Spectrophotometric pH measured at 25 degrees C using the total hydrogen ion scale from R/V Thomas G. Thompson and R/V Kilo Moana cruises TN277, KM1301, KM1312 in the Eastern North Pacific Ocean from 2012-2013 (POWOW project)

Website: https://www.bco-dmo.org/dataset/3753
Data Type: Cruise Results
Version: 3
Version Date: 2014-09-08

Project
» Seasonal and decadal changes in temperature drive Prochlorococcus ecotype distribution patterns (POWOW)

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Abstract
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Coverage

Spatial Extent: **N**:46.6888 **E**:-118.316 **S**:21.3428 **W**:-160.6166
Temporal Extent: 2012-03-01 - 2013-07-27

Dataset Description

Spectrophotometric pH measured at 25 degrees C using the total hydrogen ion scale (pHT,25C). Data are reported from the POWOW1 (TN277), POWOW2 (KM1301), and POWOW3 (KM1312) cruises.

Methods & Sampling

pH was measured spectrophotometrically (Clayton and Byrne, 1993) in triplicate at standard temperature (25 degrees C) immediately following collection. pH samples were collected following recommended procedures (Dickson et al., 2007).

Data Processing Description

BCO-DMO edits made:
- Parameter names have been changed to conform to BCO-DMO conventions.
- month_utc, day_utc, year, and time_utc were added, based on the original ISO_DateTime_UTC field.
- Rosette bottle numbers were added from the CTD cast sheets (for POWOW1 data).
- 'NaN' replaced by 'nd' to indicate 'no data'.
- Corrected dates of POWOW2 CTD07 samples.

NOTE: During POWOW1 cast CTD01, all bottles were fired at 25m depth. The bottle numbers displayed in the data for CTD01 are those bottles from which pH was measured.

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Data Files

File
pH.csv (Comma Separated Values (.csv), 135.26 KB) MD5:e23bf13fda08bff2304e00bf7de2e0d7 Primary data file for dataset ID 3753

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Related Publications

Clayton, T. D., & Byrne, R. H. (1993). Spectrophotometric seawater pH measurements: total hydrogen ion concentration scale calibration of m-cresol purple and at-sea results. Deep Sea Research Part I: Oceanographic Research Papers, 40(10), 2115–2129. doi:10.1016/0967-0637(93)90048-8
Methods

Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. Guide to best practices for ocean CO2 measurements. PICES Special Publication 3, 191 pp. ISBN: 1-897176-07-4. URL: https://www.nodc.noaa.gov/ocads/oceans/Handbook_2007.html https://hdl.handle.net/11329/249
Methods

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Parameters

Parameter	Description	Units
cruise_name	Cruise identifier (POWOW1 = TN277 = R/V Thomas G. Thompson cruise 277; POWOW2 = KM1301 = R/V Kilo Moana cruise 1301).	text
cast	Consecutive CTD cast number. CTD numbers are unique and sequential across stations.	unitless
lat	Latitude at start of CTD cast. Positive = North.	decimal degrees
lon	Longitude at start of CTD cast. Positive = East.	decimal degrees
depth_w	Depth of the water (bottom depth) at sampling station.	meters
month_utc	2-digit month of year, UTC.	mm (01 to 12)
day_utc	2-digit day of month, UTC.	dd (01 to 31)
year	4-digit year. in YYYY format	unitless
time_utc	Time (UTC) at start of sample collection, 24-hour clock.	HHMM.mm
ISO_DateTime_UTC	Date/Time (UTC) ISO8601 formatted. T indicates start of time string; Z indicates UTC.	YYYY-mm-ddTHH:MM:SS.ssZ
depth	Sample depth.	meters
bot	Rosette position of the bottle.	unitless
pH	Spectrophotometric pH measured at 25 degrees Celsius using the total hydrogen ion scale.	unitless; pH scale

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Instruments

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

TN277

Website	https://www.bco-dmo.org/deployment/58867
Platform	R/V Thomas G. Thompson
Report	http://dmoserv3.whoi.edu/data_docs/POWOW/POWOW1-cruise_report.pdf
Start Date	2012-02-29
End Date	2012-03-11
Description	The POWOW#1 cruise was a trip of opportunity to sample along temperature gradients and test out new protocols. The primary goal of this cruise was to measure the abundance, diversity and activity of Prochlorococcus and associated bacterial and viral communities across temperature (and other environmental) gradients to understand how climate change may impact ocean ecology and biogeochemistry. There are many additional scientific and broader impact goals including characterizing oxidative stress and investigating nitrogen uptake/utilization molecular diversity. Cruise information and original data are available from the NSF R2R data catalog.

KM1301

Website	https://www.bco-dmo.org/deployment/505095
Platform	R/V Kilo Moana
Report	http://dmoserv3.whoi.edu/data_docs/POWOW/POWOW2-cruise_report.pdf
Start Date	2013-01-10
End Date	2013-02-08
Description	From the cruise report: The POWOW#2 cruise was the second in a series of cruises to study the influence of temperature and other environmental variables on Prochlorococcus, its viruses and other members of the microbial community. The primary goal of this cruise was to measure the abundance, diversity and activity of Prochlorococcus and associated bacterial and viral communities across temperature (and other environmental) gradients to understand how climate change may impact ocean ecology and biogeochemistry. Cruise information and original data are available from the NSF R2R data catalog.

KM1312

Website	https://www.bco-dmo.org/deployment/515629
Platform	R/V Kilo Moana
Report	http://dmoserv3.whoi.edu/data_docs/POWOW/POWOW3-cruise_report.pdf
Start Date	2013-07-01
End Date	2013-07-28
Description	From the cruise report: The POWOW#3 cruise was the third in a series of cruises to study the influence of temperature and other environmental variables on Prochlorococcus, its viruses and other members of the microbial community in the Northern Pacific Ocean. The primary goal of this cruise was to measure the abundance, diversity and activity of Prochlorococcus and associated bacterial and viral communities across temperature (and other environmental) gradients to understand how climate change may impact ocean ecology and biogeochemistry. There are many additional scientific and broader impact goals including characterizing oxidative stress and investigating nitrogen uptake/utilization molecular diversity. The official title of the project is "Collaborative Research: Seasonal and decadal changes in temperature drive Prochlorococcus ecotype distribution patterns" and it is part of NSF #1031064 (Duke) and 1030518 (UTK). Cruise information and original data are available from the NSF R2R data catalog.

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Project Information

Seasonal and decadal changes in temperature drive Prochlorococcus ecotype distribution patterns (POWOW)

Website: http://oceanography.ml.duke.edu/johnson/research/powow/

Coverage: Eastern North Pacific Ocean

Project also known as '*Prochlorococcus* Of Warming Ocean Waters' (POWOW).

The two numerically-dominant ecotypes of the marine cyanobacterium *Prochlorococcus* partition the surface ocean niche latitudinally, with ecotype eMIT9312 dominant in the 30 degree N to 30 degree S region and eMED4 dominant at higher latitudes. These ecotypes may account for 25-50% of primary production in open ocean ecosystems, but this percentage is dependent on which ecotype dominates. The relative abundance of the two ecotypes follows a log-linear relationship with temperature, with the transition from eMIT9312 to eMED4 occurring at approx. 18 degrees C. From these descriptive data, it has been hypothesized that temperature is the primary driver of relative abundance. Their contribution to net primary production, however, appears to be independent of temperature, suggesting temperature regulates ecotype dominance through photosynthesis-independent mechanisms.

To test these hypotheses, the PIs are undertaking a series of field and lab studies to investigate the effect of temperature change on the distribution of these ecotypes. Two cruises in the North Pacific will trace the transitions from eMIT9312- to eMED4-dominated regions, with one cruise during the winter and the other during summer. They have hypothesized that the ratio of ecotype abundance will move latitudinally with the seasonal shift in temperature gradient: migration of the 18 degrees C isotherm northward in the summer will be matched by a similar migration of the 1:1 ecotype transition point. Multiple crossings of the 18 degrees C isotherm are proposed, and the summer cruise will also follow the isotherm to the Western US coast to gain insight on physical and geochemical influences. Environmental variables such as nutrient concentrations, light/mixing depths, and virus /grazing based mortality, which may impinge on the relationship between temperature and ecotype ratio, will be assessed through a series of multivariate analyses of the collected suite of physical, chemical and biological data. Seasonal comparisons will be complemented with on-deck incubations and lab competition assays (using existing and new isolates) that will establish, for the first time, how fitness coefficients of these ecotypes relate to temperature. As latitudinal shifts in temperature gradient and migration of ecotypes during seasonal warming likely share common features with high latitude warming as a

consequence of climate change, the investigator's analyses will contribute important biological parameters (e.g., abundances, production rates, temperature change coefficients) for modeling biological and biogeochemical responses to climate change. This research will be integrated with that of committed collaborators, generating data sufficient for ecosystem-scale characterizations of the contributions of temperature (relative to other forcing factors) in constraining the range and seasonal migration of these numerically dominant marine phototrophs.

Publications produced as result of this research:

Rowe, J.M., DeBruyn, J.M., Poorvin, L., LeCleir, G.R., Johnson, Z.I., Zinser, E.R., and Wilhelm, S.W. 2012. Viral and bacterial abundance and production in the Western Pacific Ocean and the relation to other oceanic realms. FEMS Microbiology Ecology, 72, p. 359. DOI: 10.1111/j.1574-6941.2011.01223.x

Morris, J.J., Lenski, R.E. and E.R. Zinser. 2012. The Black Queen Hypothesis: Evolution of Dependencies through Adaptive Gene Loss. mBio, 3, p. e00036-12. DOI: 10.1128/mBio.00036-12

Morris, J.J., Johnson, Z.I., Szul, M.J., Keller, M., and Zinser, E.R. 2011. Dependence of the cyanobacterium *Prochlorococcus* on hydrogen peroxide scavenging microbes for growth at the ocean's surface. PLoS One, 6(2), p. 16805. DOI:10.1371/journal.pone.0016805

Ringuet, S., Sassano, L., and Johnson, Z.I. 2011. A suite of microplate reader-based colorimetric methods to quantify ammonium, nitrate, orthophosphate and silicate concentrations for aquatic nutrient monitoring. Journal of Environmental Monitoring. DOI:10.1039/C0EM00290A

Ritchie, A.E. and Johnson, Z.I. 2012. Abundance and genetic diversity of aerobic anoxygenic phototrophic bacteria of coastal regions of the Pacific Ocean. Applied and Environmental Microbiology, 78, p. 2858. DOI: 10.1128/AEM.06268-11

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1031064

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