Copepod species abundances from MOCNESS tows from R/V Thomas G. Thompson and R/V Malcolm Baldridge cruises in the Arabian Sea from 1994-1995 (Arabian Sea project, Arabian Sea Diapausing Copepods project)

Website: https://www.bco-dmo.org/dataset/511656
Version: 5
Version Date: 2016-05-04

Project
» U.S. JGOFS Arabian Sea (Arabian Sea)
» Life Cycles of Diapausing Copepods in the Arabian Sea: cues for sinking at the end of the SW Monsoon (Arabian Sea Diapausing Copepods)

Programs
» U.S. Joint Global Ocean Flux Study (U.S. JGOFS)
» U.S. Joint Global Ocean Flux Study (U.S. JGOFS)

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Smith, Sharon L.	University of Miami Rosenstiel School of Marine and Atmospheric Science (UM-RSMAS)	Principal Investigator
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Table of Contents

Dataset Description

Copepods were identified, staged, and enumerated several JGOFS and GLOBEC cruises in the Arabian Sea between 1994 and 1995.

Relevant References:

Drapun, I. and S.L. Smith. 2011. Halocyprid Ostracods of the Arabian Sea Region. Sultan Qaboos University Academic Publication Board, Sultan Qaboos University, Muscat, Sultanate of Oman, 223pp.

Lane, P.V.Z. and S.L. Smith. 1997. United States Joint Global Ocean Flux Study (U.S. JGOFS) Technical Report: Zooplankton biomass in the upper water column of the Arabian Sea in 1994 and 1995. RSMAS Technical Report 97007, Rosenstiel School of Marine and Atmospheric Science, University of Miami Press, Miami, FL, 23pp.

Lane, P.V.Z., S.L. Smith, J. Zaragoza, I. Prusova and M. Roman. 1998. United States Joint Global Ocean Flux Study (U.S. JGOFS) Technical Report: Copepod taxonomy, abundance and biomass in the upper 300 meters of t he Arabian Sea during the Southwest Monsoon (August/September) of 1995. RSMAS Technical Report 98007, Rosenstiel School of Marine and Atmospheric Science, University of Miami Press, Miami, FL, 409pp.

Lane, P.V.Z., S.L. Smith, J. Zaragoza and I. Prusova. 1999. United States Joint Global Ocean Flux Study (U.S. JGOFS) Technical Report: Copepod taxonomy, abundance and biomass in the upper 300 meters of the Arabian Sea during the Northeast Monsoon (December) of 1995. RSMAS Technical Report 99004, Rosenstiel School of Marin eand Atmospheric Science, University of Miami Press, Miami, FL, 306pp.

Prusova, I., S.L. Smith, and E. Popova. 2011. Calanoid Copepods of the Arabian Sea Region. Sultan Qaboos University Academic Publication Board, Sultan Qaboos University, Muscat, Sultanate of Oman, 240pp.

Roman, M., S. Smith, K. Wishner, X. Zhang and M. Gowing. 2000. Mesozooplankton production and grazing in the Arabian Sea. Deep-Sea Research II, 47, 1423-1450.

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Smith, S.L., M. Roman, I Prusova, K. Wishner, M. Gowing, L.A. Codispoti, R. Barber, J. Marra and C. Flagg. 1998. Seasonal response of zooplankton to monsoonal reversals in the Arabian Sea. Deep-Sea Research, 45 (10-11), 2369-2403. doi:10.1016/S0967-0645(98)00075-7

Wiebe, P.H., K.H. Burt, S.H. Boyd and A.W. Morton. 1976. A multiple opening-closing net and enviromental sensing system for sampling zooplankton. Journal of Marine Research, 34, 312-326.

Wiebe, P.H., A.W. Morton, A.M. Bradley, J.E. Craddock, T.J. Cowles, V.A. Barber, R.H. Backus and G.R. Flierl. 1985. New developments in the MOCNESS, an apparatus for sampling zooplankton and micronekton. Marine Biology, 87, 313-323.

Methods & Sampling

Please see the linked pdf's for information on the type of MOCNESS system used to sample and details on the collection and processing:

TN039
TN043
TN045
TN050
TN054
MB95-03
MB95-06

Data Processing Description

Data Processing:

Any species with a number per cubic meter abundance less than 0.05 were marked with a 'p' in the abundance column to indicate its presence in the sample. Counts were first adjusted from subsample numbers to total numbers for the entire sample; total numbers were then divided by total volume filtered in cubic meters to arrive at numbers per cubic meter for each species or taxon.

BCO-DMO Processing:

- added top level header to serve data from all cruises as one dataset
- renamed column names (parameter names) to BCO-DMO standard
- replaced spaces in species names with underscores

version 2014-04-15 included data from TT050 and TT054

version 2014-05-27 added data from TT039
version 2014-12-31 added data from MN95-03 and MN95-06
version 2015-01-05 added TT043 and TT045
version 2016-05-04 corrected event and date for MB95-03/MB95-03_MOC1-33

[table of contents | back to top]

Data Files

File
copepod_MOC.csv (Comma Separated Values (.csv), 4.90 MB) MD5:71035badfdfef330c69b08eac11798e9 Primary data file for dataset ID 511656

[table of contents | back to top]

Parameters

Parameter	Description	Units
cruise_id	Cruise identifier	dimensionless
tow	MOCness tow number	dimensionless
sta_std	Arabian Sea standard station identifier	dimensionless
sta	station number from event log	dimensionless
event	event number, from event log	MMDDHHmm
date	date of sampling (GMT)	YYYYMMDD
net	MOCNESS net number: 1-8: 1/4 meter MOCNESS 11-18: 1 meter MOCNESS	dimensionless
time	time in UTC	HHMM
lat	latitude of net tow (South is negative)	decimal degrees
lon	longitude of net tow (West is negative)	decimal degrees
depth_start	depth at start of tow	meters
depth_end	depth at end of tow	meters
species	taxonomic genus and species	dimensionless
stage	developmental stage: f=female; m=male; c1-c5=copepodite stages; n=naupliar stages	dimensionless
abundance	abundance of copepod stage	number copepods/meter^3

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Folsom Splitter
Generic Instrument Name	Folsom Plankton Splitter
Generic Instrument Description	A device for sub-sampling of plankton and ichthyoplankton samples by splitting, developed by Dr. Folsom of the Scripps Institute of Oceanography. Ideally suited for splitting plankton samples with minimal debris. A measured volume of plankton sample is placed in the undivided section of the drum. This is rotated 120 degrees to divide the stirred sample with a separating blade. Standard Methods suggests splitting until a subsample of 200-500 individuals is obtained.

Dataset-specific Instrument Name	Double MOCNESS
Generic Instrument Name	MOCNESS-1D
Dataset-specific Description	The double MOCNESS is configured like two 1m2 MOCNESS systems attached side-by-side and carries twenty nets (Wiebe et al., 1985). The MOCNESS is designed to fish with a 1m2 net mouth area when towed at a 45o angle (Wiebe et al., 1976). A flow meter mounted on the frame, just ahead of the net mouth, allowed calculation of the volume of water sampled (Wiebe et al., 1976; 1985). The data-acquisition software used angle information when calculating volume of water filtered. The double MOCNESS was fitted with 153um mesh nets and included, in addition to the standard conductivity (Sea-Bird SBE4) and temperature (Sea-Bird SBE 3) sensors, a transmissometer (SeaTech, 25cm beam) and an oxygen probe (Sea-Bird SBE 13). The double MOCNESS was towed behind the ship at a speed of 1.5 to 2 knots (2.8-3.7 km h-1) through the water. Winch speed generally ranged from 10 to 25m min-1 during deployment and 5 to 15m min-1 during recovery. Target sampling depths for this report were 300-250m, 250-200m, 200-150m, 150-100m, 100-75m, 75-50m, 50-25m and 25m to surface.
Generic Instrument Description	The Double MOCNESS 1D carries 20 1m2 nets usually of mesh size 335micron and is designed to collect macrozooplankton. This MOCNESS system uses the same underwater and shipboard electronic system for operation and data acquisition as other MOCNESS systems. The nets are opened and closed sequentially by commands transmitted from the surface deck unit through a single conducting cable to the underwater unit. The command circuit has a provision to permit commands to be sent to either the left of right set of nets when using the double MOCNESS-1D. - from Wiebe et al, 1985.

Dataset-specific Instrument Name	Baby MOC, MOC-1/4
Generic Instrument Name	MOCNESS.25
Dataset-specific Description	Mesozooplankton (> 64 µm) were collected from tows with a 0.25 m^2-mouth area MOCNESS equipped with nine nets with a 7:1, mouth:length ratio (Wiebe et al., 1985).
Generic Instrument Description	The Multiple Opening/Closing Net and Environmental Sensing System or MOCNESS is a family of net systems based on the Tucker Trawl principle. The MOCNESS-1/4 carries nine 1/4-m2 nets usually of 64 micrometer mesh and is used to sample the larger micro-zooplankton.

Dataset-specific Instrument Name	1m2 MOCNESS system
Generic Instrument Name	MOCNESS1
Dataset-specific Description	The 1m2 MOCNESS system carries nine nets and is designed to fish with a 1m2 net mouth area when towed at a 45o angle (Wiebe et al., 1976). A flow meter mounted on the frame, just ahead of the net mouth, allowed calculation of the volume of water sampled (Wiebe et al., 1976). The data-acquisition software used angle information when calculating volume of water filtered. The 1m2 MOCNESS was fitted with 153um mesh nets and included, in addition to the standard conductivity (Sea-Bird SBE 4) and temperature (Sea-Bird SBE 3) sensors, a transmissometer (SeaTech, 25cm beam) and an oxygen probe (Sea-Bird SBE 13). The 1m2 MOCNESS was towed behind the ship at a speed of 1.5 to 2 knots (2.8-3.7 km h-1) through the water. Winch speed generally ranged from 10 to 25 m min-1 during deployment and 5 to 15 m min-1 during recovery. Target sampling depths for this report were 1000-750m, 750-500m, 500-250m, 250-200m, 200-150m, 150-100m, 100-50m, and 50-surface.
Generic Instrument Description	The Multiple Opening/Closing Net and Environmental Sensing System or MOCNESS is a family of net systems based on the Tucker Trawl principle. The MOCNESS-1 carries nine 1-m2 nets usually of 335 micrometer mesh and is intended for use with the macrozooplankton. All nets are black to reduce contrast with the background. A motor/toggle release assembly is mounted on the top portion of the frame and stainless steel cables with swaged fittings are used to attach the net bar to the toggle release. A stepping motor in a pressure compensated case filled with oil turns the escapement crankshaft of the toggle release which sequentially releases the nets to an open then closed position on command from the surface. -- from the MOCNESS Operations Manual (1999 + 2003).

Dataset-specific Instrument Name	oxygen probe
Generic Instrument Name	Oxygen Sensor
Dataset-specific Description	Sea-Bird SBE 13
Generic Instrument Description	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed

Dataset-specific Instrument Name	Sea Tech Transmissometer
Generic Instrument Name	Sea Tech Transmissometer
Dataset-specific Description	25cm beam
Generic Instrument Description	The Sea Tech Transmissometer can be deployed in either moored or profiling mode to estimate the concentration of suspended or particulate matter in seawater. The transmissometer measures the beam attenuation coefficient in the red spectral band (660 nm) of the laser lightsource over the instrument's path-length (e.g. 20 or 25 cm). This instrument designation is used when specific make and model are not known. The Sea Tech Transmissometer was manufactured by Sea Tech, Inc. (Corvalis, OR, USA).

Dataset-specific Instrument Name	SBE-3 Temperature
Generic Instrument Name	Sea-Bird SBE-3 Temperature Sensor
Generic Instrument Description	The SBE-3 is a slow response, frequency output temperature sensor manufactured by Sea-Bird Electronics, Inc. (Bellevue, Washington, USA). It has an initial accuracy of +/- 0.001 degrees Celsius with a stability of +/- 0.002 degrees Celsius per year and measures seawater temperature in the range of -5.0 to +35 degrees Celsius. more information from Sea-Bird Electronics

Dataset-specific Instrument Name	SBE-4 Conductivity
Generic Instrument Name	Sea-Bird SBE-4 Conductivity Sensor
Generic Instrument Description	The Sea-Bird SBE-4 conductivity sensor is a modular, self-contained instrument that measures conductivity from 0 to 7 Siemens/meter. The sensors (Version 2; S/N 2000 and higher) have electrically isolated power circuits and optically coupled outputs to eliminate any possibility of noise and corrosion caused by ground loops. The sensing element is a cylindrical, flow-through, borosilicate glass cell with three internal platinum electrodes. Because the outer electrodes are connected together, electric fields are confined inside the cell, making the measured resistance (and instrument calibration) independent of calibration bath size or proximity to protective cages or other objects.

[table of contents | back to top]

Deployments

TT050

Website	https://www.bco-dmo.org/deployment/57711
Platform	R/V Thomas G. Thompson
Start Date	1995-08-18
End Date	1995-09-15

TT054

Website	https://www.bco-dmo.org/deployment/57715
Platform	R/V Thomas G. Thompson
Start Date	1995-11-30
End Date	1995-12-28

TT039

Website	https://www.bco-dmo.org/deployment/57700
Platform	R/V Thomas G. Thompson
Report	http://usjgofs.whoi.edu/arabian-docs/smith-update.html
Start Date	1994-09-18
End Date	1994-10-07
Description	Intercalibration and Training Cruise **Methods & Sampling** 29 Oct. 2014 [NJC]: Cyndy created the .objects and .remoteobjects entries for this dataset on the JGOFS server, so the url has been changed http://usjgofs.whoi.edu/jg/serv/jgofs/arabian/copepod_MOC.html1%7Bdir=us...

MB95-03

Website	https://www.bco-dmo.org/deployment/544298
Platform	R/V Malcolm Baldridge
Report	http://usjgofs.whoi.edu/baldrige.html
Start Date	1995-04-27
End Date	1995-05-24
Description	Zooplankton and nekton sampling (GLOBEC cruise).

MB95-06

Website	https://www.bco-dmo.org/deployment/544318
Platform	R/V Malcolm Baldridge
Start Date	1995-07-31
End Date	1995-08-19
Description	Plankton sampling

TT045

Website	https://www.bco-dmo.org/deployment/57706
Platform	R/V Thomas G. Thompson
Start Date	1995-03-14
End Date	1995-04-10

TT043

Website	https://www.bco-dmo.org/deployment/57704
Platform	R/V Thomas G. Thompson
Report	http://osprey.bcodmo.org/datasetDeployment.cfm?ddid=2580&did=353&flag=view
Start Date	1995-01-08
End Date	1995-02-05
Description	Purpose: Process Cruise #1 (Late NE Monsoon)

[table of contents | back to top]

Project Information

U.S. JGOFS Arabian Sea (Arabian Sea)

Website: http://usjgofs.whoi.edu/research/arabian.html

Coverage: Arabian Sea

The U.S. Arabian Sea Expedition which began in September 1994 and ended in January 1996, had three major components: a U.S. JGOFS Process Study, supported by the National Science Foundation (NSF); Forced Upper Ocean Dynamics, an Office of Naval Research (ONR) initiative; and shipboard and aircraft measurements supported by the National Aeronautics and Space Administration (NASA). The Expedition consisted of 17 cruises aboard the R/V Thomas Thompson, year-long moored deployments of five instrumented surface buoys and five sediment-trap arrays, aircraft overflights and satellite observations. Of the seventeen ship cruises, six were allocated to repeat process survey cruises, four to SeaSoar mapping cruises, six to mooring and benthic work, and a single calibration cruise which was essentially conducted in transit to the Arabian Sea.

Life Cycles of Diapausing Copepods in the Arabian Sea: cues for sinking at the end of the SW Monsoon (Arabian Sea Diapausing Copepods)

Coverage: Arabian Sea

The infusion or transport of large-bodied copepods, whose life cycle includes diapauses (hibernation) at subsurface depths, into the upwelling area off Oman is fundamental to the success of the pelagic ecosystem in the region. Changes in the SW Monsoon wind pattern or strength can alter timing and intensity of upwelling and mixing, presenting the possibility that primary productivity during upwelling (dominated by diatoms) and the large-bodied, diapausing copepods that ingest phytoplankton, may become de-coupled. When decoupling has happened in other ecosystems, populations crash forcing a food web reorganization, often with outcomes that are undesirable. In the case of Oman, the abundant myctophid fish, a key link to upper trophic level fish of commercial importance, may be at risk for a significant population decline because of changes in the timing of primary production.

Now that climate change may be altering the monsoon cycle of wind forcing in the Arabian Sea, there exists the possibility that the life cycle of diapausing C. carinatus may become mismatched with the appearance of their food supply occurring during the upwelling season. While ontogenetic migration is generally associated with high latitude environments, where the spring bloom of phytoplankton driven by the annual cycle of sunlight provides a spatially and temporally reliable food supply, there are no other copepods inhabiting the tropics and subtropics that have diapause at depth in their life cycle (except perhaps Subeucalanus crassus in the Arabian Sea). Understanding the cues that trigger downward migration of C. carinatus at the end of the upwelling season, and investigating whether S. crassus has a phenology similar to C. carinatus, are the goals of this project. An international archive of samples from the Arabian Sea extending back to 1992, as well as new samples, will be used in this study.

Affiliated programs: The Netherlands Indian Ocean Programme, NIOP; US-GLOBEC

[table of contents | back to top]

Program Information

U.S. Joint Global Ocean Flux Study (U.S. JGOFS)

Website: http://usjgofs.whoi.edu/

Coverage: Global

The United States Joint Global Ocean Flux Study was a national component of international JGOFS and an integral part of global climate change research.

The U.S. launched the Joint Global Ocean Flux Study (JGOFS) in the late 1980s to study the ocean carbon cycle. An ambitious goal was set to understand the controls on the concentrations and fluxes of carbon and associated nutrients in the ocean. A new field of ocean biogeochemistry emerged with an emphasis on quality measurements of carbon system parameters and interdisciplinary field studies of the biological, chemical and physical process which control the ocean carbon cycle. As we studied ocean biogeochemistry, we learned that our simple views of carbon uptake and transport were severely limited, and a new "wave" of ocean science was born. U.S. JGOFS has been supported primarily by the U.S. National Science Foundation in collaboration with the National Oceanic and Atmospheric Administration, the National Aeronautics and Space Administration, the Department of Energy and the Office of Naval Research. U.S. JGOFS, ended in 2005 with the conclusion of the Synthesis and Modeling Project (SMP).

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Coverage: Global

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[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-9310577
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Office of Naval Research (ONR)	N00014-95-10042
NSF Division of Ocean Sciences (NSF OCE)	OCE-0825598
NSF Division of Ocean Sciences (NSF OCE)	OCE-1259255
NSF Division of Ocean Sciences (NSF OCE)	OCE-9911494

[table of contents | back to top]