Laboratory results on Copepod nauplii and adult gut epifluorescence in samples collected from the San Francisco estuary in 2013

Website: https://www.bco-dmo.org/dataset/546397
Data Type: experimental
Version: 2015-01-15

Project
» Feeding and food limitation in copepod nauplii, the neglected life stage (food limitation in copepod nauplii)

Contributors	Affiliation	Role
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Dataset Description

Raw data and calculations for copepod gut fluorescence. Raw data represent the computed 2D area of gut epifluorescence images containing chlorophyll. Guts of *Oithona davisae* and *Pseudodiaptomus marinus* adult and nauplii were examined.

Related Reference:

Vogt, R.A., T.R. Ignoffo, L.J. Sullivan, J. Herndon, J.H. Stillman, and W. Kimmerer. 2013. Feeding capabilities and limitations in the nauplii of two pelagic estuarine copepods, Pseudodiaptomus marinus and Oithona davisae. Limnology and Oceanography 58: 2145-2157.

Methods & Sampling

A Nikon model E400 epifluorescence microscope at 20X magnification, outfitted with a Nikon B-2A longpass filter cube (470EX/515LP, Nikon) and a custom bandpass filter cube (430EX/680EM, Omega Optical) was used. The longpass filter pair provided a brighter overall image than the bandpass filter pair and also fluoresced non-chlorophyll structures (e.g., the copepod exoskeleton fluoresces green with blue excitation). The bandpass filter cube showed fluorescence from only chlorophyll and phaeopigments. Photographs of the copepods were taken at each filter setting using a Canon® Digital model T3i single lens reflex (SLR) camera (ISO 6400, F 1/15) remotely controlled with the Canon Electro-Optical System (EOS) Utility software to produce clear images of the epifluorescence.

Images were processed with Photoshop CS6 (Adobe®). Total gut area was manually digitized using the lasso and measurement tools on the longpass-filtered images. The mean gut area of 12 individuals for each copepod species and stage was used for calculations. The threshold tool was used to select areas of the longpass-filter images containing pigment (gut pigment area) that exceeded baseline fluorescence. Signal intensity was not

used in the calculation of the gut pigment index because pigment content and composition differed among phytoplankton taxa. Pixels of the bandpass-filtered images exceeding the threshold value were selected and their area estimated using the measurement tool. The gut-pigment area was then divided by the total gut area yielding a relative GPI for each copepod. The same procedure was used to process images of copepods sampled from the control bottles. Copepods with <5% GPI were assumed not to have fed, as the GPI values in those samples were within the range of indices estimated from the controls.

Data Processing Description

The raw data (pixel area of a copepod's gut containing red pixels representing chlorophyll) were divided by a constant (the red pixel area or background fluorescence of a copepod with an empty gut). These numbers were then expressed as a percentage range (0-5, 6-25, 26-50, 51-75, 76-100).

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date, reference information
- renamed parameters to BCO-DMO standard
- replaced spaces with underscores
- changed Chaetocerous to Chaetoceros
- changed Thalassiosira weisflogii to Thalassiosira weissflogii
- changed Pseudodioptamus to Pseudodiaptomus

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Data Files

File
1_cope_gut_fluor.csv (Comma Separated Values (.csv), 47.85 KB) MD5:0f871d14f51e846f30e884968c2742a4 Primary data file for dataset ID 546397

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Parameters

Parameter	Description	Units
copepod_species	copepod species name	unitless
copepod_stage	life stage of copepod	unitless
algae_species	alga species name	unitless
photo_id	photograph file identification	unitless
gut_fullness	gut fullness	percent
gut_area	gut area	pixels
feed_duration	duration of feeding period	hours
depur_time	duration of post-feeding period	hours
comment	comments	unitless

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Instruments

Dataset-specific Instrument Name	camera
Generic Instrument Name	Camera
Dataset-specific Description	Canon® Digital model T3i single lens reflex (SLR) camera (ISO 6400, F 1/15) remotely controlled with the Canon Electro-Optical System (EOS) Utility software.
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Epifluorescence Microscope
Generic Instrument Name	Fluorescence Microscope
Dataset-specific Description	Nikon model E400 epifluorescence microscope at 20X magnification, outfitted with a Nikon B-2A longpass filter cube (470EX/515LP, Nikon) and a custom bandpass filter cube (430EX/680EM, Omega Optical)
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of fluorescence and phosphorescence instead of, or in addition to, reflection and absorption of visible light. Includes conventional and inverted instruments.

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Deployments

Kimmerer_2013

Website	https://www.bco-dmo.org/deployment/546436
Platform	SFSU RTC
Start Date	2009-09-01
End Date	2014-08-31
Description	Copepod feeding studies

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Project Information

Feeding and food limitation in copepod nauplii, the neglected life stage (food limitation in copepod nauplii)

Coverage: San Francisco Estuary

This project will investigate feeding by copepod nauplius larvae, the most abundant metazoans in the sea. It will answer three questions: 1) How does food selection by adults and nauplii differ when they are fed multiple prey species in the laboratory? 2) How does food selection by adults and nauplii differ when they are feeding on natural prey assemblages? and, 3) How do growth, development, and survival differ between copepodites and nauplii when their growth is food limited? Comparative experiments and field-based measurements will contrast the food consumed, and the effects of food limitation, between nauplii and later life stages. This contrast will include attributes of food such as size, taxon, and motility, and will include experiments with cultured prey

offered singly or in a mixture, and natural prey, and apply genetic techniques to determine prey consumption by a predatory copepod. Copepods will be collected from the San Francisco Estuary, with four species selected for experiments to span taxonomic groups, sizes, salinity ranges, and general feeding behavior. A variety of techniques will be applied to account for the inevitable biases and limitations of each; all but one have previously been applied in our laboratories. These will include laboratory feeding experiments using cultured prey individually and in mixtures, and experiments using natural prey. Consumption of prey in experimental bottles will be measured as chlorophyll concentration and through particle counts by microscopy and flow cytometry. Radioactively labeled prey will be used in short incubations to determine feeding on particular prey types. Samples from the field will be examined for gut fluorescence. Separate experiments will determine how nauplii and copepodites survive and grow at different concentrations of food. Investigations of feeding by a predatory copepod (Tortanus dextrilobatus) will use molecular techniques to identify mitochondrial and nuclear DNA from diverse suspected prey species. Specific primers will be developed for common zooplankton species consumed by T. dextrilobatus in the laboratory. General primers and screening protocols developed here will be useful for identifying food web interactions in other estuarine communities.

Copepod nauplii are important both in their diverse trophic roles in ocean foodwebs and in the population dynamics of copepods. Nauplii have a completely different feeding apparatus from later stages, and the first feeding stage can be very sensitive to starvation, making these life stages critical to population dynamics. Yet extant copepod population models treat nauplii as miniature adults. This work will provide valuable input to the growing efforts at modeling ocean ecosystems.

Further details from final report (pdf)

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0929075

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