

**I. Project Title:** Understanding the transition from dispersive larva to benthic adult: A study of the environmental factors that impact *Kelletia kelletii* larval settlement

**II. Abstract**

Kellet's whelk is a large predatory marine gastropod and emerging fisheries species. Historically, this species has been found from Baja California, Mexico to Point Conception, California. In the early 1980s they expanded their range northward to Monterey County, California, possibly in conjunction with a large El Niño event. Despite the ecological and economic importance of this species, little is known about the mechanism by which their larval dispersal translates into population connectivity. To better understand this aspect of their life history, I aim to culture Kellet's whelk larvae *in vitro* and test the efficacy of alternative environmental stimuli for promoting larval settlement. My hypothesis is that Kellet's whelk will respond preferentially to select stimuli which correspond to suitable habitat. My proposed study will have implications for this species' dispersal dynamic and lead to a deeper understanding of the causes and consequences of its northward range expansion. In turn, this information will help guide the sustainable management of its emerging fishery and further our knowledge about the impact of large scale ocean processes on marine invertebrate larval dispersal.

**III. Introduction**

Kellet's whelk (*Kelletia kelletii*) is a large predatory marine gastropod inhabiting rock and sand habitats in kelp forests (Rosenthal, 1970). The species has separate sexes and reproduces by internal fertilization. Females lay benthic egg capsules and dispersive larvae are released from the capsules after ~31 days. Larvae are pelagic for 5.5 to 9 weeks (Romero, 2012), after which settlement to the benthos occurs and is marked by the loss of the velum, a larval feeding and swimming appendage.

Until the 1970s or early 1980s, the biogeographical range of Kellet's whelk was restricted by a northern barrier, Point Conception, California (Herrlinger, 1981). However, since that time the species has expanded its northern boundary to Monterey Bay, California. This range expansion suggests a novel dispersal pattern for this species. In a study, a large pulse of settling larvae into their expanded range was correlated with a large El Niño event (Zacherl et al., 2003), suggesting changes in oceanic temperature and currents may be driving factors for the change in dispersal.

Past studies of Kellet's whelk larvae have been conducted to elucidate dispersal dynamics (Romero, 2012) and its spatial patterns of population connectivity (Zacherl 2005 and White 2010). However, little is understood about the process which bridges these two concepts. The transition from dispersive larva to benthic adult is influenced by environmental cues that induce larvae to settle out of their pelagic phase, yet the cues remain unidentified for larval Kellet's whelk. Further, environmental changes such as induction to an expanded range, climate change, fishing practices, or El Niño events may alter Kellet's whelk settlement success. For these reasons, understanding Kellet's whelk's larval biology will help guide both its fisheries management and conservation, as well as that of other species along the California coast.

#### **IV. Objectives**

- (1) Establish a detailed record of observations of Kellet's whelk transition from egg to juvenile.
- (2) Test environmental factors as settlement stimuli and quantify the settlement response of Kellet's whelk larvae.

#### **V. Methodology**

Whelks, prey items, and substrate will be collected from local reefs via SCUBA and maintained at the Cal Poly research pier. Egg capsules laid will be brought to the on campus laboratory of my co-advisor, Dr. Dean Wendt, to be cultured. Eggs released from capsules will be cultured in seawater microcosms for six weeks. Larvae competent to settle will then be placed

in covered glass dishes containing various environmental stimuli such as rock, biofilm, algae, adult Kellet's whelk, and prey items. Larval settlement behaviors will be observed and the proportion of settlement among the larvae in each dish will then be recorded. The larvae will be considered settled when they have shed their velum structure, marking the irreversible transition out of the water column and onto the benthos. Developmental stage and size will be recorded from egg to juvenile.

Dr. Danielle Zacherl at CSU Fullerton will be an unfunded partner who will provide external advice on the project, as she has already successfully cultured Kellet's whelk larvae (Romero et al., 2012), and she and my co-advisor, Dr. Crow White, have collaborated extensively on Kellet's whelk larval dispersal research.

## **VI. Timeline**

March-May 2016: Collection dives, eggs will be brought to campus, culturing will begin

Late July, early August 2016: Settlement trials will occur

October 2016: Poster created to submit for presentation at WSN conference

November 2016-January 2017: Results written into research paper for senior project, poster/lesson plan developed with the Central Coast Aquarium

## **VII. Final Products and Dissemination**

I will partner with the Central Coast Aquarium in Avila Beach to share with the community research that has local significance and to create for K-12 students teaching materials centered around marine larval biology and dispersal. The final results of this study will be compiled as my senior project. I will also apply to present my findings at the Western Society of Naturalists annual meeting (November 2016, in Monterey, CA) and at a Cal Poly Biology department seminar dedicated to student projects.

## VIII. Budget Justification

<b>Student Applicant(s):</b> Megan Wilson	
<b>Faculty Advisor:</b> Dr. Crow White, Dr. Dean Wendt	
<b>Project Title:</b> Understanding the transition from dispersive larva to benthic adult: A study of the environmental factors that impact <i>Kelletia kelletii</i> larval settlement	<b>Requested Endowment Funding</b>
<b>Travel</b> <u>subtotal</u>	<b>\$200.00</b>
Travel: In-state ( <i>Monterey, CA</i> )	<b>\$200.00</b>
Travel: Out-of-state	\$
Travel: International	\$
<b>Operating Expenses</b> <u>subtotal</u>	<b>\$</b>
Non-computer Supplies & Materials	<b>\$1105.00</b>
Computer Supplies & Materials	\$
Software/Software Licenses	\$
Printing/Duplication	<b>\$80.00</b>
Postage/Shipping	\$
Registration ( <i>WSN</i> )	<b>\$200.00</b>
Membership Dues & Subscriptions	\$
Multimedia Services	\$
Advertising	\$
Journal Publication Costs	\$
<b>Contractual Services</b> <u>subtotal</u>	<b>\$</b>
Contracted Services	\$
Equipment Rental/Lease Agreements ( <i>Scientific diving and boating</i> )	<b>\$200.00</b>
Service/Maintenance Agreements	\$
Tax	<b>\$140.00</b>
<b>TOTAL</b>	<b>\$1925.00</b>



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22 January 2016

To the Warren J. Baker and Robert D. Koob Endowments Student Selection Committee:

I am very pleased to write this letter of recommendation for Ms. Megan Wilson and her proposed research project on the larval biology of Kellet's whelk. Megan is in her third year as an undergraduate Biology major here at Cal Poly, where she is working under my supervision on a research project examining the egg and larval life history stages of Kellet's whelk in relation to marine benthic environmental cues affecting larval settlement.

Since meeting Megan in the spring of 2015, and since then working with her in the field and lab, I have been enormously impressed with Megan's intellect, hard work, creativity, and productivity. **Out of all the undergraduate students I have advised, taught and interacted with here at Cal Poly, Megan is without a doubt one of the most talented, motivated and promising as a developing scientist.** *She is truly an outstanding undergraduate student.*

The project proposed by Megan is both experimentally sound and with clear potential to advance the science of larval biology, and conservation and management of Kellet's whelk and other, related fisheries species along the California coast. To date, science has been unable to complete Kellet's whelk's life cycle, because of challenges in maintaining viable larvae during their settlement state. Megan's proposed larval culturing methods are meticulously outlined and they carefully build on the previous research conducted by myself and one of my key collaborators, Dr. Danielle Zacherl (who has come the closest to completing the life cycle and has offered to serve as an unfunded mentor to Megan during the course of her project). For these reasons I believe Megan will succeed in culturing Kellet's whelk through their settlement stage and fill this knowledge gap in the life history of the species. Further, Megan's approach to testing Kellet's whelk's response to alternative settlement cues is both feasible and experimentally sound, and expected to provide important insights on the species' larval dynamics that will help elucidate its population ecology and factors enabling for its range expansion up the coast. Given Megan's attention to detail, her strong intellect and self-motivation, and her passion for larval biology, I am fully confident that she has the ability to carry out the methods outlined in her proposal, and meet the objectives of her project.

The marine science facilities, equipment and supportive roles at Cal Poly – both at the pier and on the main campus – fully meet the needs of Megan and her proposed research project. Megan will be able to obtain samples through Cal Poly's scientific diving program, of which she is a member. She will be able to maintain whelks in a flow-through sea water tank at the pier that I had constructed for my lab and have dedicated for Megan's use. She will be able to culture

Kellet's whelk eggs and larvae in microcosms on campus in the Biological Sciences Department's sea water experimental tank room in building 53A. She will have access to glass dishes and beakers available from my lab and the Biological Science Department. I am very excited about Megan's project, and will provide extensive advising to her throughout its development, as well as leadership in keeping track of the budget and supplies purchases. I also will facilitate Megan's mentoring from my collaborator Dr. Zacherl. Megan also will receive advising from Cal Poly Biology faculty Dr. Dean Wendt, an expert in marine larval physiology.

Megan is a great pleasure to work with and she has become an outstanding member of my lab. She possesses all of the qualities that will make her a creative, ambitious scientist. Her well-thought out proposed project on Kellet's whelk larval biology is yet another example of her promise as a developing scientist, and I am fully supportive of her project and enthusiastic to watch it and Megan's career develop successfully. For all of these reasons, **I give her my highest recommendation** for support from the Warren J. Baker and Robert D. Koob Endowments.

Sincerely,

A handwritten signature in black ink, appearing to read "Crow White". The signature is fluid and cursive, with the first name "Crow" and last name "White" clearly distinguishable.

Crow White, Ph.D.  
Assistant Professor of Biological Sciences