

Papahānaumokuākea Marine National Monument
RESEARCH Permit Application

NOTE: *This Permit Application (and associated Instructions) are to propose activities to be conducted in the Papahānaumokuākea Marine National Monument. The Co-Trustees are required to determine that issuing the requested permit is compatible with the findings of Presidential Proclamation 8031. Within this Application, provide all information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Papahānaumokuākea Marine National Monument (Monument).*

ADDITIONAL IMPORTANT INFORMATION:

- Any or all of the information within this application may be posted to the Monument website informing the public on projects proposed to occur in the Monument.
- In addition to the permit application, the Applicant must either download the Monument Compliance Information Sheet from the Monument website OR request a hard copy from the Monument Permit Coordinator (contact information below). The Monument Compliance Information Sheet must be submitted to the Monument Permit Coordinator after initial application consultation.
- Issuance of a Monument permit is dependent upon the completion and review of the application and Compliance Information Sheet.

INCOMPLETE APPLICATIONS WILL NOT BE CONSIDERED

Send Permit Applications to:

Papahānaumokuākea Marine National Monument Permit Coordinator
6600 Kalaniana'ole Hwy. # 300
Honolulu, HI 96825
nwhipermit@noaa.gov
PHONE: (808) 397-2660 FAX: (808) 397-2662

SUBMITTAL VIA ELECTRONIC MAIL IS PREFERRED BUT NOT REQUIRED. FOR ADDITIONAL SUBMITTAL INSTRUCTIONS, SEE THE LAST PAGE.

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: Randall Kosaki, Ph.D.

Affiliation: NOAA/NOS/ONMS/Papahānaumokuākea Marine National Monument

Permit Category: Research

Proposed Activity Dates: 25 day window between Aug. 15, 2012 and Sept. 30, 2012

Proposed Method of Entry (Vessel/Plane): NOAA Ship HI'IALAKAI

Proposed Locations: Nihoa, Necker, French Frigate Shoals, Gardner, Laysan, Maro, Lisianski, Pearl and Hermes, Midway, Kure, others TBD

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

13

Estimated number of days in the Monument: 25

Description of proposed activities: (complete these sentences):

a.) The proposed activity would...

The proposed activities would use conventional and technical SCUBA diving technology to explore and document the biodiversity of the NWHI's deep coral reefs, as well as to document the presence or absence of alien/invasive species in these deep reef ecosystems. Of primary interest are the invasive octocoral *Carijoa riisei*, and the invasive red alga *Hypnea musciformis*. These invasive species are spreading in the Main Hawaiian Islands, and are considered a serious threat to the southeastern end of the NWHI (Godwin et al. 2006, See 2007).

Pacific coral reefs host greater macroscopic biodiversity than any other marine habitat (Pyle 1995, Reaka-Kudla 1997, Myers 1999). Photosynthetic corals have recently been documented to a depth of at least 165 m in the Pacific; yet only the upper 30 m is well studied (e.g., Pyle 1996, 1998). Like tropical rainforest canopies before 1970, deeper reefs are largely unexplored, and the biodiversity at depths of 30-200 m (more than 80% of the depth range of coral-reef habitat) remains almost completely unknown.

These "Mesophotic Coral Ecosystems" (MCEs) have recently been prioritized for study, due to a growing realization that the flora and fauna are both diverse and unique, and also face growing threats. Perhaps most ominously, these reefs occur at the lower limit of the aragonite saturation

zone in much of the Pacific (Guinotte et al. 2006), and may be especially vulnerable to ocean acidification. The World Conservation Union (IUCN) has identified this ecosystem as a top conservation priority for reef fishes (Sadovy 2007). The biodiversity of these MCEs is threatened before its documentation has begun in earnest. We therefore propose to address both issues, and are in the process of characterizing the MCE fauna of the NWHI while simultaneously conducting surveys for the invasive species most likely to impact these deep reef ecosystems.

b.) To accomplish this activity we would

To accomplish the primary activity, we would conduct technical trimix dives from small boats supported by NOAA ship *Hi'ialakai*. The barrier to exploring MCEs has largely been technological. The vast majority of research on shallow coral reefs in the NWHI and elsewhere has been conducted with conventional SCUBA, but safe and meaningful scientific research with this gear has been confined mostly to the shallowest 30 m of reef habitat. Likewise, remote sampling methods (traps and trawls) have proven ineffective for sampling this complex rocky coral-reef environment (Dennis & Aldhous 2004). Deep-sea submersibles have been used to examine marine life at depths of 30-200 m in the tropical Pacific (e.g., Hills-Colinvaux 1986, Thresher & Colin 1986, Kahng & Maragos 2006), but they typically cost \$20,000-\$60,000 per day, and are rarely deployed in remote tropical Pacific regions. Furthermore, submersibles are ill-suited to identify and collect cryptic species typical of the reef environment. Low densities of *Hypnea* and *Carijoa* would most likely go undetected by submersible observers.

The depths of our proposed dives would range between 5-35 m (conventional SCUBA), and 35-90 m (trimix). Shallow-water dives will be conducted to perform safety dives as well as to survey adjacent shallow water reefs to enable comparisons to the MCE reefs. To assess the biological diversity of the MCEs, visual surveys will be conducted to identify the flora and fauna associated with differing MCE habitats. Additional divers will make presence/absence notes on fishes encountered during the survey dives. The ultimate goal of these checklists will be published, island-by-island checklist of fishes, corals, and algae known from the deep reefs of the NWHI. Due to the unexplored nature of this region, it is probable that divers will encounter new species. If an organism is encountered that is not readily identifiable, or may represent a new geographic record or new species, up to three voucher specimens per site will be collected and sent to appropriate taxonomic experts for description and/or identification. In addition, divers will search for invasive species such as *Hypnea* and *Carijoa* as described by Wagner et al. (2011). If the invasive species in question are found, not more than three voucher specimens per dive site will be collected for taxonomic identification and genetic characterization by scientists at the University of Hawaii.

Additional information will be collected to begin monitoring efforts of abiotic factors that may influence biodiversity at these depths. For this purpose, temperature loggers will be deployed to track temperature fluctuations.

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

As nearly all of the mesophotic reef region in the Monument is undocumented, the proposed activities will provide some of the first quantitative information regarding species presence, distribution and abundance in the NWHI, as well as some of the first estimates of abiotic influences. During a preliminary survey of MCEs in the NWHI in August 2009, divers discovered extensive algal beds supporting rich populations of predominantly juvenile fishes, occurring at depths of 50-80 m. The nature and composition of these algal beds and associated habitats, and the striking abundance and diversity of juvenile fishes they harbor, appear to represent an entirely new paradigm for reef-associated ecology in general, and MCE communities in particular. Understanding the breadth of these habitats and associated communities is likely to have profound implications for future management considerations. 2009-2011 mesophotic dive surveys increased the number of fishes known from each of the NWHI by an average of 26.9%, a very significant increase in the known biodiversity of this region. In order to adequately protect any ecosystem, a necessary first step is to determine what organisms and habitats are present. Surveys resulting from this project will allow managers to establish baseline habitat and population estimates to help inform future decisions. Given the magnitude of impending threats such as climate change, it is imperative for managers to have a baseline of information to be able to identify future changes to the system.

The identification of invasive alga would help the Monument by establishing a presence-or-absence baseline at the island groups intermediate in location between the Main Hawaiian Islands (presumed source of these invasive species) and the rest of the NWHI. Nihoa and Mokumanama are the two islands/banks that are the most likely gateway or stepping stones for invasive species from the MHI to the NWHI. *Carijoa* is abundant in the waters of Maui County and Oahu, and also occurs on Kauai (Godwin et al. 2006, See 2007). It is known to overgrow black coral colonies and associated substrata in the Auau Channel (and elsewhere in the MHI). It has not yet been detected in the NWHI, but small colonies have been seen at Kaula Rock, Five Fathom Pinnacle, and Niihau, all of which are geographically intermediate between the MHI and NWHI (Montgomery, personal communication). Although existing monitoring programs in the NWHI, e.g. RAMP (Reef Assessment and Monitoring Program) survey for all taxa and will record alien or invasive species when encountered, most of these surveys are conducted between 10 and 20 m depth. *Carijoa* is most abundant in 30-100 m depth, and in the NWHI, *Hypnea* is only known from depths exceeding 35 m at Mokumanamana. Thus, existing surveys are unlikely to encounter either species. If detected at an early stage of colonization and spread, eradication may be a possibility (e.g. pilot *Carijoa* eradication project in Nawiliwili Harbor on Kauai).

Other information or background: see appended Word document for preliminary findings from previous cruises.

Section A - Applicant Information

1. Applicant

Name (last, first, middle initial):

Kosaki, Randall K.

Title: Deputy Superintendent, NOAA/ONMS Papahanaumokuakea Marine National Monument

1a. Intended field Principal Investigator (See instructions for more information):
same (Randall Kosaki)

2. Mailing address (street/P.O. box, city, state, country, zip):

[REDACTED]

Phone:

[REDACTED]

Fax:

[REDACTED]

Email:

[REDACTED]

For students, major professor's name, telephone and email address: N/A

3. Affiliation (institution/agency/organization directly related to the proposed project):

NOAA/NOS/ONMS Papahanaumokuakea Marine National Monument

4. Additional persons to be covered by permit. List all personnel roles and names (if known at time of application) here (e.g. John Doe, Research Diver; Jane Doe, Field Technician):

Kelly Gleason, Ph.D., Research Diver, NOAA PMNM

Randall Kosaki, Ph.D., Research Diver, NOAA PMNM

Ray Boland, Research Diver, NOAA NMFS PIFSC

Tony Montgomery, Research Diver, USFWS Refuges

Corinne Kane, M.S., Research Diver, State of Hawaii DLNR

Richard Pyle, Ph.D., Research Diver, B.P. Bishop Museum

Greg McFall, M.S., Research Diver, NOAA Grays' Reef National Marine Sanctuary

Yannis Papastamatiou, Ph.D., Research Diver, Florida Museum of Natural History

Daniel Wagner, Ph.D., Research Diver, NOAA PMNM

Brian Hauk, M.S., Research Diver, NOAA PMNM

Keo Lopes, Research Diver, Univ. of Hawaii

Robert Whitton, Research Diver, B.P. Bishop Museum

John Earle, Research Diver, B.P. Bishop Museum

Jasmine Cousins, small boat coxswain, PMNM

Research Diver, TBD

Section B: Project Information

5a. Project location(s):

<input checked="" type="checkbox"/> Nihoa Island	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Necker Island (Mokumanamana)	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> French Frigate Shoals	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Gardner Pinnacles	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Maro Reef			
<input checked="" type="checkbox"/> Laysan Island	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Lisianski Island, Neva Shoal	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Pearl and Hermes Atoll	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Midway Atoll	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Kure Atoll	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input type="checkbox"/> Other			

Ocean Based

NOTE: There is a fee schedule for people visiting Midway Atoll National Wildlife Refuge via vessel and aircraft.

Location Description:

5b. Check all applicable regulated activities proposed to be conducted in the Monument:

- Removing, moving, taking, harvesting, possessing, injuring, disturbing, or damaging any living or nonliving Monument resource
- Drilling into, dredging, or otherwise altering the submerged lands other than by anchoring a vessel; or constructing, placing, or abandoning any structure, material, or other matter on the submerged lands
- Anchoring a vessel
- Deserting a vessel aground, at anchor, or adrift
- Discharging or depositing any material or matter into the Monument
- Touching coral, living or dead
- Possessing fishing gear except when stowed and not available for immediate use during passage without interruption through the Monument
- Attracting any living Monument resource
- Sustenance fishing (Federal waters only, outside of Special Preservation Areas, Ecological Reserves and Special Management Areas)
- Subsistence fishing (State waters only)
- Swimming, snorkeling, or closed or open circuit SCUBA diving within any Special Preservation Area or Midway Atoll Special Management Area

6 Purpose/Need/Scope *State purpose of proposed activities:*

This project aims to shed light on the distribution and abundance of MCE organisms and habitats. To date no quantitative assessments have been conducted to determine the extent of flora and fauna distribution and abundance or potential abiotic influences in mesophotic region of the NWHI. As such, this project would provide initial baselines for the distribution and abundance of important reef fishes, corals and algae. These investigations provide the necessary first step for managers to be able to adequately manage PMNM on an ecosystem-wide scale.

7. Answer the Findings below by providing information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Monument:

The Findings are as follows:

a. How can the activity be conducted with adequate safeguards for the cultural, natural and historic resources and ecological integrity of the Monument?

No activities will be performed in the vicinity of known cultural or historical resources. If any such resources are discovered in the course of these proposed activities, their location(s) will be noted and reported to appropriate authorities. Our survey activities will cease immediately, and will be continued in another area.

Biological sampling will be limited to small numbers of voucher specimens for taxonomic ID and genetic analysis. Removal of alien /invasive species is generally considered to be beneficial to the ecosystem, habitat, and native organisms. Care will be taken to individually bag samples to preclude facilitation of reproduction or dispersal via fragmentation.

If potential new records or new species of flora or fauna are encountered, they will be individually selected and sampled. Fish specimens will be collected via pole spear or hand nets. Algal, sponge and coral specimens will be hand picked and sealed in watertight bags. All of these methods have virutally no potential for collateral damage. These methods are highly selective, and thus no damage to the habitat or accidental take of non-target species will occur.

Temperature loggers will be deployed at each site to track variations in temperature. These sensors are small (about the size of a half dollar) and unobtrusive to the surrounding environment. Care will be taken to ensure placement clear of any sensitive organisms or habitats.

b. How will the activity be conducted in a manner compatible with the management direction of this proclamation, considering the extent to which the conduct of the activity may diminish or enhance Monument cultural, natural and historic resources, qualities, and ecological integrity, any indirect, secondary, or cumulative effects of the activity, and the duration of such effects?

The proposed activities will support PMNM Management Plan's Marine Conservation Science Action plan to "develop baseline inventory of the biological resources and biodiversity of deep reefs... using all available technologies, including ... remotely operated vehicles (ROVs), and technical diving."

Diver-based searches for invasive alga support PMNM Management Plan's Alien Species Action Plan (ASAP) by conducting active surveillance to detect and monitor alien species (AS 2.1); development of alien species detection and monitoring protocols (AS 2.3), mapping the invasive red alga *Hypnea musciformis* (AS 7.1), and surveillance of the snowflake coral *Carijoa riisei* (AS 7.2).

Although *Hypnea* has been recorded at Mokumanamana (entangled in lobster traps) at depths accessible by the proposed activities of this permit application, we have yet to record *Hypnea* during any of the dives on the 2009-2011 cruises. Similarly, *Carijoa* has not yet been detected by these surveys. Unlike most situations globally where invasive species have run rampant before any monitoring of their abundance is initiated, we appear to be "ahead of the curve" in that surveys for these AS have been initiated before the AS themselves are present in any abundance. This will allow for early detection and monitoring of the spread of these species.

We recognize that all natural resources are also cultural resources. Documenting the spatial distribution of these resources, as well as identifying previously unknown taxa, is a necessary precursor to properly managing and protecting these natural/cultural resources. Our findings to date include discovery of the highest levels of endemism recorded in any marine ecosystem, which implies that these systems are in fact far more fragile and vulnerable than was previously assumed. These results have direct

management implications related to the protection and conservation of these ecosystems.

c. Is there a practicable alternative to conducting the activity within the Monument? If not, explain why your activities must be conducted in the Monument.

In order to provide managers insight into the distribution and abundance of flora and fauna of the MCE region in the Monument, surveys must be conducted in the Monument, as it has been shown that organisms vary substantially between neighboring islands and atolls.

d. How does the end value of the activity outweigh its adverse impacts on Monument cultural, natural and historic resources, qualities, and ecological integrity?

Visual surveys and related sampling will have virtually no impacts on native species, natural resources, or ecological integrity. Temperature sensors are extremely small and unobtrusive to the surrounding environment. If new records or new species of fishes, corals, sponges or algae are encountered, the minimal number of voucher species collected per site (3 maximum) is negligible compared to the importance of increasing our understanding of the composition, biodiversity, biogeographic affinities, and levels of endemism of these deep reef communities. Having this very basic level of information on biodiversity is one of the cornerstones of responsible management. It is information (from shallow-water field characterizations) on the unique natural and cultural resources of the NWHI that led to the high level of protection that these ecosystems now enjoy. We are now expanding this characterization to include the deeper half of the coral reef habitat, and the results (e.g. levels of endemism) are even more impressive than in shallow water. This kind of information is needed to maintain the high levels of protection afforded to these reefs. Perhaps even more importantly, these discoveries strengthen the argument that large-scale MPAs are valuable conservation tools because not only do they protect the biodiversity that you know of (e.g. shallow reefs), but they also protect the biodiversity that you have yet to discover (mesophotic reefs and deeper). In addition, sampling invasive species is beneficial to the ecosystem as portions of the invasive will be removed from the community.

To summarize, impacts from this proposed project are minimal, verging on undetectable. The information gained from these activities are critical to increasing manager's understanding of the ecosystems within PMNM, and important to increasing awareness of the benefits of large MPAs.

e. Explain how the duration of the activity is no longer than necessary to achieve its stated purpose.

Given the large areas of deep reef habitat that remain unexplored and uncharacterized, there is no way that this effort could be regarded as "longer than necessary." It will be minimally adequate to enable a quantitative comparison of the abundance and distribution of benthic-associated species and additionally of alien/invasive species with the heavily infested MHI, and the more pristine NWHI. These sites will provide baselines

that can be revisited at points in the future to determine what the status and trends of the environment are with regard to both local and global effects.

f. Provide information demonstrating that you are qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.

I have conducted visual qualitative and quantitative surveys of coral reef benthic and fish fauna for over 25 years. I was one of the original founding instructors of the University of Hawaii's national award-winning marine transect course, Quantitative Underwater Ecological Sampling Techniques (QUEST). I first conducted marine life surveys in the NWHI in 1982, and have been integrally involved in planning and executing the NWHI Reef Assessment and Monitoring Program (RAMP) cruises since their inception in 2000. I have logged nearly 1000 decompression dives on air, nitrox, and trimix to depths of up to 300 feet. The dive operations will be run by Ray Boland (Unit Diving Supervisor, NMFS PIFSC) and Greg McFall (Line Office Dive Officer, National Ocean Service). Both are the most highly trained technical divers within their respective NOAA line offices. Tony Montgomery (USFWS), who will be participating in these surveys, has conducted similar surveys for the State using closed-circuit rebreathers. Richard Pyle (BP Bishop Museum), is one of the most highly respected experts in the world on the application of mixed gas breathing technologies to deep coral reef research. Pyle is also the foremost expert on the taxonomy of deep coral reef fishes.

g. Provide information demonstrating that you have adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct. NOAA/NOS/PMNM will support the project with its allocation of ship time aboard NOAA R/V HI'IALAKAI, as well as with other in-kind support (salary for staff, small boat support, administrative support). Fish taxonomic analysis is funded via a PMNM contract with the B.P. Bishop Museum for taxonomic and curatorial assistance. Algal taxonomic analysis is funded via a PMNM contract with the Dept. of Botany, University of Hawaii. NOAA ships, and activities conducted off of them, are considered to be self-insured by the Federal government. Taxonomic support for sponges and other invertebrate taxa will be supported as appropriate by PMNM. Additional support for technical diving is funded by a grant from National Geographic to Principal Investigators Drs. Yannis Papastamatiou, Randall Kosaki, Carl Meyer, Brian Popp.

h. Explain how your methods and procedures are appropriate to achieve the proposed activity's goals in relation to their impacts to Monument cultural, natural and historic resources, qualities, and ecological integrity.

The proposed survey methods are among the most scientifically robust and time efficient methods for quantifying distribution and abundance of organisms. Due to limitations of technical diving, divers only have approximately 20 minutes on any given dive in which to collect information. As a result, perturbations to the environment are minimal. Additionally, proposed collection methods limit the number of specimens taken to the minimum number that will ensure accurate taxonomic identification. The numbers

required will be many orders of magnitude below that which would produce a measurable or biologically significant impact to the ecological integrity of the Monument. As noted earlier, the removal of invasive species is generally considered to be beneficial to the environment. Wherever possible, specimens will be used for additional studies (genetics) or will be added to museum collections as reference/voucher specimens where they will be available to all researchers. We recognize that natural resources are in fact cultural resources. Thus, for both biological and cultural reasons, sampling or collecting will be restricted to the bare minimum that is necessary to meet the standards of peer-reviewed science. There will be no interaction with cultural or historical resources outside of the organisms that are the direct focus of this study.

i. Has your vessel been outfitted with a mobile transceiver unit approved by OLE and complies with the requirements of Presidential Proclamation 8031?

Yes.

j. Demonstrate that there are no other factors that would make the issuance of a permit for the activity inappropriate.

There are no other factors that would make issuance of a permit inappropriate under the Proclamation and its Findings section. The sample sizes are very small, the information potentially gained is invaluable to managers, and the people recruited to staff this project are among the very best in the world when it comes to characterization of deep reefs.

8. Procedures/Methods:

Technical diving will be conducted under NOAA auspices, and will conform to the regulations of the NOAA Dive Center. Dive sites will be determined in advance through habitat suitability modeling based on bathymetry. Divers will enter the water from, and be recovered by, the primary dive platform, an 11 m Ambar boat (HI-1) launched from the starboard davit aboard Hi`ialakai. HI-1 will also have on board a backup diver with full SCUBA gear who will be available to assist the primary divers with bottle swaps, etc., during decompression and in the case of any emergency. The dive team and primary dive boat will be shadowed by a 19' SAFEboat chase boat, which will have on board a backup technical diver with a full technical trimix rig. The chase boat will be available to follow a separate lift bag or float should the members of the primary dive pair become separated. Both boats will be operated by dedicated coxswains who will not be diving. Boats will be within clear radio range of Hi`ialakai at all

times. The primary dive team will be dropped on pre-determined sites. All dives will be conducted while live-boating, i.e. no anchoring. Bottom times of 20 minutes or less are expected in waters over 200'. No dives in excess of 300' will be conducted. Decompression times of less than 45 minutes are expected, and decompression will be conducted while drifting in blue water. A lift bag or float will enable the support boats to remain in close proximity to the divers at all times.

During the dive, one diver will deploy a temporary 25 m transect to conduct a belt survey of all fishes and invertebrates within a 2 meter wide swath along the transect. This technique is best for observing and identifying fish, especially smaller or cryptic species. Following the fish survey, an additional diver will take still and video records of habitat type along the same transect. Benthic composition will be assessed based on percent cover estimates using a modified quantitative rapid ecological assessment (REA) method at each site. In addition, voucher specimens of the five most abundant algal species, as well as of any new sponge records or species, will be collected at each site (one specimen per species, no larger than 5 cm in greatest dimension). Algal specimens will be frozen for later identification by Heather Spalding (University of Hawaii, Dept. of Botany), a recognized expert in Hawaiian mesophotic algae. Sponge specimens will be preserved in 95% ethanol for later identification by Dr. Barbara Calcinai (Polytechnic University of Marche, Italy), a recognized expert in sponge taxonomy. These algae and sponge voucher specimens will be used to identify the most abundant taxa in the benthic video at the species level wherever possible.

These methods have been used to survey shallow water reefs throughout the NWHI, and will produce similar quantitative data that can be compared between shallow and deep assemblages. In addition to transect surveys, divers will make presence/absence notes on fishes encountered during dives outside of transect boundaries. These observations will enable researchers to create island-by-island checklists of fishes, corals, sponges and algae known from the mesophotic reefs of the NWHI. If any unknown fishes, coral, sponges or algae are observed during the dive, voucher specimens will be collected. These collections will be placed in sealed "dry bags," and may be sent to the surface via a lift bag for the chase boat to recover to ensure safety of the divers. The primary dive boat will have the responsibility of being near the divers at all times. Thus, recovery of lift bags by the chase boat will not compromise dive safety. No more than three samples of any given specimen type will be collected per site. All collections will follow Monument collection and transport protocols for proper collection and storage of samples while in the Monument. Only divers with appropriate taxonomic expertise in Hawaiian/Pacific mesophotic fishes (Kosaki, Pyle, Papastamatiou, Boland) will collect fish, if such collections are deemed necessary. No more than one diver per dive will collect fish to completely prevent any possibility of accidental over-collecting due to poor/no communication between divers.

Although this permit requests permission to take samples of new records or undescribed species of fishes at each site, such events are expected to be rare based on the past two years of mesophotic exploration in the NWHI by this same team of divers. We expect that fewer than 20 fish specimens (total) will be collected under this permit. A large majority of new records noted in 2009, 2010, and 2011 were based on conclusive in situ visual identification, photo/video vouchers, or both.

As divers conduct surveys and species presence/absence data, they will also be conducting searches for invasive *Hypnea* and *Carijoa*. If encountered, depth/time will be recorded, which will allow an approximate spatial fix to be established based on the support boat's GPS track. Approximate greatest dimensions of invasive colonies will be recorded, and specimens (<5cm greatest dimension) will be collected either by hand or with metal clippers. Specimens will be placed in sealed bags and will be carried to the surface with the divers.

As reef systems are driven largely by abiotic factors, we propose to continue monitoring of temperature to help explain potential causes of deep reef productivity and diversity. Divers will also deploy 4-6 temperature sensors at each of five sites (TBD) to track changes in temperature over time. These sensors are extremely small (about the size of a quarter) and will be placed on the substrate via attachment to a lead diving weight. Care will be taken to ensure placement is on bare substrate or sand so as not to impact any living organisms. These temperature loggers will be retrieved (or replaced, if future permits allow) whenever these sites are next re-visited. Logistics, funding, and permit approvals allowing, we intend to recover/replace these on a Summer 2013 cruise. If possible, four temperature loggers deployed in 2010 will be recovered and replaced this year.

A Deep Ocean Engineering ROV (remotely operated vehicle) may be opportunistically used from Hi`ialakai to ground-truth bathymetry and confirm bottom conditions at potential dive sites.

NOTE: If land or marine archeological activities are involved, contact the Monument Permit Coordinator at the address on the general application form before proceeding, as a customized application will be needed. For more information, contact the Monument office on the first page of this application.

9a. Collection of specimens - collecting activities (would apply to any activity): organisms or objects (List of species, if applicable, attach additional sheets if necessary):

Common name:

Snowflake coral

Red algae

Deep reef fishes TBD

Deep water corals TBD

Deep water algae TBD

Deep water sponges TBD

Scientific name:

Carijoa riisei

Hypnea musciformis

Other fishes, algae, corals, invertebrates, sponges TBD

& size of specimens:

If potential new records or new species of fishes, coral, invertebrates, sponges or algae are encountered, a maximum of three specimens per site will be collected. Maximum sizes for fish are dependent on size of the fish (whole specimen collected), algal samples will not exceed 10 cm in greatest dimension, whereas coral and sponge samples will not exceed 20 cm in greatest dimension (for morphological analysis).

If either *Hypnea* or *Carijoa* are encountered, three specimens per species per dive site will be collected. Maximum specimen size will be 5 cm in greatest dimension.

Collection location:

Nihoa, Mokumanama, French Frigate Shoals, Gardner Pinnacles, Maro, Laysan, Lisianski, Pearl and Hermes, Midway, Kure

Specific latitude/longitude of dive sites will be determined by NCCOS habitat suitability models, multibeam sonar bathymetry, and weather.

Whole Organism Partial Organism

9b. What will be done with the specimens after the project has ended?

Specimens will be given to the University of Hawaii, Hawaii Institute of Marine Biology, State of Hawaii, B.P. Bishop Museum and/or the Polytechnic University of Marche (sponge samples) for positive identification. Additional genetic studies will be performed by the Hawaii Institute of Marine Biology. Fish specimens will be added to the Indo-Pacific fishes reference collection at the B.P. Bishop Museum.

9c. Will the organisms be kept alive after collection? Yes No

• General site/location for collections:

TBD. Divers will aim to survey algal meadows and reef ledges in 35-100 m of water. Generally, the highest probability for encountering *Hypnea* and *Carijoa* is in these deeper waters. Some surveys will be conducted in less than 30 m, as in shallow-water habitats characterized by boulders and overhangs for community comparisons between deep and shallow reefs. Habitat suitability models (utilizing existing multibeam

bathymetry) that take into account depth ranges, bottom type (hard/soft), rugosity, and slope are being generated by NOAA NCCOS. In addition, the shipboard multibeam sonar systems on HI`IALAKAI will be used to locate suitable topographic features. These data products will be used to target suitable habitats for dive expeditions.

Similarly, some dives using conventional scuba may be conducted in shallow (0-35m) areas to search for new records.

- Is it an open or closed system? Open Closed

N/A

- Is there an outfall? Yes No

N/A

- Will these organisms be housed with other organisms? If so, what are the other organisms?

N/A

- Will organisms be released?

N/A

10. If applicable, how will the collected samples or specimens be transported out of the Monument?

Specimens of Hypnea, Carijoa, and any additional (non-invasive) algae, sponges, reef fish, and water samples will be triple-bagged, labeled, and frozen per the conditions of the Monument Specimen Transport Protocol. Coral samples will be handled per the conditions of the Monument Specimen Transport Protocol.

11. Describe collaborative activities to share samples, reduce duplicative sampling, or duplicative research:

Specimens will be shared with HIMB for molecular analyses (particularly Carijoa, but also fishes), University of Hawaii (non-invasive algal collections and water samples), USFWS (coral) and the B.P. Bishop Museum (for their reference collection of Indo-Pacific coral reef fishes).

Points of Contact:

HIMB: Dr. Rob Toonen [REDACTED]

USFWS: Mr. Anthony Montgomery [REDACTED]

BPBM: Dr. Richard Pyle [REDACTED]

12a. List all specialized gear and materials to be used in this activity:

Technical dive gear, including helium-oxygen-nitrogen compressed gas breathing mixes, and nitrox or 100% oxygen decompression mixes. All collecting will be done either by hand (algae, coral, sponges, water samples) or hand nets or pole spears (fishes).

12b. List all Hazardous Materials you propose to take to and use within the Monument:

N/A

13. Describe any fixed installations and instrumentation proposed to be set in the Monument:

Small Tidbit temperature loggers.

14. Provide a time line for sample analysis, data analysis, write-up and publication of information:

Sample analysis will begin upon return to Honolulu. Continued collections are anticipated in 2013 at islands and atolls that were undersampled between 2009-2011. Although preliminary written results will be made available within one year of return, a final analysis and publication will not be initiated until most or all of islands have been surveyed.

15. List all Applicants' publications directly related to the proposed project:

CV attached

Literature Cited:

Dennis, C. & Aldhous, P. 2004. A tragedy with many players. Nature 430: 396-398.

Godwin, S., K.S. Rodgers and P.L. Jokiel. 2006. Reducing potential impact of invasive marine species in the northwestern hawaiian islands marine national monument. Report to: Northwest Hawaiian Islands Marine National Monument Administration.

Guinotte, J.M., Buddemeier, R.W., Kleypas, J.A. 2003. Future coral reef habitat marginality: temporal and spatial effects of climate change in the Pacific basin. *Coral Reefs* 22:551-558.

Hills-Colinvaux, L. 1986. Deep water populations of *Halimeda* in the economy of an atoll. *Bull. Mar. Sci.* 38(1):155-169.

Kahng, S. E. & J.E. Maragos. 2006. The deepest, zooxanthellate scleractinian corals in the world? *Coral Reefs* 25(2): 254.

Myers, R.F. 1999. Micronesian reef fishes: a comprehensive guide to the coral reef fishes of Micronesia. Third edition, revised and expanded. Coral Graphics, Barrigada, Guam. vi + 330 p., 192 pls.

Pyle, R.L. 1995. Chapter 12. Pacific reef and shore fishes, p. 205-238. In: Maragos, J.E., Peterson, M.N.A., Eldredge, L.G., Bardach, J.E. & Takeuchi, H.F. (eds.), *Marine and coastal biodiversity in the tropical island Pacific region. Volume 1. Species systematics and information management priorities.* Program on Environment, East-West Center, Honolulu. 424 p.

Pyle, R.L. 1996. How much coral reef biodiversity are we missing? *Global Biodiversity* 6(1): 3-7.

Pyle, R.L. 1998. Chapter 7. Use of advanced mixed-gas diving technology to explore the coral reef "Twilight Zone", p. 71-88. In: Tanacredi, J.T. &

Loret, J. (eds.), *Ocean Pulse: A Critical Diagnosis*. Plenum Press, New York.
xii + 201 p.

Sadovy, Y. 2007. Final Report: Workshop for Global Red List Assessments of Groupers Family Serranidae; subfamily Epinephelinae (<http://www.hku.hk/ecology/GroupersWrasses/iucnsg/>). University of Hong Kong.

See, Kevin. 2007. Report on the marine invasive species in Papahānaumokuākea Marine National Monument. Report to NOAA/NOS Papahānaumokuākea Marine National Monument. 27 pp. Sept. 2007.

Thresher, R.E. & Colin, P.L. 1986. Trophic structure, diversity, and abundance of fishes of the deep reef (30-300 m) at Enewetak, Marshall Islands. *Bull. Mar. Sci.* 38(1): 253-272.

Wagner, D., Y.P. Papastamatiou, R.K. Kosaki, K.A. Gleason, G.B. McFall, R.C. Boland, R.L. Pyle & R.J. Toonen (2011). New records of commercially valuable black corals (Cnidaria: Antipatharia) from the Northwestern Hawaiian Islands at mesophotic depths. *Pac. Sci.* 65(2): 249-255.

With knowledge of the penalties for false or incomplete statements, as provided by 18 U.S.C. 1001, and for perjury, as provided by 18 U.S.C. 1621, I hereby certify to the best of my abilities under penalty of perjury of that the information I have provided on this application form is true and correct. I agree that the Co-Trustees may post this application in its entirety on the Internet. I understand that the Co-Trustees will consider deleting all information that I have identified as “confidential” prior to posting the application.

Signature

Date

**SEND ONE SIGNED APPLICATION VIA MAIL TO THE MONUMENT OFFICE
BELOW:**

Papahānaumokuākea Marine National Monument Permit Coordinator
6600 Kalaniana'ole Hwy. # 300
Honolulu, HI 96825
FAX: (808) 397-2662

DID YOU INCLUDE THESE?

- Applicant CV/Resume/Biography
- Intended field Principal Investigator CV/Resume/Biography
- Electronic and Hard Copy of Application with Signature
- Statement of information you wish to be kept confidential
- Material Safety Data Sheets for Hazardous Materials

Kosaki_res_pmnm_app_2012

Other information or background:

Fish data acquired by the PI under similar PMNM permits in 2009, 2010, and 2011 are summarized below. In general, the NWHI are known for high levels of endemism on the shallow reefs that have been surveyed to date (primarily by Reef Assessment and Monitoring Program [RAMP] cruises). Species checklists for each of the NWHI have been developed from these data, as well as from species records found in extensive literature searches of publications dating back to the late 1800s, searches of museum collection databases, and anecdotal accounts. These species checklists are summarized in Table 1. New records resulting from the 2009-2011 mesophotic cruises have increased the number of fish species known from each island by 4-47%, with an average increase in the number of fishes known from each island of about 27%. This is a tremendous increase in the known biodiversity of the NWHI, and underscores the fact that reefs at mesophotic depths are very poorly documented.

A large majority of these new records were collected via observational data collection and photo vouchers. The only specimens physically collected were of an undescribed species of butterflyfish (*Prognathodes* n.sp.). The holotype specimen and two paratypes were collected at Pearl and Hermes Atoll. Beta versions of a photo voucher database software system has been successfully tested on the 2011 cruise, and future use of this system will ensure that continued exploration will yield significant amounts of information without the need to collect large numbers of specimens.

Island/Atoll	Old Total Fish Spp	New Records	New Total Fish Spp	% Increase
Nihoa	111	52	163	47
Mokumanamana	120	27	147	23
French Frigate Shoals	207	28	235	14
Gardner Pinnacles	116	57	173	49
Maro Reef	161	28	189	17
Laysan	143	22	165	15
Lisianski	155	42	197	27
Pearl and Hermes	188	18	206	10
Midway	271	12	283	4
Kure	138	23	161	17

Table 1. Increase in the number of fish species recorded at each of the Northwestern Hawaiian Islands. New records represent the number of species recorded during mesophotic technical dives on the 2009, 2010, and 2011 cruises.

Perhaps the most significant finding coming out of the 2009-2011 mesophotic cruises is the phenomenally high level of endemism encountered on deep coral reefs in the NWHI (Table 1). This is particularly true of the three northern atolls, Pearl and Hermes, Midway, and Kure. Data for shallow NWHI reefs came from RAMP surveys using belt transect methods, with sites selected through a stratified random design. Data for NWHI mesophotic coral ecosystems (MCEs) were collected using belt transect methods on the 2009-2011 mesophotic cruises.

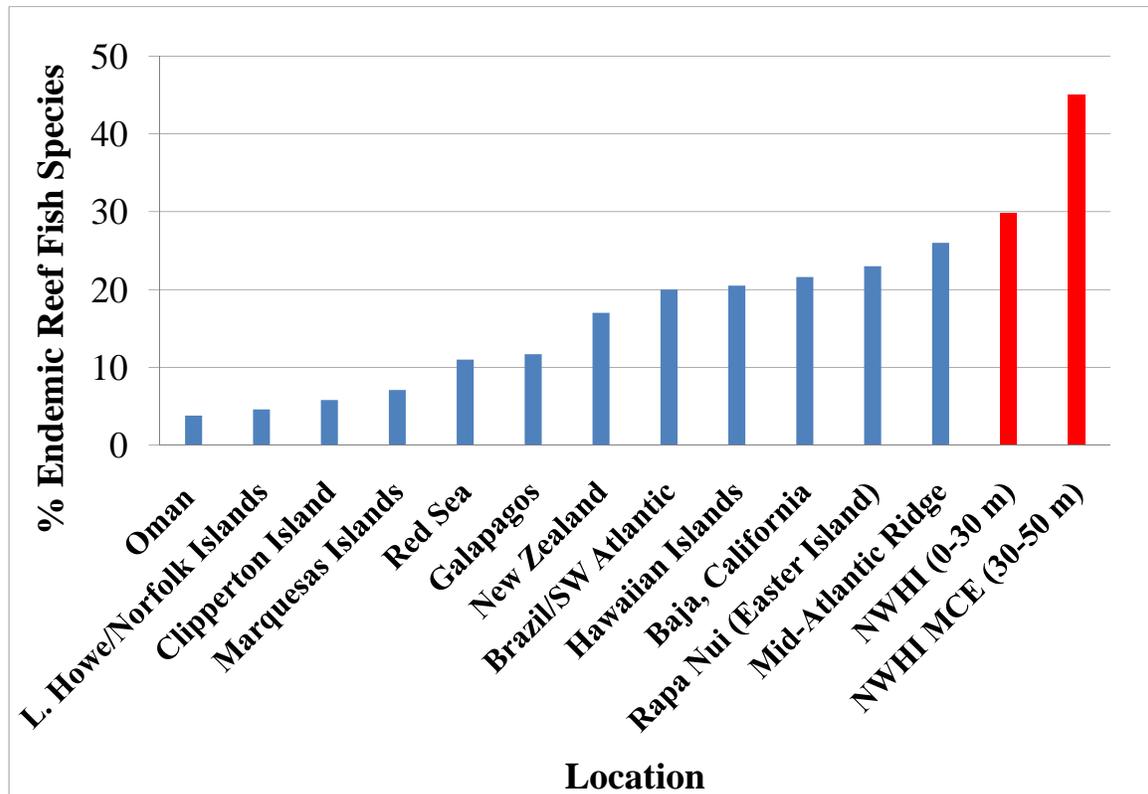


Figure 1. Percent endemism of fish fauna in marine ecosystems known globally for high rates of endemism. NWHI shallow data (0-30 m) are from RAMP cruises. NWHI mesophotic data (30-80 m) are from 2009, 2010, and 2011 cruises.

Sources: **Allen 2007**. Conservation hotspots of biodiversity and endemism for Indo-Pacific coral reef fishes. *Aquatic Conserv.: Mar. Freshw. Ecosyst.*
Gordon et al. 2010. Marine biodiversity of Aotearoa New Zealand. *PLoS One*.
Floeter et al. 2008. Atlantic reef fish biogeography and evolution. *J. Biogeography*.
 De Moura and Sazima. 2000. Species richness and endemism levels of the Southwestern Atlantic reef fish fauna. *Proc. 9th Intl. Coral Reef Symp.*

In terms of fish assemblage structure, numerical abundance of Hawaiian endemics exceeded 90% on the deep reefs of Pearl and Hermes Atoll and Midway Atoll (in review, *Coral Reefs*). As with the presence/absence data of Table 1, these findings indicate that the marine ecosystems of the NWHI have the highest known levels of endemism of any marine ecosystem on the planet.