

**Application of Northeastern University for Admission as a Partner Institution in the North Atlantic Coastal Cooperative Ecosystems Studies Unit
June 2011**

Summary

Northeastern University, through its Marine Science Center, enthusiastically submits this request to be admitted as a Partner Institution in NAC CESU. We believe our teaching, research and outreach efforts will make valuable contributions to the mission of NAC CESU. We are most excited about the opportunity to develop collaborations with other Partner Institutions and hope that our request meets with your approval.

Dr. Geoffrey C. Trussell, Director, Marine Science Center, Northeastern University

Northeastern University's Marine Science Center

Northeastern University's Marine Science Center is located on ~ 23 acres of open land with 3,500 ft of ocean frontage on East Point in the peninsular town of Nahant, Massachusetts. Nahant juts out into the ocean just 5 miles NNE of the narrow entrance to Boston Harbor. East Point is near the southern limit of solid rock outcroppings on the Atlantic Coast and contains numerous tidepools, channels and benches. Although Nahant is situated just outside a major harbor and urban center (Boston), the prevailing coastal currents provide remarkably clean seawater around East Point and the biota is characteristic of the southern Gulf of Maine. The undisturbed rocky shoreline provides numerous intertidal and subtidal habitats that are ideally suited for field research activities. Indeed, East Point is noted among marine scientists as the site where Louis Agassiz made the first collections and descriptions of many marine species in the mid 19th century, and is also where Drs. Jane Lubchenco and Bruce Menge conducted their pioneering work on rocky intertidal communities during the 1970s.

Mission of the Marine Science Center

Although the oceans play a critical role in the health, sustainability and security of our planet, human activities have led to rapid deterioration of these vital ecosystems. Indeed, the world's coastal oceans are profoundly impacted by major global environmental threats facing our planet including climate change, collapsing fisheries, the spread of invasive species, the loss of biodiversity, and increased coastal pollution. Northeastern University's Marine Science Center is aggressively expanding its existing research and academic programs to more effectively meet these global challenges. We continue to hire new faculty in strategic areas, advance our academic programs with an emphasis on marine biology and ocean and environmental science, and further develop our research and teaching infrastructure. Our prime objective is to further develop the Marine Science Center into an interdisciplinary research hub that leverages our strengths in ocean science and engineering to develop innovative science and policy that better address the major environmental issues facing the world's coastal marine habitats.

Marine Science Center Facilities

In 1966, Northeastern University acquired a former coastal defense facility from the Federal Government to establish a marine laboratory and field station on East Point. The barracks building was converted into a laboratory (the Edwards Laboratory) in 1967 to become the principal facility of the Marine Science Institute (renamed the Marine Science Center in 1987). Facilities in the Edwards Laboratory include 6 research laboratories for resident faculty, a

microscopy lab, faculty and staff offices, an indoor seawater laboratory and outdoor seawater mesocosm facility, and two apartments for visiting scientists. In 1992, an addition to the Edwards Laboratory was constructed with funds from an NSF Facilities Improvement Grant. The space in this addition is devoted to a classroom, a conference room, a computer cluster, the library and several offices.

In 2006, Northeastern constructed a new Outdoor Mesocosm Facility. This mesocosm facility is an outstanding resource for ecological experiments requiring ambient sunlight and seawater, as well as high levels of replication. Finally, Northeastern has upgraded an indoor wet laboratory by installing new plumbing and seatables. This space is primarily used to enhance the research training of students enrolled in the Three Seas Marine Biology Program each fall. During the spring and summer, this facility, in conjunction with the Outdoor Mesocosm Facility, serves the research activities of resident faculty and graduate students as well as those of visiting scientists. Thanks to a new facilities grant from the National Science Foundation, we are in the process of renovating space in Edwards to create 4 new laboratories that will support our research efforts in marine genomics, marine ecology and ocean engineering.

The MSC's flow-through seawater system is its most important resource as evidenced by heavy usage by resident scientists. In addition, scientists from several universities in the Boston area (e.g., Harvard University, Boston University, Tufts University, and the University of Massachusetts – Boston) often rely on our seawater system for their experiments. The MSC's seawater system was first constructed in 1967 and is currently undergoing a complete replacement courtesy of our recent NSF award and funds from Northeastern University. The new state-of-the-art system will deliver 500 gpm⁻¹ and will have a storage capacity of 40,000 gallons.

Outreach Program

The MSC's Outreach Program is directed by Ms. Carole McCauley. This program annually serves ~4,000 students and adults from local communities by offering several programs, including the Coastal Ocean Science Academy (COSA). COSA is an intensive 2-week program that provides an outstanding experiential education opportunity to selected students, many of whom are members of under-represented groups from the greater Boston area. In addition, our annual Open House provides excellent opportunities for area residents to connect with the Marine Science Center and its teaching, research and outreach programs.

Marine Science Center Faculty and Research

Dr. Joseph Ayers (Professor) directs a broad research program that focuses on several areas including the analysis of goal achieving behavior which involves correlated video and electrophysiological analysis of the behavior of lobsters, lamprey and jellyfish with the aim of establishing the constraints for underlying neurobiological control models for use in the development of biomimetic robots. The basis of this research is the Roboplasm program, which acquires correlated behavioral and electrophysiological data as QuickTime movies and performs frame-by-frame kinematic and electrophysiological analysis allowing us to correlate neuronal spike train activity with behavior in vivo. Dr. Ayers also focuses on the development of electronic nervous systems and robotic mariculture.

Dr. Matthew Bracken (Assistant Professor) uses an interdisciplinary approach to evaluate the linkages between marine communities and ecosystems. In particular, his research focuses on (1) the effects of ecosystem functioning (the transformation and flux of energy and materials) on patterns of distribution, abundance, and community structure and (2) the roles that organisms play in mediating ecosystem functions. In evaluating these linkages between communities and

ecosystems, he draws from a variety of ecological sub-disciplines, including community ecology, physiological ecology, and ecosystem ecology.

Dr. Donald Cheney (Associate Professor) leads a research program that focuses on marine algal biotechnology and environmental bioremediation. Currently, he is developing seaweed applications that can be used for the remediation of toxic organic pollutants in marine environments and for increasing the sustainability of fish aquaculture. For example, he has shown that certain seaweeds are extremely effective in bioremediating toxic organic pollutants, such as TNT, PAHs and PCBs in marine sediments. In addition, he has recently shown that a PCB-concentrating green macroalga (*Ulva* sp.) bloom found in a local estuarine Superfund Site (New Bedford Harbor, MA) may be playing an important role in the transfer of PCBs from sediments to top predator species like striped bass.

Dr. Slava Epstein (Professor) focuses on microbial diversity, and exploration of this diversity for biotechnological application. Over the years, his lab group has surveyed the composition and studied the ecology of microorganisms on a global scale, with research sites ranging from the tropics (Caribbean Sea off the coast of Venezuela) to polar regions (northern Greenland). They have developed a fundamentally novel approach to accessing and high throughput cultivation of novel microbial species from various environments, from seawater to terrestrial soils. Using model systems, they have identified the key requirement: signals from neighboring species, and determined the nature of such signals. Using these advancements they have performed large-scale cultivation of novel microbial species that can assist with bioremediation, are capable of producing alternative energy and bioactive compounds, and may be important to human health.

Dr. Salvatore Genovese (Director, Three Seas Marine Biology Program) is a subtidal marine ecologist whose research interests are primarily focused at the intersection of oceanography and subtidal benthic marine ecology. His research in several systems, including the Gulf of Maine, the Caribbean, and the Florida Keys, examines the consequences of internal waves and internal tidal bores on the population and community dynamics of marine invertebrates (e.g. corals, sponges) and algae. Dr. Genovese is also the Director of the Three Seas Marine Biology Program, a rigorous academic program that serves advanced undergraduate and recent post-graduate students that are pursuing academic, governmental or private-sector careers in marine science. The Three Seas Program emphasizes the importance of experience and inquiry-based learning and research training is thus a major part of its curriculum.

Dr. Gwilym Jones (Professor) is the Director of Northeastern University's Center for Vertebrate Studies (CVS), which is located at the Marine Science Center. He and his lab group use observations and experiments involving live organisms (autecology and interspecific interactions) and the extensive vertebrate collection at the CVS to evaluate questions in population, community, and evolutionary ecology. Current research focuses on degenerative bone diseases in cetaceans and the distribution and abundance of vertebrates in Massachusetts.

Dr. Geoffrey Trussell (Associate Professor) is the Director of the Marine Science Center and pursues a research program that explores a number of issues in evolutionary, population, community and ecosystem ecology. His research program has generated several papers on the factors determining the abundance and distribution of invasive species, the ecosystem consequences of changes in marine algal diversity, and the ecological and evolutionary significance of induced changes in prey morphology in response to predation risk. In addition, he has examined how predator-induced changes in prey behavior can influence community dynamics and structure and ecosystem function.

Dr. Steven Vollmer (Assistant Professor) is a molecular and evolutionary ecologist. His research focuses primarily on the evolution and ecology of reef-building corals. Dr. Vollmer is funded by NSF to study the genetics of innate immunity and disease resistance in threatened Caribbean staghorn corals, which have been decimated by White Band Disease. He is using next-generation sequencing of the coral transcriptome to identify genes involved in innate immunity and disease resistance. Another focus of the lab is to identify the pathogen(s) causing White Band Disease and the ecological drivers of disease outbreaks.

Contributions to the NAC CESU Consortium

We believe that both our infrastructural and faculty assets can make valuable contributions to this important consortium and we welcome the opportunity to make our resources available to consortium members. Our mission and researchers are highly dedicated to the understanding, conservation and management of coastal ecosystems and our membership in this consortium will only enhance our ability to better serve this mission. We are quite excited to join NAC CESU and look forward to the collaborations it fosters.

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Recent Publications

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