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

<u>SUBMITTAL VIA ELECTRONIC MAIL IS PREFERRED BUT NOT REQUIRED. FOR ADDITIONAL SUBMITTAL INSTRUCTIONS, SEE THE LAST PAGE.</u>

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: Charles H. Fletcher
Affiliation: Department of Geology and Geophysics, School of Ocean and Earth Science and Technology University of Hawai‘i (UH) at Mānoa

Permit Category: Research
Proposed Activity Dates: May thru September 2018
Proposed Method of Entry (Vessel/Plane): Vessel (M/V Searcher)
Proposed Locations: French Frigate Shoals (FFS)

Estimated number of individuals (including Applicant) to be covered under this permit: 9

Estimated number of days in the Monument: 13

Description of proposed activities: (complete these sentences):

a.) The proposed activity would…

Assess the impacts of past and present sea-level rise upon low lying islands to improve understanding 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 ….

Develop historical reconstructions of beach erosion and accretion during the recent Holocene (approximately 6,000 years ago to present), and provide managers with predictive models of sea-level rise impacts to nesting and foraging habitats for sea turtles, monk seals, and birds in Papahānaumokuākea. At FFS we propose to visit 2-3 sandy islands. At each island we would assess the interior stratigraphic architecture (layering of sediment) by recovering sediment from a maximum of 12 sites total. . Sediment recovered from the interior of the island will be strategically sampled in small quantities (120 samples total, approx. 2 tbsp/sample). The island surface will subsequently be restored to an undisturbed state by infilling sites with previously extracted sediment and best efforts will be made to avoid existing vegetation, and critical habitat for birds, turtles, and monk seals. Modern sediment will be sampled along the seafloor (120, 2 tbsp size samples) and comparisons will be made to island

sediment to quantify how sediment source and type have changed over time. To interpret historical reef habitat and accretionary response to changes in sea-level we will recover short cores (12 total: 1 m long, and 5-8 cm diameter) from the surrounding fossil reef platform using a small hand held drill.

Predictive modeling of island habitat response to future sea-level requires the acquisition of high-resolution requires topographic (land) and bathymetric (shallow seafloor) elevation data. We will derive digital elevation maps (DEMs) of each island from drone imagery and Structure-from-Motion. Real Time Kinematic Global Positioning System (RTK-GPS) control points will also be collected at the time of the drone survey to ensure that each DEM is adequately georeferenced. A vertical datum will be derived from RTK-GPS control points and a local short-term tide gauge that we will install for the duration of field work at each island. The DEM will be used to assess past changes in island habitat documented in historical imagery and in our predictive model to simulate island response to future sea-level rise.

c.) This activity would help the Monument by …

Sea-level rise is predicted to exceed 1-2 m by the end of the century (Sweet et al., 2017), which threatens the very existence of low lying islands and critical habitats for priority species found throughout Papahānaumokuākea. Ultimately our research will provide Papahānaumokuākea Marine National Monument (PMNM) staff with guidance for responsive management of critical ecosystems and endangered species in a future of elevated sea-level. This will be accomplished by first reconstructing beach erosion and accretion during the recent Holocene as sea-level rose 1-2 m approximately 2,000-4,000 years ago. For example did islands form and persist as sea-level rose, or was island formation triggered as sea-level fell below some perceived critical value? Answering this question will provide a historical basis for the capacity of island evolution and habitat response to anticipated sea-level rise.

Secondly, predictive modeling of sediment transport and wave environment will provide managers insight into how sea-level rise and perturbations to the island's shape and nearshore bathymetry at FFS will affect the convergence or divergence of wave-driven sand transport, causing the islands to accrete or erode, respectively. We strive to determine whether or not sand production from the reef is large enough to support island emergence and growth under static or rising mean sea-level conditions. If island emergence is only possible during falling sea-levels then it may be necessary to begin identifying solutions to the loss of nesting and foraging habitats for sea turtles, monk seals, and birds. Lessons learned at FFS are applicable throughout Papahānaumokuākea.

Other information or background:
Sweet et al., (2017) identifies six scenarios of potential sea-level rise that should be considered for management planning. In all scenarios there is little variation by mid-century. Approximately 30 cm (1 foot) is projected by 2050. In the second half of the

century various scenarios diverge dynamically to a mean of roughly 1.0 m by 2100, extreme of 2.0 m by 2100, and a minimum of less than 1.0 m by 2100. Which scenario plays out is being determined today by the greenhouse gas emissions of our modern society.

Models of paleo sea-level and morphologic evolution, as revealed by the proposed field work, will help to understand the processes that govern the stability of low lying islands as sea-level continues to rise in the future. This study is the first of its kind to model future impacts of sea-level rise using a process-based, shoreline evolution that couples historical geological data, high resolution imagery, and modern sediment dynamics. Considering that island loss has already been documented at FFS and prior assessments predict five of the nine islands at FFS will be entirely inundated at 2.0 m (using a passive inundation model) (Reynolds et al., 2012) it is imperative that improved scientific qualitative data be provided to guide responsive management plans for critical ecosystems and endangered species.

We have successfully implemented our methodologies in similar studies at Kapapa Island, O‘ahu, ‘Upolu Island, Sāmoa, and Bokollap Island, Majuro atoll. At Kapapa Island, Dr. Fletcher’s research has provided the best record of the Mid-Holocene higstand (Fletcher and Jones, 1996), which is the basis for our understanding of the local sea-level record for Hawai‘i over the past 6,000 years. At ‘Upolu, we have successfully employed trench and auger methods to accurately document the evolution of the sandy coastal plain environment in response to changes in Holocene sea-level (Kane et al., 2017). The sedimentological record developed at ‘Upolu shows that as sea-level fell following the mid-Holocene highstand, the coastal plain prograded (grew in the oceanward direction) allowing for increased habitatbility of coastal plain environments, and establishment of initial Sāmoan settlement sites (Cochrane et al., 2016; Kane et al., 2017a). Finally at Majuro we have shown that fossil reefs can be sampled with minimal environmental impact using a handheld drill and that our methods enable accurate reconstructions of habitat change in response to changes in sea-level (Kane et al., 2017b).

Obtaining a better understanding of the fate of reef islands is vital for understading the future of critical habitats at FFS and also for eludicating what impacts we may forsee for cultural, natural, and historic resources of the PMNM as a whole.