Results of a lab experiment to determine the range of pelagic larval duration in massive Porites larvae in Palau in 2023

Website: https://www.bco-dmo.org/dataset/997475
Data Type: experimental
Version: 1
Version Date: 2026-04-23

Project
» Collaborative Research: How do selection, plasticity, and dispersal interact to determine coral success in warmer and more variable environments? (Palau coral selection plasticity dispersal)

Contributors	Affiliation	Role
Meyer-Kaiser, Kirstin	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator, Contact
Davies, Sarah W.	Boston University (BU)	Co-Principal Investigator
Grupstra, Carsten G.B.	Boston University (BU)	Scientist
Andres, Maikani	Palau International Coral Reef Center (PICRC)	Student
Bennett, Matthew-James	University of Lisbon	Technician
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
The period of time that larvae spend in the water column, the pelagic larval duration (PLD), has a profound impact on dispersal distance. Characterizing variations in PLD across a population is critical for refined estimates of dispersal, yet this work is rarely done. We conducted an experiment to characterize the PLD of massive Porites larvae in April 2023. Adult massive Porites corals were collected from six sites in Palau immediately prior to their spawning, around the full moon. Collected corals were held in individual plastic containers in ambient unfiltered flow-through seawater tanks at the Palau International Coral Reef Center (PICRC). Larvae from two bulk crosses were pooled for this experiment. Each cross included sperm from 3 males and eggs from one female . Three-dpf larvae (n=20 individuals) were added to clear plastic culture dishes (~200 mL) with ambient seawater (ASW) at three different filtrations: unfiltered, 5 µm filtered, or 0.5 µm filtered (n=10 per treatment). No additional settlement cues were provided. Culture dishes were maintained in flow-through ASW tanks at PICRC, and ~80% water changes were conducted every 2 days. Temperature and light experienced by larvae during the experiment were recorded using Hobo pendant loggers in an identical culture dish in the same seawater tank. Immediately prior to water changes, all larvae and settlers in each culture dish were counted. Settlement was defined as a larva attaching itself to the bottom of the dish, remaining attached after mechanical disturbance (i.e., gently shaking the dish), and visually beginning to undergo metamorphosis.

Table of Contents

Coverage

Location: Palau coral reefs (Risong: 7 18.582 N, 134 28.596 E and Taoch: 7 16.033 N, 134 23.233 E)

Spatial Extent: **N**:7.3097 **E**:134.4767 **S**:7.2672167 **W**:134.3872167
Temporal Extent: 2023-04 - 2023-04

Dataset Description

Parent corals were collected from two reefs: Risong 7 18.582 N | 134 28.596 E and Taoch 7 16.033 N |134 23.233 E.

Methods & Sampling

We conducted an experiment to characterize the PLD of massive *Porites* larvae in April 2023. Adult massive *Porites* corals were collected from six sites in Palau immediately prior to their spawning season. Corals were either whole colonies or fragments of large colonies removed with a hammer and chisel (15 – 30 cm diameter).

Collected corals were held in individual plastic containers (4.2 L; 17 x 13 x 19 cm) in ambient unfiltered flow-through seawater tanks at the Palau International Coral Reef Center (PICRC).At sunset, water levels in flow-through tanks were lowered to ~15 cm so that each colony was isolated in its individual container, maintaining gametes separate until fertilization. Sperm was collected directly from male colonies using a large plastic pipette during release, and eggs were collected by pipette or by scooping from the surface with a clean petri dish.

Larvae from two bulk crosses were pooled for this experiment. Each cross included sperm from 3 males and eggs from one female (same males, different female in each cross). One hour after fertilization began, embryos underwent a series of dilutions with 5 µm filtered seawater (FSW) and gently split into multiple containers filled with 5 µm FSW to dilute any remaining sperm and prevent polyspermy. Three-dpf larvae (n=20 individuals three days post fertilization) were added to clear plastic culture dishes (~200 mL) with ambient seawater (ASW) at three different filtrations: unfiltered, 5 µm filtered, or 0.5 µm filtered (n=10 per treatment). No additional settlement cues were provided.Culture dishes were maintained in flow-through ASW tanks at PICRC, and ~80% water changes were conducted every 2 days.

Temperature and light experienced by larvae during the experiment were recorded using Hobo pendant loggers in an identical culture dish in the same seawater tank.

Immediately prior to water changes, all larvae and settlers in each culture dish were counted. Settlement was defined as a larva attaching itself to the bottom of the dish, remaining attached after mechanical disturbance (i.e., gently shaking the dish), and visually beginning to undergo metamorphosis.

BCO-DMO Processing Description

* converted dates to yyyy-mm-dd format

[table of contents | back to top]

Parameters

Parameter	Description	Units
Date	Date of observations	unitless
Day	Number of days post fertilization (dpf) for the observation	unitless
Treatment	Experimental treatment and type of artificial seawater (ASW) used. Either unfiltered, 5 micron filtered, or 0.5 micron filtered water	unitless
Rep	Replicate number	unitless
Att_cum	Cumulative number of individuals settled and attached to the bottom of the dish	unitless
Att_perc	Cumulative percentage of individuals settled and attached to the bottom of the dish	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	flow through seawater tanks
Generic Instrument Name	circulating water bath
Generic Instrument Description	A device designed to regulate the temperature of a vessel by bathing it in water held at the desired temperature. [Definition Source: NCI]

Dataset-specific Instrument Name	culture dish
Generic Instrument Name	culture dish
Dataset-specific Description	Larvae were held in in plastic dishes.
Generic Instrument Description	A dish used to culture cells or organisms.

Dataset-specific Instrument Name	Glass pipette
Generic Instrument Name	pipette
Dataset-specific Description	We held the larvae in plastic dishes, and they were transferred using glass pipettes. We didn't use a microscope to count the larvae – if you shine a flashlight on the dish from the side, you can see the larvae as small dots in the water or attached to the bottom.
Generic Instrument Description	A pipette (or pipettor) is a laboratory tool (measuring device) designed for the accurate measurement and transfer of precise volumes of liquied. It traditionally included a graduated tube, but can now be manual or digital.

[table of contents | back to top]

Project Information

Collaborative Research: How do selection, plasticity, and dispersal interact to determine coral success in warmer and more variable environments? (Palau coral selection plasticity dispersal)

Coverage: Palauan coral reefs

NSF Award Abstract:
Coral reefs host thousands of marine species, help protect coastlines from storm damage, generate tourism, and house fish used for human consumption. However, corals are vulnerable to increasing water temperatures, which can lead to coral death. One way for reefs to survive in warming oceans is for corals that are well-suited to warmer waters to repopulate reefs that have less temperature-tolerant individuals. For this strategy to succeed, however, the more temperature-tolerant corals need to be able to disperse to and survive in these different environments. This project takes advantage of reef systems in the Pacific nation of Palau that naturally experience a wide range in temperatures across short geographic distances. Using cutting-edge ecological and genomic techniques, the team of investigators is directly testing whether young corals from Palau's warmest reefs can successfully be carried by ocean currents to Palau's currently cooler reefs and subsequently survive and thrive in these habitats. Given the relevance of this research for the local ecology, the team is disseminating results to the Palauan government through a written report in conjunction with Palauan scientists who are interning with the team, and to the Palauan people through public presentations. As part of this work, the investigators are maintaining a blog and are organizing a music-lecture series combining dance, music, and science to promote awareness of the coral reef crisis across English and Spanish-speaking communities in the US. Results from this project are informing restoration and conservation practices of the Coral Conservation Consortium as well as other efforts worldwide.

A major question in evolutionary biology is how plasticity and adaptation interact to influence survival under novel environments. Understanding these processes is increasingly important as rising temperatures associated with climate change influence species globally. For marine organisms with pelagic larval phases, including reef-building corals, the post-settlement period constitutes a critical bottleneck for adaptation and plasticity, with the added complexity that the conditions experienced and time spent as larvae can incur carryover effects. This project leverages reefs in Palau that span a steep environmental gradient to study how environmental variation drives selection and plasticity and to examine if dispersal between reefs limits success across habitats due to carryover effects. The investigators are testing the overarching hypothesis that corals from warmer and more variable environments are adapted to warmer temperatures and exhibit increased plasticity, but that dispersal between reefs incurs a fitness cost. The team integrates field and molecular techniques to: 1) investigate the degree of selection occurring on warmer and more variable reefs, 2) test whether corals transplanted to more variable environments improve their thermal tolerance through developmental plasticity, and 3) examine whether delays in metamorphosis required for dispersal across reefs comes at a fitness cost due to carryover effects.

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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2048678

[table of contents | back to top]