

# Measures of anemonefish habitat quality and parental traits from field experiments conducted at Kimbe Bay, Papua New Guinea from May to August 2017

**Website:** <https://www.bco-dmo.org/dataset/823794>

**Data Type:** Other Field Results, experimental

**Version:** 1

**Version Date:** 2020-09-28

## Project

» [DISSERTATION RESEARCH: Negotiations Over Offspring Care: A Test of Alternative Hypotheses Using the Clown Anemonefish](#) (Clownfish parental care)

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## Abstract

Measures of anemonefish habitat quality and parental traits from field experiments conducted at Kimbe Bay, Papua New Guinea from May to August 2017.

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## Coverage

**Spatial Extent:** Lat:-5.1666667 Lon:-150.5

**Temporal Extent:** 2017-05-26 - 2017-08-21

## Methods & Sampling

### Study Population

Fieldwork was conducted on reefs near Mahonia Na Dari Research and Education Center in Kimbe Bay, Papua New Guinea (5.1666667°S 150.5°E) using SCUBA. These nearshore reefs support a population of over 100 groups of *Amphiprion percula* living within magnificent sea anemones *Heteractis magnifica*. From May 26 to June 23 in 2017, 117 groups were located and marked with numbered tags for identification. The experimental manipulation was conducted for two lunar months from June 24 to August 21, 2017. Lunar months were used rather than calendar months because pairs breed on lunar, semi-lunar, or trient-lunar schedules. Groups

consisted of up to 5 resident fish (female, male, and 0 to 3 subordinates) with an average of 2.9 (+/- 0.1 SE) fish across all groups. Of the 117 groups, 52 (44%) were observed with eggs at least once in the lunar month before the manipulation began. These 52 breeding groups were distributed across 10 reefs, 5 of which were surveyed each day, such that all 52 groups were surveyed every other day throughout the study.

### **Body Size**

To determine if there are positive correlations between habitat quality and parental body size, female standard length (FSL) and male standard length (MSL) were measured. The female and male from each group were captured using hand nets in the week before the start of the experiment (week of May 26, 2017) and in the week following the end of the experiment (week of August 21, 2017). Each fish was photographed to identify individuals by their color patterns and to confirm that they survived and did not move between anemones. The standard length (SL) of each fish was measured to the nearest 0.1 mm using calipers, and the average of the two measurements (start and end) provided a single measurement of FSL and MSL.

### **Reproductive Success**

To determine if there are positive correlations between habitat quality, body size and reproductive success, reproduction was monitored for all 52 groups every other day. Reproduction was detectable by the behavior of the male and the presence of eggs at the base of the anemone. The exact age of the eggs was determined by their color (day 1 = orange, day 2 = orange-brown, day 3 = brown, day 4 = black eyes, day 5 = silver eyes, day 6 = silver eyes with pupils, day 7 = gold eyes with pupils). Eggs hatched after 7 days. Photos were taken of every clutch observed with an Olympus Tough TG-870 camera (Olympus, Tokyo, Japan) early (day 1 or 2) and late (day 6 or 7) in development.

### **Parental Care**

To determine whether parental care was positively correlated with habitat quality, other parental traits, and reproductive success, 29 minute videos were taken of parental behavior early (day 3 or 4) and late (day 6 or 7) in development by setting up a tripod with an underwater camera (Olympus Tough TG-870) centered on the location of the eggs.

### **Feeding Manipulation**

To determine whether the environment generates positive correlations between parental traits, feeding manipulations were conducted. One lunar month of baseline data was collected (May 26 – June 23, 2017), followed by two lunar months of feeding manipulation (June 24 – August 21, 2017). Of 52 breeding groups, 25 were given supplemental food and 27 served as controls. As reefs were located at different distances from shore, and some anemones were bleached, groups were randomly stratified to ensure equal amounts of fed/control groups for reefs closer to shore (N = 4 reefs, N = 32 anemones) versus further from shore (N = 6 reefs, N = 20 anemones) and for bleached (N = 10) versus unbleached (N = 42) anemones. Average female size was similar in fed (average SL = 52.8mm +/- 0.87SE) and control groups (average SL = 52.3 +/- 1.12SE).

Fed groups were supplemented with 3ml freeze dried brine shrimp (Omega One, OmegaSea LLC, Sitka, AK) and 3ml fish pellets (Marine Life Spectrum, New Life International, Inc., Homestead, FL). Food was kept dry in capped tubes until delivery. Brine shrimp (positively buoyant) were delivered first, by squirting the shrimp just below the anemone with a pipette. Pellets (negatively buoyant) were delivered second by opening the vial and tipping them down onto the anemone. Through this method, most food was either immediately consumed by the fish or stuck among anemone tentacles, where the fish could consume it. Some food was consumed by the anemone or other fish species nearby. Confirmation of successful administration of food was made by observing the male and female of each group consuming at least one pellet or shrimp. Control groups received a sham feeding treatment, using an empty vial and an empty pipette, to keep disturbance to all groups consistent.

## **Data Processing Description**

### **Data Processing**

**Anemone Area** The length and width of each anemone was measured three times per month to the nearest cm using tailor's tape. The median of the three measurements was taken to account for the expansion behavior of anemones, and the area of each anemone was estimated using the equation for the area of an ellipse:  $\text{Area} = \frac{1}{2} ab$ , where  $a = \frac{1}{2}$  the length and  $b = \frac{1}{2}$  the width. These monthly median area estimates were then averaged for each anemone to provide a single anemone area measurement.

**Fish Size:** The standard length (SL) of each fish was measured to the nearest 0.1 mm using calipers at the start and end of the study period, and the average of the two measurements (start and end) provided a single measurement of FSL and MSL for each group.

**Reproductive Success:** Photos were taken of every clutch observed early and late in development, and the number of eggs per photograph was counted using ImageJ (NIH, USA) to obtain measures of number of eggs laid and the number and proportion of eggs that survived to hatching.

**Parental Care:** Twenty-nine minute videos were taken of parental behavior early (day 3 or 4) and late (day 6 or 7) in development and analyzed using JWatcher version 0.9. The first 12 minutes of video served as an acclimation period, the following 15 minutes used for data collection, and the final 2 minutes were discarded from analysis to minimize any effect of approaching researchers at the end of the recordings. Parental care was recorded as time tending, i.e. the amount of time an individual spent within one body-length of the clutch, as tending behavior shows plasticity in both parents. Behavior was scored separately for the male and female of each pair and blind to treatment.

### BCO-DMO Processing

- modified parameter names (replaced "." with underscores);
- replaced "NA" with "nd" as missing data identifier; this is used to represent situations where data were not able to be collected due to logistical constraints.

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## Data Files

File
<b>feeding_expt_2017.csv</b> (Comma Separated Values (.csv), 16.35 KB) MD5:8134644ad1738beb4c9feafd5191f8c9
Primary data file for dataset ID 823794

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## Related Publications

Barbasch, T. A., Rueger, T., Srinivasan, M., Wong, M. Y. L., Jonesnd, G. P., & Buston, P. M. (2020). Substantial Plasticity of Reproduction and Parental Care in Response to Local Resource Availability. *Oikos*.

doi:[10.1111/oik.07674](https://doi.org/10.1111/oik.07674)

*Results*

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## Parameters

Parameter	Description	Units
Anemone_ID	A unique identifier for each anemone group surveyed	unitless
FSL	Female standard length to the nearest 0.01mm	millimeters (mm)
NumOfFish	Average number of adult and juvenile fish observed in the anemone over the course of the study	unitless
anemone_area	Average anemone area determined by taking the median area out of three measurements each month	square centimeters (cm <sup>2</sup> )

Month	Experimental month (1 or 3). Month 1 was before the feeding manipulation, used to establish baseline measurements. Month 3 was in the second month of manipulation	unitless
Month_Clutch	The clutch number that month (1, 2, or 3)	unitless
Clutch_Age	The age of the clutch when observations were made	unitless
Fed1_0	Feeding treatment, Fed (F) or Control (C). Lunar month 1 was the baseline month and manipulations had not started, so the fed groups were not yet fed	unitless
M_tend	Time male spent within one body length of the eggs (number of minutes out of 15 minute video)	minutes
F_tend	Time female spent within one body length of the eggs (number of minutes out of 15 minute video)	minutes
Clutches_Laid	Number of egg clutches laid by the pair per month (0, 1, 2, or 3)	unitless
Eggs_Laid	Number of eggs laid per clutch	unitless
probhatch	Probability that a clutch hatched, given that it was laid (0 or 1)	unitless
Eggs_Hatched	Number of eggs laid that reached day of hatching per clutch	unitless
tot_eggs	Number of eggs laid across all clutches that month	unitless
Prop_hatch	Proportion of eggs laid that reached day of hatching in each clutch	unitless
MSL	Male standard length to the nearest 0.01mm	millimeters (mm)

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## Instruments

<b>Dataset-specific Instrument Name</b>	Olympus Tough TG-870 camera (Olympus, Tokyo, Japan)
<b>Generic Instrument Name</b>	Camera
<b>Generic Instrument Description</b>	All types of photographic equipment including stills, video, film and digital systems.

<b>Dataset-specific Instrument Name</b>	hand nets
<b>Generic Instrument Name</b>	Hand Net
<b>Generic Instrument Description</b>	A hand net (also called a scoop net or dip net) is a net or mesh basket held open by a hoop. They are used for scooping fish near the surface of the water.

<b>Dataset-specific Instrument Name</b>	taylor's tape
<b>Generic Instrument Name</b>	Measuring Tape
<b>Generic Instrument Description</b>	A tape measure or measuring tape is a flexible ruler. It consists of a ribbon of cloth, plastic, fibre glass, or metal strip with linear-measurement markings. It is a common tool for measuring distance or length.

<b>Dataset-specific Instrument Name</b>	SCUBA
<b>Generic Instrument Name</b>	Self-Contained Underwater Breathing Apparatus
<b>Generic Instrument Description</b>	The self-contained underwater breathing apparatus or scuba diving system is the result of technological developments and innovations that began almost 300 years ago. Scuba diving is the most extensively used system for breathing underwater by recreational divers throughout the world and in various forms is also widely used to perform underwater work for military, scientific, and commercial purposes. Reference: <a href="https://oceanexplorer.noaa.gov/technology/technical/technical.html">https://oceanexplorer.noaa.gov/technology/technical/technical.html</a>

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## Project Information

### DISSERTATION RESEARCH: Negotiations Over Offspring Care: A Test of Alternative Hypotheses Using the Clown Anemonefish (Clownfish parental care)

**Website:** <https://www.bu.edu/biology/people/profiles/peter-buston/>

**Coverage:** Coral reefs of Papua New Guinea

#### *NSF Award Abstract:*

Conflict is a pervasive feature of animal societies. Conflicts arise whenever the interests of interacting individuals are not wholly aligned, yet many social interactions require individuals to reach some compromise. Parental care is an interaction that is rife with conflict, because both parents benefit from shifting the burden of care to the other, yet requires cooperation, because both parents benefit from the total amount of care. The outcome of conflict between parents has been modeled using economic game theory models, which assume that individuals act in their best interest but that their optimal behavior depends on how others behave. This project will build on existing empirical and theoretical work to test alternative hypotheses for how parents negotiate care utilizing a tractable study system: the clown anemonefish a.k.a. Nemo. Studying how conflict among caring parents is resolved is critical to understanding why animals, including humans, form such alliances. Undergraduates involved in the project will receive training in aquarium maintenance, assist in

ongoing research, and complete independent research projects. This project will also encourage participation of underrepresented groups in science through the researchers' participation in Science Club for Girls and through work with local school groups at the Mahonia Na Dari field station. The results will be broadly disseminated through presentations at international scientific meetings and development of "data nuggets" (<http://datanuggets.org/>) to ensure that results are available in a format that will enhance public understanding.

The existence of biparental care poses a perplexing evolutionary question because parents must coordinate their behavior to raise offspring when there are costs to providing care and inherent conflicts of interest among parents. The objective of this project is to test plausible alternative hypotheses for the factors that govern how parents negotiate the amount of care to provide to their offspring, and create a more general framework for understanding conflict resolution. The researchers will test four alternative hypotheses for how parents negotiate the amount of care to provide to their offspring: H0) Parental effort is fixed; H1) Parental effort is negotiated based on partner effort alone; H2) Parental effort is negotiated with an information asymmetry; H3) Parental effort is negotiated with a power asymmetry; H4) Parental effort is negotiated with a simple form of reciprocity. Experiments will be conducted in a natural population of clown anemonefish (*Amphiprion percula*) in Papua New Guinea. By supplementing food resources, effort by each parent will be manipulated in a non-invasive and ecologically relevant manner. The anemonefish system allows tests of alternative hypotheses simultaneously, where previous studies have only tested them in isolation. Furthermore, the majority of negotiation studies have been conducted in birds, so utilizing *A. percula* will test the generality of theoretical predictions. In sum, the proposed research will use a tractable study species together with a rigorous alternative hypothesis testing approach to determine the factors that influence the outcome of negotiations. While incorporating teaching, training and learning, this research will create a more general framework for studying conflict resolution and revise our understanding of negotiations over offspring care.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Integrative Organismal Systems (NSF IOS)</a>	<a href="#">IOS-1701657</a>

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