Goby histological inventory from an anatomical analysis of the development of the olfactory and gustatory system in the gobies, E. lori and E. colini conducted betwen 2011 and 2016

Website: https://www.bco-dmo.org/dataset/779950
Data Type: experimental
Version: 1
Version Date: 2019-10-29

Project
» Collaborative Research: The Role of Larval Orientation Behavior in Determining Population Connectivity (Elacatinus Dispersal II)

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Coverage

Temporal Extent: 2011 - 2016

Dataset Description

Goby histological inventory from an anatomical analysis of the development of the olfactory system (nose) and gustatory system (taste buds) in the gobies *Elacatinus lori* and *Elacatinus colini*. Collections and experiements took place between 2011 and 2016. Gobies were collected from reef habitats at the South Water Caye Marine Reserve and Carrie Bow Caye, Belize and reared at Boston University.

Related datasets:
* Goby nose data: https://www.bco-dmo.org/dataset/780017
* Goby taste bud data: https://www.bco-dmo.org/dataset/780007

Methods & Sampling

Methodology:

Fish Collection and Rearing (for all histological and SEM analyses) - Mated pairs of E. lori and of E. colini were collected from reef habitats near Carrie Bow Caye, Belize and housed in 75-l aquaria in a flow-through seawater lab at the International Zoological Expeditions (IZE) field station on South Water Caye, Belize, or in a recirculating seawater system at Boston University, USA. Ontogenetic series of E. lori and E. colini larvae were reared in 76-l cylindrical black bins and fed a variety of cultured and wild-caught zooplankton (Figure 1). A detailed description of brood stock maintenance and larval rearing methods can be found in Majoris et al. (2018). Additional post-settlement E. lori and E. colini (settlers) were collected from reef habitats within the South Water Caye Marine Reserve. Field research in Belize and the export of samples from Belize was carried out with the approval of the Belize Fisheries Department. Fish were immersed in cold seawater (2-4 degrees C) for two minutes and then fixed in cold (2-4 degrees C) 10% formalin in seawater (or in phosphate-buffered saline, PBS) for at least two minutes for anatomical study, which is consistent with AVMA Guidelines on Euthanasia of small warm-water fish. Care was taken to ensure that fish did not contact ice directly. Chemical anaesthetic was not used for several reasons, in particular because fixation must occur prior to death to avoid post-mortem changes at the cellular level, and ensure quality of the histological data and specimens prepared for SEM.

Paraffin Histology (taste bud, nose, ear, lateral line and eye analyses) - E. lori settlers wild-caught in Belize in 2011 (n=8, 9-17 mm LS) and larvae reared at Boston University in 2015 in addition to 3 wild-caught settlers (total of 7 fish, 0-30 dph, 3 mm NL - 15 mm SL) were decalcified in Cal-Ex (Thermo Fisher Scientific, Waltham, MA, USA) for 2 hours (6-7.5 mm SL) or 7- 8 hours (>8.5 mm SL) and rinsed in PBS for 2 hours. Then they were dehydrated in ascending series of ethanol and t-butyl alcohol, infiltrated in Paraplast (Thermo Fisher Scientific) for 4 hours under vacuum, and individually embedded. Blocks were sectioned at a thickness of 8 m, serial sections were mounted on slides subbed with 10% albumin in 0.9% NaCl, stained with a modified HBQ stain (Hall, 1986), and coverslipped with Entellan (Electron Microscopy Sciences).

Plastic Histology (taste bud, nose, ear, lateral line and eye analyses) - E. lori raised in Belize in 2015 and 2016 (n=33 0-44 dph, 3 mm NL [notochordal length] - 11 mm SL [standard length]), wild-caught E. lori settlers collected at Belize in 2015 and 2016 (n=5, 9.5-14 mm SL), and E. colini raised at Boston University in 2015 (n=25, 0-50 dph, 3.5-15 mm NL or SL) were prepared for plastic resin histology. Fish larger than 6 mm SL were decalcified in Cal-Ex (Thermo Fisher Scientific, Waltham, MA, USA) for 2 hours (6-7.5 mm SL), 3.5 hours (8-8.5 mm SL), or 7 to 8 hours (>8.5 mm SL) and rinsed in PBS for 2 hours. Fish were dehydrated in an ascending ethanol series (to 95% ethanol), infiltrated overnight in glycol methacrylate resin (Technovit 7100, Electron Microscopy Sciences), and embedded in fresh resin to which polymerization agent had been added. Most of the fish were double embedded - individual fish were embedded in small resin blocks, and 6-8 small resin blocks were re-embedded in a single larger block of resin for sectioning in the transverse plane . Sections (5 m, cut using a Leica 4M2265 motorized microtome with tungsten carbide knife) were individually mounted out of distilled water onto clean slides, dried overnight, stained with 0.5% aqueous cresyl violet for 5 minutes, rinsed in running tap water, air-dried overnight, and coverslipped with Entellan (Electron Microscopy Sciences).

Note: for olfactory size, measurements were taken on histological sections at 25 (position 1), 50 (position 2) and 75% (position 3) along the rostro-caudal length of the olfactory epithelium.

Data Processing Description

BCO-DMO Data Manager Processing Notes:
* added a conventional header with dataset name, PI name, version date
* modified parameter names to conform with BCO-DMO naming conventions
* blank values in this dataset are displayed as "nd" for "no data." nd is the default missing data identifier in the BCO-DMO system.
* blank rows removed

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Related Publications

Hu, Y., Majoris, J. E., Buston, P. M., & Webb, J. F. (2018). Potential roles of smell and taste in the orientation behaviour of coral-reef fish larvae: insights from morphology. Journal of Fish Biology, 95(1), 311–323. doi:10.1111/jfb.13793

Results

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

Collaborative Research: The Role of Larval Orientation Behavior in Determining Population Connectivity (Elacatinus Dispersal II)

Coverage: Belizean Barrier Reef System

Description from NSF award abstract:
Understanding how far young fish move away from their parents is a major goal of marine ecology because this dispersal can make connections between distinct populations and thus influence population size and dynamics. Understanding the drivers of population dynamics is, in turn, essential for effective fisheries management. Marine ecologists have used two different approaches to understand how fish populations are connected: genetic methods that measure connectivity and oceanographic models that predict connectivity. There is, however, a mismatch between the predictions of oceanographic models and the observations of genetic methods. It is thought that this mismatch is caused by the behavior of the young, or larval, fish. The objective of this research is to study the orientation capabilities of larval fish in the wild throughout development and under a variety of environmental conditions to see if the gap between observations and predictions of population connectivity can be resolved. The project will have broader impacts in three key areas: integration of research and teaching by training young scientists at multiple levels; broadening participation of undergraduates from underrepresented groups; and wide dissemination of results through development of a website with information and resources in English and Spanish.

The overall objective of the research is to investigate the role of larval orientation behavior throughout ontogeny in determining population connectivity. This will be done using the neon goby, Elacatinus lori, as a model system in Belize. The choice of study system is motivated by the fact that direct genetic methods have already been used to describe the complete dispersal kernel for this species, and these observations indicate that dispersal is less extensive than predicted by a high-resolution biophysical model; E. lori can be reared in the lab from hatching to settlement providing a reliable source of larvae of all ages for proposed experiments; and a new, proven behavioral observation platform, the Drifting In Situ Chamber (DISC), allows measurements of larval orientation behavior in open water. The project has three specific objectives: to understand ontogenetic changes in larval orientation capabilities by correlating larval orientation behavior with developmental sensory anatomy; to analyze variation in the precision of larval orientation in different environmental contexts through ontogeny; and to test alternative hypotheses for the goal of larval orientation behavior, i.e., to determine where larvae are heading as they develop.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459546
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459156
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459224

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