**Title: Analysis of *Enteroctopus dofleini* (Giant Pacific Octopus) midden contents from artificial reef den sites in Puget Sound.**

**Abstract:**

Coastal development and the introduction of riprap (rocky material used to protect shorelines such as jetties, breakwalls and seawalls) to soft sediment subtidal habitats greatly alters marine environments and ecosystems. Preliminary surveys provide evidence to suggest that *E. dofleini* utilize riprap for den sites. The aim of this study is to analyze midden contents of *E. dofleini* dens in artificial structures. Underwater video transects and midden collection (using SCUBA) will be conducted at 15-20 artificial reef sites around Puget Sound. Composition of middens will be analyzed in lab by recording the number of individuals by species represented in shell remains. Results will be presented as a scientific paper, public poster presentation, and ongoing personal blog/website. Conclusions about diet may be used to further understand *E. dofleini* effects on surrounding communities.

**Introduction:**

*(2 paragraphs max.)—What is the scientific context within which your project will be placed? Relate your proposed research to: (a) the existing state of knowledge, and (b) timely and interesting questions within the field/discipline.*

As coastal communities are projected to double in the next few decades (Bulleri & Chapman, 2010), humans will continue to have a great effect on the surrounding marine habitat. Coastal development and the introduction of riprap to soft sediment subtidal habitats greatly alters marine environments and ecosystems. Riprap provides a hard substrate to which benthic sessile organisms adhere, and may increase densities of rocky habitat species. Bulleri (2005) suggests that riprap structures lack micro-habitats (rock pools or overhangs) that provide refuges from predatory species, which may affect post-settlement survival. Riprap and artificial reefs have been shown to increase fish abundance and attract larger fish (Hueckel et al., 1982). Riprap is one of the building blocks in creating novel ecosystems (in this case, an anthropogenic biome of both soft sediment and artificial reef) that affect local and regional biodiversity by modifying natural patterns of dispersal (Bulleri & Chapman, 2010).

One iconic creature, the Giant Pacific Octopus, *Enteroctopus dofleini* (Wülker, 1910), creates or chooses a den for shelter and camouflage. Octopus typically choose den sites in boulders nearby soft sediment (Scheel, 2002) but in preliminary surveys, there is evidence to suggest that octopus utilize riprap as den sites. There are numerous studies on octopus behavior, learning and camouflage (Mather & Kuba, 2013), while research regarding diet is not as extensive. Current knowledge of Giant Pacific Octopus diets state that individuals specialize while generalizing at the population level (Anderson & Mather, 2007). Scheel (2012) measured species richness and Cardona’s niche breadth in Puget Sound *E. dofleini* midden contents and found that individuals specialize more often on large common prey species. The aim of this study is to similarly analyze midden contents of *E. dofleini*, but of individuals that utilize artificial structures as den sites. By analyzing prey choice in artificial habitat, we can begin to understand the anthropogenic effect of urbanization on the surrounding ecosystem, and how *E. dofleini* interact with the rest of the community in this novel ecosystem.

**\*Research Question:***What are* E.dofleini *diets comprised of in artificial habitats around Puget Sound?*

**Methods:**

After compiling den site information, 15-20 sampling locations will be finalized across Puget Sound. Flow will be evaluated based on NOAA current charts and sites with high flow will not be chosen. Sample size of octopus dens will depend on how effectively they can be located and accessed, and will be large as possible.

Using SCUBA, repeated video transects of 20 meters will be conducted on each dive. One diver will record transects and navigate while the other diver visually searches for den sites. After spotting a den site, transects will be completed then divers will go back to collect the entire midden in bags. Octopus middens and dens will be recognized by either the presence of an octopus, telling characteristics such as excavation, and/or the presence of octopus predation marks such as drills or bites on midden materials (Anderson & Mather, 2007).

After collection, composition of middens will be analyzed in lab by recording the number of individuals by species represented in shell remains. Midden contents will give us a better idea of the diets of octopus inhabiting artificial structures. Video transects will be analyzed for den density (paired locations between riprap and neighboring soft sediment), and counts of crab and other potential prey species across sites. Prey abundance and distribution patterns may vary in relation to octopus density. Midden data will be examined visually using nonmetric multidimensional scaling (NMDS). Differences in midden composition between sites and substrate types will also be evaluated using a PERMANOVA. Results will be presented as a scientific paper, public poster presentation, and ongoing personal blog/website.

-Equipment:

* SCUBA nitrox tanks with nitrox refills
* Bags for collection of midden
* Personal vehicle, boat and fuel, ferry fare
* Rental Diver Propulsion Vehicles (DPVs)
* Digital HD camera/video with underwater housing

**Products and Timeline:**

*In bulleted or table format, list specific products you will produce (scientific paper, manual, website). What is your proposed schedule for the data collection, data analysis, and completion of your project? Be specific. Include a minimum of two meetings each quarter with faculty sponsor and three meetings with worksite supervisor. Make sure to pick a date toward the end of the quarter for an evaluation meeting.*

Products:

* Rough draft scientific paper (Autumn, 2014)
* Final draft scientific paper (Autumn, 2014)
* Poster presentation (Autumn 2014)
* Personal blog/website (Ongoing)

Timeline:

* Meet with Eliza Heery (worksite supervisor) to finalize project sampling design, sites and logistics (throughout end of Autumn quarter and Winter quarter)
* Meet with Dr. Kenneth Sebens for approval and signature on Proposal and FISH 494 contract (end of Autumn quarter)
* Meet with Eliza Heery regarding progress and potential questions (throughout Autumn, Winter, Spring following Autumn quarter)
* Data collection (January 2014-June 2014)
* Meet with Dr. Kenneth Sebens for signature on FISH 495 form (May 2014)
* Data analysis (April 2014-December 2014)
* Evaluation meeting with Dr. Kenneth Sebens and Eliza Heery (November 2014)
* Poster presentation and completion of Capstone Project (December 2014)

**Signatures:**

“We have read and discussed the above proposal thoroughly and we believe this is an achievable yet challenging project for the student named. We have also discussed how the student will get any needed supplies, etc. for this project.”

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*Student: Amy Green date*

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*Faculty Sponsor: Dr. Kenneth Sebens date*

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*Worksite Supervisor: Eliza Heery, PhD candidate date*

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