

**Papahānaumokuākea Marine National Monument**  
CONSERVATION AND MANAGEMENT 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

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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:** Dr. Kelly Gleason Keogh

**Affiliation:** Papahānaumokuākea Marine National Monument

**Permit Category:** Conservation and Management

**Proposed Activity Dates:** 04/01/2017-03/31/2022

**Proposed Method of Entry (Vessel/Plane):** Plane

**Proposed Locations:** Midway Atoll

**Estimated number of individuals (including Applicant) to be covered under this permit:** 8

**Estimated number of days in the Monument:** 21

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

a.) The proposed activity would...

This activity aims to achieve goals to explore, manage, interpret and protect maritime heritage resources in PMNM, specifically at Midway Atoll. In 2017, maritime heritage work at Midway Atoll is funded through an Office of Exploration and Research maritime archaeology grant to conduct exploratory survey for Battle of Midway related sunken aircraft sites. Archival research identifies at least 31 plane crashes within three miles of Midway Atoll (Linville, 2010). Dozens more are probable and many more lie three miles beyond Midway Atoll. Additional aircraft losses are reported by survivors who describe loss locations based on their first-hand experience. Of these 31 aircraft reported lost, 22 were American and 9 were Japanese and all considered war graves. The Battle of Midway was one of the most decisive U.S. victories of WWII and is referred to as the turning point of the war in the Pacific. To date, four sunken aircraft have been located and documented by archaeologists at Midway Atoll (Papahānaumokuākea, 2011), with three of these discovered in the last three years; dozens more remain undiscovered.

In collaboration with the National Park Service's Submerged Resources Center (NPS/SRC), East Carolina University (ECU), and Fish and Wildlife Service (FWS), this project includes approximately 10 days of exploratory remote sensing survey at Midway Atoll in specific areas of reported and probable aircraft loss during the Battle of Midway. Exploration for sunken aircraft sites will also serve as an opportunity for progressive multidisciplinary survey through

collaboration with PMNM's resource protection program to survey for alien invasive species on anthropogenic structures at Midway Atoll (specifically sunken aircraft). Additionally, the project will prioritize the development of cutting edge education, media and outreach products through innovative technology, award winning in-house journalists, and a strategy to create captivating materials that will bring this remote place and the project to people all over the world. Discoveries made during this research project will also fill gaps in knowledge relative to the material remains of the WWII Pacific front, linking them to managed sites in Pearl Harbor, Guam, and Saipan. Additionally, this project is timed to occur in advance of the June 2017 75<sup>th</sup> Anniversary of the Battle. Work conducted during this survey, including any discoveries made will contribute to the outreach efforts to honor this event.

Anticipated outputs from the project include: A) a comprehensive report providing fully analyzed remote sensing survey data, B) preliminary identification of artifacts and sites through ground trothing, C) alien invasive species survey data and species identification incorporated into reports, and D) at least two articles published in professional journals and several public presentations.

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

Exploratory survey at Midway Atoll will take place before June of 2017 in order to coincide the timing of this project and the 75th Anniversary of the Battle of Midway. Research, data analysis and outreach will take place during and immediately following field work. The 2017 expedition will include at least 10 days of survey at Midway Atoll. With the numerous targeted blocks from the witness accounts for the magnetometer study, there are ample areas for remote sensing and scientific investigations every day regardless of weather conditions or sea-state.

The primary objective of this project is to uncover the sunken history of the Battle of Midway through remote sensing, anomaly testing and historical research. Complete survey in areas of highest probable loss has yet to be complete, and is proposed with this project. This project builds upon existing survey data by conducting a more comprehensive examination of the inshore and offshore portions of Eastern and Sand Island as well as anomaly characterization in deeper water.

The SRC will serve as the lead for the magnetometer survey operations using a Geometrics G-882 magnetometer, newly developed data processing script in ArcGIS 10.2.2, and previous experience of surveying for lost aircraft. While WWII aircraft are largely aluminum alloy, which is not detectable via magnetometry, certain ferrous elements such as engine blocks, cast iron machine guns, or ferrous landing gear can be detected. Additionally, some early grades of stainless steel, like 300-grade, were used in WWII-era aircraft which can also be detectable. With only six of the 70-plus known anomalies having been visually inspected, we believe that there is a strong probability for making discoveries of lost aircraft using the existing data outside of the lagoon and new data collected inside.

One of the principal cultural resource detection devices used in submerged cultural resources survey, as it is with most submerged historical site surveys, is a magnetometer. The magnetometer has long been a standard archeological survey instrument (Arnold and Weddle

1978; Breiner 1973; Arnold and Clausen 1975; Shope 1997) for shipwrecks due to their high amount of ferrous cultural material, but they have also proven to be successful in locating other features including the focus of this project proposal: WWII-era aircraft. For the proposed study, a Geometrics G882 cesium-vapor magnetometer has been chosen, and it currently possesses the highest rated sensitivity for commercial magnetometers. It is important to note that unlike a sonar, a magnetometer emits nothing in to the water. It is simply reading the earth's magnetic field as it is towed through the water. For the proposed survey, the team will be using a 50 meter long tow cable, but the distance behind the boat will depend upon the size of the boat and the depth of the water. If the water is shallow (<50 feet) the team will only tow with 10 meters of cable out in the water.

Magnetometers in most basic terms detect and quantify magnetic fields. In hydrographic survey, ferrous or magnetic objects can be located by noting small perturbations, called “anomalies,” in the earth’s ambient magnetic field caused by the magnetic moment of ferrous material. Ferrous objects cause a localized increase or decrease, usually both, in the ambient magnetic field. These objects in this context of a marine environment are generally of cultural origin associated with maritime casualty, activity or depositional sites. Magnetometers measure and record the total magnetic field intensity in a manner independent of sensor orientation and presence of any kind of cover. In practice, because full-field magnetometers are not influenced by sediment, they are ideal detection devices for submerged cultural materials of ferrous construction on or beneath the seabed, or encrusted in marine growth such as the corals prevalent at Midway Atoll.

Typical cesium magnetometer resolution of the earth’s magnetic field is less than 1 gamma (in some cases like the G-882, its 0.1 gamma) in the earth’s field of approximately 50,000 gammas (nanoteslas). This means there is very little noise in the magnetic readings generated during marine survey, and even less in areas of the world that lack continuous, dense maritime activity like Midway Atoll. Noise reduction is important so that small ferrous objects, which produce small anomalies, can be reliably detected. The industry standard (for example, Department of Interior, Bureau of Ocean Energy Management Guidelines for Offshore Lease Block Surveys) specifies a noise level of +/- 3 gammas or less. The G-882 produces a remarkably low noise level because only processed data and power are transmitted over the tow cable. This in combination with a clean power source will be able to detect small deviations in the magnetic field that may represent similar artifacts that have already been found at Midway such as small ordinance, guns, and ferrous aircraft components.

Noise is an issue because the gamma reading of a particular ferrous mass, which is proportional to the size of the mass, declines as a cube of the distance between the sensor and the mass. Noise in high-resolution magnetometer survey masks smaller anomalies that might be of archeological interest, like the smaller variances that stainless steel from an aircraft would produce. The G-882 permits discrimination and recognition of anomalies that are hidden within the noise levels of most proton magnetometers; consequently very small anomalies may be reliably recognized. Discrimination of the smallest possible magnetic anomalies is desirable during archeological survey, because of the possibility of cultural material falling between survey lines producing a weaker return due to the greater distance from the sensor.

The most effective presentation of magnetic data for archeological purposes in our experiences are contour lines representing lines of magnetic intensity, called isogammas. Contour configurations representing relatively intense changes in the earth's field indicate the presence of ferrous materials. Magnetic readings simply indicate the presence and possible mass of an object. There is no unique relationship between anomaly intensity and isogamma contour configuration and an object. Any number of combinations of objects can produce similar anomalies. The only way to determine anomaly sources is by visual investigation via diver or with an ROV (Murphy and Saltus 1990).

The magnetometer is a valuable cultural resource detection instrument, and it is sensitive to many different types of artifacts associated with submerged aircraft as well as other cultural activities. Aircraft are often difficult to detect by visual inspection or sonar-based instruments alone because marine life encrustation and sediment coverings can easily obscure a site. The most effective and complementary multiple-instrument combination for hydrographic survey for historical cultural materials is currently the magnetometer coupled with a side scan sonar, but for the proposed Midway survey with its abundant coral cover, only a magnetometer will be employed. With the primary target of this project being WWII-era fighter planes, there will still be ample ferrous material remains, as evident in the remains at the site of 2012's discovery of the F2A-3 Brewster Buffalo.

In addition to magnetometry, this project will make use of a variety of software available for quick documentation and 3D image collection. Because the thrust of this project is exploration and not documentation, the team will need to move rapidly from site to site. In lieu of traditional hand mapping of sites, the team will rely on pioneering 3D structure from motion (SFM) reverse-angle photogrammetry and modelling. This new and exciting technology will provide the exploration team with photos and subsequent products produced from the photos that are both accurate and useful for study, but also available to the world via the internet in near real-time.

With no archaeological mapping planned for new discoveries, we feel that the Photoscan software is an effective and innovative method of collecting meaningful data for study, interpretation and management. It is also by the nature of 3D, an excellent form for outreach and educational material to engage and inform the public about the past.

In order to achieve critical resource protection goals in the Monument, exploration for sunken aircraft sites provides a unique opportunity to investigate and discover marine alien species in tandem with submerged cultural resources sites utilizing original methods and creative techniques. Of the more than 400 species of marine alien species recorded in the Hawaiian Archipelago only about 10% are established in PMNM. These marine alien species established in the Monument are made up of 2 marine plants, 38 marine invertebrates and 3 fish. The established alien marine invertebrates outnumber the fish and plants but have had the least focus due to the cryptic nature of this faunal group. Many of the established alien marine invertebrates are found at Midway Atoll and any undiscovered species would most likely be found at this location. This is due to the great alteration of the habitats and exposure to marine alien species transport mechanisms; such as ships; which was a product of military activities before, during and after WWII. We believe that genetic community characterization of these invasive species,

when compared to control communities in other locations, will provide data relevant to the date, intensity and mechanism(s) of alien species invasion.

Many of the alien marine invertebrate species that become established are generally “biofouling” organisms that easily adapt to man-made substrates (wood, metal, concrete) in the marine environment. These anthropogenic substrates provide a habitat in which these organisms have a competitive edge over native species within the same environment. Midway Atoll is a prime example of this type of dynamic in both shoreline and submerged reef habitats. Stabilization of shorelines through sea walls and docks provide a foothold for new introductions in harbor environments but near-shore and offshore habitats can also be influenced by anthropogenic substrates. Historically, lagoon and reef habitats at former military bases have been altered by the intentional dumping of man-made debris but also the unintentional loss of equipment during training and active hostilities. These objects of maritime history can act as establishment and stepping stone points for marine alien species within habitats that would otherwise be difficult to invade for these biofouling species. Finally, the historically and archeologically documented ages of aircraft and shipwrecks, now potentially colonized by invasive species provides a solid, scientifically documented point of initiation for colonizing species—as such cultural resources provide key dating insights into mechanisms of ecosystem change by species invasion. Paradoxically, while a cultural and military invasion was successfully fended off by US forces in 1942, the same military infrastructure that made that possible may have also fostered a moderately successful biological invasion. This OE supported project will explore and document both as complementary and mirrored processes. .

Focused surveys have been conducted at sea wall, and dock habitats at Midway Atoll by Scott Godwin from the PMNM from 2010 until 2014 and have proven to be establishment points for alien marine invertebrates that are considered biofouling species. The marine alien species established at Midway Atoll are made up of 1 plant, 48 marine invertebrates and 1 fish. Based on field observations (Godwin), a group of the marine invertebrates recorded in the inventory are species that have shown the ability to spread to natural reef areas from their established populations on man-made substrate. There has been little opportunity to conduct marine alien surveys in the lagoon habitats of Midway Atoll to be able to determine if any dispersal of the recorded alien marine invertebrates has taken place. There is a need to determine whether marine alien invertebrates have dispersed from these establishment points to man-made and natural habitats in close proximity. This can be determined by surveys within the lagoon habitats, which can be done in conjunction with the proposed maritime heritage surveys.

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

Through a combination of pioneering technology, original methods, and experience based strategies for survey and logistics, the team will achieve a wide suite of goals that focus on exploratory survey, resource protection and getting exciting discoveries to a wide audience from a remote atoll with a heritage that includes one of the most significant battles of World War II

and an important site for interagency management in the 75th Anniversary year of the Battle of Midway.

Midway Atoll survey in 2017 will serve to: 1) honor and enrich the legacy of the Battle of Midway, 2) connect these sites with the stories of veterans who may still be alive today, and 3) contribute significantly to the study and our better understanding of aviation archaeology. Anticipated outputs from the project include: A) a comprehensive report providing fully analyzed remote sensing survey data, B) preliminary identification of artifacts and sites through ground trothing, C) alien invasive species survey data and species identification incorporated into reports, and D) at least two articles published in professional journals and several public presentations.

Additionally, PMNM will work collaboratively with the Pacific Aviation Museum in Honolulu, Hawai`i in order to create a live broadcast from the expedition while at Midway Atoll that will engage public outreach for the 75th Anniversary of the Battle of Midway. Other outputs will include an expedition web page updated daily with photographs, video and text, 3D photogrammetric imagery, interactive video from the field and yet to be finalized museum exhibits. The expedition page will also offer daily interaction with the team, using the OER model of public interaction with scientists during the exploration and discovery phase of projects. This connection will also afford the field team daily access to WWII aircraft experts as discoveries are made. Post-expedition, the web page will continue to evolve as data analysis continues.

**Other information or background:**

Few places represent the legacy of World War II like Midway Atoll. Located within Papahānaumokuākea Marine National Monument and World Heritage Site (PMNM, the Monument), the sunken history left undiscovered at Midway represents the material remains of one of the most consequential events in the history of the Second World War (Figure 1). The potential for exploration at this remote atoll in the Northwestern Hawaiian Islands is remarkable, and the possibilities are demonstrated with the recent discoveries of a rare Brewster F2A-3 Buffalo located in shallow waters of the Midway Atoll lagoon, and even more recently the discovery of a P-40 Warhawk in 2014 and a F4U Corsair in 2015.