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: John Burns
Affiliation: UH Manoa, Hawai'i Institue of Marine Biology (HIMB), UH Hilo, Friends of Papahanaumokuakea (PPO)

Permit Category: Research
Proposed Activity Dates: June 15th - December 31 2013 (specific dates TBD)
Proposed Method of Entry (Vessel/Plane): Vessel
Proposed Locations: (TBD, dependent on NOAA field cruise destinations)

Estimated number of individuals (including Applicant) to be covered under this permit: 4 (Dr. Ruth Gates, Dr. Misaki Takabayashi, Makani Gregg, and John Burns). Only 2 individuals will need to enter the Monument to perform field surveys.
Estimated number of days in the Monument: 30

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 sampling approach to objectively survey the health of corals at multiple sites within the Monument. The resulting data will enable a comprehensive examination of coral health at large-spatial scales throughout the Monument. This work will build upon the data collected during the 2012 research activities.

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. Detailed descriptions of the surveyed colonies and visible disease signs will be recorded. We will also conduct overlappying photo and video surveys in order to create digital reconstructions of the benthic habitat. 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. The photo and video survyes will provide useful data for assessing the dynamics of coral community structure thoughout the monuument. 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.

Other information or background: Our coral health survey methods have proved useful for determining the severity and prevalence of reduced health states and diseases. This research is critical for assessing the impacts of coral health afflictions to the overall health and function of shallow-water coral reef ecosystems. Utilizing an objective and randomized survey approach on reefs throughout the Papahānaumokuākea Marine National Monument will enhance the capability of tracking and monitoring the health of coral populations within this valuable ecosystem. Currently, coral health and disease is assessed using permanent monitoring sites and repeadetly observed colonies. This method has great utility for tracking disease progression and incidence rates, however the data is less useful for determing disease characteristics at the population level. Our methodology will improve the knowledge of coral health in the Monument by creating a robust dataset pertaining to large-scale population characteristics. Ultimately, this will provide useful information for managers such as; spatial and temporal dynamics of reduced health states and disease, cofactors (species, colony size, depth, etc.) related to coral health, and measures of severity for each observed health affliction.

Section A - Applicant Information

1. Applicant

Name (last, first, middle initial): Burns, John, HR

Title: Ph.D. Candidate at UH Manoa

1a. Intended field Principal Investigator (See instructions for more information):
John HR Burns

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

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

3. Affiliation (institution/agency/organization directly related to the proposed project):
HIMB, UH Manoa, UH Hilo, PPO

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. John Burns, Research Diver & Co-Principle Investigator, PhD Candidate at UH Manoa
2. Makani Gregg, Research Diver, MS Candidate at UH Hilo, PPO member
3. Misaki Takabayashi, Backup Research Diver & Co-Principle Investigate, UH Hilo Faculty
4. Ruth Gates, Co-Principle Investigator, HIMB Faculty
5. Research Diver TBD (in case an additional diver is needed or another member is unable to dive)
**(Only two research divers will need to enter the Monument to collect data)

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:
All surveys will be conducted on coral reefs at sites determined by the NOAA PMNM research coordinators. The exact locations are still to be decided.

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 are the backbone 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. Collecting coral health data at sites within the Papahānaumokuākea Marine National Monument will also allow for comparisons to sites within the Main Hawaiian Islands. Collectively this data will facilitate comprehensive analyses of coral health throughout Hawaiian waters. The proposed methods in this permit will complement and improve upon the current assessments of coral health that utilize permanent survey sites and repeatedly surveyed colonies. Our approach of conducting surveys using a stratified random design will develop a robust dataset on coral health dynamics throughout the Monument, this information will be useful for managers to determine areas of high disease prevalence and severity. Collecting data in this manner will improve the spatial resolution of our understanding of coral health. Furthermore, continuing these surveys over time will equip managers with the capability to temporally track the health of coral populations within the Monument.

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?
Our research activities are conducted with relatively no impact to the reefs other than our presence. 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.

We avoid imposing any potential impacts on the cultural, natural, and historical resources by utilizing surveys that are conducted visually and require no physical contact or sampling of the environment. Our goal is to simply monitor the health of corals in order to ensure no degradation is occurring to these vital organisms. The personnel covered by this permit will behave in a respectful manner and operate within the guidelines created to protect and preserve the cultural resources of the Monument. All personnel has prior experience working in the Monument and have the utmost respect for the cultural resources of PMNM. Our primary goal is to provide data

that can aide the protection and conservation of the corals inhabiting the reefs throughout the Monument.

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? As stated above, our goal is to gather information that can be used to aid the management of corals inhabiting reefs throughout the Monument. Hawaiian corals are a profound cultural resource. 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. It is very important that we work to conserve and protect Hawaiian corals, as they are clearly a vital cultural and ecological resource. 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 answer important questions about disease dynamics and patterns of coral health throughout the Monument. Our proposed methods will complement the annual Reef Assessment and Monitoring Program (RAMP) by providing more detailed data on coral health and disease. For instance, RAMP coral disease surveys utilize categorical variables for colony size and disease severity. Our methods utilize a Line Intercept Transect method, rather than Belt Transect, which gives divers necessary bottom time to measure each colony as well as visible lesions in order to record a direct quantitative measure of colony size and disease severity. Our methods also record more states of reduced health and disease, such as trematodiasis, tissue discoloration, hypermycosis, brown necrotizing disease, and multiple forms of algal growth (i.e. endolithic algal growth following tissue loss versus epilithic filamentous algae growing over coral tissue). 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 cofactors) associated with disease severity (Burns and Takabayashi 2011). Combining epizootiological data with ecosystem characterization data collected throughout the Monument may provide critical insight into environmental cofactors 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. Repeating surveys at the same location and on the same colonies has excellent use for determining factors such as rates of incidence, transmission, and progression. However, these methods provide less information relevant to disease parameters, such as prevalence and severity, at the population level due to a degree of bias created by repeatedly surveying the same area. Utilizing the random sampling design will develop a robust dataset that will enable an objective determination of coral health characteristics at the population level. 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 disease dynamics 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 cofactors) at the population level. 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 enable for comparison to sites throughout the Hawaiian Islands.

d. How does the end value of the activity outweigh its adverse impacts on Monument cultural, natural and historic resources, qualities, and ecological integrity?
This 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. This will allow for determining if spatial patterns of disease prevalence and severity exist within sites or throughout the Monument. For instance, we have found water motion to be a cofactor of growth anomaly severity in East Hawai'i (Burns et al. 2010); by spatially analyzing coral health data from the Monument we will be able to determine if certain areas are more prone to coral health afflictions. By collating data pertaining to site characteristics (i.e. benthic data, water quality data, fish data) with coral health data we can try and identify cofactors of various disease states. 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 to assess patterns in coral health across the Hawaiian archipelago. Furthermore, we can compare our findings with those collected from previous RAMP surveys to address changes in coral health over time. 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, Ruth, Misaki, Makani and myself, have been conducting coral health surveys throughout Hawai‘i for several years. Our work has resulted in multiple publications and presentations. Misaki and Makani have also previously conducted research in the Monument and are members of PPO. We have a solid respect for the cultural importance of this site and hope to do our best to collect data, in an un-invasive manner, that can aide management of this immensely valuable ecosystem. The following has been added to our permit application to help clarify our response and provide more detailed information: Makani, an MS student at UH Hilo, has been a student as well as team leader for the University of Hawai’i Quantitative Underwater Ecological Survey Techniques (QUEST) course and currently works on several large grant collaborations collecting coral health data using SCUBA from several sites throughout Hawai’i Island. She is a lead scientific diver for the University of Hawai’i Diving Safety Program with an 80fsw depth rating and has completed NAUI Nitrox and Rescue Diver training. Miskai, a UH Hilo professor, is an instructor for QUEST as well as lead scientific diver for the University of Hawai’i Diving Safety Program with a 60fsw depth rating and has completed NAUI Nitrox training. Misaki has conducted coral surveys on reefs throughout Australia, while working at the University of Queensland and the University of Sydney, as well as reefs throughout the Hawaiian Islands. I myself, a PhD student at UH Manoa, am a graduate as well as an instructor for the QUEST program. I am NAUI instructor as well as a lead scientific diver and supervisor/trainer for the UH Dive Safety program, and I am also a certified fill station operator. Like Makani, I am also currently working on several large grant collaborations collecting coral health data using SCUBA from several sites throughout Hawai’i Island. 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 my 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 Ruth (HIMB) and Misaki (UH Hilo Marine Science) are 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 to assess temporal changes in coral health. If we are fortunate to perform these surveys in the future, we will be able to comprehensively assess changes in coral health over time on surveyed reefs throughout the Monument. 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 Main Hawaiian Islands. Incorporating terrestrial and marine parameters in the spatially analyses will have great utility for determining ecosystem characteristics associated with coral health. Furthermore, our research labs are currently investigating the biological implications of various coral diseases. 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. Corals are a cultural and ecological resource, providing critical habitat to a multitude of marine species. It is important to determine disease cofactors and track health changes to avoid any large-scale mortality associated with outbreaks of disease.

i. Has your vessel has 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.
As stated above, our surveys are visual and will have no detrimental impacts to the corals or the reef structures. We do not plan on taking any samples and will therefore have no adverse impact on the coral reefs.

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 a 25m transect 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), 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, cofactors) 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:
N/A

Scientific name:

& size of specimens:

Collection location:

☐ Whole Organism ☐ Partial Organism

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

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?
N/A

11. Describe collaborative activities to share samples, reduce duplicative sampling, or duplicative research:
We plan to collaborate with the Monument so all our coral health data can be archived and available when needed. The data collected by our proposed research activity will complement the coral health surveys presently being conducted at repeatedly observed sites. This will enable a more comprehensive understanding of disease characteristic (prevalence, severity, disease progression and incidence rates) at the population level across spatial scales throughout the Monument. The results of these combined studies will provide the Monument with useful data pertaining to the health of corals that can greatly aide management decisions in regards to coral reef health and function. We are also currently collaborating with several researchers to develop a 'Coral Health Atlas.' This is a website that will allow researchers to display results form coral health surveys at various study sites as well as environmental characteristics from each site/area. Our goal is to make survey results more accessible as well as visualized in the context of environmental characteristics. We hope this work will aid to decipher environmental characteristics, both marine and terrestrial, that drive the health of corals throughout the Hawaiian archipelago.

12a. List all specialized gear and materials to be used in this activity:
SCUBA gear (BCD, regulator, mask, fins, snorkels, weights, computers, compass, dive knife), slates, rulers, underwater cameras, transect tape.

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

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

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

Photo analyses, data analyses, a report write-up, and at least one publication 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

• Burns JHR (2011) Assessing the threat of growth anomalies on Hawaiian corals. Ka Pili Kai Spring Issue: 10

• Burns JHR (2010) It's not a tumor? Impacts of skeletal growth anomalies on Hawaiian corals. Ka Pili Kai Spring Issue: 6-7

• Takabayashi M, Gregg TM, Farah E, Burns J, Teves K, Cody NH (2010) The prevalence of skeletal growth anomaly and other afflictions in scleractinian coral at Waiʻōpae, Hawaiʻi. Proc 11th Int Coral Reef Symp 18: 820-824

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