ANNETTE M. HYNES

Woods Hole Oceanographic Institution, MS #51, Woods Hole, MA, USA 02543 (508) 289-3992; ahynes@whoi.edu

Education

- **Massachusetts Institute of Technology**—Cambridge, MA
  Doctorate of Philosophy, MIT-WHOI Joint Program in Oceanography
  Biological Oceanography: "Diversity of the marine cyanobacterium Trichodesmium*: characterization of the Woods Hole culture collection and quantification of field populations"*
  Advisors: Drs. Scott C. Doney and John B. Waterbury
  - GPA: 4.6 (5.0 scale)
  - Thesis Defense Date: 11 August, 2009
- **University of Nebraska-Lincoln**—Lincoln, NE
  Bachelor of Science in Biological Sciences and Mathematics
  Nebraska Initial Teaching Certificate, Natural Sciences 7-12
  - GPA: 3.978 (4.0 scale)
  - Graduated May, 1998

Research Experience

- **Woods Hole Oceanographic Institution**—Woods Hole, MA
  PhD Candidate, MIT-WHOI Joint Program in Oceanography: June 2003–present
  - Identification, ecology, and characterization of *Trichodesmium* cultured strains
  - Enumeration of *Trichodesmium* field populations with quantitative polymerase chain reaction (qPCR)
  - Phosphorus stress in field populations of *Trichodesmium*
  - Research Cruises
    * MP09 North Pacific Biocomplexity Cruise, R/V Revelle, August, 2003
    * KM0405 North Pacific Cruise, R/V Kilo Moana, February, 2004
    * KM0701 West Pacific Warm Pool Cruise, R/V Kilo Moana, January, 2007
- **Microbial Oceanography: Genomes to Biomes Summer Course**—Manoa, HI
  Student: University of Hawai'i-Mānoa: June-July, 2006
  - Discussions, lectures, and techniques in microbial oceanography
  - Two 5-day research cruises aboard the R/V Kilo Moana
- **Cedar Point Biological Station**—Ogallala, NE
  Research Assistant: May–August, 1996; Student: May–June, 1994, May–June, 1993
  - Grasshopper population ecology with Dr. J. Anthony Joern, May–August, 1996
  - Ornithology: survey of an upland grassland and a lowland meadow, May–June, 1994
  - Botany: effects of NH_3 and pH on Wisconsin fast plants *Brassica rapa*, May–June, 1993
- **Shoals Marine Laboratory**—Appledore, ME
  Student: May–July, 1995
  - Field Marine Science: survey of the intertidal zone of a rocky, exposed shore
  - Marine Vertebrates: evaluation of fishing stocks of Atlantic cod (*Gadus morhua*)

Teaching Experience

- **U.S. Peace Corps**—Kenya, East Africa
  Volunteer Teacher: September, 1999-December, 2002
  Kiundwani Secondary School, Machakos District, Kenya
  - Taught Biology, Mathematics, and Physics
  - Advised the Wildlife and Girls' Clubs; nominated and escorted students to the "Take Our Daughters to Work" Event and to the Ambassador's Scholarship Workshop; served as the Math/Science Education Representative to the Volunteer Advisory Council and Vice-Chair of the Gender and Development Committee; planned the follow-up retreat for "Take Our Daughters to Work"

- **Good Shepherd Volunteers**—Asbury Park, NJ
  Volunteer Teacher: August, 1998-August, 1999
  Sisters Academy, Asbury Park, NJ
  - Taught 5th and 6th Grade Mathematics, Science, and Gym
  - Supervised after-school activities; drove for and supervised evening study; planned math and science activities, recreational activities, and chaperoned overnight for summer camp

Research Skills

- **Computer Programs and Languages**
  - MATLAB, UNIX, and LaTeX

- **Molecular Techniques**
  - Polymerase chain reaction (PCR), real-time PCR, enzyme-labelled fluorescence, and sequencing

- **Microbiological Techniques**
  - Microscopy (phase contrast, DIC, and epifluorescence), flow cytometry, culturing of diazotrophic cyanobacteria *Trichodesmium* and *Crocosphaera*, characterization of phycobiliproteins, and measuring N_2 fixation rates through acetylene reduction

Relevant Graduate Coursework

- Mathematical Ecology
- Spatial Ecology
- Individual-Based Modeling and Ecology
- Modeling, Data Analysis, & Numerical Techniques for Geochemistry
- Bio-Physical Interactions

Activities

- Outreach and Education
  - Workshop Leader, Women in Science Conference Shewsbury, MA, April, 2008
  - Mentor, high school student Emily Lorch, Waterbury Laboratory, July-August, 2007

- Mentor, undergraduate student Emmanuel Vásquez-Rivera, Waterbury Laboratory, June-August, 2008
- Science Fair Judge, Falmouth Public Schools, 2005-2009
- Blue Lobster Bowl Judge, Ocean Science Bowl, 2005-2006

- C-MORE Executive Committee, Student Representative
- WHOI Diversity Committee
- Marine Policy Discussion Group
- SCUBA, Scientific Diver
- Big Brothers/Big Sisters of Cape Cod

Honors

- **Scholarships**
  University of Nebraska-Lincoln
  - Regents Scholarship (4 years), Eastman Memorial Scholarship for Upperclassmen in Mathematics (3 semesters)

- **Awards**
  - Participant, Ecological Dissertations in Aquatic Sciences (Eco-DĀS VIII) symposium, Manoa, HI, October 2008
  - Participant, Microbial Oceanography: Genomes to Biomes Summer Course, Manoa, HI, June-July, 2006
  - Dean's List (10 semesters), University of Nebraska-Lincoln
  - Chancellor's Leadership Award, University of Nebraska-Lincoln

- **Honoraries and Societies**
  University of Nebraska-Lincoln
  - Mortar Board National Honorary, National Residence Hall Honorary
  - Phi Beta Kappa Honor Society, Pi Mu Epsilon Mathematics Honor Society, Beta Beta Beta Biological Honor Society, Golden Key National Honor Society

Professional Societies

- American Society of Limnology and Oceanography
- National Peace Corps Association

Manuscripts

- **Published**

  Hynes, A. M., P. D. Chappell, S. T. Dyhrman, S. C. Doney and E. A. Webb. 2009. Cross-basin comparison of phosphorus stress and nitrogen fixation in *Trichodesmium*. *Limnology and Oceanography*, **54**:1438–1448.

  Hynes, A. 2008. A most ingenious paradoxical plankton, *Oceanus Magazine*, **47**:36–39.

- **In Preparation**

  Hynes, A. M., E. A. Webb, S. C. Doney and J. B. Waterbuy. Diversity of *Trichodesmium*: characterization of the Woods Hole culture collection.

  Hynes, A. M., S. C. Doney and J. B. Waterbury. Identification and enumeration of *Trichodesmium* field populations using quantitative polymerase chain reaction (qPCR).

Scientific Presentations

Hynes, A. M. and P. D. Chappell. Diversity and Iron Ecology of *Trichodesmium*. Eco-DĀS VIII Symposium, Manoa, HI, October 2008.

Hynes, A. M., E.A. Webb, J.B. Waterbury, S.C. Doney. Identification and Quantification of the Nitrogen Fixer *Trichodesmium*: Phylogeny and qPCR. 2008. Talk at the Ocean Sciences Meeting, Orlando, Florida, March, 2008.

Hynes, A. M., N. Levine, A. White, and S. C. Doney. Stochastic models investigating N and DMSP cycling. Talk, C-MORE Themes III and IV Meeting, Monterey, CA, January, 2008.

White, A. E., **A. M. Hynes**, Y. Shi, M. M. D. Al-Rshaidat, R. A. De la Iglesia, E. Harrison, R. Jones, K. Keats, P. Morton, K. Myers, J. F. Santibañez-Bustos, and S. Wilson. 2007. The effects of mesoscale eddies on microbial communities in the North Pacific: results from the first Agouron course in microbial oceanography. Poster at the ASLO Aquatic Sciences Meeting, Santa Fe, New Mexico, February, 2007.

Hynes, A. M., E. A. Webb, J. B. Waterbury, S. C. Doney. 2007. Diversity of *Trichodesmium*: characterization of the Woods Hole culture collection. Talk at the ASLO Aquatic Sciences Meeting, Santa Fe, New Mexico, February, 2007.

Hynes, A. M., E. A. Webb, S. T. Dyhrman, and S. C. Doney. 2005. Phosphorus and iron physiology in North Pacific *Trichodesmium*. Poster at the ASLO Aquatic Sciences Meeting, Salt Lake City, Utah, February, 2005.

Ph.D. Thesis Abstract

Trichodesmium is a colonial, N_2-fixing cyanobacterium found in tropical oceans. Species of *Trichodesmium* are genetically similar but several species exist together in the same waters. In order to coexist, *Trichodesmium* spp. may occupy different niche spaces through differential utilization of resources such as nutrients and light, and through responses to physical characteristics such as temperature and turbulence. To investigate niche differentiation in *Trichodesmium*, I characterized cultured strains of *Trichodesmium*, identified and enumerated *Trichodesmium* clades in the field, and investigated P stress and N_2 fixation in field populations. Species of *Trichodesmium* grouped into two clades based on sequences from 16S rDNA, the internal transcribed spacer (ITS), and the heterocyst differentiation gene *hetR*. Clade I contained *Trichodesmium erythraeum* and *Trichodesmium contortum*, and clade II contained *Trichodesmium thiebautii*, *Trichodesmium tenue*, *Trichodesmium hildebrandtii*, and *Trichodesmium pelagicum*. Each clade was morphologically diverse, but species within each clade had similar pigmentation. I developed a quantitative polymerase chain reaction (qPCR) method to distinguish between these two clades. In field populations of the Atlantic and Pacific Oceans, the qPCR method revealed that clade II *Trichodesmium* spp. were more prominent than clade I in the open ocean. Concentrations of *Trichodesmium* did not correlate with nutrient concentrations, but clade I had wider temperature and depth distributions than clade II. Temperature and light are physical characteristics that may define niche spaces for species of *Trichodesmium*. Clade I and II concentrations correlated with each other in the Pacific but not in the Atlantic, indicating that the two clades were limited by the same factors in the Pacific while different factors were limiting the abundance of the two clades in the Atlantic. *Trichodesmium* populations in the North Atlantic were more P stressed and had

higher N_2 fixation rates than populations in the western Pacific. While nutrient concentrations didn't directly correlate with *Trichodesmium* concentrations, the contrasting nutrient regimes found in the Atlantic and Pacific Oceans might influence distributions of the two clades differently. Unraveling the differences among species of *Trichodesmium* begins to explain their coexistence and enables us to understand factors controlling global N_2 fixation.

References

- **Dr. Scott C. Doney**
  Senior Scientist
  Department of Marine Chemistry and Geochemistry
  Woods Hole Oceanographic Institution, MS# 25
  Woods Hole, MA 02543
  Phone: (508) 289-3776
  email: sdoney@whoi.edu

- **Dr. John B. Waterbury**
  Scientist Emeritus
  Department of Biology
  Woods Hole Oceanographic Institution, MS# 51
  Woods Hole, MA 02543
  Phone: (508) 289-2742
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- **Dr. Eric A. Webb**
  Assistant Professor
  Department of Biological Sciences, Marine and Environmental Biology Section
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