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: Courtney Couch
Affiliation: UH Manoa, Hawai'i Institue of Marine Biology (HIMB)

Permit Category: Research
Proposed Activity Dates: May 1st - December 3rd, 2015 (specific dates TBD)
Proposed Method of Entry (Vessel/Plane): R/V Hi'ialakai
Proposed Locations: (Shallow water reef (<100 ft depth), TBD, dependent on NOAA field cruise destinations)

Estimated number of individuals (including Applicant) to be covered under this permit: 6 (Dr. Courtney Couch, Jamie Sziklay Caldwell (co-field PI), Megan Ross, John Burns, Nyssa Silbiger, TBD). Only 2-3 individuals will need to enter the Monument to perform field surveys.

Estimated number of days in the Monument: 60

Description of proposed activities: (complete these sentences):

a.) The proposed activity would…

Assess the health and community structure of corals on shallow-water reefs throughout the Papahānaumokuākea Marine National Monument. Our survey techniques will utilize a stratified-random to objectively survey the spatial variation in coral health at multiple sites within the Monument. We will also re-survey existing permanent and compare coral health data to previous studies to determine whether and to what degree coral health is changing in the Monument. These data will also be invaluable in determining the long-term implications of the 2014 bleaching event on coral disease risk and bleaching recovery. The resulting data will enable a comprehensive examination of coral health at large spatial scales throughout the Monument and the necessary framework for understanding the long-term consequences of coral disease in PMNM. In addition, surveys will be used to validate predictive models of coral disease outbreak risk.

b.) To accomplish this activity we would ….

Conduct surveys using SCUBA on shallow-water reefs to collect data on the health of corals as well as coral community structure along belt transects. Detailed descriptions of the surveyed colonies and visible disease lesions and signs of compromised health (e.g. bleaching, algal overgrowth, breakage) will be recorded to calculate prevalence and severity of each condition. By assessing coral health and disease along a subset of permanently marked transects, we will also be able to track disease prevalence, severity, incidence and rate of disease progression over time and compare those metrics of coral health with previous coral health surveys conducted in the Monument between 2004-2014. We will also conduct overlapping photo and video surveys in order to create digital reconstructions of the benthic habitat, which builds on previous research conducted in 2012 and 2013. Ultimately we will obtain detailed data on the community structure and health characteristics of surveyed corals. This research will allow us to decipher important characteristics of reduced health states affecting corals in the Papahānaumokuākea Marine National Monument.

c.) This activity would help the Monument by …

Enabling a detailed analysis of coral health and community structure on shallow-water reefs of the Papahānaumokuākea Marine National Monument. Surveying at randomly chosen coordinates within each site will create a robust dataset for an objective analysis of the prevalence and severity of coral health afflictions. These data will also be incorporated into a larger Indo-Pacific meta-analysis that addresses the role of global and local stressors in coral disease. By establishing new permanent transects and/or resurveying exisiting ones, we will also be able to determine how coral health is changing over time and what effects potential disease outbreaks and the recent thermal stress may have on long-term coral demographics. The photo and video surveys will provide useful data for assessing the dynamics of coral community structure throughout the Monument. This research will be critical for tracking changes to coral health and ecosystem function in the face of increasing global stressors such as climate change and ocean acidification. Surveys will also serve to validate forecasting models of coral disease outbreak risk currently in development at the University of Hawaii and NOAA Coral Reef Watch, which the Monument can use in the future to assess disease outbreak risk and overall probability of coral health state in relation to remotely observed environmental stressors.

Other information or background:

Given the rising threat of climate change, severity of the 2014 bleaching event and strong link to increased bleaching and disease risk, it is imperative to continue monitoring coral health using standardized survey methods that facilitate broad scale analyses both within the Papahānaumokuākea Marine National Monument and across the Pacific. In 2014, we collaborated with PMNM to expand and enhance their coral health monitoring program for the Papahānaumokuākea Marine National Monument by adapting standardized methods used by experts across the Indo-Pacific. With our 2014

PMNM permit and support from PMNM, we were able to document the 2014 bleaching event in August 2014, then return in September 2014 to survey permanent transects. These permanent transects will be crucial quantifying the level of bleaching recovery or associated mortality, potential disease outbreaks, and changes in coral community dynamics. Utilizing an objective and randomized survey approach on reefs throughout the Papahānaumokuākea Marine National Monument will enhance the capability for monitoring the health of coral populations over broad spatial scales within this valuable ecosystem. By using a combination of stratified-random and permanent sites, we will be able to assess both large scale variation in coral health across the Monument as well track disease progression and incidence rates over time in sites of concern. Surveys will be incorporated into a larger regional database of coral health observations primarily to validate predictive models, and provide a robust dataset for assessing disease characteristics at the population level. We are also requesting permission to opportunistically sample a small number coral fragments for histopathology on unknown coral lesions. While most coral lesions in PMNM have been previously characterized by Dr. Greta Aeby, we would like the opportunity to sample previously undescribed lesions since histopathological assessments have not been conducted in the Monument during the last ten years. Through this research, we will not only be able to provide mangers with information on how coral health differs spatially across the Papahānaumokuākea Marine National Monument and target sites with declining coral health, but also provide a crucial basis against which to compare future change.

Section A - Applicant Information

1. Applicant

Name (last, first, middle initial): Couch, Courtney, S.

Title: Postdoctoral Fellow, UH Manoa, HIMB

1a. Intended field Principal Investigator (See instructions for more information):
Dr. Courtney Couch, Jamie Caldwell

2. Mailing address (street/P.O. box, city, state, country, zip): [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):
HIMB, UH 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):
1. Dr. Courtney Couch, Research Diver & PI , Postdoc at UH Manoa/HIMB
2. Jamie Caldwell, Co-field PI, PhD Candidate at UH Manoa
3. John Burns, back up Research Diver, PhD Candidate at UH Manoa
4. Megan Ross, back up-Research Diver, PhD Candidate at UH Manoa
5. John Burns, back-up Research Diver, PhD Candidate at UH Manoa
6. TBD, Back up Research Diver, PhD Student Candidate at at UH Manoa

**Only 2 to 3 divers will be participating in this research.

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			

☐ Remaining ashore on any island or atoll (with the exception of Midway & Kure Atolls and Field Camp staff on other islands/atolls) between sunset and sunrise.

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

Location Description:

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:***
The purpose of our proposed activities is to perform visual surveys to collect coral health data for shallow-water reefs throughout the Papahānaumokuākea Marine National Monument. This work is needed in order to monitor and track changes in coral health on reefs within this valuable and pristine ecosystem. Corals provide the foundation of productive reef ecosystems throughout Hawai'i, as global changes affect marine environments it is important to track and quantify impacts imposed on coral reefs. As one of the world's few 'near-pristine' coral reef ecosystems, Papahānaumokuākea Marine National Monument provides an invaluable system against which to compare regions with high levels of anthropogenic stress. Through these comparisons, we will be able to assess the relative contribution of global and local stressors to coral disease dynamics in the Indo-Pacific. Our comprehensive coral health and disease monitoring program will also serve as a model for other Big Ocean sites, many of which do not have standardized coral health programs in place. The proposed methods in this permit will complement and improve upon the current assessments of coral health that utilize permanent survey sites and repeatedly survey colonies. In addition, our stratified random design will enable us to assess spatial variation in coral health dynamics throughout the Monument while still working within the logistical constraints of PMNM cruises. By characterizing spatial variation in coral health, PMNM managers will be able to identify areas of high disease prevalence and severity. Furthermore, continuing these surveys over time will equip managers with the capability to temporally track the health of coral populations within the Monument. While we do not anticipate needing to sample a large number of coral lesions due to previous research, it will be important to sample previously un-described lesions to understand the underlying causes of the lesion and distinguish coral disease from other conditions such as predation. This approach is especially valuable in coral that demonstrate a limited number of responses (e.g. lesions) to a broad suite of abiotic and biotic stressors. The proposed surveys will also provide data to validate predictive models of disease outbreak risk. NOAA Coral Reef Watch (CRW) currently produces an experimental disease risk assessment based on one disease type (white syndromes) in another coral reef ecosystems (Great Barrier Reef). Jamie Caldwell is currently developing the Coral Disease Outbreak Risk for the Hawaiian Islands to assess risk of 28 conditions associated with compromised health state, including 14 diseases, by evaluating remotely sensed environmental drivers of coral disease. The models provide *Seasonal Outlooks* at the end of winter season and near-real time *Outbreak Risk* throughout the summer months. These *Outlooks* provide an early warning system for managers and will improve the capacity of PMNM to monitor and manage coral health threats within this expansive reef system. The forecasting models will be incorporated into the NOAA-CRW suite of monitoring tools for use into the foreseeable future.

*Considering the purpose of the proposed activities, do you intend to film / photograph federally protected species? Yes ☐ No ☒

For a list of terrestrial species protected under the Endangered Species Act visit:
http://www.fws.gov/endangered/
For a list of marine species protected under the Endangered Species Act visit:
http://www.nmfs.noaa.gov/pr/species/esa/
For information about species protected under the Marine Mammal Protection Act visit:
http://www.nmfs.noaa.gov/pr/laws/mmpa/

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?
As conservation biologists, we study how best to conserve the ecological integrity of marine ecosystems and ensure that our science has the least amount of impact on theses ecosystems as possible. As the PI on this project, I will also ensure that every member of my team respects the natural and cultural resources around them and take every precaution to minimize their impacts during our fieldwork. 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. 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 and cultural resources of the Monument. No surveys or collections will occur in the vicinity of any known Native Hawaiian or western archaeological sites within the Monument, and thus, are unlikely to impact any such resources. If possible archaeological sites are seen, Global Positioning System (GPS) coordinates for the sites as well as a general description will be taken and provided to Monument staff.

Field Surveys (Stratified random design):
Surveys will be conducted in a manner that brings the divers in very limited direct contact with the natural resources and corals that are visually assessed will not be collected. All data is collected visually using transect surveys and photographs. The only physical impact is the deployments of transect tape. Transects will be carefully deployed and placed above the substrate in a manner to ensure no harmful contact with any living corals or other organisms. No tape will be wrapped or anchored in any

manner that could damage any living coral or substrate. The methods used to deploy transect tape are nearly identical to those used for CRED research activities and will have the same negligible impact on living substrate. Our research team has substantial experience conducting surveys in this manner and is adequately trained (please see diver qualification descriptions in Question #7-F) to avoid imposing any harmful affects on the benthic substrate.

Field Surveys (Permanent transects):
When possible, we will use existing permanently marked transects to track coral health dynamics through time. We will resurvey permanent transects that were surveyed in 2014 and established by Dr. Couch, Dr. Jim Maragos, Dr. Greta Aeby and NOAA's CRED. If we encounter a new disease outbreak, such as those previously reported on French Frigate Shoals or severe bleaching such as the 2014 bleaching at Lisianski Island and there are no existing permanent transects in that location, we will establish three permanent transects per site. Great care will be taken to ensure that the steel stakes are installed into the dead coral substrate and/or bare rock. At no point will any installation gear be placed on or come in contact with live coral. Whenever possible, we will use existing permanent transects.

Coral Sample Collection:
Coral tissue samples will only be taken from previously un-described lesions to minimize the number of samples collected during this project. Given the extensive previous research on coral histopathology in the Monument, we anticipate that our sample collection needs will be minimal (no more than 80-4cm2 fragments in total) and only collected from colonies greater than 20cm in diameter. If sample collection is deemed necessary, tissue will be collected from an apparently healthy region of the colony and lesion margin. Apparently healthy tissue is necessary to confirm the absence of the etiological agent compared to the lesion tissue. Whenever possible, we will collect tissue from the apical regions of the coral colonies, which have the capacity to heal faster than the central regions. Dr. Couch has extensive experience in coral sampling and histopathology, and has developed sample collection techniques that minimize damage to the overall colony. For branching species, we will use clippers to remove the region in question. For massive or encrusting taxa, we will create a shallow set of angled groves by lightly tapping with a hammer and chisel around the areas of interest until the "plug" is removed. In all cases, we will collect no more than 4cm2/sample. Samples will immediately be placed in whirl pak bags and transported to the surface, transported back to the ship, and immediately placed in air/water tight specimen containers filled with zinc-buffered formalin. These specimen bottles will be placed in a larger watertight container for transportation on the ship to ensure that no fixative is released into the surrounding water. At no point will any live tissue be transported between sites or released back into the marine environment.

Equipment and Dive Gear Disinfection:
If sample collection of coral lesions is necessary, we will follow PMNM's Best Management Practices #011 (DISEASE AND INTRODUCED SPECIES PREVENTION

PROTOCOL FOR PERMITTED ACTIVITIES IN THE MARINE ENVIRONMENT) to prevent disease spread.

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.

Each participant is required to participate in a Cultural Briefing prior to departure on the Hi'ialakai. In addition, the chief scientist, other appropriate personnel and myself will consult with the Office of Hawaiian Affairs (OHA) and the Monument's Native Hawaiian program coordinator on proper conduct while in the NWHI, on cultural sensitivities associated with the proposed activities and locations. 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. 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 traveled for hundreds of years. Because of the close relationship between Native Hawaiians and the ocean, the marine life of Papahanaumokuakea also constitute a living cultural resource whose well-being is integral to the perpetuation of cultural values and practices. We acknowledge that the corals we will survey hold great cultural significance to Native Hawaiians, in spiritual, religious, nutritional, utilitarian, and other ways. Similar to the Reef Assessment and Monitoring Program (RAMP) and NOAA CRED program, we aim to characterize and monitor the Monument's living marine resources, and directly inform traditional managers and Native Hawaiian practitioners of the health of these fragile resources within the Monument. We strive to approach our work in the Monument with the same humility, and regard for the natural world as these people. 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 Papahanaumokuakea. Dr. Couch will continue to provide updates to the Monument Management Board as upon request and will coordinate with Monument staff to ensure that information, imaging and outreach materials are disseminated to broader communities.

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”.

According to the Kumulipo, the coral polyp was the first life form to be created. This genealogical chant shows a deep respect for corals as the backbone of our productive marine ecosystems. Corals deserve this appreciation as they provide habitat for a plethora of creatures, many of which we depend on for food. Due to their profound ecological and cultural importance, it is imperative that we work to conserve and protect Hawaiian corals. Our goal is to collect data on the health and structure of coral communities in order to monitor and protect these organisms. Hawaiian corals can be considered as Kupuna that we must care for, as they are the ancestors and backbone of all marine life. Loss of corals will result in loss of habitat and function of the marine ecosystems. We hope our work will provide insight into the health of corals within the monument as well as what factors may be connected to reduced health and disease. Ultimately this work aims to safeguard these culturally and ecologically important organisms. The research methods utilized in this study have no detrimental impacts on the marine ecosystems within the Monument. The goal of collecting coral health data is to determine the impacts of deleterious health afflictions and provide management with information necessary for maintaining healthy coral reef ecosystems. Implementing our proposed survey approach, utilizing random sampling design, will facilitate objective results at the population level. These results will allow managers to identify sites of concern with ongoing disease outbreaks and/or high abundance of susceptible coral taxa. It will also allow managers to better understand the underlying processes determining disease dynamics throughout the Monument. Our proposed methods directly complement the annual Reef Assessment and Monitoring Program (RAMP) by providing more detailed data on coral health, and a standardized monitoring program for future surveys. For instance, RAMP coral disease surveys utilize categorical variables for colony size and disease severity. Our methods encompass more comprehensive disease assessments by monitoring not just disease, but also other biological interactions such as algal overgrowth, pigmentation response and predation that are often just as important as disease in colony-level mortality. Furthermore, we record extensive details of disease-related features such as colony morphology (branching, encrusting, etc.) and lesion descriptions proposed by Work and Aeby (2006, Diseases of Aquatic Organisms) in order to develop a comprehensive epizootiological (the study of the frequency, distribution, and causation of disease in an animal population; the counterpart in nonhuman animals of epidemiology) dataset. Conducting overlapping photo and video surveys provide a detailed assessment of coral community structure at each surveyed location. The resulting data enables a more thorough characterization of reduced coral health states and disease dynamics. Utilizing this epizootiological approach has enabled previous identification of environmental and biological parameters (disease co-factors) associated with disease severity (Burns and Takabayashi 2011, Couch et al. 2014). Combining epizootiological data with ecosystem characterization data collected throughout the Monument may provide critical insight into environmental co-factors associated with coral health. By sampling with a stratified random design we will obtain an objective assessment of coral health and community structure that will complement data collected from permanent survey sites and repeatedly surveyed colonies. Utilizing the random sampling design, we will develop a robust dataset that will enable an objective determination of coral

health characteristics at the population level. We also propose to return to permanently marked sites/transects established by CRED and Dr. Greta Aeby in previous surveys (Aeby et al. 2011) to assess the fate of previous disease outbreaks. By resurveying these transects, we will be able to determine how outbreaks have changed in susceptible populations such as the Acroporids in French Frigate Shoals. Ultimately, the dataset will allow for multiple disease parameters to be analyzed, in addition to those collected with RAMP and other surveys, in order to improve the understanding of coral health and forecast disease risk throughout 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.

It is important that these research activities be conducted as they are not invasive and will provide useful data for monitoring and assessing coral health within the Monument. There is no practicable alternative as the goal is to develop a robust dataset pertaining to coral health dynamics within the Monument itself. Our proposed survey methodology will complement and enhance the current coral health data being collected in the Monument. Utilizing a stratified random sampling design will provide a platform to determine general trends of coral health (prevalence and severity, spatial and temporal patterns, disease co-factors) at the population level. By conducting repeated surveys at the same location and on the same colonies, we will be able to determine how incidence, transmission, and progression are changing over time. This will complement the surveys being conducted at repeatedly visited sites and be immensely useful for assessing coral health characteristics throughout the Monument. Furthermore, this work will provide valuable data for meta-analyses of the processes driving coral disease dynamics across the Indo-Pacific and validate predictive models of coral disease outbreak risk.

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

These data will be of great value for aiding management decisions and tracking changes in coral health across spatial and temporal scales. The end value of these activities will greatly outweigh the impacts since the survey methods are non-invasive and will have relatively no effect on the coral reef ecosystems. Conducting surveys at several sites within the Monument will enable assessment of disease dynamics at various spatial scales. All transect locations will be georeferenced to enable multiple post-hoc spatial analyses. These data will help identify sites with compromised coral health as well as elucidate the underlying processes determining disease risk. By collating data pertaining to site characteristics (i.e. benthic data, water quality data, fish data) with coral health data we can also develop predictive models to assess drivers of the various disease states. For example, coral colony size and water motion are strong determinates of coral disease on Hawai'i Island (Burns et al. 2010, Couch 2014). We can also perform spatially based analyses, such as the nearest neighbor algorithm, to investigate if the prevalence of certain afflictions display patterns indicative of vector-

borne disease transmission. While our proposed methods are more detailed than those conducted by RAMP surveys, certain basic parameters can still be combined to improve the spatial resolution of coral health data collected throughout the Monument. Data from the Monument can also be collated with data collected from the Main Hawaiian Islands and wider Indo-Pacific to assess patterns in coral health across the Hawaiian archipelago. Continuing our surveys in the future will enable an even more robust temporal analysis, this may be very useful when investigating disease severity and can shed light on which health afflictions pose the largest "threat" to coral reefs within the Monument.

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

The duration of our activities is dependent on the planned NOAA research cruises. We will use the allotted time efficiently to maximize our data collection, therefore needing no time outside that planned by the PMNM research coordinators.

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

Our research team has been conducting coral health surveys throughout Hawai‘i the last seven years. Through this research, we have not only acquired extensive experience in coral disease science, experimental design, monitoring, and data analysis, but we have also developed the a profound respect for Hawaii's cultural resources. Our work has resulted in multiple publications and presentations. John and Jamie have also previously conducted research in the Monument.

John is a PhD candidate at UH Manoa, and is a graduate as well as an instructor for the QUEST program. He is a NAUI instructor as well as a lead scientific diver and supervisor/trainer for the UH Dive Safety program, and he is also a certified fill station operator. John is also currently working on several large grant collaborations collecting coral health data using SCUBA from several sites throughout Hawai’i Island. Jamie is a PhD candidate at UH Manoa and is currently developing predictive models of disease risk in Hawaii. She is a NAUI Master Diver with NITROX certifications, as well as an active member of the UH Dive program. Jamie successfully conducted coral health surveys with in PMNM in 2013. Megan is a graduate student specializing in coral demographics and coral disease ecology. Megan has conducted extensive field studies on the causes of coral cover loss on Maui and has conducted detailed assessments of *Montipora* white syndrome outbreaks along East Maui. She has extensive scientific diving experience and is an active UH diver. Dr. Couch is a postdoctoral research fellow at the Hawaii Institute of Marine Biology. She is currently co-funded by NOAA/PMNM and The Nature Conservancy to standardize coral health and disease monitoring across the Indo-Pacific, address the role of land-based pollution in coral health in Hawai‘i, and build capacity with marine resource managers to address coral disease. She

successfully lead coral health and disease surveys during on two 2014 PMNM cruises and was responsible for documenting the coral bleaching event that affecting many of the Monument's reefs. She has ten years of scientific diving experience, as well as NAUI Rescue Diver, Nitrox and AAUS certifications. She was also the lead diver on a 3-year coral health disease project on Hawai'i Island and a 2-year project in Indonesia through Cornell University. Dr. Couch also an active University of Hawai'i Diver. She has also conducted coral disease assessments in the Caribbean, Philippines and Indonesia, and have extensive experience in managing and analyzing large datasets. Collectively our work has resulted in several coral health related publications and presentations that are listed below in our Permit Application as well as in Dr. Couch's attached curriculum vitae.

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 research labs of Megan Donuahue (Dr. Couch's postdoc mentor) is well funded by several grants and are equipped with all the analytical software necessary for disseminating the collected data. Due to the un-invasive nature of our survey methods we would be capable of mitigating any potential impacts if they occurred.

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 methods and procedures are designed to be un-invasive and as thorough as possible. We utilize a unique approach to assessing coral health and colony characteristics in order to decipher the dynamics of health afflictions at the population scale. As mentioned above, our surveys use quantitative and detailed methodology to create a comprehensive epizootiological dataset pertaining to coral health for all surveyed areas. We plan to assess and measure any and all forms of visible coral health afflictions present on surveyed corals within the Monument. Several parameters, such as disease prevalence and severity, can be collated with RAMP data and the Hawaii Coral Disease Database to assess temporal changes in coral health. If we are fortunate to continue performing these surveys in the future, we will be able to comprehensively assess changes in coral health over time on surveyed reefs throughout the Monument and provide invaluable information on the long-term effects of the bleaching event. Georeferencing our survey areas allow for various spatial analyses to be employed to investigate disease dynamics within and between surveyed sites. Georeferencing the coral health data will also enable spatial comparisons to sites within the Indo-Pacific. Incorporating terrestrial and marine parameters in the spatial analyses will have great utility for determining ecosystem characteristics associated with coral health. Once we determine the impacts of these diseases at the organismal level our findings can be collated with disease severity data to quantify the impact and threat of various diseases at the population level within the Monument. Ultimately, this work will provide the Monument with a comprehensive and robust dataset pertaining to the health

of shallow-water coral reefs and enable testing and validation of predictive models of coral disease outbreak risk. Corals are a cultural and ecological resource, providing critical habitat to a multitude of marine species. It is important to determine disease co-factors and track health changes to avoid any large-scale mortality associated with outbreaks of disease.

i. Has your vessel been outfitted with a mobile transceiver unit approved by OLE and complies with the requirements of Presidential Proclamation 8031?
Our work will be conducted in conjunction with the planned NOAA summer field cruises; we will therefore operate on NOAA vessels and be in compliance with all marine vessel requirements.

j. Demonstrate that there are no other factors that would make the issuance of a permit for the activity inappropriate.
Our activities in PMNM will be restricted to those explicitly described in this permit application.

8. Procedures/Methods:
Surveys will be conducted using SCUBA, transport to the sites will be facilitated by NOAA research vessels. Two divers will descend on the shallow-water coral reef sites (~15-80ft) chosen for surveys. Divers will deploy 3 15 to 20m transects at a pre-determined location in the direction of a pre-determined bearing. Transect locations will be established by utilizing a random stratified sampling design in order to objectively survey all study sites. Working in unison, divers will investigate all corals underneath the deployed transect tape. Divers will record multiple parameters, such as colony size and severity (proportional surface area affected), for each surveyed colony and visible health affliction. All observed colonies will also be photographed to facilitate digital image analyses. Divers will also conduct an overlapping photo and video survey so the transect can be digitally reconstructed. The analyzed data will be used to determine coral health dynamics (i.e. spatial, temporal, co-factors) for all surveyed reefs within the Monument.

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:

Table coral, finger staghorn coral, rice coral, branching rice coral, pork chop coral, corrugated coral, maldive coral, ocellated coral, crust coral, oval mushroom coral, swelling coral, lace coral, thin cauliflower coral, cauliflower coral, antler coral, brigham's coral, finger coral, mound coral, lobe coral, nierstrasz's coral, stellar coral

Scientific name:
Acropora cytherea, Acropora humilis, Montipora capitata, Montipora incrassata, Pavona duerdeni, Pavona varians, Pavona maldivensis, Cyphastrea ocellina, Leptastrea purpurea, Fungia scutaria, Leptoseris incrustans, Pocillopora damicornis, Pocillopora eydouxi, Pocillopora ligulata, Pocillopora meandrina, Porites brighami, Porites compressa, Porites evermanni, Porites lobata, Psammocora nierstraszi, Psammocora stellata

& size of specimens:
up to a total of 80 coral fragments, with a maximum fragment size of 4cm2 each

Collection location:
a maximum of 10 fragments per island region at up to 8 regions

☐ 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 Couch will maintain a database of samples and provide for the storage of all samples collected at HIMB until such time as the Monument co-trustees request that they be returned to them.

9c. Will the organisms be kept alive after collection? ☐ **Yes** ☒ **No**
All samples will be preserved in 20% zinc-buffered formalin (Z-fix) immediately following collection. This will be conducted by placing samples in pre-filled watertight specimen jars with zinc-buffered formalin. These jars will be transported in an air and watertight container to prevent chemical pollution into PMNM waters.

• General site/location for collections:
Collections will be stored in the wetlab on the Hi'ialakai after field collection and then kept at Dr. Megan Donahue's lab at HIMB.

• Is it an open or closed system? ☐ Open ☐ Closed
N/A

• Is there an outfall? ☐ Yes ☒ No

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

• Will organisms be released?
At no point will any live samples be transported between locations or released back into Monument waters.

10. If applicable, how will the collected samples or specimens be transported out of the Monument?
Specimen jars will be transported in an air and watertight container to prevent chemical pollution into Monument waters. These will be 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 Drs. Couch and Aeby at HIMB, PMNM and the RAMP program, and NOAA CRED. Given Dr. Aeby's previous coral disease research and description of coral lesions using histopathology, we will collaborate with Dr. Aeby and NOAA CRED to review previously described lesions prior to the 2015 PMNM cruises. These surveys will also be conducted alongside the RAMP divers to ensure that the data augment ongoing benthic monitoring efforts and minimize overlap. We will only collect samples from previously un-described lesions or those that are unclear in origin. All findings will be discussed with coral disease specialists at HIMB, UH Hilo and NOAA CRED.

12a. List all specialized gear and materials to be used in this activity:
Coral health and disease surveys: SCUBA gear (BCD, regulator, mask, fins, snorkels, weights, computers, compass, dive knife), slates, rulers, underwater cameras, transect tape. Rebar stakes and cable ties may also be used if permanent transects are established.

Coral lesion collection: whirl pak bags, hammer, chisel, clippers, specimen bottles, air/water tight bins, 20% zinc-buffered formalin.

12b. List all Hazardous Materials you propose to take to and use within the Monument:
Tissue preservation solutions include zinc-buffered formalin (Z-fix). MSDS sheets attached.

13. Describe any fixed installations and instrumentation proposed to be set in the Monument:
If time permits, we will establish permanent steel stakes at a subset of sites of concern to determine whether coral disease levels are changing over time in PMNM. When

possible, we will use permanent transects previously established by Dr. Greta Aeby or NOAA CRED. If permanent transects are deemed necessary, we will drive steel stakes into the dead coral substrate and/or bar rock using a hammer. Two stakes will be used per transect to mark the beginning and end of the transects, with three transects per site (6 stakes per site). Each site will be marked with a GPS and all transects will be mapped, photographed and marked with cable ties (on the rebar stakes) to facilitate easy relocation in subsequent years.

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

Photo analyses, data analyses, sample processing and a report write-up will be completed within a year of the field surveys. We hope to complete several publications utilizing this coral health dataset within a few years of data collection.

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

• Burns JHR, Takabayashi M (2011) Histopathology of Growth Anomaly Affecting the Coral, Montipora capitata: Implications on Biological Functions and Population Viability. PLoS ONE 6(12): e28854

• Burns JHR, Rozet NK, Takabayashi M (2011) Morphology, severity, and distribution of growth anomalies in the coral, Montipora capitata, at Waiʻōpae, Hawaiʻi. Coral Reefs 30: 819-826

• Couch, C. S. 2014. Intrinsic host and extrinsic environmental factors of coral health and disease. PhD Dissertation, Dept. of Ecology and Evolutionary Biology, Cornell University.

• Couch, C. S., J. Garriques, C. Barnett, L. Preskitt, S. Cotton, J. Giddens, W. Walsh (2014). Spatial and Temporal Patterns of Coral Health and Disease along Leeward Hawai`i Island. Coral Reefs. DOI 10.1007/s00338-014-1174-x

• Ross, M., Stender, Y., White, D., Aeby, G. Outbreak of the coral disease, Montipora White Syndromein Maui, Hawaiʻi. Proceedings of the 12th International Coral Reef Symposium, Cairns, Australia, 9-13 July 2012.

• Walsh, W., R. Sparks, C. Barnett, C. Couch, S. Cotton, D. White, K. Stone, E. Conklin. 2013. Long-term monitoring of coral reefs of the Main Hawaiian Islands Final Report. 2009 NOAA CRCP. State of Hawai`i Monitoring Report. NA06NOS4260113.

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