

**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:  
NOAA/Inouye Regional Center  
NOS/ONMS/PMNM/Attn: Permit Coordinator  
1845 Wasp Blvd, Building 176  
Honolulu, HI 96818  
nwhipermit@noaa.gov  
PHONE: (808) 725-5800      FAX: (808) 455-3093

**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:** Haunani Hi'ilani Kane

**Affiliation:** National Science Foundation Postdoctoral Fellow at the University of Hawai'i at Hilo

**Permit Category:** Research

**Proposed Activity Dates:** July 2020

**Proposed Method of Entry (Vessel/Plane):** SSV Makani Olu

**Proposed Locations:** French Frigate Shoals, and Nihoa

**Estimated number of individuals (including Applicant) to be covered under this permit:**  
20

**Estimated number of days in the Monument:** 15

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

a.) The proposed activity would...

Assess impacts of Hurricane Walaka upon islands and the shallow marine environment at French Frigate Shoals. Our survey techniques will use a non-invasive method to collect high resolution imagery to document island sediment and shallow reef lost and subsequent recovery following Hurricane Walaka. Our island and nearshore sediment data collection method will enable shifts in dominant sediment types and sources from the nearshore reef to be identified. This will enable estimates for future sediment production and replenishment to islands following environmental stressors. The proposed activities will improve the understandings of the potential loss and timescales for recovery of critical habitat following extreme storm events. The proposed activities will also improve understandings of how future sea level rise will impact essential habitats for priority species (e.g. sea turtles, monk seals, and various seabirds).

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

1.) Use a remotely operated vehicle (ROV), to map and quantify the impacts of Hurricane Walaka upon 10 nearshore shallow reefs at Nihoa (2 reefs) and at FFS (8 reefs). 2.) Collect GPS data and aerial imagery using an unmanned aerial system (UAS) at three islands within FFS. 3.) Collect sediment samples (total: 200, ¾ cup

volume) from the shallow marine environment (80,  $\frac{3}{4}$  cup volume), and modern beach face (100,  $\frac{3}{4}$  cup volume) at three islands within FFS. 3D digital reconstructions of the nearshore reef habitat, and island environments will be derived from ROV and UAS imagery. These models will be compared to 3D models of island environments collected in 2018 by Dr. Fletcher's team (includes Dr. Kane, McDonald, and Dominique-Tavares listed on this permit), and supplement reef models collected at deeper depths by Dr. John Burns. Comparing 2018 & 2020 3D island models and sediment composition will enable sediment budgets for each island to be quantified by both sediment source, and sediment volume. 3D models of the shallow reef will enable dominant sediment sources (including but not limited to calcareous red algae, *Halimeda*, coral) to be mapped and quantified. Ultimately we will obtain detailed data on the impacts of extreme storm events, and the capacity of atoll islands to naturally recover from environmental stressors. This research will allow us to decipher important characteristics of reduced resiliency affecting islands and critical island habitats across PMNM.

c.) This activity would help the Monument by ...

Providing detailed analyses of island habitat and nearshore reefs is useful for determining the severity and prevalence of Hurricane Walaka impacts across FFS. By resurveying sites visited in 2018 (Gin and East Island) we will provide visual representations of island recovery and loss. The 3D island reconstructions will provide useful data for assessing island elevation, and island sedimentary budgets. Both are useful metrics for predicting future time scales of vulnerability to storms and sea level rise. Furthermore analyses of island sediments will reveal the dependency of islands upon the adjacent nearshore reef for sediment replenishment following environmental stressors. Our research will provide PMNM staff with guidance for responsive management of critical ecosystems and endangered species in a future of elevated sea-level.

**Other information or background:**

Obtaining a better understanding of the fate of reef islands is vital for understanding the future of critical habitats at FFS and also for depicting what impacts we may foresee for cultural, natural, and historic resources of the PMNM as a whole. Our island surveying methods have proved useful for determining the impacts of past and future sea level rise and storms. Combining a geologic sedimentary approach with cutting edge 3D reconstruction techniques will produce excellent data products that will enhance our understandings of the bio-geological parameters that govern reef-island resiliency and vulnerability to climate related stressors. This research will ultimately provide useful information for managers such as the spatial and temporal dynamics of island evolution and recovery, keystone island sediment species that disproportionately contribute to island composition, and the ability to identify and map the source of keystone species upon adjacent reefs.

## **Section A - Applicant Information**

### **1. Applicant**

Name (last, first, middle initial): Kane, Haunani, H

Title: Postdoctoral Research Fellow, University of Hawai'i at Hilo

#### **1a. Intended field Principal Investigator (See instructions for more information):**

Dr. Haunani H. Kane

#### **2. Mailing address (street/P.O. box, city, state, country, zip):**

[REDACTED]

Phone: [REDACTED]

Fax:

Email: [REDACTED]

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

#### **3. Affiliation (institution/agency/organization directly related to the proposed project):**

National Science Foundation and the Department of Marine Science, University of Hawai'i at Hilo.

#### **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. Kammie Dominique Tavares, Coastal Geologist & Survey technician
2. Kristian McDonald, Coastal Geologist & Drone operator
3. Aloha Kaponu, Coastal Geologist & ROV operator
4. Shacles Chong, Videographer
5. Pelika Andrade, Intertidal researcher
6. Kim Morishige, Intertidal researcher
7. Lauren Kaponu, Intertidal researcher
8. Anthony Mau, Intertidal researcher
9. Brad Kaaleleo Wong, Cultural specialist, Office of Hawaiian Affairs
- 10-12. 2-3 TBD
13. Makani Olu Crew 1 TBD
14. Makani Olu Crew 2 TBD
15. Makani Olu Crew 3 TBD
16. Makani Olu Crew 4 TBD

17. Makani Olu Crew 5 TBD
18. Makani Olu Crew 6 TBD
19. Makani Olu Crew 7 TBD
20. Makani Olu Crew 8 TBD

**Section B: Project Information**

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

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

NOTE: Shallow water is defined by water less than 100 meters in depth.

Remaining ashore on any island or atoll (with the exception of Sand Island, at Midway Atoll 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:

At Nihoa, and French Frigate Shoals (East Island, Gin Island, La Perouse Pinnacle, and Tern Island) we propose to collect video and photos of the shallow reef using a Trident Underwater drone (<https://www.sofarocan.com/products/trident>).

At East island, Gin island, La Perouse Pinnacle, and Tern Island we propose to collect imagery of the island and surrounding shallow nearshore environment using a unmanned aerial system.

At East island, Gin island, and Tern Island we propose to survey, and collect sediment samples (3/4 cup) from the beach face, and the nearshore environment. At Tern Island we propose to excavate two shallow trenches and collect sediment samples.

We will follow best management practices for moving between islands, boat operations and diving activities, and unmanned aerial systems. All survey and sample locations will be conducted at sites determined by the Dr. Kane, under the guidance of PMNM resource monitors that accompany this project. The exact loactions are still to be decided. Additional photos and video collected by our documenter will document research methods and the recovery of each island following Hurricane Walaka. Images and video will be used only for educational outreach and research purposes.

**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 collect imagery and sediment samples to assess the impacts of Hurricane Walaka upon islands and the shallow marine environment. This work is needed in order to monitor and track changes in island erosion and accretion, and future island sediment availability. Our activities will improve understandings of potential loss and recovery of essential habitats for priority species. This information will provide guidance for PMNM managers tasked with developing responsive management plans.

Atoll reef islands within the PMNM, provide critical nesting habitat for 96% of the population of the threatened Hawaiian green sea turtle (*Chelonia mydas*), one-third of the population of endangered Hawaiian monk seal (*Monachus schauinslandi*), and the largest colony of tropical seabirds in the world (Baker et al., 2006; Reynolds, et al., 2012). These critical species require stable island habitats that are becoming increasingly threatened by sea level rise (Anderson et al., 2018; Romine et al., 2013) and more frequent tropical cyclone activity (Murakami et al., 2013). In 2018, FFS received international attention after East Island was removed in its entirety following a direct hit from Walaka, a category three tropical cyclone. Since 2018 reefs and islands have both accreted and eroded by bio-geological processes that are still not fully understood.

Our activities bridge this gap in knowledge by employing non-invasive interdisciplinary approaches to address management and conservation questions during a time when impacts related to environmental change are accelerating. We propose to do the following: 1.) Use a remotely operated vehicle (ROV), to map and quantify the impacts of Hurricane Walaka upon 10 nearshore shallow reefs at Nihoa (2 reefs) and at FFS (8 reefs). 2.) Collect GPS data and aerial imagery using an unmanned aerial system (UAS) at three islands within FFS. 3.) Collect sediment samples (total: 200,  $\frac{3}{4}$  cup volume) from the shallow marine environment (80,  $\frac{3}{4}$  cup volume), and modern beach face (100,  $\frac{3}{4}$  cup volume) at three islands within FFS. In addition at Tern Island two shallow trenches will be sampled (not to exceed a total of 20 samples,  $\frac{3}{4}$  cup volume) to compare pre and post-Walaka derived sediments.

The research activities of this project build upon a 2018 data collection effort focused on assessing the impacts of sea level rise upon FFS. Pre (July 2018) and post (July 2020) Walaka UAS derived datasets will be compared to quantify island-specific volumes of sediment gains and losses. Furthermore pre and post-Walaka sediment analyses will elucidate shifts in island sediment composition and identification of island sediment sources from the nearshore reef. The resulting data of the activities proposed in this study will be critically valuable to better understandings of the timescales and spatial extent of island vulnerability and the potential for natural recovery following environmental stressors. The application and relevance of the products produced by the proposed activities extend beyond FFS and are applicable both across PMNM and to

other low-lying island ecosystems such as the Maldives (Indian Ocean), Tuvalu, Kiribati and the Marshall Islands (Pacific).

#### References

Baker, J. D., Littnan, C. L. & Johnston, D. W., 2006. Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna in the Northwestern Hawaiian Islands. *Endanger. Species Res.* 2, 21–30.

Reynolds, M., Berkowitz, P., Courlot, K. N. & Krause, C. M., 2012. Predicting Sea-Level Rise Vulnerability of Terrestrial Habitat and Wildlife of the Northwestern Hawaiian Islands.

Anderson, T. R. et al., 2018. Modeling multiple sea level rise stresses reveals up to twice the land at risk compared to strictly passive flooding methods. *Sci. Rep.* 8.

Romine, B. M., Fletcher, C. H., Barbee, M. M., Anderson, T. R. & Frazer, L. N., 2013. Are beach erosion rates and sea-level rise related in Hawaii? *Glob. Planet. Change* 108, 149–157.

Murakami, H., Wang, B., Li, T. & Kitoh, A., 2013. Projected increase in tropical cyclones near Hawaii. *Nat. Clim. Chang.* 3, 749–754.

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

If so, please list the species you specifically intend to target.

We do not plan to specifically target protected species. However, we will be using a drone to collect imagery of the islands, and nearshore environment and Shacles Chong intends to capture on camera whatever he encounters naturally while at FFS. Thus, our images may ultimately capture endangered species.

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?

The activities proposed will be conducted with adequate safeguards for the resources and ecological integrity of the Monument. We acknowledge that there are concerns with disturbing sediment from the islands and nearshore. We welcome discussion with PMNM staff including cultural experts to ensure that our research is conducted in a manner that is respectful of the place, and its cultural, natural, and historical resources. All survey and sample locations will be conducted at sites determined by the Dr. Kane, under the guidance of PMNM resource monitors that accompany this project. For sediment sample collection at Tern Island we will consult USFWS contaminants biologist. Collection equipment will be inspected and disinfected between sampling different areas to mitigate for the spread of aquatic invasive species, coral disease or other pathogens or parasitic organisms. Best efforts will be made to ensure that the collection of samples is conducted in such a manner as the process does not result in any additional harm to surrounding marine or terrestrial organisms. Efforts will be made to distribute collection activities across shoreline/reef flat/benthic areas, so as not to consolidate the impacts of data collection in one location.

As a means to ensure that our research aligns with PMNM we will follow best management practices for moving between islands, boat operations and diving activities, and unmanned aerial systems. We will be operating a drone to collect high-resolution imagery of FFS islands. In July 2018 our drone pilot Kristian McDonald successfully collected drone imagery and constructed 3D, Digital Evolution Models (DEMs) of East Island, and Gin Island. This baseline data will be compared to 2020 3D DEMs to quantify changes in the volume of sediment loss and gain following Hurricane Walaka. Kristian is a DOT/FAA certified remote pilot and has experience piloting UAS in FFS and working with PMNM resource monitors to assure that we make every effort to follow established drone protocols and best management practices. We will also seek guidance from the PMNM before any UAS derived data is made publically available. Additional photos and video collected by our documenter will document research methods and the recovery of each island following Hurricane Walaka. Images and video will be used only for educational outreach and research purposes.

Our research group will pay respect and conduct culturally appropriate protocols at each island visited as well as throughout the research to continue to connect to place and stay grounded as a group. As a part of our cultural plan, our research cruise will be conducted in partnership with the Office of Hawaiian Affairs and Nā Maka Onaona. We will have group discussions centered around huli 'ia, a tool developed by Nā Maka Onaona, to document environmental observations experienced through all of our senses while in Papahānaumokuākea. Researchers will participate in discussions contributing their observations sharing noticeable dominant characteristics of Iani (sky), honua (earth), and kai (ocean) as a way to characterize that time (season) and space (Papahānaumokuākea). This broader holistic view will support our research team in intimately understanding moods and characteristics of Papahānaumokuākea and through this documentation process, supports the development of best practices

enabling communities to adjust and adapt their activities to assist in mālama 'āina (care for the land). In addition as a part of our cultural plan, we will provide data and information to assist the Cultural Working Group's effort to develop Hawaiian names and descriptions for new processes and spaces that may be encountered in the island and in the shallow nearshore environment. Finally, in an effort to create intergenerational capacity building, native Hawaiian students and early scholars will be included in the research team, and be mentored in all aspects from research development, fieldwork, and post-cruise data analysis.

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? Our research activities will temporarily disturb island sediment at two shallow trenches at Tern Island. However, the lessons learned from our research has the potential for researchers and managers to better plan for the very existence of low lying islands throughout PMNM as hurricane impacts become more prevalent and sea-level continues to rise into the future.

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 is no practicable alternative to conducting activities in the Monument. We are addressing questions that are directly relevant to the very existence of critical habitat within the Monument in a future of increased impacts related to more prevalent and intense hurricanes and elevated sea level. Hence the study must be carried out within the Monument. We are limiting our study site to Nihoa and four islands at FFS. Lessons learned from FFS are applicable to low lying sandy islands throughout the PMNM. An important implication of this work is relevant to endangered species management plans. As sandy habitat in PMNM becomes unstable as a result of increased storminess and sea level rise the main Hawaiian Islands may be considered as future replacement habitat. Therefore, it is the specific location of PMNM that is necessary for this research.

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 management value of data produced by our research activities outweighs the impacts upon Monument resources. FFS has already experienced island lost at Disappearing island, Trig Island, and most recently East Island following Hurricane Walaka in 2018. Devastating impacts on reefs at FFS have also documented. Furthermore, a preliminary study by the USGS predicts that under 2 m of sea level rise five of the nine islands at FFS will be completely submerged assuming a passive inundation model. Here we propose to improve upon previous studies by characterizing Hurricane Walaka impacts and recovery of the critical island and shallow reef habitats. This project will contribute to the formulation of monitoring and management action for reefs and island habitats at French Frigate Shoals. Our project will increase

conservation and management capacity for mitigating the impacts of hurricane damage and sea level rise thus contributing to the decision making ability for stewardship of PMNM. Research products produced at FFS are applicable across the PMNM. In addition, we will do our best to ensure that our methods have minimal impact on monument resources. Finally, we will work with PMNM staff including the OHA to return samples in a culturally appropriate manner.

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

The actual fieldwork component of this research involves the minimum time required to obtain the desired data necessary to assess the impacts and recovery of critical habitat following Hurricane Walaka. Because SSV Makani Olu is largely powered by wind, we anticipate the majority of the 15 days will be for transiting from O'ahu, with a maximum of 5 days allotted for research at FFS and Nihoa. Weather permitting, we propose to visit 4 islands at FFS (Gin, East, Tern, La Perouse), and Nihoa during the 15 day period.

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

Key project members:

Haunani H. Kane (National Science Foundation and the University of Hawai'i at Hilo): Dr. Kane is currently funded through a National Science Foundation Postdoctoral Research Fellowship to assess the impacts of sea level rise and storms upon atoll reef islands at French Frigate Shoals. Haunani was a part of the team that collected the baseline data for her postdoctoral research in July of 2018. Dr. Kane returned in 2019 with the FWS and NOAA to assist with debris removal following Hurricane Walaka and field camp set up at Tern Island. Haunani's previous research modeled future impacts of coastal erosion and sea level rise upon cultural assets (Journal of Coastal Research, 2012), and Hawaiian wetlands (Climatic Change, 2015; Regional Environmental Change, 2015). Haunani has investigated the impacts of sea level rise upon islands within Sāmoa (Quaternary Research, 2017; The Holocene, 2015), and the Republic of the Marshall Islands (Earth's Futures in review). Haunani has worked with the USGS to collect sediment data that contributed to a 700-year paleotsunami record for Hawai'i (Sedimentology, 2019). Haunani has published 6 peer-reviewed manuscripts and presented her research to the PMNM Board (January 2020) and numerous local and international conferences. More information on Haunani's research can be found at [haunanikane.com](http://haunanikane.com)

Kammie Dominique Tavares, Coastal Geologist & Survey technician: Kammie recently completed defended her M.S. thesis in the Earth Sciences department at the University of Hawai'i at Mānoa. Kammie's research models the risk of hardening future beaches in Hawai'i in response to sea level rise. Kammie is also a former NOAA Educational Partnership Program Minority Serving Institution (NOAA EPP/MSI) scholar and has worked with Dr. Randy Kosaki to identify the vulnerability of Hawaiian monk seal critical

habitat to sea level rise. Kammie participated in the 2018 research expedition to FFS and is well versed in best management practices and cultural protocol for collecting sediments and survey data.

Kristian McDonald, Coastal Geologist & Drone operator: Kristian McDonald is a DOT/FAA-certified remote pilot (certification # 4156006) and a current M.S. student in the department of Earth Sciences at the University of Hawai'i at Mānoa. Kristian successfully conducted drone surveys in 2018 at Gin and East Island, FFS. Kristian is well versed in best management practices related to UAS in the PMNM. Kristian also has experience conducting drone surveys in the remote islands of the Republic of the Marshall Islands, and coastal settings across Hawai'i.

Aloha Kapono, Coastal Geologist & ROV operator: Aloha Kapono's background is in Geographic Information System (GIS) mapping and cultural resource management at the Pōhakuloa Training Area. Aloha will begin the Tropical Conservation Biology and Environmental Science graduate program at the University of Hawai'i at Hilo in the fall and her research project will focus upon assessing impacts of storms and sea level rise upon atoll islands within PMNM. Aloha's background in both GIS and resource management make her well qualified to assess the Walaka impacts on resource management in PMNM.

Shacles Chong, Documenter: Shacles Chong has a BA in both Hawaiian Studies and Art, with a focus on photography and videography from the University of Hawai'i at Mānoa. Shacles has experience documenting cultural and natural resource management within various communities across Hawai'i.

Pelika Andrade, Intertidal researcher: Pelika Andrade is the Hawai'i Island Seagrass Extension Agent. Pelika has a long history of developing alternative approaches to monitoring Hawai'i's shoreline and supporting the implementation of a management strategy that supports healthy, balanced communities in Hawai'i. Pelika has conducted numerous forms of research and huli 'ia trainings both across Hawai'i and within PMNM. Pelika will assist in assessing impacts and recovery specific to the intertidal zone and lead the Huli 'ia component.

Kim Morishige, Intertidal researcher: Kim Morishige is a Zoology PhD student at the University of Hawai'i at Mānoa. Kim's research focuses upon Hā'uke'uke (*Colobocentrotus atratus*), an important Hawaiian intertidal resource. Kim will assist in huli 'ia and assessing impacts and recovery specific to the intertidal zone.

Lauren Kapono, Intertidal researcher: Lauren Kapono will begin the Tropical Conservation Biology and Environmental Science graduate program at the University of Hawai'i at Hilo in the fall and her research project will focus upon assessing the impacts of sea level rise upon intertidal resources. Lauren will assist in assessing the impacts of Hurricane Walaka, and recovery specific to the intertidal zone.

Anthony Mau, Intertidal researcher: Anthony Mau received a Ph.D. Molecular Biosciences and Bioengineering from the University of Hawai'i at Mānoa. His research focuses upon intertidal natural resources such as 'Opihi (*Cellan sandwicensis*). Anthony will assist in assessing the impacts of Hurricane Walaka, and recovery specific to the intertidal zone.

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 Office of Hawaiian Affairs will provide vessel funding support for the upcoming 2020 PMNM access to French Frigate Shoals. National Science Foundation Postdoctoral research funds obtained by Dr. Kane have been allocated to support post PMNM access sample and data processing. Dr. Kane is also a co-PI on a National Fish and Wildlife Refuge grant proposal and we are optimistic about receiving this source of funding. These resources will be adequate to conduct and complete the proposed activities and mitigate any potential impacts resulting from its conduct.

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 surveying methods and procedures are designed to be as un-invasive and thorough as possible. We utilize a unique approach to assessing the impacts and recovery of the island and shallow reef environments to decipher the dynamics between sediment production at reefs and sediment delivery to adjacent islands. We have successfully implemented our methodologies in similar studies at 'Upolu Island, Sāmoa, the Republic of the Marshall Islands, and at FFS in July of 2018. Our island and shallow reef surveys will enable 3D reconstructions of shallow coral habitats and island environments. These methods are non-invasive and provide high-resolution data pertaining to reef and island topography that cannot be acquired from remotely sensed satellite imagery. Sediment sampling will enable island sediment sources and availability from the shallow marine environment to be quantified. Comparisons to data collected in 2018 provide baselines for detecting changes in island and reef sediment sources following Hurricane Walaka. Ultimately this work will provide the PMNM with a comprehensive and robust dataset pertaining to the vulnerability and or resiliency of atoll reef islands systems to environmental stressors such as storms and sea level rise. Islands and corals are cultural and ecological resources that provide critical habitat to a multitude of marine and terrestrial species.

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

Yes the SSV will be equipped with appropriate mobile transceiver units.

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

There are no other factors that would make the issuance of a permit for our proposed activities inappropriate.

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

### **1.) Map shallow reefs using an ROV**

We propose to use a remotely operated vehicle (ROV), to map and quantify the impacts of Hurricane Walaka upon 10 nearshore shallow reefs at Nihoa (2 reefs) and at FFS (8 reefs). ROV derived imagery will be post-processed at the University of Hawai'i using Structure-from-Motion. 3D models and orthophotos of the shallow reef habitat will be created for each surveyed site. We anticipate surveying at most 2 sites at Nihoa, and approximately 2 sites at each island at FFS (La Perouse, Gin, East, and Tern Islands). Surveyed sites will be approximately 100 m<sup>2</sup> in size. The ROV used by our team is a Trident Underwater drone (<https://www.sofaroccean.com/products/trident>). Our ROV is compact (7.5 lbs and 16.1in x 8.1in x 3.4in) and is tethered to the surface where real-time video enables the pilot to navigate the ROV. The ROV will be deployed from a small boat operated by the SSV Makani Olu crew. Our team is experienced in operating the ROV in numerous coastal and nearshore settings. We will follow the protocols from the PMNM Boating and Diving BMP. We will avoid contact with live corals and take great care when navigating around islands so that corals are not impacted by our work.

### **2.) UAS island surveys**

Topographic or island elevations will be acquired from UAS imagery. We propose to collect high resolution imagery of 3 islands (Gin, East, and Tern Islands) and the surrounding nearshore environment using a UAS equipped with an internal GPS and a camera. Canvas targets (1 m x 1 m) will be laid out on the island at the time that imagery is collected and later surveyed with an RTK-GPS for ground control. The RTK-GPS includes a fixed base station that will sit on a tripod during the duration of the survey. The rover system is attached to a pole, and the surveyor will transport the rover to each survey site (corners of trenches, GPS control points, and geological features). UAS imagery and GPS control points will be post-processed at the University of Hawai'i. A topographic DEM of each island will be derived from UAS imagery using Structure-from-Motion.

### **3.) Sediment collection**

We propose to collect no more than 200 sediment samples (not to exceed ¾ cup volume) from the shallow marine environment (80, ¾ cup volume), and modern beach face (100, ¾ cup volume). Sampling the shallow seafloor will involve a small team (at least 2 people) deploying a benthic sediment sampler from a small boat operated by the crew of the SSV Makani Olu. The benthic sediment sampler will be tethered to the boat. Sediment will be sampled adjacent to ROV survey sites (at least 2 samples per survey site) and additional sandy sites surrounding each island. If necessary, the team may also enter the nearshore marine environment with snorkel gear to recover sediment. We will follow the protocols from the PMNM Boating and Diving BMP. We will avoid contact with live corals and take great care when navigating around islands so that corals are not impacted by our work.

No more than 100 sediment samples will be collected from the beach face at Gin, East, and Tern island. At Tern Island two shallow trenches will be sampled (not to exceed a total of 20 samples,  $\frac{3}{4}$  cup volume) to compare pre and post Walaka derived sediments. We anticipate trenching along the beach side of the runway as this site was noted in 2019 to have Walaka lagoon sediments deposited upon the Pre Walaka soil and subsurface sand layer. Trenches will not exceed 1 m x 1 m x 1 m in size. Trenches will be opened only long enough to be described, sampled (no more than 20 samples total), and photographed. Each trench will be backfilled with preexisting sediment. We don't anticipate any trenches being left unattended or opened overnight. We hope these measures will limit the potential for a listed species (turtle or monk seal) from entering the trench. Furthermore, we will consult with the resource monitor that accompanies us on our proposed project and the USFWS contaminants biologist to determine the safest place to excavate at Tern island.

Sediment samples will be taken back to the University of Hawai'i for compositional analysis under the microscope, and radiocarbon dating. Upon completion of analyses, samples will be returned to PMNM under the guidance of PMNM staff including the OHA.

**NOTE: If land or marine archeological activities are involved, contact the Monument Permit Coordinator at the address on the general application form before proceeding.**

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

We will not collect any living specimens however we do anticipate collecting skeletal reef derived material in the beach and nearshore sediment samples. Anticipated organisms include sand-sized fragments of unidentified coral species, red calcareous algae, green calcareous algae (*Halimeda*), mollusks, and foraminifera (e.g. *Amphistigena*).

Common name:

Scientific name:

# & size of specimens:

Not to exceed 200 samples, each approximately  $\frac{3}{4}$  cup in size.

Collection location:

Gin, East, and Tern Island.

Whole Organism  Partial Organism

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

Specimens will be returned to PMNM staff under the guidance of PMNM. The Office of Hawaiian Affairs will be consulted for cultural guidance.

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

No live organisms will be sampled.

• General site/location for collections:

Gin, East, Tern Island

• Is it an open or closed system?  Open  Closed

N/A

• Is there an outfall?  Yes  No

N/A

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

N/A

• Will organisms be released?

N/A

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

Sediment and fossil reef samples will be stored in sample bags and transported out of the monument on the chartered vessel.

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

All results, imagery, and products will be made publicly available, and provided to PMNM.

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

Shovel

Elevation survey equipment (total station, tripod, survey rod, survey ribbon, survey prism, canvas targets, brunton compass, RTK GPS base station and rover, etc.)

Phantom drone (lithium batteries, ipad)

Trident Underwater drone and ipad

Miscellaneous tools (handheld GPS, notebooks, walkie talkies, cameras, measuring tape, etc)

Snorkeling gear (mask, fins)

Sample bags and vials

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

Lithium batteries for the drone

**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:**

Sample analysis, data analysis, and write-up/publication of information will be completed within 24 months of the proposed research cruise.

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

- \*Kane, HH, Fletcher, CH. Rethinking reef island stability in relation to future sea level rise. *Earth's Future*. In Review.
- \*Dominique-Tavares, K, Fletcher, C, and Anderson, T. Risk of shoreline hardening and associated beach loss peaks before mid-century. *Scientific Reports*. In Review.
- \*McDonald, K. UAS surveys reveal high spatiotemporal variability in beach morphology including subcell sand exchange and accretion during swell events: Waikīkī, Hawai'i. MS thesis, University of Hawaii, USA. In preparation.
- Summers, A, Fletcher, CH, Spirandelli, D, \*McDonald, K, Over, J-S, Anderson, T, Barbee, M, Romine, BM. 2018. Failure to protect beaches under slowly rising sea level. *Climatic Change* 151: 427-443.
- \*Kane, HH, Fletcher, CH, Cochrane, EE, Mitrovica, JX, Habel, S, Barbee, M. 2017. Coastal plain stratigraphy records tectonic, environmental, and human habitability changes related to sea-level drawdown, 'Upolu, Samoa. *Quaternary Research* 87: 246-257.
- \*Kane, HH, Fletcher, CH, Frazer, LN, Anderson, T, Barbee, M. 2015. Modeling sea level rise vulnerability of coastal environments using ranked management concerns. *Climatic Change* 131: 349-361.
- \*Kane, HH, Fletcher, CH, Frazer, N, Barbee, M. 2015. Critical elevation levels for flooding due to sea-level rise. *Regional Environmental Change*. *Regional Environmental Change* 15: 1679-1687.
- \*Kane, HH, Fletcher, CH, Romine, BM, Anderson, TR, Frazer, NL, Barbee, MM. 2012. Vulnerability Assessment of Hawai'i's Cultural Assets Attributable to Erosion Using Shoreline Trend Analysis Techniques. *Journal of Coastal Research* 28: 533-539.

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.

*Kavanaugh* \_\_\_\_\_ 4/2/2020 \_\_\_\_\_  
Signature Date

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

NOAA/Inouye Regional Center  
NOS/ONMS/PMNM/Attn: Permit Coordinator  
1845 Wasp Blvd, Building 176  
Honolulu, HI 96818  
FAX: (808) 455-3093

**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