

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: Pelika Andrade

Affiliation: Na Maka Onaona (formerly Na Maka o Papahānaumokuākea) & UH Mānoa

Nā Maka Onaona (NMO) is a non-profit 501(c)3 supporting Aina Momona: A thriving and productive Hawaii. NMO cultivates and supports Aina Momona through providing culturally grounded educational programs and partnerships that support the over all health of our communities; mentally, spiritually, emotionally, and physically. NMO has been developing programs focused on investing in our communities and the next generation to lay a foundation for change paving the way to redefining health, wellness, and productivity. Most issues we face today are rooted in the misbehavior of people and the values, or lack of, we collectively share today. NMO focuses on addressing people to shift our behaviors, our values and our relationships and including people in healing the natural world around us. NMO strongly believes that the health of our environment is reflected in our people and the health of our people are reflected in our environment and it is a journey we must all take together.

Permit Category: Native Hawaiian Practices

Proposed Activity Dates: July 2-16, 2020

Proposed Method of Entry (Vessel/Plane): Vessel – MAKANIOLU

Proposed Locations: Nihoa, Mokumanamana, Mokupapapa (French Frigate Shoals, La Perouse Pinnacle)

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

16-18 (10 project personnel + 6-8 vessel crew) total people will be covered to conduct activities under this permit, co-listed under the Research application submitted by Dr. Haunani Kane.

Estimated number of days in the Monument: 12

Description of proposed activities: (complete these sentences):

a.) The proposed activity will...

Support sustainable fisheries and aina momona through continuing intertidal surveys and monitoring across the archipelago to advise and direct management strategies to support the

intertidal fishery focusing on Opihi/Limpet productivity. Over the past decade of collaborative intertidal monitoring, our locally led research team has identified significant shortcomings to the current research being conducted on Hawai‘i’s unique wave-dominated, rocky intertidal shoreline. For instance, prior data collection methods failed to measure environment – a key component to intertidal ecology and sustainable fisheries management. From recent findings, we draw new hypotheses and a new survey method (PACC) that focus on the effects of seasonal changes in habitat on patterns of reproductive cycles, recruitment and productivity of rocky intertidal communities. The work generated would be used to develop a sustainable fishery model for evaluating species productivity on any intertidal coastline in Hawai‘i. As a model system for intertidal mollusc fisheries, our objectives are to assess the stock status for three species of limpet (*Cellana* spp.) in the Hawaiian Islands by: (1) describing and delineating their environment and habitat, (2) improving the understanding of the biology and ecology of *Cellana* spp., and (3) proposing sustainable harvest practices and management measures using an indicator-based approach.

Sustainable ecosystems and aina that are thriving and productive are fundamental in Native Hawaiian values and systems. Looking beyond the obvious Native Hawaiian practice of harvesting and gathering, there was a system in place that supported productive lands, oceans, and communities generationally. Our proposed activities are supporting the Native Hawaiian practice of Aina Momona.

Since 2009, Na Maka Onaona has been a major partner in Hawaii’s Intertidal Monitoring Partnership conducting research in PMNM. Over the past eleven years, our team has been conducting intertidal monitoring along Hawaii’s wave-exposed shorelines to address community concerns on sustainable harvest of ‘opihi (*Cellana* spp). Working with numerous schools and community organizations, we have learned valuable lessons about both the productivity of our shorelines, and how this productivity aligns within the larger goals of thriving communities (Morishige et al. 2018). Through integrating institutional research, traditional knowledge systems, end-user (i.e. fisher) engagement, and outreach/education, our team has developed a unique research approach - made possible through the contributions of these multiple perspectives, considerations, and relationships. This journey provides us the capacity to understand a space through the multiple lenses within a community and create a platform that is inclusive of various knowledge systems to address the needs of our people, our environment, and a thriving relationship between the two entities. Building on recent research, our understanding of place changes by season and across multiple landscapes. We have developed a modified survey to look at the role of different habitat types, and the influence of environment on the carrying capacity of our intertidal fishery. Based on a shared goal of a productive and sustainable fishery, our latest series of questions have led us to identify management strategies that can maximize replenishment in these rocky intertidal ecosystems. We believe the sharing of this journey is valuable, and will encourage a more inclusive conversation to evolve management and conservation to truly support ‘aina momona, abundant and productive communities of people and place.

PACC surveys aim to better understand how natural fluctuations occur even on remote shorelines with low human impact. This research will shed light on seasonal growth and die back of populations in relation to their habitat size and local physical environment. In 2012, the intertidal data was collected for the fourth consecutive year and Dr. Chris Bird and intertidal monitoring crews have noted changes over time. For example, there was a high density of recruits recorded in June 2010, however, they did not all survive, suggesting that more ‘opihi settled on the shore than the habitat could sustain. In 2010, participants recorded numerous small one month old ‘opihi (300 per m²), whereas in 2011, there were less 1.5-year-old ‘opihi (50 per m²) (http://www.papahanaumokuakea.gov/news/opihi/opihi_chris_b.html). Although one year might seem like there are many recruited ‘opihi, the habitat and environmental conditions can limit their survival and influence successful recruitment into adult populations. This highlights the importance of considering the maximum and minimum thresholds of population densities by size to identify stable carrying capacities.

PACC implements a mix of standardized and novel methodologies across boulder, bench, and sloped rocky substratum to: 1) examine the effect of swell exposure (Low, Medium, High) on habitat size; 2) develop a practical, routine method for determining opihi growth rates and age in-situ; and 3) measure species fecundity and reproductive output in relation to major environmental drivers such as temperature. Our project evaluates how environment, growth and age structure, and reproductive output affects total shellfish production on temporal and spatial scales; and re-establishes productive ecosystems as a fundamental strategy of traditional Hawaiian resource management.

The outputs of this project will be the identification of optimal habitat for a productive intertidal fishery, effective management strategies/tools, and support for stakeholder decision-making based on the sustainable opihi population density for respective shorelines-types. If we can understand a shoreline’s stable habitat (habitat size and population densities at its minimum normally during the seasonal dieback), we can understand that shoreline’s stable carrying capacity of ‘opihi. This research in PMNM is part of an on-going initiative to survey multiple locations in the Main Hawaiian Islands to inform management techniques to sustainably harvest and rest populations that compliments cyclical productivity. Locations across the Hawaiian Archipelago have been selected due to existing, long-term partnerships and/or areas of interest expressed by Native Hawaiian community members. Our research team will train and work with local and Native Hawaiian communities to build local research capacity by surveying their intertidal ecosystems.

Consistent with proclamation 8031, these activities will strengthen cultural and spiritual connections to the Northwestern Hawaiian islands and foster the expansion and perpetuation of Native Hawaiian ecological knowledge and research methodologies. This knowledge may be critical as it is observed by local Hawaii residents that 'opihi and hā‘uke‘uke stocks are generally diminishing in size and number in the main Hawaiian Islands, therefore more data in this area may help to curb the decline. The continuation of ‘opihi data collection, and comprehensive intertidal surveys (including fishes, algae and invertebrates) using Native Hawaiian ecological

knowledge and methodologies coupled with western science will help to contribute to the overall health of Papahānaumokuākea.

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

conduct PACC surveys to examine ‘opihi densities by size classes and maximum sizes within each vertically stratified zone (black zone (basalt rock) and pink zone (crustose coralline algae zone)). The black zone is located on the upper extent of the shoreline defined as the Emergent Tidal Zone where black rock is exposed to the air depending on the tide and the pink zone is located lower on the shoreline in the Wave Zone (Bird et al. 2013). Rugosity measurements will be recorded for the black zone and pink zone to identify differences in ‘opihi carrying capacity by distinct habitat zones within the intertidal ecosystem. Tight measurements will also quantify the growth and shrinkage of the broader shoreline within each survey site to provide a practical measure of seasonal habitat threshold. PACC surveys will provide a total rugosity measurement for black and pink zones within the mixed (overlap of black and pink zones) rugosity zones. In order to increase the precision of ‘opihi habitat availability, PACC will also record differences in ‘opihi habitat and non-habitat to develop more precise estimates of ‘opihi densities.

We will collect ‘opihi to dissect gonads and use histological methods that can provide fecundity estimates and reproductive state by sizes that have not been used for ‘opihi in PMNM in prior years. To determine fecundity-at-size, we will examine ‘opihi ovaries histologically for all size groups except size class A (0-1 cm SL). A total of n=80 specimens will be collected from Nihoa using an ‘opihi knife. These specimens will be measured by caliper for shell length, shell width, and shell height, and weighted by scale for total weight, soft-body weight, and gonad weight. Gonad tissue will be fixed in 10% v/v Neutral Buffered Formalin and rinsed with 70% v/v ethanol prior to haematoxylin and eosin staining (H&E) at the University of Hawaii’s Histology and Imaging Core Facility (Honolulu, Hawaii). Using a microscope and imageJ, oocytes will be measured for diameter, and enumerated to determine fecundity.

Extra shells from collections will be saved where a subset of them will be analyzed to measure sub-annual growth rates. Following the methods of Mau et al. (2019), each shell will be cross-sectioned from anterior to posterior direction using a low speed saw (Isomet 1000, Buehler) equipped with a 0.5 mm diamond coated blade. Parallel cuts will be made at the apex or maximal growth-axis to obtain two replicate 1.3 mm thick-sections per specimen. The replicate thick-section will be mounted in its entirety on a large glass slide using quick-drying epoxy (EPO-TEK 301, Epoxy Technology Inc, Billerica, MA), grinded with F1000 grit SiC powder secondarily, and polished with 3 and 1µm Al₂O₃ powder on a lapping wheel. The polished, thick-sections will be stained with Mutvei’s solution to expose major lines, micro lines, and micro increments by light microscopy (Schöne et al. 2005). Shell thick-sections will be placed in a petri dish and submerged in Mutvei’s solution for 45 minutes held constant at 37-40°C with 14 constant stirring. These stained thick-sections will be imaged using a Nikon Eclipse E600 Polarizing light microscope at 100x magnification. Daily growth will be measured along two axes using the standard measuring tool in ImageJ. To measure daily growth (as shell length) along the

horizontal axis, we will record x-coordinates for each point where a micro increment band intersects the outermost layer, and subtract x-coordinates of sequential points to calculate horizontal distance or growth. Back-calculated shell length measurements will be used to model age-at-length data.

We will also be engaging in Huli ‘ia, an observational process documenting seasonal changes and shifts across entire landscapes, *ma uka* (ocean) to *ma kai* (ocean) identifying dominant correlating cycles to support and guide our management and best practices that support a productive and thriving community, ‘aina momona. It is an observational process documenting natural changes over time, identifies dominant cycles within certain species or occurrences (*flowering, fruiting, presence/absence of flora/fauna, cloud formations, spawning, or recruiting of fish species, etc.*) and assists in identifying correlations between species and/or occurrences as indicators of the other. When one thing happens (a flower blooms in mass), it indicates that another occurrence (a fish is spawning in mass) is happening (Sterling et al. 2017, Morishige et al. 2018). It allows natural cycles to support and guide our management practices allowing the flexibility needed to ensure the best times to rest areas or species and/or to harvest areas or species. Huli ‘ia stems from traditional management systems driven by an intimate understanding of the natural environment and the ability for communities to adjust and adapt their activities to support these systems of nature. Through this documentation process, Huli ‘ia supports the development of best practices enabling communities to adjust and adapt their activities to assist in malama ‘aina.

- Lani (atmospheric) observations include looking at cloud formations, noting wind direction/strength and what times it changes, visibility of the horizon, bird activity, other weather related observations such as rain or rainbows, the rising and setting of the moon and sun, the moon phase, and stars.
- Honua (land) observations include looking at any plants that are flowering, seeding or fruiting, new growth, animals reproducing, precipitation and soil moisture, bird arrival and departure and any other animal behaviors. Land observations from the main Hawaiian Islands during the expedition may also be useful to help remember activities in the NWHI during that time. For example, we notice hala fruiting here on the main islands and can relate that in the Northwestern Hawaiian Islands, this is the season when juvenile iwa are still in the nest.
- Kai (ocean) observations include noting the tide (high/low and time), waves and currents, identifying and looking at the behavior of invertebrates, limu (algae) and fish in the intertidal environments, noting any spawning or aggregation of species, and noting any juveniles and newly recruited species. (see observation datasheet)

To ensure responsible and ethical practices, we will refrain from collecting ‘opihi and hā‘uke‘uke if populations appear too small to sustain collections. Consumption of intertidal resources including invertebrates, limu will further support cultural practice and relationship between participants and our islands. Consumption feeds physical, spiritual, and cultural health rooting us in our ancestral ties and customary practices. Consumption allows us to be nurtured

and nourished by place and genealogy. Our islands and the resources thriving here are older siblings and customary relationships are based on the reciprocal practice of being fed and cared for by our older siblings while we care for and “feed” them in return. Our presence, activities, oli, observations, surveys, etc feed and care for place further supporting the physical, spiritual and cultural health of our islands and ourselves. Consumption also allows us to interact with place and understanding the network involved to produce a meal, which feeds a community. The research team will work together to apply this integrated monitoring approach. The research team will be comprised of cultural researchers / practitioners, scientists, and managers. To ensure the success of these field studies, the team will conduct appropriate protocol and offer ho'okupu (cultural offerings) to maintain the spiritual integrity of the sites that are visited.

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

This activity will not only add to the current knowledge of the marine environment in the NWHI, it will help to gain a better understanding of the resources by looking at the resources through a Native Hawaiian cultural lens ensuring a holistic approach to interaction and care. It will also help the monument by continuing to re-establish Native Hawaiian ancestral consciousness and awareness about the health and condition of the marine resources. This integrated monitoring research cruise is the only one of its kind that integrates Native Hawaiian worldview and knowledge systems with western scientific methods to better understand the status of intertidal marine resources. It helps the Monument strengthen its management of cultural resources and ensures the strong participation of Native Hawaiians in the region's long-term protection. By providing opportunities to conduct cultural research, (cultural) researchers will assist in the recovery of important Native Hawaiian marine management practices and support the use of Native Hawaiian traditional ecological knowledge. Additionally, the permitted cultural practitioners and researchers will be key to the development of an eventual cultural access and monitoring plan for the NWHI.

The scientific research methods will build on the valuable long-term monitoring data collected on previous intertidal research cruises.

Other information or background:

Additionally this project is also supported by the following activities in the Monument Management Plan, (NHCH-2.1, 2.2, 2.3, 2.5, 2.6, 3.4, 4.2, 5.3 and NHCI – 3.1 and 3.2) all of which call for the identification of Native Hawaiian research priorities and access opportunities.

NHCH-2.1: Continue to compile information and conduct new cultural historical research about the NWHI.

NHCH-2.2: Support Native Hawaiian cultural research needs.

NHCH-2.3: Facilitate cultural field research and cultural education opportunities annually.

NHCH-2.5: Incorporate cultural resources information into the Monument Information