

Q-PCR counts of *Synechococcus* clades from R/V Knorr, R/V Kilo Moana, R/V Seward Johnson KN192-05, KM0701, SJ0609 in the S. Atlantic subtropical gyre and Benguela upwelling region from 2006-2007 (Fe_ *Synechococcus* project)

Website: <https://www.bco-dmo.org/dataset/3627>

Version:

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Project

» [The role of iron \(Fe\) in controlling in situ distributions and activities of marine *Synechococcus*](#)

(Fe_ *Synechococcus*)

Contributors	Affiliation	Role
Webb, Eric A.	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
Goepfert, Tyler	Woods Hole Oceanographic Institution (WHOI)	Student
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Dataset Description

Synechococcus is one of the most abundant phytoplankton on earth and contributes significantly to marine primary production, thus an understanding of the distribution and diversity of this genus is important. This quantitative PCR enumeration of nine marine *Synechococcus* clades found in multiple oceanic regimes is the most comprehensive study to date. This work builds on the research of Zwirgmaier et al (2007 and 2008) and Tai and Palenik (2010), confirming patterns seen previously and extending observations into new areas, but it also provides new information on previously unstudied clades, the environmental niches of different clades, and defining the dominant oligotrophic clade.

Methods & Sampling

Samples were collected on open ocean research cruises and coastal research cruises in locations throughout the Pacific and Atlantic oceans: The tropical North Atlantic (R/V Seward Johnson, SJ0609, in June 2006), the tropical South Atlantic and Benguela Upwelling system (CoFeMUG, R/V Knorr, KN192-05 Nov 2007), a transect through the North and South Pacific (R/V Kilo Moana, KM0701 Feb 2007), the San Pedro Channel off Southern California (R/V Seawatch). The SPOT0509 cruise on R/V Seawatch was a single day cruise in May 2009 to the San Pedro Ocean Time Series station (33.55, -118.4).

Pacific: Transect from Hawaii to Brisbane, Australia

North Atlantic: From Cape Verde to Barbados

South Atlantic: Brazil to Namibia

North Pacific from Hawaii to Bering Sea

Costa Rica Upwelling dome

Samples for all cruises, except the tropical North Atlantic and the South Pacific (from New Caledonia to Australia), were collected by taking a 100 ml sample from a Niskin bottle on the CTD rosette, filtered through a 0.4 um polycarbonate filter, and frozen at -20 °C until DNA extraction. In the North Atlantic and South Pacific, larger volumes (1-2 L with the volume always determined) were filtered onto 0.2 um polyethersulfone filters and frozen in liquid nitrogen.

Data Processing Description

BCO-DMO calculated lon from the lon_360 column provided by the PI. Parameter names were changed to conform to BCO-DMO convention.

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Data Files

File
Synechococcus_QPCR.csv (Comma Separated Values (.csv), 116.88 KB) MD5:5faecee1e83ec8d0a40ebf330717baa3
Primary data file for dataset ID 3627

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Parameters

Parameter	Description	Units
cruise_id	Cruise identifier.	text
cruise_synonym	Alternate identifier of the cruise.	text
month_start	Month the cruise began (2-digits).	mm (01 to 12)
day_start	Day the cruise began (2-digits).	dd (01 to 31)
year_start	Year the cruise began (4-digits).	YYYY
month_end	Month the cruise ended (2-digits).	mm (01 to 12)
day_end	Day the cruise ended (2-digits).	dd (01 to 31)
year_end	Year the cruise ended (4-digits).	YYYY
region	Description of the geographic sampling area.	text
lat	Latitude in decimal degrees. Positive = North.	decimal degrees
lon	Longitude in decimal degrees. Positive = East. Calculated from the original lon_360 provided by PI.	decimal degrees
lon_360	Longitude ranging from 0 to 360 degrees.	decimal degrees
depth	Sample depth.	meters
temp	Temperature.	
sal	Salinity.	
NO3_NO2	Nitrate and Nitrite, micromolar.	uM
NO3	Nitrate, micromolar.	uM
NO2	Nitrite, micromolar.	uM
PO4	Orthophosphate, (phosphate, reactive phosphorus), micromolar.	uM
clade	Clade.	text
abundance	Number of cells per milliliter.	cells/mL

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Instruments

Dataset-specific Instrument Name	Niskin bottle
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Deployments

KN192-05

Website	https://www.bco-dmo.org/deployment/57852
Platform	R/V Knorr
Report	http://bcodata.whoi.edu/CoFeMUG/CruiseReport_KN192-5.pdf
Start Date	2007-11-16
End Date	2007-12-13
Description	<p>The South Atlantic subtropical gyre and Benguela Upwelling region were sampled for chemistry and biological properties relating to the trace metal nutrition and phytoplankton diversity and productivity. Specifically cobalt and iron dissolved seawater concentrations will be measured and related to the abundance of cyanobacteria including nitrogen fixers and eukaryotic phytoplankton. The phytoplankton of the Benguela Upwelling region were also examined to determine if their growth was iron or cobalt limited. A total of 27 station locations were occupied in the study area to collect the water chemistry and biological samples for these analyses (see cruise track). Iron and cobalt analyses will be conducted using inductively coupled plasma mass spectrometry and cathodic stripping voltammetry electrochemical methods. The sample preparation and subsequent analyses are technically demanding, but data generated from the cruise samples are being contributed beginning in mid 2009. The CoFeMUG KN192-5 cruise was supported by NSF OCE award # 0452883 http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0452883 A station map showing the 27 sampling locations is available as a PDF file. Original cruise data are available from the NSF R2R data catalog CoFeMUG - South Atlantic 2007 Cruise Participant List</p> <ol style="list-style-type: none"> 1. Mak Saito (Chief Scientist/WHOI) 2. Abigail Noble (Saito/WHOI) 3. Alysia Cox (Saito/WHOI) 4. Whitney Krey (Delong/Saito/MIT/WHOI) 5. Carl Lamborg (clamborg AT whoi.edu/WHOI) 6. Phoebe Lam (pjlam AT whoi.edu WHOI) 7. Chad Hammerschmidt (chammerschmidt AT whoi.edu, Wright State) 8. Caitlin Frame (cframe AT whoi.edu, WHOI/Casciotti Student) 9. Tyler Goepfert (tgoepfert AT whoi.edu Webb/Saito) 10. Jill Sohm (sohm AT usc.edu) 11. Maria Intermaggio 12. Jack DiTullio (leep AT cofc.edu U. Charleston) 13. Peter Lee (DiTullio U. Charleston) 14. Sarah Riseman (DiTullio U. Charleston) 15. Amanda McLenan (amanda.mclennon AT gmail.com, DiTullio U. Charleston) 16. Mike Seracki (Bigelow) 17. Nicole Poulton (Bigelow) 18. Juan Alba, jualanba AT usp.br (Bigelow) 19. Jane Heywood (Bigelow) 20. Gabrielle Rocap (rocap AT whoi.edu, U. Washington) 21. Emily Nahas (enahas AT u.washington.edu) 22. Michele Wrable (mlw22 AT u.washington.edu) 23. Bob Morris (rmorris AT lifesci.ucsb.edu) 24. Christian Frazar (Chris, U. Washington, Morris lab) 25. Jason Hilton (Zehr, UCSC) 26. Reserved for Angolan Observers 27. Reserved for Angolan Observers <p>Collecting GEOTRACES-compliant samples for:</p> <ol style="list-style-type: none"> 1. Laura Robinson (Pa Th isotopes) 2. Bob Anderson (Pa Th isotopes - intercalibration) 3. Olivier Rouxel (Se and Fe isotopes) 4. Karen Casciotti (N isotopes) 5. Ben Reynolds (Si and Fe isotopes) 6. Chris Measures (Al) 7. Kristin Buck (FeL)

KM0701

Website	https://www.bco-dmo.org/deployment/58165
Platform	R/V Kilo Moana
Report	http://bcodata.whoi.edu/WP2/wp2_cruise_report.pdf
Start Date	2007-01-03
End Date	2007-02-12
Description	<p>A cruise aboard the R/V Kilo-Moana from Hawaii to Brisbane, Australia through the stratified WPWP during January - February 2007. For additional information on KILO MOANA data/data formats see: Formats_of_data_2007.pdf Cruise information and original data are available from the NSF R2R data catalog.</p>

SJ0609

Website	https://www.bco-dmo.org/deployment/58017
Platform	R/V Seward Johnson
Start Date	2006-06-18
End Date	2006-07-31
Description	Leg 1 of the cruise began in Ft. Pierce FL with a rapid transit to Bridgetown, Barbados and two hydrostations (001-002) en route. Leg 2 extended from Barbados to Mindelo, Cape Verde, with nine hydrostations (003-010, 012). Leg 3 included a run south to the equator, then northwestward to Barbados with eleven hydrostations (013-023).

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Project Information

The role of iron (Fe) in controlling in situ distributions and activities of marine *Synechococcus* (*Fe_Synechococcus*)

Coverage: Pacific: Transect from Hawaii to Brisbane, Australia; North Atlantic: from Cape Verde to Barbados; South Atlantic: Brazil to Namibia

The unicellular cyanobacterium *Synechococcus* is one of the most abundant primary producers in the marine environment. It is also extremely widespread; *Synechococcus* has been found in open ocean, coastal and even polar environments. Unlike its close relative, *Prochlorococcus*, *Synechococcus* has the ability to use NO₃ and has been shown to respond in the field to NO₃ inputs, suggesting that this organism may play a key role in global carbon cycling and especially new production. To date, 16 potential clades have been identified, and it is thought that this high diversity allows for the radiation of *Synechococcus* into many different environmental conditions. However, despite the ubiquity and abundance of *Synechococcus*, there are few studies characterizing the physiology and niche adaptations of each clade. Iron (Fe) shows great potential as a defining factor for niche adaptations, as its concentration varies over the geographic range of *Synechococcus*, as well as annually at specific locations, and has been shown to limit primary production in both open ocean and coastal settings. In addition, culture work indicates that *Synechococcus* strains have different abilities to grow on low concentrations of Fe. A comparison of the available genomes of marine *Synechococcus* shows great diversity in the presence or absence of known genes related to Fe stress, suggesting that Fe could have played a key role in the diversification and niche adaptation of *Synechococcus*. This project will study the effects of Fe on growth and carbon fixation in 11 different clades of *Synechococcus* (using at least 2 strains from each clade whenever possible) and the role of Fe limitation in determining the distribution of *Synechococcus* clades on temporal and spatial scales. This project will produce a comprehensive and systematic data set on the impact of Fe-specific niche differentiation in *Synechococcus*, offer new insight into the factors that control clade distribution, and provide understanding of the biogeochemical consequences of *Synechococcus* diversity.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0825922

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