

## **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:** Donald C. Potts

**Affiliation:** Institute of Marine Sciences, University of California, Santa Cruz

**Permit Category:** Research

**Proposed Activity Dates:** 1 June 2010 - 31 December 2011

**Proposed Method of Entry (Vessel/Plane):** Plane: USFWS flights from/to Honolulu

**Proposed Locations:** Midway Atoll: multiple shallow sites (0-35 m depth)

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

10

**Estimated number of days in the Monument:** up to 100 person-days per year

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

a.) The proposed activity would...

...determine sedimentary conditions prevailing on Midway Atoll before human contact began in the late 1800s; detect changes in the composition of sediments and rates of sedimentation since then; and determine whether changes can be attributed to the major engineering modifications of the reefs and islands between ~1930 and ~1980. This activity continues previous multidisciplinary studies of the effects of environmental change on marine benthic habitats of Midway Atoll, and will contribute to a broader assessment of whether Midway Atoll will be sustainable as a viable atoll ecosystem during the climatic and oceanographic changes expected over the next century.

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

... use a portable corer to extract 5 m long sediment cores from the main areas of sediment deposition in the lagoon and sites of sediment export from the atoll. We will establish the historical record and detect changes by describing grain composition and sizes along the cores, by comparing these with samples of surface sediments collected in 2007-09, and by selecting single elements for isotopic dating of major transitions. We will then use models to predict potential physical and ecological changes on Midway Atoll under various IPCC scenarios of climatic and oceanographic change, and to identify and explore ways to enhance positive trends and reduce deleterious effects.

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

... expanding the knowledge base of detailed information about Midway's physical structure, biotic communities and ecosystem processes; by documenting the nature and extent of changes

in patterns of erosion and deposition of sediments associated with past modifications of the atoll; by establishing current baselines for hydrodynamic processes; by providing input for modeling responses to rising sea-levels over the next century; and by informing management about ways to enhance the long-term sustainability of Midway Atoll. This will be the most extensive study (in space and time) of sediments ever conducted in the NWHI, and many results should be relevant to other atolls in the PMNM

**Other information or background:**

Midway Atoll may be particularly vulnerable to changing patterns of erosion and sedimentation, driven partly by sea-level change, for several reasons:

1. It lies near Grigg's (1982) "Darwin Point" (~29°N), the latitude north of which natural processes of reef destruction (by erosion, sediment export and subsidence) exceed rates of reef growth (by corals, coralline algae and sediment deposition).
2. It is also ecologically marginal and many reef-building species (e.g. corals, coralline algae) appear to have relatively low growth and survival rates, while bio-eroding species (e.g. fish, sea urchins), which are major producers of new sediments, are abundant and capable of rapid destruction of both new and old coral growth.
3. It has been greatly modified by dredging, cutting channels through the reef margin, island expansion and construction of many kinds, especially between 1930 and 1990. These modifications have lowered lagoon water levels and altered residence times of water; changed current strengths and wave energy; and increased sediment transport, scouring, and export from the reef. These modifications probably continue to contribute directly and indirectly to habitat degradation over much of the lagoon and backreef habitats (i.e. compared to the largely unmodified Kure Atoll).
4. Existing climate models lack the regional resolution for predicting probable future climatic and oceanographic conditions at Midway Atoll, but since rates of CO<sub>2</sub> increase, sea-level rise, and ocean acidification are already exceeding those assumed for many IPCC (2007) projections, it is likely that effects of climate change are already altering physical processes on marginal reefs such as Midway.

Some environmental changes predicted for mid-latitudes are likely to be beneficial, rather than detrimental for Midway Atoll. For example:

1. Warming of cooler waters not only tends to increase calcification and growth rates of corals and coralline algae, but also tends to reduce absorption of CO<sub>2</sub> and hence slows acidification.
2. Lighter winds and less intense storms reduce physical erosion and export of sediments, although more frequent or more intense storms tend to accelerate erosion.
3. Rising sea-levels will increase available habitat for upward growth of corals and coralline algae, although during severe weather, deeper water also increases the potential hydraulic energy of waves and currents, leading to greater erosion of both reef margins and islands, and accelerating sediment loss.

This project builds on work begun in 2005 under USFWS permits and continued under permits PMNM-2007-013, PMNM-2008-056a, PMNM-2008-056b, PMNM-2008-065 and PMNM-2009-040.