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
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: 06/01/14-11/15/14
Proposed Method of Entry (Vessel/Plane): R/V Hi'ialakai
Proposed Locations: Shallow water reef (<100 ft depth) focused on Pocillopora colonies in forereef and pinnacle habitats. Specific locations for the study will depend on cruise logistics but ideally will include sites around French Frigate Shoals, Midway, Lisianski, Pearl & Hermes, and/or Kure.

Estimated number of individuals (including Applicant) to be covered under this permit: 11
Estimated number of days in the Monument: 30

Description of proposed activities: (complete these sentences):

a.) The proposed activity would…

(i) characterize the cryptic fish and invertebrate communities that live within Pocillopora meandrina (POME) colonies across the Hawaiian Archipelago, including the (ii) within-species genetic diversity and between-species community diversity. This study merges genetic connectivity and ecological dynamics, helping PMNM managers to relate Archipelago-wide connectivity to local-scale community connectivity and resilience. By focusing genetic and ecological survey efforts on a fairly discrete community unit, this project will provide Monument management with information regarding connectivity, cryptic species diversity, and species interactions within PMNM coral reefs at scales that are not being addressed by ongoing surveys. These results will enable us to develop models of reef metacommunities that can be used to predict community responses to global change at local and regional spatial scales, thereby strengthening our ability to establish effective ecosystem-based marine management strategies.

b.) To accomplish this activity we would ….

(i) visually survey the communities (fishes and mobile invertebrates) living within the structure created by POME colonies at forereef sites spanning a depth range of 30 to 100 feet at several sites at each atoll. The size and health status of POME colonies will be assessed in situ and in photographs.

(ii) place video cameras to record species interactions in 3 POME colonies at each site for 30 to 60 minutes. The interactions recorded on these videos will be scored to improve our understanding of community dynamics, and evaluate differences in community dynamics between the MHI and NWHI.

(iii) collect tissue samples and analyze genetic data (in coordination with Drs Brian Bowen and Rob Toonen) to assess intraspecific genetic diversity and connectivity between sites. In particular, we would survey for 4 fish species and 7 invertebrate species at all visual survey sites, using small polespears and handnets to collect fish, nonlethal tissue biopsies for invertebrates, and DNA sequencing to assess genetic diversity and connectivity among reef habitats.

(iv) relate community composition, diversity, and behavior to remotely sensed and in situ environmental data from NASA and NOAA CRED (including pH, temperature, salinity, and chlorophyll).

c.) This activity would help the Monumen**t** by …
characterizing a community that is not captured by current survey efforts, including several Hawai‘i endemics. Although POME colony size and density are assessed in current benthic RAMP surveys, the specialist semi-cryptic community of invertebrates and fishes that live within POME colonies have not been systematically assessed. Therefore, this study will provide a baseline for these semi-cryptic POME communities within the NWHI. This study will also document within species genetic variability and connectivity at smaller scales than those evaluated by Drs Toonen and Bowen providing Monument managers details on natural barriers to connectivity at the individual island scale. At the nexus of genetic connectivity and ecological dynamics, this study will combine these measures of diversity and connectivity with the relative strength of species interactions (from video footage) to develop metacommunity models. These models will be used to assess community resilience at local and regional scales.

Other information or background: To the extent practicable, forereef sites will be co-located with NOAA-CRED sites to minimize impact and ease collaboration of data resources. We are actively coordinating with Drs. Toonen and Bowen to ensure that there is not a duplication of effort in the genetic sampling. These POME communities have not been targeted in previous surveys for genetic connectivity by Bowen and Toonen, and Field PI Chelsie Counsell will work closely with them on the collection and analysis of samples. Our active coordination and collaboration with Drs. Bowen and Toonen will minimize the take of individuals from the Monument.

Section A - Applicant Information

1. Applicant

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

Title: Associate Researcher, Hawai'i Institute of Marine Biology

1a. Intended field Principal Investigator (See instructions for more information):
Chelsie W Counsell, graduate student

2. Mailing address (street/P.O. box, city, state, country, zip): [redacted]

[redacted] major professor's name, telephone and email address:

3. Affiliation (institution/agency/organization directly related to the proposed project):
Hawai'i Institute of Marine Biology (HIMB), School of Ocean and Earth Science and Technology, University of Hawai'i 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
Chelsie Counsell, Field PI, research diver
Brian Bowen, research diver
Nyssa Silbiger, research diver
Joshua Copus, HIMB grad student
Jonathan Whitney, research diver

Section B: Project Information

5a. Project location(s):

		Ocean Based	
☒ Nihoa Island	☐ Land-based	☒ Shallow water	☐ Deep water
☒ Necker Island (Mokumanamana)	☐ Land-based	☒ Shallow water	☐ Deep water
☒ French Frigate Shoals	☐ Land-based	☒ Shallow water	☐ Deep water
☒ Gardner Pinnacles	☐ Land-based	☒ Shallow water	☐ Deep water
☒ Maro Reef			
☒ Laysan Island	☐ Land-based	☒ Shallow water	☐ Deep water
☒ Lisianski Island, Neva Shoal	☐ Land-based	☒ Shallow water	☐ Deep water
☒ Pearl and Hermes Atoll	☐ Land-based	☒ Shallow water	☐ Deep water
☒ Midway Atoll	☐ Land-based	☒ Shallow water	☐ Deep water
☒ Kure Atoll	☐ Land-based	☒ Shallow water	☐ Deep water
☐ Other			

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. To ensure maximum flexibility (for weather or other unforeseen changes to the cruise schedule), we have included a list of coordinates outlining areas within which all surveys would occur.

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
Necker Island	-164.13627752700	23.71705429230
Necker Island	-164.13373024500	23.20505064020
Necker Island	-164.92084033700	23.20505064020
Necker Island	-164.92338761900	23.71960157420
Nihoa Island	-161.66031956700	23.23816530420
Nihoa Island	-161.66286684900	22.94013332760
Nihoa Island	-162.05005369100	22.94268060940
Nihoa Island	-162.05260097200	23.23561802240

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:***
Within the NWHI, a decade of RAMP surveys have documented the composition of fishes, corals, algae, and some macroinvertebrates in the benthic reef communities, and Autonomous Reef Monitoring Structures (ARMS) are capturing cryptic and encrusting benthic reef species. This project will complement these ongoing studies by describing the species richness, species interactions, and patterns of genetic diversity in the semi-cryptic assemblages that live in Pocillopora meandrina (POME) colonies . This study will focus on a closely-interacting community that is not well-surveyed by existing efforts. To date, genetic work within the NWHI has clarified archipelago-wide connectivity patterns for a variety of species (Toonen et al. 2011). By analyzing genetic samples taken at a finer resolution, this project will determine natural barriers to connectivity at the scale of individual islands and the relative connectivity of closely interacting species. This project has four main objectives.

1st Objective: Document a baseline of diversity within POME reef communities.
In addition to its intrinsic value, biodiversity helps to maintain ecosystem function (Cavender-Bares et al. 2009; Martens et al. 2003) making it a fundamental attribute of the Monument's ecological resources. POME colonies are a common feature of Hawaiian reefs that provide habitat for a closely associated fish and invertebrates, including several Hawaiian endemics. We will conduct surveys of these cryptic communities on forereef sites within the Monument. The size and abundance of fish and invertebrate species within 30 coral heads at 4 to 8 distinct sites (each site is an area of 1 hectare) per atoll will be recorded. In addition, tissue samples will be taken from individuals of up to 4 fish and 6 invertebrate species at each site. These data will enable us to determine diversity at a variety of scales: within species genetic diversity, species diversity within each colony, diversity among colonies with-in sites, diversity at the island-scale, and diversity within different regions across the archipelago. Documenting diversity across scales can depict patterns of ecosystem structure and indicate the spatial scales at which resilience mechanisms operate. Despite being protected from direct anthropogenic effects, the ecological resources of the Monument are still susceptible to stressors from global change. Within-species genetic diversity provides important insight into a species' ability to adapt to changing conditions, and greater genetic diversity can confer resilience to the community.

2nd Objective: Investigate fish and invertebrate behavior in semi-cryptic reef communities that are exposed to natural levels of transient predatory species.
Biodiversity promotes ecosystem stability and productivity (Balvanera et al. 2006, Cardinale et al. 2006, Worm et al. 2006) through different mechanisms. Sometimes a few species have disproportionately large functional roles and increased biodiversity stabilizes the community through an increased probability of including these key species. In other systems, species play complementary roles in an ecosystem, and the added value of each species drives the stabilizing effect of biodiversity. We will use characterize species interactions to assess the relative value of each species to the community by monitoring species behavior in the communities occupying POME colonies. Video surveys will be conducted using a stationary

multi-camera setup on a subset of the coral colonies (see Objective 1). The recorded behaviors will be scored to determine the functional redundancy of species, the strength of species interactions, and the relevance of transient community members. Preliminary behavioral observations on communities around Oahu suggest competition between the Hawaiian Dascyllus and the blue eyed damselfish will be an important species interaction. Functional redundancy may be found between the speckled scorpionfish, the dwarf scorpionfish, the Hawaiiian velvetfish, and the Hawaiian lionfish. PMNM is the only place where the behavior of these communities can be considered with natural levels of transient community members including predatory fishes.

3rd Objective: Determine small-scale patterns of connectivity in the absence of localized anthropogenic effects.
Research continues to support the idea that connectivity patterns are driven by a complex assortment of factors including currents, chemical and audible cues from the benthic habitat (Igulu et al. 2013; Tolimieri et al. 2000), and availability of settlement structure. While previous studies have focused on the patterns of connectivity at the archipelago-scale (e.g., Toonen et al. 2011), these studies do not address natural barriers to connectivity within the Monument at the scale of individual islands. Focusing on highly site-attached, POME-associated species, including four fish species (Hawaiian lionfish, speckled scorpionfish, dwarf scorpionfish, Hawaiian velvetfish) and six invertebrate species (common guard crab, yellow-spotted guard crab, brown guard crab, rusty guard crab, cauliflower coral shrimp, elate drupe) that are commonly found within POME colonies, this project will analyze within-atoll connectivity. PMNM provides a unique study site where correlations can be made between patterns of local connectivity and natural features (e.g., benthic cover, bathymetry) without the confounding effects of anthropogenic inputs that are found in most reef communities (e.g., chemicals in runoff, boat traffic sounds).

4th Objective: Develop a metacommunity model and run sensitivity analyses on community composition to global changes across a gradient of local anthropogenic impact.
The dynamics of biodiversity can be theoretically assessed through the conceptual framework of metacommunities - local communities linked by the dispersal of species and influenced by heterogeneity in environmental variables, species interactions, and recruitment limitations (Mouquet & Loreau 2003). Because each POME colony contains a fairly distinct community and POME has relatively fast growth and high mortality rates, these communities occur on discrete spatial and temporal scales making them ideal for studying metacommunity dynamics. Traditional ecology focuses on understanding processes at either the local or the ecosystem scale; metacommunity models provide a way to combine local dynamics with spatial heterogeneity to make more realistic predictions about community resilience at both local and ecosystem scales (Chesson et al. 2005). The fine-scale connectivity, diversity, and species interaction data collected in this project will be combined with data from parallel surveys conducted around Oahu and complementary environmental data from the RAMP surveys, to develop metacommunity models with POME colonies as the functional community unit. By altering various components within the model, we will be able to

theoretically perturb the community dynamics (e.g., connectivity, diversity, environmental parameters) to predict species and community resilience at the scale of a POME colony and at the scale of the Hawaiian archipelago. These simulations will help Monument management anticipate changes to the reef community based on different potential risk scenarios (e.g., removal of a species or functional group due to disease, increased variability in weather patterns due to global change).

Summary of Purpose:
This study merges genetic connectivity and ecological dynamics, helping PMNM managers to relate Archipelago-wide connectivity to local-scale community connectivity and resilience. By focusing genetic and ecological survey efforts on a fairly discrete community unit, this project will provide Monument management with information regarding connectivity, cryptic species diversity, and species interactions within PMNM coral reefs at scales that are not being addressed by ongoing surveys. These results will enable us to develop models of reef metacommunities that can be used to predict community responses to global change at local and regional spatial scales, thereby strengthening our ability to establish effective ecosystem based marine management strategies.

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 is a natural and inherent part of any research we conduct, especially 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. 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.

When obtaining tissues for genetic data, lethal sampling will only be used as needed if the species are widespread and abundant. We will collect from multiple locations to ensure we are collecting at a low density in any one area. Specimen collections will total less than a few kilograms per island or atoll. Considering that apex predators remove 30,000 tons of fish annually on each atoll (Sudekum et al. 1991; Freidlander and DeMartini 2002), the impact our removal will have on the ecosystem is negligible.

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.

Papahanaumokuakea is a sacred place to native Hawaiians; a place that is included in the oral history of chants and meles; 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 reef ecosystems of Papahanaumokuakea. 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 community dynamics of coral reef communities in the Monument and using this knowledge to understand and mitigate the impacts of anthropogenic global change on Hawaiian reef ecosystems.

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 proposed 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. Because of concerns about cumulative impacts, a threat assessment of the activities in the Monument has been conducted (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, divers will survey POME colony communities with the help of flashlights, photography, and short term videography. Any negative impacts on the reefs, atolls, and Monument of this work are exceedingly small (e.g. temporary altering the behavior of smaller species within the reef community via our appearance within their environment, potentially touching the Pocillopora colonies to assist in efficiently surveying the communities living within their structural features) while the positive impacts of

the results of our research are Monument-wide. Removal of tissues/specimen for genetic data will be conducted following a careful systematic approach to ensure minimal impacts to the Monument's resources at both small and large scales. As outlined above and below, we have implemented every reasonable safegaurd for the resources integrity of the Monument, and there will be no detectable impact on Monument resources.

Our overriding goal is to provide scientific information to managers so that the Papahanaumokuakea Marine National Monument can be managed and protected based on policy grounded in sound science. Our divers are experienced in surveying coral reef communities with minimal impact. Each diver has been through intensive dive training and is a certified scientific diver with the American Association of Underwater Scientists. We are already conducting similar POME surveys in Kane'ohe Bay and around Oahu, honing our methods and ensuring efficient work with negligible impact on the reef ecosystem.

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. Documenting the biodiversity of pristine POME communities that include endemic Hawaiian species requires conducting surveys on highly protected Hawaiian reefs. To understand small scale patterns in connectivity relative to natural barriers, genetic surveys must be conducted in an area without confounding local anthropogenic effects. To develop realistic metacommunity models that can predict how reef communities respond to the loss of a species or changes in environmental variables, we need information regarding the naturally occurring community compositions, species behavior within a pristine environment (i.e. with abundant predatory fishes), and connectivity between communities on a small scale.

d. How does the end value of the activity outweigh its adverse impacts on Monument cultural, natural and historic resources, qualities, and ecological integrity?
The end value of this activity will greatly outweigh its imperceptible impact on the resources of the Monument. Our tissue/specimen collections will total only a few kilograms of fish and invertebrates and this will be spread across various sites within the Monument, this is a miniscule removal compared to the harvest removed by large predators. In addition, no monitoring devices or other field gear would be left behind. An increased understanding of the cryptic reef biodiversity, species behavior, and small scale community connectivity within the Monument will enhance our knowledge about the ecological resources we are protecting and may improve the design of resource management within the MHI. The ability to make realistic predictions relative to cryptic reef community stability and risk scenarios the Monument may face also has a large end value for alerting managers to what scenarios warrant the most concern.

e. Explain how the duration of the activity is no longer than necessary to achieve its stated purpose.
Based on preliminary surveys in the MHI, a site survey will take 3-5 dives by 3-4 divers. Therefore, we expect surveying will proceed at a rate of about one site per day. We anticipate surveying 8-16 sites and we will focus on forereef habitat of one or a few atoll(s), although specific survey locations will depend on cruise logistics. Given travel time on the R/V

Hi'ialakai, we estimate that 30 days within the Monument would be 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 19 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. I was privileged to enter the Monument for the first time in May 2010 to support Scott Godwin's (PMNM) surveys of invasive species and Rob Toonen's connectivity sampling. I entered the Monument in July 2011 on my own permit to study bioerosion rates. My experience on previous cruises has been excellent preparation for the study proposed here. This is my third permit application for work in the Monument.

The field PI for this application is Chelsie Counsell. She is an AAUS certified scuba diver (since 2011) and a PADI dive master (since 2010). She has conducted research on SCUBA on reef communities in the Caribbean, the Gulf of Mexico, and Hawaii. She has played an integral role in organizing and conducting preliminary surveys of the POME reef communities around Oahu including mentoring an undergraduate research intern. Chelsie received her Master's degree from Florida State University and is currently a doctoral student in my laboratory; she is an experienced coral reef diver having worked as a marine biologist in the Florida Keys and the Turks and Caicos Islands prior to her MS.

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 (metacommunity diversity sampling) and Bowen and Toonen (fish and invertebrate interspecific diversity quantification) laboratories at the Hawaii Institute of Marine Biology. Chelsie is currently supported by NSF and is applying for a variety of small research grants to support this work. In addition, there are adequate finances in the Donahue lab and Toonen-Bowen lab to support the described work.

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 metacommunity dynamics in the Monument and predicting the ability of these communities to respond to global scale changes. The impacts of our study will help guide stewardship practices that appropriately preserve and manage the qualities and integrity of the Monument's cultural and natural and historic resources. Our data will provide a strong scientific understanding of coral

reef ecosystem community 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's 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, 2012, and 2013 Donahue held a permit for research activities in the Monument and demonstrated compliance with all permit and reporting requirements.

8. Procedures/Methods:
The proposed surveys of the semi-cryptic community living within the structural features of Pocillopora meandrina (POME) colonies have 3 main field components: (1) documenting diversity by surveying the fish and invertebrate species at different sites around atoll(s), (2) using video to document species' behaviors within a subset of the POMEs, (3) collecting a statistically appropriate yet ecologically tiny sample of select fish and invertebrate species from the POMEs. The survey design is an expansion of ongoing surveys around Oahu. The 3 main field components are described below.

(1) The communities that live within the structural features of POMEs are often partially hidden within the coral. To survey these communities, a diver will slowly approach a colony while recording the size and number of fish that may have ventured out into the peripheral portion of the colony's shelter. Once a diver is in close proximity of the coral, they will utilize a dive light to survey the community living within the POME branches, identifying and estimating the size of all mobile fish and invertebrate species. Photographs of each focal POME will be taken to characterize the colony (e.g., size, percent live tissue, branch gaps) and its surrounding habitat (e.g., overall coral cover, nearest conspecific neighbor distance). Tissue samples will be obtained from each survey site (see 3 for further details). At each site (up to 1 hectare), 30 POMEs will be surveyed over the course of 3-5 dives. The divers will tow a surface GPS unit to approximate the location of each coral colony and to record the survey tracks.

(2) After the first two POMEs are surveyed on each dive, 2 GoPro video cameras will be oriented around the POMEs so that one is angled down into the coral branches and the other is angled to catch activity at the outer top edges of the POME. These cameras will be attached to a Pelican surface float to ensure their retrieval at the end of each dive. These GoPros will record the activity immediately around and within focal coral colonies for 30 min to an hour (the duration of the dive and any additional time that can be spared as the divers break down their gear). Post dive, the recorded behaviors will be coded and scored to characterize positive and negative interactions between species. The footage will also be used to evaluate

the importance of transient community members. Please see the attached diagram of the camera set-up.

(3) To analyze small-scale connectivity and genetic diversity patterns, genetic samples will be collected at a rate of 30-50 individuals per species per site. These genetic surveys will focus on species that are commonly found within POMEs: four fish species (Hawaiian lionfish, speckled scorpionfish, dwarf scorpionfish, Hawaiian velvetfish) and seven invertebrate species (common guard crab, yellow-spotted guard crab, brown guard crab, rusty guard crab, cauliflower coral shrimp, elated drupe). The tissue collections will be made at a low density (approximately 30 individuals per hectare) using nets and small polespears when nonlethal approaches are ineffective. For invertebrates (and fish when possible), we will sample non-lethally, remove a leg (or other small piece of tissue) and then release the animal in the location from which it was collected. Our sample size reflects careful consideration. Statistical rigor requires a minimum sample size of 30 individuals per location (Ruzzante 1998). Therefore, in the interest of collecting data with statistical rigor while minimizing the number of samples collected, our target sample size will be 30 specimens per species per site with 50 per site as an upper bound only to be reached with species for which nonlethal sampling is successful. DNA aliquots will be maintained in long-term storage at HIMB so that the genetic material is available for future studies. Every effort will be made to minimize the impact of these collections on the natural communities. Please note that we recognize the challenge of sampling these cryptic communities without using chemical anesthetics but have had some success hand sampling these communities around O'ahu. If we are unable to aquire adequate sample sizes to assess within-atoll variation and connectivity, we will still be able to assess larger scale connectivity across the Archipelago (connectivity of these species has not been assessed previously), as well as addressing the ecological questions posed in Objectives 1, 2, and 4.

This project includes a fourth main objective where the data collected will be synthesized with complementary data sets to develop a metacommunity model. This model will be used to assess community resilience to perturbation.

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:
Hawaiian lionfish, speckled scorpionfish, dwarf scorpionfish, Hawaiian velvetfish, common guard crab, yellow-spotted guard crab, brown guard crab, rusty guard crab, cauliflower coral shrimp, elated drupe

Scientific name:
Dendrochirus barberi, Sebastapistes coniorta, Sebastapistes fowleri, Caracanthus typicus, Trapezia intermedia, Trapezia flavopunctata, Trapezia digitalis, Trapezia bidentata, Alpheus lottini, Drupella cornus

& size of specimens:
30-50/species/site, 8-16 sites; all sizes

Collection location:
French Frigate Shoals, Gardner Pinnacles, Maro Reef, Laysan, Lisianski, Pearl and Hermes, Midway, Kure, Nihoa, Mokumanamana (we are planning to collect at a minimum of 8 sites, maximum of 16, ideally spread around 1 to 4 atolls)

☒ Whole Organism ☒ Partial Organism

9b. What will be done with the specimens after the project has ended?
To the greatest extent possible, specimens will be frozen and vouchered so that future research efforts can use archived material instead of collecting new specimens. Preserved tissue samples suitable for DNA work will be archived at HIMB for future permitted uses. No samples will be provided to researchers outside HIMB unless a material transfer agreement is provided by the Monument.

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?
Frozen fin clips, tissue samples, and fish collected for genetic analysis will be transported aboard the RV Hi'ialakai.

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, Toonen, and Bowen laboratories at HIMB.
The species included in this study have not previously been sampled by the Toonen and Bowen laboratories; these samples, as well as any relevant past and future collections, will be shared. At this point, we anticipate sharing these samples with Dr. Robert Toonen, [redacted] Dr. Brian Bowen, [redacted] We are open to sharing with other scientists who express interested, with appropriate monument approval.

12a. List all specialized gear and materials to be used in this activity:
Divers with use standard open-circuit SCUBA and snorkeling equipment .
Survey data will be collected using underwater flashlights, dive slates, a high resolution digital camera in underwater housing, and GoPro high definition video cameras.
Genetic data will be collected using a collection bag, polespear, hand nets, and tissue biopsy tools. Tissue preservative solutions will be used post tissue collection.

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; MSDS attached), and saturated salt buffer with dimethylsulfoxide (DMSO; MSDS attached).

13. Describe any fixed installations and instrumentation proposed to be set in the Monument:
None.

14. Provide a time line for sample analysis, data analysis, write-up and publication of information:
Data analysis, write-up of observed metacommunity dynamics including species interactions from the video footage, and development of a realistic metacommunity model will be completed within 1-3 years of this cruise. Regardless of the time to publication, the results from these studies will be 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 will also communicate with NGO community and general public through 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 a year 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 any published results. However, Donahue has published previously on metacommunity models (listed below). Please see attached CVs for other publications that are not directly related to this project.

Chesson P, MJ Donahue, B Melbourne, and AL Sears. 2005. Scale transition theory for understanding mechanisms in metacommunities. In M. Holyoak, M. Leibold, and R. Holt, editors. Metacommunties: spatial dynamics and ecological communities.
Melbourne B, AL Sears, MJ Donahue, and P Chesson. 2005. Applying scale transition theory to metacommunities in the field. In M. Holyoak, M. Leibold, and R. Holt, editors. Metacommunties: spatial dynamics and ecological communities.

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Balvanera, P., A.B. Pfisterer, N. Buchmann, J.S. He, T. Nakashizuka, D. Raffaelli, B. Schmid. 2006. Quantifying the evidence for biodiversity effects on ecosystem functioning and services. Ecology Letters 9: 1146-1156.

Cardinale, B.J., D.S. Srivastava, J.E. Duffy, J.P. Wright, A.L. Downing, M. Sankaran, C. Jouseau. 2006. Effects of biodiversity on the functioning of trophic groups and ecosystems. Nature 443: 989-992.

Cavender-Bares, J., K.H. Kozak, P.V.A. Fine, S.W. Kembel. 2009. The merging of community ecology and phylogenetic biology. Ecology Letters 12: 693-715.

Chesson, P., M.J. Donahue, B. Melbourne, A.L. Sears. 2005. Scale transition theory for understanding mechanisms in metacommunities. In M. Holyoak, M. Leibold, and R. Holt, editors. Metacommunities: spatial dynamics and ecological communities.

Friedlander, A.M., E.E DeMartini. 2002. Contrasts in density, size, and biomass of reef fishes between the northwestern and the main Hawaiian Islands: the effects of fishing down apex predators. Mar Ecol Prog Ser 230:253–264.

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Mouquet, N., M. Loreau. 2003. Community patterns in source-sink metacommunities. The American Naturalist 162(5): 554-557.

Martens, P., J. Rotmans, D. de Groot. 2003. Biodiversity: luxury or necessity? Global Environmental Change 13: 75-81.

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Selkoe, KA, BS Halpern, RJ Toonen. 2008. Evaluating anthropogenic threats to the Northwestern Hawaiian Islands. Aquatic Conservation. 18(7): 1149-1165.

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Sudekum, A.E., Parrish J.D., Radtke R.L., Ralston S. 1991. Life history and ecology of large jacks in undisturbed, shallow, oceanic communities. Fish Bull 89:493–513.

Tolimieri, N., A. Jeffs, J.C. Montgomery. 2000. Ambient sound as a cue for navigation by the pelagic larvae of reef fishes. Marine Ecology Progress Series 207: 219-224.

Toonen, R.J., K.R. Andrews, I.B. Baums, C.E. Bird, C.T. Concepcion, T.S. Daly-Engel, J.A. Eble, A. Faucci, M.R. Gaither, M. Iacchei, J.B. Puritz, J.K. Schultz, D.J. Skillings, M. Timmers, B.W. Bowen. 2011. Defining boundaries for applying ecosystem-based management: A multispecies case study of marine connectivity across the Hawaiian Archipelago. Journal of Marine Biology, Article ID 460173

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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

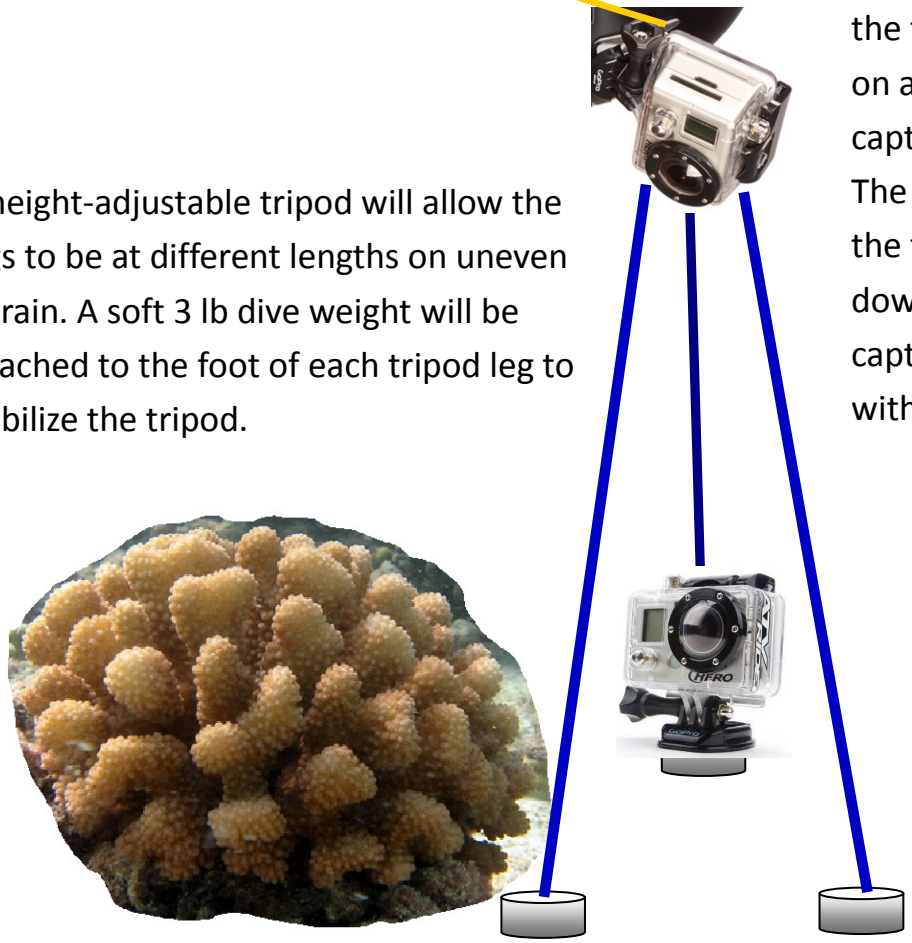
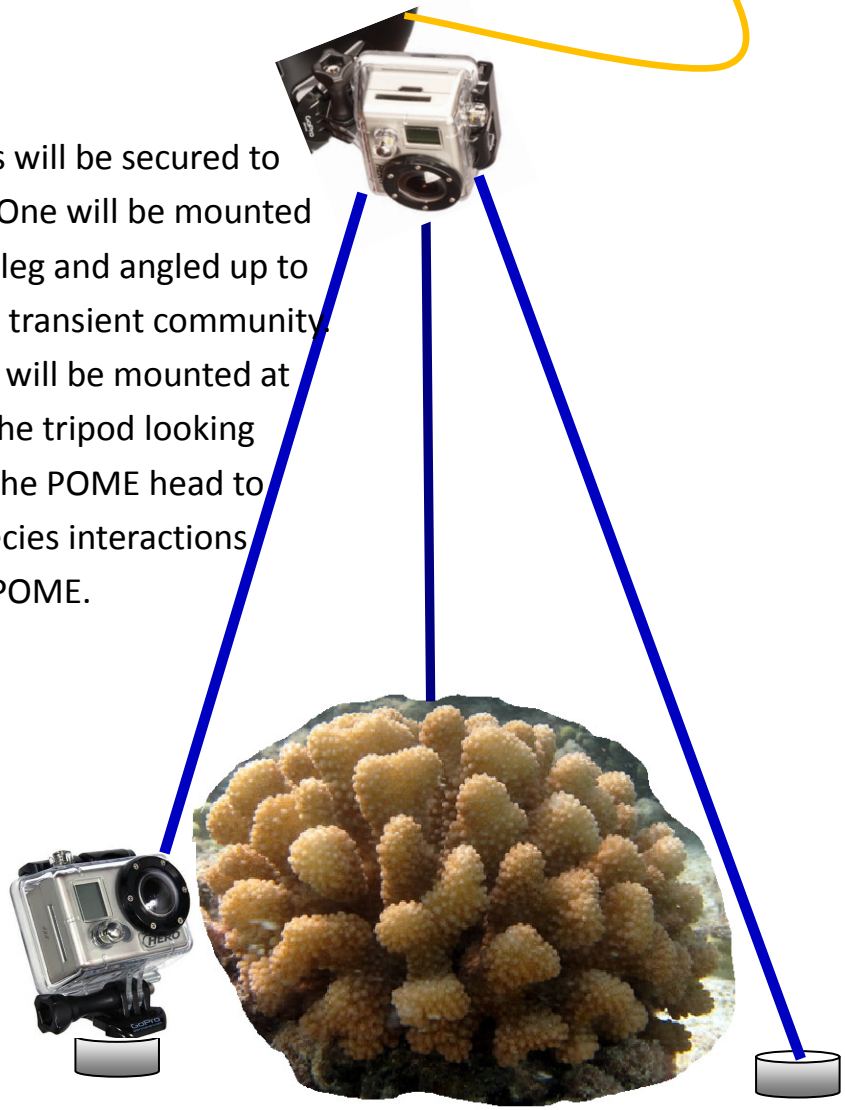
DID YOU INCLUDE THESE?

☒ 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

Species	Sites*	Individuals per Site (count)	Size Range	Lethal Sampling (Y/N)
Hawaiian lionfish, *Dendrochirus barberi*	4-8 FFS sites, 4-8 PHR sites, 4 Midway sites, 4 Kure sites	30	3-10 cm, TL	Y
Speckled scorpionfish, *Sebastapistes coniorta*	4-8 FFS sites, 4-8 PHR sites, 4 Midway sites, 4 Kure sites	30	3-10 cm, TL	Y
Dwarf scorpionfish, *Sebastapistes fowleri*	4-8 FFS sites, 4-8 PHR sites, 4 Midway sites, 4 Kure sites	30	3-10 cm, TL	Y
Hawaiian velvetfish, *Caracanthus typicus*	4-8 FFS sites, 4-8 PHR sites, 4 Midway sites, 4 Kure sites	30	3-10 cm, TL	Y
Common guard crab, *Trapezia intermedia*	4-8 FFS sites, 4-8 PHR sites, 4 Midway sites, 4 Kure sites	30-50	1-5 cm CW	N
Yellow-spotted guard crab, *Trapezia flavopunctata*	4-8 FFS sites, 4-8 PHR sites, 4 Midway sites, 4 Kure sites	30-50	1-5 cm CW	N
Brown guard crab, *Trapezia digitalis*	4-8 FFS sites, 4-8 PHR sites, 4 Midway sites, 4 Kure sites	30-50	1-5 cm CW	N
Rusty guard crab, *Trapezia bidentata*	4-8 FFS sites, 4-8 PHR sites, 4 Midway sites, 4 Kure sites	30-50	1-5 cm CW	N
Cauliflower coral shrimp, *Alpheus lottini*	4-8 FFS sites, 4-8 PHR sites, 4 Midway sites, 4 Kure sites	30-50	1-3 cm CL	N
Elated drupe, *Drupella cornus*	4-8 FFS sites, 4-8 PHR sites, 4 Midway sites, 4 Kure sites	30	1-4 cm SL	Y

*Ideally we will sample from 8 distinct sites around French Frigate Shoals (FSS) and 8 distinct sites around Pearl and Hermes (PHR). If cruise logistics are such that there is not enough time for 8 sites at these two locations, but there is enough time to sample 4 sites at these locations and at two other locations, then we will survey at 4 sites around each of four locations (e.g., FFS, PHR, Midway, and Kure). Each site is up to one hectare in size.

A Pelican float will be attached to each tripod. Pelican floats will allow retrieval of the camera system from the boat, after the divers have surfaced. Plenty of slack will be available in the line to account for wave action. The the surface floats will only be deployed when there is no surface current.

Two GoPros will be secured to the tripod. One will be mounted on a tripod leg and angled up to capture the transient community. The second will be mounted at the top of the tripod looking down into the POME head to capture species interactions within the POME.

A height-adjustable tripod will allow the legs to be at different lengths on uneven terrain. A soft 3 lb dive weight will be attached to the foot of each tripod leg to stabilize the tripod.