

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: Robert J. Toonen

Affiliation: Hawaii Institute of Marine Biology, University of Hawaii at Manoa

Permit Category: Research

Proposed Activity Dates: 05/15/10 through 11/15/10

Proposed Method of Entry (Vessel/Plane): R/V Hi'ialakai

Proposed Locations: Shallow water habitats (< 100 feet depth), focused on collecting algae and bivalves for isotope studies. To identify sources of nutrients along the archipelago. Collections can be made on any islands with some emphasis given to those known presently and or historically to house bird colonies.

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

One berthing position for my research team, plus available members of researchers from other permitted activities who can collect opportunistically on our behalf. The person taking this berth will also work with Donahue's team.

Estimated number of days in the Monument: Up to approximately 30 days

Description of proposed activities: (complete these sentences):

a.) The proposed activity would...

collect samples of common reef algae and small bivalve species. The purpose of these collections is to determine the relative role of terrestrial sources (primarily resulting from seabirds) of nutrients to primary productivity along the archipelago. Historically seabirds were much more common within the Northwest Hawaiian Island's and deposited large quantities of guano. In the late 1800's and early 1900's there was considerable pressure on bird populations and extensive guano mining especially on Laysan Island. Did the loss of this terrestrial input of nutrients from bird sources alter productivity in the Northwest Hawaiian Island's and result in some of the shifts in productivity still seen today? To begin to address this question we propose to collect isotope signatures along the NWHI archipelago and to apply a relatively new technique microbial source tracking (MST; e.g. Stoekel et al 2007) to identify sources of microbes found in bivalves samples. Isotope signatures are often used as indicators of terrestrial based nutrients however sources are harder to identify. Fecal indicator bacteria such as Escherichia coli (E. coli) and enterococci are associated with all warm-blooded animals and can persist for days to

weeks in the environment (Anderson et al. 2005; Badgley et al. 2010; Ferguson et al. 2005; de Oliveira et al. 2008). Recently MST has been used to track fecal contamination of humans, sheep, and cows up to 6 km off shore and these indicators were associated with known terrestrial sources of nutrients (Cornelisen et al. In press). We will use a similar technique focused on bird guano to track sources of nutrient inputs in near shore environments along the NWHI.

b.) To accomplish this activity we would
collect target algal samples by hand. Isotope studies require a very small amount of tissue. Samples will be collected and dried on board and isotope analysis conducted on dried samples at the University of Hawaii. Bivalve samples are collected and the digestive glands removed and processed for MST analysis. To conduct MST bacterial counts are conducted using a standard fermentation technique (Cornelisen et al in press). DNA is then extracted for analysis at HIMB using markers developed for Hawaiian sea bird species.

c.) This activity would help the Monument by ...
It has been well documented that marine derived nutrients subsidize terrestrial island food webs (e.g. through deposition of algae on beaches or through seabird/seal droppings). The contribution of allochthonous nutrient inputs to island food webs has been explored extensively; however, there has been little research into the extent to which nutrients derived from the open ocean that are deposited in concentrated quantities on remote islands are returned to the marine environment and support primary production in intertidal and near shore waters. In the NWHI, there are large seabird populations that nest on small/steep islands that are immediately surrounded by productive macroalgal and reef habitats. Seabirds feed on fish over extensive open ocean areas and return to the islands and deposit large quantities of guano that are high in nutrients such as nitrogen; hence, the seabirds likely nourish the island ecosystem as well as near shore communities. Loss of seabirds and mining of guano may be responsible for shifts in community structure and may be underestimated. Knowing the role of seabirds would help management by identifying a major nutrient vector and help to understand what underlies differences in primary productivity among islands and through time. Knowing the base of variation in primary productivity is essential to management of marine systems and understanding the linkage between the ocean and terrestrial systems will provide a basis for shared management strategies.

Other information or background: There is mounting evidence that marine systems can subsidize terrestrial environments and newer less abundant evidence that the reverse is also true. Thus there is an important connection between oceanic, terrestrial, and near shore productivity with multiple connections driven by major linking species. Breaks or alterations in these links may have severe impacts on all three ecosystems. Seabirds feed offshore then return to islands and release nutrients derived from the oceanic system. Guano from these birds can then enter near shore systems where they may affect local productivity. Thus seabirds have the potential to be a very important link in the connection between oceanic systems and productivity of island

systems. Recent developments in isotopes analysis allow us to examine food webs in greater detail than previously possible and molecular tracers allow us to trace species specific microbes along with nutrient exchange among systems. Here we propose to link isotope studies with MST to examine the importance and extent of seabird fertilization of near shore systems.