Abundance of copepods in Wilkinson Basin Time Series Station, Gulf of Maine, 2005-2016

Website: https://www.bco-dmo.org/dataset/768306
Data Type: Cruise Results
Version: 1
Version Date: 2019-05-20

Project
» Collaborative Research: Mechanisms supporting persistence of a key plankton species during climate change on the Northwest Atlantic continental shelf (Calanus Persistence GoM)

Contributors	Affiliation	Role
Runge, Jeffrey A.	Gulf of Maine Research Institute (GMRI)	Principal Investigator
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Abstract
Abundance (number per square meter) of copepod species captured with a 200-micron mesh vertical net at the Wilkinson Basin Time Series Station, Gulf of Maine from 2005 to 2016.

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Coverage

Spatial Extent: **Lat**:42.8614 **Lon**:-69.8614
Temporal Extent: 2005-01-30 - 2016-10-12

Dataset Description

Abundance (number per square meter) of copepod species captured with a 200-um mesh vertical net at the Wilkinson Basin Time Series Station, Gulf of Maine from 2005 to 2016.

Methods & Sampling

Sampling at the Wilkinson Basin Time Series (WBTS) station followed as a guideline the protocols established by the Atlantic Zone Monitoring Program (AZMP) established by Fisheries and Oceans Canada (Mitchell et al. 2002).

Sampling and analytical procedures:

Environmental data. The R/V Gulf Challenger system comprised a Sea-Bird Electronics (SBE) 25Plus CTD, an SBE-55 Sampling Rosette with six four-liter Niskin bottles, a dedicated Hawboldt Industries SPR 1424/S Science winch, and a SBE-33 real-time monitoring and sampling deck unit. The system provided high-resolution vertical profiling of hydrographic properties (e.g. conductivity, salinity, temperature), physiochemical properties (e.g. Photosynthetically Active Radiation (PAR)), and surrogates for biological and geological processes (e.g. dissolved oxygen, chlorophyll-a fluorescence, and beam transmittance). The raw CTD data and bottle trips were acquired by SBE Seasave on a

Windows 7 workstation and were processed from hex files to .cnv files. Post cruise data processing was completed on a Windows 7 machine running SEABIRD SBE DATA Processing version 7.22.5 At most stations, Niskin bottles were used to capture water samples at depths of 2, 10, 20 and 40 meters. To measure chlorophyll a concentration at discrete depths, duplicate, 100 mL or 500-550 mL subsamples were collected from Niskin bottles at the surface, 10, 20 and 40 meters. Water was filtered immediately on the vessel using glass fiber filters (GF/F) and polycarbonate membrane filters with pore sizes of 0.7 µm and 0.1µm. Chlorophyll-a concentrations were calculated were using equations in Strickland and Parsons (1972). Prior to 2014, IOP profilers calibrated annually were used to measure water column stimulated fluorescence. After 2014, the nominal chlorophyll-a readings from stimulated fluorescence measured with a Wetlabs Wetstar Chlorophyll Fluorometer S/N WSS-164 were corrected with chlorophyll concentrations measured from bottle samples.

Copepod data: To measure zooplankton abundance and biomass, two net two casts were made using a 0.75 meter diameter single ring or a SEA-GEAR Model 9600 twin-ring 200µm mesh net, The nets were towed vertically at approx.. 40m/min from within 5 meters of the bottom. The samples were preserved in 4% buffered formaldehyde. For the dual ring casts, a third sample was preserved in 95%, denatured ethanol and on many occasions, the fourth sample was kept live, diluted with sea water and distributed into 3.7 L plastic containers, and placed in a cooler until they could be transported back to the lab for live image analysis.

The zooplankton samples fixed in formalin were further processed for identification and enumeration of species. Samples were diluted in seawater and subsamples were taken until 200 copepods and at least 75 Calanus were identified.

Data Processing Description

Data processing:
Zooplankton analysis: All samples were preserved in a 4% seawater-buffered formaldehyde solution. In the laboratory, samples were split using a Folsom plankton splitter. Half of the sample was archived for identification and enumeration of zooplankton species. The archived split was diluted and a 5- to 10-mL subsample taken to obtain a target number of 200 organisms. An additional subsample of 75–200 individuals was analyzed to enumerate stages of Calanus finmarchicus, copepod. The counts were normalized to number/m2, taking into account the subsample dilution factor and split factors. Volume sampled was determined geometrically as the area of the net multiplied by the station depth. This was found to be more consistently reliable than the volume calculated from flowmeter readings. Note that the depth of water sampled by the net was typically within 5 m of the station depth.

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- re-formatted date from m/d/yyyy to yyyy-mm-dd
- rounded some Sample_examined_for_zoo and sample_examined_for_Cfin from 16 to 5 decimal places

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Data Files

File
copepod_abund_M2_WBTS.csv (Comma Separated Values (.csv), 8.89 KB) MD5:998f200d6100ae08475d984877cdb934 Primary data file for dataset ID 768306

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Supplemental Files

File
GoM_WBTS_CruiseReport_WBTS_FIN_24April19.docx (Microsoft Word document, 324.18 KB) MD5:3e52e3557ee271adc84de1cfd2d8709f Cruise report for Wilkinson Basin Time Series study

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Related Publications

Mitchell, M. R., Harrison, G., Pauley, K., Gagné, A., Maillet, G., & Strain, P. (2002). Atlantic zonal monitoring program sampling protocol (pp. iv+-23). Fisheries & Oceans Canada, Maritimes Region, Ocean Sciences Division, Bedford Institute of Oceanography.Canadian Technical Report of Hydrography and Ocean Sciences 223. ISSN 071 1-6764; http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.482.7471&rep=rep1&type=pdf
Methods

Record, N., Runge, J., Pendleton, D., Balch, W., Davies, K., ... Thompson, C. (2019). Rapid Climate-Driven Circulation Changes Threaten Conservation of Endangered North Atlantic Right Whales. Oceanography, 32(2). doi:10.5670/oceanog.2019.201
Results

Runge, J. A., Ji, R., Thompson, C. R. S., Record, N. R., Chen, C., Vandemark, D. C., ... Maps, F. (2015). Persistence of Calanus finmarchicus in the western Gulf of Maine during recent extreme warming. Journal of Plankton Research, 37(1), 221–232. doi:10.1093/plankt/fbu098
Results

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Parameters

Parameter	Description	Units
Date	Date (local) of visit to WBTS by the R/V Gulf Challenger	unitless
NET_depth	Estimated depth to which net was deployed (from wire out)	meters
Water_Depth	Bottom depth recorded on day of sampling	meters
Num_Cfin_Id_subsample	Total number of C. finmarchicus counted in subsample	each
Nauplii	Number of all C. finmarchicus nauplius stages per m2	per meter^2
CI	Number of C. finmarchicus stage CI per m2	per meter^2
CII	Number of C. finmarchicus stage CII per m2	per meter^2
CIII	Number of C. finmarchicus stage CIIII per m2	per meter^2
CIV	Number of C. finmarchicus stage CIV per m2	per meter^2
CV	Number of C. finmarchicus stage CV per m2l	per meter^2
Female	Number of C. finmarchicus adult females per m2	per meter^2
Male	Number of C. finmarchicus adult males per m2	per meter^2
Calanus_finmarchicus	Number of all C. finmarchicus copepodid stages per m2	per meter^2

Calanus_hyperboreus	Total Calanus hyperboreus abundance	per meter^2
Paraeucheata_spp	Total Paraeuchaeta spp. abundance	per meter^2
Pseudocalanus_spp	Total Pseudocalanus spp. abundance	per meter^2
Centropages_spp	Total Centropages spp. abundance	per meter^2
Metridia_spp	Total Metridia spp. abundance	per meter^2
Oithona_spp	Total Oithona spp. abundance	per meter^2
Microcalanus_spp	Total Microcalanus spp. abundance	per meter^2
Clauso_Para_Parvo_spp	Total Clausocalanus/Paracalanus/Parvocalanus spp. abundance	per meter^2
Temora_spp	Total Temora spp. abundance	per meter^2
other_copepod_spp	Total other copepod species abundance	per meter^2

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Instruments

Dataset-specific Instrument Name	Leica stereomicroscopes: models MZ12.5, MZ16.5, MZ205C or MS5
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Used to identify copepods.
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	Niskin bottles
Generic Instrument Name	Niskin bottle
Dataset-specific Description	SBE-55 Sampling Rosette with six four-liter Niskin bottles
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.

Dataset-specific Instrument Name	plankton nets
Generic Instrument Name	Plankton Net
Dataset-specific Description	An 0.75 meter diameter single ring or a SEA-GEAR Model 9600 twin-ring 200-micron mesh net.
Generic Instrument Description	A Plankton Net is a generic term for a sampling net that is used to collect plankton. It is used only when detailed instrument documentation is not available.

Dataset-specific Instrument Name	Sea-Bird Electronics (SBE) 25Plus CTD
Generic Instrument Name	Sea-Bird SBE 25 Sealogger CTD
Generic Instrument Description	The Sea-Bird SBE 25 SEALOGGER CTD is battery powered and is typically used to record data in memory, eliminating the need for a large vessel, electrical sea cable, and on-board computer. All SBE 25s can also operate in real-time, transmitting data via an opto-isolated RS-232 serial port. Temperature and conductivity are measured by the SBE 3F Temperature sensor and SBE 4 Conductivity sensor (same as those used on the premium SBE 9plus CTD). The SBE 25 also includes the SBE 5P (plastic) or 5T (titanium) Submersible Pump and TC Duct. The pump-controlled, TC-ducted flow configuration significantly reduces salinity spiking caused by ship heave, and in calm waters allows slower descent rates for improved resolution of water column features. Pressure is measured by the modular SBE 29 Temperature Compensated Strain-Gauge Pressure sensor (available in eight depth ranges to suit the operating depth requirement). The SBE 25's modular design makes it easy to configure in the field for a wide range of auxiliary sensors, including optional dissolved oxygen (SBE 43), pH (SBE 18 or SBE 27), fluorescence, transmissivity, PAR, and optical backscatter sensors. More information from Sea-Bird Electronics: http:www.seabird.com.

Dataset-specific Instrument Name	SBE-33 real-time monitoring and sampling deck unit
Generic Instrument Name	Sea-Bird SBE 33 Carousel Deck Unit
Generic Instrument Description	The rack-mountable SBE 33 provides power and real-time data acquisition and control for an SBE 32 Carousel Water Sampler that has the SBE 33 interface option installed in its pylon. The SBE 33 is compatible with all Carousel sizes - full size, compact, and sub-compact. When powered and controlled by the SBE 33, the Carousel can be used: - with an SBE 19, 19plus, 19plus V2, 25, 25plus, or 49 CTD - without a CTD - with a Neil Brown Mk III CTD (requires optional interface for both SBE 32 and 33) The SBE 33 can also provide power and real-time data acquisition and control for the smaller SBE 55 ECO Water Sampler used with an SBE 19, 19plus, 19plus V2, 25, 25plus, or 49 CTD, or no CTD. See http://www.seabird.com/sbe33-deck-unit for further details.

Dataset-specific Instrument Name	Wetlabs Wetstar Chlorophyll Fluorometer S/N WSS-164
Generic Instrument Name	WET Labs (Sea-Bird WETLabs) WETStar fluorometer
Dataset-specific Description	Used to measure chlorophyll concentrations.
Generic Instrument Description	Submersible fluorometer designed for through-flow or pumped CTD applications manufactured by WetLabs and which can be configured for various types of fluorescence. The probe has a temperature range of 0-30 degrees C and a depth rating of 600 meters.

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Deployments

GC_GoM_2004-2018

Website	https://www.bco-dmo.org/deployment/768357
Platform	R/V Gulf Challenger
Report	https://datadocs.bco-dmo.org/docs/Calanus_Persistence_GoM/data_docs/GoM_WBTS_CruiseReport_WBTS_FIN_24April19.docx
Start Date	2004-05-21
End Date	2018-03-01
Description	Wilkinson Basin is one of the three major basins, where depths exceed 200 meters, in the Gulf of Maine. The Wilkinson Basin Time Series station (WBTS) is located at a depth of 256 meters and is approximately 38 nautical miles from New Castle, NH, home port of the University of New Hampshire research vessel, R/V Gulf Challenger.

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Project Information

Collaborative Research: Mechanisms supporting persistence of a key plankton species during climate change on the Northwest Atlantic continental shelf (Calanus Persistence GoM)

Coverage: Gulf of Maine/Northwest Atlantic Ocean

Description from NSF award abstract:
In the Gulf of Maine region, rapid warming of the ocean surface in recent years has raised concern in the research and resource management communities, fishing industry and the general public about effects on the coastal marine ecosystem. This interdisciplinary, collaborative project will improve understanding of the physical and biological processes controlling the abundance of a planktonic animal that is particularly important in the food web of the northeast coastal ocean. About the size of a grain of rice, the marine copepod *Calanus finmarchicus* is the primary prey for herring and other forage fish, as well as for the endangered northern right whale. This study will examine whether transport of *C. finmarchicus* into the Gulf of Maine from cold Canadian waters, in combination with growth and reproduction in the relatively cold Maine Coastal Current, is sufficient to supply the region with the numbers needed to attract and nourish the fish, seabirds and mammals that rely on its energy rich life stages, despite recent ocean warming. The research team will develop a computer model that links extensive understanding of the species' life history with ocean currents and temperature. Results from the model will be tested against field collections at two locations. This study will also contribute to the new Integrated Sentinel Monitoring Network, a joint effort planned by federal and state agencies with academic research participation to monitor future ecosystem change on the northeastern coastal shelf. It will train a graduate student and postdoctoral scientist in interdisciplinary research and also provide support for an early-career investigator.

The project will take a process modeling approach that takes into account regional and mesoscale interaction between life history and bathymetry and circulation to improve understanding of planktonic species distribution shifts. It will combine two decades of research on *Calanus finmarchicus* life history, including diapause, with a high resolution regional circulation model into an innovative application of a three dimensional, physical-biological model. The modeling approach represents an advancement of climate forecasts of species ranges by coupling a Lagrangian perspective with local processes to better resolve complex range boundaries. It will use Lagrangian parameters such as finite-scale or finite-time Lyapunov exponents, translating particle trajectories into scalar fields that represent the structure of the advective regime. The model will be informed by and tested with measurements of vital rates and demographic data collected on a research vessel at two time series stations. It will be used in backward-in-time and forward-in-time modes to test hypotheses about sources and destinations of *C. finmarchicus* in the Gulf of Maine, effects of match/mismatch in phenologies, and exploration effects of climate forced scenarios on advective pathways.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459087
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459216

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