between the system's two main impoundments, the Reservoir and Old Oaken Bucket Pond, because flows are controlled by the Scituate's water department. Low flows combined with poorly designed fish ladders

have caused a decline in the herring population for which the brook is named. Given these flow issues, the lack of an active herring run and an interest by the Town in increasing its water withdrawal permit, a condition has been included in Scituate's permit that they should investigate approaches to maintain adequate flows in the river for ecological benefits and determine the necessary steps to restore anadromous fish passage in the system. A team of stakeholders from nonprofit, local, state, and federal agencies has been working to provide the information needed to move forward with restoration of this system and to educate the Town about their options. Efforts have included establishment of flow gauges, evaluation of habitat and water quality in the impoundments, and the use of modeling of the system to provide restoration scenarios based on meeting environmental flow goals and improving passage in the system while maintaining adequate water supply for the town. Scituate is currently working with the NSRWA, Mass. Bays and Mass. Division of Ecological Restoration to control summertime water usage through watering restrictions and to implement operational plans for water releases that will enable the Town to meet minimum flow goals while still maintaining a reliable municipal supply.

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ACIDIFICATION OF THE COASTAL OCEAN: EVALUATING THE IMPACTS OF SEDIMENT CORROSIVITY ON BIVALVES.
While long ignored, it is now well-recognized that a significant proportion of biogenic CaCO3 produced shoreward of the shelf-break dissolves in both terrigenous and carbonate sediments. Undersaturated surface sediments have been documented in many coastal regions along the east coast of the United States and are presumably found worldwide in regions with similar sediment types. In addition to respiratory (or metabolic) acid production in surface sediments, eutrophication and interactions with terrestrial discharge also lowers pH. It is now recognized that lowered carbonate mineral saturation states have negative impacts on both pelagic larval and benthic juvenile bivalves. Lower pH and saturation state can cause increased mortality in bivalve larvae as well as delayed metamorphosis. When settling, bivalves will reject sediments with lower pH/saturation state and will choose to settle elsewhere. Once in sediments, small bivalves are subject to significantly slower and/or stunted growth when exposed to lower pH/saturation state. Lastly, significant increases in bivalve mortality can also result when settlement into lower pH/saturation state mud.

Gregory, S. Island Creek Oysters, Duxbury, MA <shore@islandcreekoysters.com>
SOCIAL AND ECONOMIC IMPLICATIONS OF OYSTER AQUACULTURE ACROSS LOCAL, REGIONAL, AND GLOBAL SCALES
Island Creek Oysters, based in Duxbury, MA was founded in 1995. The story of the rise of aquaculture in Duxbury is a story of industry and regulators working together. Through this collaboration, shellfish aquaculture in Duxbury was able to withstand challenges and provide a solutions orientated approach to important social and economic issues on a local, regional, and global stage.

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SETTING GOALS FOR OYSTER REEF RESTORATION BASED ON ECOSYSTEM SERVICES.
There is a growing literature describing the current loss of productive marine habitats such as oyster reef. The most recent estimate of the global reduction in the extent of oyster reef habitat is 85% over historic levels (Beck et al. 2011). At the same time we are documenting these losses we are also developing an understanding of the positive contributions of these habitats to the functioning of our coastal and estuarine ecosystems and the direct and indirect economic benefit they provide to coastal communities. A current study has extended the oyster reef condition assessment and developed models for estimating the provision of ecosystem services provided by oyster reefs in U.S. estuaries, including water filtration, denitrification and increased fish production. This modeling framework allows a description of oyster restoration targets not as an attempt to return to an historic level of oyster abundance, but in terms of

identifying a desired level of ecosystem service and defining the amount of oyster restoration required to achieve it. The present direction of oyster restoration will be described in the context of the ecosystem services and economic value provided by this habitat.

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DIETARY CONNECTIONS BETWEEN FUNDULUS HETEROCLITUS AND A PCB-CONTAMINATED ULVA BLOOM IN NEW BEDFORD HARBOR

New evidence collected regarding the polychlorinated biphenyl (PCB)-contaminated Ulva bloom located in the upper region of New Bedford Harbor (NBH), MA, Superfund site suggests that macroalgal blooms may be more harmful than previously considered. In the past, we have shown that the NBH Ulva bloom can concentrate total PCBs to levels as high as 99 ppm. Here we present data collected from June to December, 2011, assessing the bloom's role as a major source of PCB entry into the NBH food web. We explored the dietary relationship between the Ulva bloom and one of the most abundant mid-trophic NBH consumers, Fundulus heteroclitus (mummichogs). Monthly gut content analysis shows a consumption pattern correlating to Ulva biomass and is consistent with preliminary data collected from May to December, 2010. Gut contents were categorized as Ulva, detritus, or invertebrates and quantified for both total percent gut composition and biomass. Ulva was the dominant food item in the gut contents of Fundulus sampled from July-September (55.5-74.1%) which represents the period of highest Ulva abundance. A dietary shift from Ulva to invertebrates was detected between September (55% Ulva, 43.5% inverts) and October (13.99% Ulva, 72% inverts), coinciding with a sharp decline in Ulva abundance from 656.6 g/m2 to 9.8 g/m2. Additional photographic evidence from field grazing experiments suggests that a mesocosm containing three Fundulus can consume a 150 cm2 Ulva blade within a 10 day period. Overall, these results imply a trophic connection between the contaminated bloom and its consumers which may increase the bioavailability of PCBs to higher trophic species in the NBH food web including the system's top-trophic predator, striped bass.

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TWO- AND THREE-DIMENSIONAL PHOTOGRAMMETRIC MASS ESTIMATION TECHNIQUES FOR TWO PHOCID SPECIES: *HALICHOERUS GRYPUS* AND *PHOCA VITULINA CONCOLOR*

To determine the mass of Western North Atlantic Grey seal (*Halichoerus grypus*) and Atlantic Harbor seal (*Phoca vitulina concolor*) pups, a researcher must physically measure each animal. This produces stress for both pups and their mothers. Photogrammetric analysis (PGA) (evaluating photographs to obtain characteristics of a subject) has been used to determine physical measurements in a number of marine mammals. The purpose of this study was to develop a nonintrusive method for determining the mass of grey and harbor seal pups. We developed two- and three-dimensional PGA multiple regression models for predicting body mass. Photographs of grey seal pups were taken in the field and harbor seal photographs were taken in a captive setting. Three-dimensional stereo-PGA was the most accurate close-range mass estimation technique. The most accurate grey seal model demonstrated significant agreement ($p=0.006$, $r2=0.913$) between predictions and the true population mean at a 95% CI. The harbor seal model with the highest accuracy demonstrated significant agreement as well ($p= <0.0001$, $r2=0.904$). Two-dimensional grey and harbor seal PGA models functioned best when used for distance PGA, predicting mass within 4% - 20% accuracy, at distances up to 22 meters. PGA models were validated through results of models created from physical measurements. For instance, a high correlation, Adjusted $r2=0.885$, was seen in harbor seal physical models, however a strong correlation, Adjusted $r2=0.807$, was seen in harbor seal PGA models as well. Models built in this study will be useful in future field and captive setting work with both species.

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EXAMINING THE RESPONSE OF NITROGEN-FIXATION AND DENITRIFICATION TO NUTRIENT ENRICHMENT IN SALT MARSHES OF NARRAGANSETT BAY, R.I.
Throughout the last half-century, there has been a considerable effort to characterize nutrient fluxes within salt marshes. Although the exchange of nutrients between the marsh and tidal waters is now reasonably well-understood, the exchange of nitrogen with the atmosphere has been much more difficult to quantify. In past years, nitrogen (N)-fixation in marshes has received much attention, but in recent years research efforts have focused on denitrification, often with the goal of understanding the potential for marshes to remove terrestrial anthropogenic nitrogen before it reaches estuarine or offshore waters. The salt marshes of Narragansett Bay, R.I., located along a gradient of long-term anthropogenic nutrient inputs, are excellent for studying the effects of nutrient enrichment on nitrogen dynamics in marshes. We have been measuring N-fixation using the acetylene reduction assay and denitrification using the isotope pairing technique in two marshes located along the extremes of the nutrient concentration gradient in Narragansett Bay. In the fall of 2010 and summer and fall of 2011, we measured rates of N-fixation and denitrification using intact whole cores in mesocosm experiments using methods we developed to capture activity 2-3cm deep in the sediment. N-fixation was extremely low in the nutrient enriched marsh, but denitrification activity in the fall was significant. The least enriched marsh showed the opposite trend, with high N-fixation and lower denitrification. At both sites ambient summer denitrification was negligible, likely due to very low ambient nitrate concentrations in the water column. However, the potential for denitrification was significant at both sites and highest in the eutrophic marsh.

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SEDIMENT FLUX BETWEEN AN URBAN SALT MARSH AND LONG ISLAND SOUND
The continued persistence of urban salt marshes depends on adequate sediment supply and deposition. However, our knowledge of material exchange between marshes and coastal waters is limited, particularly in urban areas. The present study reports data on sediment flux and accumulation in an urban Long Island Sound salt marsh. This work reports sediment dynamics on multiple spatial and temporal scales. High resolution tidal cycle flux data were obtained using an acoustic Doppler current meter and a YSI multi-parameter sonde deployed at the creek mouth. These equipment were deployed for two months, capturing. Sediment traps deployed on the marsh surface reflect medium-term (seasonal) sediment accumulation, and sediment cores, dated using ^{210}Pb, ^{137}Cs, and Hg, capture long-term accumulation and accretion rates. Over tidal cycles, the marsh is characterized by large variations in the direction and magnitude of sediment flux, with storm events increasing sediment import four-fold. Over seasonal and decadal time scales, accumulation and accretion rates are more stable.

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ENVIRONMENTAL DRIVERS OF *SPARTINA ALTERNIFLORA* FLOWERING PATTERNS
Salt marshes provide valuable ecosystem services such as carbon sequestration, habitat for commercially important fish, and coastal protection from storm damage. Along the U.S. East Coast, many marshes are dominated by *Spartina alterniflora* (smooth cordgrass), a low marsh plant that provides a foundation for ecosystem development. Despite the critical role of this species, many aspects of its life history are poorly understood, in particular the drivers of phenotypic plasticity on within-marsh scales. We explored how gradients in environmental stress between high-stress panne and low-stress creekbank habitats influence the flowering phenology of *S. alterniflora*. We transplanted culms of *S. alterniflora* between these sub-habitats in a salt marsh on Prudence Island in Narragansett Bay, RI and monitored them over the course of the growing season. Transplantation significantly affected stem diameter, height, and the size of flowers produced, and had a marginally significant effect on the maximum proportion of flowering stems. Transplantation also affected the relative timing and duration of flowering. The impact of stress on this important species, and the importance of within-marsh variation, should be considered when managing salt marshes in the context of climate change.

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STABLE ISOTOPIC ANALYSES OF ARCHAEOLOGICAL FISH BONES REVEAL A SIGNIFICANT SHIFT IN NEARSHORE ECOSYSTEMS AFTER EUROPEAN SETTLEMENT, PENOBSCOT BAY, GULF OF MAINE

The carbon, nitrogen, and sulfur stable isotope compositions of organic matter extracted from well-preserved archeological fish bones provide information on fish diets, primary production, and food web dynamics through time. Shell middens in Penobscot Bay, Maine, provide a record of human occupation dating back approximately 5000 years and contain large numbers of fish and mammal bones and invertebrate shells. We analyzed stable C, N and S isotopes of bulk collagen and the C isotopes in individual amino acids of winter flounder (Pseupleuronectes americanus), Atlantic cod (Gadus morhua), and longhorn sculpin (Myoxocephalus octodecimspinous) bones from several coastal middens in Penobscot Bay spanning the last 5000 years to reconstruct fish diets. The combined isotope datasets reveal that there was significantly more eelgrass biomass available to fuel the base of the food web in Penobscot Bay prior to 1300 years ago relative to today. The most accelerated rates of eelgrass loss occurred over the last 400 years. The decline in eelgrass biomass may have resulted from a combination of factors, including increases in water turbidity (brought about by land-use changes and/or increases in nutrient delivery), disease and climate change. This study provide information on shifts in baseline conditions in coastal ecosystems that occurred after western European settlement of the North American continent and argues for the importance of analyzing materials from the geological and archaeological records to better understand ecosystem function, potential, and resilience.

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RESOURCE LIMITATION AFFECTS HETEROCYST FORMATION AND PRODUCTIVITY IN NITROGEN-FIXING CYANOBACTERIA

The primary goals of my study were to compare growth and heterocyst development of the cyanobacterium *Anabaena circinalis* over a nitrogen and phosphorus gradient as well as determine if substitutable resource acquisition strategies can differentially affect the environment. *Anabaena* was an appropriate model organism to test the concept of substitutable resource optimization because of its ability to acquire nitrogen through fixation of nitrogen gas or assimilation of nitrate. A regression design was used to establish growth solutions with a nitrogen gradient from 0.3 to 300.3 mg/L nitrate and a phosphorus gradient from 0.035 to 70 mg/L phosphate. Samples were inoculated and incubated for 14 days before being analyzed for chlorophyll a concentration, dry biomass, heterocyst density, filament length, 13-C and 15-N isotope fractionation, pH, and alkalinity. The phosphorus gradient had no significant effect on any treatment. Chlorophyll a concentration, filament length, and pH all agreed that optimal growth occurred at 30 mg/L nitrate. Heterocyst density showed that heterocysts only formed below 10 mg/L nitrate. This nitrate level corresponds to the point at which *Anabaena* switches between nitrogen acquisition strategies. These strategies had differential effects on the environment as nitrate assimilation generated alkalinity while nitrogen fixation did not. Because nitrate assimilation generated alkalinity, the total pool of dissolved inorganic carbon actually increased as available nitrogen increased. These results provided an indication of the nutrient conditions that stimulate algal blooms as well as how those blooms chemically alter their environment.

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GROWTH RATE AND SHELL ANALYSIS OF *PATELLA VULGATA* (THE COMMON LIMPET) FROM THE SANDWICK SOUTH SITE, UNST, SHETLAND ISLANDS, UK

Patella vulgata shells were collected from a Norse site at Sandwick South, Unst, Shetland Islands, occupied from the 12th to 15th centuries. Shell growth rate and oxygen isotope data were collected and compared to modern shells to provide environmental information across time periods. Modern day limpets grew significantly faster (~60%) than shells from the 12th/ early 13th century, 14th century, and the House Tephra phase (1362). This may be due to: higher primary productivity, warmer sea surface

temperatures, and less competition at present compared to the past. Modern shells were significantly less enriched in ^{18}O than shells from all but one of the archaeological phases. If salinity was constant, modern day and the late 13th/early 14th century temperatures may have been warmer than the three other archaeological phases. These data are being used to determine environmental changes at the site related to human inhabitance and climate change information.

Kachmar*, J. and C. Shetterly. The Nature Conservancy, Boston, MA <jkachmar@tnc.org>
CONSERVING AND RESTORING NEARSHORE COASTAL HABITATS IN MASSACHUSETTS: ENABLING CONDITIONS FOR SEAGRASS AND WILD SHELLFISH COMMUNITIES
The water quality enabling conditions are critical to successfully stemming the downward trajectory of the health of estuarine waters in the US. Both point sources and non-point sources of nutrient loading contribute to ecologically stressed nearshore waters. Our estuaries and embayments in Massachusetts are significantly stressed by degraded water quality as are other coastal waters in the US, significant habitat alteration has occurred, and we are facing an accelerated warming trend in our ocean waters. The Nature Conservancy is undertaking a strategy of coastal resource assessment and prioritization for conservation and restoration of the natural resources that constitute the biodiversity of Massachusetts' estuaries, as well as other embayments on the East Coast. In an effort to reverse this downward trajectory of ecological productivity from our coastal habitats, which provide ecological services for nature and people, this session will provide an overview of the work the Conservancy is undertaking in Massachusetts and other southern New England waters.

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THE BENEFITS OF SHELLFISH AQUACULTURE TO THE ECONOMIC, ECOLOGICAL, AND SOCIAL INTEGRITY OF MARTHA'S VINEYARD
For almost 35 years, the Martha's Vineyard Shellfish Group, Inc., a non-profit consortium of the shellfish departments of the six island towns, has conducted and promoted shellfish aquaculture to benefit the Island community. Its primary mission is the operation of a shellfish hatchery and the application of other aquaculture technologies for the improvement of the Island's historic commercial shellfisheries. Over the years with a growing understanding of the importance of shellfish to marine ecosystems and their ecological services in maintaining water quality, the original goal of augmenting natural recruitment in support of the public fishery has evolved and expanded. On a resort island where the wealth of the tourist economy is tied to the health of its water bodies, both public and private aquaculture have been encouraged to reduce turbidity and attenuate nitrogen overloads resulting from an increased human population. As in the Chesapeake Bay, oyster restoration is undertaken not only to support a commercial fishery but also to clean the water and restore ecosystems. In the wake of diminished offshore wild fish stocks, the development of private shellfish farms provides alternative marine-based employment opportunities for Vineyard fishers, maintains working waterfronts, and preserves the cultural integrity of coastal communities

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THE EFFECTS OF GENOTYPIC DIVERSITY ON *SPARTINA ALTERNIFLORA* RESPONSE TO SEA LEVEL RISE AND NUTRIENT LOADING
Genotypic diversity is known to enhance resistance to disturbance in seagrass ecosystems, but little to no research has been done to determine how genotypic diversity plays a role in *Spartina alterniflora*-dominated salt marshes. As sea level rise (SLR) and nutrient loading threaten the structure and functions of these marshes, the role of genotypic diversity must be understood to better protect these ecosystems. Stems growing in clusters of four were collected from the Wells National Estuarine Reserve in June 2011 and planted in pots containing a 50-50 mixture of sand and potting soil. Each pot contained three stems and was assigned one of three levels of genotypic diversity (stems from 1, 2, or 3 clones). Half the pots were given nutrients to simulate nitrogen loading. Half the pots were then placed in "low" tanks to simulate a natural tidal cycle and half were placed in "high" tanks that simulate SLR of approximately

40cm. Surveys were conducted at weeks 7, 15, and 22 to determine growth and survivability of each treatment. Diversity appeared to play a role in response to SLR at week 7 but not at subsequent weeks, and played no significant role in response to nutrient additions. Interestingly, at week 22 nutrients enhanced growth under SLR, but not under normal hydrologic conditions. When analyses were constrained to account for the effects of high mortality, diversity was found to have an impact on *Spartina* response to both nutrient loading and SLR. These results suggest some interactive effects between genotypic diversity, nutrient loading, and SLR, and may offer important information for future marsh management options.

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ECONOMIC CONSIDERATIONS IN SHELLFISH AQUACULTURE AND NUTRIENT MANAGEMENT IN NEW ENGLAND COASTAL PONDS
Nutrient loading is one of the most important agents of adverse ecological change in coastal ecosystems. Most efforts to address nutrient over-enrichment problems have focused on source reduction of nutrient inputs. This tends to be difficult and expensive, as the main nutrient sources – septic systems, atmospheric deposition, and fertilizers – cannot be reduced without significant technological or behavioral change. In certain cases, it may be equally effective and less costly to mitigate the effects of nutrients after they have entered the water. One such approach involves removing nutrients and improving water quality in estuaries by using bivalve molluscs as natural biofilters. Research suggests that the propagation and harvesting of bivalve molluscs can be a viable method for removing nitrogen from estuaries and improving coastal water quality through grazing on phytoplankton blooms, nutrient sequestration, and enhancement of denitrification in sediments. Shellfish aquaculture is a profitable commercial activity, and as such it usually has a lower direct cost than upstream nitrogen removal alternatives. However, shellfish farming also potentially imposes two types of indirect costs that must be taken into consideration: (1) it requires exclusive allocation of space in the bay to the aquaculture activity, reducing the value of the Bay for recreational purposes; and (2) because the farming gear (trays, etc.) is at least partially exposed at lower tides, it imposes real or perceived aesthetic costs on residents and users of the bay. In this presentation, we consider an approach to modeling the economics of using shellfish aquaculture to manage nutrient levels in a New England coastal bay, and suggest a way for coastal communities to think in economic terms about the tradeoffs involved in taking this approach.

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EUTROPHICATION: EFFECTIVENESS OF *MYA ARENARIA* IN CONTROLLING PHYTOPLANKTON POPULATION IN PLUM ISLAND ESTUARY, MA
This research aims to identify the effectiveness of clams, Mya arenaria, in controlling phytoplankton population in Plum Island estuary (PIE) in Massachusetts. This goal was accomplished by examining the relationship among phytoplankton density, food resources and clam growth. For this, water samples and ~ 40 clams (2" and 4") were collected monthly during the months of May to November in 2010 and April 2011 at eight sites in three regions of the estuary: the upper, the middle and the lower. Chlorophyll-a concentration in the water samples were estimated through fluorometry. The stable isotope analyses of δ13C, δ15N, δ34S and δD were performed on freeze-dried and ground adductor muscles of clams and internal growth ring analyses on shells for each site. When compared to the middle and lower estuaries, the upper region shows: 1) much higher phytoplankton density during growth season (May to October); 2) higher δ15N (~ 9 vs. ~8‰) and δD (~ -126 vs. ~ -133‰) and lower δ13C (~ -21 vs. ~ -19‰) and δ34S (~9 vs. 14‰) concentrations, which indicates clams in the upper region depend on diverse terrestrial resources as well as marine resources; 3) distinguished and diverse food resources based on non-metric multidimensional scaling analyses on the isotope data; 4) significant decrease in size and biomass of clams on the same age group in the ring analyses. Isotope analyses and phytoplankton density exhibit the upper region is better in food supply. However, the ring analyses demonstrate significant decrease of clams' biomass and size from the lower to the upper estuaries. It indicates salinity is an influential factor on clams growth and on determining the effectiveness of clams in controlling phytoplankton population in PIE.

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INVESTIGATING THE IMPACT OF ADVANCED WASTEWATER TREATMENT ON NUTRIENT DYNAMICS IN NARRAGANSETT BAY, RI

Between 2000 and 2009, eight wastewater treatment facilities which discharge into Narragansett Bay or its tributaries upgraded their treatment protocols to remove additional nitrogen and/or phosphorus from their effluent streams. The combined impact of this reduction is approximately 100 million moles of nitrogen and 4.2 million moles of phosphorus per year, or roughly 17% and 16% of the Bay's annual total nitrogen and phosphorus load respectively. We investigate the impact of this reduction on the nutrient standing stock, annual cycling, and seasonal patterns. Our results show roughly in-kind reductions in standing stock of nitrogen, with little or no change in seasonal pattern in either the upper or lower bay. Phosphorus concentrations have declined dramatically, in part due to plant reductions, but also due to other legislation removing phosphates from detergents and surfactants. While the results show some promise for the ability of the system to rapidly respond to loading changes, we see no change in chlorophyll (or primary productivity), indicating that the reduction is either insufficient to elicit biological response at this juncture, or that this response may be delayed or masked by interannual variability.

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THE TOWN POND RESTORATION - THEY DUG THE HOLE, NOW WHAT DO WE DO?

Prior to 1949, Boyd's Marsh was a small coastal pond and pocket marsh system (approximately 40 acres) located off Mount Hope Bay in Portsmouth, RI. However, with the dredging of the shipping channel through Mount Hope Bay and into Fall River, Boyd's Marsh became a depository for the dredge materials excavated and by 1950 was reduced from a coastal pond to a mudflat. By the 1970's, Boyd's Marsh had become a monoculture of *Phragmites australis*, a nonindigenous invasive reed. The combination of dredge fill and plant invasion had converted a healthy functioning ecosystem into a disturbed system with severely reduced diversity. In 2000, a host of federal, state and local agencies and NGO's, lead by the US Army Corps of Engineers, initiated a planning process to restore Boyd's Marsh (now referred to as Town Pond) to its original configuration, based on information generated from 1939. Construction started in 2005 and the flow of tidal waters into the restored coastal pond commenced on September 21, 2007. While the physical reconstruction was completed in 2007, the question remained of when and how will the ecological functions of the coastal pond be restored? To facilitate the biological recovery of the pond, we have been collaborating with the USACE, NOAA and RIDEM to establish viable oyster beds along the shoreline of Town Pond. The area was prepared with shell cultch and planted with 200,000 juvenile oysters during the fall of 2008. Since then, we have been introducing new oyster seed annually and have been monitoring the results of our efforts. This presentation will cover the successes and failures of our on-going efforts to re-establish the ecological services of a functioning oyster population in Town Pond.

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SEDIMENT CHLOROPHYLL *A* AND ORGANIC MATTER CONTENT ALONG THE RHODE ISLAND COAST

Organic matter (phytoplankton, zooplankton feces, etc.) sinks out of the water column to the bottom, where it serves as a source of labile organic material for benthos. Measurements of organic content of the sediments help tell us how much of this organic material is delivered to the sea floor. Chlorophyll *a* is the most abundant photopigment in phytoplankton, so measurements of sediment chlorophyll may reflect how much of this organic matter is derived from primary production by phytoplankton. We measured chlorophyll *a*, phaeopigment concentrations, and organic matter content in surface sediments from cores taken at stations along the Rhode Island coast that represent a gradient of depth and nutrient inputs. Organic matter content, sediment chlorophyll *a*, and phaeopigment concentrations were significantly higher in the Providence River estuary than the other sites, which is probably a reflection of the high

phytoplankton biomass and primary production in surface waters of this area. Concentrations of sediment chlorophyll *a* in mid Narragansett Bay were similar to a past study at this location, while concentrations in Rhode Island Sound and Block Island Sound were higher than values measured in other studies of a nearby inner-shelf system. Organic matter content ranged from an average of 3.3% in the Rhode Island Sound to 10.8% in the Providence River Estuary. Chlorophyll *a* concentrations ranged from an average of 9.6 μg cm^2 in mid Narragansett Bay to 31.8 μg cm^2 in the Providence River Estuary.

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A SPATIAL AND TEMPORAL ANALYSIS OF LEAD IN NARRAGANSETT BAY SINCE 1850
As New England's largest estuary, Narragansett Bay provides many important economic and environmental services. Since the onset of the Industrial Revolution around 1850, the bay has been subject to heavy metal inputs from various industrial and urban activities. These metals can be harmful for aquatic life if re-suspended in the water column through activities such as dredging. This study aims to determine how the concentration of lead (Pb), as recorded in sediments of the bay, has changed over space and time since 1850. About 25 sediment cores taken throughout Narragansett Bay were analyzed for Pb concentrations using x-ray florescence spectrometry. Linear age models were applied to each core, using 1850 as the date of significant Pb increase above the pre-industrial baseline of about 5 ppm. Pb values were linearly interpolated for every decade between 1850 and 2000 and maps of Pb concentration for each decade were spatially interpolated in ArcGIS. Preliminary results show an absolute maximum value of 671ppm in 1890 in the uppermost bay (Seekonk River), and a maximum bay-wide average appears to occur in 1950. A strong latitudinal gradient exists between the lower bay Pb values, ranging from 5 ppm to 45ppm, and the upper bay Pb values, ranging from 108ppm to 671ppm. Additional analysis will use a smaller interpolation area and improved age models.

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THE COMPARATIVE STUDY OF ACTIN AND MYOSIN GENES IN *MOLGULA MANHATTENSIS*, *STYELA CLAVA*, AND *LIMULUS POLYPHEMUS*: IMPLICATION ON MITOCHONDRIAL DNA MAINTENANCE
Classified under the phylum Chordata, *Molgula manhattensis*, the sea grape, and *Styela clava*, the sea squirt, are invasive to Long Island Sound and pose a threat as fouling organisms by depleting the resources of local shellfish such as *Limulus polyphemus*, the horseshoe crab. The blue blood of the endangered *L.polyphemus* is highly coveted in the field of medicine as a detector for bacterial endotoxins. Myosin and actin are genes of interest in tunicates and shellfish due to their conservative nature as well as their structural and functional similarities. Myosin's dependence on actin caused the focus of research to be redirected to actin, a protein that functions in the cell as a contractile system for the muscles. DNA was extracted from the tunicate body wall and gonads using spin columns, and from the shellfish blood clots using FTA cards. Then student-designed primers were created using the actin sequence similarities in *M.citrina, M.occulata, and S.clava*. After amplification through PCR, the products were purified and quantitated for downstream analysis. Templates from M.manhattensis, S.clava and L.polyphemus were sequenced in the school-owned ABI Prism 310 Genetic Analyzer, a single capillary automated sequencer. Subsequent results are being evaluated using NCBI and EMBL to determine the evolutionary relationships between the tunicates and the horseshoe crab. Prior research concludes that some β-actin resides in human mitochondria and that gene silencing of β-actin affects mitochondrial DNA copy number and organization. Collectively, these results strongly implicate the actomyosin cytoskeleton in mammalian mitochondrial DNA maintenance. (Reyes, 2011)

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SOCIAL ASPECTS OF SHELLFISH AQUACULTURE AND RESTORATION PROGRAMS
Commercial shellfish aquaculture in New England, as practiced today, is relatively young. Shellfish growers use the same waters as many other groups, potentially leading to multiple conflicts. Unlike land-based farmers who own farm property, shellfish growers lease public waters – many eyes watching their

every move. The numerous societal benefits from shellfish aquaculture may not be clear and public perception may be influenced by a lack of knowledge or understanding about the commercial activity. Yet shellfish restoration enjoys widespread acceptance and support especially from those who recognize biological and societal benefits of shellfish aquaculture. However, there are conflicts with these activities as well. Best Management Practices, a tool used to resolve conflicts, have recently been developed for both commercial shellfish aquaculture and shellfish restoration. Incorporating best practices demonstrates that the commercial farmer is serious about what he/she is doing and making the best effort possible to grow shellfish in an environmentally and socially conscionable manner, being a "good neighbor" while also growing an economically viable business. Incorporating BMPs in a restoration program demonstrates careful project planning with appropriate state or local shellfish control officers, that their project has state approval and adheres to the requirements of the National Shellfish Sanitation Program. In both cases BMPs lead to public confidence that the projects are conducted to the highest benefit possible including the addition of shellfish to the waters, providing ecological services, community awareness, environmental integrity and public education.

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FACTORS INFLUENCING EXPANDED USE OF URBAN ESTUARINE HABITATS BY FORAGING WADING BIRDS

Urban estuarine habitats are often utilized by wildlife for foraging and other activities despite surrounding anthropogenic impact or disturbance. However little is known of the ecological factors that determine habitat value of these and other remnant natural habitats. We examined the use of urban estuarine habitats in a northeast US estuary to try to elucidate the factors driving enhanced foraging activity at these sites. Using a bioenergetic model, we compared energy intake to energy expenditure and examined differences in behavior and foraging success of great egrets Egretta ardea at six urban and rural salt marshes in Narragansett Bay, Rhode Island USA. Mean per site available nekton energy averaged 4.44 ± 0.97 GJ site-1 and was significantly higher at urban than at rural sites. While energy expenditure by birds was similar across all sites, mean strike and prey capture rate were significantly greater at urban sites, and 70.1 ± 12.2% of strikes by egrets at urban sites were successful. Egrets foraging at urban sites consumed significantly more energy (23.2 ± 6.62 W bird-1) than those at rural sites. Model results indicated a net energy gain by egrets foraging at urban sites, versus a net energy loss at rural sites. Our results may help explain previously observed increases in the numbers of egrets foraging at urban estuarine habitats, and help provide input into decisions about the extent to which these areas should be considered for restoration or protection.

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A UNIQUE COASTAL SALT POND MARSH SYSTEM AT ODIORNE POINT STATE PARK, RYE, NEW HAMPSHIRE

Vegetation patterns in the coastal salt pond system at Odiorne Point State Park, Rye, New Hampshire, the state's only viable example, are described based on recent surveys and historical data. Three natural communities within the system, influenced by hydrology and salinity gradients, are coastal salt pond flat, coastal salt pond emergent marsh, and coastal salt pond meadow marsh. These communities are newly described in NH and the Northeastern U.S. A total of 69 native or naturalized vascular plant taxa from 54 genera and 33 families have been documented here between 1967 and 2011. The families best represented were Cyperaceae (10 taxa), Poaceae (9 taxa), and Asteraceae (6 taxa); the largest genera were Hypericum (4 taxa), Eleocharis (4 taxa), and Agrostis (3 taxa). In 2011, only 35 of the 69 plant taxa were documented; a difference that can be attributed to the spatial and temporal variation of hydrologic and tidal processes governing the system. Three of the 69 plant taxa are rare in the state. Five plant taxa are non-native invasive in the state and region. The uncertainty of the status of Typha angustifolia, which dominates the site, has significant implications for future management decisions. Measurement of surface

and pore water salinity in late summer to early fall of 2011 revealed oligohaline conditions at the surface (1.1±0.5ppt), while pore water at two depths implied mesohaline conditions at 10cm (5.8±1.8ppt) and 40cm (8.1±1.8ppt). Mean pore water salinity measured using electromagnetic induction (EMI) was significantly different between each of the natural communities examined, suggesting that hydrology and salinity may influence species composition and distribution within coastal salt pond marsh systems.

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PLANT COMMUNITY STRUCTURE OF TIDAL WETLANDS IN THE SACO RIVER ESTUARY, MAINE
To date, very little is known about the tidal wetlands of the Saco River estuary. This study aimed to determine what plant species are present in the estuary's marshes, as well as what patterns exist in their distribution among the varying salt, brackish, and freshwater tidal wetlands found there. Ten tidal wetlands were selected for study along a salinity gradient in a stratified random manner. We used the point intercept method to quantify plant cover in 1m2 quadrats along randomly placed transects at each study site. Cluster analysis was used to determine plant associations, and indicator species analysis revealed dominant species within each identified group. We also discovered a number of plant species currently listed as rare or threatened in the state of Maine, including Bidens hyperborea, Crassula aquatica, Eriocaulon parkeri, Lilaeopsis chinensis, Limosella australis, Sagittaria calycina, Sagittaria rigida, Samolus valerandi and Zannichellia palustri. The next step is to look for relationships between plant associations and abiotic factors, including salinity, distance up-river, available nitrogen, and shoreline development.

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EFFECTS OF LIGHT INTENSITY AND EUTROPHICATION ON AUTOTROPHIC NITROGEN-FIXATION IN NARRAGANSETT BAY, RHODE ISLAND SALT MARSHES
Salt marshes are critically important ecosystems and significant inputs of human-derived nutrients into our coastal marine systems has generated interest in better understanding nitrogen (N)-cycling dynamics in salt marshes. Narragansett Bay, Rhode Island is an excellent location for research because a long history of human-derived nutrient inputs at the head of the bay has resulted in a north-south decreasing gradient in nutrient concentrations. The goal of this project was to assess the effects of nutrient pollution and light levels on autotrophic N-fixation, a part of the N-cycle in which microbes make N2 gas bio-available. In fall 2011 we collected small surface sediment cores in three salt marshes along the north-south nutrient gradient in the bay to measure gross N-fixation using the acetylene reduction assay. The cores were incubated in a light box that exposed them to a range of light intensities. Our results show that lower levels of nutrient pollution were associated with higher rates of N-fixation. In addition, increased light intensity stimulated N-fixation activity in the least polluted marsh. This marsh also showed significant contributions to N-fixation by autotrophic microbes, which contributed more than half of the total N-fixed at light levels over 500 μE-2sec-1. Light intensity showed little to no relationship with N-fixation rates at the more polluted sites, where N-fixation appears to be inhibited by high nutrients levels. These results confirm previous studies which have found that nutrient pollution has a noticeable effect on salt marshes. Our work also highlights potentially significant contributions of autotrophic N-fixation in vegetated marsh sediments.

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LONG-TERM VARIATION IN $\delta^{15}N$ OF EELGRASS IN PLEASANT BAY, MASSACHUSETTS, SURROUNDING FORMATION OF A NEW INLET
Nitrogen isotope ratios of seagrasses reflect primarily the isotopic composition of N sources. Because wastewater-derived N in groundwater is enriched in ^{15}N relative to natural pools, the $\delta^{15}N$ of estuarine seagrasses is frequently correlated with the percent contribution of wastewater to N loads. Therefore, seagrass $\delta^{15}N$ is often proposed as an indicator of estuarine N enrichment. To date, however, most

evidence linking $\delta^{15}N$ of seagrasses to wastewater input has been based on spatial variation in macrophyte isotopic signatures among watersheds along an urbanization gradient; corroborative evidence from changes in seagrass $\delta^{15}N$ over long time scales is lacking. We measured $\delta^{15}N$ of eelgrass (*Zostera marina*) in Pleasant Bay, Massachusetts, during the period of peak eelgrass biomass (July-August) from 2003 to 2011. Pleasant Bay is a coastal embayment on Cape Cod that receives wastewater N from surrounding watersheds via groundwater. In April 2007, a new inlet formed in the barrier beach separating Pleasant Bay from the Atlantic Ocean, resulting in increased flushing rates and small reductions in modeled estuarine N concentrations. The $\delta^{15}N$ of eelgrass leaves and roots/rhizomes showed considerable interannual variability during our nine years of study, but the long-term patterns are consistent with a hypothesis of decreasing availability of wastewater N following formation of the new inlet. Our results emphasize the importance of time series data in interpreting relationships between seagrass isotopic signatures and land use patterns and confirm use of $\delta^{15}N$ to indicate both increasing and decreasing wastewater loads to estuaries.

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INFLUENCE OF ORGANIC CARBON AVAILABILITY ON THE NITROGEN CYCLE IN SEDIMENT FROM RHODE ISLAND COASTAL WATERS

Denitrification and anaerobic ammonium oxidation (anammox) are the main microbial pathways contributing to net removal of nitrogen in the ocean. Research suggests that both organic carbon (C) and nitrate (NO3-) variation play a role in controlling the balance between these two processes, however a quantitative understanding is currently lacking. To test the hypothesis that anammox and denitrification rates can be predicted based on a ratio of C: NO3-, a laboratory experiment was developed using eight pulsed-chemostats containing sediment from the “mudpatch”, a shelf station (70 m water depth) south of Rhode Island. The C: NO3- ratio was varied at different absolute loading rates. Changes in nutrients (NO3-, NO2- NH4+) were measured every 2-3 days within the chemostats for eight weeks. Potential rates of denitrification and anammox were measured bi-weekly using standard nitrogen isotope pairing experiments. In addition molecular the presence of molecular markers for anammox bacteria (hzo) and denitrifiers (nosZ) were examined with PCR. Although hzo and nosZ were present at the start of the experiment, no anammox potential rates were detected until week 6, when similar levels of anammox activity were detected in all treatments. Although the chemostats differed in NO3- concentration during the course of the experiment, potential denitrification rates were high and remained similar among treatments. The results indicate that anammox activity responded differently than expected and that experiments to examine the ratio effect on anammox and denitrification require further refinement.

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LONGFIN INSHORE SQUID (*LOLIGO PEALEII*) PARALARVAL DISTRIBUTIONAL ECOLOGY: DATA GAPS AND NOVEL FIELD STUDIES

The early life history of cephalopods is poorly understood, particularly the phase immediately following hatching. The spatiotemporal dynamics of paralarval dispersal are largely unknown. Preliminary results of *in situ* monitoring of longfin inshore squid (*Loligo pealeii*) embryonic development conducted in Nantucket Sound (Massachusetts, USA) support laboratory findings, indicating a predictable relationship between water temperature and the duration of embryogenesis. *In situ* validation of laboratory-derived relationships between seawater temperature and embryonic development may prove useful for predicting paralarval temporal distribution. Models currently applied to marine fishes and invertebrates may be applied to resolve questions surrounding paralarval dispersal from spawning areas when combined with systematically collected data on spatiotemporal distribution of spawning. However, a critical data gap exists regarding vertical distribution of *L. pealeii* in the time immediately following hatching. Laboratory studies and fishermen’s observations suggest that positive phototaxis contributes to post-hatching daytime surface-layer distribution in nearshore waters. A novel discrete-depth vertical pump sampler, the Squid ParaLArval Trap (SPLAT), is being developed to measure vertical distribution of newly hatched paralarvae in an inshore shallow-water spawning area.

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POPULATION STATUS OF THE SEASIDE SPARROW IN RHODE ISLAND: A 25-YEAR ASSESSMENT

The Seaside Sparrow (*Ammodramus maritimus*) is currently listed as a species of 'special concern' in Rhode Island and has been designated as a 'watch list' species in the Partners in Flight North American Landbird Conservation Plan. To assess the population status of breeding Seaside Sparrows in Rhode Island, we repeated a 1982 survey conducted by Stoll and Golet. During June and July in 2007 and 2008, 19 salt marshes were surveyed for the presence of breeding Seaside Sparrows. Counts decreased at 10 of the 11 marshes where Seaside Sparrows had been found in 1982, and on average Seaside Sparrow counts decreased 40% during the quarter-century between the historical and recent count periods. To identify possible reasons for the decline in Seaside Sparrows, we used available spatial data to quantify 1) the increase in residential and commercial development within 150 m and 1 km buffers surrounding each marsh, and 2) the loss of salt marsh habitat at each site. During the period between surveys, development within the 150 m buffer increased by an average of 69%, and salt marsh habitat decreased by an average of 14%. It is of anecdotal interest that the single marsh site that showed no decrease in sparrow populations lacked new development in the 150 m buffer, but lost 14% of its marsh area. Our findings document a dramatic decline in Seaside Sparrow numbers on Rhode Island marshes. Further research is needed to compare the local decline of breeding populations and marsh habitat to regional population trends, as well as the changing condition of their wintering grounds.

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ESTIMATING THE DISTRIBUTION, CANOPY HEIGHT AND CANOPY VOLUME OF EELGRASS BEDS (*ZOSTERA MARINA*) IN EASTERN CAPE COD BAY, MA USING AN INTERFEROMETRIC SONAR SYSTEM

In this study, an interferometric sonar system was used to map and measure canopy height and volume of Zostera marina beds located in eastern Cape Cod Bay, Massachusetts. An interferometric sonar system is ideal for mapping seagrass beds because it collects collocated sidescan and 3D bathymetric data simultaneously. The backscatter data provides georeferenced acoustic imagery needed to document the location and spatial heterogeneity of eelgrass beds at decimeter scale resolution, and the bathymetry can provide volumetric measurements of the vegetation such as canopy volume. Distribution maps, made at a resolution of approximately 6 m/pixel, were created using backscatter data and a statistically based backscatter-clustering program (QTC SwathView). The bathymetric data from one study area was used to calculate a canopy volume of 5309 m3, using surface-differencing calculations between digital terrain models of the acoustically-detected canopy and the seafloor beneath the canopy. Maps were groundtruthed through sediment grab samples and eelgrass sampling data obtained through Cape Cod National Seashore's eelgrass monitoring program. The combination of the bathymetric data and the distribution map allowed for an easy estimate of the depth of the 'deep edge' of eelgrass beds in the area, an important piece of information in evaluating the water clarity of the area. Overall, using an interferometric sonar system to map seagrass beds will make monitoring efforts for this important habitat more efficient and yield high-resolution data due to its ability to simultaneously collect collocated bathymetric and backscatter data, which can be easily interpreted with the help of automated backscatter-clustering programs.

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THE DESIGN AND TESTING OF A PROCEDURE TO LOCATE FRESH SUBMARINE GROUNDWATER DISCHARGE IN CYPRUS
The aim of this project was to develop a procedure for identifying fresh submarine groundwater discharge (SGD) in Cyprus. SGD is a flow of water from coastal aquifers into the ocean. Understanding SGD is crucial for informed groundwater management. In some cases, SGD can provide supplementary freshwater. This is particularly enticing for countries such as Cyprus, where expensive desalination plants are necessary to meet freshwater demand. A preliminary protocol for locating SGD was developed based on a review of literature and tailored to suit Cyprus. An infrared camera mounted on a manned aircraft was used to obtain an ocean surface temperature map to identify temperature anomalies indicative of groundwater input. Anomalous areas were revisited by boat to measure salinity in situ using a conductivity, temperature and depth sensor (CTD). This protocol was tested in Chrysochou Bay, selected based on relatively high estimates of SGD from published water mass balances. The designed method proved effective; areas of anomalous salinities and temperatures were found. However the protocol can be improved based on experience gained through this study. Unmanned aerial vehicles are preferable to manned aircrafts for a full-scale study due to lower costs, fewer flight restrictions, and superior navigational equipment. Additionally, obtaining a salinity profile by a series of point measurements, as with the CTD, is time-consuming and should only be used once indications of SGD have been found using more efficient methods. A thorough investigation of SGD is planned in Cyprus in the spring, when SGD is highest. This project presents a recommended procedure for the spring investigation based on the results of this study.

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IN THE WAKE OF DRAKE, COOK AND DARWIN: EXPLORING COASTAL PATAGONIA AT THE END OF THE AMERICAS
In February 2012, I spent three weeks hosting a Vassar College alumnae trip to Patagonia. We traveled from Buenos Aires to Ushuaia, Argentina, the southernmost city in the world, on the Beagle Channel in Tierra del Fuego. We then cruised the Cape Horn islands, through Chilean fjords, past glaciers, to the Magellanic penguin rookery on Isla Magdalena in the Straits of Magellan. After landing in Punta Arenas, Chile, we spent several days at Torres del Paine National Park below the southern ice field of Chile. We then flew to Puerto Montt, which is the center of the Chilean salmon aquaculture industry. After a few days in Santiago, a few of us continued on to Easter Island to complete the trip.

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COMPARING AND CONTRASTING TWO INTERTIDAL MUDFLAT MITIGATION PROJECTS IN RUMNEY MARSH, SAUGUS, MASSACHUSETTS.
Two intertidal flats were constructed from an abandoned highway embankment as mitigation for the loss of six acres of mudflats impacted from a dredging project and a seawall construction project. The first mitigation area was designed to create elevations subject to tidal flooding, to allow the sediments on the slopes to remain coarse grained while the bottom of the flat accumulated fine grained material, and to establish a self-sustaining soft-shell clam population through clam seeding. The second mitigation site was designed following completion of the first, incorporating many of the same goals but using lessons learned from the first construction effort. The second site was designed to create an integrated intertidal flat/salt marsh habitat, which involved using a shallower sloped mudflat (graded towards an existing tidal creek) and the planting of salt marsh grass along the edge of the mudflat. No clams were seeded at the second site. To assess ecological functions of both sites, a 5-year monitoring effort followed construction. The macrobenthic communities, shellfish populations, and sediment composition were recorded. Results from 5-years of monitoring demonstrated that macrobenthic communities and shellfish populations showed trends of increasing diversity and abundance, with and without clam seeding. Also noted are the changes in elevations and sediment type deposited on the flats, as well as salt marsh coverage. Comparisons to a reference site during the 5-year monitoring effort will also be discussed.

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RECONSTRUCTING PAST SEA SURFACE TEMPERATURES IN NARRAGANSETT BAY USING THE UK'37 SST PROXY: FROM VALIDATION TO APPLICATION

Knowledge of past sea surface tempertures (SSTs) for a given estuary is critical to habitat adaptation and restoration strategies. Luckily, the rapid deposition of both marine and terrestrial material in estuarine and coastal systems makes them valuable archives of high-resolution paleo-environmental information contained in proxies. One such proxy, the alkenone-based Uk'37 index, has been widely and successfully applied to the reconstruction of open ocean SSTs past climates on centennial to orbital timescales. However, the utility of the Uk'37 proxy is thought to break down in near-shore settings experiencing more-dynamic nutrient and salinity fluctuations. Here, we present a 3-year-long monthly to sub-weekly resolved record of water column Uk'37 and alkenone concentration (C37total) and associated instrumental SST suggesting that while important and informative seasonal inconsistencies exist, especially during alkenone blooms, the integrated Uk'37 signal preserved in Narragansett Bay sediments reflects mean annual instrumental SST. Alkenone-producing species detected via 18S rRNA in Narragansett Bay include E.huxleyi and G.oceanica – the dominant open-ocean producers. A second 'brackish' alkenone-producing population is suspected on the basis of high contributions of the C37:4 alkenone in the low-salinity upper Bay. We have extended this improved understanding of Uk'37 into the sediment record of Narragansett Bay to produce a nearly 600 year long sub-decadally resolved record of SST-inferred climate change for Narragansett Bay. Comparison with a 115-year-long instrument-inferred SST record suggests Uk'37 should be a viable SST proxy in other high-salinity estuaries.

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TRENDS IN SALT MARSH POND AND PANNE EXTENT OVER AN 81 YEAR PERIOD IN HEMPSTEAD BAY, LONG ISLAND, NY

Most of the salt marshes in eastern North America were lost and losses persist even with wetlands protection laws. The continued loss of relatively untouched marsh must derive from natural or indirect anthropogenic impacts. The proportion of marsh area occupied by marsh vegetation is also important, but not often studied. Hempstead Bay still includes approximately 2,700 hectares of salt marsh islands that were grid ditched prior to the early 20th century. Trends in unvegetated marsh surface (ponds and pannes) were measured from eleven sets of aerial photographs (1926 - 2007) and compared with anthropogenic and natural influences. The trends in the persistence and growth of individual unvegetated patches were also estimated. Loss of pond area was associated with intensive drainage efforts for mosquito control in the 1950s and 1960s. The percentage of unvegetated marsh tended to return to 1926 - 1950 levels after side-ditching and maintenance were discontinued in the 1970s. Sections of the marsh associated with waterways having higher nutrient loading were more likely to remain vegetated, while marshes surrounded by water with falling nutrient levels had pond/panne coverages that more often grew and exceeded pre-1956 percentages, although the interval of pond persistence did not seem to differ.

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BOSTON HARBOR SOFTSHELL CLAM *(MYA ARENARIA)* ENHANCEMENT AND OUTREACH

Since 2006, MarineFisheries has been collaborating with a broad base of partners to restore Boston Harbor clam beds decimated by poor recruitment, disease,habitat degradation,and overfishing. The main goal of the project is to enhance populations of soft shell clams in Boston Harbor through cooperative programs with local municipalities, industry, volunteers, and the Northeast Massachusetts Aquaculture Center. MarineFisheries and its partners began the project on a pilot scale and gradually expanded as the team gained familiarity with the technology and processes of softshell clam aquaculture. Adaptive restoration methods have been developed to fit the specific coastal regions of Boston Harbor with special considerations made to protect public health and ensure success across a wide range of site characteristics. To date, approximately 7 million clams have been planted at over 35 restoration sites throughout Boston Harbor. MarineFisheries has been monitoring clam growth and the long term survival of restoration sites

as well as the economic impact of enhancement activities. During the 2011 season the project expanded its efforts by leading the development and implementation of a collaborative educational outreach initiative based at the Thompson Island Outward Bound Education Center. The effort is aimed at protecting the long-term commercial and biological sustainability of shellfish resources in Boston Harbor by educating local communities on the historic and current role shellfish play in the ecology and economy of Boston Harbor.

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THE ROLE OF GENETICS IN EELGRASS POPULATION RESILIENCE IN SOUTHERN NEW ENGLAND AND NEW YORK

Genetic, biological, and environmental parameters were collected for eelgrass (*Zostera marina* L.) populations in coastal waters of southern New England and New York. We assessed the population structure, genetic diversity, and gene flow across the region using an experimental factorial design of potential stress parameters to yield maps of eelgrass distribution and resilience to multiple stressors. Seven microsatellites were used to genotype populations and predict metapopulation structure along these coasts. All populations showed a high degree of genetic diversity with few large clones. Genetically distinct eelgrass populations with unique alleles were re-sampled for subsequent experimental mesocosm evaluation of their response to stressors including reduced light, increased temperature, and organic enrichment of sediments. The results showed distinct levels of resilience among genetically different eelgrass populations, distinguishing between better and worse donor plant populations for restoration. Our study advances management and restoration science by first providing information on environmetal parameters and stressors to eelgrass that can improve site selection for restoration; second, by identifying genetically diverse populations of eelgrass to improve restoration success; and third, by creating a geographic database of eelgrass distribution, genetic diversity and population resilience for management application.

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NUTRIENT EFFECTS ON SPARTINA PATENS DECOMPOSITION DYNAMICS IN A NEW ENGLAND SALT MARSH

Decomposition of organic matter is a crucial process in salt marshes, determining their status as sinks or sources of carbon and nitrogen and affecting their ability to maintain elevation with sea level. Nutrient enrichment, a growing problem in estuaries worldwide, may increase rates of decomposition in salt marshes directly by stimulating microbial decomposers, or indirectly by stimulating detritivore populations through bottom-up processes. This study examines the effect of 8 years of nitrate addition (15x ambient concentrations) to flooding tidal waters in 2 salt marsh creeks on rates of organic matter decomposition in the *Spartina patens*-dominated high marsh zone in Plum Island Estuary, Massachusetts. Decomposition dynamics were measured in four ways: (1) Above- and belowground litter bags were used to measure decomposition rates of *S. patens* leaf and root detritus, respectively. (2) CO_2 flux of high marsh sediment and roots was measured to determine net respiration of the sediment. (3) Sediment nitrogen mineralization was measured to determine the rate of nitrogen release from decaying organic matter. (4) The existing live and dead stock biomass of *S. patens* was measured. Taken together, results suggest faster aboveground and belowground decomposition rates with chronic nutrient enrichment, which may ultimately affect a marsh's ability to maintain elevation with accelerated sea-level rise.

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ATLANTIC COAST SALT MARSH RESPONSE TO SEA LEVEL RISE: EFFECTS ON SEDIMENT MICROBIAL DECOMPOSITION

Climate-induced sea level rise (SLR) has the potential to disturb the natural maintenance of coastal salt marsh surface elevation. Microbial decomposition helps regulate sediment accretion rates, but the functional response of marsh sediment microbes to SLR is largely unknown. Our primary goals in this

study were to examine sediment microbial community response to simulated SLR and to attempt to explain any observed differential responses across sites on a latitudinal gradient and within sites at varying elevations. We collected multiple sediment samples from six coastal marshes between Virginia and Maine and separated them into “microbial cages” (dialysis tubing bags) to isolate the microbial communities. We exposed these cages to two hydrological treatments in a flow-through seawater system: normal and increased tidal inundation. During the experiment we repeatedly measured microbial respiration and used this as a proxy for decomposition rate to evaluate microbial response to SLR. Our results indicate that at low tidal elevations, the microbial communities in northern sites take longer to respond to SLR and respond negatively while southern sites show an earlier, positive response. The higher organic matter content of the northern sites appears to contribute to the later response seen in these communities. The results of this study and an accompanying study examining how environmental factors influence microbial community structure will improve models forecasting marsh elevation changes, thereby enhancing management efforts in coastal wetlands.

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EVALUATING THE SACO BAY ESTUARY SYSTEM AS A NURSERY GROUND FOR COMMERCIALLY VALUABLE AND ECOLOGICALLY IMPORTANT FISH SPECIES

Coastal river systems, such as the Saco River, are known to play an important role in the early life history of many marine species within the Gulf of Maine (GOM). Although the Saco River is the fourth largest in Maine, data regarding the fauna within this dynamic system is limited. The goal of this project is to compile an up to date baseline ecosystem structure of the wild fish populations within the Saco River estuary (SRE). Over the course of this five year study, various sampling methods including beach seines, modified lobster traps, plankton tow nets, and settlement collectors have been used to collect larval, post-larval, and juvenile fish species from this habitat. Sizes and relative abundances of species caught have been recorded and analyzed on a seasonal and geospatial basis. Out of a total 48 fish species collected, 44 species representing 31 families have been observed using the SRE system as a nursery ground. Overall, fish abundance and diversity was highest during spring and summer months with both marine and freshwater species observed representing resident, migratory, and transient life history categories. *Alosa aestivalis* (blueback herring), *Alosa pseudoharengus* (alewife), *Menidia menidia* (Atlantic silverside), *Ammodytes americanus* (American sand lance), and *Pomatomus saltartrix* (bluefish) were among the most abundant species collected. Examining early life history characteristics of the significant species richness present in these waters is essential for future conservation and management of commercially important and threatened GOM fish stocks.

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THE CHARACTERIZATION OF ORGANIC CARBON IN SEDIMENTARY CORE FROM *ZOSTERA MARINA* BEDS, MAQUOIT BAY, GULF OF MAINE

Seagrass beds are important ecosystems in nearshore environments. They provide nutrients and habitat for commercially important fish species, buffer against storm erosion, and are effective at sequestering carbon. Globally, they are in a state of decline due to human activities. Since little is known about natural fluctuations in seagrass distribution, this study uses organic geochemical techniques to determine if seagrass organic matter can be detected in sediment cores from Maquoit Bay, Casco Bay, Gulf of Maine. Maquoit Bay has extensive beds of *Zostera marina* (eelgrass). Sediment cores (ranging 20-50 cm) were taken and subsampled for organic geochemistry [bulk and higher plant leaf wax (HPLW) lipid carbon isotope composition], plutonium dating, and grain size determinations. Plutonium results indicate that the sediment cores represent the last 50 years of deposition. The $\delta^{13}C$ of the bulk sediments ranged from -17‰ at the coretop to -22‰ at depth. Given the multiple sources of carbon and varying $\delta^{13}C$ values in the system, it is impossible to determine the degree to which eelgrass contributes to the total organic pool. Preliminary analysis of lipid biomarker data indicates that eelgrass and sediments contain HPLW lipids (C24, C26, C28 fatty acids). High values of HPLWs have also been found at the surface of the core, which decrease with depth. Isotope analysis shows high C24 and C26, indicating a high even-over-odd predominance typical of HPLW lipids. Final carbon isotope composition of HPLW lipids may provide an

important proxy for eelgrass in other nearshore environments.

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BACTERIA IN THE SACO RIVER
Fecal Indicator Bacteria (FIB), which includes *Escherichia coli*, detects the presence of fecal waste in an environment, which can contain pathogens that negatively effect humans and other organism's health. The Saco River flows through many towns, farms and wetlands, making it a potentially high in FIB, and therefore a water quality concern. This study focuses on 18 sights along the 134mile river from 2010 to 2012. Water and sediment samples are retrieved using the Idexx Colilert-18© and Enterolert© water testing system which gives the number of FIB in the sample; the Colilert-18© test for both total coliform bacteria and total number of *E. coli*, while the Enterolert© cover enterococci. The results show relatively low concentrations of bacteria in the winter months, leading to a large spike in April after a rain event and increasing throughout the summer months. In order to fully understand the data a side study was done to determine the effects of environmental factors on *E.coli*. Three different survivability experiments were done testing against varying degrees of sunlight, temperature, and salinity. The base test showed that *E. coli* can survive for weeks in sterile river water, but in contact with sunlight deactivated within a couple hours. Similar results showed that with increased temperature (40 C) and high salinity (30 ppt) also increased death rates. Some of the results translate to the data on the river, with very low numbers of FIB found at Biddeford Beach, a high saline environment. Sampling continues into 2012 and will examine other factors involved.

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SEASONALITY OF DRINKING PLACE BROOK SITE, VINALHAVEN, ME, BASED ON MARGIN ANALYSIS OF ARCHAEOLOGICAL MICROGADUS TOMCOD OTOLITHS
Evaluation of site seasonality is an integral part of archaeological research. The aim of my study was to determine seasonality of occupation of Drinking Place Brook, an 840 year old site on Vinalhaven, Maine, using archaeological tomcod otoliths. This was done through otolith margin analysis which was based on the assumption that growth ring type (opaque or translucent) at the otolith margin can be used as an indicator of season of capture. Using modern otoliths from winter-caught fish from Randolph, ME, and from St. Anne River, Quebec, the otolith marginal state in winter was examined and compared with the midden otoliths. The margins of 33 out of 44 midden samples yielded a summer estimate for season of capture, thereby suggesting summer as season of site occupation. While the seasonal results could extend to fall due to a possible delay in growth ring formation, they generally disagreed with local archaeologists' initial assumption that Drinking Place Brook was used as a winter fishing site.

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CONNECTICUT'S NITROGEN CREDIT EXCHANGE - A COLLABORATIVE EFFORT TO ATTAIN NITROGEN REDUCTION GOALS FOR LONG ISLAND SOUND CELEBRATES 10 YEARS OF PROGRESS
Connecticut's Nitrogen Credit Exchange (NCE) was the first significant pollutant trading program in the nation designed to meet a sewage treatment plant (STP) wasteload allocation (WLA) required by a Total Maximum Daily Load (TMDL). The Long Island Sound (LIS) TMDL was a bi-state effort of CT and NY that set a 58.5% total nitrogen reduction target for LIS, to be attained by 2014 to alleviate the expansive hypoxia event that persists each summer. The program provides an alternative compliance mechanism for 79 STPs located throughout the state to meet their WLAs, and is completing its tenth annual trade based on 2011 operations. The NCE's establishment in 2002 predated EPA policy and guidance for water quality trading programs, which were just being recognized for their potential to accelerate progress, and lower cost. Despite initial national enthusiasm for trading, and numerous publications on the topic, CT's NCE remains unique in both its level of activity and effectiveness and is responsible for the vast majority of trades made in the US to date. After 10 years, the total number of credits exchanged is approaching 20 million with a value exceeding $50 million and the 2014 nitrogen loading target is within reach. For its

efforts, the NCE has been awarded EPA's Blue Ribbon for trading and the New England Water Environment Association's Founders Award. This presentation will review progress of the NCE, reasons for its success and lessons for application as an important tool for meeting difficult and costly pollutant reduction goals. Its contribution to the overall nitrogen management goal, and water quality improvement in LIS, will also be examined.

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STATUS AND TRENDS OF NUTRIENTS IN STREAMS OF THE NORTHEASTERN UNITED STATES, 1975-2003
Nutrient data for 130 U.S. Geological Survey (USGS) water-quality monitoring stations were evaluated for trends in concentration and load, and annual loads were estimated, during 1975-2003 (the long-term period) and 1993-2003 (when more stations were available) as part of a USGS National Water Quality Assessment Program regional study extending from Maine to Virginia. Long-term regional downward trends in flow-adjusted concentrations of total nitrogen (18 of 32 stations) and total phosphorus (19 of 32 stations) indicate improvements in nutrient-related conditions. Upward trends in total phosphorus during the 1993-2003 period (17 of 83 stations) indicate possible reversals to long-term improvements. Long-term downward trends in total nitrogen were frequent in a subset of 12 stations in New England: 10 downward trends in flow-adjusted concentration, 9 downward trends in instream concentration, and 7 downward trends in load; upward trends in flow-adjusted and instream concentrations of total nitrogen were detected at two stations during 1993-2003. Despite frequent long-term downward trends, concentrations of nutrients in many streams persist at levels that are likely to promote freshwater or estuarine eutrophication and affect aquatic habitat adversely. Regionally, instream concentrations of total nitrogen persisted at levels higher than ecoregion-based criteria proposed by the U.S. Environmental Protection Agency at 21 of 46 stations analyzed during 1993-2003. In New England, instream concentrations frequently exceeded proposed criteria for total nitrogen at 8 of 15 stations during 1993-2003, including stations monitoring small urban and agricultural drainage basins, and larger basins that drain to Long Island Sound.

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INFLUENCE OF PHYTOPLANKTON ABUNDANCE AND GUILD MEMEBRSHIP ON ROCKY INTERTIDAL SPECIES PERFORMANCE AND NITROGEN FLUX
Phytoplankton blooms are natural phenomena in many coastal ecosystems but can be exacerbated by anthropogenic nutrient inputs, as well as environmental variability. Benthic filter feeding invertebrates are impacted by these blooms due to changes in water quality and to the more obvious change in food abundance. We investigated the impact of varying phytoplankton concentrations and filter feeder guild membership on the growth, feeding, and nitrogen excretion rates of two dominant New England rocky intertidal species, the acorn barnacle *Semibalanus balanoides* and blue mussel *Mytilus edulis*. In replicate artificial tide pools, mussels and barnacles were distributed in monoculture and mixed culture treatments. Over 64 days, mussels grew to a larger size under high phytoplankton conditions, while barnacle growth was unaffected. Monocultures of mussels excreted more nitrogen than barnacles alone but the highest nitrite and nitrate concentrations were found in the mixed cultures. Given the increasing interest in using benthic filter feeders to mitigate cultural eutrophication, our data highlight the importance of ecological context – including knowledge of species-specific performance and interspecific interactions – in mediating the performance and ecosystem services provided by such species.

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INUNDATION EFFECTS ON GROWTH AND DECOMPOSITION OF TWO TIDAL MARSH PLANT SPECIES, *SPARTINA ALTERNIFLORA* AND *TYPHA ANGUSTIFOLIA*
Tidal marshes of southern New England have exhibited substantial changes over the past century: multiple anthropogenic stressors, such as enhanced rates of sea level rise, hydrological modifications, the

introduction of invasive species, and increased nutrient loading have resulted in negative impacts to tidal wetland integrity. In light of projected sea level increases, inundation effects on dominant species are of particular concern for scientists and managers hoping to promote marsh resilience. Here, we report on field experiments conducted at Narragansett Bay National Estuarine Research Reserve during the summer of 2011, where we examined the effects of inundation on above and below-ground growth and decomposition of Spartina alterniflora (low marsh dominant) and Typha angustifolia (marsh-upland ecotone species dominant) by growing plants in 'marsh organs' under four different inundation regimes. We monitored plant growth, soil respiration, pore-water salinity and sulfide concentrations over the course of the experiment, and measured soil shear strength, and above- and belowground biomass at the conclusion of the experiment in late fall. All factors measured responded to inundation, however rather than finding linear correlations between inundation and response variables, we found key inundation thresholds, such that significant differences were found for variables measured at elevations above and below the thresholds. This experiment provides fundamental information on the response of New England tidal marsh plants to increased inundation, and suggests that future response to increased inundation may be nonlinear in nature.

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A COMPARATIVE STUDY OF *PHRAGMITES* CONTROL MEASURES
Three different methods of invasive *Phragmites australis* control were tried in three discrete stands at each corner of a small (1/4 hectare) triangular-shaped isolated salt marsh in Salem, Massachusetts. Both Method 1 (weekly cutting of *Phragmites* stalks during three growing seasons) and Method 2 (weekly cutting combined with the application of BurnOut II™, an organic herbicide) had little or no effect, as measured by the average height of 20 of the tallest stalks. Method 3 (increasing seawater inundation at high tide by excavating to lower the surface level) has so far shown a significant reduction in the height of the tallest *Phragmites* stalks, from an average of 355cm preceding excavation to 181cm four years after excavation. A nearby Reference Site stand showed an insignificant decrease in average tallest height from 243cm to 228cm over the same time period.

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A COMPARISON OF THE δ13C STABLE ISOTOPES AND TRACE MINERAL CONCENTRATIONS OF MODERN AND ARCHAEOLOGICAL *MYA ARENARIA* SHELLS FROM THE TURNER FARM MIDDEN AND NEARBY MUDLFATS ON NORTH HAVEN ISLAND, PENOBSCOT BAY, MAINE
My study compares organic carbon stable isotopes and trace mineral concentrations in archaeological Mya arenaria shells from the Turner Farm midden on North Haven Island, Penobscot Bay, Maine and modern shells from nearby mudflats to determine whether shell geochemistry reflects changes in the near-shore ecosystem. Modern shells are 3.52‰, 2.3‰ and 1.52‰ more enriched in δ13C than shells from 4400, 1200 and 875 years BP, respectively. This may be a consequence of differences in amounts of primary productivity, its sources, or temperature. Similarly, Ba:Ca ratios decreased significantly from 24.6 to 8.5, and Mg:Ca ratios increased from 669.0 to 1691.5 over the last 4400 years. These may indicate decreasing productivity and increasing temperature, respectively. The lack of significant difference in Sr:Ca ratios suggests metabolism hasn't changed, although the increase from 2107.0 to 2337.4 suggests that increasing temperature may have indirect effects. These data suggest temperature differences may be responsible for differences in δ13C over the last 4400 years but difference among time periods in primary production sources are also possible.

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EVOLUTION OF THE ACTIN GENE: COMPARING DNA SEQUENCES OF *LIMULUS POLYPHEMUS* AND *ARGOPECTEN IRRADIANS* AND THE IMPLICATION IN MITOCHONDRIAL FUNCTION

Actin is a highly conserved protein found in cytoskeletons, thin filaments, and part of the contractile apparatus of the muscle. This gene interplays with mitochondrial function in the cytoskeletons of many types of cells including neurons and are essential for normal mitochondrial morphology, motility, and distribution. *Argopecten irradians* and *Limulus polyphemus*, (the Bay Scallop the Atlantic Horseshoe Crab respectively), are highly sought-after organisms indigenous to Long Island Sound. The Scallop serves as an important food source for the fishing industry; the Horseshoe Crab's blood is of medicinal importance containing LAL, Limulus Amoebocyte Lysate, as a detector of bacterial endotoxins. The organisms were provided by NOAA and the University of New Haven for experimentation and analysis. DNA was extracted from the blue blood of *L. polyphemus* with FTA cards and from the adductor muscle and gonads of *A. irradians* using spin columns. These DNA samples were quantitated using a biophotometer to obtain a targeted concentration of 50-100ng prior to PCR. To amplify the gene, students designed two sets of primers unique to the organisms utilizing GenBank and ClustalW as resources. The purified products were re-quantitated and diluted in order to be sequenced using the school's ABI Prism 310 Genetic Analyzer. The results, analyzed using the bioinformatics sources, NCBI and EMBL, are being utilized to study how divergence and duplication play a role in the evolution of the actin gene. Sequences will be submitted to GenBank by June 2012.