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: Bowen, Brian W.
Affiliation: Hawaii Institute of Marine Biology

Permit Category: Research
Proposed Activity Dates: 5/1/10 - 10/31/10
Proposed Method of Entry (Vessel/Plane): RV Hi'ialakai
Proposed Locations: Shallow water habitats (< 200 feet depth), focused on Kure, Midway, Pearl & Hermes, Lisianski, Laysan, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Mokumanmana, and Nihoa. However, we request latitude to sample other regions as weather and opportunity dictate.

Estimated number of individuals (including Applicant) to be covered under this permit: 16
Estimated number of days in the Monument: 55

Description of proposed activities: (complete these sentences):
a.) The proposed activity would…
be a genetic survey of reef fishes, designed to address the level of isolation between reef ecosystems across the Hawaiian Archipelago, and especially throughout the Papahanaumokuakea Marine National Monument.

One aspect of the project is that we will use DNA technology to examine a parasite that may have been accidentally introduced in the 1950's. This parasitic nematode, Spirocamallanus istiblenni, apparently hitchhiked to Hawaii with the blueline snapper Lutjanus kasmira and has subsequently spread to native fishes. While the introduction occurred on Oahu, the parasite has been detected in the Monument but has an uncertain distribution.

Another aspect of the project is to measure genetic diversity in five parrotfish species, to compare healthy stocks in the NW Hawaiian Islands with depleted stocks in the main Hawaiian Islands, and previously healthy stocks in the main Hawaiian Islands. This will be accomplished by sequencing mtDNA from parrotfish remains in middens (trash pits) dating back 100-1000 years. To accomplish this we need a maximum of 50 parrotfish specimens from each species, at

collection sites spread across the Monument. No more than 10 specimens/species will be taken at any single island or atoll, and every effort will be made to sample nonlethally. The benefit if this research is to determine whether there has been a historical decrease in genetic diversity in these parrotfishes due to human predation.

Another new aspect to the project is the expansion of diving efforts to greater than 130 feet depth. Specimens will be collected on deep reefs to evaluate the hypothesis that deep reefs can serve as refugia to replenish shallow reefs. Genetic studies can validate or refute this hypothesis, which has clear implications for management and conservation of biological resources. Deep dives during the permit period in 2009 will be used to select species for genetic analysis (ones that are abundant and feasible to collect). In addition, we wish to collect specimens of any new species encountered at depths greater than 130 feet, for genetic characterization, description, and vouchering in the Bishop Museum (see Appendix 1, opportunistic collections). This is an essential activity to characterize the biodiversity of the Monument, and will only be invoked in cases where speces are sufficiently abundant (encounter rate of 5+ per hour) to sustain collections without adverse impact.

b.) To accomplish this activity we would ....
survey approximately 30 fish species at locations across the entire archipelago, using polespears and traps to collect fish, and using mtDNA sequencing technology to resolve novel evolutioanry lineages, genetic diversity and connectivity among reef habitats.

c.) This activity would help the Monument by ...
determining whether the Monument is a series of relatively fragile (isolated) ecosystems, or whether individual reef habitats are connected in a larger and more robust ecosystem. There is also a concern about whether the NWHI serves as a source of larvae to replenish depleted fisheries in the main Hawaiian Islands. The assays of population connectivity outlined here will address these issues in a format that has statistical power and scientific credibility.

For example, the most recent findings from this research indicate that the Yellow Tang (Zebrasoma flavescens) is divided into 4-7 isolated populations within the Hawaiian Archipelago, including three populations in the PMNM (Eble et al. Submitted). This fish is heavily harvested for the ornamental fish trade, and so findings will realign management units for this species. Findings also indicate some connectivity between the Main Hawaiian Islands and the lower NWHI.

Other information or background: To preserve biodiversity, it is important to know how it is arises (Bowen and Roman 2005). While the main objective is to assess genetic connectivity among shallow reef habitats, a "value added" component is that we can assess the age and origin of Hawaiian fauna as well as the age and origins of populations on each island. A genealogical approach to relationships among mtDNA haplotypes will indicate whether the closest relatives to the Hawaiian fauna lie predominantly to the West (Ogasawara Arch, Wake Island, or Marshall Islands) or to the South (Johnston Atoll, Line Islands; Gosline 1955; Maragos and Jokiel 1986;

Maragos et al. 2004). In these cases, populations of the widespread Indo-Pacific species will be compared to the Hawaiian endemic. The geographic source of the Hawaiian form (especially Hawaiian endemics) will be resolved with parsimony networks and phylogenetic tools (see Methods), and the age of colonization events will be estimated with the mtDNA molecular clock.

Reef fauna typically have a pelagic phase (eggs and larvae), which lasts 20-60 days, followed by settlement onto a reef where they remain through juvenile and adults stages. Long distance dispersal is accomplished almost exclusively during the pelagic larval phase. However, the geographic limits of such dispersal are uncertain (Bowen et al. 2006a; 2006b). Recent research shows that effective dispersal of marine larvae can fall short of their potential (Swearer et al. 2002). This may be particularly true of the damselfishes, as recent evidence indicates (Ramon et al. 2008), and so we have added four damselfish species to this investigation.