NEERS SPRING 2014 MEETING

May 1 – 3, 2014

Salem Waterfront Hotel, Salem, MA

Organized and Hosted By

Tay Evans, Local Chairperson – Massachusetts Division of Marine Fisheries
John Brawley – Woods Hole Group; Robert Buchsbaum – Massachusetts Audubon Society
Robert Vincent – NOAA Fisheries Service; Barbara Warren – Salem Sound Coastwatch
Alan Young – Salem State University

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Coastal and Estuarine Research Federation

Gold Supporters
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The Value of Experience
ENVIRONMENTAL, LAND USE AND REAL ESTATE LAW
GLENN A. WOOD, ATTORNEY AT LAW
50 Rowes Wharf, Boston MA 02110
99 Willow Street, Yarmouthport, MA 02675
617.330.7550 | www.rubinrudman.com

MEETING PROGRAM

All events are at the Salem Waterfront Hotel
All oral sessions are in the Grand Ballroom

Thursday, May 1st

11:30 am – 12:30 pm	Meeting registration
12:30 – 5:30 pm	Special Symposium: Salt Marsh Restoration in the Northeast – Where We've Been and Where We're Going
5:30 – 6:30 pm	Meeting registration
5:30 – 7:00 pm	Welcoming social (Compass Room)

Friday, May 2nd

7:00 – 9:00 am	Meeting registration
7:00 – 8:00 am	Continental breakfast (Grand Ballroom)
8:00 – 9:10 am	Oral presentations: Estuarine Physical and Biogeochemical Processes
9:10 – 9:55 am	Ignite presentations: Hot Topics
9:55 – 10:15 am	Break (Grand Ballroom)
10:15 am – 12:00 pm	Oral presentations: Species of Interest – Rare, Invasive, and Just Plain Cool!
12:00 – 1:00 pm	Lunch (Grand Ballroom)
1:00 – 2:15 pm	Oral presentations: Large-scale Assessment, Protection, and Management
2:15 – 4:15 pm	Poster presentations and refreshment break (Compass Room)
4:15 – 5:30 pm	Oral presentations: Ecology of Tidal Marshes
5:30 – 6:15 pm	NEERS Business Meeting (Grand Ballroom)
6:30 – 7:30 pm	Social and more poster viewing (Compass Room)
7:30 – 9:00 pm	Banquet (Grand Ballroom)
9:00 pm - ?	Music and dancing at a local venue

Saturday, May 3rd

7:00 – 8:00 am	Continental breakfast (Grand Ballroom)
8:00 – 9:30 am	Oral presentations: Estuarine Water Quality
9:30 – 10:30 am	Ignite presentations and panel discussion: Involving Citizens in Coastal Resource Science and Management
10:30 – 10:50 am	Break (Grand Ballroom)
10:50 am – 12:20 pm	Oral presentations: Ecology and Management of Estuarine Fish
12:20 pm	Student awards and Closing words
12:30 pm	Meeting adjourn
1:15 pm	Boat trip departs from Salem Wharf

Thursday, May 1st

SPECIAL SYMPOSIUM:
"Salt Marsh Restoration in the Northeast: Where We've Been and Where We're Going"

Chairs: Robert Buchsbaum and Rob Vincent *Presenter

12:30 Welcome – Robert Buchsbaum
Massachusetts Audubon Society, Wenham, MA

12:40 Burdick*, David M.[1] and C. T. Roman[2]
[1]Jackson Estuarine Lab, Univ. of New Hampshire, Durham NH
[2]US National Park Service and Grad. School of Oceanography, Univ. of RI, Narragansett, RI
TIDAL RESTORATION: AN ESSENTIAL TOOL FOR SALT MARSH RESTORATION IN NEW ENGLAND

1:00 Warren, R. Scott
Department of Botany (Emeritus), Connecticut College, New London, CT
A TALE OF TWO MARSHES: ORIGINS OF SALT MARSH RESTORATION SCIENCE AND MANAGEMENT IN NEW ENGLAND

1:30 Smith*, Stephen M.[1] and R. S. Warren[2]
[1]Cape Cod National Seashore, Wellfleet, MA
[2]Connecticut College, New London, CT
SALT MARSH RESTORATION: INFLUENCE OF BIOLOGICAL, HYDROLOGIC AND CHEMICAL VARIABLES ON ATTAINMENT OF TARGET VEGETATION COMMUNITIES

1:50 Moore*, Gregg E.[1,2], C. R. Peter[1], and D. M. Burdick[1,3]
[1]Jackson Estuarine Lab, [2]Dept. of Biological Sciences, [3]Natural Resources and the Environment, Univ. of New Hampshire, Durham NH
HIGH RESOLUTION SALINITY MAPPING AS A TOOL FOR PREDICTING PLANT COMMUNITY RESPONSE FOLLOWING SALT MARSH RESTORATION IN NEW ENGLAND

2:10 Adamowicz*, Susan C.[1], J. Kramer[1], T. Mikula[1], D. Burdick[2], and L. Wagner[1]
[1]US Fish and Wildlife Service, Rachel Carson NWR, Wells, ME
[2]Univ. of New Hampshire, Durham, NH
LONG-TERM EFFECTS OF DITCH PLUGGING ON SALT MARSHES AND THE QUEST FOR NEW RESTORATION TECHNIQUES

2:30 BREAK

2:50 Morris*, James T.[1], K. Sundberg[1], and J. Edwards[2]
[1]Baruch Institute, [2]Marine Science Program, Univ. of South Carolina
THE FUTURE OF PLUM ISLAND ESTUARY MARSHES

3:20 Cole Ekberg*, Marci L.[1], W. Ferguson[1], and K. B. Raposa[2]
[1]Save The Bay, Providence, RI
[2]Narragansett Bay National Estuarine Research Reserve, Prudence Island, RI
SALT MARSH ADAPTATION STRATEGIES IN RHODE ISLAND: RESTORING SALT MARSH HYDROLOGY WITH RUNNELS AND OTHER TECHNIQUES

3:35 Raposa, Kenneth B.[1], M. C. Ekberg[2], R. L. J. Weber[1], and W. Ferguson[2]
[1]Narragansett Bay National Estuarine Research Reserve, Prudence Island, RI
[2]Save The Bay, Providence RI
DIEBACK EVENTS ACCELERATE ONGOING *SPARTINA PATENS* DECLINE IN RHODE ISLAND SALT MARSHES

3:50 Turek*, James[1], E. Hutchins[2], and S. Block[2]
[1]NOAA Restoration Center, Narragansett, RI
[2]NOAA Restoration Center, Gloucester, MA
TIDAL MARSH RESTORATION IN THE NORTHEAST: NOAA'S EXPERIENCES AND FUTURE DIRECTIONS

4:05 Durey, Hunt
MA Department of Fish and Game, Division of Ecological Restoration, Boston, MA
TIDAL WETLAND RESTORATION IN MASSACHUSETTS: WHERE TO FROM HERE?

4:20 Kachmar*, Jon L.
The Nature Conservancy, Boston, MA
SALT MARSH RESTORATION IN MAINE AND FROM THE NONGOVERNMENTAL ORGANIZATION PERSPECTIVE

4:35 Chmura, Gail L.
Dept. of Geog. and Global Environmental and Climate Change Centre, McGill Univ., Montreal, QC
RETURN OF ECOSYSTEM SYSTEM SERVICES WITH MARSH RESTORATION AND RECOVERY

4:55 Panel Discussion

5:25 Closing Words – Rob Vincent
NOAA Fisheries Service, Gloucester, MA

5:30 **NEERS WELCOMING SOCIAL** (Compass Room)

7:00 Dinner on your own in Salem

Friday, May 2nd

8:00 Welcome and Introductory Remarks – John Brawley, NEERS President

Estuarine Physical and Biogeochemical Processes

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

8:10 Berounsky*, Veronica M.[1], R. Sharif[1], L. Maranda[1], D. Borkman[1], L. Green[2], R. Smith[2], and S. W. Nixon[1]
[1]Graduate School of Oceanography, Univ. of Rhode Island, Narragansett, RI [2]Watershed Watch Program, Univ. of Rhode Island, Kingston, RI 02881
THE ROLE OF NITROGEN IN WHOLE-BASIN ECOSYSTEM METABOLISM FOLLOWING AN ANOXIC WATER VENTILATION.

8:25 **(K)** Valentine*, Kendall[1], E. R. Kristiansen[1], G. C. Kineke[1], W. R. Geyer[2], and D.K. Ralston[2]
[1]Boston College, Chestnut Hill, MA
[2]Woods Hole Oceanographic Institution, Woods Hole, MA
A TALE OF TWO SEDIMENT POPULATIONS: CHARACTERIZATION OF BOTTOM SEDIMENT IN THE CONNECTICUT RIVER ESTUARY

8:40 **(K)** Kristiansen*, Ellen R.[1], K. M. Valentine[1], G. C. Kineke[1], W. R. Geyer[2], and D. K. Ralston[2]
[1]Boston College, Chestnut Hill, MA
[2]Woods Hole Oceanographic Institution, Woods Hole, MA
EFFECTS OF FRONTS ON FINE-SEDIMENT TRAPPING IN THE CONNECTICUT RIVER ESTUARY

8:55 Schillaci*,Christopher A.[1,2], G. Bettencourt[1], M. Litvaitis[2], and J. Salisbury[3]
[1]Massachusetts Division of Marine Fisheries, Gloucester, MA
[2] Dept. of Natural Resources and the Environment, Univ. of NH, Durham, NH
[3]Univ. of New Hampshire, Ocean Process Analysis Laboratory, Durham, NH
A COMPARISON OF CALCIUM CARBONATE SEDIMENT BUFFERS TO INCREASE THE LARVAL SETTLEMENT AND JUVENILE RECRUITMENT OF MYA ARENARIA

9:10 **Ignite Session: Hot Topics**

Wigand, Cathleen
US EPA NHEERL, Atlantic Ecology Division, Narragansett, RI
MARSH SOIL RESPONSES TO NUTRIENTS: BELOWGROUND STRUCTURAL AND ORGANIC PROPERTIES

Logan*, John M.[1], S. Voss[1], K. Ford[1], and L. Deegan[2]
[1]Massachusetts Division of Marine Fisheries, New Bedford, MA
[2]The Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA
SHADING IMPACTS OF SMALL DOCKS AND PIERS ON SALT MARSH VEGETATION

Watson*, Elizabeth .B.[1], C. Wigand[1], A. J. Oczkowski[1], K. Sundberg[2], D. Vendettuoli[1], S. Jayaraman[1], K. Saliba[1], and J. T. Morris[3]
[1]Atlantic Ecology Division, U.S. EPA, ORD-NHEERL, Narragansett, RI
[2]Baruch Marine Field Laboratory, Univ. of South Carolina, Georgetown, SC
[3]Belle Baruch Institute for Marine & Coastal Sciences, Univ. of South Carolina, Columbia, SC
DEATH BY *ULVA*

Tyrrell*, Megan C.[1], K. Adams[2], M. Adams[1], B. Argow[1], J. Barnes[1], K. Corwin[1], R. Dye[1], A. Dijkstra[1], P. Gares[2], C. Mejia[1], S. Smith[1], M. Tanis[1], A. Thime[1], and T. Wasklewicz[2]
[1]Cape Cod National Seashore, Wellfleet, MA; [2]Eastern Carolina Univ., Greenville, NC
CAPE COD'S SALT MARSH DIEBACK - MARKED ELEVATION CHANGE, SHIFTS IN PLANT DISTRIBUTION, AND EROSION STEMMING FROM CRAB ACTIVITY

Neckles, H. A.
USGS Patuxent Wildlife Research Center, Augusta, ME
LOSS OF EELGRASS ASSOCIATED WITH GREEN CRABS IN MAINE: IS THIS THE NEW NORMAL?

(R) Boyer*, Michaela, L. Logan, and K. Plotner
Department of Biology, Salem State, Salem MA
EFFECTS OF LIGHT AVAILABILITY ON GROWTH AND DENSITY OF EELGRASS (*ZOSTERA MARINA*) IN SALEM, MASSACHUSETTS

Bednarski*, Michael S.[1] and B. Lambert[2]
[1]Massachusetts Division of Marine Fisheries, New Bedford, MA
[2]Massachusetts Division of Ecological Restoration, Boston, MA
RESPONSES OF DIADROMOUS FISHES TO PASSAGE RESTORATION IN THE MILL RIVER, MASSACHUSETTS

9:45 Ignite Discussion

9:55 BREAK

Species of Special Interest: Rare, Invasive, and Just Plain Cool!

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

10:15 Pregnall*, A. Marshall[1, 2], C. Cardillo[2], M. Foster[3], N. Mazagwu and A. Darer[4]
[1]Biology Department, [2]Environmental Studies Program, [3]Mathematics Department, [4]Biochemistry Program, Vassar College, Poughkeepsie, NY
EGGSHELL FRAGMENT CATION RATIOS AND GEOMETRY HELP DISTINGUISH TURTLE SPECIES FROM DEPREDATED NESTS IN A WETLAND TURTLE COMMUNITY

10:30 **(R)** Wheeler*, Carolyn R.[1], C. E. Little[1], G. Wippelhauser[2], G. Zydlewski[3], M. Kinnison[3], and J. A. Sulikowski[1]
[1]Department of Marine Sciences, Univ. of New England, ME
[2]Maine Department of Resources, Augusta, ME
[3]School of Marine Sciences, Univ. of Maine, Orono, ME
DETERMINING SEX RATIOS AND SEXUAL MATURITY OF ATLANTIC STURGEON (*ACIPENSER OXYRINCHUS*) IN THE SACO RIVER, MAINE

10:45 **(R)** Novak*, Ashleigh N.[1], C. E. Little[1], G. Wippelhauser[2], G. Zydlewski[3], M. Kinnison[3], and J. A. Sulikowski[1]
[1]Univ. of New England, Biddeford, ME
[2]Maine Department of Resources, Augusta, ME
[3]School of Marine Sciences, Univ. of Maine, Orono, ME
IS DIET RELATED TO THE MOVEMENT OF ATLANTIC STURGEON (*ACIPENSER OXYRINCHUS*), IN THE SACO RIVER, MAINE?

11:00 Colarusso*, Philip D.[1], M. R. Carman[2], E. P. Nelson[1], M. M. Chintala[3], D. W. Grunden[4], M. C. Wong[5], C. McKenzie[6], K. Matheson[6], J. Davidson[7], C. Heinig[8], S. Fox[9], H. Neckles[10], S. Schott[11], C. Pickerell[12] and J. Dijkstra[13]
[1]US EPA, Boston, MA; [2]Woods Hole Oceanographic Institution, Woods Hole, MA; [3]US EPA, Narragansett, RI; [4]Oak Bluffs Shellfish Dept., Oak Bluffs, MA; [5]Dept. of Fisheries and Oceans Canada, Nova Scotia; [6] Dept. of Fisheries and Oceans Canada, Newfoundland; [7]Atlantic Veterinary College, Univ. of Prince Edward Island, Charlottetown, PEI; [8]MER Assessment Corporation, Brunswick, ME; [9]Cape Cod National Seashore, Eastham, MA; [9]USGS Patuxent Wildlife Research Center, Augusta, ME; [10]Cornell Univ. Cooperative Extension of Suffolk County, Southold, NY; [11]Univ. of New Hampshire, Durham, NH
CASUAL OBSERVATIONS, RANDOM MUSINGS AND WILD EXTRAPOLATIONS BASED ON SOME ACTUAL DATA ON THE IMPACT OF INVASIVE TUNICATES TO EELGRASS

11:15 Young*, Alan M., J. A. Elliott, J. M. Incatasciato, and E. C. Fertsch
Biology Department, Salem State Univ., Salem, MA
SURVEY OF GREEN CRABS (*CARCINUS MAENAS*) IN SALEM SOUND, MASSACHUSETTS

11:30 **(R)** Elliott*, James A. and A. M. Young
Biology Department, Salem State Univ., Salem, MA
COMPARISON OF PROPOSED CONTROL METHODS FOR THE INVASIVE EUROPEAN CRAB (*CARCINUS MAENAS*)

11:45 **(K)** Sobel, Amanda J.
Department of Biological Sciences, Univ. of New Hampshire, Durham, NH
THE PHYLOGEOGRAPHY OF *TENELLID* NUDIBRANCHS

12:00 – 1:00 LUNCH

Assessment, Protection, and Management at Watershed and Regional Scales

Chair: Alan Young *Presenter

1:00 Latimer*, James S.[1], C. Tilburg[2], J. Copeland[1], A. Elskus[3], M. Ten Brink[1], J. Brawley[4], and P. Wells[5]
[1]US EPA, Office of Research and Development, Narragansett, RI
[2]EcoSystem Indicator Partnership; Buxton, ME; [3]USGS, Orono, ME
[4]Woods Hole Group, East Falmouth, MA; [5]Bay of Fundy Ecosystem Partnership, Halifax, NS
A COMPARATIVE ECOLOGICAL APPROACH TO ASSESS THE ROLE OF WATERSHEDS IN ESTUARINE CONDITION

1:15 Stacey*, Paul E.[1], M.A. Tedesco[2], J.S. Latimer[3], R.L. Swanson[4], C. Yarish[5] and C. Garza[6]
[1]Great Bay National Estuarine Research Reserve, NH Fish & Game Dept. Durham, NH
[2]Long Island Sound Office, US EPA, Stamford, CT
[3]Office of Research & Development, US EPA, Narragansett, RI
[4]School of Marine and Atmospheric Science, Stony Brook Univ., Stony Brook, NY
[5]Dept. of Ecology and Evolutionary Biology, Univ. of Connecticut, Stamford, CT
[6]Div. of Science and Environmental Policy, Cal. State Univ., Monterey Bay, Seaside, CA
LONG ISLAND SOUND: PROSPECTS FOR THE URBAN SE – A FOCUS ON INTEGRATING SCIENCE AND MANAGEMENT AND LESSONS FOR GREAT BAY, NH

1:30 Babson*, Amanda L.[1], A. Neil[2] and D. S. Ullman[3]
[1]National Park Service, Narragansett, RI
[2]College of the Environment and Life Sciences, Univ. of Rhode Island, Kingston, RI
[3]Graduate School of Oceanography, Univ. of Rhode Island, Narragansett, RI
MAKING THE MOST OF EXISTING TIDE DATA AND PRIORITIZING NEW LOCATIONS TO SUPPORT CLIMATE ADAPTATION DECISION MAKING

1:45 Griffin*, Matthew, D. Leavitt, S. Patterson, and T. Scott
Center for Economic and Environmental Development, Roger Williams Univ., Bristol, RI
RHODE ISLAND OYSTER RESTORATION: WE'RE GREAT AT GROWING OYSTERS BUT WHAT HAPPENS TEN YEARS LATER?

2:00 Feurt*, Christine and P. Morgan
Department of Environmental Studies, Univ. of New England, Biddeford, ME
WE'RE ALL IN THE SAME BOAT! ESTUARINE RESEARCH AND STAKEHOLDER ENGAGEMENT TO SUSTAIN THE SACO ESTUARY, MAINE

2:15 POSTER SESSION (Map of poster locations is on final page)

*Presenter; **(D)** Dean Prize candidate for best graduate student poster,
(W) Warren Prize candidate for best undergraduate student poster

Regional Land-Cover Mapping and Partnerships for Planning and Management

A-1 Adams*, Mark B.[1], D. Nelson[2], T. P. Smith[1] and S. Fox[1]
[1]Cape Cod National Seashore, National Park Service, North Truro, MA
[2]National Trails System, National Park Service, Salt Lake City, UT
A REMOTE SENSING APPROACH TO LAND COVER MAPPING FOR SALT MARSH RESTORATION IN THE HERRING RIVER FLOODPLAIN, CAPE COD NATIONAL SEASHORE, WELLFLEET MA

A-2 Bickford, Susan A.
Maine Coastal Ecology Center, Wells National Estuarine Research Reserve, Wells ME
HIGH RESOLUTION LAND COVER MAP: A PILOT PROJECT BETWEEN THE WELLS NATIONAL ESTUARINE RESEARCH RESERVE AND NOAA'S COASTAL SERVICES CENTER

A-3 Aman*, Jacob, K. Wilson, P. Dest, and T. Smith
Wells National Estuarine Research Reserve, Wells, ME
BUILDING COLLABORATIVE PARTNERSHIPS AT THE WELLS NATIONAL ESTUARINE RESEARCH RESERVE TO RESTORE BRANCH BROOK, WELLS, ME

Estuarine Metabolism

B-1 Oczkowski*, Autumn[1], Oviatt, C. A.[2], and S. W. Nixon[2]
[1]US EPA, Atlantic Ecology Division, Narragansett, RI
[2]Graduate School of Oceanography, Univ. of Rhode Island, Narragansett, RI
MONITORING THE PRODUCTIVITY OF COASTAL SYSTEMS USING pH: WHEN SIMPLER IS BETTER

B-2 **(W)** Hernandez*, Maria D., W. L. Prell, and D. W. Murray
Department of Geological Sciences, Brown Univ., Providence, RI
EVENT-SCALE PLANKTON BLOOMS AND BOTTOM WATER HYPOXIA IN UPPER NARRAGANSETT BAY DURING THE SUMMER MONTHS (2007-2010)

B-3 **(W)** Raposo*, Michael, W. Prell, and J. Orchardo
Department of Geological Sciences, Brown Univ., Providence, RI
SEDIMENT OXYGEN DEMAND IN NARRAGANSETT BAY MEASURED *IN SITU* BY BENTHIC CHAMBERS

Benthic Invertebrates and Habitats

C-1 **(W)** Bragdon*, Briar and A. L. Bass
Marine Science Center, Univ. of New England, Biddeford, ME
DESCRIPTION OF LOW MARSH AND TIDAL MUDFLAT SEDIMENTS OF THE SACO RIVER ESTUARY, MAINE

C-2 Bass*, Anna L., T. Berndt, B. Bragdon, L. Charette and C. Hodgdon
Marine Science Center, Univ. of New England, Biddeford, ME
BENTHIC INVERTEBRATES FROM LOW TIDAL MUDFLATS AND LOW MARSHES OF THE SACO RIVER ESTUARY, MAINE

C-3 Martin*, April, and W. Prell
Department of Geological Sciences, Brown Univ., Providence RI
SMALL-SCALE SPATIAL VARIABILITY OF BENTHIC HABITATS AND FORAMINIFERA IN NARRAGANSETT BAY SEDIMENTS

C-4 **(D)** Edquist, Sara K.
Department of Biological Sciences, Univ. of New Hampshire, Durham, NH
DISTRIBUTION PATTERNS OF THE TREMATODE PARASITE, ZOOGONUS RUBELLUS, AND ITS INTERMEDIATE HOSTS ILYANASSA OBSOLETA AND ALITTA VIRENS IN THE GREAT BAY ESTUARY SYSTEM,NH

Estuarine Water Quality and Nutrient Dynamics

D-1 **(W)** Louisos*, Jeremy N., and J. B. Hubeny
Department of Geological Sciences, Salem State Univ., Salem, MA
$\delta^{13}C$, $\delta^{15}N$, and $\delta^{34}S$ AS SOURCE INDICATORS FOR PARTICULATE MATTER IN SALEM HARBOR, MA

D-2 **(W)** Lauden*, Andrea, B. J. Johnson, M. J. Retelle, and P. Dostie
Department of Geology, Bates College, Lewiston, ME
$\delta^{15}N$ ISOTOPE ANALYSIS OF A SEDIMENT CORE TO RECONSTRUCT WATERSHED HISTORY OF NUTRIENT CYCLING IN NEQUASSET LAKE, WOOLWICH, ME

D-3 **(W)** Cunningham*, Tanner and B. Johnson
Department of Geology, Bates College, ME
NUTRIENT DYNAMICS IN NEQUASSET LAKE: ANADROMOUS ALEWIFE SUBSIDIES

D-4 **(D)** Lamb*, Annesia L.[1, 3], L. M. Anderson[3], H. D. Sioux[3], and B. F. Branco[1,2,3]
[1]Dept. of Earth and Environ. Sci., The Graduate Center, City Univ. of NY, New York, NY
[2]Dept. of Earth and Environ. Sci., Brooklyn College, City Univ. of NY, Brooklyn, NY
[3]Aquatic Res. and Environ. Assessment Ctr., Brooklyn Coll., City Univ. of NY, Brooklyn, NY
A UNIALGAL CULTURING METHOD FOR *ULVA SPP.* FOR USE IN MESOCOSM EXPERIMENTS

D-5 **(D)** Brannon*, Elizabeth[1], S. Moseman-Valtierra[1], and J. P. E. McCaughey[2]
[1]Department of Biological Science, Univ. of Rhode Island, Kingston, RI
[2]Narragansett Bay Commission, Providence, RI
THE GRAND EXPERIMENT: DO SMALLER NITROGEN LOADS INTO NARRAGANSETT BAY MEAN LARGER GREENHOUSE GAS EMISSIONS AT FIELDS POINT?

D-6 Charlestra*, Lucner, E. H. Dettmann, and M.A. Abdelrhman
U.S. EPA, ORD, NHEERL, Atlantic Ecology Division, Narragansett, RI
SPATIALLY AND TEMPORALLY DETAILED MODELING OF WATER QUALITY IN NARRAGANSETT BAY

D-7 **(W)** Hernandez*, Eugenio J. and C. Feurt
Department of Environmental Studies, Univ. of New England, Biddeford, ME
WHAT'S IN THE WATER? EXPLORING CONNECTIONS BETWEEN ENVIRONMENTAL AWARENESS AND STEWARDSHIP

Salt Marsh Ecosystems: Sea-Level Rise, Storm Disturbance, and Bird Abundance

E-1 Tanis*, Mike S., M. C. Tyrell, S. M. Smith, S.M., M. B. Adams, K. C. Medeiros, C. Mejia, A. Thime, and A. Dijkstra
NPS, Cape Cod National Seashore, Wellfleet, MA
THE RELATIONSHIP BETWEEN HYPSOMETRY AND TIDAL INUNDATION WITHIN AND BETWEEN SALT MARSHES IN CAPE COD NATIONAL SEASHORE

E-2 Medeiros*, Kelly C.[1], C. T. Roman[2], J. Lynch[3], and M. J. James-Pirri[4]
[1]NPS, Cape Cod National Seashore, Wellfleet, MA
[2]NPS, Cooperative Ecosystem Studies Units, Narragansett, RI
[3]NPS, Northeast Coastal and Barrier Network, Kingston, RI
[4]URI, Graduate School of Oceanography, Narragansett, RI
MONITORING SALT MARSH ELEVATION AT CAPE COD NATIONAL SEASHORE: UNDERSTANDING THE RESPONSE TO SEA LEVEL RISE

E-3 Browne*, James P.[1] and R. Carr[1,2]
[1]Conservation & Waterways, Town of Hempstead, NY
[2]Department of Biology, Hofstra Univ., Hempstead, NY
A POST-SANDY REASSESSMENT OF MARSH TRENDS, MARSH PEAT STRENGTH, AND THE EFFECTS OF EUTROPHICATION IN HEMPSTEAD BAY, LONG ISLAND, NY.

E-4 Walsh*, Eric S.[1], W. J. Berry[1], M. Nightingale[1], and S. M. Lussier[1]
[1]U.S. EPA, Narragansett, Rhode Island, USA
RECENT TRENDS IN BIRD ABUNDANCE ON RHODE ISLAND SALT MARSHES

E-5 **(W)** Murphy*, Shane, N. Perlut, and P. Morgan
Department of Environmental Studies, Univ. of New England, ME
FACTORS THAT AFFECT TIDAL MARSH BIRD DIVERSITY IN THE SACO ESTUARY OF SOUTHERN MAINE

Invasive Species

F-1 **(W)** Cowles*, Sarah and P. Morgan
Department of Environmental Studies, Univ. of New England, ME
A STUDY OF THE INVASIVE SPECIES *PHRAGMITES AUSTRALIS* AND ITS RELATIONSHIP TO ABIOTIC FACTORS

F-2 Vincent*, Robert E.[1] and M. Tyrrell[2]
[1]NOAA Fisheries Service, Gloucester, MA; [2]NPS, Cape Cod National Seashore, Truro, MA
THE ROLE OF HISTORIC WETLANDS IN THE ESTABLISHMENT AND MAINTENANCE OF *PHRAGMITES AUSTRALIS* IN COASTAL DUNE HABITAT OF CAPE COD, MASSACHUSETTS

F-3 **(W)** Logan*, Jouis L.[1], K. M. Boyer[2], and L. K. Plotner[3]
Department of Biology, Salem State Univ., MA
ZOSTERA MARINA GROWTH IN THE PRESENCE OF INVASIVE TUNICATES

F-4 Durant*, Daisy[1], K. B. Raposa[1], and I. Mateo[2]
[1]Narragansett Bay National Estuarine Research Reserve, Prudence Island, RI
[2]NOAA Alaska Fisheries Science Center, Ted Stevens Marine Research Institute, Juneau, AK
PREDICTING THE EFFECTS OF CLIMATE CHANGE ON *HEMIGRAPSUS SANGUINEUS* POPULATIONS IN INTERTIDAL COBBLE BEACHES

Estuarine Fish and Fisheries

G-1 **(W)** Rudnicky*, Brenda N., J. M. Reynolds, K. M. Smith, and J. A. Sulikowski
Univ. of New England, Biddeford, ME
ABIOTIC INFLUENCES ON THE JUVENILE FISH ASSEMBLAGE OF THE SACO RIVER ESTUARY, MAINE

G-2 **(W)** LeBlanc*, Jordyn A, and J. A. Sulikowski
Department of Marine Sciences, Univ. of New England, Biddeford, ME
MOVEMENT OF SHORTNOSE STURGEON(*ACIPENSER BREVIROSTRUM*) IN THE SACO RIVER ESTUARY

G-3 **(D)** Whitefleet-Smith*, Laura A., C. E. Tilburg, and A. L. Bass
Department of Marine Sciences, Univ. of New England, Biddeford, ME
SPECIES IDENTIFICATION OF HAKE IN MAINE MARKETS

G-4 **(W)** Pray*, Nicole and J. K. Buttner
Northeastern Massachusetts Aquaculture Center and Cat Cove Marine Laboratory, Department of Biology, Salem State Univ., Salem, MA
LOBSTER TALES AND SEA CUCUMBER TOXIN: THE FRENCH-CANADIAN CONNECTION

Restoration of Submerged Habitats

H-1 Naham*, Stephen, A. Kanonik, R. Carr, and J.P. Browne
Department of Conservation and Waterways, Hempstead, NY
SPATIAL PATTERNS OF OYSTER GROWTH AND MORTALITY

H-2 Evans*, Tay, W. Dukes, J. Carr and R. Kessler
Massachusetts Division of Marine Fisheries, Gloucester, MA
LOOKING BACK AT 10 YEARS OF EELGRASS RESTORATION IN MASSACHUSETTS BAY

H-3 Carr*, Jillian and N. T. Evans
Massachusetts Division of Marine Fisheries, 30 Emerson Avenue, Gloucester, MA
CASE STUDIES USING “CONSERVATION MOORINGS” AS A COMPONENT OF EELGRASS (ZOSTERA MARINA) RESTORATION AND REHABILITATION IN TWO MASSACHUSETTS HARBORS

4:15 ORAL PRESENTATIONS RESUME

Ecology of Tidal Marshes

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

4:15 **(K)** Buckley*, Sarabeth B.[1] and R. W. Fulweiler[1,2]
Departments of [1]Earth and Environment and [2]Biology, Boston Univ., Boston, MA
SALT MARSHES AND SEA LEVEL RISE IN LONG ISLAND SOUND: A SYNTHESIS

4:30 **(K)** Hill*, Troy D.
School of Forestry and Environmental Studies, Yale Univ., New Haven CT
SEA LEVEL RISE AND SEDIMENT: RECENT MARSH ACCRETION IN CONNECTICUT AND NEW YORK

4:45 **(R)** Hill*, Katherine L.[1] and G. P. Zogg[2]
Departments of [1]Environmental Studies and [2]Biology, Univ. of New England, Biddeford, ME
THE EFFECTS OF SEA-LEVEL RISE AND WARMING ON PLANT PRODUCTION AND DECOMPSITION IN A NEW ENGLAND SALT MARSH

5:00 **(K)** van Ardenne*, Lee and G. L. Chmura
Dept. of Geog. and Global Environmental and Climate Change Centre, McGill Univ., Montreal, QC
MODELLING CO_2 EMISSIONS FROM RECLAIMED SALT MARSHES IN THE BAY OF FUNDY

5:15 **(K)** Slater*, Michelle A.[1] and P. A. Morgan[2]
Depts. of [1]Marine Sciences and [2]Environmental Studies, Univ. of New England, Biddeford, ME
TRANSPORT REGIMES OF *PHRAGMITES AUSTRALIS* IN THE SACO RIVER ESTUARY, MAINE, USA

5:30 **BUSINESS MEETING**

6:30 **SOCIAL AND MORE POSTER VIEWING**

7:30 **BANQUET**

9:00 Music and dancing at a local venue

Saturday, May 3rd

Estuarine Water Quality

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

8:00 **(K)** Price*, Andrea M.[1], V. Pospelova[2], G. L. Chmura[1] and J. S. Latimer[3]
[1]Department of Geography, McGill Univ., Montreal, QC
[2]School of Earth and Ocean Sciences, Univ. of Victoria, Victoria, BC
[3]US Environmental Protection Agency, Narragansett, RI
DINOFLAGELLATE CYSTS AS INDICATORS OF WATER QUALITY IN NORTHEAST US ESTUARIES

8:15 **(R)** Payne*, Joshua C. and S. C. Wainright
Department of Science, U.S. Coast Guard Academy, New London, CT
DETECTION OF SEWAGE-DERIVED NITROGEN IN NEW ENGLAND COASTAL WATERS USING STABLE NITROGEN ISOTOPES

8:30 **(K)** Maguire*, Timothy J.[1] and R. W. Fulweiler[1,2]
[1]Department of Biology and [2]Earth and Environment, Boston Univ., Boston, MA
URBANIZED WATERSHEDS – POTENTIAL SOURCES OF SILICA TO RECEIVING WATERS

8:45 Fox*, Sophia E.[1], D. K. Ralston[2], J. A. Colman[3], H. K. Bayley[1], K. D. Lee[1], K. C. Medeiros[1], B. A. Keafer[2], D. M. Anderson[2], and M. L. Brosnahan[2]
[1]National Park Service, Cape Cod National Seashore, Wellfleet, MA
[2]Woods Hole Oceanographic Institution, Woods Hole, MA
[3]USGS New England Water Science Center, Northborough, MA
UNDERSTANDING NUTRIENT DYNAMICS IN AN EUTROPHIC, TEMPERATE ESTUARY

9:00 Gallagher*, Eugene D.[1], C. Haak [2], K. E. Keay[3], J. A. Blake[4], and N. J. Maciolek[4]
[1]School for the Environment, UMass Boston, Boston MA
[2]Wildlife, Fish & Conservation Biology, UMass Amherst, Amherst MA
[3]Environmental Quality Division, Massachusetts Water Resources Authority, Charlestown MA
[4]AECOM, Woods Hole MA
BOTH THE MASSACHUSETTS BAY SEWAGE EFFLUENT OUTFALL AND CLIMATE CHANGE AFFECT MASSACHUSETTS BAY BENTHIC BIODIVERSITY

9:15 Browne*, James P.[1], C. A. Crown[1], and J. A. Vanek[1,2]
[1]Conservation & Waterways, Town of Hempstead, NY
[2]Department of Biology, Hofstra Univ., Hempstead, NY
INDICATORS OF LIFE: ESTUARINE BREEDING BIRDS AND EUTROPHICATION ON LONG ISLAND, NY

9:30 Ignite Session: Involving Citizens in Coastal Resource Science and Management

Chair: Tay Evans *Presenter

Grady*, Sara P.[1] and J. Buckley[2]
[1]Massachusetts Bays Program, South Shore Region, North and South Rivers Watershed Association, Norwell, MA; [2]Cohasset Junior Senior High School, Cohasset, MA
A "SUMMER STUDENT ACADEMY" APPROACH TO FIELD DATA COLLECTION

Brewer, Elaine J.
Massachusetts Division of Marine Fisheries, Gloucester, MA
VOLUNTEERS ARE THE BACKBONE OF SOLID RESEARCH AND RESTORATION

Kennedy, Cristina G.
Charles River Watershed Association, Weston, MA
CHARLES RIVER IN CHARGE: THE CHALLENGES AND OPPORTUNITIES OF LONG-TERM CITIZEN SCIENCE DATA

Vaudrey, Jamie M. P.
Department of Marine Sciences, Univ. of Connecticut, Groton, CT.
COMMUNITY-BASED MONITORING OF LONG ISLAND SOUND EMBAYMENTS: CURRENT STATUS AND SUGGESTIONS FOR DEVELOPING A COMMUNITY-BASED MONITORING COOPERATIVE

Miller*, Jeremy[1] and A. Pappal[2]
[1]Wells National Estuarine Research Reserve, Wells, ME
[2]Massachusetts Office of Coastal Zone Management, Boston, MA
MIMIC: USING CITIZEN SCIENTISTS TO TRACK THE SPREAD OF MARINE INVASIVE SPECIES AT THE WELLS NATIONAL ESTUARINE RESEARCH RESERVE, WELLS, ME

Warren, Barbara G.
Massachusetts Bays Program, Salem Sound Region, Salem Sound Coastwatch, Salem, MA
CONSIDERATIONS FOR SUCCESSFUL CITIZEN SCIENCE PROGRAMS

10:00 Panel Discussion

10:30 BREAK

Ecology and Management of Estuarine Fish

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

10:50 (K) Smith*, Kayla M., C. J. Byron, and J. A. Sulikowski
Department of Marine Sciences, Univ. of New England, Biddeford, ME
DIADROMOUS FISH ASSEMBLAGE ASSESSMENT IN THE SACO RIVER ESTUARY, ME, 2012-2013

11:05 **(R)** Reynolds*, Julia R. and J. A. Sulikowski
Department of Marine Sciences, Univ. of New England, Biddeford, ME
ESTIMATING SIZE CLASSES, SPAWNING PERIODS, AND RESIDENCE TIMES OF TELEOSTS IN THE SACO RIVER ESTUARY SYSTEM BASED ON TOTAL LENGTHS

11:20 Wilson*, Kristin R., J. Aman, and J. Miller
Wells National Estuarine Research Reserve, Wells, ME
FYKE NETTING OF FRINGING MARSHES OF THE SACO RIVER, MAINE REVEALS HIGH NEKTON DIVERSITY

11:35 Bauer*, Tracey C. and J. A. Sulikowski
Department of Marine Science, Univ. of New England, Biddeford, ME
ABUNDANCE, ASSEMBLAGE, AND DISTRIBUTION OF ICHTHYOPLANKTON AROUND THE SACO RIVER PLUME

11:50 Dubay, Timothy, J. Miller, and K. Wilson
Wells National Estuarine Research Reserve, Wells, ME
OBSERVATIONS ON ICHTHYOPLANKTON COMMUNITY STRUCTURE, ABUNDANCE, AND DIVERSITY IN A TEMPERATE ESTUARINE SYSTEM, WEBHANNET RIVER, WELLS NATIONAL ESTUARINE RESEARCH RESERVE, WELLS, ME

12:05 Sheppard*, John J.[1], S. Block[2], H. L. Becker[3] and D. Quinn[4]
[1]Massachusetts Division of Marine Fisheries, New Bedford, MA
[2]National Oceanic and Atmospheric Administration Restoration Center, Gloucester, MA
[3]EA Engineering, Science and Technology, Lincoln, NE; [4]DQ Engineering, Walpole, MA
THE ACUSHNET RIVER RESTORATION PROJECT: RESTORING DIADROMOUS FISH POPULATIONS TO A SUPERFUND SITE IN SOUTHEASTERN MASSACHUSETTS

12:20 Presentation of Student Presentation Prizes and Closing Words – John Brawley, NEERS President

12:30 Adjourn

1:15 Boat trip departs from Salem Wharf, which is a 5-10 minute walk from Salem Waterfront Hotel: from the hotel go east on Derby Street, turn right on Blaney Street

ABSTRACTS

Adamowicz*, S. C.[1], J. Kramer[1], T. Mikula[1], D. Burdick[2], and L. Wagner[1]. [1]US Fish and Wildlife Service, Rachel Carson NWR, Wells, ME; [2]University of New Hampshire, Durham, NH
< susan_adamowicz@fws.gov>

LONG-TERM EFFECTS OF DITCH PLUGGING ON SALT MARSHES AND THE QUEST FOR NEW RESTORATION TECHNIQUES

Most East Coast salt marshes have been ditched since Colonial times either for salt haying or mosquito control. These ditches drain both surface and subsurface water from the marsh in order to increase salt hay production or reduce mosquito-breeding areas. One consequence of ditching is the loss of surface water habitat suitable for waterfowl, wading birds and shore birds as well as fish and crustaceans. Other consequences include changes in vegetation community structure. Ditch plugging, has been employed widely in East Coast Spartina marshes as a means of increasing surface water habitat on previously ditched marshes. Ditch plugs are formed by excavating peat from the surface of a salt marsh and packing it in a narrow portion of a ditch. Water then is impounded in the ditch channel on the upstream side of the plug. We examined bulk density, percent organic matter, interstitial hydrogen sulfide concentrations, groundwater levels, vegetation community, and above-ground biomass at ditched and unditched marshes at 2 sites each in Maine, Massachusetts and Connecticut in 2005. The study was repeated in 2009 with the addition of 1 unditched marsh (with natural creeks) in southern Maine. We then also provide data from a site where a ditch plugs had been lowered or removed. Results are given in light of long-term consequences for maintaining peat integrity and salt marsh accretion processes in the face of sea level rise. As a consequence of the failure of ditch plugging to maintain high quality salt marsh traits, innovative, more self-sustaining restoration techniques were developed and are now in pilot application. Preliminary findings from pilot seasons will also be reviewed here.

Adams*, M. B.[1], D. Nelson[2], T. P. Smith[1], and S. Fox[1]. [1]Cape Cod National Seashore, National Park Service, North Truro, MA; [2]National Trails System, National Park Service, Salt Lake City, UT
< mark_adams@nps.gov>

A REMOTE SENSING APPROACH TO LAND COVER MAPPING FOR SALT MARSH RESTORATION IN THE HERRING RIVER FLOODPLAIN, CAPE COD NATIONAL SEASHORE, WELLFLEET MA

Monitoring and change detection are essential for the success of salt marsh restoration efforts at Wellfleet's Herring River. Land cover mapping and field-based monitoring will inform adaptive management as tidal influences are re-introduced in the coming years. Semi-automated repeat remote sensing to visualize change will compliment quantitative methods such as vegetation sampling, sediment elevation tables and elevation surveys. The Herring River's 1100-acre floodplain was restricted by a culvert in 1909 and extensively ditched and drained for mosquito control. The National Park Service (Cape Cod National Seashore) has jurisdiction over 80% of the floodplain, providing an opportunity and rationale for restoration. Current conditions of habitat degradation include toxic acid sulfate soils, oxygen depletion, sediment subsidence -- with native salt marsh vegetation almost totally usurped by dense dry woody shrubs and exotics. Current extent of *Spartina* spp. and other salt marsh vegetation is less than 10% of its historical range within the floodplain. With NPS funding, GIS specialists and ecologists created a floodplain land cover base map using spring and fall 2013 Worldview 2 satellite imagery. Reliability of high resolution satellite imagery is expected to support change detection for the duration of the project. The remote sensing challenge is to identify and define land cover classes for current degraded conditions as well as restored natural habitat types. Methods include stratified unsupervised classification (via Intergraph ERDAS ISODATA algorithm) with 8-band Worldview 2 imagery and analysis of multiple-return LIDAR. A preliminary classification of existing conditions is presented here.

Aman*, J., K. Wilson, P. Dest, and T. Smith. Wells National Estuarine Research Reserve, Wells, ME
< jacobaman@wellsnerr.org>

BUILDING COLLABORATIVE PARTNERSHIPS AT THE WELLS NATIONAL ESTUARINE RESEARCH RESERVE TO RESTORE BRANCH BROOK, WELLS, ME

Habitat fragmentation in Maine streams is a human legacy that dates back to the first mills and roads of the 1600's. Impacts to stream habitat have only recently begun to factor into community level planning and decision making, and lack of resources and access to information are barriers to community implementation of best management practices in aquatic environments. To be effective, stream restoration practitioners must work holistically, plan at a watershed scale, engage a broad range of stakeholders, and employ both a strategic and opportunistic approach in applying

resources. This approach is being put to use in Branch Brook, through collaborative partnerships with the, Kennebunk, Kennebunkport, and Wells, Water District, USFWS Gulf of Maine Coastal Program, The Nature Conservancy, Maine Rivers, Rachel Carson National Wildlife Refuge, Trout Unlimited, and the Maine Coastal Program. These relationships have led to increased knowledge of existing stream barriers through training and technical support of assessments surveys. Priority restoration projects were identified through partner facilitated information sharing and GIS. Funding for implementation of restoration priorities was secured through networking and grant writing to diverse sources. Restoration of passage for sea-run fish has been achieved at the head of tide dam in Branch Brook with the repair and upgrade of a non-functional fish ladder. Monitoring will track fish use of restored habitat and data will inform ongoing restoration efforts.

Babson*, A. L. [1], A. Neil[2], and D. S. Ullman[3]. [1]National Park Service, Narragansett, RI; [2]College of the Environment and Life Sciences, University of Rhode Island, Kingston, RI; [3]Graduate School of Oceanography, University of Rhode Island, Narragansett, RI < amanda_babson@nps.gov>

MAKING THE MOST OF EXISTING TIDE DATA AND PRIORITIZING NEW LOCATIONS TO SUPPORT CLIMATE ADAPTATION DECISION MAKING

There is a wealth of tide gauge data that can assist with climate adaptation in coastal national parks, but there are gaps in coverage and limitations on existing data that keep it from being used to support climate adaptation decisions. This talk will present mapping and evaluation of existing tide data for twelve northeast coastal national parks. Examples of uses of tide data will include Salem Maritime National Historic Site and Cape Cod National Seashore. It will describe efforts to identify and prioritize where improved tide gauge coverage will best support research and monitoring and aid climate adaptation in coastal parks. Tidal datums, which are calculated from water level observations, are important for establishing the relationship between water levels and elevations on land, and are thus crucial in assessing inundation risk. An evaluation of the accuracy to which tidal datums calculated through NOAA's VDatum transformation tool at park sites is being used to determine where this tool can fill observational gaps to addresses park management questions.

Bass, A. L., T. Berndt, B. Bragdon, L. Charette, and C. Hodgdon. Marine Science Center, University of New England, Biddeford, ME < abass@une.edu>

BENTHIC INVERTEBRATES FROM LOW TIDAL MUDFLATS AND LOW MARSHES OF THE SACO RIVER ESTUARY, MAINE

Although consistent monitoring of the Saco River has occurred above the West Channel dam and sporadic sampling has been conducted near the mouth, infaunal invertebrate community composition data is unavailable for the fringing marshes of the Saco River Estuary, Maine. As part of a collaborative project on the Saco River Estuary, we conducted sampling to determine the community composition of invertebrates and to investigate the effects of abiotic and anthropogenic forces on these communities. Sampling of six marsh sites (three on the north side and three on the south side of the river) was conducted monthly from May to August of 2013. Three replicate core samples were taken at low tide from low marsh and low tidal relief mudflats in close proximity (< 100 meters from mean low water) to the Saco River. Pore water salinity and mean grain size was determined for each marsh site and for each habitat type (mudflat and low marsh). Core samples were preserved in an ethanol/rose bengal mixture and then size sorted using 2.0 mm and 0.5 mm sieves. Invertebrates collected from the 2.0 mm fraction were identified at the lowest taxonomic level possible. Here we report initial findings on the community composition and diversity of infaunal invertebrates as a function of salinity, distance from the mouth of the river, mean grain size and sampling period.

Bauer*, T. C. and J. A. Sulikowski. Department of Marine Science, University of New England, Biddeford, ME < tbauer2@une.edu>

ABUNDANCE, ASSEMBLAGE, AND DISTRIBUTION OF ICHTHYOPLANKTON AROUND THE SACO RIVER PLUME

Located in southern Gulf of Maine, the Saco River Estuary System has been recognized as an important nursery area for many fish species. The ecosystem is highly unique due to the shallow freshwater Saco River plume that drastically alters abiotic conditions in Saco Bay. However, the ensuing effects of this plume on biota are not well understood. To better understand how the Saco River plume may be affecting larval fish in Saco Bay, research was conducted between 2006 and 2009, which led to the discovery of 27 ichthyoplankton species. In addition, plume dynamics indicated possible effects on ichthyoplankton distribution. For example, when surface plankton tows were conducted at stations within and outside the plume, a higher density of ichthyoplankton was observed outside the

plume. In 2009, mid-water and surface tows were conducted to expand upon the previous sampling to determine if any differences existed in ichthyoplankton vertical distribution around the plume waters. Ichthyoplankton density was significantly greater at the surface than in the mid-water. However, no difference was observed in ichthyoplankton abundance within and outside of the plume in the mid-water areas sampled. The next step in this ongoing project is to further examine ichthyoplankton vertical distribution in Saco Bay in order to determine what abiotic and biotic factors may be effecting any patterns observed. Information gained from this study is crucial for understanding this complex ecosystem, and will allow for better management of the area in the future so that it continues to be an important nursery area.

Bednarski*, M. S.[1] and B. Lambert[2]. [1]Massachusetts Division of Marine Fisheries, New Bedford, MA; [2]Massachusetts Division of Ecological Restoration, Boston, MA < mike.bednarski@state.ma.us>
RESPONSES OF DIADROMOUS FISHES TO PASSAGE RESTORATION IN THE MILL RIVER, MASSACHUSETTS
Studies of the effectiveness of dam removal, particularly within southern New England, are limited. To address this information gap, we tracked the response of diadromous fishes to the removal of three dams on the Mill River, Taunton, Massachusetts. Our objectives were to (1) assess which diadromous fishes utilize habitats above the former dam sites, (2) describe run characteristics, including timing, peak, and relative abundance of observed diadromous species and (3) compare the run characteristics of river herring (Alosa pseudoharengus and A. aestivalis) in the Mill to the nearby Nemasket River. The first dam, Hopewell Mills, was removed in summer 2012. We employed a video monitoring system above the former dam site in 2013 and 2014. We identified several diadromous species including alewife, sea lamprey (Petromyzon marinus), and American eel (Anguilla rostrata). Alewife were the most common species observed. Although the Mill River herring run was smaller than our reference site, we noted similarities in hourly timing. Our results demonstrate that the diadromous fish community of the Mill River responded rapidly to the removal of the Hopewell Mills Dam. Further work will assess the response of river herring, sea lamprey, and American eel to full restoration of the Mill River.

Berounsky, V. M.[1], R. Sharif[1], L. Maranda[1], D. Borkman[1], L. Green[2], R. Smith[2], and S. W. Nixon[1]. [1]Graduate School of Oceanography, University of Rhode Island, Narragansett, RI; [2]Watershed Watch Program, University of Rhode Island, Kingston, RI < vmberounsky@mail.uri.edu>
THE ROLE OF NITROGEN IN WHOLE-BASIN ECOSYSTEM METABOLISM FOLLOWING AN ANOXIC WATER VENTILATION.
The Pettaquamscutt (Narrow River) Estuary is a 9km estuary in southern Rhode Island with two deep (13m and 18m) basins containing anoxic waters overlaid with 3-4m of well-oxygenated waters. In October 2007, a ventilation occurred in the northern basin and anoxic waters mixed throughout the water column. Such events are natural and occur when drought conditions, strong winds and a drop in temperature exacerbate the normal fall weakening of stratification. Daily profiles of water column parameters and weekly samples for phytoplankton and nutrients were taken from the day after the ventilation to early December. Ammonium concentrations were very high (150-400µM) soon after the ventilation but decreased (40-80µM) over the next 6 weeks. Nitrate plus nitrite concentrations were low in the upper water column (undetectable to 1µM) but increased slightly (3µM) over the next 6 weeks, while bottom water stayed at about 4µM. Calculations of rates were made for the basin as a whole. Rates of ammonium loss were within the range of literature values for phytoplankton uptake of ammonium in the adjacent Narragansett Bay. Rates of nitrate plus nitrate gain were similar to rates of nitrification in Narragansett Bay. As additional evidence for ammonium incorporation into phytoplankton biomass, rates of phytoplankton carbon fixation were also calculated based on these nitrogen values and Redfield stoichiometry, and the resulting chlorophyll was within the range of measured values. This study provides evidence that despite low oxygen values, phytoplankton and bacteria can take advantage of the nutrients made available by anoxic events in an ecosystem.

Bickford*, S. A. Maine Coastal Ecology Center, Wells National Estuarine Research Reserve, Wells ME < suebickford@wellsnerr.org>
HIGH RESOLUTION LAND COVER MAP: A PILOT PROJECT BETWEEN THE WELLS NATIONAL ESTUARINE RESEARCH RESERVE AND NOAA'S COASTAL SERVICES CENTER
The Wells National Estuarine Research Reserve (Wells NERR) worked in partnership with NOAAs Coastal-Change Analysis Program (C-CAP) to produce a high-resolution land cover map for the Wells NERR watershed and surrounding coastal area of southern Maine (an approximately 100 square mile area), as well as a more detailed habitat classification for areas of perpetual interest (i.e., areas targeted for repeated high-resolution mapping over

time to monitor change). Much of this work was derived through the exploitation of high-resolution National Agricultural Imagery Program (NAIP) imagery, NOAA Integrated Ocean and Coastal Mapping (IOCM) low tide imagery, lidar-derived elevation and slope data, and additional ancillary information. The resulting map product(s) met the needs of both the Wells NERR and the Coastal Services Center and was produced with significant cost savings compared to producing the two products independently. This presentation or poster will review the data, classification methods used (with particular emphasis on the use of image segmentation), how the two levels of mapping relate, and issues encountered in production. It will also discuss the usefulness of the products to the local communities for issues such as watershed water quality monitoring, disaster response plans, and sea-level rise.

Boyer, M., L. Logan, and K. Plotner. Department of Biology Salem State, Salem MA < micboyer@yahoo.com>
EFFECTS OF LIGHT AVAILABILITY ON GROWTH AND DENSITY OF EEL GRASS (*ZOSTERA MARINA*) IN SALEM, MASSACHUSETTS
Eel grass (*Zostera marina*) is an essential habitat for juvenile fish and shellfish. It anchors sediment, filters water, and dissipates wave energy making it a protected habitat (Edgar and Shaw 1995). Z. marina can be used as an indicator of coastal marine health because it is a fragile system that is greatly affected by water quality and light availability. Over a period of three months we surveyed Z. marina at Juniper Point beach in Salem, MA. We mapped the perimeter of the meadow, divided the meadow into three depth transects, monitored blade height and plant density using a modified version of Seagrass Net's protocol tailored specifically to our project. Light and temperature data from July through November at the shallow and deep transects was recorded using HOBO Pendant Temperature/Light Data Loggers.We hypothesized that the difference in light availability between the two depth would affect growth and density. To test our hypotheses, we sampled growth rates at each transect and compared the data. Our light recordings show that the shallow depth had higher light availability which had a positive correlation for higher density, longer blade length, and higher growth rate, compared to the deep transect which had less available light for growth.

Bragdon*, B. and A. L. Bass. Marine Science Center, University of New England, Biddeford, ME
< bbragdon@une.edu>
DESCRIPTION OF LOW MARSH AND TIDAL MUDFLAT SEDIMENTS OF THE SACO RIVER ESTUARY, MAINE
As part of a larger project on infaunal invertebrates of the Saco River Estuary, we examined affect of sediment composition on infaunal invertebrate communities. Each sample was collected from six marsh sites between May and August of 2013. Within these six marsh sites, two different habitat types were sampled, low tidal relief mudflats and low marsh. Sediment samples were taken from the same sites where coring for the invertebrate sampling was conducted. Each soil sample was returned to the lab and frozen prior to processing. The samples were treated with hydrogen peroxide to eliminate organic matter from the samples. After treatment with hydrogen peroxide and drying each sample was size sorted using multiple sieves (mesh size 4.0mm - 0.063mm) to develop a quantitative description of the sediment. The mass (gm) of sample from each sieve was recorded and used to estimate the graphic mean and associated parameters. We determined if there were any differences among the sample sites alone and in comparison to invertebrate community composition.

Brannon*, E.[1], S. Moseman-Valtierra[1], and J. P. E. McCaughey[2]. [1]Department of Biological Science, University of Rhode Island, Kingston, RI; [2]Narragansett Bay Commission, Providence, RI < ebrannon@my.uri.edu>
THE GRAND EXPERIMENT: DO SMALLER NITROGEN LOADS INTO NARRAGANSETT BAY MEAN LARGER GREENHOUSE GAS EMISSIONS AT FIELDS POINT?
Nitrous oxide (N_2O) and methane (CH_4), potent greenhouse gases (GHG), have been found to be significant by-products of the nitrogen (N) removal process employed at wastewater treatment plants (WWTP). In 2013, the Narragansett Bay Commission's Field's Point WWTP in Providence, RI significantly increased N removal to decrease high N loads into Narragansett Bay. This research represents the first investigation of N_2O and CH_4 fluxes simultaneously over all seasons from one of the secondary wastewater treatment tanks at the Field's Point facility. The treatment system, designed to remove BOD and N, contains 4 zones: pre-anoxic, aerated Integrated Fixed Film Activated Sludge (IFAS), post anoxic, and re-aeration. N_2O, and CH_4 fluxes were measured from each zone twice a month beginning in January 2014 by connecting a floating gas-trapping chamber to a cavity ring down spectrometer that measures N_2O and CH_4 concentrations in real time. Preliminary results show N_2O and CH_4 fluxes as large as 15 mmol N_2O m^{-2} hr^{-1}, and 3 mmol CH_4 $m^{-2}hr^{-1}$. The N_2O emissions represent up to 4% of the N removed. All fluxes are dynamic between zones, with the largest N_2O fluxes occurring in the re-aeration zone and the largest CH_4 fluxes

occurring in both the IFAS and re-aeration zones. More research is needed to explain the variation of fluxes daily and seasonally and to predict impacts of the N removal and GHG emissions on the adjacent bay ecosystem.

Brewer, E. J. Massachusetts Division of Marine Fisheries, Gloucester, MA < elaine.brewer@state.ma.us>
VOLUNTEERS ARE THE BACKBONE OF SOLID RESEARCH AND RESTORATION
The Massachusetts Division of Marine Fisheries (*MarineFisheries*) manages the Commonwealth's living marine resources, with the goal of maintaining a healthy ecosystem to support sustainable fisheries. This requires monitoring, restoration, and research on many aspects of fisheries and their habitats. Our small number of biologist can't be everywhere at once, so we routinely rely on volunteers to add to our data collection. With volunteer help, we can gather a larger amount of information that, in turn, informs us when making management decisions. For example, recreational anglers collect fish scales that we use to assess the age and growth structure of coastal species. Other volunteers are put to work helping in restoration efforts, such as prepping eelgrass to be planted. We have seen a huge benefit in utilizing our citizen scientists. Volunteers not only make up an important component of our data collection and field assistance, but they also become advocates for the resource. We have found that as people become more interested in the work they are doing, they want to continue to help, and they spread the word about the interesting findings that come out of the research. Some of our projects taking advantage of the enthusiasm and aid of dedicated citizen scientists are the Sportfish Angler Data Collection Team (SADCT), Eelgrass Restoration, and our shellfish planting program.

Browne*, J. P.[1], C. A. Crown[1], and J. A. Vanek[1,2]. [1]Conservation & Waterways, Town of Hempstead, NY; [2]Department of Biology, Hofstra University, Hempstead, NY < ecojimb@gmail.com>
INDICATORS OF LIFE: ESTUARINE BREEDING BIRDS AND EUTROPHICATION ON LONG ISLAND, NY
Because piscivorous birds represent the upper trophic, they are sensitive indicators of ecosystem function and are heavily studied as indicators of fish stocks. Reproductive success is linked to prey species populations that are supported, in turn, by plankton blooms, however trophically mediated reactions by seabirds to anthropogenic nutrient sources in estuaries remain unclear. We investigate correlations between nutrients and nesting bird populations feeding in estuaries of the marine districts of New York State, a heavily populated urban region. Data from the New York State Breeding Bird Atlases, the Long Island Colonial Waterbird Surveys, and Osprey (*Pandion haliaetus*) breeding records were compared with water quality data from several sources covering the complete region. General estuarine bird diversity, piscivorous breeding pair numbers, and Osprey nesting success were statistically compared with the nearby nutrient levels. We found that the highest diversity of estuarine breeding birds was associated with moderate to high nutrient availability, some species only occurred at higher nutrient levels, others at higher nutrients given the occurrence of necessary nesting habitat, and Osprey chick survival was higher at higher nutrient levels. These results seem to be similar to published associations between the breeding success of upper trophic level sea birds to natural phytoplankton blooms. These results may also lend support to reported negative effects to some upper trophic level species when faced with with nutrient reductions.

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A POST-SANDY REASSESSMENT OF MARSH TRENDS, MARSH PEAT STRENGTH, AND THE EFFECTS OF EUTROPHICATION IN HEMPSTEAD BAY, LONG ISLAND, NY
Salt marshes are an important resource and a buffer against storm damage. However, salt marshes on the east coast of North America are slowly disappearing and the impact of Katrina and other hurricanes on salt marshes has often been devastating and may have been exacerbated by high nutrient loads. We have used aerial photographs taken since 1926 to make long term assessments of the causes of this loss and trends for overall area, ponds/pannes, and ditches. After Hurricane Sandy we reassessed our trends analysis of area, ponding, and changes in ditches by adding photographs taken by NOAA on November 3 & 4, 2012 to our data set. We have also added an assessment of peat strength by taking measurements measured along several cross-bay transects that were approximately perpendicular to the existing nutrient gradient. Although Hurricane Sandy did much damage to nearby structures and ocean beaches, significant erosion to salt marshes did not seem to occur. At least one large deep pond broke through its edges to become tidal, potentially leading to a future recovery of marsh plants. We find that the long term trends in pond expansion and changes in ditch morphology and size are little changed and the overall rate of area loss for remaining marshes marshes may have slowed. The peat strength results do not show patterns that trend with recent water quality gradients but may show greater strength characteristics than published results would imply.

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SALT MARSHES AND SEA LEVEL RISE IN LONG ISLAND SOUND – A SYNTHESIS

Historically, salt marshes have been able to keep up with sea level rise through accretion and inland migration. However, in the northeastern United States sea level is increasing at a rate 3-4 times faster than in the rest of the country. Recent research in Rhode Island found that salt marshes in Narragansett Bay are not keeping up with sea level rise and are therefore susceptible to future drowning. In an effort to understand if this phenomenon is widespread we have begun a study examining salt marshes in Long Island Sound (LIS). Our first efforts are focused on synthesizing the previous work on salt marsh accretion and decomposition rates in LIS. Historical as well as current measurements from the northern border in Connecticut (CT) and on the southern border in New York (NY) were gathered from the literature and we have analyzed trends as a function of sea level rise data from the 1930s. As expected, the tidal gauge data showed that sea level has been rising along all portions of the sound with rates ranging from 0.25 cm yr-1 to 0.88 cm yr-1. Initial analyses show that accretion rates in different areas of LIS, were found to be decreasing overall with the exception of one site along the central CT coast that has a very long flooding period and higher rates of trapping of allochthonous inorganic sediment. Additionally, it appears that decomposition rates may have also decreased. We will discuss the likely mechanisms driving these initial findings.

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TIDAL RESTORATION: AN ESSENTIAL TOOL FOR SALT MARSH RESTORATION IN NEW ENGLAND

Salt marshes have been building in elevation and expanding across coastal New England for the past 4,000 years as sea levels rose 1-2 mm/yr. With population growth over the past 400 years, vast areas of tidal marsh were destroyed and degraded; some intentionally (e.g., filled) and some unintentionally (e.g., undersized culverts). As the biophysical feedbacks that sustain marshes have become better known over the past 40 years, many of our colleagues have devoted their careers to restore tidal hydrology and ecological functions to marshes. We organized a volume authored by scientists, engineers, and restoration practitioners to share our experiences from New England and Atlantic Canada and to synthesize the science and practice of restoring tidal flow to salt marshes. The book serves as a valuable reference and guide to tidal marsh restoration, but as sea level rates rise, there is uncertainty if tide-restored marshes, often having undergone decades of subsidence, can keep up. Tide-restricted marshes should be restored now. However, the balance between restored hydrology (water levels) and marsh elevation capital (relationship between tide elevation, marsh elevation, and plant growth range) should be calculated in future restoration projects to determine the marsh area that will survive for some specified time and SLR rate. Without restoration, it is likely that these marshes will become unvegetated when barriers ultimately fail. Removing or managing barriers to tidal flow, facilitating landward migration through removal of shoreline structures, establishment of buffer zones, and providing sediments to marshes are all essential for the long-term sustainability of tidal marshes and their associated ecosystem services.

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CASE STUDIES USING “CONSERVATION MOORINGS” AS A COMPONENT OF EELGRASS (*ZOSTERA MARINA*) RESTORATION AND REHABILITATION IN TWO MASSACHUSETTS HARBORS

Increasing interest in the use of conservation mooring systems (helical anchors and flexible rodes) to both proactively protect and restore eelgrass and serve as mitigation for past eelgrass losses prompted us to investigate the effectiveness of this emerging technology. MarineFisheries conducted two case studies in Manchester Harbor (2010) and West Falmouth Harbor (2013) where traditional chain moorings were replaced with conservation moorings and monitored annually. We compared the response of eelgrass to the conservation moorings in scars with and without eelgrass transplants as well as reference scars where traditional block and chain mooring systems remain. In Manchester, all scars were reduced in size, regardless of whether or not they were supplemented with transplants. Filling-in occurred very slowly and in three years none of the scars were completely restored to densities found in the surrounding meadow. The topography within the scar and the existence of the old mooring block may impede regrowth. In West Falmouth, eight moorings were converted in spring 2013 and time-zero monitoring showed seedlings growing in many of the scars. Results of these studies will have direct management implications by informing resource managers of the utility and effectiveness of conservation moorings in protecting eelgrass.

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SPATIALLY AND TEMPORALLY DETAILED MODELING OF WATER QUALITY IN NARRAGANSETT BAY

Nutrient loading to Narragansett Bay has led to eutrophication, resulting in hypoxia and anoxia, finfish and shellfish kills, loss of seagrass, and reductions in the recreational and economic value of the Bay. We are developing a model that simulates the effects of external nutrient and hydrologic loading on water quality in Narragansett Bay. Extensive field monitoring programs and process studies by the Narragansett Bay Commission, Federal and State agencies, municipalities, and university groups have been measuring physical parameters, nutrient concentrations and other water quality parameters in the Bay and its tributaries, nutrient inputs from wastewater treatment facilities, and process kinetic parameters. We are using data for existing nutrient concentrations, river flow and wastewater treatment facility effluent flow to estimate nutrient loading for non-sampled days using the U.S. Geological Survey's Load Estimator (LOADEST) software. The time-variable data so generated will be used as input to the U.S. Environmental Protection Agency's WASP\EUTRO model linked with a calibrated three-dimensional hydrodynamic model, the Environmental Fluid Dynamics Code (EFDC). The primary objectives of the modeling effort are to simulate the effects of nutrient loading on dissolved oxygen concentrations and chlorophyll-a, an important parameter for water clarity and seagrass viability, to estimate the sensitivity of the Bay to changes in nutrient loading and freshwater inflow, and to explore the potential effects of management actions and other factors such as climate change on these water quality parameters in the Bay.

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RETURN OF ECOSYSTEM SYSTEM SERVICES WITH MARSH RESTORATION AND RECOVERY

One of the most dramatic alterations of tidal salt marshes is "reclamation" or drainage for terrestrial use. Beginning with Acadian occupation in the 17th century, extensive areas of Bay of Fundy salt marshes have been drained. (Although some have been developed agricultural uses, still predominate.) Drainage included not just construction of levees to prevent tidal flooding and tidal gates to allow freshwater out, but a network of ditches and "landforming" to enhance drainage in inter-ditch areas. After 100 or more years isolated from the tides what chance do these marshes have to recover ecosystem services? We have compared ecosystem services of reference marshes to two recovered agricultural marshes: Saints Rest, a marsh that had been drained for at least 100 yrs and John Lusby, which had been drained for over 250 yrs. Studies of vegetation, surface and subsurface hydrology, fauna of marsh pools and carbon stocks indicate that ecosystem services can be regained. In fact, the hybrid drainage network present in recovered agricultural marshes may make them even more valuable than reference marshes are for fish. The potential to store Blue Carbon in their soils gives economic incentive to marsh restoration and considering that John Lusby is the largest marsh on the Bay of Fundy the potential is great. However, carbon prices, alone, may not provide enough incentive to the agricultural community and I suggest ideas for artisanal agriculture practice that may increase the economic return.

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CASUAL OBSERVATIONS, RANDOM MUSINGS AND WILD EXTRAPOLATIONS BASED ON SOME ACTUAL DATA ON THE IMPACT OF INVASIVE TUNICATES TO EELGRASS

Tunicates, more commonly known as sea squirts, can grow as a solitary organism or as part of extensive colonies. Tunicates are more frequently associated with hard substrate, but a number of invasive tunicate species have now been found to colonize eelgrass. We attempted to quantify what impact these tunicates may have on eelgrass. Using HOBO light sensors, we measured the ability of 5 different tunicate species to block light. In several ponds on Martha's Vineyard, we measured a number of eelgrass parameters (canopy height, leaves per shoot, growth rate, tissue sugar concentration) in both plants without tunicates and plants heavily colonized by tunicates. We found that all species of tunicates tested blocked between 70-85% of ambient light. We found that plants colonized by tunicates

had fewer leaves per shoot, smaller canopy height, lower growth rates, but high tissue sugar concentrations than plants not colonized by tunicates. In 2013, we attempted to assess the extent of the problem, by coordinating a study of 19 different sampling locations from New Jersey to Canada. Participants sampled eelgrass meadows and documented the presence/absence of tunicates, identified tunicate species, estimated the extent of the colonization, measured eelgrass shoot density and canopy height and in some locations collected water temperature. Invasive tunicates were observed on eelgrass in all meadows sampled from Newfoundland to New Jersey, though the number of species present and the extent of the colonization varied greatly.

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SALT MARSH ADAPTATION STRATEGIES IN RHODE ISLAND: RESTORING SALT MARSH HYDROLOGY WITH RUNNELS AND OTHER TECHNIQUES

Under historic rates of sea level rise, salt marshes are able to survive by accreting sediment and organic matter at a rate comparable to sea level rise. Rhode Island has seen an increased rate of sea level rise in recent years. Rapid sea level rise may lead to erosion of the low marsh margin, and increased inundation and deterioration of the high marsh. In many marshes, it appears that instead of a slow shift in the vegetation community from high marsh to low marsh, higher water levels are flooding the high marsh. During a two year state wide salt marsh assessment, we documented that Rhode Island salt marshes are showing signs of marsh response to the effects of sea level rise and increased inundation described above. This presentation will discuss adaptive management techniques currently being tested or proposed to restore marsh hydrology impacted by sea level rise. Techniques include hand digging small runnels, excavating clogged creeks using low pressure ground equipment, and raising marsh elevation with dredge material.

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A STUDY OF THE INVASIVE SPECIES *PHRAGMITES AUSTRALIS* AND ITS RELATIONSHIP TO ABIOTIC FACTORS

The ecology of the Saco River estuary, located in southern Maine, has been under-researched. We were interested in studying the relationship between an invasive plant species found in the tidal marshes, *Phragmites australis* , to various abiotic factors, including soil nitrate, ammonium and total nitrogen levels, and soil pore water salinity. We used resin bags to measure the amount of available nitrate and ammonium in marsh soils over 51 days during the growing season, from the end of June to the middle of August. A total of 54 resin bags were placed in, on the edge of, or just outside of nine patches of *Phragmites australis* located at various locations on both sides of the river. We also measured soil porewater salinity and determined plant species diversity in the same areas. We hypothesized that there would not be differences in the amount of ammonium found inside, on the edge of, or just outside the patch, and that there would be more nitrate available overall. We found twice as much available nitrate in the middle of the *Phragmites* patches as on the edge or outside of the patches. We also found more available nitrate than ammonium in all sample plots.

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NUTRIENT DYNAMICS IN NEQUASSET LAKE: ANADROMOUS ALEWIFE SUBSIDIES

This study aims to create a detailed budget for nitrogen and phosphorous in Nequasset Lake, Woolwich, ME. Nequasset supplies drinking water to Bath and Brunswick, and every spring receives an annual migration of the Alewife Alosa Pseudoharengus. These anadromous fish swim upriver from the Gulf of Maine to spawn in the lake and have the potential to bring with them biomass and nutrients from the marine system that will be incorporated into lake nutrient cycles via excretion, gamete release, and fish mortality. Young of the year fish in turn export some of these nutrients with their fall emigration. Fish passage, however, is limited by a dilapidated fish ladder and commercial alewife harvest. Preliminary results from a fish passage count, water nutrient concentration data, and carbon and nitrogen stable isotope analysis indicate that these marine derived nutrients (MDNs) currently represent a small proportion of total lake nutrient budgets. Current modeling efforts seek to quantify the effects of potential fish ladder restoration and increased Alewife migration strength on lake health.

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OBSERVATIONS ON ICHTHYOPLANKTON COMMUNITY STRUCTURE, ABUNDANCE, AND DIVERSITY IN A TEMPERATE ESTUARINE SYSTEM, WEBHANNET RIVER, WELLS NATIONAL ESTUARINE RESEARCH RESERVE, WELLS, ME

In the Gulf of Maine (GOM), very few larval fish studies sample bi-monthly year-round, collect co-occurring water quality variables, and concentrate sampling efforts within marsh-dominated, intertidal systems despite the importance of marshes as critical nursery and forage grounds for many marine and estuarine fish species. This study examines the community structure, diversity, and abundance of larval fishes in the Webhannet River Estuary, Wells, ME, USA. Ichthyoplankton were sampled on incoming tides 2-6 times monthly from July 2008 to December 2013 at a single sampling station and fixed depth of 1 meter. Chlorophyll was sampled monthly using a Teledyne ISCO automated water sampler while water temperature, pH, salinity, dissolved oxygen and turbidity were collected every 15 minutes using YSI model 6600 datasondes. A total of 3,037 individual fish were collected representing 23 species, more than any other comparable study in the GOM. The three dominant species by number were Tautogolabrus adsperus (cunner), Ammodytes americanus (sand lance), and Enchelyopus cimbrius (four-bearded rockling), respectively. Overall, larval fish abundance peaked in the fall corresponding to a fall phytoplankton bloom, however species diversity (Shannon Weiner index) was greatest in the spring. The occurrence of Centropristis striata (black sea bass) larva in 2013, coupled with increasing water temperatures in the GOM, may be a sign of range expansions of southerly species into the Gulf. This study shows that the Webhannet River Estuary supports high larval fish species richness and diversity and degradation to water quality or habitat loss could have significant impacts on nearshore food webs.

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PREDICTING THE EFFECTS OF CLIMATE CHANGE ON *HEMIGRAPSUS SANGUINEUS* POPULATIONS IN INTERTIDAL COBBLE BEACHES

In only 25 years, the Asian shore crab, *Hemigrapsus sanguineus*, has invaded and become established along the eastern US coast. Unfortunately, environmental factors that affect the distribution and density of this invasive species are not fully understood. In this study we identify environmental and substrate factors that affect *H. sanguineus* density and use the results to infer its potential response to future changes in climate. A generalized additive model (GAM) was used to explore nonlinear relationships between *H. sanguineus* density and water quality, weather, and substrate data collected around Prudence Island, RI. Percent deviance explained, as well as variables' relative influence (percentage of the contribution to the deviance reduction) were calculated. One-Way ANOVA was used to determine significant differences in density, abiotic and substrate characteristics among sites. The GAM fits explained 76% of the deviance in the model. The 3 variables that contributed the most to the percentage explanation of the deviance were year (43%), site (15%) and cobble (13%); the least influential (<1%) were gravel, shell, and PAR. Our results showed that habitats with significantly higher percent cobble and significantly lower salinity had significantly higher crab densities (ANOVA, $P<0.001$). The long-term data sets analyzed provided valuable insights into the ecology of *H. sanguineus*. According to predicted climate change scenarios of higher temperatures and more precipitation (hence lower salinities) in RI, we might expect that invasive species like *H. sanguineus* will be more prevalent as the climate changes, as long as the proper habitat is available.

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TIDAL WETLAND RESTORATION IN MASSACHUSETTS – WHERE TO FROM HERE?

Traditional forms of tidal wetland restoration, such as hydro re-connection and fill removal, have reached their apex in Massachusetts. During the past twenty years, restoration partners of all stripes have worked together to restore 82 sites encompassing over 1,500 acres. While many important restoration opportunities remain, the "low-hanging fruit" have been picked. At the same time, new threats and opportunities, such as sea level rise and the effects of relic ditches, present several potential paths forward for restoration work. The question is which paths to blaze and how to decide?

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DISTRIBUTION PATTERNS OF THE TREMATODE PARASITE, ZOOGONUS RUBELLUS, AND ITS INTERMEDIATE HOSTS ILYANASSA OBSOLETA AND ALITTA VIRENS IN THE GREAT BAY ESTUARY SYSTEM,NH

Helminth parasites have the potential to mediate indirect interactions among community members due to their complex life cycles. The trematode Zoogonus rubellus sequentially infects two intermediate hosts: first the Eastern mud snail Ilyanassa obsoleta, followed by a common baitworm species Alitta virens, before reaching its definitive host the American eel Anguilla rostrata. While the relationship between Z. rubellus and first intermediate host I. obsoleta has been well studied, very little is known about the symbiosis with second intermediate host(s). Currently only one species, A. virens, has been identified in the literature as a natural host, but it has been often speculated that other species may also serve as second intermediate host to Z. rubellus. To establish the distribution of Z. rubellus and its intermediate hosts, field surveys of infection prevalence among I. obsoleta and local nereid worms in the Great Bay Estuary system, NH were conducted during the summer of 2012 and 2013. Field surveys suggest that two closely related worm species, Nereis succinea and Hediste diversicolor, also serve as natural hosts to Z. rubellus. To confirm the presence of Z. rubellus in N. succinea and H. diversicolor, metacercariae were dissected and the CO-I gene was sequenced and compared to known individuals of Z. rubellus extracted from I. obsoleta.

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COMPARISON OF PROPOSED CONTROL METHODS FOR THE INVASIVE EUROPEAN CRAB (*CARCINUS MAENAS*)

Carcinus maenas , the European Green Crab, is a universal problem for the New England shellfish industry. Recently, several statewide and region-wide meetings have been held to discuss methods to control this invasive and destructive species. Preliminary results of a survey of green crabs in Salem Sound, Massachusetts, suggest that the crab density is not as great as in some areas in New Hampshire and Maine. Nevertheless, these crabs do have a negative impact in Salem Sound. Ways to decrease the green crab population throughout New England are being considered. One option might be to create a market for human consumption, a practice that seems to have been mastered in parts of Europe. This presentation will compare the latest suggested control methods for the omnipresent green crab with an insight into the political and social dynamics involved. Also discussed will be the possibility of setting up an analogous operation to that in Europe.

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LOOKING BACK AT 10 YEARS OF EELGRASS RESTORATION IN MASSACHUSETTS BAY

Marine Fisheries is in its' 10th year of eelgrass restoration and monitoring at sites in Boston Harbor and Salem Sound. To date we have successfully restored approximately 12 acres of eelgrass to Massachusetts Bay. Some planting sites have proven to be very successful while others failed even after initial site selection and test plot success. Successful plantings, planted overtime from 2004 to 2007 at Long Island and Peddocks Island in Boston Harbor, have now more than doubled in area, and the measured shoot density and percent cover has reached equivalence with natural reference sites and continues to persist. In Salem Sound sites planted in 2011 weathered two hurricanes with losses at some sites of up to 75% of the originally planted plots. But by 2013 we recorded rebounds at two of the three sites and continued planting at those sites. Successfully test plotted sites failed or declined for a variety of reasons including annual variability due to storms, interaction with fishing gear and bioturbation. Our work suggests that restoration is a process and is more successful when conducted through small plantings over several years, rather than all at once.

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WE'RE ALL IN THE SAME BOAT! ESTUARINE RESEARCH AND STAKEHOLDER ENGAGEMENT TO SUSTAIN THE SACO ESTUARY, MAINE

The Saco Estuary holds special meaning for communities, businesses, recreation enthusiasts and a group of scientists who have focused research efforts on the estuary for the past five years as part of Maine's Sustainability Solutions Initiative. Scientists and students from the University of New England and Wells National Estuarine Research Reserve worked in collaboration with over twenty stakeholder groups. Scientists and stakeholders documented the

qualities of the estuary that are valued, identified perceived threats to the estuary and documented the ways that stewardship practices of the stakeholder groups contribute to sustaining what people care about. The Saco estuary supports the greatest documented fish diversity of any estuary in Maine. Over one third of all bird species in Maine use the Saco estuary and tidal wetlands as habitat. These tidal wetlands exhibit a continuum from salt to fresh and contain ten rare plant species of special concern for the state. Improvements in water quality as a result of water quality regulations and policies have contributed to the restoration of the Saco. Understanding the ways that the ecological health of the estuary, as indicated by species biodiversity, water quality, and land use/land cover, is connected to the decisions, policies and practices of stakeholder groups guides this approach to sustainability science on the Saco. Collaborative Learning is used to cultivate productive relationships among students, scientists and stakeholders. These relationships have evolved during the course of the project as scientists learn from stakeholders and stakeholders adapt scientific findings into their stewardship strategies.

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UNDERSTANDING NUTRIENT DYNAMICS IN AN EUTROPHIC, TEMPERATE ESTUARY

Estuaries in the northeastern US are severely threatened by nutrient over-enrichment. As a result, algal blooms are increasing in frequency, as are their associated effects on ecosystems, including more frequent occurrences of hypoxia/anoxia, as well as losses of seagrasses and commercially important fin- and shellfish species. Nutrients may also lead to increased frequency and duration of toxic algal blooms, which increase public health risks and economic losses associated with shellfishing closures. To understand the nutrient dynamics in the Nauset Marsh estuarine system, we measured NH_4, NO_3, and PO_4 concentrations, phytoplankton biomass as chlorophyll *a* concentration, and salinity at locations throughout the estuary during winter, spring, and summer. The highest nutrient and chlorophyll concentrations were found in the upper reaches of the estuary and the salt ponds where water residence times were longest. Nutrients were highest nearshore in close proximity to groundwater flows where salinities were lowest. In mid-summer, when bio-available forms are rapidly taken up by abundant primary producers, nutrient concentrations, particularly NO_3, were lowest. Even in summer, however, some portions of the estuary had high nitrogen (> 5 µM) and phosphate (> 1 µM) concentrations. Surprisingly, nutrients did not consistently correlate with phytoplankton biomass. To begin to develop strategies to mitigate the extensive habitat degradation associated with excess nutrient inputs, it is critical to identify groundwater sources from the watershed and to understand the spatial and temporal availability of nutrients in estuarine waters.

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BOTH THE MASSACHUSETTS BAY SEWAGE EFFLUENT OUTFALL AND CLIMATE CHANGE AFFECT MASSACHUSETTS BAY BENTHIC BIODIVERSITY

Boston Harbor was among nation's most polluted harbors in the 1980s. The centerpiece of the cleanup of Boston Harbor was the construction of the Deer Island Secondary Sewage Treatment plant, which daily treats approximately 1.3 million m^3 of sewage effluent (4.8 million m^3 peak flow) which is discharged through a 15-km long outfall to a series of 17 risers and diffusers at about 35 m depth in Massachusetts (MA) Bay. As part of the assessment of the effects of the outfall, sampling of MA Bay's benthic communities began in August 1992. We report on the environmental analysis of the benthos at 36 MA Bay stations during 9 years of pre-outfall sampling and 8 years of post-outfall sampling (864 0.043-m^2 grabs). We analyzed Fisher's log-series alpha biodiversity index with a Before-After Control-Impact (BACI) mixed model analysis of variance (ANOVA), finding that the outfall did have modest adverse effect on MA Bay benthic biodiversity (p=0.013, Kendall Rogers F test), about a 5% reduction in species richness in stations near the outfall relative to more distant stations. But, the major effect was a striking 17-y increase in species richness due to climate change correlated to the Atlantic Multidecadal Oscillation (AMO). Studies of environmental effects using BACI designs or other approaches must incorporate the potential effect of climate change in their design and analyses.

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A "SUMMER STUDENT ACADEMY" APPROACH TO FIELD DATA COLLECTION
The Cohasset Center For Student Coastal Research (CSCR) in Cohasset, MA trains and engages high school students from the nearby communities in applied environmental research on the South Shore of Massachusetts. CSCR students monitor wetlands, assess water quality, and analyze tidal circulation and flushing patterns in the harbor among other projects. Students work as partners with community leaders, municipal officials, and state and federal scientists. The program provides these partners with much-needed assistance with field data collection, which is one of the greatest strengths of the program along with establishing these community relationships. The program also has the advantage of local knowledge and the participation of teachers from nearby schools. Due to the seasonal nature of the program, efforts at including data analysis and interpretation in the student experience have not been as successful, with the exception of individual projects undertaken by exceptional students year-round.

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RHODE ISLAND OYSTER RESTORATION: WE'RE GREAT AT GROWING OYSTERS BUT WHAT HAPPENS TEN YEARS LATER?
Federal, State and local non-profit organizations have long recognized the ecological and socioeconomic importance the oyster, *Crassostrea virginica*, represents to coastal communities. Oyster restoration programs in Rhode Island date to the early 1900's and have been making considerable progress and gaining popularity in the past decade. Despite the increase in restoration activities, careful monitoring of restored populations and associated habitat often takes a back seat to efforts of introducing shellfish into estuaries, thus hindering adaptive management. To better understand both short and long term performance of oyster restoration in Rhode Island we assessed growth, survival, disease and recruitment over three years in two distinct programs; Roger Williams University's Oyster Gardening for Restoration (2006-present) and the North Cape Shellfish Restoration Program (2003-2008). The two programs have resulted in over 8.5 million seeded oysters in thirteen distinct restoration sites in Rhode Island waters including salt ponds, tidal creeks and open coves in Narragansett Bay. Monitoring both programs allowed us to compare oyster performance across varied spatial and temporal scales. This presentation will focus on results from our monitoring efforts and cover successes and failures of our ongoing restoration.

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WHAT'S IN THE WATER? EXPLORING CONNECTIONS BETWEEN ENVIRONMENTAL AWARENESS AND STEWARDSHIP
Proximity to the ocean and Saco River are an attraction for UNE students. Appreciation of aesthetic features of water may not be connected in student's minds to daily choices that can have an impact on the very values that brought students to UNE in the first place. ENV 260 Sustaining Water - Global Perspectives, Local Action and ENV 321 Environmental Communication are elements of the core curriculum at UNE. Sustainability science is part of both classes connected to the Saco Estuary Project. As my capstone project for these courses I was interested in exploring the connection between environmental awareness and stewardship actions that contributed to sustaining Saco water quality. Flushing non-biodegradable items can clog UNE's waste water treatment facility, one of three such facilities discharging to the Saco Estuary. Students' use of chemicals like bleach impacts the organic bacteria used to break down substances during the waste water treatment process. I surveyed students on campus and determined that 55% didn't know there was a waste water treatment facility on campus and that the treated water gets released into the Saco Estuary. To increase water related environmental literacy and foster stewardship behaviors on campus, I created a short U Tube video as a class project. The design of my message used a story telling format to foster connections and mindfulness that students' actions contribute to sustaining the Saco. We hope to increase awareness and foster change in daily routines to prevent harm to the Saco River.

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EVENT-SCALE PLANKTON BLOOMS AND BOTTOM WATER HYPOXIA IN UPPER NARRAGANSETT BAY DURING THE SUMMER MONTHS (2007-2010)
Studies of summer water quality data have shown that Mid and Upper Narragansett Bay suffers from episodic hypoxia (dissolved oxygen (DO) <3.0mg/l). Hypoxia is caused by multiple factors including temperature,

stratification, advection within the water column, and organic matter decomposition in the surface sediments. Here, we use lower Providence River data to examine the event-scale relationship between organic matter flux from plankton blooms, indicated by chlorophyll (mg/l), DO (mg/l) and oxygen saturation (DO%), and potential drivers of primary productivity such as temperature, solar flux (SFQ) and fresh water discharge (FWQ) . We compare the timing of bloom events to bottom water hypoxia. We define blooms as a concentration of chlorophyll and/or DO% that is 1.5 σ higher than the monthly average. We observe three types of bloom events: blooms synchronous with peaks in FWQ and SFQ (Type I), blooms that lag FWQ until SFQ peaks (Type II), and blooms that coincide with maximum SFQ with no discharge event in FWQ (Type III). Because FWQ events are associated with cloudy conditions, SRQ does not peak until a few days later. The frequency, amplitude and duration of blooms is greatest for Type II events with Type I and Type III events being rare (about one per summer). The lags between FWQ and blooms is on the same order as the flushing time for the Providence River. Type II blooms have a greater effect on bottom water DO (mg/l) with longer FWQ events resulting in larger blooms and subsequently to a longer duration of hypoxia.Although primary productivity is high in the upper Bay, we conclude that blooms mostly reflect excess nutrients from FWQ events.

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THE EFFECTS OF SEA-LEVEL RISE AND WARMING ON PLANT PRODUCTION AND DECOMPSITION IN A NEW ENGLAND SALT MARSH
Salt marshes in New England are threatened by the impacts of climatic change. In particular, sea level rise could threaten the balance between primary production and decomposition which helps to maintain surface elevation in a salt marsh. If salt marshes cannot build up plant material at a faster rate than the sea level rises, then they can literally disappear. In addition, global warming may impact the ability of salt marshes to persist. This study considered the combined effects of sea level rise and warming on production and decomposition within a salt marsh in the Great Bay National Estuarine Research Reserve (NH). Sea level rise was simulated by transplanting microcosms containing *Spartina alterniflora* to a lower tidal elevation, and warming was accomplished using greenhouse plastic. Plant production, measured as cumulative stem height and above-ground biomass, and the decomposition of leaves and stems in nylon mesh bags, were monitored throughout a single growing season. Our data indicated that sea level rise caused decomposition to increase, but had no affect on production. On the other hand, warming resulted in an increase in both production and decomposition, although the affect on production was greater. These results suggest that although sea level rise poses a threat to this salt marsh by increasing decomposition rates, global warming has the potential to offset the affects of sea level rise by increasing plant production.

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SEA LEVEL RISE AND SEDIMENT: RECENT MARSH ACCRETION IN CONNECTICUT AND NEW YORK
Salt marshes occupy a narrow elevation range within the intertidal zone. If they are to persist in the face of sea level rise, marshes must rise at a rate commensurate with sea levels. To understand the prospects for accommodating future sea level rise, this research asks whether marshes in New York and Connecticut have kept pace with rising sea levels over the past century. Sediment cores were taken from 14 marshes in Long Island Sound and New York City. Age-depth models were calibrated using multiple independent age markers; ^{210}Pb, ^{137}Cs, and total Hg. Subsamples from 1-2 cm depth increments were combusted to determine mineral and organic content. Water level loggers deployed at each site were used to model historic tide data based on the 150-year record for New York City. These data were used to estimate how tidal flooding has changed over time at each site. Marsh surface accretion has varied spatially and temporally, but at many sites accretion has lagged behind sea level rise. Where increased flooding has not been matched by sediment accretion, the frequency and duration of tidal flooding have increased by, on average, 50% since 1900. The contributions of mineral and organic sediment to marsh accretion are examined within the context of changing flooding regimes. These results suggest an uncertain future for many coastal wetlands in the northeastern US.

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SALT MARSH RESTORATION IN MAINE AND FROM THE NONGOVERNMENTAL ORGANIZATION PERSPECTIVE
This presentation will discuss salt marsh restoration efforts in Maine. An additional topic will be broader coastal restoration from the perspective of The Nature Conservancy in the Gulf of Maine and Southern New England. Topics

will include how an NGO views coastal wetland restoration in light of sea level rise and a warming climate, how restoration efforts are prioritized, and expected outcomes of this work over the long term.

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CHARLES RIVER IN CHARGE: THE CHALLENGES AND OPPORTUNITIES OF LONG-TERM CITIZEN SCIENCE DATA
Data from citizen science long-term studies are an untapped resource for scientists and managers, especially when state and federal budgets for baseline environmental monitoring are shrinking. Citizen science volunteer data collection programs have challenges, but with those challenges come unique opportunities. The Charles River Watershed Association (CRWA) has been regularly monitoring the water quality of the Charles River in the greater Boston region of Massachusetts since 1995. CRWA relies on a trained and supervised network of volunteers, working under a well-established study design, and a federal and state government-approved Quality Assurance Project Plan. Data collected by our water quality monitoring program guides the decisions of the EPA and the Massachusetts Department of Environmental Protection related to control of stormwater and combined sewer overflows. The use of volunteers allows CRWA to collect a large number of samples from an expansive geographic area in a short amount of time. Informed volunteers dedicated to the monitoring and improvement of the river become stakeholders and advocates for a cherished urban river. Our program - a collaboration between watershed scientists, managers and volunteers - is a successful model for collecting relevant data and involving citizens in watershed protection and restoration.

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EFFECTS OF FRONTS ON FINE-SEDIMENT TRAPPING IN THE CONNECTICUT RIVER ESTUARY
The Connecticut River estuary is a high-energy environment dominated by strong tides and a short residence time. Prior research suggests fine sediment delivered to the estuary is rapidly discharged into Long Island Sound, resulting in predominantly sandy bottom sediment in the estuary. More recent observations have found fine-sediment deposits within the estuary. Due to morphology, regions of the Connecticut River estuary are sites of frequent frontogenesis. Estuarine fronts, or intense horizontal salinity gradients, are thought to be efficient sediment traps, forming secondary turbidity maxima, or elevated suspended sediment concentrations (SSCs), well downstream of the landward extent of the salt intrusion. During three research cruises in November 2012, May 2013 and November 2013, high-resolution temporal and spatial data of current velocity, bottom stress, salinity and SSC in regions of expected frontogenesis were obtained using an Acoustic Doppler Velocimeter, Conductivity, Temperature, Depth Sensor, Optical Backscatter Sensor, and Acoustic Doppler Current Profiler. Additionally, a total of 252 sediment cores were retrieved throughout the estuary with higher resolution sampling in regions of expected frontogenesis. Preliminary findings suggest elevated SSCs in regions of persistent frontogenesis and frontal passage. Frontal characteristics and associated SSCs vary in different regions and with the phase of the tide. From calculated boundary shear stress it appears SSCs are due to a combination of resuspension, advection and potentially enhanced settling. Additionally, the bottom sediment characteristics indicate that some the fine sediment is deposited in frontal zones, at least temporarily.

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A UNIALGAL CULTURING METHOD FOR *ULVA SPP*. FOR USE IN MESOCOSM EXPERIMENTS
Ulva spp. are opportunistic macroalgae abundant in eutrophic coastal shallow lagoons in the Eastern U.S and world-wide temperate zones. *Ulva* blooms in estuaries are a chronic symptom of nitrogen pollution from urban and rural watersheds. Mesocosms provide an opportunity to study the impacts of *Ulva spp.* while controlling potential confounding variables (i.e. diatoms, flow variability, light, etc.) that are present in the natural environment. In addition, *Ulva* is difficult to identify at the species level, and mixed assemblages introduce variability into controlled experiments. Thus, we suggest using single *Ulva* species in experiments and mesocosm work to minimize variability of results. Cytological results suggest we have established culturing protocols for *U. lactuca* and *U. compressa*. Measured growth rates and nutrient uptake rates of our cultured *Ulva* are similar to published values for field specimens. We also found that *Ulva's* life cycle could not be replicated in the laboratory and therefore continuous propagation from the diploid/asexual adults is required to maintain generations. Viable freezing techniques can allow

generations to be maintained continuously for a period of years. This method has suitable applications to answer a variety research questions with mesocosms designed for phycological, ecological, and environmental studies. Future work aims to use cultured *Ulva* to quantify effects on nitrogen fluxes in Jamaica Bay, New York.

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A COMPARATIVE ECOLOGICAL APPROACH TO ASSESS THE ROLE OF WATERSHEDS IN ESTUARINE CONDITION

Estuarine condition is a function of the nature of the estuary, ocean, and atmospheric systems, and the upstream watershed. To fully understand and predict how an estuary will respond to drivers and pressures, each compartment must be characterized. For example, eutrophication's effects on estuarine condition are generally well known; less understood is how the attributes of estuarine watersheds, and their spatial distributions, relate to estuarine conditions. The goal of this research program is to develop methods and indicators for mapping watershed integrity and aquatic condition in order to predict watershed condition. As part of a national program, a comparative ecological approach is used to examine relationships between watershed characteristics and estuarine condition. The analysis utilizes a common set of watershed spatial indicators and estuarine state/impact indicators. This study builds on past work in Southern New England on relationships between land use characteristics and aquatic habitat extent metrics (e.g., eelgrass) and on work in Northern New England, through the EcoSystem Indicator Partnership, which has assembled a large database of watershed, contaminants, climate change, aquaculture and eutrophication variables. The aquatic condition data are comprised of regional data sets including EPA's National Coastal Assessment. Watersheds are being characterized by a combination of indicators developed in other efforts within the national program and those already acquired, or are under development regionally. The results will be used to develop methods, models, and data on estuarine condition and watershed characteristics that can ultimately be used to help protect watershed integrity across the country.

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d15N ISOTOPE ANALYSIS OF A SEDIMENT CORE TO RECONSTRUCT WATERSHED HISTORY OF NUTRIENT CYCLING IN NEQUASSET LAKE, WOOLWICH, ME

Nitrogen isotopes of lake sediment cores can be used to better understand changes in nitrogen cycling and sources of nitrogen entering a watershed through time. In lakes that receive marine derived nutrients (MDN) from anadromous fish migrations, the nitrogen isotope composition of core sediments can be used to reconstruct the relative strength of paleo-anadromous fish runs. Nequasset Lake serves as an annual spawning habitat for the anadromous alewives (Alosa pseudoharengus). Repairs to a water control dam since its original construction in 1730 and other natural and anthropogenic changes to the watershed have impacted nutrient cycling and the alewife migration. Biogeochemical cycling within Nequasset Lake is currently a subject of study by the Bates, Bowdoin, and USM SSI team and the Kennebec Estuary Land Trust. The purpose of this study is to examine the nitrogen and carbon isotope compositions of a sediment core from Nequasset Lake to reconstruct watershed history. Preliminary interpretations suggest that the presence of anadromous fish migrations have occurred throughout the sedimentary record, as evidenced by consistently elevated d15N values compared to a nearby lake that does not receive anadromous fish. A significant shift in the sedimentary record between 26 and 14 cm is marked by a decrease in C/N ratios, % organic carbon and nitrogen, and an increase in d15N. The lake likely experienced a fundamental shift in nutrient cycling that may be explained by increased input of MDN and/or eutrophication. Radiocarbon dated samples will be used to align sedimentary changes with anthropogenic and natural watershed alterations.

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MOVEMENT OF SHORTNOSE STURGEON(*ACIPENSER BREVIROSTRUM*) IN THE SACO RIVER ESTUARY

The shortnose sturgeon (*Acipenser brevirostrum*) is an endangered, anadromous fish species known to inhabit river systems along the eastern coast of the U.S. and Canada. This highly migratory, k-selected species is estuarine dependent, moving upriver to spawn in freshwater and moving back downstream to forage and grow before entering marine environments. Previous studies on this species inhabiting the Saco River suggest the shortnose sturgeon never utilized this watershed (Reynolds and Casterlin, 1985; Furey and Sulikowski, 2011). However, Atlantic sturgeon,

(*Acipenser oxyrinchus*), a similar species, were rediscovered in the Saco River in 2007, initiating a study to investigate the reappearance of this species. Sampling for Atlantic sturgeon led to the incidental capture and first documented occurrence of the endangered shortnose sturgeon in 2009, indicating a possible importance of this habitat (Little et al., 2013). From the summer months of 2009 to 2013, a total of 47 shortnose sturgeon have been observed in this ecosystem. Of these 47 individuals, 18 have been acoustically tagged. Seasonal movement patterns of shortnose sturgeon in to and out of the Saco River as well as changes in habitat utilization will be analyzed using the R statistical computing software. In addition, geographic information systems (GIS) mapping will be used to examine the temporal and spatial distribution of shortnose sturgeon within the estuary system. Understanding this important connection between this endangered species and this estuarine habitat is essential for establishing a future management plan for recovery and survival of this population.

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SHADING IMPACTS OF SMALL DOCKS AND PIERS ON SALT MARSH VEGETATION

Proliferation of small docks in salt marsh habitats poses potential cumulative impacts to this important habitat through shading effects. The New England District of the Army Corps of Engineers recommends a 1:1 height to width ratio for docks overlying marsh to reduce shading, although a specific height requirement is not currently mandated under the Wetlands Protection Act. In 2013, we initiated a field study in Marshfield, MA to examine the relationship between dock height and shading impacts on salt marsh vegetation by installing a network of 4 foot wide wooden docks (n=24)set at three heights: 2, 4 and 6 feet. All other dock design components were standardized to allow the effects of dock height to be experimentally tested. Half of the docks were installed over the *Spartina alterniflora*-dominated low marsh and half were placed over the *S. patens*-dominated high marsh. Shading effects were quantified by monthly visual surveys and an end of season clip plot survey. The visual survey estimates showed an average reduction of *S. alterniflora* density of 75% under 2 foot docks relative to control, unshaded plots in the low marsh region. In the low marsh, clip plots from the 2 foot docks also showed significant reductions in stem weight and number relative to the taller docks and control plots. Control plots had a greater stem density but shorter stem lengths than all dock treatments. In the high marsh, the 6 foot docks had a greater stem density than shorter docks and control treatments, greater stem biomass than the 2 foot docks, and, along with the controls, shorter stems than the two shorter dock treatments. Preliminary study results are discussed in the context of existing regulations.

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ZOSTERA MARINA GROWTH IN THE PRESENCE OF INVASIVE TUNICATES

Eel grass beds, such as *Zostera marina*, are an important part of the coastal environment because they provide an important habitat to house a large, diverse population of aquatic organisms compared to areas of no vegetation. A study was conducted on the effects of invasive tunicates in an eel grass bed at Juniper Beach in Salem, MA by three students at Salem State University. To test any impacts the tunicates have on eel grass, we monitored the grass growth rate, biomass, and blade length using a modified SeagrassNet protocol. Temperature and light intensity were measured throughout the course of the study, June –November 2013, with growth rate measurements during October and November. Observations during June –August showed invasive tunicate settlement on grass blades with densities averaging at 25% coverage; many blades were below and few were above that percent cover. The grass that was infested by tunicates became weighted to the bottom and died off. If the grass can outgrow the rate of tunicate settlement until the colder months then they should remain healthy because tunicate coverage was nonexistent during October and November. Tunicate recruitment is highest during the summer months then trickles down as the temperature drops; there are no new tunicates that can replace them once they die off in the winter. Therefore monitoring the growth rate during the summer months, when tunicate coverage is more abundant, will give more conclusive data on the negative impacts of these invaders because we will have growth rates during the most productive months for eel grass and tunicates.

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$\delta^{13}C$, $\delta^{15}N$, and $\delta^{34}S$ AS SOURCE INDICATORS FOR PARTICULATE MATTER IN SALEM HARBOR, MA

A multi-facetted stable isotopic approach was utilized to constrain the origin of particulate matter responsible for the turbid conditions in Salem Harbor, Massachusetts. The estuary has experienced increasing turbidity levels over past decade; previous studies suggest a 70% depletion of *Zostera marina* in that time. From May 2012 to present, samples

have been collected to monitor suspended sediment (as point-sampled filter water samples and sediment traps), as well as potential sources of particulate matter (harbor surface samples and filtered water samples from rivers). Four hypothesized sources of particulate matter have been examined; resuspended surface sediment associated with mooring activity, freshwater runoff from the watershed, phytoplankton blooms, and wastewater effluent. Elemental concentrations (CNS) and stable isotope ratios ($\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$) of all samples were quantified using a continuous flow elemental analyzer/stable isotope ratio mass spectrometer. Water filter and sediment trap $\delta^{13}C$ and C/N ratio results, were consistent with phytoplankton signatures. River input samples were more depleted in $\delta^{13}C$ than sediment trap samples. Surface sediment samples showed higher C/N ratios than water filter and sediment trap samples. Further, surface sediment samples had negative $\delta^{34}S$ values, while river and suspended sediments were positive, suggesting resuspended sediment is not a turbidity source. $\delta^{13}C$ and C/N data were consistent with phytoplankton organic matter sources. The approach used in this study has applications in turbidity source identification for other estuarine environments.

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URBANIZED WATERSHEDS - POTENTIAL SOURCES OF SILICA TO RECEIVING WATERS

Dissolved silica (DSi) is a key macronutrient for diatoms, the siliceous phytoplankton that form the base of many productive marine food webs. The majority of DSi enters the ocean via rivers. Historically, watershed DSi export was thought to be primarily driven by chemical weathering of the lithosphere. However, recent work has highlighted that the terrestrial biosphere plays an important role in altering the timing and magnitude of DSi watershed export. Terrestrial vegetation incorporates DSi into biomass which can provide structural support as well as defense against herbivory, heavy metal toxicity, and desiccation. Thus, as human activities alter the landscape they may also be changing the export of DSi to marine systems. While the impact of changing land use/land cover (LULC) on nitrogen and phosphorus are well known this same phenomenon for DSi is only just being recognized. Using a seven-year Massachusetts Water Resource Authority (MWRA) record for DSi concentrations in three urban rivers around Boston and Boston Harbor we explore relationships between watershed DSi export and downstream receiving water Si concentrations. The monthly urban riverine flux of silica will be compared to previous research on silica fluxes in local non-urban rivers and to monthly patterns of silica concentrations in the inner harbor. We hypothesize that (1) the silica flux of these urbanized rivers will be greater than previously examined non-urban rivers and, (2) the patterns of silica concentrations in the harbor will be partially attributable to the delivery of silica via the rivers.

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SMALL-SCALE SPATIAL VARIABILITY OF BENTHIC HABITATS AND FORAMINIFERA IN NARRAGANSETT BAY SEDIMENTS

Estuarine environments and habitats are known to be heterogeneous so the question arises, “how representative is any one sediment sample?” Here, we address the spatial variability of benthic foraminifera and associated sediment characteristics over about a 10 m^2 area. We obtained ten sets of surface sediment grab samples at the corners of a 3m x 3m area (4 samples per site). Samples were analyzed to measure size fraction (mud <63 μm), C and N content, metal content, and benthic foraminifera populations. We followed the taxonomy of Cushman (1944), Phleger and Parker (1952), and Todd and Low (1981) and report here on the distribution and variability of major species groups. The benthic habitats represent a wide range of sand/mud fraction, organic carbon content, and metal content. However, the variation within the 4 samples at each site was small relative to the site to site variation. We find that the total abundance (#/g) and the species composition of benthic foraminifera varies significantly over the range of the sites but that the within site variability is small (within 1 σ). We conclude that single sediment samples are representative of both habitat and foraminifera populations on the $10m^2$ scale.

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MONITORING SALT MARSH ELEVATION AT CAPE COD NATIONAL SEASHORE: UNDERSTANDING THE RESPONSE TO SEA LEVEL RISE

Tidal marshes are critical coastal resources at Cape Cod National Seashore and throughout the northeast. Salt marsh integrity and the ability of marshes to build vertically are impacted by human activities such as dikes or other tidal

restrictions, which alter natural sediment transport patterns and contribute to the loss of salt marsh habitat. Salt marsh surface elevation must keep pace with sea level rise. When relative sea level rise is greater than marsh surface elevation increase, marshes may convert to intertidal mudflats or sub-tidal shallow open water habitat. To understand the response of Seashore salt marshes to sea level rise, as well as to the impacts of tidal restriction, Cape Cod National Seashore has been employing the Surface Elevation Table-Marker Horizon (SET-MH) method for over a decade at three systems (Hatches Harbor, Herring River and Nauset Marsh). At Nauset Marsh, a back-barrier system, marsh surface elevation is increasing at a rate similar to the regional rate of sea level rise. At Herring River and Hatches Harbor, the monitoring design includes sampling within tide-unrestricted and tide-restricted or tide-restored portions of these systems. Trends in marsh surface elevation in relation to sea-level rise are variable at these sites, related to bioturbation, altered hydroperiod, and sediment supply, among other factors. The concept of elevation capital is offered as a method for coastal managers to apply SET data toward forecasting the long-term status of salt marshes under a regime of rising sea levels.

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MIMIC: USING CITIZEN SCIENTISTS TO TRACK THE SPREAD OF MARINE INVASIVE SPECIES AT THE WELLS NATIONAL ESTUARINE RESEARCH RESERVE, WELLS, ME.
The Marine Invader Monitoring and Information Collaborative (MIMIC) is a network of trained volunteers and scientists who monitor marine invasive species throughout the northeastern United States. MIMIC is coordinated by the Massachusetts Office of Coastal Zone Management with support from the U.S. Fish and Wildlife Service, the Northeast Aquatic Nuisance Species Panel, and local monitoring organizations that recruit and train volunteers. The purpose is to detect newly-introduced species as well as changes in the abundance and distribution of established non-native species. MIMIC provides an opportunity for the general public to: (1) actively participate in an invasive species early-detection network, (2) identify new marine invaders before they spread, and (3) improve our understanding of the behavior of established invaders. Volunteers range from school-aged children to seniors and all are trained in an adapted visual rapid assessment protocol and proper identification of marine invertebrate species before participation in the field. Monitoring occurs monthly from June to October at 6 established sites from York to South Portland, ME. Data are uploaded to the Massachusetts Ocean Resource Information System (MORIS) where they are available to scientists and managers. A total of 243 species reports have been documented so far. Both host organizations and volunteers benefit from this shared experience as valuable biological data is collected in and around the host organizations boundaries and volunteers are educated about the impacts of invasive species and how they can help stop the spread of these invaders.

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HIGH RESOLUTION SALINITY MAPPING AS A TOOL FOR PREDICTING PLANT COMMUNITY RESPONSE FOLLOWING SALT MARSH RESTORATION IN NEW ENGLAND
Increasing salinity is critical to the efficacy of tidal restoration projects designed to deter common reed (Phragmites australis). Pore water salinity is among the most commonly monitored parameters in salt marsh restoration next to vegetation change. Salinity measures have the potential to not only explain presence of an existing plant community, but also predict the most likely transitional community to establish as the process of restoration develops over time. When data are mapped spatially, rather than presented only as an average value for a site, important patterns emerge that may improve our ability to manage invasive species and proactively encourage dominance of native species. To explore this idea, we present both short and long-term salinity data collected from a variety of sites restoration in New England using several approaches (e.g. salinity wells, pore water sippers, and electromagnetic induction). These data illustrate variation in the rate, magnitude and timing of salinity changes that contribute to the high variability in plant community response to tidal restoration witnessed throughout New England.

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THE FUTURE OF PLUM ISLAND ESTUARY MARSHES
Stabilizing feedbacks among flooding, sedimentation, and plant growth are being investigated at the Plum Island Estuary, LTER site. Plum Island marshes are unusual because of their extreme elevation, high tides, low suspended mineral sediment loads, and age. The marshes appear to be keeping pace with sea level currently by a process of cannibalization. With a rise in sea level there is an increase in the volume of the tidal prism. This is accommodated

by a widening of tidal creeks. Much of the eroded peat is apparently redeposited on the surface of the marsh platform. Evidence for this is the 1,832-year age of the organic "fines" in the upper 5 cm. Analysis of PIE LiDAR data shows that between 2005 and 2011 there was a loss of 0.27 km^2 of marsh area, defined as area between MSL and MHHW. That represents a loss of 4,050 m^3 of peat, assuming loss by slumping of edges to a depth of 1.5 m. If that peat were deposited on the remaining surface of the marsh, the accretion rate should be about 2.3 mm/yr. In a Spartina patens marsh that has been monitored intensively since 1999 the marsh surface has risen 2.2 mm/yr in reference plots and 2.5 mm/yr in fertilized plots. Hence, cannibalization could be accounting for much of this. Simulations with the Marsh Equilibrium Model (MEM) suggest there will be a gradual decline in relative elevation, but survival to 2100 following a 1 m rise in sea level. The future estuary looks like one with more open water and lower marsh habitat, perhaps dominated by S. alterniflora.

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FACTORS THAT AFFECT TIDAL MARSH BIRD DIVERSITY IN THE SACO ESTUARY OF SOUTHERN MAINE

Increasing species diversity is an indicator of greater ecosystem resiliency. In coastal tidal marshes, habitat size, salinity, native plant diversity and the extent of invasion by non-native plants are known to influence bird species diversity. We explored how marsh bird diversity (Shannon Wiener Index) in the tidal marshes of the Saco River Estuary in southern Maine was influenced by plant species diversity, marsh size, salinity, the distance from the mouth of the river, marsh width, composition of edge habitat and extent of invasion by non-native Phragmites australis. We conducted point counts at 16 tidal marshes from May through September, 2010-2013; we conducted one high tide and one low tide count each month at each point. We detected 53 species of marsh birds and identified 70 species of marsh plants. Increasing salinity, which varied from <1.0 ppt to 18.6 ppt, was positively associated with increasing marsh bird diversity. The extent of barren land (15% or less vegetative coverage, primarily shrubs and no mature tree species) bordering the marsh was negatively associated with bird diversity. Plant species diversity, marsh width (9 m to 200 m), distance from the mouth of the river (478 m to 7000 m) and marsh size (0.21 ha to 19.12 ha) did not explain variation in bird diversity. Only six of 16 sites had Phragmites and the proportion of marsh area colonized by Phragmites (0% to 28.7%) did not explain variation in marsh bird diversity. Our results suggest that tidal marsh bird diversity can be increased if barren conditions on the edge of marshes can be transformed into other vegetated habitat types.

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SPATIAL PATTERNS OF OYSTER GROWTH AND MORTALITY

In 2008 the Town of Hempstead Department of Conservation and Waterways initiated a project to test the efficacy of remote set oyster reefs designed for local conditions. Reefs were constructed in raised beds using two tiers of bagged shell. Because there is no longer a known natural oyster population, the upper tier included oysters set using spat-on-shell methods. The reefs were set near or below mean low tide to mimic the natural oyster occurrences found in Delaware Bay and further northward. Between 2009 and 2011 a combined total of 187 meters, containing roughly 2,000 surviving adult oysters, were constructed in two reef locations. The preexisting species diversity and sediment characteristics were recorded. Subsequent observations indicated an increase in overall species diversity. Future expansion and the addition of a third reef site is planned. In addition to the reefs, oyster samples were stationed throughout Hempstead Bay starting in 2008. These samples were initiated as spat that were maintained in "shellfish purses" and monitored to determine spatial trends and interactions between water quality, shell growth, and mortality. Results from locations with recent samples are presented that show reduced growth and survival in low circulation urbanized creeks.

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LOSS OF EELGRASS ASSOCIATED WITH GREEN CRABS IN MAINE: IS THIS THE NEW NORMAL?

Maquoit Bay is a ~1000-ha embayment that forms the northwestern arm of Casco Bay, ME. Historically, Maquoit Bay supported ca. 550 ha of eelgrass (*Zostera marina* L.) in nearly continuous cover from the low intertidal zone to the 3-m depth contour. Between 2011 and 2013 almost all of the eelgrass in the bay disappeared. Loss of eelgrass was coincident with a coast-wide population explosion of European green crabs (*Carcinus maenas*). Green crabs are known to damage and uproot eelgrass shoots through foraging, and destruction by green crabs is the primary cause of

eelgrass decline in Nova Scotia. Therefore, in 2013 I conducted a pilot field study to help determine whether green crab disturbance caused the eelgrass loss in Maquoit Bay. I established three exclosures in a shallow, formerly vegetated cove of Maquoit Bay to test the hypothesis that environmental conditions are suitable for eelgrass growth in the absence of green crabs. Exclosures were 2.4m x 2.4m (sides) x 0.5m (height) with walls of 0.5-cm plastic mesh rimmed with angled aluminum flashing to hinder crab entry over the top. Eelgrass shoots were planted inside and outside of each exclosure (30 shoots per experimental unit) on 5 September and harvested after 26d. Eelgrass survival inside the exclosures was 82% $\pm$14 (SE) vs. 24% $\pm$14 (SE) outside. Shoots that were undamaged by crabs produced a mean of 2 to 3 new leaves during the experiment, which is comparable to measurements from New England eelgrass beds during September. Results suggest green crabs as a primary cause of eelgrass loss in Maquoit Bay. Local observations and environmental data help rule out other possible causes (water clarity, temperature, sediment organics, storms/ice).

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IS DIET RELATED TO THE MOVEMENT OF ATLANTIC STURGEON (*ACIPENSER OXYRINCHUS*), IN THE SACO RIVER, MAINE?

Atlantic sturgeon (*Acipenser oxyrinchus*) are a highly migratory anadromous fish species, ranging from Labrador, Canada to Florida. Populations of this large and late maturing species decreased significantly along the coast in the early 20th century due to overharvest, development of dams, and pollution. As a result, this species of sturgeon was extirpated from many river systems, including the Saco River, Maine, by the 1950s and is currently considered a threatened species in this ecosystem. To investigate the reappearance of this species to the watershed, a comprehensive study of the distribution and movement patterns by means of acoustic telemetry, and diet analysis was established in 2008. A total of 51 sturgeon collected using gill nets were measured, fixed with external and internal tags, including surgically implanted acoustic transmitters. Preliminary observations from the acoustic array in the Saco River have shown that sturgeon preferred to stay within the first few river kilometers of the estuary. Analysis of stomach contents, obtained through gastric lavage, revealed that American sand lance (*Ammodytes americanus*), which school at the mouth of the river, are the most common prey item retrieved. In addition, the preliminary results of benthic grabs, beam trawls and beach seines conducted within the Saco river, suggest that the distribution of prey items found in the stomach contents, were correlated with the acoustic data. Further research on diet and prey availability for Atlantic sturgeon in the Saco River is needed to better understand the role this habitat plays in their recovery.

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MONITORING THE PRODUCTIVITY OF COASTAL SYSTEMS USING pH: WHEN SIMPLER IS BETTER

The impact of nutrient inputs to the eutrophication of coastal ecosystems has been one of the great themes of coastal ecology. There have been countless studies devoted to quantifying how human sources of nutrients, in particular nitrogen (N), affect coastal water bodies. These studies, which can measure in situ concentrations of nutrients, chlorophyll, and dissolved oxygen, are often spatially and/or temporally intensive and expensive. We provide evidence from experimental mesocosms, coupled with data from the water column of a well-mixed estuary, that pH can be a quick, inexpensive, and integrative measure of net ecosystem metabolism. In some cases, this approach is a more sensitive tracer of production than are direct measurements of chlorophyll and carbon-14. Taken together, our data suggest that pH is a sensitive, but often overlooked, tool for monitoring estuarine production.

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DETECTION OF SEWAGE-DERIVED NITROGEN IN NEW ENGLAND COASTAL WATERS USING STABLE NITROGEN ISOTOPES

Introduction of excess nitrogen into the coastal waters, via sewage and farm fertilizer run-off, has been linked to hypoxia, habitat degradation, and harmful algal blooms. Recent studies to identify sources and loadings within specific watershed regions have begun to utilize stable isotope ratios of in situ samples. We adopted a similar approach wherein macroalgae samples (principally *Fucus* and *Ascophyllum*) were collected from sample sites along coastal New England from Portland, ME to West Port, CT for determination of delta^{15}N ratios. Sample sites were chosen for proximity to sewage treatment plants, some nearby and others farther away. The delta^{15}N values were

found to range from 4.8 to 11.4 per mil. Macroalgae from sites in close proximity to sewage treatment plants had higher delta^{15}N values. Trends in delta^{15}N values have surfaced between states as well as by region. Northern sites were found to have lower values than sites to the south. Final comparisons and data presentation will utilize a Geographical Information System. Results have shown the practicality of utilizing stable isotope ratios for identification of nitrogen point sources, and the benefit of GIS for cataloguing sites of interest for treatment.

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LOBSTER TALES AND SEA CUCUMBER TOXIN: THE FRENCH-CANADIAN CONNECTION
Internships can prove an invaluable experience and meaningful extension of traditional coursework. In early 2013 arrangements were made to intern at the marine fisheries byproduct lab at the Institut de recherche sur les zones côtières, inc. (IRZC), in Shippagan, New Brunswick. Shippagan is a coastal community with a population of 2,600 people; its economy is fueled by the fishing and peat moss industries. The summer internship focused on two primary efforts. The first effort targeted development of an optimal recipe for lobster bait using byproducts from the local commercial fisheries. Different ingredients and different combinations of ingredients were assessed as to attractiveness to lobsters and integrity in the trap. Lobster baits produced showed an increased attraction to lobsters. The second effort examined the effects of sea cucumber (*Cucumaria frondosa*) toxin on an ecotoxicological model. Levels of specific biomarkers including malondialdehyde, acetylcholinesterase, and glutathione S-transferase were examined to help characterize the toxin. The sea cucumber initiative was supervised by a Ph.D. student from France as part of his dissertation studies. Enzyme levels in the oyster worked as a base line to see what changes need to be done for the experiment to get more results to help further the study. Beyond the data generated and knowledge acquired, the internship afforded me the opportunity to work in a lab with colleagues from other countries, to contribute to better understanding/management of our coastal resources, and to learn firsthand that collaboration extends beyond the United States.

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EGGSHELL FRAGMENT CATION RATIOS AND GEOMETRY HELP DISTINGUISH TURTLE SPECIES FROM DEPREDATED NESTS IN A WETLAND TURTLE COMMUNITY
Turtle conservation efforts are often challenged with high nest depredation rates. Since fragmentation of eggs by predators destroys the original egg shape and dimensions and may confound determination of the numbers of eggs present, there can be considerable uncertainty about the species of turtle that laid a depredated nest. We analyzed cation ratios (Ca:Mg and Mg:K, mg mg^{-1}) and estimated shell fragment geometry (curvature, degree of ellipsis, egg asymmetry) using shell fragments from depredated nests of known painted turtles (*Chrysemis picta*), snapping turtles (*Chelydra serpentina*), and Blanding's turtles (*Emydoidea blandingii*) and from depredated nests of unknown species from a complex of natural and constructed wetlands in Dutchess County, New York. Plots of Ca:Mg versus Mg:K distinguished eggs of known painted turtles from Blanding's turtles, while snapping turtles overlapped both species. However, egg morphology (spherical versus elliptical) and clutch measures (approximate number of eggs versus dry eggshell mass) helped distinguish snapping turtles from both painted and Blanding's turtles. The vast majority of unknown depredated nests clustered with the painted turtle cation ratios and egg morphology characters, suggesting that conservation efforts for the threatened Blanding's turtle are effectively protecting their nests from mesopredators such as skunks, possums and raccoons.

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DINOFLAGELLATE CYSTS AS INDICATORS OF WATER QUALITY IN NORTHEAST US ESTUARIES
Determining the total input of nutrients to estuaries is a challenge. Nutrient concentrations in coastal waters do not always reflect the total amount of nutrients entering a water body, as they can be rapidly taken up by phytoplankton and aquatic vegetation. One method to evaluate nutrient input is nutrient loading models, such as the SPARROW model. Another method relies upon using indicators to act as early warning signs in water quality degradation. We are investigating the use of dinoflagellate cysts (the fossilizable life stage of planktonic dinoflagellates) from sediments as a means to evaluate and monitor levels of eutrophication. Dinoflagellate cyst assemblages are known to reflect sea-surface conditions and are used in paleo-environmental reconstructions to provide information on past

sea-surface temperature, salinity, productivity and nutrient availability. Previous studies have noted the impact of eutrophication on species, abundances and diversity of cysts in sediments, but no study has yet compared empirical values of nutrient loading to cyst taxa. In this study our main objective is to determine if cyst assemblages can be correlated to nitrogen levels as estimated from nutrient loading models. 61 sediment samples from 20 different estuaries from Maine to Delaware collected by the EPA were analyzed for dinoflagellate cysts. As samples encompass four main estuary types (riverine, lagoon, coastal embayment and fjord) we can determine if the cyst response varies by estuary type. Over 60 dinoflagellate cyst taxa were identified and we are analyzing nutrient loading and other environmental variables as factors influencing the cyst assemblages.

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DIEBACK EVENTS ACCELERATE ONGOING *SPARTINA PATENS* DECLINE IN RHODE ISLAND SALT MARSHES
New England salt marshes are currently impacted by multiple stressors, including accelerating sea level rise and recent anomalous high tides, which threaten marsh sustainability. If marshes are unable to keep pace with rising sea levels, impacts will include creek sloughing, ponding and vegetation dieback in the high marsh, and drowning. Two complementary salt marsh monitoring and assessment programs are documenting marsh responses to sea level rise in Narragansett Bay, RI. Here we combine data from these two programs to show that salt marsh vegetation and habitats are changing rapidly and dramatically. Long-term vegetation monitoring at two salt marshes shows that the salt meadow foundation species *Spartina patens* is decreasing significantly over time as it is largely replaced by *Spartina alterniflora*. If the current trend continues, *S. patens* may be lost from one marsh as early as 2017. Areas where *S. patens* declined were on average 4 cm lower in elevation than areas where *S. patens* remained stable. Vegetation dieback, which was related to unusually high tide levels, accelerated the loss of *S. patens* by 63%. A broader spatial assessment indicates that these patterns are likely occurring throughout much of Narragansett Bay, especially in marshes near the Bay's mouth that are more susceptible to sea level rise. With sea levels expected to rise even faster, we predict that RI marshes will continue to lose salt meadow habitat and convert to stunted *S. alterniflora* interspersed with dieback. Our monitoring and assessment data will help managers identify and prioritize marshes for restoration efforts aimed at helping them keep pace with sea level rise.

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SEDIMENT OXYGEN DEMAND IN NARRAGANSETT BAY MEASURED *IN SITU* BY BENTHIC CHAMBERS
In Narragansett Bay, the development of hypoxia threatens the health of the estuary. A number of factors affect the dissolved oxygen budget of the bottom waters, including stratification, mixing processes, primary productivity, respiration, as well as sediment oxygen demand (SOD). Here, we examine SOD through *in situ* measurements made in mid to upper Narragansett Bay. Our *in situ* measurements are made via two benthic chambers, which have a footprint of 0.128 m^2 and a volume of 0.065 m^3. Changes in the chamber dissolved oxygen (DO, mg/m^2/hour) are made with YSI 6290 sondes over durations of 3 to 5 hours. Chambers are filled with near-surface water and lowered to the bottom with one open to both sediment and chamber volume (total oxygen demand, TOD) and the other only to the chamber volume (water column demand, WCOD). The difference between TOD and WCOD is the SOD. Multiple measurements at one upper bay location document that SOD has a strong positive relationship with water temperature, organic carbon of the surface sediment, and the DO gradient between the near-surface water and the bottom water. Spatially, SOD decreases from North (286 mg/m^2/hour) to South (73 mg/m^2/hour) along the observed nutrient and productivity gradients of the bay, with the highest rates observed in the Seekonk River and the lowest at our lower/mid bay stations near Prudence Island and Conanicut Island. Compared to previous studies on benthic respiration within Narragansett Bay, our estimates for SOD are consistently larger, suggesting SOD may provide a more significant role in the overall oxygen budget and development of hypoxia.

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ESTIMATING SIZE CLASSES, SPAWNING PERIODS, AND RESIDENCE TIMES OF TELEOSTS IN THE SACO RIVER ESTUARY SYSTEM BASED ON TOTAL LENGTHS
Coastal estuaries serve as vital nursery grounds for many commercially valuable fish species despite the variability in abiotic conditions. Within the Gulf of Maine (GOM) and in comparison to other larger estuarine regions, the Saco

River estuary has shown significant species diversity in its fish assemblage. From 2007, ongoing fish surveys have been conducted in order to better understand the diversity, abundance, and distribution of larval fish within the Saco River estuary. To further reveal and understand the ecological value of this watershed, it is essential to define the size classes, spawning phases, and residence times of these important fishery species utilizing the estuary system. Thus far, a total of 61 fish species have been identified including the commercially important Atlantic herring (*Clupea harengus*) and Atlantic cod (*Gadus morhua*) as well as the NOAA species of concern cusk (*Brosme brosme*). This high species diversity indicates the system serves a vital role in the GOM. Preliminary analyses confirms this significance through increasing growth trends in larval and juvenile fish, evidence of larger class sizes of fish settling out, and spawning events.

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ABIOTIC INFLUENCES ON THE JUVENILE FISH ASSEMBLAGE OF THE SACO RIVER ESTUARY, MAINE

Considered among the most productive marine environments within the Gulf of Maine (GOM), estuaries are known to provide habitat, resources, and shelter for diverse fish communities. These complex coastal ecosystems are physiologically challenging habitats due to large variations in abiotic parameters, such as temperature, salinity, dissolved oxygen, and pH. The Saco River Estuary (SRE) is an established nursery ground and habitat for 60 marine, diadromous, and freshwater fish species, including many that are considered threatened or of commercial and recreational importance in the GOM. Although the fish community has been well studied in the SRE, no study to date has attempted to correlate seasonal fluctuations in fish abundance to environmental factors. Preliminary information on the abiotic characteristics of the SRE suggests that the estuary exhibits large fluctuations in relative salinity (0-30ppt) and surface water temperatures (14-31°C). In addition, preliminary data suggests that abundance and diversity of juvenile fish species in the SRE fluctuates on relatively short (month) and long (annual) temporal scales, with highest abundance occurring late summer while diversity is highest mid-summer. Since physical properties associated with estuaries can affect the function of biological systems, this research will give insight to which abiotic factors (e.g. temperature, salinity, dissolved oxygen, pH) are influencing the juvenile fish assemblage of the SRE. Furthermore, with the current threats to this region (e.g. climate change, coastal development, pollution, and overfishing), understanding the dynamics of fish communities are imperative for proper conservation and management.

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A COMPARISON OF CALCIUM CARBONATE SEDIMENT BUFFERS TO INCREASE THE LARVAL SETTLEMENT AND JUVENILE RECRUITMENT OF MYA ARENARIA

Calcium carbonate in the form of aragonite and calcite is an essential constituent of shell formation in marine bivalves. As a result of natural processes, sediment pore water can be significantly undersaturated with respect to aragonite and calcite near the surface water interface. While this is a common occurrence, anthropogenic changes to coastal and open ocean environments have intensified the process. This can result in (intertidal mud) flat rejection and size-dependent shell dissolution and mortality of newly settled bivalves. The addition of calcium carbonate buffers to sediments has been shown to offset these effects by increasing the aragonite saturation state of interstitial water and thus increasing the rate of settlement and recruitment of the soft-shell clam, Mya. arenaria to buffered sediments. Various materials have been suggested as possible sediment buffers; however, no research has directly focused on comparing the efficacy of different buffer materials and the necessary application concentration. We conducted a study to compare the efficacy of four different locally-available buffer materials, each at three different concentrations, to increase the calcium carbonate saturation state of interstitial water and the settlement and recruitment of M. arenaria. The data indicate specific buffer materials and increased concentrations of buffer materials have a positive correlation with both the calcium carbonate saturation state of interstitial water and the settlement and recruitment of M. arenaria.

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THE ACUSHNET RIVER RESTORATION PROJECT: RESTORING DIADROMOUS FISH POPULATIONS TO A SUPERFUND SITE IN SOUTHEASTERN MASSACHUSETTS
The Acushnet River has been the focus of a large-scale effort to restore river herring and American eel populations by improving access into the primary spawning and nursery habitat. Restoration efforts included the construction of a Denil fishway at the New Bedford Reservoir dam in 2002 and the installation of nature-like fishways at two downstream dams in 2007. Monitoring of river herring and juvenile eel (elver) populations was conducted pre- and post-construction using census counting and abundance estimation, respectively. Numbers of adult river herring returning to the reservoir during pre-construction were low and declining numbers of elvers served as a baseline to determine the effectiveness of the new fishways. Results from post-construction monitoring indicated an increasing trend of spawning adult river herring returning to the reservoir with a total count in 2013 representing an increase of 1870% over baseline conditions. Post-construction monitoring also suggests increased elver recruitment into the river, as well as increased numbers of elvers accessing habitat in the upper watershed. Monitoring results suggest that the fish passage improvements to the three dams on the river have improved passage for both elvers and river herring, thereby increasing the probability of restoring these populations to the Acushnet River.

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TRANSPORT REGIMES OF *PHRAGMITES AUSTRALIS* IN THE SACO RIVER ESTUARY, MAINE, USA
Phragmites australis is a unique but troublesome resident of many wetland ecosystems. This investigation's focus is on understanding the early stages of *P. australis* spread within the tidal portion of the Saco River in southern Maine. We looked at hydrodynamic dispersal in the estuary and also determined if any patterns exist among various parameters including patch location, size, stem density, stem height, salinity, nutrient availability, clonal diversity and other possibly related characteristics. Both ecological , genetic, and physical oceanographic techniques were employed to determine where propagules are hydrodynamically inclined to travel, if stands are native or invasive, and if stands are forming as a result of clonal spread and/or sexual reproduction. The long-term goal is to develop management initiatives to handle further spread of this problematic species and increase stakeholder interest and participation in its control.

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DIADROMOUS FISH ASSEMBLAGE ASSESSMENT IN THE SACO RIVER ESTUARY, ME
Coastal watersheds, such as the Saco River estuary (SRE), are known to play an important role in the life history of many diadromous fish species within the Gulf of Maine (GOM). Migratory fishes, key components of estuaries and marine food webs, have experienced significant population declines in the GOM since the early 20th century prompting the need to examine habitat use in order to maintain sustainable populations. Although the lower portion of the SRE serves as a nursery ground and a proposed foraging stop-over site for Atlantic and shortnose sturgeon, little is still known about the abundance and distribution of migratory fishes in small coastal rivers in Maine. To evaluate the structure and spatial resolution of this assemblage, weekly gillnet surveys were conducted at three sites from June-September to record fish presence and environmental conditions (bottom temperature, water column salinity and dissolved oxygen). During 2012 and 2013, the threatened Atlantic sturgeon, endangered shortnose sturgeon, and striped bass were among the 13 marine, diadromous and freshwater species observed representing resident, migratory, and transient life history categories. Fish abundance and diversity was lowest in areas of the estuary with significant salinity mixing and greatest in areas with less tidal influence. Fish species diversity was highest in the mixed middle area of the estuary with a positive correlation observed between fish abundance and temperature. Establishing a baseline dataset of annual fluctuations of diadromous fishes entering and leaving this estuary is essential for future restoration and management of these threatened GOM fish stocks.

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SALT MARSH RESTORATION: INFLUENCE OF BIOLOGICAL, HYDROLOGIC AND CHEMICAL VARIABLES ON ATTAINMENT OF TARGET VEGETATION COMMUNITIES

Vegetation is perhaps the most conspicuous manifestation of hydrologic and physico-chemical processes transformed by both tidal restrictions and subsequent enhancements of tidal flow (restoration). The plants themselves, both living and dead, comprise much of the above- and below-ground physical structure of tidal marsh systems, while plant vigor, species composition, and phenology are indicators of ecosystem health. Returning seawater flow to these systems started gaining popularity in New England in the 1980s and these projects are now occurring with increasing frequency throughout the United States. However, the rate at which we are now returning tides to restricted salt marshes has greatly outpaced efforts to quantitatively monitor vegetation in ways that can support rigorous analyses of the impacts and effectiveness of this work. This has limited our ability to evaluate progress and anticipate change. In reality, responses are quite variable. However, these variations in recovery are of great interest in that they enhance our understanding about the process itself and the range of possible outcomes. Vegetation responses to tidal restoration can take a number of different trajectories because they depend on a large number of physical, chemical, hydrologic, biological and anthropogenic variables, many of which cannot be measured. This talk will focus on many of these variables and discuss their influences on reaching target vegetation communities.

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THE PHYLOGEOGRAPHY OF *TENELLID* NUDIBRANCHS

Tenellia adspersa, a tiny estuarine nudibranch, is found in temperate climates globally. Scientific literature is conflicted and vague in officially describing which *Tenellid* species reside in which region. By composing a study of the biogeography of *Tenellid* nudibranchs using molecular data, I will resolve this issue. A Molecular approach is needed (as opposed to morphological and developmental comparisons) because *Tenellids* exhibit poecilogony (more than one developmental mode) and morphological comparisons have not produced a clear way to identify the species. This research has ecological, evolutionary, and even human health implications; *Tenellia spp*. may be used to study drugs that affect memory and learning due to their quick learning patterns and ease of culture. However, the species must be fully described before this type of testing occurs. This research is part of my Master of Science thesis dissertation, “Ecological, Evolutionary, and Human Interest Implications of *Tenellid* Nudibranch Phylogeography”.

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LONG ISLAND SOUND: PROSPECTS FOR THE URBAN SEA – A FOCUS ON INTEGRATING SCIENCE AND MANAGEMENT AND LESSONS FOR GREAT BAY, NH

Long Island Sound: Prospects for the Urban Sea, the most recent publication in the Springer Series on Environmental Management, is the first synthesis of the science of Long Island Sound in more than 35 years. Technical chapters summarize the advances in geology, physical oceanography, geochemistry, pollutant history, and biology and ecology related to the Sound. The influence of the geologic and natural histories of Long Island Sound on its cultural history is reviewed to help explain patterns of development, use, and impairment. A key theme is the understanding of the Sound’s ecosystem in the context of centuries of intense human use and subsequent degradation, followed by decades of active environmental management to the present. As for Great Bay, progress has been made in recent decades in restoring habitats, greatly reducing toxic contaminant loads, and managing living resources. Long Island Sound’s comprehensive program to manage nutrient load that address widespread cultural eutrophication and hypoxia impacts has championed innovative management including nutrient trading, bioextraction, and watershed controls, all with an eye to integrated and adaptive watershed management. In the Long Island Sound synthesis, these management successes and limitations are explored, and a prognosis made for a future driven by climate change forces. We will overview these actions and lessons, evaluate their relevance and transferability to the Great Bay, NH, setting and draw parallels for Great Bay actions and comprehensive watershed planning and a prognosis for the future.

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THE RELATIONSHIP BETWEEN HYPSOMETRY AND TIDAL INUNDATION WITHIN AND BETWEEN SALT MARSHES IN CAPE COD NATIONAL SEASHORE

Salt marshes are important ecosystems which are under threat from rising sea levels. To keep pace with sea level rise, salt marshes must accrete sediment and grow vertically, or the plants will gradually drown and die off. It is important to obtain highly accurate surface elevation measurements to assess which marshes are most vulnerable to sea level rise. In the summer of 2013, 7 salt marshes at Cape Cod National Seashore (CACO) were intensively surveyed using Real-Time Kinematic (RTK) GPS. 9,560 elevation measurements were taken in 20x20m grids spanning the entire vegetated surface of each marsh. These points were used to create digital elevation models (DEMs) for each marsh. Additionally, pressure loggers were deployed in 5 of these marshes at the upper and lower boundaries and in the transition zone between low and high marsh. This data was coupled with elevation data to investigate the relationship between hypsometry (area at particular elevations) and duration of tidal inundation within and between marshes. Based on the hypsometry and inundation period, qualitative assessments of the contributing characteristics of the 5 marshes to their relative vulnerability to SLR and climate change storm effects were made.

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TIDAL MARSH RESTORATION IN THE NORTHEAST: NOAA'S EXPERIENCES AND FUTURE DIRECTIONS

NOAA involvement in tidal marsh restoration in the Northeast has occurred through its Office of Habitat Conservation's Restoration Center (RC). The RC has provided technical assistance in and funding of all project phases (assessment through post-project performance monitoring) through its Community-Based Restoration Program (CRP) and Damage, Assessment, Remediation, and Restoration Program (DARRP), with fewer experiences via other programs (e.g., ARRA, ERA, Appropriated funds). NOAA project experiences have included hydrologic reconnection, fill removal, invasive plant control, native marsh plantings, tide gate installation, ditch plugging, and fill placement. Most of these projects have been completed through successful steadfast partnerships with non-governmental organizations and state, local and other federal agencies. Project technical challenges and beneficial outcomes will be summarized. NOAA has also supported and continues to dedicate staff and limited, targeted funding for marsh research activities, restoration performance metrics, and strengthening assessment and design practices. For on-going and future marsh restoration efforts, NOAA faces technical, regulatory, and funding challenges in addressing priority restoration actions including accelerating sea level rise affecting biogenic marshes of the Northeast. NOAA directed restoration funding will likely continue to be tight-metered by the on-going federal sequestration and Congressional impasse, and of limited funds available, will be targeted through the Habitat Blueprint strategy for high-priority, landscape-scale projects benefiting federally-listed species and federally-managed fisheries, while enhancing coastal resiliency and community vitality.

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CAPE COD'S SALT MARSH DIEBACK - MARKED ELEVATION CHANGE, SHIFTS IN PLANT DISTRIBUTION AND EROSION STEMMING FROM CRAB ACTIVITY

Denudation of salt marsh vegetation (aka salt marsh dieback) on Cape Cod, MA is driven by herbivory of a native, nocturnal crab species, Sesarma reticulatum. High densities of intertidal crabs at the mouth of Wellfleet's Herring River have led to large areas of bare sediments as well as rapid and surprising shifts in the distribution and abundance of palatable plant species. To quantify where and when sediments were eroding, we conducted annual ground-based elevation surveys from 2011-13. A 2013 ground based LiDAR scan in 2013 provided image-like elevation data which was used to provide a conservative estimate the volume of sediment lost due to the vegetation dieback. Sediment accumulation rates and relative flow associated with: 5 plant species, dead vegetation and bare areas were quantified. Total suspended solids (TSS) concentrations below dieback areas as well as areas of intact vegetation were also assessed. Plant community type affected dieback erosion rates as measured by TSS with the maximum difference in TSS concentration five times higher at a dieback site than at a vegetated site. We also mapped the various plant communities using ground based methods in 2012 and 2013. Shifts in plant distributions driven by elevation change, herbivory and sediment characteristics have occurred over the three year study period. Difference

in the susceptibility to herbivory as well as sediment accumulation rates/dynamics associated with different cover types have synergistically contributed to the rapid change in the physical and biological characteristics of this site. The consequences for the ecosystem function of this site and similar dieback sites in the region will be discussed.

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A TALE OF TWO SEDIMENT POPULATIONS: CHARACTERIZATION OF BOTTOM SEDIMENT IN THE CONNECTICUT RIVER ESTUARY
The Connecticut River Estuary is known to be a high-energy environment characterized by large sandy bedforms. Fronts have been observed in the estuary which have the potential to create local turbidity maxima and areas of fine sediment trapping. A high-resolution array of cores was taken in Fall 2012 and Spring and Fall 2013 in areas of suspected frontogenesis. Additional water column data, including velocity, depth, and suspended sediment were collected using an Acoustic Doppler Current Profiler, Acoustic Doppler Velocimeter, Conductivity Temperature Depth sensor, and Optical Backscatter Sensor. Grain size analysis of the surface sediment revealed a gradual fining towards the mouth of the river. Seasonally, grain size varied significantly between the Spring and Fall in 2013, with a finer median grain size in the spring. Within the frontal zone regions, there appears to be two distinct populations of sediment with different median grain sizes: one composed of a fine sand component and one composed of a clay and silt component. The sand fraction is present in all sampled areas, while the mud fraction is in concentrated regions. The two populations of sediment behave differently; the sand fraction is seasonally and annually stable, while the mud fraction varies on both the seasonal and annual scales. This indicates that the fine fraction could be dependent on shorter time-scale phenomena like discharge, while the sand fraction is more likely reflective of longer-time scale conditions, like underlying geology and mean flow.

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MODELLING CO_2 EMISSIONS FROM RECLAIMED SALT MARSHES IN THE BAY OF FUNDY
Extensive areas of salt marsh on the Bay of Fundy have been diked and drained for agricultural use, beginning with early Acadian settlement in the 17th century. We assume that this land use change resulted in considerable release of carbon dioxide to the atmosphere, but there are few direct measurements of carbon dioxide release with marsh drainage. We took a modelling approach to estimate how much carbon dioxide could have been lost from the top meter of soil due to historical marsh reclamation on the Bay of Fundy. We simulate carbon dioxide loss, starting with the C content measured in Bay of Fundy marshes today, apply a decay rate determined from agricultural soils, and assume that as the marsh soil decomposed that agricultural activities would simultaneously have added carbon. The loss from drainage and gain from agriculture nears equilibrium within 120 years, but minor losses of carbon dioxide could continue for another 100 years. Assuming that 85% or the original marsh area on the Bay of Fundy was transformed to agricultural land, then approximately 9*108 kg carbon dioxide could have been released due to this land transformation. Even with agricultural management only 1309 g carbon of the original carbon stored (41000 g carbon) in the top meter of marsh soil was retained in the model upon reaching equilibrium. The land use transformation has had a greater impact on carbon dioxide emissions than many other anthropogenic sources from the Maritime Provinces.

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COMMUNITY-BASED MONITORING OF LONG ISLAND SOUND EMBAYMENTS: CURRENT STATUS AND SUGGESTIONS FOR DEVELOPING A COMMUNITY-BASED MONITORING COOPERATIVE
This project was an exploration of the potential for coordination between community-based monitoring groups and data end users in Long Island Sound, including educators, scientists and managers. Community-based monitoring groups represent a valuable source of water quality information. The characteristics of established groups were assessed and opinions of these groups were sought to help guide the further development of community-based monitoring in Long Island Sound. Both groups of stakeholders stand to benefit from this type of coordination with the ultimate benefit being a healthier, better understood Long Island Sound. This project was phase one of what is hoped to be the development of a community-based monitoring cooperative. Suggestions included the development of standardized protocols, training methods and reporting procedures designed to align reporting; access for community groups to data visualization tools and a chance to compare across systems; and assuring quality such that end users have the confidence necessary to utilize the data collected as part of community-based monitoring

programs. Suggestions for pursuing the development of a cooperative will be shared and your input on this subject is invited.

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THE ROLE OF HISTORIC WETLANDS IN THE ESTABLISHMENT AND MAINTENANCE OF *PHRAGMITES AUSTRALIS* IN COASTAL DUNE HABITAT OF CAPE COD, MASSACHUSETTS

A variety of invasive species can be found along the coastal dunes of Cape Cod, Massachusetts. One such species is *Phragmites australis* (common reed); an aggressive plant that typically out-competes natives for space and resources. Extensive coastal erosion resulting from winter storms of 2012 has provided insight into one mechanism that aids in the proliferation of *P. australis* along the sand dunes at Coast Guard Beach. Portions of a 9,000-year-old wetland were exposed approximately 4 meters below the dune surface. The peat from this wetland provides a semi-impervious surface that traps lateral groundwater flow and rain water filtering down through the sand layer. Live roots and rhizomes from *P. australis* were observed growing in this peat layer, suggesting a competitive advantage for *P. australis*. One thought is that *P. australis* was present during modern times when the freshwater wetland was exposed prior to dune formation. If confirmed, this would suggest that *P. australis* grew upward in concert with dune development, with the original roots and rhizomes anchored in the freshwater peat providing water and nutrients in an otherwise limiting environment (sand dunes). The alternative hypothesis is that *P. australis* grew downward through the sand dunes to access water and nutrients in the buried peat layer. Thus, the historical freshwater peat layer allows *P. australis* to persist in coastal dune habitats along Cape Cod. Understanding the site-specific physical and biological mechanisms that provide *P. australis* with competitive advantages can improve management of this invasive species.

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RECENT TRENDS IN BIRD ABUNDANCE ON RHODE ISLAND SALT MARSHES

Salt marsh habitat is under pressure from development on the landward side, and sea level rise from the seaward side. The resulting loss of habitat is potentially disastrous for salt marsh dependent species. To assess the population status of three species of salt marsh dependent birds in Rhode Island, we repeated a survey previously conducted in 2007 and 2008. During June and July of 2013 nine Rhode Island salt marshes were surveyed in their entirety for the presence of Saltmarsh and Seaside Sparrows and Willets. Seaside Sparrow relative abundance declined between 2008 and 2013, similar to a previous decline between 1982 and 2007/2008. Seaside Sparrow relative abundance decreased at four of the six marshes where they had been observed in 2007/2008. No Seaside Sparrows at all were detected in 2013 on two of those marshes on which sparrows had been detected in earlier surveys. The average Seaside Sparrow relative abundance decreased from 8.2 and 11.2 sparrows per marsh in 2007 and 2008 respectively to 5.3 sparrows per marsh in the 2013 survey. Average Saltmarsh Sparrow relative abundance per marsh appeared to not change between 2007, 2008, and 2013 (26, 27.75, and 26.77 sparrows per marsh respectively). Nor did the relative abundance of Willets appear to change (9.7, 13.1, and 12.4 Willets per marsh respectively). Our research indicates a continued decline in Seaside Sparrow relative abundance on Rhode Island marshes while the relative abundance of Saltmarsh Sparrows and Willets appeared to be more stable. Further research is needed to compare the local changes in salt marsh bird populations on our marshes with changes in salt marsh habitat and regional population trends.

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CONSIDERATIONS FOR SUCCESSFUL CITIZEN SCIENCE PROGRAMS

Since Salem Sound Coastwatch's (SSCW) inception in 1990, citizen science has been a key component of program activities. Trained volunteers collect water samples, conduct shoreline surveys, monitor salt marshes, record observation of marine invasive and native species, and conduct winter waterfowl surveys. SSCW is currently exploring new citizen science programs that monitor climate change impacts. Developing citizen science programs requires thoughtful design and preparation. Program development should be driven by a need and/or question. Protocols must be defined and vetted. A federal and/or state government-approved Quality Assurance Project Plan is a necessity if data are being collected that could result in governmental actions. Volunteers must be trained to follow protocols and supervised to assure quality control (even when there is no QAPP). SSCW's experience is that citizen scientists need and appreciate on-site supervision during monitoring. Another factor to be considered is where and how the data collected by citizen scientists are stored and used. SSCW has experienced problems with proprietary databases that have stopped working--causing problems for long-term data maintenance and retrieval. Data analysis

and reporting findings are time-consuming tasks. Outside funding can drive data analysis and report development, but when funding is not supporting long-term data collection, reporting may slip by the wayside. People who volunteer as citizen scientists want to learn, collect useful information and see the results of their collective work. Designing citizen science monitoring programs that meet these criteria is a worthwhile challenge.

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A TALE OF TWO MARSHES: ORIGINS OF SALT MARSH RESTORATION SCIENCE AND MANAGEMENT IN NEW ENGLAND
The first attempts at restoring community structure and ecosystem functions to tidally restricted, salt marshes in New England were at the Pine Creek system in Fairfield, CT and the Barn Island marsh complex in Stonington, CT. Pine Creek has a highly urbanized watershed and heavily developed marsh upper border; tide range is *ca.* 2 m. With urbanization came a series of 9 flood protection tide gates. In 1945 100+ ha of Pine Creek marshes were open to the tides; by 1968 just 6.4 ha of marsh remained tidally linked to Long Island Sound. Gated marshes converted largely or completely to *Phragmites australis*. The Barn Island Wildlife Management Area includes a 290 ha largely undeveloped forest watershed fronting 120 ha of salt and brackish tidal marsh; tide range is < 1 m. From 1946 to 1965 the State of Connecticut impounded and tide gated five of the six valley marshes in this system; by 1968 one was dominated by *Typha angustifolia*, two others by *P. australis* and one by open water. In 1972 the Town of Fairfield and the State of Connecticut began restoring tides to sections of Pine Creek and Barn Island. At both sites *Spartina* dominated vegetation and typical salt marsh invertebrate, fish and bird communities returned, following individual trajectories. These successes lead to a state program of streamlined bureaucratic permitting, adaptive agency management, and scientific research on restoration mechanisms and processes - and arguably provided impetus for the large body of research and on-the-ground projects of salt marsh restoration throughout New England.

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DEATH BY *ULVA*
We report on a series of field and laboratory mesocosm experiments where we examined the effects of two levels of decomposing Ulva on Spartina alterniflora growth, soil biogeochemistry, and nitrogen dynamics. Monitoring of porewater revealed rapid mineralization to ammonium from decomposing Ulva, with porewater levels quickly attaining potentially toxic concentrations. In addition, Ulva soil amendments were associated with elevated porewater sulfide levels. Plant uptake of Ulva-derived nitrogen was documented using an 15N label, but higher nitrogen availability did not subsidize growth. In fact, higher levels of Ulva exposure resulted in pronounced reductions in above and belowground productivity, while lower levels of Ulva exposure resulted in reductions in belowground productivity only. Our findings support the hypothesis that decaying Ulva mats may create hotspots of adverse physiochemical conditions in salt marshes, similar to those reported for benthic and tidal flat habitats. Furthermore, decaying Ulva mats may compromise the erosion resistance of salt marshes via decreased plant belowground biomass. We conclude that additional field and laboratory studies are needed to establish more concretely which Ulva related stressors are primary, and whether similarly adverse responses are observed under natural field conditions.

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DETERMINING SEX RATIOS AND SEXUAL MATURITY OF ATLANTIC STURGEON (*ACIPENSER OXYRINCHUS*) IN THE SACO RIVER, MAINE
The Atlantic sturgeon (*Acipenser oxyrinchus*) is a long-lived, anadromous fish species ranging from Labrador, CA to Florida, USA. In the Saco River, located in the Gulf of Maine, Atlantic sturgeon were common in the 1920's, but were extirpated by the 1950's due to overfishing. However, after a 60 year absence, Atlantic sturgeon reappeared in the Saco River in 2007. Although the reason for the return of this species to this river system remains unknown, research on basic life history information is necessary to facilitate the conservation of this federally protected species. Understanding reproductive parameters such as sex ratios and sexual maturity are vital to effective management of any species. Unfortunately, this information is typically obtained by lethal, gross dissection, or stress inflicting endoscopy. Thus, in order to better understand these important life history parameters, three non-invasive techniques (steroid hormone analysis, ultrasonography, and external morphological features) are being utilized to non-lethally

determine sex ratios, sexual maturity, and reproductive status for sturgeon captured within the Saco River watershed. Preliminary results suggest that the combination of these three techniques provides the most accurate assessment of reproductive parameters in Atlantic sturgeon. This study will continue to couple these techniques in order to determine reproductive parameters of Atlantic sturgeon inhabiting the Saco River, which in the future can be applied to other sturgeon populations.

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SPECIES IDENTIFICATION OF HAKE IN MAINE MARKETS

Gadoid fishes (including cod, haddock, pollock and hake) comprise a commercially and ecologically important group both in the Gulf of Maine and worldwide. Hakes are particularly interesting as a number of different species from multiple families are referred to as hake. The use of this common name increases the potential for ambiguous or inaccurate labeling of hake products. Authenticating the species of commercially sold fish is important for consumer health and prevention of sale of lesser value fish as higher value fish. In this study, a Polymerase Chain Reaction Restriction Fragment Length Polymorphism (PCR-RFLP) assay was developed to differentiate between five species of hake and six additional species of groundfish common in the Gulf of Maine. Assay development and validation was conducted using tissue samples collected and identified by scientists and volunteers in the northwest Atlantic Ocean. In collaboration with local Maine markets, this assay is currently being used to describe the species composition of hake fillets and assess the validity and specificity of labels for hake and Atlantic Pollock fillets. The assay is accurate at identifying hake species with 100% of samples matching the predicted restriction fragment patterns for *Phycis chesteri* (n=8), *Urophycis tenuis* (n= 10) and *U.chuss* (n=20) as well as 92.3% for *U.regia* (n=13) and *Merluccius bilinearis* (n=13). This technique may be used in the future for continued quality assurance testing as well as monitoring the species composition of hake in the marketplace over time.

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MARSH SOIL RESPONSES TO NUTRIENTS: BELOWGROUND STRUCTURAL AND ORGANIC PROPERTIES

Coastal marsh responses to nutrient enrichment apparently depend upon soil matrix and whether the system is primarily biogenic or minerogenic. Deteriorating organic rich marshes (Jamaica Bay, NY) receiving wastewater effluent had lower belowground biomass, organic matter, and soil strength, larger rhizomes, and greater carbon dioxide emission rates than stable marshes. The deteriorating marshes maintained soil volume through production of larger diameter rhizomes and swelling of waterlogged peat, and were able to keep pace with sea level rise. In contrast, marsh responses to 12 years of fertilization in a minerogenic marsh system (North Inlet, SC) were an increase in organic matter, an increase in rhizomes, a decrease in fine roots, and an increase in carbon dioxide emission rates. Other marshes in the North Inlet system were influenced by nutrient inputs associated with residential development. These marshes had significantly larger rhizomes, more organic matter, and higher carbon dioxide emission rates compared to marshes at the mouth of the system, which is dominated by exchange with bay waters. The results suggest sediment and particulate inputs in minerogenic systems may have a mitigating effect on coastal marsh responses to nutrient inputs.

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FYKE NETTING OF FRINGING MARSHES OF THE SACO RIVER, MAINE REVEALS HIGH NEKTON DIVERSITY

Very few studies have characterized nekton communities of the Saco River Estuary. This study uses fyke nets to sample nekton from eight fringing marshes over two consecutive tidal cycles every August from 2010 to 2013. Fyke nets captured 4,167 individuals representing 27 fish species and 2 crustaceans. Total numbers captured were highly variable across years and sites and reveal a mixture of native and non-native species. In general, species richness increased with distance from the river mouth mostly through the addition of freshwater species (25-60% of species at upriver sites). This observation tracks a measured salinity gradient. Both the Shannon-Weiner and Simpson's diversity indices reveal that the site furthest upriver was the most diverse in all but 2012. In terms of species composition, Sorenson's Similarity Index shows this site was most like sites near it and most dissimilar from sites located closest to the river mouth. At the estuary scale, eight species (*Anguilla rostrata, Alosa aestivalis, Carcinus maenas, Micropterus salmoides, Fundulus heteroclitus, Crangon spemspinosa, Fundulus majalis, and Morone americana*) were found in all years. The dominant species by number in the system was *Alosa pseudoharengus* in

2010 (961 individuals, 44% of the total catch) and *Alosa aestivalis* in 2011, 2012, and 2013 (660 individuals, 73% of the total catch, 504 individuals, 68% of the total catch, and 189 individuals, 57% of the total catch, respectively). The dominant species by biomass in all years was *Anguilla rostrata*, comprising 24-66% of total system biomass. This study shows that the Saco River Estuary supports diverse nekton communities that may be of conservation interest.

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SURVEY OF GREEN CRABS (*CARCINUS MAENAS*) IN SALEM SOUND, MASSACHUSETTS

Since the arrival of the invasive European green crab (*Carcinus maenas*) in Massachusetts waters in the 1880's the species has had a significant negative impact on the soft-shell clam (*Mya arenaria*) industry. Various locations in New England have noted a recent increase in the numbers of green crabs with a concurrent decline in soft-shell clams. In an effort to get a better picture of the current green crab population in Salem Sound, an ongoing year-long trapping survey was initiated in July 2013. To date nearly 3000 green crabs have been collected using baited traps deployed off docks once per month at several locations in Salem and Beverly harbors and the Danvers River and Bass River estuaries within Salem Sound. Preliminary data on crab sex ratios, carapace widths, and ventral surface colorations (after molting, the color of a crab's ventral surface progresses from green to yellow to orange to red due to photodegradation) will be presented and compared to similar recent green crab trapping projects from other areas in New England.

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