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: Christopher Winn, PhD
Affiliation: Hawaii Pacific University, Oceanic Institute

Permit Category: Research
Proposed Activity Dates: 06/09/09-10/21/09
Proposed Method of Entry (Vessel/Plane): NOAA Research Vessel HI'IALAKAI
Proposed Locations: Shallow banks to depths of <1000m of the Monument waters associated with Kure Atoll, Midway Atoll, Pearl and Hermes Atoll, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Mokumanamana, and Nihoa Island.

Estimated number of individuals (including Applicant) to be covered under this permit: 5
Estimated number of days in the Monument: 30

Description of proposed activities: (complete these sentences):

a.) The proposed activity would…

The proposed activity would collect water samples from various depths and distances from the islands within the Monument to analyze and characterize the carbonate chemical make-up of the water surrounding the atoll systems in Papahanaumokuakea. Some analyses would take place onboard, while other, more complex analyses would be conducted in land-based laboratories once the ship returns to Honolulu. The analyses would be overseen by scientists at the Oceanic Institute in collaboration with scientists at NOAA's Pacific Marine Environmental Lab.

b.) To accomplish this activity we would ….

The R/V HI'IALAKAI's CTD would be utilized during non-diving hours and in conjunction with other projects onboard to collect water samples from waters associated with the atoll systems. Use of the CTD and associated instrumentation, including probes, Niskin water collecting bottles, and storage for transport would follow all standard hydrographic and water sampling methodology and procedures.

c.) This activity would help the Monument by …

By studying the oceanic carbon system we aim to vastly improve our knowledge of ocean acidification in Monument waters. We propose to do this by establishing a baseline of carbonate chemistry parameters that future environmental changes can be compared against. We also endeavor to broaden our understanding of the influence of ocean acidification on the marine communities of Papahanaumokuakea Marine National Monument.

Other information or background: Global climate change due to rising atmospheric Carbon Dioxide is a major threat to the world's coral reef ecosystems (Guinotte et al 2003). Of particular concern is the alteration of the ocean's carbonate chemistry, often coined Ocean Acidification. Evidence indicates that the ocean's pH and CaCO3 saturation state has declined in recent decades and will continue to do so in the foreseeable future (Caldeira and Wickett 2003, Feely et al 2004). These changes will likely cause rates of biogenic calcification to decline and rates of carbonate dissolution to increase (Lechercq et al 2000, Orr et al 2005, Morse et al 2006).

The coral reef ecosystem of the Hawaiian Archipelago covers a significant latitudinal gradient, spanning from 19 degrees to 29 degrees north and covering approximately 1500 miles. CaCO3 saturation state decreases with increasing latitude in the open ocean and forecasted ocean acidification is expected to have a larger and more immediate effect on calcifying organisms in high latitude regions compared to lower latitude regions (Kleypas et al 2006). Substantial speculation and significant uncertainty exist on the quantitative impact of ocean acidification on coastal ocean systems including high latitude coral reefs of the Northwester Hawaiian Islands (NWHI) where growth conditions are often suboptimal with regards to light and temperature regimes (Grigg 1982, 1983).

Coastal regions of the worlds' ocean remain largely under sampled and little is known about the state of the carbon systems found there (Chavez et al 2007). Previous research has shown that dissolution of high magnesium calcite from carbonate banks can serve to buffer reef habitat and locally elevate the aragonite saturation state of the surrounding ocean (Agegian et al 1988). While there is significant effort focused on forecasting global, large-scale ocean impacts of climate change and acidification, assessing the potential impact on the various NWHI islands, atolls, banks and shoals requires a finer-scale investigation of the local conditions.

The Gulf of the Farallones National Marine Sanctuary is also beginning to address these issues and collaboration between these two sanctuary sites may prove invaluable to the Sanctuary Program's informed ecosystem based management of our national marine protected areas.

Selected references:

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Caldeira, K. and M. E. Wickett (2003). Oceanography: Anthropogenic carbon and ocean pH. Nature 425: 365.

Feely, et al. (2004). Impact of anthropogenic CO2 on the CaCO3 system in the ocean. Science 305: 362 – 366.

Lechercq, N., J-P. Gattuso and J. Jaubert (2000). CO2 partial pressure controls calcification rate of a coral community. Global Change Biology 6: 329-334.

Orr et, al. (2005). Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. Nature 437: 681 – 686.

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Kleypas J.A., R.A. Feely, V.J. Fabry, C. Langdon, C.L. Sabine and L.L. Robbins (2006). Impacts of ocean acidification on coral reefs and other marine calcifiers: A guide for future research. A report of a workshop held 18-20 April 2005. NSF, NOAA, and USGS, St. Petersburg, FL 88pp.

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Grigg, R.W. (1983). Community structure, succession and development of coral reefs in Hawaii. Mar Ecol Prog Ser 11:1-14.

Chaves, F.P., et. al. (2007). Coastal Oceans. IN: The First State of the Carbon Cycle Report (SOCCR): The North American Carbon Budget and Implications for the Global Carbon Cycle, Synthesis and Assessment Product 2.3, Report by the U.S. Climate Change Science program and Subcommittee on Global Change Research.

Agegian, C.R., F.T. MacKenzie, J.S. Tribble and C. Sabine (1988). Carbonate production and flux from a mid-depth bank ecosystem, Penguin Bank, Hawaii. In: Agegian CR (ed) Biogeochemical cycling and fluxes between the deep euphotic zone and other oceanic realms. National Undersea Research Program, U.S. Dept. of Commerce, Washington, D.C.