Subtidal ocean water temperature at Van Damme State Park, California, from May 1992 to August 2023

Website: https://www.bco-dmo.org/dataset/929825
Data Type: Other Field Results
Version: 1
Version Date: 2024-06-14

Project
» Collaborative Research: The effects of marine heatwaves on reproduction, larval transport and recruitment in sea urchin metapopulations (Urchin metapopulations)

Contributors	Affiliation	Role
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Abstract
Ocean water temperatures were collected from May 14, 1992 to August 22, 2023 (these logger deployments are ongoing) from 10 meters benthic depth, at Van Damme State Park, Mendocino County, Northern California. Water temperatures were collected with Onset Hobotemp® and TidbiT® temperature loggers in degrees Celsius. Data are presented as daily averages of 10-minute minimum intervals. Ocean water temperatures were collected to document long-term temperature conditions on the bottom at the level of the reef. Loggers were placed 1 meter off the bottom on stainless cages used to monitor juvenile abalone and sea urchin recruitment. Water temperatures are presented as daily averages for the period of record. Some data gaps exist due to equipment failure, loss, or rough conditions precluding placement of data loggers. The data gaps are listed in the "Problems/Issues" section of the metadata. These data are unique in that they are benthic seawater temperature data (1 meter from the bottom where the benthic animals live) which can be used to compare with the more readily available sea surface temperature data.

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Coverage

Location: Sub-tidal zone, North Coast of California, Sonoma and Mendocino counties
Spatial Extent: **N**:39.271698 **E**:-123.790407 **S**:39.269002 **W**:-123.797805
Temporal Extent: 1992-05-14 - 2023-08-22

Methods & Sampling

Onset Hobotemp® and TidbiT® temperature loggers were deployed and retrieved by SCUBA from California Department of Fish and Wildlife patrol boats, UC Davis boats, or occasionally by swimming from shore. The loggers were attached 1 meter above the substrate on a recruitment module at 10 meters depth. Loggers

were deployed from May 14, 1992 to August 22, 2023 at 10 meters benthic depth, at Van Damme State Park, Mendocino County, Northern California, USA.

Data Processing Description

Data were downloaded after retrieval via HOBOware® software and processed in Excel to exclude pre- and post-deployment temperatures (visibly higher than the ocean water temperatures). Ocean water temperatures of 10-minute minimum intervals were calculated as daily averages and are presented in degrees Celsius. The original data at 10-minute minimum intervals are retained in archive.

BCO-DMO Processing Description

- Imported original file "NSF_OCE_2023664_Van_Damme_CA_mean_daily_TEMP_1992_2023_v1_20240325.csv" into the BCO-DMO system.
- Converted Date field to YYYY-MM-DD.
- Added columns for site latitude and longitude.
- Saved the final file as "929825_v1_subtidal_ocean_temp_van_damme_state_park.csv".

Problem Description

Temperature Data are not available for:
- March 24, 1998, through August 17, 1999
- September 6, through 24, 2003
- August 19 through 24, 2005
- August 21, 2008
- August 17 and 18, 2009
- August 16 through 18, 2010
- August 16 through 18, 2016

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Parameters

Parameter	Description	Units
Date	The date of the daily mean	unitless
Mean_Daily_Temperature_C	The mean daily temperature from a minimum of 10-minute intervals in degrees Celsius	degrees Celsius
Site_Latitude	The latitude of the location (Van Damme State Park)	decimal degrees
Site_Longitude	The longitude of the location (Van Damme State Park); negative values = West	decimal degrees

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Instruments

Dataset-specific Instrument Name	Onset Hobotemp® and TidbiT® temperature loggers
Generic Instrument Name	Temperature Logger
Generic Instrument Description	Records temperature data over a period of time.

Project Information

Collaborative Research: The effects of marine heatwaves on reproduction, larval transport and recruitment in sea urchin metapopulations (Urchin metapopulations)

Coverage: Coastal California Waters from San Diego through Mendocino Counties

NSF Award Abstract:
Rapid and extreme warming events such as El Niño and marine heatwaves have had ecological and economic impacts on nearshore marine ecosystems. These impacts include reductions in biomass and collapses in commercial fisheries. For many species, population booms and busts are controlled by shifts in reproduction and juvenile dispersal related to warmer temperatures and ocean circulation. However, how population fluctuations are shaped by interacting processes that control adult reproduction and larval survival remains unclear. Marine heatwaves often accompany major disruptions in ocean circulation, which can affect survival and the distribution of species that produce free-floating, planktonic larvae. As a result, species can be impacted directly by temperature effects on organismal reproduction and survival, and indirectly by shifts in ocean circulation that affect larval success. This project is examining how the joint effects of temperature and ocean circulation are controlling populations of purple sea urchins (Strongylocentrotus purpuratus). To address project objectives, the team is developing oceanographic models to predict dispersal of planktonic larvae in combination with controlled experiments on adult reproductive success. This project is advancing the understanding of how ecologically important species respond to ocean temperature and circulation, which are forecast to shift under future climate change scenarios. Broader impacts of the project include training of students and post-docs in STEM and educational outreach. Curriculum development and implementation is occurring in collaboration with existing K-12 outreach programs that focus on underserved communities and under-represented groups. The goal is to empower the next generation of scientists to use integrative approaches to predict ecological consequences of climate change.

Purple sea urchins are an ideal species for studying the coupled impacts of warming and ocean circulation on recruitment and survival given a wealth of ecological and organismal data. The species has a mapped genome, can be transported large distances as larvae by ocean currents, and larval abundances in California exhibit orders of magnitude variation with heatwaves and El Niño fluctuations. To quantify the processes that shape spatial and temporal variability in larval supply, researchers are applying a novel combination of biophysical modeling, experiments and statistical modeling of long-term, high-resolution data on larval settlement across the Southern California Bight (SCB). Research module 1 is quantifying spatial and temporal patterns of larval transport using a 3D-biophysical model of the SCB. The model is testing how interactions among historical changes in ocean circulation and temperature, larval life history, and larval behavioral traits affect variation in larval supply in space and time. Research module 2 is focused on how temperature could affect spatial and temporal variation in egg production. Experiments are characterizing reproductive thermal performance curves and quantifying how these vary among populations and organismal history. A novel assay is assessing epigenetic regulation of gene expression associated with performance curves. Finally, Module 3 will integrate mechanistic models from Modules 1 and 2 to statistically assess their ability to explain spatial and temporal trends in a nearly three-decade dataset of larval settlement from six sites in the SCB. This is one of the first studies that integrates models of larval transport, reproductive performance and settlement data to empirically test how physical and biological processes affect local recruitment patterns in complex marine meta-populations.

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.

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2023664