Abundance *Calanus finmarchicus* 1995 – 2014.
Northwest Atlantic United States
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1. INTRODUCTION

This data product shows the seasonal abundance per cubic meter (log-transformed) of the copepod *Calanus finmarchicus* (a species of zooplankton). This dataset was created by The Nature Conservancy (TNC) using data provided by the Northeast Fisheries Science Center (NEFSC) in Narragansett, RI. This dataset covers offshore waters from North Carolina to northern Maine, and from the coast line until the 1600 meter bathymetry line. The spatial resolution of this layer is 2600 meters.

Source data was collected by the Northeast Fisheries Science Center (NEFSC) as part of their shelf-wide research vessel surveys (Kane 2007, 2011). These surveys are conducted over the continental shelf, from Cape Hatteras (North Carolina) to Cape Sable (Nova Scotia). Plankton samples were collected using a bongo net as part of two types of cruises: broad-scale surveys dedicated to plankton, and trawl and dredge surveys were plankton samples were also collected across the region. Coordinates of sample locations were also collected using a GPS. In the laboratory, zooplankton organisms were sorted, counted, and identified to the lowest possible taxa. NEFSC provided values in abundances by $100m^3$. All abundance values were divided by 100 to obtain abundance by cubic meter, and values were log-transformed (ln(x+1)) since the distribution of zooplankton values resembled a Poisson distribution (values skewed to smaller abundances). The reason for adding 1 to the abundances prior to calculating the natural log was to prevent irrational values when abundance values are zero.

Sample points were separated in four groups based on the year and season collected: Spring 1995-2004 (1560 points), Fall 1995-2004 (2048 points), Spring 2005-2014 (1338 points), Fall 2005-2014 (1929 points). Seasons were defined to be consistent with meteorological seasons: Spring (March 1st – May 31st); Fall (September 1st – November 30th). Composites of point data samples for each group were interpolated separately using the ArcGIS function "Diffuse interpolation with barriers" to create surfaces. The reason for using this interpolation method was to prevent values being interpolated across land masses (e.g. from North to South of Cape Cod). No data values in this layer represent areas where there were not enough points to interpolate a surface. Finally, layers were clipped to the area of study.

2. PURPOSE

This layer was created to visualize seasonal patterns of zooplankton abundance across space, and to provide the means for comparison between species and between decades. It addresses data gaps and provides the most up-to-date information on zooplankton abundance for the area of study. This supports the Northeast Regional Ocean Council (NROC) efforts to provide datasets to stakeholders and managers to facilitate coastal and ocean planning.

Zooplankton includes a diverse group of free-floating organisms. Zooplankton organisms are secondary consumers, feeding often on phytoplankton organisms. They provide an essential link within the trophic chain, transferring energy from primary producers to predators higher up the trophic chain. *Calanus finmarchicus*, a large planktonic copepod, is one of the most common zooplankton organisms in the area. It is an herbivore, feeding mainly on phytoplankton organisms such as diatoms and dinoflagelates. These copepods are a key component of the food web in Northwest Atlantic waters. They are the food of choice of many planktivorous species, such as herring and mackerel, as well as many larval fish.

3. SOURCES AND AUTHORITIES

- Northeast Fisheries Science Center (NEFSC) zooplankton database
- Kane J (2007) Zooplankton abundance trends on Georges Bank, 1977-2004. ICES Journal of Marine Science 64(5):909-91
- Kane J (2011) Inter-decadal variability of zooplankton abundance in the Middle Atlantic Bight. Journal of Northwest Atlantic Fishery Science 43: 81-92

4. DATABASE DESIGN AND CONTENT

Native storage format: ArcGIS File Geodatabase Raster
Columns and Rows: 366, 377

Number of Bands: 1
Cell Size: 2600 meters (0.03374 degrees)
Source Type: generic
Pixel Type: floating point
Pixel Depth: 32 Bit
Statistics:

Season	Decade	Minimum	Maximum	Mean	Standard Deviation
SPRING	1995-2004	0.0501602776348590	7.33148956298828	4.38437068890120	1.48336773261974
	2005-2014	0.0983010903000831	7.16238069534301	4.38216733119433	1.32672381251084
FALL	1995-2004	2.799312824208e-005	6.02835130691528	2.68292773179519	1.48393248116052
	2005-2014	0.00366221438162028	5.66099309921264	2.72927507600717	1.4317988279322

Dataset Name:
- CalanusFall1995to2004
- CalanusFall2005to2014
- CalanusSpring1995to2004
- CalanusSpring2005to2014

Dataset Status: Complete

5. SPATIAL REPRESENTATION

Reference System: GCS North American 1983
Horizontal Datum: North American Datum 1983
Ellipsoid: Geodetic Reference System 1980
Linear Unit: Meter (1.0)
Angular Unit: Degree (0.0174532925199433)
False Easting: 0.0
False Northing: 0.0
Central Meridian: 0.0

Geographic extent: -76.45 to -64.101, 33.674 to 46.395

IS0 19115 Topic Category: biology, environment, oceans

Place Names:

Albemarle Sound, Baltimore Canyon, Bay of Fundy, Block Island Delta, Cashes Ledge, Chesapeake Bay, Cholera Bank, Delaware Bay, Georges Bank, Georges Basin, German Bank, Great South Channel, Gulf of Maine, Hudson Canyon, Hydrographer Canyon, Jeffreys Ledge, Jordan Basin, Lake Ontario, Long Island Sound, Mid-Atlantic Bight, Nantucket Shoals, Norfolk Canyon, Northeast Channel, Stellwagen Bank, Southern New England, Wilkinson Basin

Recommended Cartographic Properties:

(Using ArcGIS ArcMap nomenclature)

Stretch, Standard Deviations (2.5), Prediction color ramp.

To compare different Calanus layers using the same scale, use statistics from Custom settings (reference values from Spring 1995-2004):

Min: 5.0160277634859099e-002

Max: 7.3314895629882804

Mean: 4.3843706889012104

Std Dev.: 1.4833677326197501

Scale range for optimal visualization: 1:5,000,000

6. DATA PROCESSING

Processing environment: Microsoft Windows 7 Professional, Service Pack 1; ESRI ArcGIS 10.2.2, extensions: Geostatistical Analyst, Spatial Analyst; Microsoft Office 2010

	Process Steps Description
1	In Excel, database was queried for selected decade, season, and species. Abundances where divided by 100 to obtain abundances by $1m^3$. Finally, results were log-transformed (ln+1).
2	Plotted results in ArcGIS. Point data was interpolated into raster surface using DIFFUSION INTERPOLATION WITH BARRIERS from the Geostatistical Analyst extension. Used polygon shapefile of US states as absolute barriers, and bandwidth of 20,000m.
3	Layer was clipped to area of study using EXTRACT BY MASK function from the Spatial Analyst extension.

7. QUALITY PROCESS

Attribute Accuracy: The accuracy of the data is a result of the accuracy of the source data provided by NEFSC.

Logical Consistency: These data are believed to be logically consistent.

Completeness: This layer is a composite from all available data samples within each season and decade. Areas with data gaps signify locations without enough samples to interpolate a surface.

Positional Accuracy: The accuracy of the data is a result of the accuracy of the GPS units used when samples were collected. Also, interpolations of point data samples to surfaces may create inaccuracies in certain areas.

Timeliness: Based on data from January 1995 - December 2014.

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