Nutrient concentrations from Hood Canal, Puget Sound, Washington, USA from R/V Clifford A. Barnes CB960, CB974, CB980, CB985 from 2011-2012 (Nitrification and Marine Planktonic Biodiversity project)

Website: https://www.bco-dmo.org/dataset/540882
Data Type: Cruise Results
Version: 2014-11-17

Project
» Significance of nitrification in shaping planktonic biodiversity in the ocean (Nitrification and Marine Planktonic Biodiversity)

Program
» Dimensions of Biodiversity (Dimensions of Biodiversity)

Contributors	Affiliation	Role
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Abstract
Nutrient concentrations from Hood Canal, Puget Sound, Washington, USA from R/V Clifford A. Barnes CB960, CB974, CB980, CB985 from 2011-2012.

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Dataset Description

Nitrate, nitrite, ammoniumn, phosphate, silicate, oxygen concentrations from various depths in the Hood Canal, 2011-2012.

Methods & Sampling

Samples for nutrient measurements (nitrate ($NO3^-$), nitrite ($NO2^-$), ammonium ($NH4^+$), phosphate ($PO4^{3-}$) and silicate ($SiO4^{4-}$)) and ammonia oxidation rates were collected using a conductivity, temperature, depth (CTD) rosette (Sea-Bird Electronics) equipped with 12 10 L Niskin bottles. Dissolved oxygen (O2) concentrations were measured with a CTD sensor package (SBE-43; Sea-Bird Electronics) on the Hoodsport ORCA buoy mooring and were calibrated against Winkler O2 determinations for all but the CB974 cruise. Ammonium and nitrite concentrations were measured within 2 h of sample collection onboard using the o-phthaldialdehyde (OPA) fluorescence method and spectrophotometrically, respectively. See Jacquot et al. (2014) for further details.

Data Processing Description

Samples for NO3, PO4, and SiO4 were filtered with a 0.22 um size pore filter and frozen at -20 °C for shore-based analysis at the University of Washington. Those analyses were performed at the Marine Chemistry Laboratory of the School of Oceanography using a Technicon AutoAnalyzer II (UNESCO, 1994).

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Related Publications

Jacquot, J. E., Horak, R. E. A., Amin, S. A., Devol, A. H., Ingalls, A. E., Armbrust, E. V., … Moffett, J. W. (2014). Assessment of the potential for copper limitation of ammonia oxidation by Archaea in a dynamic estuary. Marine Chemistry, 162, 37–49. doi:10.1016/j.marchem.2014.02.002
Methods

Moffett, J. W., & Dupont, C. (2007). Cu complexation by organic ligands in the sub-arctic NW Pacific and Bering Sea. Deep Sea Research Part I: Oceanographic Research Papers, 54(4), 586–595. doi:10.1016/j.dsr.2006.12.013
Methods

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Parameters

Parameter	Description	Units
cruise_id	cruise identification	unitless
year	year	yyyy
month	month	1-12
depth	sample depth	meters
NO2	nitrite concentration	uM
DIN	dissolved inorganic nitrogen concentration	uM
NH4	ammonium concentration	uM
NH4_lab	ammonium concentration from later lab analysis	uM
NO3	nitrate concentration	uM
PO4	phosphate concentration	uM
SiO4	silicate concentration	uM
O2	dissolved oxygen concentration	uM
DIN_PO4	ratio of dissolved inorganic nitrogen to phosphate	unitless
AmOx_rate	rate of ammonia oxidation	nM/day

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Instruments

Dataset-specific Instrument Name	GO-FLO
Generic Instrument Name	GO-FLO Bottle
Dataset-specific Description	10 L Teflon-coated Go-Flo bottles (General Oceanics) attached to Kevlar wire
Generic Instrument Description	GO-FLO bottle cast used to collect water samples for pigment, nutrient, plankton, etc. The GO-FLO sampling bottle is specially designed to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

Dataset-specific Instrument Name	Nutrient Autoanalyzer
Generic Instrument Name	Nutrient Autoanalyzer
Generic Instrument Description	Nutrient Autoanalyzer is a generic term used when specific type, make and model were not specified. In general, a Nutrient Autoanalyzer is an automated flow-thru system for doing nutrient analysis (nitrate, ammonium, orthophosphate, and silicate) on seawater samples.

Dataset-specific Instrument Name	SBE-43 DO
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Generic Instrument Description	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. More information from the manufacturer: https://www.seabird.com/products/sbe-43-dissolved-oxygen-sensor

Dataset-specific Instrument Name	CTD SBE 911plus
Generic Instrument Name	Sea-Bird SBE 911plus CTD
Generic Instrument Description	[tethered, real-time] The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

Dataset-specific Instrument Name	spectrophotometer
Generic Instrument Name	Spectrophotometer
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

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Deployments

CB960

Website	https://www.bco-dmo.org/deployment/540518
Platform	R/V Clifford A. Barnes
Start Date	2011-07-18
End Date	2011-07-22

CB974

Website	https://www.bco-dmo.org/deployment/540519
Platform	R/V Clifford A. Barnes
Start Date	2012-05-07
End Date	2012-05-13

CB980

Website	https://www.bco-dmo.org/deployment/540522
Platform	R/V Clifford A. Barnes
Start Date	2012-07-16
End Date	2012-07-22

CB985

Website	https://www.bco-dmo.org/deployment/540524
Platform	R/V Clifford A. Barnes
Start Date	2012-08-25
End Date	2012-08-30

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Project Information

Significance of nitrification in shaping planktonic biodiversity in the ocean (Nitrification and Marine Planktonic Biodiversity)

Microorganisms sustain the biogeochemical cycling of nitrogen, one of the most important nutrient cycles on earth. A key step in this cycle, the oxidation of ammonia to nitrite by autotrophic microorganisms, was for a century thought mediated by a few restricted bacterial genera. Significant ammonia oxidation, perhaps most, is now attributed to a previously enigmatic group of Archaea - the ammonia-oxidizing archaea (AOA) - of high abundance in both marine and terrestrial environments. The investigators prior physiological and environmental analyses, the foundation for this proposal, have shown that AOA are active within the marine photic zone and that their competitive fitness in the marine environment is at least in part attributable to an extremely high affinity for ammonia, growing at near maximum growth rates at concentrations of ammonia that would not sustain known bacterial ammonia oxidizers, and an unusual copper-based respiratory system that may render them more competitive in iron limited environments. The compelling inference from these prior analyses is that AOA alter and possibly control the forms of fixed nitrogen available to other microbial assemblages within the photic zone by converting ammonia, a nearly universally available form of nitrogen, into nitrite, a form only available to nitrite oxidizing bacteria and some phytoplankton. If correct, this has a significant impact on biodiversity.

The PIs will use the most recent technological advances in protein and high throughput sequencing to evaluate the significance of nitrification in shaping biodiversity (genomic and metagenomics), activity (transcriptome, proteome and stable isotope probing), and in controlling availability of an important trace element (copper). In turn, by resolving the environmental and biotic variables that influence the diversity, distribution and activity of AOA, they will advance general understanding of their taxonomy. More directly, functional knowledge of the contribution of AOA to regenerated nitrate will improve estimates of new ocean production ("biological pump") based on nitrate assimilation, which in the past has mostly neglected the importance of nitrification as a major source of nitrate. Together these studies will transform understanding of the marine nitrogen cycle, estimates of new production, and will ultimately provide a better understanding of the impact of human activity on this critical nutrient cycle.

The nitrogen cycle has been profoundly affected by anthropogenic inputs of reactive nitrogen into terrestrial, marine, and atmospheric systems having, or predicted to have, major impacts on marine biological production, increased N20 emissions, nitrogen pollution, and eutrophication. Likewise, there is a poor understanding of the relationship between nitrogen cycling and productivity in marine ecosystems. Marine systems are increasingly affected by ocean acidification and by atmospheric inputs of reactive nitrogen. Since both changes greatly alter nitrogen available to microorganisms, the characterization of the response of these environmentally relevant AOA is of tremendous relevance to understanding the affect of acidification and anthropogenic nitrogen inputs on major ocean processes.

The proposed project encompasses and integrates the three dimensions (functional genetic, and taxonomic) of biodiversity. First, the project is framed by function: microbial control of one of the most important nutrient cycles on earth, the nitrogen-cycle. Second, it is motivated by recent genetic analyses that associate activities of a novel clade of Archaea (provisionally assigned to a new kingdom within the Archaea, the Thaumarchaeota) with control of ammonia oxidation in the ocean. Third, it is built upon a compelling synthesis of physiological and environmental data that lead to its central hypothesis that by altering and possibly controlling the form of nitrogen, the AOA also alter biodiversity and ecological function in one of the most productive environments on earth. It identifies a specific taxonomic imperative. The tremendous genetic diversity among the globally abundant AOA catalogued almost exclusively by gene sequencing surveys and therefore lacking formal description makes it essential to resolve membership into ecologically relevant groups or clades as a prelude to developing a formal taxonomy. The investigators have assembled a group of researchers with specific expertise in each of dimension and uniquely qualified to address the research objectives outlined in an integrative way.

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Program Information

Dimensions of Biodiversity (Dimensions of Biodiversity)

Website: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503446

Coverage: global

(adapted from the NSF Synopsis of Program)
Dimensions of Biodiversity is a program solicitation from the NSF Directorate for Biological Sciences. FY 2010 was year one of the program. [MORE from NSF]

The NSF Dimensions of Biodiversity program seeks to characterize biodiversity on Earth by using integrative, innovative approaches to fill rapidly the most substantial gaps in our understanding. The program will take a broad view of biodiversity, and in its initial phase will focus on the integration of genetic, taxonomic, and functional dimensions of biodiversity. Project investigators are encouraged to integrate these three dimensions to understand the interactions and feedbacks among them. While this focus complements several core NSF programs, it differs by requiring that multiple dimensions of biodiversity be addressed simultaneously, to understand the roles of biodiversity in critical ecological and evolutionary processes.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1046098

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