Upper thermal limits (LD50) for two common coastal copepods during thermal experiments with individuals collected from Long Island Sound between July 2017 and November 2019

Website: https://www.bco-dmo.org/dataset/955739
Data Type: experimental
Version: 1
Version Date: 2025-03-11

Project
» Linking eco-evolutionary dynamics of thermal adaptation and grazing in copepods from highly seasonal environments (evolutionary_copepods)

Contributors	Affiliation	Role
Dam, Hans G.	University of Connecticut (UConn)	Principal Investigator
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Abstract
These data include estimates of upper thermal limits for two common coastal copepods collected from Long Island Sound between July 2017 and November 2019. Individual survival measurements were made for both field and laboratory acclimated individuals exposed to temperatures ranging from 10°C to 39°C. These data highlight how acclimation and rapid adaptation may influence responses of populations to rapid climate change. Data were collected by Dr. Matthew Sasaki at the University of Connecticut.

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Coverage

Location: Copepods were collected from Eastern Long Island Sound using surface plankton tows in the top three meters of water.
Spatial Extent: **Lat**:41.32074 **Lon**:-72.001655
Temporal Extent: 2017-05-07 - 2019-11-17

Methods & Sampling

Copepods were collected using a 250-um mesh plankton net with a solid cod end. Upper thermal limits were measured as LD50, or the temperature at which only 50% of individuals survived after a 24-hour acute heat shock, estimated from a thermal survivorship curve. These curves were generated by exposing individual copepods to a static temperature for 24 hours. Each individual was placed in a 2 mL microcentrifuge tube with 1.5 mL of 0.2 um filtered seawater. These tubes were then moved to 15-well dry baths, set to temperatures between 10°C and 39°C. Each individual experienced only one temperature. After the 24 hour period, survival for each individual was checked. This binary survival data was then used to generate survivorship curves for each collection using a logistic regression. LD50 was then extracted from these curves.

Organism identifiers (Life Science Identifier (LSID))
copepod, Acartia tonsa, urn:lsid:marinespecies.org:taxname:345943
copepod, Acartia (Acartiura) hudsonica, urn:lsid:marinespecies.org:taxname:149751

Data Processing Description

Thermal tolerance (LD50) values were extracted from logistic regressions of individual survival against stress temperature. All raw data and code associated with these analyses are available from a Dryad repository: https://doi.org/10.5061/dryad.9kd51c5dg

BCO-DMO Processing Description

* Data from submitted file "Sasaki Dam 2020 LD50_bcodmo-edit_MS-response.xlsx" was imported into the BCO-DMO data system for this dataset. Values "NA" imported as missing data values. Table will appear as Data File: 955739_v1_a-tonsa-hudsonica-thermal-limits.csv (along with other download format options).

Missing Data Identifiers:
* In the BCO-DMO data system missing data identifiers are displayed according to the format of data you access. For example, in csv files it will be blank (null) values. In Matlab .mat files it will be NaN values. When viewing data online at BCO-DMO, the missing value will be shown as blank (null) values.

* Organism LSIDs added from matches at the World Register of Marine Species (WoRMS) on 2025-03-11.

Note, "Acartia hudsonica Pinhey, 1926" (urn:lsid:marinespecies.org:taxname:157664) is classified as an "alternate representation" of the currently accepted name "Acartia (Acartiura) hudsonica Pinhey, 1926" (urn:lsid:marinespecies.org:taxname:149751). The accepted name LSID was added to the Methods & Sampling metadata.

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Data Files

File
955739_v1_a-tonsa-hudsonica-thermal-limits.csv (Comma Separated Values (.csv), 2.48 KB) MD5:d808b33decf072631e05003fbe7d45d2 Primary data file for dataset ID 955739, version 1

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Related Publications

Sasaki, M. C., & Dam, H. G. (2020). Genetic differentiation underlies seasonal variation in thermal tolerance, body size, and plasticity in a short-lived copepod. Ecology and Evolution, 10(21), 12200–12210. Portico. https://doi.org/10.1002/ece3.6851
Results

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Related Datasets

IsRelatedTo

Sasaki, M., &; Dam, H. (2021). Genetic differentiation underlies seasonal variation in thermal tolerance, body size, and plasticity in a short-lived copepod (Version 3) [Data set]. Dryad. https://doi.org/10.5061/DRYAD.9KD51C5DG https://doi.org/10.5061/dryad.9kd51c5dg

Sasaki, M., Dam, H. G. (2025) **Acartia tonsa prosome length measurements in 2019 during a common garden split-brood experiment several generations after copepod collection in Long Island Sound in summer and fall of 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-03-11 doi:10.26008/1912/bco-dmo.955742.1 [view at BCO-DMO]
Relationship Description: These datasets utilized the same collections. Results for both datasets were published in Sasaki et al. (2020).

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Parameters

Parameter	Description	Units
species	"tonsa" or "hudsonica", referring to the species thermal tolerance was measured for (Acartia tonsa and Acartia hudsonica, respectively)	unitless
acclimation	whether copepods were acclimated to field- or laboratory conditions prior to thermal tolerance measurements.	unitless
collection_id	the collection ID. For field-acclimated copepods this is the date of collection, while for laboratory-acclimated copepods this is the culture ID.	unitless
collection_date	collection date	unitless
collection_month	collection month	unitless
collection_year	collection year	unitless
collection_temp	the water temperature recorded at the time of collection. degrees Celsius.	degrees Celsius
acclimation_temp	the temperature copepods were acclimated to prior to thermal tolerance measurements. This is equivalent to collection-temperature for field-acclimated copepods, while for laboratory-acclimated copepods indicates the static temperature they were reared at.	degrees Celsius
LD50	upper thermal limit for each collection, measured as the temperature where 50% mortality is observed.	degrees Celsius
SE	standard error estimate for the LD50 measurement.	degrees Celsius

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Instruments

Dataset-specific Instrument Name	15-well drybaths from USA Scientific
Generic Instrument Name	Incubator
Dataset-specific Description	The 24 hour acute heat stress used 15-well drybaths from USA Scientific.
Generic Instrument Description	A device in which environmental conditions (light, photoperiod, temperature, humidity, etc.) can be controlled. Note: we have more specific terms for shipboard incubators (https://www.bco-dmo.org/instrument/629001) and in-situ incubators (https://www.bco-dmo.org/instrument/494).

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Project Information

Linking eco-evolutionary dynamics of thermal adaptation and grazing in copepods from highly seasonal environments (evolutionary_copepods)

Coverage: Connecticut and Florida

NSF Award Abstract:

Many parts of the ocean are warming rapidly, but it is still unknown how this warming will affect marine food webs. Copepods, small crustaceans, are the most abundant animals in the ocean; consequently, they play crucial roles in plankton marine food webs and in the transfer of energy to fishes. Many species of copepods are able to choose between prey such as microscopic plants and single-celled animals. The choice affects how energy moves through marine food webs. Past work suggests that increasing temperature should favor herbivory over carnivory. This project is investigating whether this prediction holds in the face of genetic adaptation to warming in highly seasonal systems such as coastal temperate zones. Results from this study are contributing to understanding and predicting the response of marine ecosystems to future climate conditions, as well as for planning and implementing sustainable fisheries management plans. Other broader impacts include the development of learning modules for high school and college students. Hands-on science exhibits for K-6 students and public presentations at established lecture series focus on the role of copepods in marine food webs in coastal habitats.

Predicting responses of the oceanic biota to climate change is limited not only by an incomplete understanding of how warming affects ecological interactions and evolutionary dynamics individually, but also by how these two factors interact. Copepods are both grazers of phytoplankton and predators of microzooplankton in marine systems. Increasing temperatures may drive a large-scale shift in the diet of omnivorous copepods towards stronger herbivory, with significant consequences for the structure of marine food webs and the control of primary productivity. However, thermal adaptation may moderate or even nullify these shifts. This project examines the interactive role ecological and evolutionary dynamics plays in shaping grazing and individual fitness in a warming ocean. The main goals of the project are to: 1) quantify seasonal variation in thermal performance curves in dominant coastal copepod species; 2) determine whether observed seasonal variation in thermal performance is caused by genetic differentiation or phenotypic plasticity; 3) assess how temperature affects respiration and protein synthesis rates, selective feeding, and individual fitness; and 4) determine how changes in the thermal performance curve, via both genetic differentiation and phenotypic plasticity, affect the relationship between temperature and food preference. Selective feeding experiments are being paired with measurements of egg production and hatching success across a wide range of temperatures to measure thermal effects on feeding selectivity and individual fitness. Finally, genetic differentiation and phenotypic plasticity on temperature sensitivity is being investigated across populations from environments that differ in their thermal regime. The outcomes of this project contribute to the parameterization of models that forecast fisheries dynamics in response to climate change.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1947965

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