

# Classified Zooplankton ZooCam Images Captured by the Hoodport ORCA Profiling Mooring Mounted SPC-2 Zoocam in the Hood Canal, Puget Sound, Washington from July to September 2018 (Zooplankton Swimming project)

**Website:** <https://www.bco-dmo.org/dataset/927518>

**Data Type:** Other Field Results

**Version:** 1

**Version Date:** 2024-05-14

## Project

» [Causes and consequences of hypoxia and pH impacts on zooplankton: Linking movement behavior to vertical distribution.](#) (Zooplankton Swimming)

Contributors	Affiliation	Role
<a href="#">Keister, Julie E.</a>	University of Washington (UW)	Principal Investigator, Contact
<a href="#">Grunbaum, Daniel</a>	University of Washington (UW)	Co-Principal Investigator
<a href="#">Crouser, Deana</a>	National Oceanic and Atmospheric Administration - Alaska Fisheries Science Center (NOAA-AFSC)	Student
<a href="#">Wyeth, Amy</a>	University of Washington (UW)	Student
<a href="#">Newman, Sawyer</a>	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

## Abstract

This dataset consists of images of individual zooplankton taken by an in-situ camera system (the SPC UW ZooCam) that was deployed on the Hoodport ORCA profiling mooring in Hood Canal (Puget Sound), WA in summer 2018. Images were taxonomically identified by expert zooplankton ecologists. These images are sorted into folders by taxonomic identification and were used as a training set for Machine Learning classification of unknown images to study the behavior of zooplankton under varying ocean conditions.

## Table of Contents

- [Coverage](#)
- [Dataset Description](#)
  - [Methods & Sampling](#)
  - [Data Processing Description](#)
  - [BCO-DMO Processing Description](#)
  - [Problem Description](#)
- [Related Datasets](#)
- [Parameters](#)
- [Instruments](#)
- [Deployments](#)
- [Project Information](#)
- [Funding](#)

## Coverage

**Location:** Hood Canal, Puget Sound, Washington, USA

**Spatial Extent:** **Lat:**47.421817 **Lon:**-123.112583

**Temporal Extent:** 2018-07-09 - 2018-09-22

## Dataset Description

## Image Directory Category Descriptions

- ClusteredSnow - Non-symmetrical "aggregated" clusters of marine snow
- Filament\_Filaments - singular and/or multiple, slender filament/threadlike objects
- MarineSnow - Non-symmetrical "scattered" snow (smaller and numerous vs ClusteredSnow)
- Unknown - Images that are too blurry to confidently classify or are "unknown"

### Gelatinous:

- Anthomedusae - (*Euphysa tentaculata*)
- Cydippida - (*Euplokamis dunlapae*)
- Cydippida - (*Pleurobrachia bachei*)
- Cydippida - (Unknown)

### Lobata:

- Siphonophore - Calyphorae (*Muggiaea atlantica*)
- Trachymedusae - (*Aglantha digitale*)
- Trachymedusae - (*Pantachogon haeckeli*)
- Trachymedusae - (young)

### Copepoda:

- Calanoida - (*Acartia* spp.)
- Calanoida - (*Calanus* sp.)
- Calanoida - (*Centropages abdominalis*)
- Calanoida - (*Metridia* spp.)
- Calanoida - (Pseudo Micro Para) - includes pseudocalanus, microcalanus, and paracalanus
- Copepoda - (nauplii)
- Cyclopoida - (*Oithona* spp.)
- Harpacticoida - (*Microsetella rosea*)
- Poecilostomatoida - (*Ditrichocoryceus anglicus*)
- Poecilostomatoida - (*Triconia* spp.)

### Amphipoda:

- Cyphocariidae - (*Cyphocaris challengerii*)
- Hyperiidea - (*Themisto pacifica* Hyperoche sp.)
- Gammaridea - (possibly *Calliopius* sp.)

### Phytoplankton:

- Dinoflagellata - (*Noctiluca*)
- (Diatoms)

### Other:

- Chaetognatha
- Decapoda - Caridea (Shrimp)
- Euphausiacea - Euphausiidae (Krill)
- Ostracoda - (Halocyprididae)
- Fish\_larvae
- Larvacea - (*Oikopleura dioica*)
- Pteropoda - (*Clione limacina*)
- Pteropoda - (*Limacina helicina*)

## Methods & Sampling

These images were collected by the SPC-UW-Zoocam, which is an underwater imaging system that was mounted on a profiling mooring. Images were collected during profiling of the mooring at depths between 5 - 110 meters.

Image data processing (Region of Interest (ROI) selection) was conducted internally, with processed and

compressed images streamed to shore over cellular networks.

## Data Processing Description

### Image processing

Images were visually (manually) identified for taxonomy and sorted into folders. In this dataset, some images were duplicated and rotated to create an augmented dataset to train a Machine Learning algorithm (labeled as "augmented" in each file name).

Images that are too blurry to confidently classify are stored within the "Unknown" folder in the zipped image directory file.

### Image File Naming Convention

File name example: SPC-UW-1534792542343244-337276376507-004392-154-2546-848-756-780.png

SPC: Scripps Plankton Camera

UW: University of Washington

1534792542343244: Unix Date/Timestamp [To convert to UTC, use  $(X / 86400) + 25569$ .]

337276376507: Directory and subdirectory extension specific to this directory organization system.

154-2546-848-756-780: ROI (Region of Interest) details (x, y, w, h, image size)

### Processing for Reuse

This dataset needs to undergo pre-processing steps (i.e., image augmentation and balancing) before it should be used to train an algorithm for best results.

## BCO-DMO Processing Description

- Latitude and longitude values added to the data file
- augmented\_image\_flag column added to indicate if an image file has gone through augmentation
- A human readable datetime column was created from the unix\_datetimestamp value present in the filename
- roi\_x, roi\_y, roi\_h, and roi\_image\_size columns added from the image file name; this was parsed from the image file name

## Problem Description

Many images are blurry or the organism was imaged at a non-oblique angle, making taxonomic classifications somewhat subjective, even for trained taxonomists. The classifications represent the best possible visual identification, but should not be considered definitive.

Images that are too blurry to confidently classify are stored within the "Unknown" folder in the zipped image directory file.

[ [table of contents](#) | [back to top](#) ]

---

## Related Datasets

### IsRelatedTo

---

Keister, J. E., Grunbaum, D., Roberts, P. (2024) **In Situ Amphipod and Copepod Video Output Captured by the Hoodport ORCA Profiling Mooring Mounted SPC-2 Zoocam in the Hood Canal, Puget Sound, Washington from August to September 2018 (Zooplankton Swimming project)**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-05-21 doi:10.26008/1912/bco-dmo.928222.1 [[view at BCO-DMO](#)]  
*Relationship Description: The images in this primary dataset were used to train the classification algorithm applied to the videos in this related dataset.*

[ [table of contents](#) | [back to top](#) ]

---

## Parameters

Parameter	Description	Units
filename	Filename of an individual zooplankton image, i.e., region of interest (ROI)	unitless
relative_filepath	Relative directory path where the "filename" image is stored within the zip file, SPC-UW-ZooCam_Training_Photos.zip	unitless
filesize_bytes	Image file size	bytes
md5sum	Image file md5sum value	unitless
latitude	Latitude of mooring location where the ZooCam camera was deployed and the image file was collected in decimal degrees; a positive value indicates a Northern coordinate	decimal degrees
longitude	Longitude of mooring location where the ZooCam camera was deployed and the image file was collected in decimal degrees; a negative value indicates a Western coordinate	decimal degrees
augmented_image_flag	A "augmented_image" value indicates that an image was duplicated and rotated to create an augmented dataset; blank data values in this column indicate that an image was not augmented	unitless
datetime_utc	Datetime value derived from the unix timestamp represented in the image filename.	unitless
roi_x	ROI (region of interest) x value of image file	image_analysis
roi_y	ROI (region of interest) y value of image file	image_analysis
roi_w	ROI (region of interest) w value of image file	image_analysis
roi_h	ROI (region of interest) h value of image file	image_analysis
roi_image_size	ROI (region of interest) image size	pixels

[ [table of contents](#) | [back to top](#) ]

---

## Instruments

<b>Dataset-specific Instrument Name</b>	SPC-UW-Zoocam
<b>Generic Instrument Name</b>	Underwater Camera
<b>Dataset-specific Description</b>	The SPC-UW-Zoocam designed and built specifically for this project. The Zoocam was custom-built by Paul Roberts in the Jaffe Imaging Laboratory at the University of California San Diego. It is an underwater camera system that captured still images of zooplankton within a 500-mL imaged area using lighting in the visible wavelength range.
<b>Generic Instrument Description</b>	All types of photographic equipment that may be deployed underwater including stills, video, film and digital systems.

[ [table of contents](#) | [back to top](#) ]

---

## Deployments

### UW\_SPC-2\_Zoocam

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/775291">https://www.bco-dmo.org/deployment/775291</a>
<b>Platform</b>	ORCA-UW-Hoodsport
<b>Start Date</b>	2018-06-26
<b>End Date</b>	2018-10-24
<b>Description</b>	A University of Washington SPC-2 Zoocam was deployed on UW/APL Hoodsport, Hood Canal ORCA buoy.

[ [table of contents](#) | [back to top](#) ]

---

## Project Information

### Causes and consequences of hypoxia and pH impacts on zooplankton: Linking movement behavior to vertical distribution. (Zooplankton Swimming)

**Coverage:** Puget Sound, WA

#### *NSF Award Abstract:*

Low oxygen (hypoxia) and low pH are known to have profound physiological effects on zooplankton, the microscopic animals of the sea. It is likely that many individual zooplankton change vertical migration behaviors to reduce or avoid these stresses. However, avoidance responses and their consequences for zooplankton distributions, and for interactions of zooplankton with their predators and prey, are poorly understood. This study will provide information on small-scale behavioral responses of zooplankton to oxygen and pH using video systems deployed in the field in a seasonally hypoxic estuary. The results will deepen our understanding of how zooplankton respond to low oxygen and pH conditions in ways that could profoundly affect marine ecosystems and fisheries through changes in their populations and distributions. This project will train graduate students and will engage K-12 students and teachers in under-served coastal communities by developing ocean technology-based citizen-scientist activities and curricular materials in plankton ecology, ocean change, construction and use of biological sensors, and quantitative analysis of environmental data.

Individual directional motility is a primary mechanism underlying spatio-temporal patterns in zooplankton population distributions. Motility is used by most zooplankton species to select among water column positions that differ in biotic and abiotic variables such as prey, predators, light, oxygen concentration, and pH. Species-

specific movement responses to de-oxygenation and acidification are likely mechanisms through which short-term, localized impacts of these stressful conditions on individual zooplankton will be magnified or suppressed as they propagate up to population, community, and ecosystem-level dynamics. This study will quantify responses by key zooplankton species to oxygen and pH using in situ video systems to measure changes in individual behavior in hypoxic, low- pH versus well-oxygenated, high-pH regions of a seasonally hypoxic estuary. Distributions and movements of zooplankton will be quantified using three approaches: 1) an imaging system deployed in situ on a profiling mooring over two summers in a hypoxic region, 2) imagers deployed on Lagrangian drifters to sample simultaneously throughout the water column, and 3) vertically-stratified pumps and net tows to verify species identification and video-based abundance estimates. These field observations will be combined with laboratory analysis of zooplankton movements in oxygen and pH gradients, and with spatially-explicit models to predict how behavioral mechanisms lead to large-scale impacts of environmental stresses.

The following deployments were conducted in 2017 and 2018:

CB1077: <https://www.bco-dmo.org/deployment/735746>

CB1072: <https://www.bco-dmo.org/deployment/735748>

Zoocam\_ORCA\_Twanoh\_2017: <https://www.bco-dmo.org/deployment/735762>

RC0008: <https://www.bco-dmo.org/deployment/775288>

Mooring ORCA\_Hoodsport; NANOOS-APL4: <https://www.bco-dmo.org/deployment/775291>

[ [table of contents](#) | [back to top](#) ]

---

## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1657992</a>

[ [table of contents](#) | [back to top](#) ]