Dr. Ivan Valiela
Dr. Erin Kinney
Woods Hole Environmental Associates
July 28, 2011

Mr. Tom Irwin
Conservation Law Foundation
27 North Main Street
Concord, NH 03301

Dear Mr. Irwin,

You have requested that we review the Numeric Nutrient Criteria developed by the New Hampshire Department of Environmental Services (NHDES) relative to the Great Bay estuary, as well as various arguments raised by John Hall & Associates, and that we provide our opinion regarding the scientific validity of the NHDES Numeric Nutrient Criteria as a basis for regulatory decision making. We have conducted substantial research on the effects of nitrogen loading on estuarine systems. Dr. Ivan Valiela has been studying the effects of nitrogen loading on estuarine systems for 41 years. He has published dozens of peer-reviewed studies of the effects of nitrogen on estuaries, and is well-recognized as a leader in the field. He has been part of national and international boards and panels dealing with these issues, and has been part of many other key organizations in relevant fields. Dr. Erin Kinney conducted her dissertation research on the effects of nitrogen loading on Waquoit Bay, MA, Great Sippewissett Marsh, MA and Great South Bay, NY and has published several peer-reviewed studies. She is currently studying nitrogen management options for Great South Bay, NY and the effects of long-term nitrogen loading on salt marsh vegetation and sediments. Our curriculum vitae are attached.

Great Bay has been the subject of scientific study for decades, and more recently has been the subject of studies in regard to water and habitat quality. We have reviewed the NHDES Numeric Nutrient Criteria for the Great Bay Estuary, the two external reviews of that report, the Draft Analysis of Nitrogen Loading Reductions for Wastewater Treatment Facilities and Non-Point Sources in the Great Bay Estuary Watershed (2009), and the Amendment to the New Hampshire 2008 Section 303(d) List Related to Nitrogen and Eelgrass in the Great Bay Estuary

(2009). We have also reviewed the technical memorandum prepared by the consulting firm HydroQual at the request of Hall & Associates (2011), reviewing the NHDES Numeric Nitrogen Criteria, the Comments from the NHDES on HydroQual's Technical Memorandum (2011), and the Memorandum of Agreement between the Great Bay Municipal Coalition and the NHDES relative to Reducing Uncertainty in Nutrient Criteria for the Great Bay/ Piscataqua River Estuary (2011). Finally, we have reviewed Powerpoint slide presentations from the public hearing on the draft Exeter wastewater treatment plant permit convened by the EPA on June 9, 2011.

In response to a number of environmental concerns, in 2009, the NHDES developed numeric water quality criteria for the Great Bay Estuary. The criterion established for preservation of eelgrass meadows requires median total nitrogen concentrations at or below 0.3 mg N/L. In addition, the criterion established for maintaining oxygen concentrations above critical levels requires median total nitrogen concentrations at or below 0.45 mg N/L.

We found the NHDES Numeric Nutrient Criteria report to be a well organized and thorough summary of the available nutrient and water quality data for Great Bay. While we would have preferred to see a watershed nutrient load-based approach, as this would provide a better basis for interpretations and comparisons of a variety of land-derived[1] nutrient sources and drivers of eutrophication, it is our opinion that the use of available data on concentrations was appropriate and was strengthened by using multiple lines of evidence to arrive at the numeric nutrient criteria. Below we address the connection between estuarine nitrogen concentration and load and eelgrass loss as found in Great Bay, the Squamscott River, and by scientific studies in New England estuaries and elsewhere. Then, we address the concerns raised in by Hall & Associates and the town of Exeter about dissolved oxygen measurements and the reliability of the available data.

**Nitrogen**

*Nitrogen concentrations and seagrasses*

While the interpretation of nitrogen concentrations can be complicated, the data reviewed in the NHDES report clearly show that nitrogen concentrations in various parts of the estuary are elevated, especially in the tributary rivers. Below, we compare the nitrogen concentrations in

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[1] As used in this document, "land derived" includes nitrogen from wastewater treatment plants, atmospheric deposition and non-point sources.

Great Bay and the Squamscott River to New England estuaries that have similar nitrogen concentrations.

There is persuasive evidence that shading created by increased primary production (of phytoplankton, macroalgae, and epiphytes) has negative effects on eelgrass (Duarte 1995, Borum 1996, Valiela and Cole 2002, Hauxwell et al. 2003). The NHDES (2009a) finding that there is some linkage between chlorophyll and dissolved inorganic nitrogen concentrations in water in Great Bay is certainly in keeping with what we, and many others, have seen in other systems with increasing nitrogen loading. We can compare the effect of nitrogen concentrations on seagrasses by compilations of values of concentrations (Table 1) in a variety of coastal waters. Great Bay's median dissolved inorganic nitrogen concentration is similar to the dissolved inorganic nitrogen concentration in the Quashnet River, for example. The Quashnet River experiences macroalgal blooms and has no eelgrass remaining. Other estuaries, with concentrations 2-2.4 µM, do still contain eelgrass meadows. These comparisons suggest that Great Bay is in transition in terms of the status of its eelgrass meadows: from an eelgrass dominated system to one dominated by macroalgae. We further note that the NHDES proposed nitrogen criterion related to eelgrass, expressed as DIN concentration, lies close to the DIN concentrations found in the Quashnet River. Since no eelgrass survives in that Cape Cod estuary, the similarity suggests that DIN criteria might presently be too high to allow increases in extent of eelgrass beds in Great Bay as a whole. This observation is consistent with NHDES's observation that the numeric nitrogen criteria is for the preservation of current eelgrass areas and might not be low enough for expansion of the current eelgrass area (NHDES 2010).

*Table 1. Measured DIN concentrations (µM) in Massachusetts and Great Bay estuaries and concentrations proposed by NHDES numeric nutrient criteria. Squamscott, Great Bay, and criteria values calculated DIN as 37% of TN (NHDES 2009).*

| Estuary | DIN (µM) | Eelgrass | Source |
|---|---|---|---|
| Sage Lot Pond, MA | 2 | Y | Tomasky Holmes 2008 |
| Jehu Pond, MA | 2.4 | Y | Olsen et al. 2010 |
| NHDES numeric nitrogen criteria (eelgrass) | 8 | | NHDES 2009a |
| Quashnet River, MA | 10 | N | Tomasky Holmes 2008 |
| Great Bay, NH | 11 | Y | NHDES 2009a |
| NHDES numeric nitrogen criteria (DO) | 11.6 | | NHDES 2009a |
| Squamscott River, NH | 19.7 | N | NHDES 2009a |
| Childs River, MA | 22 | N | Tomasky Holmes 2008 |

More particularly, the NHDES report shows the median DIN concentration in the Squamscott River system was approximately 20 μM, nearly as high as the Childs River, the most eutrophic sub-estuary in the Waquoit Bay system (Table 1). The Childs River has no eelgrass area remaining, suffers intensive macroalgal blooms, and frequent hypoxia as a result of its high nitrogen load (Fox et al. 2008); we might expect similar future conditions in the Squamscott River. Additionally, the nitrogen in the Squamscott River contributes to the total nitrogen in Great Bay, threatening eelgrass in the Bay.

*Nitrogen loads and seagrasses*

According to the Powerpoint presentations from the June 9, 2011 public hearing, Hall argued that there was no evidence for a direct cause and effect of nitrogen on eelgrass loss. Latimer and Rego (2010) and others have demonstrated that increased land-derived nitrogen load was significantly related to loss of eelgrass habitats (Figure 1, and Short and Burdick 1996). Loss of eelgrass area increases steeply as land-derived N loads increase, and there is a near complete

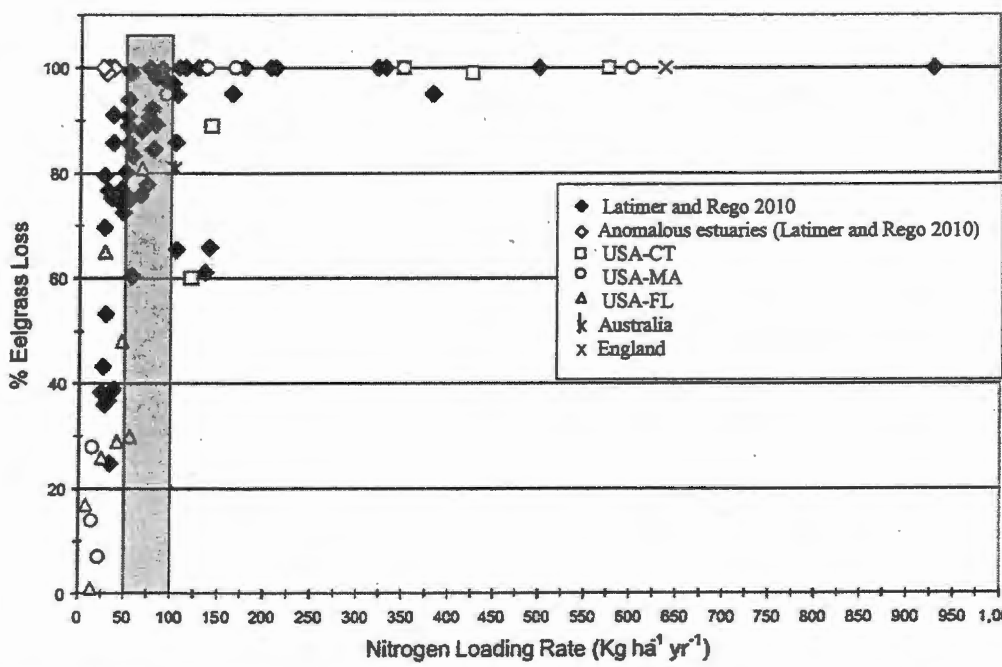


*Figure 1. Plot of eelgrass loss (percent) vs. nitrogen loading rate (Kg N ha$^{-1}$ yr$^{-1}$) (from Latimer and Rego 2010; other data sources: Valiela and Cole 2002, Steward and Green 2007, Vaudre, 2008); note not all of the data from the literature are for* Zostera marina. *Gray bar is the loading threshold range from the literature 50 - 100 Kg ha$^{-1}$ yr$^{-1}$).*

loss of these important habitats at N loads beyond 100 kg N ha$^{-1}$ yr$^{-1}$. Furthermore, Latimer and

Rego (2010) found that physical processes within the estuary were less important than total nitrogen load in determining eelgrass loss. This is a relevant observation, as there have been claims that hydrodynamic forcing in Great Bay may be more consequential than land-derived nitrogen loads.

The fact that eelgrass is still present in certain areas of Great Bay is highly significant. It means that the nitrogen loads to those areas of Great Bay have not exceeded the threshold at which eelgrass is eliminated entirely. Land use on the Great Bay watershed has changed in ways that inevitably increase land-derived nitrogen loads (Latimer et al. 2009). Those loads have increased differently within the subwatersheds of the Great Bay estuary. More detailed modeling to ascertain the local delivery of nitrogen in the different parts of the Great Bay estuary will be a useful asset to management. We understand that J. Latimer of US EPA Narragansett has calculated some of these loads and is in the process of completing others (Latimer et al. 2009).

*Table 2. N loads to estuaries per hectare of estuary in the USA and abroad.*

| Estuary | N load (kg N $ha^{-1}$ $yr^{-1}$) | Seagrass | Reference |
|---|---|---|---|
| Sage Lot Pond, Massachusetts, USA | 14 | Y | Valiela et al. (2000) |
| Moreton Bay, Australia | 24 | Y | O'Donohue et al. (2000) |
| Barnegat Bay, New Jersey, USA | 24.5-30.1 | Y | Bowen et al. (2007) |
| Pleasant Bay, Massachusetts, USA | 25 | Y | Carmichael et al. (2004) |
| Tampa Bay, Florida, USA | 28 | Y | Bianchi et al. (1999) |
| Hamblin Pond, Massachusetts, USA | 28 | Y | Kinney and Valiela (submitted) |
| Jehu Pond, Massachusetts, USA | 29 | Y | Kinney and Valiela (submitted) |
| Chincoteague Bay, Virginia, USA | 31 | Y | Boynton et al. (1999) |
| Great South Bay, New York, USA | 38 | Y | Kinney and Valiela (2011) |
| Sarasota Bay, Florida, USA | 56 | Y | Bianchi et al. (1999) |
| West Falmouth Harbor, Massachusetts, USA | 76 | Y | Carmichael et al. (2004) |
| Venice Lagoon, Italy | 130 | Y | Sfriso et al. (1992) |
| **Great Bay, upstream of Adams Point** | **161** | **Y** | **estimate based on NHDES 2010** |
| Roskild Fjord, Denmark | 204 | Y | Nienhuis (1992) |
| Quashnet River, Massachusetts, USA | 350 | N | Valiela et al. (2000) |
| Wadden Sea, Northern Europe | 500 | N | Nienhuis (1992) |
| Childs River, Massachusetts, USA | 601 | N | Valiela et al. (2000) |
| **Squamscott River, New Hampshire, USA** | **1576** | **N** | **NHDES 2010** |

To assess the degree of eutrophication of Great Bay and the Squamscott River, it is useful to compare conditions to those in other estuaries (Table 2). According to our best-estimate calculation, nitrogen load to Great Bay (upstream of Adam's Point) is 161 kg N $ha^{-1}$ $yr^{-1}$ (Latimer 2009)[2], putting Great Bay in the range of moderate nitrogen loads to estuaries (Table 2).

[2] Area 7300 acres, from Great Bay National Estuarine Research Reserve website

We can then compare this figure to the data of Figure 1 to see what this may mean in terms of the fate of eelgrass beds: a load between 100-200 kg N $ha^{-1}$ $yr^{-1}$ is consistent with our view that Great Bay is in transition, nearing very high rates of eelgrass loss.

We can also extend these comparisons to more localized geographical areas. NHDES calculated nitrogen load to Squamscott (Exeter) River as 1576 kg N $ha^{-1}$ $yr^{-1}$ (NHDES 2010), which is more than twice the nitrogen load per hectare than Childs River (Table 2). As might be expected, there is no eelgrass today in Squamscott River (NHDES 2009b), although there was eelgrass there in 1948 and in 1960, and below the railroad bridge as late as 1990 (Short 2011).

More evidence of a direct link between increases in N loads and loss of eelgrass is given in many peer-reviewed papers. Increased N, as nitrate or ammonium, has been argued to be detrimental to eelgrass via shading of growing meristem by macroalgae (Hauxwell et al. 2003) and shading by epiphytes and plankton (Valiela and Cole 2002, Hauxwell et al. 2003).

Hauxwell et al. (2003), in studies in Cape Cod estuaries, found that the mean annual irradiance reaching eelgrass decreased with increasing nitrogen load when they evaluated the light interception by the water column, epiphytic growth on eelgrass, and macroalgal growth for established shoots and for new growth of eelgrass (Figure 2). In the estuary with highest nitrogen load (Hamblin Pond, 28 kg N $ha^{-1}$ $yr^{-1}$), macroalgae and epiphytes had the potential to intercept close to 100% of sunlight available to eelgrass. The results from Waquoit Bay corroborate our earlier observations (see pages 3 – 4) that that the higher nitrogen loads in Great Bay could result in higher macroalgal and epiphytic growth, and therefore higher potential interception of irradiance. In Great Bay, macroalgal abundance, currently at 137 acres of macroalgal mats (NHDES 2009a, Figure 18), is increasing and threatening eelgrass beds. The maps and trends again suggest that the Great Bay ecosystem is in transition. In addition, the amount of epiphytic biomass growing (and further shading eelgrass leaves) is higher in Great Bay than is found in Massachusetts estuaries (Short 2003). The inference is that the trend in macroalgal and epiphytic growth is diminishing eelgrass beds.

The amount of light in the water column of the Squamscott River has also been much discussed in the various documents we have read. Squamscott River has a history of eelgrass growing as far upstream as Chapman's Landing as recently as 1960. This suggests that transparency of the water column was adequate for eelgrass growth. We have no reason to

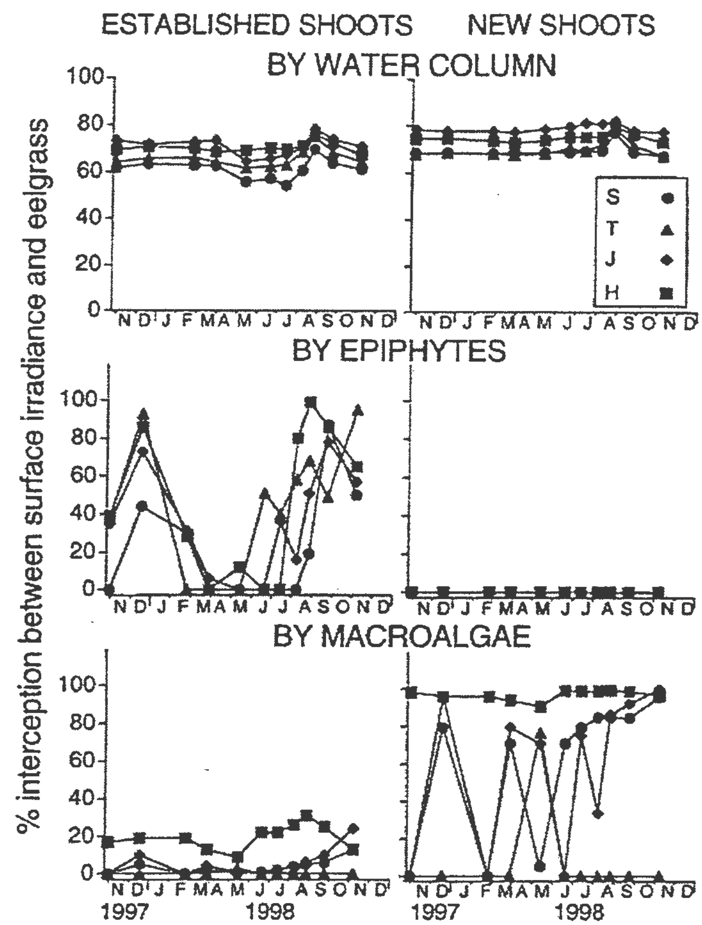


*Figure 2. Percentage of surface irradiance attenuated through the water column (top), by epiphytes (middle), and by macroalgal canopies (bottom) for established (left) and newly recruiting (right) eelgrass shoots between November 1997 and November 1998 in 4 estuaries of Waquoit Bay subject to different rates of nitrogen loading from, lowest to highest, (T: Timms Pond, S: Sage Lot Pond, J: Jehu Pond, H: Hamblin Pond). Epiphyte and macroalgal light attenuation were based on incoming irradiance after water-column attenuation (from Hauxwell et al. 2003).*

assume that natural color, organic or inorganic dissolved matter in the Squamscott River have changed since that time. However there is evidence that nitrogen inputs have increased.

**Dissolved oxygen**

Hall argued that there was uncertainty as to the extent that nitrogen is causing low dissolved oxygen (DO) in Great Bay, and also stated that DO was not changing due to plant growth, but due to physical factors. It is our opinion that, instead, the data presented in the NHDES response to the HydroQual report, which showed daily increased dissolved oxygen during the day, and decreased oxygen concentrations during the night, are an evident signature of the influence of increased primary production, and this, in turn, is almost certainly a result of increased nitrogen loading.

DO is highly sensitive to a variety of factors that affect plant, fish, and benthic communities (Howarth review of NHDES report). Hourly and daily variation can make sampling technically challenging, but the use of continuous sampling devices has greatly increased the scope and accuracy of DO measurements in the field. The continuous measurements of oxygen concentrations in Great Bay and the Squamscott River (NHDES 2009a) consistently showed that DO begins to increase in the morning, peaks during mid-day, and becomes lower at night, reaching low values early in the morning: the simplest explanation of this repeated daily effect is that concentrations of DO are largely influenced by the daily activity of the plants and algae within the estuary. This clear diurnal pattern would definitely not be so evident if tidal exchange or other hydrodynamic processes were controlling DO concentration (because changes in daylight and tides are not synchronous). A completely similar pattern, governed by producer daily activity, was reported from the estuaries of Waquoit Bay, Massachusetts (D'Avanzo et al 1996), which highlights the strong control that producers have on oxygen concentrations in shallow coastal waters. NHDES's comments on HydroQual's technical memorandum also clearly demonstrate that the data show that physical factors are less important than primary productivity in controlling DO.

**Conclusions**

There is very strong, empirical evidence that there have been increases in land-derived nitrogen loads and nitrogen concentrations and that eelgrass habitat and minimum dissolved oxygen concentrations are lowered as a result, in global (Waycott et al. 2009) and regional (Latimer and Rego 2010) terms. The Great Bay estuary shares this fate, judging from the evidence we have seen, and does not differ at all from what we have seen elsewhere.

We therefore agree with the opinion given by Dr. Robert W. Howarth, and Dr. Walter R. Boynton, who were asked by the Environmental Protection Agency (EPA) to provide independent peer reviews of the report by NHDES. Dr. Howarth and Dr. Boynton are highly regarded experts in the field of estuarine biogeochemistry and eutrophication, have published dozens of peer-reviewed studies of the effects of nitrogen on estuaries, and have been well-recognized as leaders in these fields. Both have been part of national and international panels dealing with these issues, both have been Presidents of the Coastal and Estuarine Research Federation, and have been part of many other key organizations in relevant fields. Their opinions have to be taken as authoritative.

We agree with Howarth's and Boynton's assessments that the Numeric Nutrient Criteria for the Great Bay Estuary provides an excellent basis for protecting the estuary and is an improvement over narrative nutrient criteria. Both opined that the NHDES report was easy to follow and the methods were transparent. We also agree with Howarth and Boynton that a nutrient load based approach might have been stronger, but add that we believe that long-term (9 years) extensive empirical datasets on several key indicators of eutrophication status that are available from Great Bay and several of the tributary rivers give considerable strength to the conclusions drawn by NHDES.

Eelgrass is a rather sensitive indicator of effects of nutrient loads, so that the nutrient criteria advanced by NHDES, based on protection of eelgrass habitats are, as a consequence, a reasonable conservative standard to use as an assessment of the health of the estuary in general. Moreover, owing to the ecological services furnished by eelgrass meadows, as Dr. Boynton clearly stated, "preventing the loss of SAV and preventing the proliferation of macroalgae is of prime importance," as well as serving as a conservative sentinel of the status of Great Bay.

The Great Bay estuary appears to be a system transitioning from threatened eelgrass habitat into habitats dominated by other kinds of estuarine producers (macroalgae), and the transition seems closely linked to increases in land-derived nitrogen loads. There can always be more study, to more fully understand every factor contributing to the health of the estuary, but we believe that the evidence for the need to decrease the land-derived nitrogen load is overwhelming. No amount of hydrodynamic modeling or larger data sets will change the fact that the amount of nitrogen entering the Great Bay estuary is increasing and there must be substantial nitrogen reductions if the eelgrass habitats, and all of the ecosystems services that they provide, are to survive. The solution to the eutrophication of the Great Bay estuary is going to require control of wastewater nitrogen—a significant and controllable source of nitrogen. The plan to deal with the problem also will need to include a combination of point and non-point nitrogen sources, and future changes in land use (NHDES 2010). The conclusions of NHDES regarding Numeric Nutrient Criteria of the Great Bay estuary are supported by studies in other

New England estuaries and can provide a sound basis for permitting decisions, including those for the Exeter wastewater treatment plant.

Sincerely,

Ivan Valiela

Erin L Kinney

Erin Kinney

# EXHIBIT 29 (AR H.13)



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***Education:***

Ph.D., Cornell University (1968), Ecology; B.S., Rutgers University (1964), Agricultural Research.

***Member:***

American Soc. of Limnology and Oceanography, Coastal and Estuarine Research Federation, North Eastern Estuarine Research Soc.

***Academic activities:***

Senior Res. Scientist, The Ecosystems Center, Marine Biological Laboratory (2008-present).

Emeritus Professor, 2008-present; Professor, 1980-2007, Assoc. Professor (1975-1980), Assist. Professor (1969-1975).

Co-Director, Marine Ecology Course, Marine Biological Laboratory (1975-1983).

Act. Director, Boston Univ. Marine Progr. (1986-1987),

Coord., Woods Hole Mar. Sci. Consortium (1985-present), and Director, REU site Coastal Bays of New England (1995-2007).

Taught courses at Fac. de Biologia, Univ. de Barcelona (1985), Inst de Biologia Marina y Pesquera "Alte. Storni", San Antonio Oeste, Argentina (1986); Facultad de Ciencias del Mar, Univ. de Las Palmas, Gran Canaria, Spain (1989-1991); Inst. de Ciencias del Mar y Limnologia, Univ. Nac. Autonoma de Mexico (1998), Inst. Oceanografia, Univ. de Sao Paulo, Brazil (1998); Facultad de Biologia, Universidad de Oviedo, 2006, Università Ca' Foscari, Venice, 2007.

Visiting Scholar, Dept. of Oceanography, Univ. of Washington (1981), Univ. of Barcelona (1982).

Post-doctoral NIH Trainee, Department of Zoology, Michigan State University (1969).

***Institutional and editorial activity:***

Member, Consiglio Cientifico, Stazione Zoologica "Anton Dohrn", Naples (1995-2000); Board Member, Fundacion Antorcha, Argentina; Jury for Fundacion Bunge y Born National Prize, Argentina; Bd. of Dir., Assoc. for Preservation of Cape Cod (1989-1991); Bd of Adv., Amer. Littoral Soc. (1982-1996), Ext. Rev. Board, University of Groningen, the Netherlands; Member-at-large of Governing Board of CERF (2007-2010); Jury for BBVA Prize for Biodiversity and Conservation (2008), Member, NOAA Science Advisory Board Ecosystem Sciences and Management Working Group, Pres., Comité Ejecutivo del Laboratorio Internacional de Cambio Global.

Editorial Board, *Rev. Hist. Nat. Litoral* (Argentina) (1982-2000), *Limnetica* (1987-2000), Board of Editors, *Limnology and Oceanography* (1989-1992), *Scientia Marina* (1989-2006). Editor, Estuarine, Coastal and Shelf Science (2006-present).

***Other Activities:***

Consultant, advisor, and lecturer in coastal ecology to educational institutions, government agencies, towns, and government agencies in Massachusetts, Virginia, New Jersey, New York, Alaska, Argentina, Italy, Spain, Portugal, Mexico, Brazil, Holland, and Trinidad and Tobago.

Manuscript, book, and proposal reviewer for many journals, government agencies, private foundations, and panel member in various sections of NSF, NASA, EPA, NOAA Sea Grant Programs.

EXHIBIT 29 (AR H.13)

Author of widely used texts: *"Marine Ecological Processes"*, Springer-Verlag, New York, 1984, and 2nd Ed. 1995; *"Doing Science: Design, Analysis, and Communication of Scientific Research"* Oxford University Press, New York, 2001, and 2nd Ed., 2009; *"Global Coastal Change"*, Blackwell Publ. London, 2006.

### *Awards*

Achievement Award, New England Estuarine Research Society, for very significant contributions to estuarine science, education, conservation, and management. 2005.

William A. Niering Outstanding Educator Award, Estuarine Research Federation, for excellence in coastal and estuarine education. 2005.

Wiese Distinguished Lecturer, Dauphin Island Sea Laboratory, 2007

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## EDUCATION

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- B.A., Dartmouth College, Hanover, NH, 2002. Environmental and Evolutionary Biology
  - Biology Foreign Studies Program:
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## RESEARCH EXPERIENCE

- Post-doctoral scientist, The Ecosystems Center, Marine Biological Laboratory (2010-present). Assessing management options for Great South Bay, NY and studying the effects of long-term fertilization on salt marsh vegetation and sediments.
- Research Assistant, The Ecosystems Center, Marine Biological Laboratory (2009-2010). Using stable isotopes to study the effects of long-term fertilization on salt marsh sediments.
- Research Assistant, The Ecosystems Center, Marine Biological Laboratory (2008-2009). Using GIS and nitrogen loading models to study the nitrogen loading to Great South Bay, NY.
- Graduate Research Fellow, National Oceanic and Atmospheric Administration/National Estuarine Research Reserve, Woods Hole, MA (2007-2008). Studying the $\delta^{15}N$ profiles in salt marsh sediments: Calibrations using decadal scale N loads.
- Research Scientist Consultant, Martha's Vineyard Commission (2005-2006). Using nitrogen loading models and groundwater sampling to study the nutrient inputs and water quality of Old (Ice) House Pond, West Tisbury, Martha's Vineyard.
- Graduate Research Fellow, National Oceanic and Atmospheric Administration/National Estuarine Research Reserve, Woods Hole, MA (2005-2007). Using stable isotopes to study the use of *Spartina alterniflora* as an indicator of waste water N-load to a coastal watershed in Waquoit Bay, MA.
- Research Assistant, Marine Sciences Research Center, Stony Brook University (2002-2003). Conducting radio-isotope experiments investigating the bioaccumulation and release of dissolved and food-related trace metals in marine bivalve mollusks.
- Research Assistant, Dartmouth College (2001-2002). Studying the reaction of tadpoles to commercially used aerial pesticides, the trophic transfer of toxic metals in aquatic food webs.
- Research Assistant, Marine Sciences Research Center, Stony Brook University (2002). Conducting radioactive experiments investigating the bioaccumulation and release of trace metals in aquatic bivalve mollusks.

EXHIBIT 29 (AR H.13)

- Intern, Dartmouth College (1999). Studying the mutualistic interaction between *Daphnia* and their ectosymbionts.

**TEACHING/MENTORING EXPERIENCE**

- Organizer, Young Scientist Symposium. Marine Biological Laboratory (2005-present). Planned and ran meeting of junior and senior scientists in a variety of disciplines at the Marine Biological Laboratory.
- Organizer, Research Experience for Undergraduates. Marine Biological Laboratory (2005-present). Organized and ran undergraduate internship program. Coordinated research projects, seminars, housing, and support for undergraduate students.
- 2008. Mentor to undergraduate intern Emily Olesin (UMASS Amherst), National Science Foundation Research Experience for Undergraduates.
- 2006. Mentor to undergraduate intern Amanda DeLoureiro (Mt. Holyoke College), Woods Hole Marine Science Consortium.
- 2005. Graduate teaching assistant, Marine Ecology. Boston University Marine Program.
- 2002. Undergraduate teaching assistant, Animal Behavior laboratory. Dartmouth College.

**RESEARCH GRANTS / AWARDS**

- National Oceanic and Atmospheric Administration/ National Estuarine Research Reserve Graduate Research Fellowship (2007-2008)
- National Oceanic and Atmospheric Administration/ National Estuarine Research Reserve Graduate Research Fellowship (2005-2007)
- Rainer Voigt Memorial Award, Boston University Marine Program (2005)
- Sounds Conservancy Grant (2007)

**MANUSCRIPTS IN PREPARATION**

Kinney, E. L. and I. Valiela. A sedimentary record of nitrogen loading at a watershed scale: Changes in $\delta^{15}N$ in salt marsh sediments in the Waquoit Bay estuarine system

**MANUSCRIPTS IN REVIEW**

Kinney, E. L. and I. Valiela. *Spartina alterniflora* $\delta^{15}N$ as an indicator of estuarine nitrogen load in the Waquoit Bay estuarine system

Kinney, E. L. and I. Valiela. A sedimentary record of nitrogen loading: Changes in $\delta^{15}N$ in salt marsh sediments in a long-term fertilization study

**PUBLISHED/IN PRESS MANUSCIPTS**

Fox, L., I. Valiela, and **E. L. Kinney**. *In press*. The effect of nutrient enrichment and sea level rise on salt marsh vegetation. Estuaries and Coasts.

**Kinney, E. L.** and I. Valiela. 2011. Nitrogen loading to Great South Bay: Report on Phase 2 Management Scenarios. Report to the NY State Department of State Division of Coastal Resources.

**Kinney, E. L.** and I. Valiela. 2011. Nitrogen loading to Great South Bay: Land use, sources, retention, and transport from land to Bay. Journal of Coastal Research 27: 672-686.

Olsen, Y. S., **E. L. Kinney**, S. E. Fox, M. Teichberg, I. Valiela. 2010. Differences in urbanization and degree of marine influence are reflected in $\delta^{13}C$ and $\delta^{15}N$ of producers and consumers in seagrass habitats of Puerto Rico. Marine Environmental Research 69: 198 – 206.

EXHIBIT 29 (AR H.13)

Valiela, I., **E. Kinney**, J. Culbertson, E. Peacock, and S. Smith. 2009. Global losses of mangroves and salt marshes: Magnitudes, causes and consequences. In Duarte, C. (ed.). Global Loss of Coastal Habitats: Magnitudes, Causes, and Consequences. Fundación BBVA. Madrid.
Baines, S. B., N. S. Fisher, and **E. L. Kinney**. 2006. Effects of temperature on uptake of aqueous metals by blue mussels *Mytilus edulis* from Artic and temperate waters. Marine Ecology Progress Series 308: 117 – 128.
Baines, S. B., N. S. Fisher, and **E. L. Kinney**. 2005. The influence of temperature on dietary metal uptake in arctic and temperate mussels. Marine Ecology Progress Series 289: 201 – 213.

**CONFERENCE PRESENTATIONS / SEMINARS**

*As presenter:*

2011. **Kinney, E. L.** and I. Valiela. Nitrogen loading to Great South Bay, NY: Management Options and Build Out Scenarios. Invited speaker, Meeting of the Nature Conservancy of Long Island and stakeholders of Great South Bay, West Sayville, New York, February, 15.
2010. **Kinney, E. L.** and I. Valiela. Nitrogen loading to Great South Bay, NY: Workshop on Management Scenario Options. Invited speaker, Meeting of the Nature Conservancy of Long Island and stakeholders of Great South Bay, Stony Brook, New York, November, 10.
2009. **Kinney, E. L.** and I. Valiela. Nitrogen loading to Great South Bay, NY: Land use sources, retention and transport from land to Bay. Coastal and Estuarine Research Federation Conference, Portland, Oregon, November 1-5.
2009. **Kinney, E. L.** Nitrogen loading to Great South Bay, NY: Land use sources and transport from land to Bay. Invited speaker, The Ecosystems Seminar Series, Marine Biological Laboatory, Woods Hole, Massachusetts, May 12.
2007. **Kinney, E. L.** and I. Valiela. Using $\delta^{15}N$ signatures in salt marsh plants and sediments as indicators of estuarine nitrogen loads. Estuarine Research Federation Conference, Providence, Rhode Island, November 4-8.
2007. **Kinney, E. L.** and I. Valiela. A sensitive and widespread indicator of estuarine nitrogen loads: Stable isotopic signatures in salt marsh cordgrass in Cape Cod estuaries. American Society of Limnology and Oceanography Aquatic Sciences Meeting, Santa Fe, New Mexico, February 4-9.
2006. **Kinney, E. L.** and I. Valiela. Salt marshes and the development of a sensitive and widespread indicator of estuarine nitrogen loads: stable isotopic signatures in salt marsh cordgrass. Invited speaker, Mashpee National Wildlife Refuge Conservation Partnership, Waquoit Bay National Estuarine Research Reserve, Waquoit, Massachusetts, August 15.
2006. **Kinney, E. L.** and I. Valiela. Development of a sensitive and widespread indicator of estuarine nitrogen loads: Stable isotopic signatures in salt marsh cordgrass. New England Estuarine Research Society, Spring Meeting, Hull, Massachusetts, April 6-7.
2006. **Kinney, E. L.** A progress report - Development of a sensitive and widespread indicator of estuarine nitrogen loads: stable isotopic signatures in salt marsh cordgrass. Boston University of Marine Program Departmental Seminar Series, Woods Hole, Massachusetts, February 24.

*As co-author:*

2008. Valiela, I. and **E. Kinney**. Nitrogen loading to Great South Bay: land use, sources and transport from land to Bay. Invited speaker, Meeting of the Nature Conservancy of Long Island and the Bluepoints Bottomlands Council, Stony Brook, New York, October, 14.