Copepod species abundances from bongo tows, Arabian Sea JGOFS Process cruises R/V Thomas G. Thompson TT050, TT054 from Aug-Nov 1995 (Arabian Sea project, Arabian Sea Diapausing Copepods project)

Website: https://www.bco-dmo.org/dataset/506116
Version: 2014-04-07

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)

Contributors	Affiliation	Role
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Dataset Description

Copepods identified, staged, and enumerated from TT050 (Aug./Sept.) and TT054 (Nov/Dec) in 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 pper 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.

Smith, S.L., L.A. Codispoti, J.M. Morrison and R.T. Barber. 1998. The 1994-1996 Arabian Sea Expedition: an integrated, interdisciplinary investigation of the response of the northwestern Indian Ocean to monsoonal forcing. Deep-Sea Research II, 45, 1905-1916.

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.

Methods & Sampling

Bongo net. Bongo net collections covering the upper 200 meters were made at all intermediate stations and at some hydrographic stations, but not at the 48-hour time-series stations. Bongo net frames were 60cm diameter and were fitted with 153 and 335um mesh nets. Only the 153um mesh samples were analyzed. General Oceanics model 2030R flow meters were placed in the net mouth openings for the determination of volume filtered. The nets were towed obliquely from the side of the ship at approximately 1.5 to 2 knots (2.8-3.7 km h-1) through the water. Winch speed was generally 30m min-1 during deployment and 20m min-1 during recovery. The net was allowed to settle for about 30 seconds while at maximum wire out. The target depth for all Bongo tows was 200m, unless the sonic depth was less than that, and the wire out was adjusted during each tow, depending on the wire angle, to attain that depth. The maximum sampling depth of each tow was determined from a Wildlife Computers Mk3e Time Depth Recorder (TDR) attached to the net frame. Elapsed sampling time versus depth was plotted from TDR data for representative tows from cruises TN050 (August 18, 1995 - September 15, 1995) and TN 054 (November 30, 1995 - December 29, 1995). These comparisons showed that retrieval of the net was reasonably steady in both monsoon seasons so that all depth intervals were sampled uniformly. In the worst weather (TN 050; SW Monsoon), the rate of vertical ascent of the net was 11m min-1 (+/- 3; n=4), while in the better weather (TN054; NE Monsoon) ascent rate was 14m min-1 (+/-2; N=4).

The samples from the 153um Bongo net were split in a modified Folsom splitter, which split the sample into four parts consisting of 50%, 20%, 20% and 10%. In general, 10% was used for dry weight measurements (Lane and Smith, 1997;), 20% was preserved for collaborating scientists, and 70% was preserved for displacement volume measurements and taxonomic analysis.

Laboratory analysis. The samples reported here were split one to four times, depending on the amount of plankton present, in a Folsom splitter at the Rosenstiel School of Marine and Atmospheric Science (RSMAS), University of Miami. Subsamples were concentrated to 20 to 100ml and were transported to Ukraine (Russia) for enumeration and identification at the Institute for Biology of the Southern Seas (IBSS) in Sevastopol. Treatment of the samples at IBSS depended on the amount of plankton present in each sample. When the sample contained only a small amount of plankton, the entire split was analyzed for all species. In most cases, however, organisms smaller than ~1.5mm were identified and counted in smaller subsamples collected with a 1, 2 or 5ml Stempel pipette. Two replicate subsamples were withdrawn and counted and the data were averaged for calculation of abundance; generally 1-40 individuals per taxon were identified and sometimes more when a taxon was particularly abundant. Organisms ranging in size from ~1-2mm were counted in another part of the subsample collected with a 5ml Stempel pipette or by splitting the subsample into two or four equal parts. The entire subsample originating at RSMAS was then analyzed for abundance of organisms larger than 2mm, including copepods, euphausiids, amphipods, fish larvae, ostracods and any rare, large organisms. A total of 300 to 500 organisms per entire split were identified and counted. The identifications were performed with the aid of Leningrad Optic-Mechanics Company (LOMO) binocular microscopes using various magnifications depending on the sizes of the individuals being identified. Copepod species are listed in alphabetical order. All copepod adult stages, copepodite stages and nauplii found in each sample are listed. The taxonomic notations are: c1 = copepodite stage I of the species; c2 = copepodite stage II of the species; c3 = copepodite stage III of the species; c4 = copepodite stage IV of the species; c5 = copepodite stage V of the species; c = undetermined copepodite stage of the species; m = adult males of the species; f = adult females of the species. Total length of the copepods is the average length in mm measured microscopically for that taxon.

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Data Files

File
copepod_bongo.csv(Comma Separated Values (.csv), 342.89 KB) MD5:d1e92930dd645141fb46ad4f579a5cb0 Primary data file for dataset ID 506116

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Parameters

Parameter	Description	Units
cruise_id	cruise identification	unitless
event	event number; from event log	unitless
year	year	unitless
mon	month	unitless
day	day	unitless
time	time; GMT	unitless
sta	sequential station number; from event log	unitless
sta_std	Arabian Sea standard station identifier. E30 is British station Arabesque.	unitless
tow	bongo tow number	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
depth_start	depth sample collection started	meters
depth_end	depth sample collection stopped	meters
species	taxonomic genus and species name	unitless

stage	development stages of copepods : n=naupili; f=adult female; c1=copepodite stage I; etc.	unitless
abundance	abundance number of the specific taxa/group counted per unit area or volume	number copepods/meter^3
ISODateTime_UTC	ISO formatted UTC date/time	
yrday_gmt	GMT day and decimal time, where Jan. 1 = yrday 0; 325.5 is noon on the 326th day of the year, or November 22 at 1200 hours (noon).	

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Instruments

Dataset-specific Instrument Name	Bongo Net
Generic Instrument Name	Bongo Net
Dataset-specific Description	Bongo net frames were 60cm diameter and were fitted with 153 and 335um mesh nets. Only the 153um mesh samples were analyzed. General Oceanics model 2030R flow meters were placed in the net mouth openings for the determination of volume filtered.
Generic Instrument Description	A Bongo Net consists of paired plankton nets, typically with a 60 cm diameter mouth opening and varying mesh sizes, 10 to 1000 micron. The Bongo Frame was designed by the National Marine Fisheries Service for use in the MARMAP program. It consists of two cylindrical collars connected with a yoke so that replicate samples are collected at the same time. Variations in models are designed for either vertical hauls (OI-2500 = NMFS Pairovet-Style, MARMAP Bongo, CalVET) or both oblique and vertical hauls (Aquatic Research). The OI-1200 has an opening and closing mechanism that allows discrete "known-depth" sampling. This model is large enough to filter water at the rate of 47.5 m3/minute when towing at a speed of two knots. More information: Ocean Instruments, Aquatic Research, Sea-Gear

Dataset-specific Instrument Name	Flow Meter
Generic Instrument Name	Flow Meter
Dataset-specific Description	General Oceanics model 2030R
Generic Instrument Description	General term for a sensor that quantifies the rate at which fluids (e.g. water or air) pass through sensor packages, instruments, or sampling devices. A flow meter may be mechanical, optical, electromagnetic, etc.

Dataset-specific Instrument Name	binocular microscope
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Leningrad Optic-Mechanics Company (LOMO) binocular microscopes using various magnifications depending on the sizes of the individuals being identified
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	
Generic Instrument Name	Plankton sub-sampler
Dataset-specific Description	Folsom plankton splitter and 1, 2 or 5ml Stempel pipette
Generic Instrument Description	Various devices for sub-sampling plankton samples Folsom splitter: http://www.aquaticresearch.com/folsom_plankton_splitter.htm Motoda box splitter: http://www.aquaticresearch.com/motodo_plankton_splitter.htm Hensen Stempel Pippette: http://www.envcoglobal.com/catalog/product/plankton-counting/hensen-stem... Sedgewick-Rafter Plankton Counting Chamber: http://www.benmeadows.com/wildco-sedgewick-rafter-counting-chambers_3681...

Dataset-specific Instrument Name	TDR
Generic Instrument Name	Wildlife Computers Time-Depth Tag (TDR)
Dataset-specific Description	Attached to bongo net frame.
Generic Instrument Description	Time depth recorders (TDR's) manufactured by Wildlife Computers, Redmond WA) are designed for studies of seals, penguins, fish, and marine mammals. Standard TDR's are mounted externally on the animal's body, where they record temperature and depth. See more information from the manufacturer.

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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

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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

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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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Funding Source	Award
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NSF Division of Ocean Sciences (NSF OCE)	OCE-1259255

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