Squid tag movement data and environmental sampling acquired in November 2021 and May 2023 near Faial and Pico Islands, Azores archipelago.

Website: https://www.bco-dmo.org/dataset/924340
Data Type: Other Field Results
Version: 1
Version Date: 2024-04-15

Project
» RAPID: Too hot to hold: Effects of unseasonable warming on the Azores nekton community and its keystone taxon (Too hot to hold)

Contributors	Affiliation	Role
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Abstract
ITAGs were used to measure squid movement dynamics. The sensor package was small (12.5 × 2.6 × 2.7 cm) and was affixed using surgical sutures . Additionally, ITAGs were neutrally buoyant, hydrodynamic, and focal tagged squid exhibited normal swimming and schooling behaviors with other conspecifics. ITAGs contain an inertial measurement unit (IMU) which measures acceleration, magnetic field strength, and angular velocity. These tags were used to measure the swimming behavior or free-ranging animals in the Azores region in November 2021, and May 2023. These data provide movement intensities, behaviors, and allow us to measure the environment including light, temperature, and the animal's depth. Here, we are submitting the tag data from the free-ranging animals in matrix form (.csv).

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Coverage

Location: Near Faial and Pico Islands, Azores archipelago
Spatial Extent: **Lat**:38.3003 **Lon**:-28.3522
Temporal Extent: 2022-11 - 2023-05

Methods & Sampling

Field deployments occurred in November 2021 and May 2023 near Faial and Pico Islands, Azores archipelago (38.3003° N, 28.3522°W). Data were collect during day boat trips (21 foot center console RIB) when winds were below 15 knots. Animals were caught at depths of around 250 meters, and were tagged by PI and Chief Scientist Aran Mooney.

Care was taken during capture and handling of animals to limit physical stress. Squid were caught by jigging, which is a minimally invasive means of capture since it reduces damage to the fragile epi- dermal layer. Once at

the surface, animals were transferred to a padded table equipped with constant seawater flow to ventilate the gills. Only large squid with DMLs greater than 45 cm were selected for tagging. Squid eyes were covered during tagging to reduce light and visual stress. Tagged squid were immediately released over their capture site within 6−11 min.

The ITag contains a triaxial inertial measurement unit (IMU) with an accelerometer, gyroscope, and magnetometer sampled at 100 Hz (TDK Invensense MPU9250), and pressure, temperature (Keller 7LD), and light sensors (Intersil ISL29125) sampled at 1 Hz.

Data Processing Description

The data uploaded have not been post-processed, and have only been downloaded from MATLAB and transferred into .csv form.

BCO-DMO Processing Description

* Merged 4 individual (.movement.csv, environmental.csv) files into 1
* Added species, year, julian day and sensor id to dataset
* Added date in ISO format
* Adjusted parameter names to comply with database requirements

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Data Files

File
924340_v1_squidtag.csv (Comma Separated Values (.csv), 3.72 GB) MD5:70a007d24f6761b7e8efd85c196fbe18 Primary data file for dataset ID 924340, version 1

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Parameters

Parameter	Description	Units
species	veined squid (Loligo forbesii)	unitless
year	Year data were collected	unitless
julian_day	The Julian day the tag was deployed	unitless
date	The day, month, year in which tag was deployed	unitless
latitude	latitude of sampling location, south is negative	decimal degrees
longitude	longitude of sampling location, west is negative	decimal degrees
sensor_id	Which ITAG version was used for the deployment	unitless
time_vector	Time stamp associated with data	unitless
surge_acceleration	acceleration along the x axis, which was align with squid long axis	gravities
sway_acceleration	acceleration along the y axis, which was align with squid lateral axis	gravities
heave_acceleration	acceleration along the z axis, which was align with squid dorsoventral axis	gravities
x_magnetic_field_strength	magnetic field strength along x vector	microTesla
y_magnetic_field_strength	magnetic field strength along y vector	microTesla
z_magnetic_field_strength	magnetic field strength along z vector	microTesla
x_angular_velocity	Rotation about the x axis	degress/sec
y_angular_velocity	Rotation about the y axis	degress/sec
z_angular_velocity	Rotation about the z axis	degress/sec
red_light	red wavelength light intensity	micro Watts per cm2
blue_light	blue wavelength light intensity	micro Watts per cm2
green_light	green wavelength light intensity	micro Watts per cm2
temperature	temperature of ambient water around animal	degrees Celsius (°C)
pressure	Pressure at the animals vertical position	millibar

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Instruments

Dataset-specific Instrument Name	ITag
Generic Instrument Name	tracking tag
Dataset-specific Description	The ITag (12.5 × 2.6 × 2.7 cm) is a custom-built biologging tag designed for soft-bodied invertebrates. It contains a triaxial inertial measurement unit (IMU) with an accelerometer, gyroscope, and magnetometer sampled at 100 Hz (TDK Invensense MPU9250), and pressure, temperature (Keller 7LD), and light sensors (Intersil ISL29125) sampled at 1 Hz.
Generic Instrument Description	Devices attached to living organisms with the purpose of determining the location of those organisms as a function of time after tagging and release.

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Project Information

RAPID: Too hot to hold: Effects of unseasonable warming on the Azores nekton community and its keystone taxon (Too hot to hold)

Coverage: Azores

NSF Award Abstract
Across the globe it has become increasingly clear that climate change is influencing animal movement patterns. The daily vertical migration of marine animals such as squid is often termed “the largest migration on Earth.” Understanding the impacts of climate change on diel vertical migration is essential for an understanding of how ocean ecosystems will fare with increasing temperatures. Central Atlantic waters are ca. 2-3 °C above normal; this unusual warming event provides a short and urgent window of opportunity to examine how global warming will affect this huge migration. The movements and energetics of squid and their larger community are being measured using traditional oceanographic methods and innovative, new high-resolution sensor and motion tags. The new data are providing novel insights into how warm temperatures are affecting movements, migrations, changes in biomass, and other energetic consequences of behavioral responses to environmental change. The project leverages an animal group (squid) that links top predators and smaller prey within a complex trophic web. As a group, squids are one of the world’s largest fisheries, they are of global food-resource importance, and they are prey for many commercially important fish species (tuna, swordfish), sea birds and marine mammals. Predicting climate-driven changes on these animals and their daily migratory patterns is critical for sustainable resource management. Educational broader impacts are focused on training opportunities for graduate and undergraduate students with emphasis on recruiting participants from underrepresented groups. The graduate students are gaining international experience in field work and scientific collaborations.

Diel vertical migrations are a vital process of ocean energy exchange that are influenced by the physical environment, yet few experimental data address how warming affects these migrations. Central Atlantic waters are ca. 2-3° C above normal, extending stratified summer conditions and stressful warmer waters into a key time of year when organisms “expect” greater mixing and cooler oceans. These fleeting warm-water conditions present a unique opportunity to study how a vertically migrating nekton community and its key component (squid) are adjusting their movements to balance energetic demands and expenditures. Building from a suite of before-and-after data, this project is examining the response of the migratory community and the squid to unusually warm, physiologically stressful, ocean conditions during a critical life-stage. The prediction is that the community and squid are utilizing an energetically costly set of responses, leading to altered movement patterns and decreased densities of migratory organisms in surface waters at night. The timeframe of the project coincides with a period when squid invest in somatic and reproductive growth via substantial foraging and interactions within the larger nekton community. New data are being collected to (i) examine movement ecology and energetics by tagging Loligo forbesii squid near the Azores using novel motion tags and environmental sensors (ITAGs), (ii) quantify the nekton community and prey layer density and

movements via scientific echosounders in locations overlapping with tagged animals, (iii) characterize environmental conditions using standard oceanographic casts, surface satellite data, and the eco-sensor data from animal-borne tags, and (iv) assess vertical movement and habitat use changes as seasonality progresses using longer-term, lower resolution, movement tags. The central hypothesis being tested is that the migratory community is responding to thermal stress by changing vertical migration patterns and feeding strategies. These responses have negative consequences on the squid’s energy balance and lead to higher foraging costs and decreased feeding success.

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-2203204

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