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: Ruth D Gates
Affiliation: Hawaii Institute of Marine Biology

Permit Category: Research
Proposed Activity Dates: May - Spetember 2010
Proposed Method of Entry (Vessel/Plane): Hi'ialakai NOAA RV
Proposed Locations: French Frigate Shoals, Pearl & Hermes

Estimated number of individuals (including Applicant) to be covered under this permit:
4
Estimated number of days in the Monument: 30

Description of proposed activities: (complete these sentences):

a.) The proposed activity would…
identify and monitor biological indicators of coral disease, bleaching, and impact to the reef and assess the diversity of coral-endosymbionts in Papahānaumokuākea.

b.) To accomplish this activity we would ….
sample coral colonies to determine the molecular diversity of coral endosymbionts. These activities will be performed using SCUBA from small boat operations launched from the Hi'ialakai NOAA vessel.

c.) This activity would help the Monument by …
identifying biological indicators of disease; revealing the diversity of coral-endoymbionts in Papahānaumokuākea; and determining the affect of global climate change on the coral reef ecosystem.

Other information or background: The scleractinian corals provide the structural and biological framework that supports the high diversity of marine organisms that inhabit coral reef ecosystems. As such, the health status and functional integrity of coral has profound ramifications for other members of these environments (Hoegh-Guldberg 1999). Corals are susceptible to a variety of environmental disturbances that include changes in seawater

temperature, salinity, UV light, pollution, and increased sedimentation (Brown 1997, Williams & Bunkley-Williams 1990, Barber et al 2001, Hoegh-Guldberg 1999). Many of these disturbances are predicted to increase in frequency and magnitude due to changes in the global climate, and these coupled with direct anthropogenic pressure has implications for even the most remote coral reef ecosystems (Hoegh-Guldberg 1999, Bellwood et al 2004). Corals respond to these environmental insults by losing their symbionts (bleaching) and/ or by exhibiting an increased susceptibility to coral diseases. These compromised biological states culminate in reduced growth and reproduction and ultimately, the death of the coral and the degradation of the habitat (Hoegh-Guldberg & Smith 1989, Jokiel & Coles 1977, Gleason & Wellington 1993, Goreau 1964, Kushmaro et al 1996, Glynn 1993). One of the most striking facets of corals that are exposed to deleterious conditions or exposed to disease agents is that they do not respond uniformly, that is, different species are differentially sensitive and members of the same species are not equally impacted or susceptible. At this point, our understanding of the biological factors that drive this variation in response is not well developed although we know that corals form intimate intracellular relationships with a variety of dinoflagellate symbionts, and the taxonomic specifics of these unions potentially influence the vulnerability of corals to environmental disturbance and disease causing agents. These symbionts belong to the genus Symbiodinium, a highly diverse group that show geographic, depth, and host specificity (LaJeunesse 2005, Stat et al 2006). Given the fundamentally important role that these symbionts play in coral biology, it is not surprising that the type of Symbiodinium that a coral hosts affects the growth rate and thermal tolerance of the colony (Little et al. 2004, Rowan 2004). Other biological traits that have been discussed as contributing to the vulnerability of specific corals to environmental disturbance and or disease agents include colony morphology and coral size (Loya et al 2001). Thus, a detailed understanding of morphological characteristics of the corals combined with a thorough characterization of the types of symbionts they harbor has the potential to be extremely informative about the sensitivity of the specific corals and reef assemblages to environmental shifts and disease agents.

Recent research has demonstrated a relationship between sea surface temperature anomalies and the incidence of coral bleaching and coral disease (Bruno et al. 2007; Liu et al. 2003; Selig et al. in press; Strong et al. 2004). The spatial patterns of Thermal Stress Anomalies (TSA) which have been correlated with coral bleaching (Liu et al. 2003; Strong et al. 2004) and Weekly Sea Surface Temperature Anomalies (WSSTA) which have been correlated with coral disease (Bruno et al. 2007) were examined for a 20-year period (1985-2005). The spatial variability in the cumulative number of TSA and WSSTA events within an atoll and between atolls provides a powerful tool to explore how differences in temperature have affected reef communities in the Monument and around the world. In this manner, shifts towards the thermally tolerant and stress-resistant clade D Symbiodinium is indicative of impact to a reef ecosystem. Our previous research conducted on Symbiodinium diversity in Montipora capitata (bleach susceptible) and Porites lobata (bleach resistant) from Pearl & Hermes (relatively high frequency of TSA) and French Frigate Shoals (relatively low frequency of TSA) revealed an absence of clade D Symbiodinium. Also, our work conducted at Johnston Atoll (Stat et al 2009) revealed that Pocillopora meandrina can associate with Symbiodinium clade A, C and D. Therefore, Pocillopora may be a more sensitive indicator of reef health as it can associate with a more diverse array of symbionts and displays high susceptibility to bleaching. Given the potential for Pocillopora to be a biological indicator for reef impact in Hawaii, it is critical that we obtain an understanding of symbiont diversity in

this coral from areas of relatively high and low frequencies of thermal stress anomolies in the Monument.

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