

State of Hawaii  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
Division of Aquatic Resources  
Honolulu, Hawaii 96813

May 11, 2012

Board of Land  
and Natural Resources  
Honolulu, Hawaii

Request for Authorization and Approval to Issue a Papahānaumokuākea Marine National Monument Research Permit to Megan Donahue, University of Hawaii, Hawaii Institute of Marine Biology, for Access to State Waters to Conduct Bioerosion Study Activities

The Division of Aquatic Resources (DAR) hereby submits a request for your authorization and approval for issuance of a Papahānaumokuākea Marine National Monument research permit to Megan Donahue, Assistant Researcher, University of Hawaii, Hawaii Institute of Marine Biology, pursuant to § 187A-6, Hawaii Revised Statutes (HRS), chapter 13-60.5, Hawaii Administrative Rules (HAR), and all other applicable laws and regulations.

The research permit, as described below, would allow entry and research activities to occur in Papahānaumokuākea Marine National Monument (Monument), including the NWHI State Marine Refuge and the waters (0-3 nautical miles) surrounding the following sites:

- Nihoa Island
- Necker Island (Mokumanamana)
- French Frigate Shoals
- Gardner Pinnacles
- Maro Reef
- Laysan Island
- Lisianski Island, Neva Shoal
- Pearl and Hermes Atoll
- Kure Atoll

The activities covered under this permit would occur between July 25, 2012 and July 24, 2013. This work would build upon investigation from previous years and is a renewal of work previously permitted and conducted in the Monument. New activities in this application include recovery of previously installed calcium carbonate blocks and deployment of new blocks in new locations.

INTENDED ACTIVITIES

The Applicant is proposing to measure bioerosion rates and bioeroder community composition (i.e. hydrozoans, bryozoans, barnacles, and tiny mollusks) at up to 21 different reef sites in Papahānaumokuākea Marine National Monument. The purpose of these activities is to test the

effectiveness of using bioerosion rates and bioeroder communities as indicators of climate change, specifically ocean acidification.

To carry out this survey, the applicant is requesting to retrieve calcium carbonate blocks that were deployed last year during previously permitted activities and which serve as settling substrate for bioeroders; place new blocks at Kure Atoll; and collect pieces of dead coral for taxonomic and molecular analyses of bioeroder communities.

Specifically this will involve:

1. Retrieving 5 small calcium carbonate blocks that were deployed last year at each of 15 different forereef sites (FFS, LIS, and PHR) and 20 blocks from a lagoon site at Midway
2. Placing 5 new calcium carbonate blocks at each of 5 sites at Kure
3. Collecting up to 10 small pieces of dead *Porites compressa* at each of 16 different sites (FFS, LIS, PHR and Midway) and 20 small pieces at each of 5 sites at Kure

The activities proposed by the applicant directly support the Monument Management Plan's priority management needs 3.1 – Understanding and Interpreting the NWHI (through action plan 3.1.1 – Marine Conservation Science).

The activities described above may require the following regulated activities to occur in State waters:

- Removing, moving, taking, harvesting, possessing, injuring, disturbing, or damaging any living or nonliving monument resource
- Drilling into, dredging, or otherwise altering the submerged lands other than by anchoring a vessel; or constructing, placing, or abandoning any structure, material, or other matter on the submerged lands
- Touching coral, living or dead
- Swimming, snorkeling, or closed or open circuit SCUBA diving within any Special Preservation Area or Midway Atoll Special Management Area

#### REVIEW PROCESS:

The permit application was sent out for review and comment to the following scientific and cultural entities: Hawaii Division of Aquatic Resources, Hawaii Division of Forestry and Wildlife, Papahānaumokuākea Marine National Monument (NOAA/NOS), NOAA Pacific Islands Regional Office (NOAA-PIRO), United States Fish and Wildlife Service Hawaiian and Pacific Islands National Wildlife Refuge Complex Office, and the Office of Hawaiian Affairs (OHA). In addition, the permit application has been posted on the Monument Web site since March 15, 2012, giving the public an opportunity to comment. The application was posted within 40 days of its receipt, in accordance with the Monument's Public Notification Policy.

#### **Comments received from the scientific community are summarized as follows:**

Scientific reviews support the acceptance of this application.

The following concerns were raised. Applicant responses are noted below.

1. How well would the data from the calcium carbonate blocks (i.e. blocks of dead coral) correlate with data (bio-erosion community/bio-erosion rates, etc.) from the existing surrounding natural reef?
  - The applicant explains that the blocks are natural pieces of dead *Porites* sp. skeleton collected from the Hawaiian Islands, and that this is the same substrate that is naturally available to bioeroders. The primary concern with comparing the naturally occurring community and the community in the blocks is that the bioerosion blocks may capture only a small subset of the community because of their limited 1-year deployment time. To help with this comparison, the applicant's permit includes collections of small pieces of dead coral skeleton from each site. They would use these natural samples to identify members of the bioeroder community: invertebrates would be carefully extracted from these samples for taxonomic identification and sequencing for the ReefChip. The database from these samples would then be used to identify the bioeroder community in the blocks. Therefore, there would be a direct measure of the deviation in community composition between the blocks and the natural samples. Based on this comparison, the applicant would be able to evaluate how representative these blocks are of the natural reef substrate. If, as is expected, the community composition in blocks is a subset of that in the natural substrate, then the blocks may underestimate bioerosion rates; nonetheless, it would still be possible to compare the relative rate of bioerosion across sites.
2. Could the applicant provide references which demonstrate the technique using calcium carbonate blocks to visualize and catalog bioerosion rates efficacy?
  - The applicant states that there are several previous studies that have used calcium carbonate blocks to measure bioerosion rates. The most widely used method for quantifying bioerosion rates uses blocks similar to the ones proposed, but measures skeletal density before and after deployment using only buoyant weight (see, White 1980, Hutchings and Bamber 1985, Kiene and Hutchings 1994, Reaka-Kudla et al. 1996, Pari et al. 2002, Tribollet et al. 2002). The drawback of this approach is that buoyant weight confounds accretion and erosion: increases in buoyant weight due to establishment of crustose coralline algae or other accreting organisms confound the measurement of erosion rates. Another approach is to use 2D imaging techniques (e.g., Harvey & Fletcher 2003). In this case, large pieces of reef substrate are collected and cut to image long-term bioerosion. This method is typically used for long time-scale estimates of erosion rates. The applicant's proposed study uses a method incorporating microCT technology. CT scanners are 3D imaging tools commonly used in the medical field to locate and quantify skull fractures. The microCT method can quantify bioerosion scars down to 50 microns, allowing accurate measurement of both bioerosion and accretion rates. While her study would be the first time that microCT would be used to quantify whole community bioerosion and accretion rates, she notes that previous studies have used this method to visualize bioeroding sponge infestation (see, Beuck et al. 2007, Schönberg and Shields 2008). As with prior microCT studies, the microCT imaging allows 3D reconstruction of boring patterns. The shape and structure of scars left by borers is

characteristic to boring functional groups (Sammarco & Risk 1990), and these functional group assignments could be used as another measure of community composition.

3. Much of the intended research uses the “ReefChip”. Is there preliminary data from using the ReefChip that would support this technique’s effectiveness? More specifically, are there safeguards within the microarray to prevent cross-hybridization between species with similar genes? If not, please explain how the results from this technique would still prove valuable in attaining the goals of this work.
  - The applicant responds that the ReefChip provides a method for us to genetically identify organisms in a mixed sample to measure community composition. She notes that as the reviewer points out, safeguarding against cross-hybridization is critical to the effectiveness of this method. To avoid this, the applicant is developing 8-10 25bp probes for each unique species. In the analysis, a species must hybridize to all (or nearly all – this will be evaluated statistically in test runs) probes for that species. This ensures that cross-talk on one or a few probes would not lead to a false positive. The ReefChip technology is still under development, and the first prototypes for ReefChip are being prepared this month, so preliminary proof of concept could be available soon. If the ReefChip technology proves too fraught for the proposed project, the applicant offers two other approaches that can be used to evaluate changes in community composition:
    - a. As mentioned above, the 3D imaging technology of the microCT would allow reconstruction of the shape and structure of scars left by bioeroders. The shape and structure of these scars are attributable by functional group, and would allow comparison of community shifts at the functional group level within and between sites.
    - b. Instead of trying to identify particular organisms to species, a mass sequencing approach could be used to look at diversity and sequence turnover from site to site. This approach would necessarily be presence-absence and could still be confounded by cross-hybridization. However, this approach to community composition in mixed samples is common in microbial systems. The drawback of this approach is that these sequences changes would not be readily traceable back to species-level changes in community composition.
4. How will bioerosion of the carbonate blocks be tied to pH? Without regular pH measurements, how will you assess the pH exposure history of the forereef samples?
  - The applicant states that she would coordinate with NOAA’s Coral Reef Ecosystem Division to obtain oceanographic data, including pH, from each of their sites. These data are already collected and available. However, she notes that the reviewer’s concern is well-founded -- these data are limited to only single time points and do not take into consideration the pH time series of each site.

She explains that while shallow, closed systems with high residence times often display very high variability in pH, recent evidence suggests that deeper, open sites have a quite stable pH throughout time (Hofmann et al. 2011). The proposed sites are forereef sites, ~20m deep, which are open and connected with the open ocean; this suggests that they have relatively stable pH over the exposure history of the bioerosion blocks. Nonetheless, there are currently no long-term pH data sets in the Monument. Dr. Florence Thomas, a colleague of the applicant, has submitted a permit to deploy pH sensors for a month at a subset of the forereef sites used in this study. If that permit is approved, then the dataset could validate the assumption of long-term pH stability at these sites.

Even with these measurements, the direct connection between pH and bioerosion rate from this dataset is tenuous. The applicant has two other ongoing experiments that would elucidate this relationship more convincingly. First, she is just completing a deployment of bioerosion blocks along a reef flat to reef slope transect on Coconut Island in Kaneohe Bay, Oahu, where they have regular measurements of pH and other environmental variables at the location of each block along that transect. She expects that this dataset could elucidate the environmental drivers of bioerosion rate better than the Archipelagic-wide survey. Second, this fall, the applicant will perform a controlled experiment to test the effect of pH on bioerosion rates directly. Together with the Archipelagic-wide survey, she expects to be able to demonstrate (or not) any influence of pH on bioerosion rates.

5. The DLNR supports this activity, and is interested in both how the information gathered would complement the applicant's research in the main Hawaiian Islands (MHI) and how the information could be extrapolated across the Hawaiian archipelago and across species. To this end, does the applicant expect that *Porites lobata* heads collected from the MHI will have the same bioeroder colonies, CaCO<sub>3</sub> loss and/or accretion rates as *P. lobata* from the NWHI? Furthermore, does the applicant believe that the bioeroder communities would remain consistent amongst different coral species both in and between the MHI and NWHI?
  - The applicant states that this summer, in cooperation with CRED, she will deploy additional sites around Oahu and Maui. This would allow the direct comparison between NWHI and MHI in which the reviewer is interested. She expects to see some differences in CaCO<sub>3</sub> loss and/or accretion and bioeroder community composition between the MHI and the NWHI. Other large-scale bioerosion studies conducted in the Great Barrier Reef and French Polynesia have found significant differences in bioerosion rates and communities between windward/leeward reefs and across their study areas. In addition, anthropogenic effects such as nutrient enrichment and sedimentation have been shown to influence bioerosion rates and communities in other locales. Finally, recruitment of bioeroders to CaCO<sub>3</sub> substrate is dependent on the available larval pool. The larval pool may be different between the MHI and the NWHI (e.g., more introduced species are established in the MHI) and this could also affect the bioeroder community composition across the Archipelago. Therefore, the applicant expects to see some changes in community composition across the

Archipelago. Differences in bioerosion rate across the Archipelago could be driven by these community differences, but also by archipelago-scale environmental gradients in temperature and productivity.

To answer the reviewer’s question about differences in species, the applicant responds that there is evidence which suggests that there would be differences in both bioerosion rates and bioeroder community composition between different species of coral. She notes that a study conducted in Kanoeh Bay in the 1970s found different bioerosion rates and communities in *Montipora capitata* and *Porites compressa* skeleton (White 1980), and that other studies have also found large differences in bioerosion among coral species (Highsmith 1981).

- 6. Confirm that all clove oil brought into the Monument would only be used and handled on board the ship and within appropriate laboratory setting.
  - The applicant states that clove oil would only be brought on board the ship, used in appropriate laboratory settings, and would never be introduced into Monument waters.

**Comments received from the Native Hawaiian community are summarized as follows:**

Cultural reviews support the acceptance of this application. No concerns were raised.

**Comments received from the public are summarized as follows:**

No comments were received from the public on this application.

**Additional reviews and permit history:**

Are there other relevant/necessary permits or environmental reviews that have or will be issued with regard to this project? (e.g. MMPA, ESA, EA)      Yes       No   
If so, please list or explain:

- The proposed activities are in compliance with the National Environmental Policy Act.
- The Department has made an exemption determination for this permit in accordance chapter 343, HRS, and Chapter 11-200, HAR. See Attachment (“DECLARATION OF EXEMPTION FROM THE PREPARATION OF AN ENVIRONMENTAL ASSESSMENT UNDER THE AUTHORITY OF CHAPTER 343, HRS AND CHAPTER 11-200 HAR, FOR PAPAHA NAUMOKU AKEA MARINE NATIONAL MONUMENT RESEARCH PERMIT TO MEGAN DONAHUE, HAWAII INSTITUTE OF MARINE BIOLOGY, FOR ACCESS TO STATE WATERS TO CONDUCT BIOEROSION STUDY ACTIVITIES UNDER PERMIT PMNM-2012-033”)

Has Applicant been granted a permit from the State in the past? Yes       No    
If so, please summarize past permits:

- The applicant was granted permit PMNM-2011-032 in 2011 to measure bioerosion rates, bioeroder community composition and physical parameters of associated microhabitats,

which included deployment of calcium carbonate blocks, coral and seawater collections and water chemistry measurements.

Have there been any a) violations: Yes  No   
 b) Late/incomplete post-activity reports: Yes  No   
 Are there any other relevant concerns from previous permits? Yes  No

### STAFF OPINION

DAR staff is of the opinion that Applicant has properly demonstrated valid justifications for her application and should be allowed to enter the NWHI State waters and to conduct the activities therein as specified in the application with certain special instructions and conditions, which are in addition to the Papahānaumokuākea Marine National Monument Research Permit General Conditions. All suggested special conditions have been vetted through the legal counsel of the Co-Trustee agencies (see Recommendation section).

### MONUMENT MANAGEMENT BOARD OPINION

The MMB is of the opinion that the Applicant has met the findings of Presidential Proclamation 8031 and this activity may be conducted subject to completion of all compliance requirements. The MMB concurs with the special conditions recommended by DAR staff.

### RECOMMENDATION

Based on the attached proposed declaration of exemption prepared by the department after consultation with and advice of those having jurisdiction and expertise for the proposed permit actions:

1. That the Board declare that the actions which are anticipated to be undertaken under this permit will have little or no significant effect on the environment and is therefore exempt from the preparation of an environmental assessment.
2. Upon the finding and adoption of the department's analysis by the Board, that the Board delegate and authorize the Chairperson to sign the declaration of exemption for purposes of recordkeeping requirements of chapter 343, HRS, and chapter 11-200, HAR.
3. That the Board authorize and approve a Research Permit to Megan Donahue, Hawaii Institute of Marine Biology, with the following special conditions:
  - a. This permit is not to be used for nor does it authorize the sale of collected organisms. Under this permit, the authorized activities must be for noncommercial purposes not involving the use or sale of any organism, by-products, or materials collected within the Monument for obtaining patent or intellectual property rights.

- b. The permittee may not convey, transfer, or distribute, in any fashion (including, but not limited to, selling, trading, giving, or loaning) any coral, live rock, or organism collected under this permit without the express written permission of the Co-Trustees.
- c. To prevent introduction of disease or the unintended transport of live organisms, the permittee must comply with the disease and transport protocols attached to this permit.
- d. Tenders and small vessels must be equipped with engines that meet EPA emissions requirements.
- e. Refueling of tenders and all small vessels must be done at the support ships and outside the confines of lagoons or near-shore waters in the State Marine Refuge
- f. No fishing is allowed in State Waters except as authorized under State law for subsistence, traditional and customary practices by Native Hawaiians.

Respectfully submitted,



GUY KAULUKUKUI  
Acting Administrator

APPROVED FOR SUBMITTAL



WILLIAM J. AILA, JR.  
Chairperson



**Papahānaumokuākea Marine National Monument**  
RESEARCH Permit Application

**NOTE: *This Permit Application (and associated Instructions) are to propose activities to be conducted in the Papahānaumokuākea Marine National Monument. The Co-Trustees are required to determine that issuing the requested permit is compatible with the findings of Presidential Proclamation 8031. Within this Application, provide all information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Papahānaumokuākea Marine National Monument (Monument).***

**ADDITIONAL IMPORTANT INFORMATION:**

- Any or all of the information within this application may be posted to the Monument website informing the public on projects proposed to occur in the Monument.
- In addition to the permit application, the Applicant must either download the Monument Compliance Information Sheet from the Monument website OR request a hard copy from the Monument Permit Coordinator (contact information below). The Monument Compliance Information Sheet must be submitted to the Monument Permit Coordinator after initial application consultation.
- Issuance of a Monument permit is dependent upon the completion and review of the application and Compliance Information Sheet.

**INCOMPLETE APPLICATIONS WILL NOT BE CONSIDERED**

Send Permit Applications to:

Papahānaumokuākea Marine National Monument Permit Coordinator

6600 Kalaniana'ole Hwy. # 300

Honolulu, HI 96825

[nwhipermit@noaa.gov](mailto:nwhipermit@noaa.gov)

PHONE: (808) 397-2660      FAX: (808) 397-2662

**SUBMITTAL VIA ELECTRONIC MAIL IS PREFERRED BUT NOT REQUIRED. FOR ADDITIONAL SUBMITTAL INSTRUCTIONS, SEE THE LAST PAGE.**

## **Papahānaumokuākea Marine National Monument Permit Application Cover Sheet**

This Permit Application Cover Sheet is intended to provide summary information and status to the public on permit applications for activities proposed to be conducted in the Papahānaumokuākea Marine National Monument. While a permit application has been received, it has not been fully reviewed nor approved by the Monument Management Board to date. The Monument permit process also ensures that all environmental reviews are conducted prior to the issuance of a Monument permit.

### **Summary Information**

**Applicant Name:** Megan Donahue

**Affiliation:** Hawaii Institute of Marine Biology

**Permit Category:** Research

**Proposed Activity Dates:** 06/01/12-11/15/12

**Proposed Method of Entry (Vessel/Plane):** R/V Hi'ialakai

**Proposed Locations:** Shallow water reef (<100 ft depth) focused on bioeroder communities in forereef and lagoon habitats. Specific locations for the study will depend on cruise logistics but will include forereef sites at FFS, LIS, PHR, and KUR and lagoon sites at MID.

**Estimated number of individuals (including Applicant) to be covered under this permit:**

4

**Estimated number of days in the Monument:** 50

**Description of proposed activities:** (complete these sentences):

a.) The proposed activity would...

measure bioerosion rates and bioeroder community composition on reefs in the NWHI to evaluate whether internal bioeroders can serve as indicators of community response to ocean acidification on coral reefs. Taking advantage of variation in pH at large and small spatial scales, we will test whether the total bioerosion rate and/or the community composition of internal bioeroders responds to natural spatial variation in pH or other environmental drivers along the Archipelago. Bioerosion rates will be measured using microCT scans of coral blocks to get a 3D image of the eroded material; this method gives a better estimate of bioerosion rate than the traditional buoyant weight technique and allows characterization of distinct bioeroder groups. Community composition will be measured using a ReefChip, a molecular microarray that will be customized to detect and quantify the bioeroder community. If effective, this method would be an efficient and inexpensive way to detect community level effects of ocean acidification in remote areas.

b.) To accomplish this activity we would ....

(i) measure bioerosion rates by installing small calcium carbonate blocks (5x5x2cm) on reef substrate at each site. Five calcium carbonate blocks were deployed at 15 forereef sites (5 sites each at FFS, LIS, PHR) and 20 blocks were deployed at one lagoon site (MID) during the July-August 2011 cruise to the PMNM (a site is a 20m x 20m area of reef). If cruise logistics allow, we will deploy additional blocks this year at 5 forereef sites at Kure. These blocks act as a settling substrate for bioeroding organisms. Prior to deployment, each block is scanned by microCT (to create a 3D image of the block) and autoclaved. On the upcoming cruise, we will retrieve these calcium carbonate blocks, rescan with microCT, calculate bioerosion rates, and assess the bioeroder community composition at each site. At each forereef site, blocks were attached to calcification acidification units (CAUs) previously deployed by NOAA's Coral Reef Ecosystem Division (CRED). At the lagoon site, blocks were affixed to dead reef substrate.

(ii) measure variation in the natural occurring bioeroder community. On the 2011 cruise to the PMNM, we collected 10 small pieces (5x5x5cm) of dead coral skeleton at each of 16 sites (5 sites on FFS, 5 sites on LIS, 5 sites on PHR, and 1 site on MID). These pieces of reef substrate have been reserved for identification using molecular approaches (the ReefChip microarray). This year, we are requesting permission to take additional samples for traditional taxonomic identification; these additional samples are critical for providing vouchered taxonomic specimens to associate with the molecular sequences we find in our samples from 2011 and put on the ReefChip microarray. To get adequate taxonomic coverage across the Archipelago, we request permission to take up to 10 additional samples (5x5x5cm) at each of the 16 sites from the 2011 cruise; in addition, we request permission to take up to 20 samples from each of five new sites on Kure.

(iii) relate bioerosion rates to environmental data collected by NOAA CRED (including, pH, nitrate, dissolved inorganic carbon, temperature, salinity, and chlorophyll)

c.) This activity would help the Monument by ...  
evaluating whether internal bioeroders can serve as indicators of community response to ocean acidification on coral reefs. The community structure and function of bioeroding organisms may have a major effect on coral reef resilience: the sponges, polychaete worms, and tiny mollusks that comprise bioeroder communities control the strength and complexity of the coral reef framework, which is the habitat for more charismatic coral reef organisms. Shifts in the composition and functioning of these out-of-sight, but fundamental members of coral reef ecosystems may change the accretion-erosion balance of coral reefs. The methods developed here will help managers anticipate the likely effects of ocean acidification on bioeroder communities and bioerosion rates. If effective, this method would be an inexpensive way to detect community level effects of ocean acidification in remote areas.

**Other information or background:** All forereef sites are co-located with NOAA-CRED permanent sites. This minimizes the impact to the reefs and facilitates sharing of information.

## **Section A - Applicant Information**

### **1. Applicant**

Name (last, first, middle initial): Donahue, Megan J.

Title: Assistant Researcher, Hawaii Institute of Marine Biology

**1a. Intended field Principal Investigator (See instructions for more information):**  
Nyssa Silbiger, graduate student

**2. Mailing address (street/P.O. box, city, state, country, zip):** Hawaii Institute of Marine Biology, [REDACTED]

Phone: [REDACTED]

Fax: [REDACTED]

Email: [REDACTED]

For students, major professor's name, telephone and email address:

**3. Affiliation (institution/agency/organization directly related to the proposed project):**  
Hawaii Institute of Marine Biology (HIMB), University of Hawaii at Manoa

**4. Additional persons to be covered by permit. List all personnel roles and names (if known at time of application) here (e.g. John Doe, Research Diver; Jane Doe, Field Technician):**

Megan Donahue, PI, research diver  
Nyssa Silbiger, Field PI, research diver  
Holly Bolick, research diver  
Scott Godwin, research diver  
Un-named Individual, research diver

**Section B: Project Information**

**5a. Project location(s):**

<input checked="" type="checkbox"/> Nihoa Island	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Necker Island (Mokumanamana)	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> French Frigate Shoals	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Gardner Pinnacles	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Maro Reef			
<input checked="" type="checkbox"/> Laysan Island	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Lisianski Island, Neva Shoal	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Pearl and Hermes Atoll	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Midway Atoll	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Kure Atoll	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input type="checkbox"/> Other			

**Ocean Based**

NOTE: There is a fee schedule for people visiting Midway Atoll National Wildlife Refuge via vessel and aircraft.

Location Description:

Specific locations for the study will depend on cruise logistics, but out target sites are:

Island/Atoll	Site Name	Latitude	Longitude
French Frigate Shoals	FFS-34	23.62792	-166.13538
French Frigate Shoals	FFS-12	23.63835	-166.18005
French Frigate Shoals	FFS-H6	23.88046	-166.27306
French Frigate Shoals	FFS-21	23.84695	-166.32695
French Frigate Shoals	FFS-33	23.83651	-166.26669
Midway Atoll	MID-H11A	28.217667	-177.403217
Midway Atoll	MID-H11B	28.2175	-177.40305
Pearl and Hermes Atoll	PHR-39	27.94045941	-175.8613056
Pearl and Hermes Atoll	PHR-44	27.91026	-175.90483
Pearl and Hermes Atoll	PHR-42	27.75312882	-175.9489414
Pearl and Hermes Atoll	PHR-R26	27.78583	-175.78028
Pearl and Hermes Atoll	PHR-R33	27.78546679	-175.82355
Lisianski Island Marine Area	LIS-09	25.9580487	-173.8823619
Lisianski Island Marine Area	LIS-R10	25.94461746	-173.9536197
Lisianski Island Marine Area	LIS-18	26.00425931	-173.99409
Lisianski Island Marine Area	LIS-R14	26.07838458	-173.9970317
Lisianski Island Marine Area	LIS-R9	26.03954921	-174.0124643
Kure Atoll	KUR-12	28.382308	-178.324479
Kure Atoll	KUR-33	28.416767	-178.378433
Kure Atoll	KUR-02	28.453633	-178.344017
Kure Atoll	KUR-04	28.426650	-178.285870
Kure Atoll	KUR-06	28.386780	-178.347920

However, cruise logistics will influence the specific locations for our study, so I have listed all possible sites below. This ensures maximum flexibility due to weather or unforeseen changes to our cruise schedule. All activities will occur within the area outlined by the following coordinates.

Location:	Longitude	Latitude
Kure Atoll	-178.19706492000	28.55825235580
Kure Atoll	-178.19623585400	28.29958375730
Kure Atoll	-178.45987884800	28.29958375730
Kure Atoll	-178.46070791400	28.55742328970
Midway Atoll	-177.19638223300	28.37419969920
Midway Atoll	-177.19721129900	28.13377055310
Midway Atoll	-177.52800864100	28.13459961920
Midway Atoll	-177.52800864100	28.37419969920
Pearl and Hermes Atoll	-176.08850981800	28.04643025580
Pearl and Hermes Atoll	-175.63289162600	28.04539944540
Pearl and Hermes Atoll	-175.63289162600	27.70729363750
Pearl and Hermes Atoll	-176.08954062900	27.70626282710
Lisianski Island	-173.67292570900	26.25150771120
Lisianski Island	-173.67292570900	25.83942708400
Lisianski Island	-174.23095155800	25.83942708400
Lisianski Island	-174.23095155800	26.25150771120
Laysan Island	-171.47900122300	25.96027179830
Laysan Island	-171.47725234300	25.65596666490
Laysan Island	-171.97918092500	25.65771554490
Laysan Island	-171.97918092500	25.96202067840
Maro Reef	-170.18133220600	25.69968866680
Maro Reef	-170.17958332600	25.21524888540
Maro Reef	-171.00505472200	25.21524888540
Maro Reef	-171.00505472200	25.69968866680
Gardner Pinnacles	-167.74832319300	25.26070709440
Gardner Pinnacles	-167.75087047400	24.34878019150
Gardner Pinnacles	-168.36221811900	24.35132747340
Gardner Pinnacles	-168.36476540100	25.26070709440
French Frigate Shoals	-165.93465851400	23.94630965900
French Frigate Shoals	-165.93465851400	23.56421738120
French Frigate Shoals	-166.45685129400	23.56421738120
French Frigate Shoals	-166.45685129400	23.94630965900

**5b. Check all applicable regulated activities proposed to be conducted in the Monument:**

Removing, moving, taking, harvesting, possessing, injuring, disturbing, or damaging any living or nonliving Monument resource

- Drilling into, dredging, or otherwise altering the submerged lands other than by anchoring a vessel; or constructing, placing, or abandoning any structure, material, or other matter on the submerged lands
- Anchoring a vessel
- Deserting a vessel aground, at anchor, or adrift
- Discharging or depositing any material or matter into the Monument
- Touching coral, living or dead
- Possessing fishing gear except when stowed and not available for immediate use during passage without interruption through the Monument
- Attracting any living Monument resource
- Sustenance fishing (Federal waters only, outside of Special Preservation Areas, Ecological Reserves and Special Management Areas)
- Subsistence fishing (State waters only)
- Swimming, snorkeling, or closed or open circuit SCUBA diving within any Special Preservation Area or Midway Atoll Special Management Area

**6 Purpose/Need/Scope *State purpose of proposed activities:***

Bioerosion, the removal of CaCO<sub>3</sub> reef structure by biological agents (Neumann 1966), is a natural process that influences the mechanical stability, structural complexity, and net accretion rate of coral reefs. Extensive bioerosion can compromise the mechanical stability and structural complexity of reefs, thereby increasing susceptibility to storm damage (Hutchings 1986) and decreasing habitat availability for other reef organisms (Hoegh-Guldberg et al. 2007), and organisms that rely on emergent land, including Hawaiian monk seals, sea turtles, and sea birds. Bioeroders may be classified into three functional groups: microborers (e.g., euendoliths), macroborers (e.g., sponges, polychaetes, and bivalves), and grazers (e.g., urchins and fish). Micro- and macroborers erode the interior of reef substrate and are typically more abundant in dead coral substrate than live coral (Highsmith 1981). In the PMNM, micro- and macro-borers communities have remained largely unstudied and, although grazer density has been estimated on a few reefs, erosion rates due to bioeroders of any group have never been measured directly.

The community of bioeroders are a good target for detecting community changes in response to ocean acidification: (i) bioerosion is integral to long-term reef sustainability (Grigg 1982), (ii) bioerosion rates are sensitive to pH (Tribollet et al 2009), (iii) bioeroder community composition may shift in response to changes in pH, and (iv) applying new technologies will allow the efficient measurement of bioerosion rates and community composition that is critical for managers. The effective use of bioerosion rates as a monitoring and management tool requires distinguishing the effects of ocean acidification from other environmental parameters; this is the challenge that motivates this project.

Anthropogenic climate change is an environmental threat that challenges conventional management solutions. The 38 Gt of anthropogenic carbon dioxide (CO<sub>2</sub>) emitted each year has resulted in the highest concentrations of atmospheric CO<sub>2</sub> in the last 740,000 years (Petit et al 1999), resulting in increased sea-surface temperature, sea-level rise, and alteration of the carbon cycle in our oceans (IPCC 2007). In Hawai'i, the Hawai'i Ocean Timeseries has detected a 0.075 decrease in mean annual pH at Station Aloha over the past 20 years (Doney et al 2009); globally, a further decrease of 0.14-0.35 pH units is predicted for the 21st century (IPCC 2007). Despite these predictions, the effects of ocean acidification on coral reef communities are unknown and unregistered because we lack effective monitoring tools.

Available predictions of pH in the coastal zones (Orr et al 2005, IPCC 2007) are based on models of open ocean values. Applying these predictions to coral reef ecosystems is complicated by new data highlighting the temporal and spatial variability of pH in coastal waters (Gagliano et al 2010). These new studies show substantial small scale variation in pH within and between reef habitats, including a range of natural variation that can be as large as predicted changes in ocean acidification at the global scale (Gagliano et al 2010, K. Anthony, pers comm). For instance, recent work shows pH variation from 7.82 to 8.12 in the shallow waters of Kane'ohe Bay (Miles 2010). This is not unexpected: studies of reef metabolism



indicate that these differences in pH may be influenced by relative abundance of respiring and photosynthesizing organisms, flushing rate of the overlying water mass (and, therefore, the presence and thickness of boundary layers), and the history of the water mass. While this variation in pH complicates our predictions of coral reef response to ocean acidification, it also provides an opportunity to examine community-level responses to pH variation and, further, how communities may respond to future change.

In the proposed project, we take advantage of natural variation in the pH over small spatial scales in lagoonal reefs and at large scales over the Hawaiian Archipelago to examine how bioeroding communities may respond to ocean acidification and to test the effectiveness of using bioerosion rates and bioeroder communities as indicators of climate change in remote coral reef systems. We include forereef sites to decrease the within-site variation and examine Archipelago-wide patterns. Bioeroder community composition will be assessed using a combination of taxonomic and molecular techniques, including the ReefChip microarray, which is under development in Dr. Rob Toonen's laboratory. The ReefChip allows species-specific identification of organisms in a mixed environmental sample. Concomitant benefits of the project include accurate measurement of crustose coralline algal growth using microCT and tests for the presence of undetected alien species in the NWHI using the ReefChip technology.

The specific objectives identified for this project are:

- 1) Characterize variation in bioeroder community composition within reefs and across the Archipelago using ReefChip
  - a) Contribute sequences to ReefChip to customize it to the bioeroding community of the Hawaiian Archipelago
  - b) Using ReefChip, test for undetected alien species among bioeroders of the NWHI
- 2) Measure bioerosion rates using microCT technology
  - a) Compare CaCO<sub>3</sub> loss within and between reefs across the Archipelago
  - b) Measure CaCO<sub>3</sub> accretion by CCA
  - c) Use 3-dimensional reconstructions to associate specific patterns of erosion with specific taxa
- 3) Evaluate the relationship between pH, bioerosion rate, and bioeroder community composition

**7. Answer the Findings below by providing information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Monument:**

The Findings are as follows:

- a. How can the activity be conducted with adequate safeguards for the cultural, natural and historic resources and ecological integrity of the Monument?

We are a team of conservation biologists, teaching and studying the science of how best to manage and conserve the ecological integrity of marine ecosystems. Therefore, minimizing our impact to the ecosystem we are trying to conserve is a natural and inherent part of any research we conduct within the Monument. It is my goal to inculcate in students and trainees that work with me a respect for the resources that we study. This respect requires that we carefully consider the impact of our study design, that our study design is robust and will produce useful results, and that our work is disseminated to scientists and managers to improve the conservation efforts in these systems. In developing our research methods, we have taken care to minimize any potential negative impacts to the system as outlined in the methods section below. We believe that we have implemented every reasonable safeguard for the natural resources and ecological integrity of the Monument in our research, and we do not expect any detectable impact from our research sampling. As outlined in detail below, our sample size and methodologies have all been selected to provide robust and scientifically rigorous information to managers with the least possible impact to the natural resources of the Monument.

Our work will not impact historic resources: we do not set foot on land within the Monument, and we report but do not touch any submerged artifacts discovered during our diving activities.

As in previous years, each participant is required to participate in a Cultural Briefing prior to departure on the Hi'ialakai. Each member of my team is aware of the unique ecological status of the Monument, and this briefing reminds all team members of the cultural significance of the place. However, this separation of natural, cultural, and historic resources is itself a western construct. Stewardship of natural resources is a central theme in the relationship that Hawaiians have with the natural world and, thus, there is no difference between a natural and cultural resource.

Papahānaumokuākea is a sacred place to native Hawaiians; a place that is included in the oral history of chants and mele; a place where native Hawaiians have travelled for hundreds of years. We strive to approach our work in the Monument with the same humility, wonder, and regard for the natural world as these travelers. We intend that our research in the Monument will give a strong foundation to stewardship practices that best manage and protect the coral reefs ecosystems of Papahānaumokuākea. Native Hawaiians learned when and where important food fish were spawning and, understanding their potential impact on fish populations, protected these times and areas. In a similar way, we will be learning about the bioeroding communities of the Monument and trying to understand and mitigate the impacts of anthropogenic climate change

b. How will the activity be conducted in a manner compatible with the management direction of this proclamation, considering the extent to which the conduct of the activity may diminish or enhance Monument cultural, natural and historic resources, qualities, and ecological integrity, any indirect, secondary, or cumulative effects of the activity, and the duration of such effects?

The research we propose here is the type of research directly mandated by the Proclamation: it is “research designed to further understanding of monument resources and qualities... [and] will assist in the conservation and management of the monument”. The research we propose is necessary to both maintain ecosystem integrity and provide for adaptive ecosystem management

in the face global climate change. As outlined above and below, our activities have no detectable effect to diminish Monument resources, nor have any known indirect, secondary or cumulative effects on the ecosystem or resources therein. Because of concerns about cumulative impacts, a threat assessment of the activities in the Monument have been conducted (Selkoe et al. 2008), and a compiled cumulative impact threat map of the Monument (Selkoe et al. 2009) has been provided to the co-trustees for use in future management decisions.

Our proposed activities are minimally invasive. On forereefs, coral blocks were attached to permanent transect stakes and CAUs (artificial units that measure accretion rates) with cable ties that were previously installed by NOAA's Coral Reef Ecosystem Division (CRED). On lagoon reefs, coral blocks were attached to dead substrate with marine epoxy, carefully avoiding live coral. These blocks were deployed on the July-August, 2011 NOAA cruise to the PMNM. This year, we will retrieve the blocks deployed last year and, if cruise logistics permit, deploy blocks at five forereef sites at Kure, where we were unable to deploy last year. The small samples of dead coral skeleton (5x5x5cm) that we plan to collect from reefs are a tiny fraction of the reef substrate removed naturally by external bioeroders (e.g., urchins, parrotfish). Negative impacts on the reefs, atoll, and Monument are exceedingly small, while the positive impacts of the results of our research are Monument-wide.

Our overriding goal is to provide scientific information to managers so that the Papahānaumokuākea Marine National Monument can be managed and protected based on policy grounded in sound science. Our divers are experienced in moving in and around coral and coral reefs so as to not cause damage. Each diver has been through intensive dive training and is a certified scientific diver with the American Association of Underwater Scientists. We are conducting these activities already in Kaneohe Bay, allowing us to hone our methods to minimize impacts on the Monument.

c. Is there a practicable alternative to conducting the activity within the Monument? If not, explain why your activities must be conducted in the Monument.

There are no alternatives to conducting this activity within the monument. Our research is aimed at understanding how bioerosion processes shift along the Hawaiian Archipelago. There is no practicable alternative to doing this in the Monument because it is the reefs in the Monument that will need to be managed. For example, the same information from reefs in the main Hawaiian Islands is interesting – indeed, we are pursuing a similar study in Kaneohe Bay-- but there is no basis upon which to say that the reefs in the Monument are like the Main Hawaiian Island reefs. In fact, we know they are not the same -- Kaneohe Bay has many introduced species that are not present in the Monument, and a concomitant benefit of our study is understanding the potential impacts of these introduced species.

d. How does the end value of the activity outweigh its adverse impacts on Monument cultural, natural and historic resources, qualities, and ecological integrity?

We anticipate truly negligible impact of our study on the resources of the Monument and, therefore, believe that the end value of this research clearly outweighs that imperceptible impact. Further, an understanding of bioerosion rates across this region will greatly increase the decision

making capacity of the co-trustees in dealing with the potential impacts of global climate change within the Monument

e. Explain how the duration of the activity is no longer than necessary to achieve its stated purpose.

It is anticipated that retrieving the coral blocks, collecting pieces of dead coral skeleton, and collecting associated data will take 2-3 days per atoll with 2-4 divers. We are proposing to study 5 forereef sites at each of 3-4 atolls (retrieval at FFS, LIS, PHR; deployment at KUR) and one lagoon site at Midway Atoll. Given preliminary cruise itineraries, we will need to participate on two cruises to retrieve currently deployed blocks. As such, the estimated number of days in the monument (50 days) is necessary to accomplish the research goals outlined in this permit application.

f. Provide information demonstrating that you are qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.

I have been an AAUS certified scuba diver and NAUI instructor for 18 years. I have used diving for research and trained others to dive on projects in the Gulf of Maine, California, and Hawaii, including research in other protected areas like the Channel Islands National Park. I have a PhD in Ecology from the University of California, Davis and have publications on marine ecology and spatial population dynamics relevant to this study. This is my second permit application for work in the Monument. I was privileged to enter the Monument on the July-August, 2011 cruise to deploy calcium carbonate blocks for the project outlined in this application and on the May 2010 cruise to support other projects, including Scott Godwin's (PMNM) surveys of invasive species and Rob Toonen's connectivity sampling. My experience on previous cruises has been excellent preparation for the study proposed here.

The field PI for the July cruise (anticipating collection at PHR, LIS, FFS, and deployment at KUR) is Nyssa Silbiger. She was a field PI on the July-August 2011 cruise and also assisted Derek Smith on the May 2010 cruise. Nyssa is a graduate student in my laboratory and an experienced coral reef diver; her masters research was performed at Aquarius, an underwater ocean laboratory located in the Florida Keys National Marine Sanctuary.

The field PI for the June cruise (anticipating collection at MID) is Scott Godwin. Scott serves as Resource Protection Specialist for PMNM and has been chief scientist on multiple cruises to PMNM.

g. Provide information demonstrating that you have adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct. The project proposed here is a collaboration between the Donahue (sampling of bioeroders) and Toonen (ReefChip) laboratories at the Hawaii Institute of Marine Biology, and NOAA CRED (site coordination and environmental data). We anticipate funding through Hawaii SeaGrant for this project: we have been notified of our inclusion in the 2012-2014 Hawaii SeaGrant omnibus to support this work. In addition, there are adequate finances in the Donahue lab and through the PMNM-HIMB partnership to conduct and complete all the research outlined

herein. This research is currently or has been previously funded by a combination of the NWHI PMNM-HIMB partnership, the University of Hawaii, and NSF.

h. Explain how your methods and procedures are appropriate to achieve the proposed activity's goals in relation to their impacts to Monument cultural, natural and historic resources, qualities, and ecological integrity.

Our choice of sites will be guided by the vessel and Monument staff while aboard the NOAA vessel Hi'ialakai. We generally avoid any sites that are identified as culturally significant, and focus our activities in regions that maximize the safety of the crew while ensuring that the proposed work will be completed. The questions we are addressing are central to understanding reef erosion processes and the Monument's response to global climate change. Any negative impacts of our study are minimal and temporary and should not alter the Monument's cultural, natural and historic resources, qualities or ecological integrity. The positive impacts of our study will help guide appropriate stewardship practices to preserve and manage the qualities and integrity of the Monument's cultural and natural and historic resources. Our data is necessary to provide a strong scientific understanding of coral reef ecosystem processes by which proper management protocols can be designed. These data also are invaluable in providing a baseline with which to monitor the success of management efforts.

i. Has your vessel has been outfitted with a mobile transceiver unit approved by OLE and complies with the requirements of Presidential Proclamation 8031?

We will be on board NOAA vessel Hi'ialakai

j. Demonstrate that there are no other factors that would make the issuance of a permit for the activity inappropriate.

In 2011, Donahue held a permit for similar research activities in the Monument and demonstrated compliance with all permit and reporting requirements.

### **8. Procedures/Methods:**

There are two aspects to the study (i) characterizing the bioeroding community in dead coral substrate (ReefChip) and (ii) measuring bioerosion rates using experimental coral blocks (microCT). Each aspect of the study leverages cutting edge technology to rapidly advance our understanding of bioerosion on reefs and accelerate the development of effective tools for managers.

For the overall study, we expect to spend 1 day the Midway lagoon site and a half-day at each of 20 forereef sites (FFS, LIS, PHR, KUR), depending on cruise logistics. Below we describe the sampling methodology for each of these sites.

#### **SAMPLING**

On the 2011 cruise to the PMNM, we collected 10 small pieces (5x5x5cm) of dead coral skeleton at each of 15 sites (5 sites on FFS, 5 sites on LIS, 5 sites on PHR), and 20 small pieces at 1 site on MID. These pieces of reef substrate have been preserved and will be used for

identification using molecular approaches (the ReefChip microarray). This year, we are requesting permission to take additional samples for traditional taxonomic identification; these additional samples are critical for providing vouchered taxonomic specimens to associate with the molecular sequences we find in the 2011 samples and put on the ReefChip microarray. To get adequate taxonomic coverage across the Archipelago, we request permission to take up to 10 additional samples (5x5x5cm) at each of the 16 sites from the 2011 cruise; in addition, we request permission to take up to 20 samples from each of five new sites on Kure. For each Kure site, 10 of these samples will be preserved for identification using molecular approaches and up to 10 separate samples will be collected specifically for traditional taxonomic identification and vouchering. The maximum number of dead coral skeleton samples (5x5x5cm) proposed for the Monument in 2012:  $260 = 10 \times 16 \text{ sites (5 sites FFS, 5 sites PHR, 5 sites LIS, 1 site MID)} + 20 \times 5 \text{ sites (KUR)} = 0.0325 \text{ cubic meters.}$

For the taxonomic collections taken at all sites, these samples will be taken in seawater back to the ship. These samples of dead coral skeleton contain numerous epibiotic and bioeroding organisms. Shipboard, each sample will be placed in approximately 250 mL of seawater; a drop of clove oil (5% clove oil solution suspended in 95%EtOH, MSDS attached) will be added to the sample to evacuate the organisms from the coral skeleton. The sample will then be dyed with rose bengal (MSDS attached) and preserved. This process facilitates taxonomic preservation and identification. The samples will be stored in vials of >70% ethanol or saturated salt buffer at room temperature, given a unique sample number, and archived in a database. Upon return to HIMB, organisms will be carefully extracted from the coral skeleton. These organisms will be identified, vouchered, and sequenced in cooperation with Holly Bolick of the Bishop Museum, Scott Godwin of PMNM, and the laboratory of Rob Toonen at HIMB. For a small number of organisms, particularly sponges, we may need to send samples to other taxonomic experts for identification. As this need arises, we will contact the Monument to facilitate permissions for appropriate transfer of Monument material.

For the collections to be used for molecular sequencing (only at Kure in 2012), samples will be brought back to the ship and preserved in >70% ethanol. Upon return to HIMB, these samples will be crushed or dissolved in an acid solution to extract the bioeroding organisms from the coral skeleton and homogenized for analysis on the ReefChip (see below). All samples will be maintained in perpetuity and future permit requests for DNA sampling of species in the NWHI can be redirected to the existing tissue sample "museum" that will result from our collections.

#### COMMUNITY COMPOSITION USING REEF CHIP

The ReefChip is a specialized microarray composed of an array of short DNA fragments (25-35 nucleotides), each of which differentially binds to the DNA of a specific species, that are attached to a specially polished and chemically coated glass microscope slide in a process called "printing". Each unique DNA fragment, or probe, is placed in a specific position on the slide so that we can keep track of identity of the probes. Next, an environmental sample is collected (here, a piece of coral skeleton with its associated bioeroding community that has

been collected and homogenized) and the DNA of all species present is isolated and extracted from the sample. The extracted environmental DNA sample is broken into smaller fragments and fluorescent molecules are attached, thereby labeling the environmental DNA. The labeled, double-stranded environmental DNA is separated into single strands and hybridized to the DNA "capture" probes on the ReefChip, forming double stranded DNA where one strand is a capture probe and the other strand is the labeled environmental DNA. The excess labeled environmental DNA that did not match and, therefore, did not bind to the capture probes is washed away, leaving only the targeted environmental DNA that has been captured by the ReefChip. Finally, the ReefChip is dried and scanned at the wavelengths emitted by the fluorescent labels attached to the environmental DNA, producing an image of fluorescing (positive identification of a targeted species) and non-fluorescing spots (absence of a targeted species). Further, the intensity of the fluorescence of each spot can be used to estimate the quantity of the targeted species in the environmental sample.

ReefChip technology will allow us to detect, quantify, and compare species assemblages throughout the Hawaiian Archipelago at a scale beyond what would be possible using traditional taxonomic methods. This technology does not obviate the need for taxonomic expertise; like all barcoding approaches, individual specimens must be vouchered and identified to species so that a DNA sequence can be used to generate a species-specific probe. An important limitation of this technology is that it will not detect a species for which there is no species-specific probe. To manage this limitation, ReefChip also includes probes for higher taxonomic categories; e.g, a species-specific probe will detect only *Mycale armata* but the Demospongiae probe will detect any sponge in Class Demospongiae. This makes it possible to know when a taxonomic group is present that does not have a species-specific probe.

## BIOEROSION RATES

At each site 16 sites (5 at FFS, 5 at PHR, 5 at LIS, 1 at MID), we will retrieve previously installed calcium carbonate blocks (5x5x2cm). In addition, we will deploy 5 blocks at each of 5 sites at KUR. These blocks are attached to Calcification Acidification Units (CAUs), previously installed by NOAA Coral Reef Ecosystem Division (CRED), with cable-ties. CAUs are used by CRED to measure coral accretion rates and are composed of small pieces of rebar and a 5cm x 5cm piece of plastic. In 2011, a single block was attached to each CAU (there were 5 CAUs per site) at each of 15 forereef sites. At Midway, our lagoon site, we attached 20 blocks to non-living parts of the reef. These blocks were cut from dead *P. lobata* heads that wash up on exposed shores of the main Hawaiian islands. These blocks will act as settling substrate for bioeroders. Prior to deployment, calcium carbonate blocks were scanned using an eXplore CT120  $\mu$ CT scanner at Cornell University. Micro computer-aided tomography is a powerful technology for visualizing the internal structure of solid objects. The exceptional resolution of this technology allows for precise examination of coral skeletal density and the size, shape, and location of each bore hole in a given coral block. By performing pre- and post-deployment scans of the coral blocks, we can accurately measure of the amount of CaCO<sub>3</sub> removed to

calculate bioerosion rate, as well as any accretion of CaCO<sub>3</sub> by crustose coralline algae. Pre- and post-deployment scans will be aligned and subtracted to show the total volume of lost substrate and the size, shape, and location of excavation sites. The size, shape, and location of the excavation sites will be used to associate particular taxa with particular excavation types. Depending on the organism and the quality of preservation, organisms associated with particular excavation sites will be identified by morphology and/or DNA sequence. We will develop a model based on excavation characteristics that will predict the taxon associated with a particular excavation based on its location and dimensions. Finally, the entire block and all associated tissue will be homogenized and run on ReefChip to describe bioeroder community composition.

**NOTE: If land or marine archeological activities are involved, contact the Monument Permit Coordinator at the address on the general application form before proceeding, as a customized application will be needed. For more information, contact the Monument office on the first page of this application.**

**9a. Collection of specimens - collecting activities (would apply to any activity): organisms or objects (List of species, if applicable, attach additional sheets if necessary):**

Common name:

We will be collecting pieces of dead Porites spp. skeleton. Dead coral skeleton harbors a diverse community of bioeroding organisms that has not been systematically targeted for study previously in the PMNM. One of the goals of this project is to more thoroughly document the composition of the bioeroding community in the PMNM. Based on studies in the MHI and previous work of the Census of Marine Life, we anticipate a wide variety of sponges and marine worms, as well as hydrozoans, bryozoans, barnacles, tiny mollusks, and turf algae. We expect a subset of these organisms will settle on our deployed blocks of calcium carbonate. Although we cannot give a specific list of the numbers of individual species we will find in samples, we have attached an excel sheet with a list of bioeroders and other organisms that commonly settle on coral skeleton in Kaneohe Bay, Oahu (based on White 1980 and our own observations).

Scientific name:

dead Porites spp skeleton

# & size of specimens:

up to 260 pieces, 5x5x5 cm each (total: 0.0325 cubic meters)

Collection location:

up to 10 pieces per site at 16 sites (5 sites on FFS, 5 sites on PHR, 5 sites on LIS, 1 site at MID);  
up to 20 pieces per site at 5 sites on KUR

Whole Organism  Partial Organism



**9b. What will be done with the specimens after the project has ended?**

Preserved samples remain the property of the Monument and will be made available to others requesting access to these materials through the appropriate permit process. PI Donahue will maintain a database of samples and provide for the storage of all samples collected at HIMB until they are consumed by the study or such time as the Monument co-trustees request that they be returned to them. Taxonomic voucher specimens will be submitted for permanent inclusion in the Bishop or Smithsonian museum collections as per the terms of material transfer agreement.

**9c. Will the organisms be kept alive after collection?**  Yes  No

• General site/location for collections:

• Is it an open or closed system?  Open  Closed

• Is there an outfall?  Yes  No

• Will these organisms be housed with other organisms? If so, what are the other organisms?

• Will organisms be released?

**10. If applicable, how will the collected samples or specimens be transported out of the Monument?**

Calcium carbonate blocks and samples of dead coral tissue will be preserved for taxonomic and genetic analyses (in ethanol or saturated salt buffer) and transported back to HIMB aboard the R/V Hi'ialakai. See attached MSDS sheets.

**11. Describe collaborative activities to share samples, reduce duplicative sampling, or duplicative research:**

All HIMB researchers working on similar species have coordinated to share samples and avoid duplicate sampling. This project reflects this coordination, as a joint effort between the Donahue and Toonen laboratories at HIMB, and NOAA CRED. HIMB and NOAA monument staff hold semiannual meeting and annual meetings with other agencies working in the monument so that research projects and resources available are widely known. To my knowledge, no other

systematic collections of internal bioeroders and measures of bioerosion rates have been made in the Monument.

Anticipated sharing of collections:

Samples of bioeroders in dead *Porites* spp. skeleton: We anticipate doing most of the sample processing at HIMB, including extracting bioeroding organisms from the samples, most morphological inspection, DNA extraction, and running on the ReefChip microarray. DNA extracted from some samples may be sent out for sequencing to facilities on UH Manoa main campus or off campus. We request permission to share samples with our collaborator, Holly Bolick, at the Bishop Museum, who will be working with us on taxonomic identification (contact information below). For some number of organisms, we may need to send samples to taxonomic experts outside of Hawaii for identification. Taxonomic specialists are few and far between; therefore, we request the flexibility to share specimens with the appropriate specialists to help identify difficult taxa that we cannot identify on our own. These taxonomic specialists are listed below.

Holly Bolick  
Collections Manager- IZ  
Bishop Museum



Barbara Calcinaï  
Dipartimento di Scienze del Mare  
Universita Politecnica delle Marche



Dale R. Calder  
Department of Natural History  
Royal Ontario Museum



Rolando Bastida Zavala  
Universidad del Mar LABSIM



Leslie Harris, Collections Manager  
Research & Collections

Natural History Museum of Los Angeles County



Daphne Fautin  
Haworth Hall



Kevin J. Tilbrook  
Museum of Tropical Queensland  
Queensland Museum



Roger J. Cuffey  
Dept. of Paleontology  
Pennsylvania State University



**12a. List all specialized gear and materials to be used in this activity:**

- Divers will use standard open-circuit SCUBA and snorkling equipment.
- We will retrieve calcium carbonate blocks by cutting cable-ties with clippers or a dive knife
- On the ship, samples of dead coral skeleton and calcium carbonate blocks will be placed in plastic containers filled with ethyl alcohol or salt-saturated dimethyl sulfate and dyed with rose bengal.

**12b. List all Hazardous Materials you propose to take to and use within the Monument:**

Tissue preservative solutions for DNA analyses include: 95% ethanol (EtOH) and saturated salt buffer with dimethylsulfoxide (DMSO). Shipboard, clove oil (5% solution suspended in 95% ethanol) is added to taxonomic samples before preservation. Rose bengal is also added to taxonomic samples shipboard at the time of preservation. MSDS sheets are attached.

**13. Describe any fixed installations and instrumentation proposed to be set in the Monument:**

In 2011, a total of 95 calcium carbonate blocks were attached to either CAUs or bare rock with cable-ties and marine epoxy, respectively. In 2012, we will remove every block deployed in 2011. If the cruise schedule permits, we will also deploy 25 blocks at Kure Atoll to existing NOAA-CRED CAU sites identical to the 2011 deployment.

**14. Provide a time line for sample analysis, data analysis, write-up and publication of information:**

Analysis of bioeroders in the pieces of dead coral skeleton will take up to a year, as it requires dissolution of the calcium carbonate, vouchering of specimens, DNA extraction and sequencing, and running the entire sample on the ReefChip. We anticipate that extraction of organisms, vouchering of specimens, and DNA extraction and sequencing will take place within one year of returning from the cruise, followed by ReefChip microarray analysis of dead coral skeleton samples. Once the calcium carbonate blocks are retrieved in August, 2012, we will immediately send them to the microCT laboratory at Cornell University to be scanned. Upon return, these coral blocks will be homogenized and run on the ReefChip microarray to identify organisms. The analysis of bioeroder communities in environmental samples of dead coral skeleton will be completed and submitted for publication within two years of the cruise. Analysis of bioerosion rates along the Archipelago and analysis of bioeroder community composition will be completed within 1-2 years of this cruise. Regardless of the time to publication, the results from these studies are made available to Monument managers as quickly as possible through the brown-bag luncheons, semi-annual reports, and semi-annual mini symposium during which all researchers involved in this project present the most current findings from their ongoing research to the broader management community. We also reach the NGO community and general public each year with presentations at the Hawaii Conservation Conference, Hanauma Bay seminar series, and other education and outreach venues. In sum, these efforts ensure that research results are provided to the Monument co-trustees almost as quickly as they become available, and made available to the greater management community within no more than 6 months of the data being collected.

**15. List all Applicants' publications directly related to the proposed project:**

This is a new project, and we do not yet have published results. Please see the attached CVs for other publications that are not directly related to the project.

With knowledge of the penalties for false or incomplete statements, as provided by 18 U.S.C. 1001, and for perjury, as provided by 18 U.S.C. 1621, I hereby certify to the best of my abilities under penalty of perjury of that the information I have provided on this application form is true and correct. I agree that the Co-Trustees may post this application in its entirety on the Internet. I understand that the Co-Trustees will consider deleting all information that I have identified as “confidential” prior to posting the application.

---

Signature

Date

**SEND ONE SIGNED APPLICATION VIA MAIL TO THE MONUMENT OFFICE BELOW:**

Papahānaumokuākea Marine National Monument Permit Coordinator  
6600 Kalaniana'ole Hwy. # 300  
Honolulu, HI 96825  
FAX: (808) 397-2662

**DID YOU INCLUDE THESE?**

- Applicant CV/Resume/Biography
- Intended field Principal Investigator CV/Resume/Biography
- Electronic and Hard Copy of Application with Signature
- Statement of information you wish to be kept confidential
- Material Safety Data Sheets for Hazardous Materials

## Papahānaumokuākea Marine National Monument Compliance Information Sheet

**1. Updated list of personnel to be covered by permit. List all personnel names and their roles here (e.g. John Doe, Diver; Jane Doe, Field Technician, Jerry Doe, Medical Assistant):**

Scott Godwin, Field PI, Diver  
 Holly Bollick, Diver  
 Oscar Guayadol i Roig, Diver

**2. Specific Site Location(s): (Attach copies of specific collection locations):**

Island/Atoll	Site Name	Latitude	Longitude
French Frigate Shoals	FFS-34	23.62792	-166.13538
French Frigate Shoals	FFS-12	23.63835	-166.18005
French Frigate Shoals	FFS-H6	23.88046	-166.27306
French Frigate Shoals	FFS-21	23.84695	-166.32695
French Frigate Shoals	FFS-33	23.83651	-166.26669
Midway Atoll	MID-H11A	28.217667	-177.403217
Pearl and Hermes Atoll	PHR-39	27.94045941	-175.8613056
Pearl and Hermes Atoll	PHR-44	27.91026	-175.90483
Pearl and Hermes Atoll	PHR-42	27.75312882	-175.9489414
Pearl and Hermes Atoll	PHR-R26	27.78583	-175.78028
Pearl and Hermes Atoll	PHR-R33	27.78546679	-175.82355
Lisianski Island Marine Area	LIS-09	25.9580487	-173.8823619
Lisianski Island Marine Area	LIS-R10	25.94461746	-173.9536197
Lisianski Island Marine Area	LIS-18	26.00425931	-173.99409
Lisianski Island Marine Area	LIS-R14	26.07838458	-173.9970317
Lisianski Island Marine Area	LIS-R9	26.03954921	-174.0124643

**3. Other permits (list and attach documentation of all other related Federal or State permits):** PMNM-2011-032, SAP-2012-61-Silbiger

**3a. For each of the permits listed, identify any permit violations or any permit that was suspended, amended, modified or revoked for cause. Explain the circumstances surrounding the violation or permit suspension, amendment, modification or revocation.**

PMNM-2011-032 was amended to PMNM-2011-032-M1 for the following changes: (i) amended to reflect a change in 2011 cruise logistics that required taking fewer samples (10 samples/site at 16 sites) in more locations, rather than more samples in fewer locations (20 samples/site at 8-10 sites); the total amount of collection (200 samples) was unchanged; (ii) amended to allow sharing of sea water samples with Dr's Winn and Kahng on permit PMNM-2011-0221 to limit duplicative field work.

We have just received per SAP-2012-61-Silbiger to perform and analogous experiment (deploy bioerosion blocks and collect bioeroder samples) in the MHI; there have been no violations or modifications to that permit.

**4. Funding sources (Attach copies of your budget, specific to proposed activities under this permit and include funding sources. See instructions for more information):** please see attached

**5. Time frame:**

Activity start: July 23, 2011

Activity completion: Jan 31, 2014

Dates actively inside the Monument:

From: July 5, 2012

To: July 25, 2012

Describe any limiting factors in declaring specific dates of the proposed activity at the time of application:

The currently scheduled dates for the 2012 Maritime Heritage cruise are July 5-25, 2012 aboard the R/V Hi'ialakai, but these are subject to change at NOAA's discretion. The Activity Completion Date is based on the end of our SeaGrant funding, but if this grant has a no-cost extension, the activity dates may be extended.

Personnel schedule in the Monument: Godwin, Bollick, and Guoyadol i Roig will be in the monument aboard the Maritime Heritage cruise, currently scheduled for July 5-25, 2012.

**6. Indicate (with attached documentation) what insurance policies, bonding coverage, and/or financial resources are in place to pay for or reimburse the Monument trustees for the necessary search and rescue, evacuation, and/or removal of any or all persons covered by the permit from the Monument:**

All divers are requested to carry DAN insurance in addition to UH workers compensation that will cover any diving related injury or an accident that occurs while on a diving research cruise.

**7. Check the appropriate box to indicate how personnel will enter the Monument:**

NOAA R/V Hi'ialakai Vessel

Aircraft

Provide Vessel and Aircraft information: NOAA R/V Hi'ialakai

**8. The certifications/inspections (below) must be completed prior to departure for vessels (and associated tenders) entering the Monument. Fill in scheduled date (attach documentation):**

- Rodent free, Date:
- Tender vessel, Date:
- Ballast water, Date:
- Gear/equipment, Date:
- Hull inspection, Date:

**9. Vessel information (NOTE: if you are traveling aboard a National Oceanic and Atmospheric Administration vessel, skip this question):**

Vessel name:

Vessel owner:

Captain's name:

IMO#:

Vessel ID#:

Flag:

Vessel type:

Call sign:

Embarkation port:

Last port vessel will have been at prior to this embarkation:

Length:

Gross tonnage:

Total ballast water capacity volume (m3):

Total number of ballast water tanks on ship:

Total fuel capacity:

Total number of fuel tanks on ship:

Marine Sanitation Device:

Type:

Explain in detail how you will comply with the regulations regarding discharge in the Monument. Describe in detail. If applicable, attach schematics of the vessel's discharge and treatment systems:

Other fuel/hazardous materials to be carried on board and amounts:

Provide proof of a National Oceanic and Atmospheric Administration (NOAA) Office of Law Enforcement-approved Vessel Monitoring System (VMS). Provide the name and



contact information of the contractor responsible for installing the VMS system. Also describe VMS unit name and type:

VMS Email:  
Inmarsat ID#:

\* Individuals MUST ENSURE that a type-approved VMS unit is installed and that its automatic position reports are being properly received by the NOAA OLE system prior to the issuance of a permit. To make sure your VMS is properly configured for the NOAA OLE system, please contact NOAA OLE at (808) 203-2503 or (808) 203-2500.

\* PERMITS WILL NOT BE ISSUED TO INDIVIDUALS ENTERING THE MONUMENT VIA VESSEL UNTIL NOAA OLE HAS CONTACTED THE MONUMENT PERMIT COORDINATOR WITH A 'POSITIVE CHECK' READING.

#### **10. Tender information:**

On what workboats (tenders) will personnel, gear and materials be transported within the Monument? List the number of tenders/skiffs aboard and specific types of motors:

### **Additional Information for Land Based Operations**

**11. Proposed movement of personnel, gear, materials, and, if applicable, samples:**

**12. Room and board requirements on island:**

**13. Work space needs:**

DID YOU INCLUDE THESE?

- Map(s) or GPS point(s) of Project Location(s), if applicable
- Funding Proposal(s)
- Funding and Award Documentation, if already received
- Documentation of Insurance, if already received
- Documentation of Inspections
- Documentation of all required Federal and State Permits or applications for permits

## Papahānaumokuākea Marine National Monument Compliance Information Sheet

**1. Updated list of personnel to be covered by permit. List all personnel names and their roles here (e.g. John Doe, Diver; Jane Doe, Field Technician, Jerry Doe, Medical Assistant):**

Nyssa Silbiger, Field PI, Diver  
 TBN, Diver  
 TBN, Diver

**2. Specific Site Location(s): (Attach copies of specific collection locations):**

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**4. Funding sources (Attach copies of your budget, specific to proposed activities under this permit and include funding sources. See instructions for more information):** please see attached

**5. Time frame:**

Activity start: July 23, 2011

Activity completion: Jan 31, 2014

Dates actively inside the Monument:

From: Aug 1, 2012

To: Aug 24, 2012

Describe any limiting factors in declaring specific dates of the proposed activity at the time of application:

The currently scheduled dates for the 2012 RAMP cruise are Aug 1-25, 2012 aboard the R/V Hi'ialakai, but these are subject to change at NOAA's discretion. The Activity Completion Date is based on the end of our SeaGrant funding, but if this grant has a no-cost extension, the activity dates may be extended.

Personnel schedule in the Monument: Silbiger and one or two unnamed divers will be in the monument aboard the RAMP cruise, currently scheduled for Aug 1-24, 2012.

**6. Indicate (with attached documentation) what insurance policies, bonding coverage, and/or financial resources are in place to pay for or reimburse the Monument trustees for the necessary search and rescue, evacuation, and/or removal of any or all persons covered by the permit from the Monument:**

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NOAA R/V Hi'ialakai Vessel

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Captain's name:

IMO#:

Vessel ID#:

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Vessel type:

Call sign:

Embarkation port:

Last port vessel will have been at prior to this embarkation:

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Gross tonnage:

Total ballast water capacity volume (m3):

Total number of ballast water tanks on ship:

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Type:

Explain in detail how you will comply with the regulations regarding discharge in the Monument. Describe in detail. If applicable, attach schematics of the vessel's discharge and treatment systems:

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On what workboats (tenders) will personnel, gear and materials be transported within the Monument? List the number of tenders/skiffs aboard and specific types of motors:

### **Additional Information for Land Based Operations**

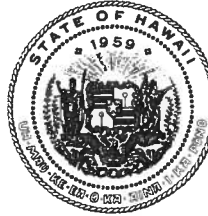
**11. Proposed movement of personnel, gear, materials, and, if applicable, samples:**

**12. Room and board requirements on island:**

**13. Work space needs:**

DID YOU INCLUDE THESE?

- Map(s) or GPS point(s) of Project Location(s), if applicable
- Funding Proposal(s)
- Funding and Award Documentation, if already received
- Documentation of Insurance, if already received
- Documentation of Inspections
- Documentation of all required Federal and State Permits or applications for permits



SPECIAL  
ACTIVITY  
PERMIT

SAP 2012-61

STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
HONOLULU, HAWAII 96813

Date Issued 4/20/12

Expires 4/19/13

SPECIAL ACTIVITY PERMIT

The Board of Land and Natural Resources (the Board) hereby grants permission for certain activities involving aquatic life belonging to the people of Hawai'i under the authority of Section 187A-6, Hawai'i Revised Statutes, and other applicable laws, to:

Permittee: Ms. Nyssa Silbiger  
Hawaii Institute of Marine Biology  
[Redacted]

This permit is issued, subject to the general and special conditions below, to take coral, subject to the other conditions of this permit. This permit allows the **TAKE, CATCH, POSSESS, or TRANSPORT** certain aquatic life from waters of the State, as follows below.

This permit, signed by the Department, authorizes the permittee, and only the designated assistants on the final page(s) of, or attachments to, this permit, to engage in activities otherwise prohibited by law, subject to the general and special conditions.

TYPES OF AQUATIC LIFE	SCIENTIFIC NAME	LIMITS (SEE SPECIAL CONDITIONS A, C & E)	GEAR	LOCATIONS
Coral and live rock	<i>Porites compressa</i> and <i>Porites lobata</i>	200, 2-in <sup>3</sup> dead pieces, along with Special Conditions A, C & E.	Hand only; along with Special Conditions D.	At specific sites on Oahu and Maui; as listed in Special Conditions



## PART I. GENERAL CONDITIONS

1. The permittee and each assistant will not make the Department or the State of Hawai'i liable in any way for any claim of personal injury or property damage which may result from activity authorized by this permit; the permittee and each assistant agree to hold the Department and State harmless against any and all claims of injury, death or damage resulting from actions or omissions under this permit.
2. This permit conveys a privilege to engage in **ONLY** those activities under the jurisdiction of the Department. The permittee and each assistant are responsible for complying with all applicable authorities County, State and Federal requirements. This permit does NOT convey any privilege of access over or through private property.
3. The permittee and each assistant is individually responsible and accountable for his or her actions while conducting activities authorized by this permit; the permittee is additionally responsible and accountable for the actions of each assistant.
4. Any person whose name does not appear on this permit and is conducting any activity described herein is subject to prosecution for violation of State laws.
5. The permittee may request changes to the permit. Any such request to make changes to the permit must be made in writing and received by the Department at least forty-five days prior to the change. No change may be implemented without written approval from the Department. The addition of new assistants will require each individual to sign the Attachment page stating that they have read, understood, and agree to abide by all general and special permit conditions. Original signed versions of the Attachment page must be returned to the Department for validation; once approved, such persons are added to the permit.
6. This permit is neither transferable nor assignable to another person.
7. The permittee or assistant must carry a copy of this permit on location while conducting activities authorized by this permit. Upon request of an authorized representative of the Department, the permittee shall produce the original permit for inspection.
8. Authority granted by this permit **ends** on the expiration date (i.e. "Not Valid After") on the first page of this permit. Within **thirty (30) days** of the expiration date, or the cessation of activities covered under this permit (whichever comes first), the permittee agrees to **return the original permit** to the Division of Aquatic Resources (Division) **with a Final Report**. The Final Report shall include *all* collecting and other activities covered under this

permit, and other information if required, under the special conditions.

9. The permittee and assistants agree to provide access to data obtained under this permit upon request of the Division, to provide the Division one copy of each report prepared with such data and published for distribution, and to allow Department staff to inspect the organisms collected under this permit, and the premises where they are kept. This provision shall be valid for up to sixty (60) days beyond the expiration of the permit.
10. Violation of any condition of this permit by any person may be cause for immediate suspension of the permit, and may result in revocation of the permit. The person responsible for the violation (and the permittee) may be subject to penalty as provided by law; any violation may also be cause for denial of future permit applications.

**PART II. SPECIAL CONDITIONS**

**A. SUMMARY OF AUTHORIZATION:** This permit authorizes collecting and possessing dead stony coral and live rock, from O'ahu and Maui, subject to the other conditions of this permit. Any dead coral piece with organisms visibly attached, up to the amounts listed in table 1, would be live rock and authorized under this permit.

**B. LOCATIONS:** Collecting activities under this permit is limited to five sites off Oahu (Appendix 1) and five sites off Maui (Appendix 2), and is expressly prohibited at the following locations.

<u>ISLAND OF MAUI</u>	<u>ISLAND OF O'AHU</u>	<u>ISLAND OF HAWAI'I</u>
Kahului Harbor FMA <sup>1</sup>	Ala Wai Canal FMA	Hilo Bay FMA
Honolua-Mokuleia MLCD <sup>2</sup>	Coconut Island MLR	Kealakekua Bay MLCD
Molokini MLCD	Diamond Head SFMA	Kailua Bay FMA
Ahihi-Kinau NAR <sup>3</sup>	Haleiwa Harbor FMA	Kawiahae Harbor FMA
	Hanauma Bay MLCD	Old Kona Airport MLCD
<u>ISLAND OF LANA'I</u>	Heeia Kea FMA	Lapakahi Bay MLCD
Manele Harbor FMA	Kapalama Canal FMA	Puako FMA
Manele-Hulopoe MLCD	Paiko Lagoon Wildlife Refuge	Waiakea PFA <sup>4</sup>
<u>ISLAND OF MOLOKA'I</u>	Pupukea MLCD	Wailea Bay MLCD
Kaunakakai Harbor FMA	Waialua Bay FMA	Wailuku River FMA
	Waikiki MLCD	Wailoa River FMA
<u>ISLAND OF KAUA'I</u>		Waiopae Tidepools MLCD
Ahukini Pier FMA	<u>ISLAND OF KAHO'OLAWA</u>	West Hawaii Regional Fishery Management Area (comprising 9 Fish Replenshment Areas)
Hanamaulu Bay FMA	All waters	
Kapaa Canal FMA		
Waikaena Canal FMA		
Waimea Pier & Bay FMA		

<sup>1</sup> FMA -Fisheries Management Area; <sup>2</sup> MLCD - Marine Life Conservation District; <sup>3</sup>NAR - Natural Area Reserve; <sup>4</sup> PFA - Public Fishing Area

**C. COLLECTING PRACTICES:** The permittee is responsible for persons engaging in activities under this permit behaving professionally and responsibly, in a manner which does not generate conflict with public or private sectors, including fishing and dive-tour industries and local communities.

1. Collecting activities under authority of this permit must be supervised directly, on site, by either the permittee or their appointed representative (who must be a signatory of this permit). All corals will be documented in-situ prior to collection with both GPS and images.
2. An approved alien species protocol will be filed with DAR prior to initiation of any collection activities. Protocol will include mechanisms for ensuring that the individuals listed on this permit do NOT serve as vectors for the transport or introduction of alien species through their activities.
3. **No extractive or invasive sampling will be done on or adjacent to (i.e. within 1 m) any large (> 1 m diameter), intact live coral colony.** Specific efforts will be made to avoid damage to any large colonies of coral.
4. No coral species other than those listed on this permit will be collected or impacted by any activities conducted under this permit.
5. The Department reserves the right to require the permittee to accommodate presence of an observer specified by the Division during collection and research activities.
6. A record will be kept of each collection comprising specific location, date, species and amount collected; and in cases of return to ocean, the same information along with notification to DAR prior to the return activity. These records will be made available to the Department upon request.
7. **NOTIFICATION:**
  - a. Collecting generally - the permittee or an identified assistant responsible for the field activity must notify the office of the Department's Division of Conservation and Resources Enforcement (DOCARE), at least 24 hours prior to initial commencement of any collection activity under this permit. Information to be transmitted will include: the permit number; type of activity; proposed date, time, and location of activity; along with the vessel name or HA number and number of persons to be involved. Telephone Numbers for DOCARE: Oahu 587-0077 and Maui 984-8110.
  - b. Mass mortality - the permittee must notify DAR O'ahu at 808-587-0092 during the next working day of:
    - 1) Any instance of unauthorized damage caused to coral or other marine natural resources as a result of activities conducted under this permit.
    - 2) Any un-planned mass die-off of collected material after field collection.

D. **GEAR AND METHODS**

**Use of any chemical substances** pursuant to Section 188-23, Hawai'i Revised Statutes, **electrical shocking devices, or explosives remains expressly prohibited.**

1. A hammer and chisel is authorized to collect dead coral samples and to hammer up to a total of 50 stainless steel rods into the dead coral substrate at the ten identified sites. A drill is also authorized to drill the rods into the substrate.
2. The placement of calcium carbonate blocks (2" x 2" x 1") and calcification acidification units (CAU) on the substrate at the 10 sites listed in Part II.B. above is authorized.

E. **USE OF ORGANISMS:** Coral and live rock taken from State waters under authority of this permit may be used only for research use, except as authorized by prior written approval of the Division (or as detailed above):

1. Organisms collected under authority of this permit may not be used for sale; organisms collected under this permit may not be traded, bartered or loaned to other individuals, institutions or entities;
2. Written approval must be obtained from the Division prior to
  - a. Co-mingling organisms collected or maintained under this permit with any other organisms (regardless of origin), alive from any other party.
  - b. Transporting any live organism (regulated or not) out-of-State, between islands.
  - c. Transfer of any organisms collected under this permit to any other person not on this permit (no transfer allowed to organizations or agencies).
3. Disposition: Captive organisms may not be released or returned to the wild without the authorization of the Division, and assurances that such a release meets conditions listed under HRS §197-3, Introduction of aquatic life and wildlife.
  - a. The permittee must renew this permit if organisms collected under this permit are kept alive beyond the permit's end date.
  - b. The permittee must gain written authorization from the Department which will directly accompany transfer of dead organisms (or parts thereof) to parties out of the Permittee's control and/or after the permit's end date.
4. The permittee may not convey in any fashion (including, but not limited to, selling, trading, or giving) any coral or live rock to any person or party in Hawai'i which does not already have a permit from the Department authorizing possession of same and without direct, written approval from the Division.

- F. **REPORTS:** The permittee must provide to the Division the following:
1. A Final written Report: summarizing results of collecting activity carried out under this permit and the analysis of the data. All reports and the original expired permit should be returned to: The Division of Aquatic Resources, 1151 Punchbowl St., Room 330, Honolulu, HI 96813.
    - a. The annual report should provide a written explanation as to how the collection of and/or impact to these regulated aquatic species for this activity is benefiting the State of Hawai'i in general and specifically, the improved management of the species impacted.
    - b. The final report must describe, in form specified by the Department,
      - 1). Species identification and total numbers/quantities of all specimens collected under this permit, specific collection location with GPS and photos (pre-and immediately post-collection of the immediate habitat the organisms was on). In addition, a detailed inventory of organisms (dead or alive) present at the facility or with the permittee the end of the report period, in form acceptable to the Division, must accompany the final report.
      - 2). Their dispositions (e.g. on display; released/returned to the ocean; died), along with documentation, if required.
      - 3). **Description of any additional benefits** beyond the scientific analysis provided to the Division or the public during the period.
      - 4). Gear used – including dated photos of gear pre- and post-recovery.
  3. The Final Report will include copies (as listed appendices within the final report) of all amendments, lists of all assistants, and any intermediate reports (ex. Monthly Reports) as required.
  4. **The Final Report is due at the Division's Honolulu office within one calendar month after expiration of the permit**, or the cessation of activities covered under this permit (whichever comes first), and is required prior to any renewal of this permit.

VALIDATING SIGNATURE

---

WILLIAM J. AILA, Chairperson

Board of Land and Natural Resources

cc: DLNR Division of Conservation and Resources Enforcement

DAR - Maui

ACKNOWLEDGING SIGNATURE

By my signature below, I attest that I have read and understand the General and Special Conditions of Special Activity Permit SAP 2012-61 and that, further, I agree to comply with all of these conditions.

---

Ms. Nyssa Silbiger

Primary Permittee

Designated Assistants

Sign Type name Megan Donahue	Sign Type name
Sign Type name	Sign Type name
Sign Type name	Sign Type name
Sign Type name	Sign Type name
Sign Type name	Sign Type name
Sign Type name	Sign Type name
Sign Type name	Sign Type name
Sign Type name	Sign Type name



NAME: Megan Donahue  
TITLE: Bioeroding communities and response to climate change  
BUDGET PERIOD: Year 1 (2012-2013)

## Budget Justification

### Personnel:

#### Senior Personnel:

Dr. Megan Donahue (PI) will be responsible for general oversight of the project and direct supervision of the SeaGrant Trainee, Nyssa Silbiger, working on the project. She will assist in experimental design, data analysis, and writing of manuscripts. She has committed 1.4 months at \$8498/month match to this project for a total value of \$11,897.

Dr. Flo Thomas (Associate PI) is an expert in measuring fine scale environmental variation and has the equipment for the fine scale measurements proposed here. She will oversee collection of the environmental data, advise on data analysis, and contribute to the writing of manuscripts. She has committed 0.75 months to this project at \$11,090/month for a total match of \$8,318.

Dr. Rob Toonen currently holds multiple grants that support ReefChip development. We will leverage that support for this project in the development of a chip focused on bioeroder communities. Toonen will supervise the molecular identification of bioeroders. He has committed 0.75 months to this project at \$9009/month for a total match of \$6757.

Nyssa Silbiger will be the SeaGrant Trainee; she is currently a doctoral student advised by PI Donahue, and APIs Toonen and Thomas are members of her dissertation committee. The proposed work is integral to Silbiger's dissertation research.

#### Fringe Benefits:

The UH institutional rates for fringe benefits for Drs. Donahue, Thomas, and Toonen are typically 36.7% but are limited to 22% by SeaGrant for match. Total match from fringe benefits is \$5934 (= \$26971 × 0.22). These are approved institutional rates.

### Permanent Equipment:

We request \$6500 to purchase a YSI sonde with oxygen and pH sensors. Currently, the ReefSense fixed array is maintained continually at the Kaneohe Bay site, but the sonde for the mobile array is shared among several projects and must be removed from the site frequently. This additional sonde will be the dedicated mobile sonde for the ReefSense array.

### Expendable Supplies and Minor Equipment:

#### Expendable Supplies and Minor Equipment:

ReefChip -- All consumables for molecular analysis are budgeted as supplies for this project. We will leverage our current development effort, which includes several of the species found in the bioeroder community and many introduced species found only in the MHI. We anticipate the addition of 50 species to the current array. For each species, we estimate a cost of \$10 for extraction and sequencing to identify probes, and \$6 per oligonucleotide probe × 10 probes per species for array printing; this will cost \$3500 based on historical use rates. Once we have the oligonucleotides, the cost of printing the array, extracting and labeling samples, hybridizing the sample to the ReefChip, and scoring the results will be \$50 per sample for 150 experimental blocks and 150 environmental blocks (\$15,000). These cost estimates are based on historical usage for similar analyses in our labs. These are the total costs for the project and will be split between years. Total \$8,500 in year 1 (\$10,000 in year 2).

Water Samples - We are requesting funds for supplies to collect and analyze nutrients, chlorophyll, pH, and total alkalinity in 188 water samples over the course of the Kaneohe Bay study. We request \$500 for expendables related to the collection, filtration, and shipping of samples for nutrient analysis. We will measure TA and pH at HIMB using a Mettler T150 auto-titrator and MolecularDevices SpectraMax M2 spectrophotometer. Both analyses require Certified Reference Material (CRM) for calibration and expendables for sampling and analysis at a cost of \$2/sample for pH and TA together (\$500). These cost estimates are based on historical usage for similar analyses in our labs. Total: \$1000 in year 1.

### Travel:

There is no travel.

**Publication and Documentation Costs:**

/

**Other:**

Mark Riccio, Research Engineer and Facility Manager for the MicroCT Facility at Cornell University, will run microCT scans of each block before and after deployment on a GE eXplore CT120 Micro-CT scanner at 75um. The cost is \$150 per block for 150 blocks. Total: \$22,500 (\$11,250 each year).

**Contributing Organizations:**

There are no contributing organizations.

NAME: Megan Donahue  
TITLE: Bioeroding communities and response to climate change  
BUDGET PERIOD: Year 2 (2013-2014)

## Budget Justification

### Personnel:

#### Senior Personnel:

Dr. Megan Donahue (PI) will be responsible for general oversight of the project and direct supervision of the SeaGrant Trainee, Nyssa Silbiger, working on the project. She will assist in experimental design, data analysis, and writing of manuscripts. She has committed 1.4 months at \$8498/month match to this project for a total value of \$11,897.

Dr. Flo Thomas (Associate PI) is an expert in measuring fine scale environmental variation and has the equipment for the fine scale measurements proposed here. She will oversee collection of the environmental data, advise on data analysis, and contribute to the writing of manuscripts. She has committed 0.75 months to this project at \$11,090/month for a total match of \$8,318.

Dr. Rob Toonen currently holds multiple grants that support ReefChip development. We will leverage that support for this project in the development of a chip focused on bioeroder communities. Toonen will supervise the molecular identification of bioeroders. He has committed 0.75 months to this project at \$9009/month for a total match of \$6757.

Nyssa Silbiger will be the SeaGrant Trainee; she is currently a doctoral student advised by PI Donahue, and APIs Toonen and Thomas are members of her dissertation committee. The proposed work is integral to Silbiger's dissertation research.

#### Fringe Benefits:

The UH institutional rates for fringe benefits for Drs. Donahue, Thomas, and Toonen are typically 36.7% but are limited to 22% by SeaGrant for match. Total match from fringe benefits is \$5934 ( =  $\$26971 \times 0.22$ ). These are approved institutional rates.

### Permanent Equipment:

There is no permanent equipment.

### Expendable Supplies and Minor Equipment:

#### Expendable Supplies and Minor Equipment:

ReefChip -- All consumables for molecular analysis are budgeted as supplies for this project. We will leverage our current development effort, which includes several of the species found in the bioeroder community and many introduced species found only in the MHI. We anticipate the addition of 50 species to the current array. For each species, we estimate a cost of \$10 for extraction and sequencing to identify probes, and \$6 per oligonucleotide probe  $\times$  10 probes per species for array printing; this will cost \$3500. Once we have the oligonucleotides, the cost of printing the array, extracting and labeling samples, hybridizing the sample to the ReefChip, and scoring the results will be \$50 per sample for 150 experimental blocks and 150 environmental blocks (\$15,000). These are the total costs for the project and will be split between years. Total \$10,000 in year 2 (\$8500 in year 1).

Mesocosm Water Samples - We will measure TA and pH at HIMB using a Mettler T150 auto-titrator and MolecularDevices SpectraMax M2 spectrophotometer. Both analyses require Certified Reference Material (CRM) for calibration and expendables for sampling and analysis at a cost of \$2/sample for pH and TA together. The mesocosm experiment requires 720 pH samples and 48 TA samples. Total: \$1000 in year 2.

Field supplies: We request \$665 to cover the cost of field deployment, including supplies, boat time, and tank fills. Total: \$800 in year 2.

### Travel:

There is no travel.

### Publication and Documentation Costs:

/

**Other:**

Mark Riccio, Research Engineer and Facility Manager for the MicroCT Facility at Cornell University, will run microCT scans of each block before and after deployment on a GE eXplore CT120 Micro-CT scanner at 75um. The cost is \$150 per block for 150 blocks. Total: \$22,500 (\$11,250 each year).

Nutrient analyses will be sent to the Marine Chemistry Laboratory at the University of Washington, Department of Oceanography. For phosphate, silicate, nitrate, nitrite, & ammonia, analysis is \$16/sample for 168 samples (\$2688). Total: \$2688 in year 2.

**Contributing Organizations:**

There are no contributing organizations.

**SEA GRANT BUDGET FORM 90-4  
2012-2013**

<b>GRANTEE:</b> University of Hawaii Sea Grant College Program			<b>GRANT/PROJECT NO.:</b>	
<b>PRINCIPAL INVESTIGATOR:</b> Donahue, Megan			<b>DURATION (months):</b> 12 months	
<b>A. SALARIES AND WAGES:</b>			<b>man-months</b>	
	<b>No. of</b>	<b>Amount</b>	<b>Sea Grant</b>	<b>Matching</b>
	<b>People</b>	<b>of Effort</b>	<b>Funds</b>	<b>Funds</b>
1. Senior Personnel				
a. (Co) Principal Investigator:	1			\$11,897
b. Associates (Faculty or Staff):	2			\$15,075
<b>Sub Total:</b>	3		-0-	\$26,972
2. Other Personnel				
a. Professional:				
b. Research associate:				
c. Professional school student:				
d. Pre-Baccalaureate student:				
e. Secretarial-clerical:				
f. Technical-shop:				
g. Miscellaneous:				
<b>Total Salaries and Wages:</b>	3		-0-	\$26,972
<b>B. FRINGE BENEFITS:</b>			-0-	\$5,934
<b>Total Personnel (A and B):</b>			-0-	\$32,906
<b>C. PERMANENT EQUIPMENT:</b>			\$6,500	-0-
<b>D. EXPENDABLE SUPPLIES AND EQUIPMENT:</b>			\$9,595	-0-
<b>E. TRAVEL:</b>				
1. Domestic:				
2. International:				
<b>Total Travel:</b>			-0-	-0-
<b>F. PUBLICATION AND DOCUMENTATION COSTS:</b>			-0-	-0-
<b>G. OTHER COSTS:</b>				
1. Analytical Services			\$11,250	
2. Communications, Photocopying				
3. Computer Costs				
4. Equipment Maintenance and Use				
5. Ship Time, Dive Packages				
6. Consultant				
7. Subcontract				
8. Others (Freight, Gas, etc)				
9. Post-Doctoral Stipends (no O/H)				
10. Other (no O/H)				
<b>Total Other Costs:</b>			\$11,250	-0-
<b>TOTAL DIRECT COST (A. through G.):</b>			\$27,345	\$32,906
<b>INDIRECT COST:</b>				
Research On Campus: 36.7% of \$20,845 (MTDC)			\$7,651	
Research Off Campus: 20.6% of -0- (MTDC)				
Other On Campus: 25% of -0- (MTDC)				
Other Off Campus: 19% of -0- (MTDC)				
Training On Campus: 27.5% of -0- (MTDC)				
Training Off Campus: 20% of -0- (MTDC)				
State/Local Gov't: 3.5%				
<b>Total Indirect Cost:</b>			\$7,651	
<b>TOTAL COSTS:</b>			\$34,996	\$32,906

Reviewed and approved by Departmental Fiscal Officer:

**SEA GRANT BUDGET FORM 90-4  
2013-2014**

<b>GRANTEE:</b> University of Hawaii Sea Grant College Program			<b>GRANT/PROJECT NO.:</b>	
<b>PRINCIPAL INVESTIGATOR:</b> Donahue, Megan			<b>DURATION (months):</b> 12 months	
<b>A. SALARIES AND WAGES:</b>	<b>man-months</b>		<b>Sea Grant</b>	<b>Matching</b>
		<b>No. of People</b>	<b>Amount of Effort</b>	<b>Funds</b>
1. Senior Personnel				
a. (Co) Principal Investigator:	1			\$11,897
b. Associates (Faculty or Staff):	2			\$15,075
<b>Sub Total:</b>	3		-0-	\$26,972
2. Other Personnel				
a. Professional:				
b. Research associate:				
c. Professional school student:				
d. Pre-Baccalaureate student:				
e. Secretarial-clerical:				
f. Technical-shop:				
g. Miscellaneous:				
<b>Total Salaries and Wages:</b>	3		-0-	\$26,972
<b>B. FRINGE BENEFITS:</b>			-0-	\$5,934
<b>Total Personnel (A and B):</b>			-0-	\$32,906
<b>C. PERMANENT EQUIPMENT:</b>			-0-	-0-
<b>D. EXPENDABLE SUPPLIES AND EQUIPMENT:</b>			\$11,665	-0-
<b>E. TRAVEL:</b>				
1. Domestic:				
2. International:				
<b>Total Travel:</b>			-0-	-0-
<b>F. PUBLICATION AND DOCUMENTATION COSTS:</b>			-0-	-0-
<b>G. OTHER COSTS:</b>				
1. Analytical Services			\$13,938	
2. Communications, Photocopying				
3. Computer Costs				
4. Equipment Maintenance and Use				
5. Ship Time, Dive Packages				
6. Consultant				
7. Subcontract				
8. Others (Freight, Gas, etc)				
9. Post-Doctoral Stipends (no O/H)				
10. Other (no O/H)				
<b>Total Other Costs:</b>			\$13,938	-0-
<b>TOTAL DIRECT COST (A. through G.):</b>			\$25,603	\$32,906
<b>INDIRECT COST:</b>				
Research On Campus: 36.7% of \$25,603 (MTDC)			\$9,397	
Research Off Campus: 20.6% of -0- (MTDC)				
Other On Campus: 25% of -0- (MTDC)				
Other Off Campus: 19% of -0- (MTDC)				
Training On Campus: 27.5% of -0- (MTDC)				
Training Off Campus: 20% of -0- (MTDC)				
State/Local Gov't: 3.5%				
<b>Total Indirect Cost:</b>			\$9,397	
<b>TOTAL COSTS:</b>			\$35,000	\$32,906

Reviewed and approved by Departmental Fiscal Officer:

# SUMMARY BUDGET

Principal Investigator: Donahue, Megan

Proposal Title: Bioeroding communities and response to climate change

SALARIES & WAGES Name, Title	Benefits %	SG FTE	CS FTE	SG MM	CS MM	Sea Grant	Cost Share
<b>Senior Personnel</b>							
Megan Donahue, PI	0.367	0.000	0.233	0	2.8	\$0	\$23,794
Florence Thomas, Associate PI	0.367	0.000	0.125	0	1.5	\$0	\$16,636
Robert J. Toonen, Associate PI	0.367	0.000	0.125	0	1.5	\$0	\$13,514
<b>Other Staff &amp; Students</b>							
There are no other staff or student.							
<b>A. TOTAL SALARIES &amp; WAGES</b>						\$0	\$53,944
<b>B. FRINGE BENEFITS</b>						\$0	\$11,868
<b>C. EXPENDABLE MATERIALS &amp; SUPPLIES</b>						\$21,260	\$0
<b>TRAVEL</b>							
Domestic Travel						\$0	\$0
<b>D. TOTAL TRAVEL</b>						\$0	\$0
<b>E. PUBLICATION COSTS</b>						\$0	\$0
<b>OTHER COSTS (subcontractors, consultants, etc.)</b>							
MicroCT Facility at Cornell University for 2012-2013						\$11,250	\$0
MicroCT Facility at Cornell University for 2013-2014						\$11,250	\$0
Nutrient analysis at the Univ of Washington Marine Chemistry Lab for 2013-2014						\$2,688	\$0
<b>F. TOTAL OTHER COSTS</b>						\$25,188	\$0
<b>G. Subtotal DIRECT COSTS (sum A-F)</b>						\$52,948	\$65,812
<b>INDIRECT COSTS/RATES (includes A, B, C, D, E, F)</b>							
On Campus, 0.367 of 27,345						\$7,651	\$0
On Campus, 0.367 of 25,603						\$9,397	\$0
<b>H. TOTAL INDIRECT COSTS</b>						\$0	\$0
<b>PERMANENT EQUIPMENT - \$5000 or more per unit</b>							
YSI sonde with pH and oxygen						\$6,500	\$0
<b>I. TOTAL PERMANENT EQUIPMENT</b>						\$6,500	\$0
<b>OTHER COSTS NOT REQUIRING INDIRECT</b>							
<b>J. TOTAL OTHER COSTS NOT REQUIRING INDIRECT</b>						\$0	\$0
<b>K. GRAND TOTAL (sum G-K)</b>						\$69,996	\$65,812

A Graduate Student has been requested for 2 years (additional match of \$30,532 required)

Sources of Cost Share

For budget period 2012-2013: \$11,897 PI-Donahue salary cost share (1.65 mos), \$ 8,318 AI-Thomas salary cost share (0.75 mos), \$ 6,757 AI-Toonen salary cost share (0.75 mos), \$ 5,934 total fringe cost share (22% of all salaries)

For budget period 2013-2014: \$11,897 PI-Donahue salary cost share (1.65 mos), \$ 8,318 AI-Thomas salary cost share (0.5 mos), \$ 6,757 AI-Toonen salary cost share (0.5 mos), \$ 5,934 total fringe cost share (22% of all salaries)



## Budget Period 2012-2013

Principal Investigator: Donahue, Megan

Proposal Title: Bioeroding communities and response to climate change

SALARIES & WAGES Name, Title	Monthly Salary	Benefits %	SG FTE	CS FTE	SG MM	CS MM	Sea Grant	Cost Share
<b>Senior Personnel</b>								
Megan Donahue, PI	\$8,498	0.367	0.000	0.117	0	1.4	\$0	\$11,897
Florence Thomas, Associate PI	\$11,090	0.367	0.000	0.063	0	0.75	\$0	\$8,318
Robert J. Toonen, Associate PI	\$9,009	0.367	0.000	0.063	0	0.75	\$0	\$6,757
<b>Other Staff &amp; Students</b>								
There are no other staff or students.								
<b>A. TOTAL SALARIES &amp; WAGES</b>							\$0	\$26,972
<b>B. FRINGE BENEFITS</b>							\$0	\$5,934
<b>C. EXPENDABLE MATERIALS &amp; SUPPLIES</b>							\$9,595	\$0
<b>TRAVEL</b>								
Domestic Travel							\$0	\$0
<b>D. TOTAL TRAVEL</b>							\$0	\$0
<b>E. PUBLICATION COSTS</b>							\$0	\$0
<b>OTHER COSTS (subcontractors, consultants, etc.)</b>								
MicroCT Facility at Cornell University							\$11,250	\$0
<b>F. TOTAL OTHER COSTS</b>							\$11,250	\$0
<b>G. Subtotal DIRECT COSTS (sum A-F)</b>							\$20,845	\$32,906
<b>INDIRECT COSTS/RATES (includes A, B, C, D, E, F)</b>								
On Campus: 0.367 of 20,845							\$7,651	\$0
<b>H. TOTAL INDIRECT COSTS</b>							\$7,651	\$0
<b>PERMANENT EQUIPMENT - \$5000 or more per unit</b>								
YSI sonde with pH and oxygen							\$6,500	\$0
<b>I. TOTAL PERMANENT EQUIPMENT</b>							\$6,500	\$0
<b>OTHER COSTS NOT REQUIRING INDIRECT</b>								
There are no other costs not requiring indirect.								
<b>J. TOTAL OTHER COSTS NOT REQUIRING INDIRECT</b>							\$0	\$0
<b>K. GRAND TOTAL (sum G-K)</b>							\$34,996	\$32,906

A Graduate Student has been requested (additional match of \$15,266 required)

Sources of Cost Share

\$11,897 PI-Donahue salary cost share (1.65 mos); \$ 8,318 AI-Thomas salary cost share (0.75 mos); \$ 6,757 AI-Toonen salary cost share (0.75 mos); \$ 5,934 total fringe cost share (22% of all salaries)



## Budget Period 2013-2014

Principal Investigator: Donahue, Megan

Proposal Title: Bioeroding communities and response to climate change

SALARIES & WAGES Name, Title	Monthly Salary	Benefits %	SG FTE	CS FTE	SG MM	CS MM	Sea Grant	Cost Share
<b>Senior Personnel</b>								
Megan Donahue, PI	\$8,498	0.367	0.000	0.117	0	1.4	\$0	\$11,897
Florence Thomas, Associate PI	\$11,090	0.367	0.000	0.063	0	0.75	\$0	\$8,318
Robert J. Toonen, Associate PI	\$9,009	0.367	0.000	0.063	0	0.75	\$0	\$6,757
<b>Other Staff &amp; Students</b>								
There are no other staff or students.								
<b>A. TOTAL SALARIES &amp; WAGES</b>							\$0	\$26,972
<b>B. FRINGE BENEFITS</b>							\$0	\$5,934
<b>C. EXPENDABLE MATERIALS &amp; SUPPLIES</b>							\$11,665	\$0
<b>TRAVEL</b>								
Domestic Travel							\$0	\$0
<b>D. TOTAL TRAVEL</b>							\$0	\$0
<b>E. PUBLICATION COSTS</b>							\$0	\$0
<b>OTHER COSTS (subcontractors, consultants, etc.)</b>								
MicroCT Facility at Cornell University							\$11,250	\$0
Nutrient analysis at the Univ of Washington Marine Chemistry Lab							\$2,688	\$0
<b>F. TOTAL OTHER COSTS</b>							\$13,938	\$0
<b>G. Subtotal DIRECT COSTS (sum A-F)</b>							\$25,603	\$32,906
<b>INDIRECT COSTS/RATES (includes A, B, C, D, E, F)</b>								
On Campus: 0.367 of 25,603							\$9,397	\$0
<b>H. TOTAL INDIRECT COSTS</b>							\$9,397	\$0
<b>PERMANENT EQUIPMENT - \$5000 or more per unit</b>								
There is no permanent equipment.								
<b>I. TOTAL PERMANENT EQUIPMENT</b>							\$0	\$0
<b>OTHER COSTS NOT REQUIRING INDIRECT</b>								
There are no other costs not requiring indirect.								
<b>J. TOTAL OTHER COSTS NOT REQUIRING INDIRECT</b>							\$0	\$0
<b>K. GRAND TOTAL (sum G-K)</b>							\$35,000	\$32,906

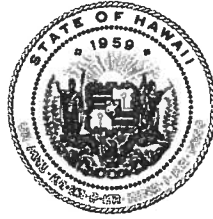
A Graduate Student has been requested (additional match of \$15,266 required)

Sources of Cost Share

Donahue, Megan  
Bioeroding communities and response to climate change

\$11,897 PI-Donahue salary cost share (1.65 mos); \$ 8,318 AI-Thomas salary cost share (0.5 mos); \$ 6,757 AI-Toonen salary cost share (0.5 mos); \$ 5,934 total fringe cost share (22% of all salaries)

NEIL ABERCROMBIE  
GOVERNOR OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
DIVISION OF AQUATIC RESOURCES  
1151 PUNCHBOWL STREET, ROOM 330  
HONOLULU, HAWAII 96813

WILLIAM J. AILA, JR.  
CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
COMMISSION ON WATER RESOURCE MANAGEMENT

GUY KAULUKUKUI  
FIRST DEPUTY


WILLIAM M. TAM  
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES  
BOATING AND OCEAN RECREATION  
BUREAU OF CONVEYANCES  
COMMISSION ON WATER RESOURCE MANAGEMENT  
CONSERVATION AND COASTAL LANDS  
CONSERVATION AND RESOURCES ENFORCEMENT  
ENGINEERING  
FORESTRY AND WILDLIFE  
HISTORIC PRESERVATION  
KAHOOLAWE ISLAND RESERVE COMMISSION  
LAND  
STATE PARKS

May 11, 2012

TO: Division of Aquatic Resources File

THROUGH: William J. Aila, Jr., Chairperson

FROM: Guy Kaulukukui, First Deputy and Acting Administrator  
Division of Aquatic Resources 

DECLARATION OF EXEMPTION FROM THE PREPARATION OF AN ENVIRONMENTAL ASSESSMENT  
UNDER THE AUTHORITY OF CHAPTER 343, HRS AND CHAPTER 11-200 HAR, FOR  
PAPAHĀNAUMOKUĀKEA MARINE NATIONAL MONUMENT RESEARCH PERMIT TO MEGAN  
DONAHUE, UNIVERSITY OF HAWAII, HAWAII INSTITUTE OF MARINE BIOLOGY, FOR ACCESS TO  
STATE WATERS TO CONDUCT BIOEROSION STUDY ACTIVITIES  
UNDER PERMIT PMNM-2012-033

The following permitted activities are found to be exempted from preparation of an environmental assessment under the authority of Chapter 343, HRS and Chapter 11-200, HAR:

Project Title:

Papahānaumokuākea Marine National Monument Research Permit to Megan Donahue, University of Hawaii, Hawaii Institute of Marine Biology, for Access to State Waters to Conduct Bioerosion Study Activities

Permit Number: PMNM-2012-033

Project Description:

The research permit application, as described below, would allow entry and activities to occur in Papahānaumokuākea Marine National Monument (Monument), including the NWHI State waters from July 25, 2012 through July 24, 2013.

This project is to measure bioerosion rates and bioeroder community composition (i.e. hydrozoans, bryozoans, barnacles, and tiny mollusks) at up to 21 different reef sites in Papahānaumokuākea Marine National Monument. The purpose of these activities is to test the effectiveness of using bioerosion rates and bioeroder communities as indicators of climate change, specifically ocean acidification. The activities in the permit would include retrieving previously deployed calcium carbonate blocks at 16 different sites, which serve as settling substrate for bioeroders; placing new blocks at Kure, and collections of pieces of dead coral at all sites.

ITEM F-2c

The proposed activities are in direct support of the Monument Management Plan's priority management need 3.1 – Understanding and Interpreting the NWHI (through action plan 3.1.1 – Marine Conservation Science). This action plan specifies to conduct "marine research, characterization, and monitoring designed to support an ecosystem-based approach to protection and management". It also notes that monitoring data can help scientists understand causes of change. Activities to support marine conservation science, including community composition and change studies such as those to be carried out by the permittee, are also addressed in the Monument Management Plan Environmental Assessment (December 2008) which resulted in FONSI. This EA summarizes that understanding the populations change could be helpful to forecast, prepare for and mediate potential threats to populations within the Monument (PMNM MMP Vol. 2, p.171). Measurements of bioerosion rates and community composition, such as those proposed, would enhance this understanding.

Consulted Parties:

The permit application was sent out for review and comment to the following scientific and cultural entities: Hawaii Division of Aquatic Resources, Hawaii Division of Forestry and Wildlife, Papahānaumokuākea Marine National Monument (NOAA/NOS), NOAA Pacific Islands Regional Office (NOAA-PIRO), United States Fish and Wildlife Service Hawaiian and Pacific Islands National Wildlife Refuge Complex Office, and the Office of Hawaiian Affairs (OHA). In addition, the permit application has been posted on the Monument Web site since March 15, 2012, giving the public an opportunity to comment. The application was posted within 40 days of its receipt, in accordance with the Monument's Public Notification Policy.

Exemption Determination:

After reviewing HAR § 11-200-8, including the criteria used to determine significance under HAR § 11-200-12, DLNR has concluded that the activities under this permit would have minimal or no significant effect on the environment and that issuance of the permit is categorically exempt from the requirement to prepare an environmental assessment based on the following analysis:

1. All activities associated with this permit, including the measuring of bioerosion rates and community composition, have been evaluated as a single action. As a preliminary matter, multiple or phased actions, such as when a group of actions are part of a larger undertaking, or when an individual project is precedent to or represents a commitment to a larger project, must be grouped together and evaluated as a single action. HAR § 11-200-7. Since this permit involves an activity that is precedent to a later planned activity, i.e. the retrieval of the calcium carbonate blocks, the categorical exemption determination here will treat all planned activities as a single action.

2. The Exemption Class for Scientific Research with no Serious or Major Environmental Disturbance Appears to Apply. Chapter 343, HRS, and § 11-200-8, HAR, provide for a list of classes of actions exempt from environmental assessment requirements. HAR §11-200-8.A.5. exempts the class of actions which involve "basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource." This exemption class has been interpreted to include fish collection for marine surveys and research, as well as research related to the development

and management of various aquatic organisms, including life history, migration, and growth studies, such as those being proposed.

In addition Exemption Class #5, Exempt Item #5 includes “surveys, censuses, inventories, studies . . . collection, culture and captive propagation of aquatic biota.” DEPARTMENT OF LAND & NATURAL RESOURCES, EXEMPTION LIST FOR THE DIVISION OF FISH AND GAME 3-4 (January 19, 1976).

The proposed measuring of bioerosion rates and community composition activities here appear to fall squarely under the exemption class identified under HAR § 11-200-8.A.5. As discussed below, no significant disturbance to any environmental resource is anticipated from the collection of water and dead coral, nor from the placing of instruments and settlement blocks. Thus, so long as the below considerations are met, an exemption class should include the action now contemplated.

3. Cumulative Impacts of Actions in the Same Place and Impacts with Respect to the Potentially Particularly Sensitive Environment Will Not be Significant. Even where a categorical exemption appears to include a proposed action, the action cannot be declared exempt if “the cumulative impact of planned successive actions in the same place, over time, is significant, or when an action that is normally insignificant in its impact on the environment may be significant in a particularly sensitive environment.” HAR § 11-200-8.B. To gauge whether a significant impact or effect is probable, an exempting agency must consider every phase of a proposed action, any expected primary and secondary consequences, the long-term and short-term effects of the action, the overall and cumulative effect of the action, and the sum effects of an action on the quality of the environment. HAR § 11-200-12. Examples of actions which commonly have a significant effect on the environment are listed under HAR § 11-200-12.

No prior studies of this type have been undertaken to date. This project would be the first systematic documentation of internal bioeroders and their respective bioerosion rates in the Monument. However, the majority of activities to be carried out (collections and block deployments) are standard marine research tasks that have been used in the Monument before, with no deleterious impacts. With this in mind, significant cumulative impacts are not anticipated as a result of this activity, and numerous safeguards further ensure that the potentially sensitive environment of the project area will not be significantly affected. All activities will be conducted in a manner compatible with the management direction of the Monument Proclamation in that the activities do not diminish monument resources, qualities, and ecological integrity, or have any indirect, secondary, cultural, or cumulative effects. The joint permit review process did not reveal any anticipated indirect or cumulative impacts, nor did it raise any cultural concerns, that would occur as a result of these activities.

The activities would be conducted from the NOAA Ship HI’IALAKAI (PMNM-2012-009) during its July and August cruises. The following table lists additional activities that are anticipated to take place on these cruises pending approval of permit applications.

**Table 1. Concurrent Projects Aboard NOAA SHIP HI’IALAKAI**

Permit	Purpose and Scope	Location
PMNM-2012-009 NOAA Ship HI'IALAKAI	The permit allows NOAA Ship HI'IALAKAI entry into PMNM. Personnel aboard the vessel will be permitted under separate permits.	All locations
PMNM-2011-018 Meyer	This permit allows collection of reef fish and tagging of top predators as well as acoustic receiver deployment.	All locations
PMNM-2012-020 Tagawa (proposed)	The proposed action is to allow fin clip collections and tagging of two Jack (Ulua) species, <i>Caranx ignobilis</i> and <i>Caranx melampygus</i> .	All locations
PMNM-2012-028 Lemus (proposed)	The proposed action is to conduct interviews with research scientists during the course of their field work, and film both the natural resources under study and the scientists conducting the studies to develop multimedia resources for distance learning.	All locations
PMNM-2012-035 Godwin (proposed)	The proposed action is to allow alien marine invertebrate voucher specimen collections and monitoring.	All locations

The Applicant is collecting coral samples, however her samples are of dead coral only and therefore do not overlap with other proposed collections, such as Godwin's collections of alien marine invertebrates (PMNM-2012-035). None of the other projects are similar in nature to the activities being proposed by the Applicant.

**Table 2. Concurrent projects aboard NOAA SHIP OSCAR ELTON SETTE**

Permit	Purpose and Scope	Location
PMNM-2012-008 NOAA Ship OSCAR ELTON SETTE	The permit allows NOAA Ship OSCAR ELTON SETTE entry into PMNM. Personnel aboard the vessel will be permitted under separate permits.	All locations
PMNM-2012-001 Co-Trustee	The proposed action is to facilitate the needs of the monk seal field camp.	All locations
PMNM-2012-013 Parrish/ Van Atta (proposed)	The proposed action is conduct selected removal of predatory sharks from Hawaiian monk seal pupping sites at French Frigate Shoals.	FFS



The NOAA Ship OSCAR ELTON SETTE (PMNM-2012-008) will also be in the Monument during the same time frame as the July cruise of the HI'IALAKAI. However, none of the activities overlap with the proposed actions of the Applicant.

The culmination of these permits, and their disparate activities, occurring throughout the Monument over a 4-week period, is not anticipated to have significant cumulative impacts.

Since no significant cumulative impacts or significant impacts with respect to any particularly sensitive aspect of the project area are anticipated, the categorical exemptions identified above should remain applicable.

4. Overall Impacts will Probably be Minimal and Insignificant. Any foreseeable impacts from the proposed activity will probably be minimal, and further mitigated by general and specific conditions attached to the permit. Specifically, all research activities covered by this permit will be carried out with strict safeguards for the natural, historic, and cultural resources of the Monument as required by Presidential Proclamation 8031, other applicable law and agency policies and standard operating procedures.

Conclusion. Upon consideration of the permit to be approved by the Board of Land and Natural Resources, the potential effects of the above listed project as provided by Chapter 343, HRS and Chapter 11-200 HAR, have been determined to be of probable minimal or no significant effect on the environment and exempt from the preparation of an environmental assessment.

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WILLIAM J. AILA, JR.  
Chairperson, Board of Land and Natural Resources

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Date