

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: Dr. Scott A. Shaffer

Affiliation: niversity of California, Santa Cruz and San Jose State University

Permit Category: Research

Proposed Activity Dates: December 31 2010 - December 31 2015

Proposed Method of Entry (Vessel/Plane): USFWS chartered plane or vessel

Proposed Locations: Tern Island, French Frigate Shoals (FFS); Eastern Island, Midway Atoll NWR (MA)

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

7

Estimated number of days in the Monument: 90-120 days PER year PER site, during the early stages of breeding (late Jan to early Apr) in Red-footed, Brown, and Masked boobies. We also understand that the timing of our visits will depend on availability of flights or ship transport to the islands, USFWS schedules, and weather.

Description of proposed activities: (complete these sentences):

a.) The proposed activity would...

study the foraging ecology of Red-footed, Brown, and Masked boobies by monitoring 1) the movement patterns, at-sea distribution, and habitat use of breeding birds from FFS or MA using GPS data loggers, 2) the diet of boobies by collecting opportunistic samples when/if birds regurgitate when handled, 3) long term diet signals based on stable isotope analysis of feathers, and 4) stress levels as indicated by corticosterone levels in blood samples collected when the bird is captured for tag deployment AND removal. The foraging ecology of the birds would be studied in relation to environmental conditions that can be monitored with remotely sensed data (e.g. wind patterns, sea surface temperature, chlorophyll-a concentration). Because we already conduct similar studies on Laysan and Black-footed albatrosses at these locations, this work would be an extension of our research program on albatrosses. The study would also take a comparative approach to examine species and/sex differences in foraging ecology which are commensurate with differences in life history patterns of each booby species.

b.) To accomplish this activity we would
at EACH location (i.e. FFS and MA) PER breeding season, we would deploy 20 g GPS loggers on up to 20 breeding Red-footed AND on up to 20 breeding Brown AND on up to 20 Masked boobies during the incubation, chick-brooding, OR chick-rearing phases (see Collection Table). Each bird would be studied once but handled twice: 1) to attach the data loggers, collect 0.5 mL of blood, and to weigh the bird during logger deployment, and 2) to remove the GPS loggers, collect 0.5 mL of blood, weigh the bird, and collect up to 3 body feathers during recovery. In addition, we would opportunistically collect any diet samples regurgitated by the bird during handling. In summary, we would study up to 20 individuals of EACH species at EACH site PER breeding season. In all likelihood, our numbers of tag deployments would be much lower because of limitations on tracking tags, funding, number of personnel in the field, etc. Trip durations will be measured on both equipped and non-equipped birds to test for gear-effects (we have done this in previous seasons as well and have not found any affects).

c.) This activity would help the Monument by ...
providing the Refuge/Monument managers with a greater understanding of the habitat use by boobies within the Monument, because all three booby species' foraging ranges are within Monument waters (~50-200 km from the colony), in contrast to our study on albatross which forage predominantly outside of the Monument. Thus, these studies would enhance our understanding of resources utilization by species that breed and predominately feed within the Papahānaumokuākea Marine National Monument. We may find that certain sectors of the Monument are more important to the boobies than others, which could dictate further management, protection, or study. The boobies are also unique in that they rely heavily on sub-surface predators like tuna and sharks that drive prey like flying fish or squid to the surface. Thus, studies that focus on the foraging ecology and subsequent breeding performance of boobies could also provide information about the abundance of sub-surface predators within Monument waters. Finally, like the albatrosses, boobies are probably the next abundant group of seabirds within the Monument, numbering several thousands pairs (specifically Red-footed boobies). As such, they act as a conduit between the marine and terrestrial environments by transferring nutrients between ecosystems. Therefore, Red-footed boobies, which are tree nesters, could be a key species that provides nutrients to the limited tree species that exist within the Monument.

Other information or background:

Background and Rationale:

As top marine predators, seabirds are known to intensify their foraging effort in oceanic habitats where biological productivity concentrates their prey along upwelling regions, eddies, and frontal zones. Numerous studies recognize the potential to use seabirds as bioindicators of marine habitats and biological productivity, thus allowing researchers to determine "hot spots" for the conservation of marine ecosystems. Seabirds are probably the only component of marine ecosystems that are easy to study because they are fundamentally constrained by the fact that they commute between colonies where they breed and marine habitats where they feed. As a result, breeding success is closely coupled with the temporal and spatial variability of food in the marine environment. One of the keys to understand how seabirds integrate environmental

variability is to couple information on where birds find food with indices of the physical environment in which they inhabit. The present study investigates this by remotely tracking boobies at sea and comparing bird locations and behaviour to oceanic conditions to determine and/or evaluate “hotspot” regions around the Monument and surrounding seascape.

Biological productivity is known to be low in tropical/subtropical seas; however, many seabird species breed prolifically on islands throughout tropical and subtropical latitudes. For example, there are large colonies of boobies on several islands within the Northwest Hawaiian Island chain. Almost nothing is known about the at-sea behaviour of boobies beyond that which has been determined from at sea surveys. More recent studies on boobies breeding elsewhere show that foraging ranges from breeding colonies can be extensive (up to a few hundred km). Thus, how far boobies, where they travel to, and what oceanographic features they associate with around or beyond the Monument is virtually unknown. Previous research also shows that spatial segregation exists among booby species that breed in other locations, with red-footed boobies travelling furthest offshore compared to Masked or Brown boobies. Hence, there are fascinating ecological/evolutionary implications that influence the foraging ecology of these seabirds, yet this has not been rigorously examined. Lastly, boobies are known to rely extensively on their associations with sub-surface predators like tunas, sharks, and marine mammals to find food. This trophic interaction makes boobies even more interesting bio-indicators of marine ecosystems because fisheries can influence this relationship. The time to conduct such a study is more important than ever because the conservation of marine habitats around the globe has become a priority due to the numerous threats such as the development of fisheries and putative long-term changes in climate.

In the present study, we seek to examine the foraging ecology of boobies (Red-footed, Masked, and Brown) using GPS loggers and remotely sensed oceanographic data, to elucidate whether these seabirds use specific oceanographic features or “hotspots” to find food within the Monument and surrounding seascape. The fine resolution (in space and time) of the GPS tags will also allow us to evaluate whether boobies exhibit foraging behavior that is consistent with associations of subsurface predators like marine mammals, sharks, and tunas. Previous research conducted elsewhere using the same tracking devices suggests that specific flight patterns (straight line trajectories, slow flight speeds, frequent landings or dives) of boobies measured with tracking devices are consistent with visual observations of birds feeding amongst dolphins and tunas. The tracking devices will also allow us test the hypothesis that each booby species partitions their prey resources by segregating at sea, which has been suggested as a mechanism to reduce competition between different species. Overall, the results of this research will shed new light on the ecological and environmental factors that affect the abundance and diversity of tropical seabirds in the Monument. More importantly, these results will provide a basis with which to more fully manage the natural resources of the Monument.

Section A - Applicant Information

1. Applicant

Name (last, first, middle initial): Shaffer, Scott A.

Title: Assistant Research Biologist IV (at UCSC) and Assistant Professor (at SJSU)

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

Dr. Scott A. Shaffer

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

[REDACTED]

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

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

Institute of Marine Sciences and Ocean Sciences Department, University of California Santa Cruz, Department of Biological Sciences, San Jose State University

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):

Melinda Conners, Doctoral Student of Dr. Shaffer's at UCSC, Sara Maxwell, Postdoctoral Scholar, UCSC, Dr. Michelle Kappes, Oregon State University, a new doctoral student to be determined, and two field technicians to be determined. Once determined, the Monument will be notified before entry. This project is also collaborative in nature in that we will work closely with the refuge biologists (i.e. Paula Hartzell, John Klavitter and Pete Leary) at each location, and USFWS staff researchers (e.g. Beth Flint, Maura Naughton).

Section B: Project Information

5a. Project location(s):

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

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

Location Description:

Red-footed, Masked, and Brown booby breeding colonies at EACH site, including areas along the landing strips, bunk houses, and dining halls.

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:*

Red-footed (*Sula sula*), Masked (*Sula dactylatra*), and Brown (*Sula leucogaster*) Boobies offer a stark contrast to our research on albatrosses, because boobies forage relatively close to the atolls compared to albatrosses that range across the North Pacific. Based on previous research (Dr. Shaffer's own as well as other published studies), boobies forage within 50-200 km of their nesting colonies and they consume very different prey than albatrosses, which focus mostly on squid, fish and fish eggs. Previous studies conducted elsewhere show that boobies rely on flying fish, flying squids, sardines, pomfrets, needlefish, halfbeaks, and anchovetta that are scared up to the surface by dolphins, tunas, and sharks. Thus, boobies are truly (sub)tropical compared to albatrosses which forage in more productive waters at higher latitudes. Consequently, we expect boobies to use different foraging strategies (e.g. more area-restricted searching that is dependent on subsurface predators) compared to albatrosses. Yet, only a few studies exist that have tagged boobies with tracking devices (Anderson and Ricklefs 1987; Ballance 1995; Weimerskirch et al. 2005, 2006, 2008, 2009; Young et al. 2010) and none of these were conducted within Hawaiian waters. Red-footed booby colonies are prolific within the Northwest Hawaiian Islands, and they are therefore a major top predator within Monument waters, unlike albatrosses which predominantly exploit the more productive waters of higher latitudes. We are requesting permission to investigate the foraging ecology of the boobies using highly accurate GPS tags. These data would provide the Refuge/Monument managers with a greater understanding about the habitat use of boobies within the Monument because this species' foraging range is truly within Monument waters. We might find that certain areas of the Monument are more important to the boobies than others. In addition, we request the ability to collect blood samples before and after a foraging trip to evaluate corticosterone levels. This is a classic stress response hormone that is elicited during times when food is more scarce and animals have to fast more often. Thus, these samples could be critical for understanding how boobies cope with variability in food in Monument waters.

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?

We enter the Papahānaumokuākea Marine National Monument knowing that these islands are a resource to be protected and respected for their natural beauty, cultural and historical significance, and importance as a sensitive ecosystem. As a result, we conduct our activities with full awareness of these facts and carefully scrutinize our protocols to ensure proper safeguards for the animals, flora, and cultural and historical artefacts and sites. We avoid unnecessary entry into sites that are covered by our research permits to minimize trampling and habitat destruction, and we only enter sites not associated with our research permits if given permission by Refuge staff. Nothing is collected unless it is associated with our research activities and is covered by our permits.

Like all of our previous field efforts, we will carefully evaluate each bird, prior to deployment, to ensure that nervous or poorly conditioned birds are not studied. We will also take every precaution to minimize our impact to surrounding nests and birds. Nest markers (rocks, flagging tape) are temporary only. Each bird is handled as minimally as possible and with awareness of the increased stress associated with being handled by humans. To ease capture and avoid disturbance, boobies will be captured with a noose-pole. Once caught with the noose, the bird will be carefully lifted out of the tree (Red-footed boobies) or away from its nest on the ground (Masked and Brown boobies), and moved to a work area to minimize disturbance to other birds on the tree. This method is routinely used in the field to capture seabirds, particularly boobies, with minimal effect on birds captured. Birds will be lifted straight up off the nest to avoid disturbance to the egg. After a bird is removed from its nest, the nest will be marked with flagging or tape, the egg will be covered with a cloth while the adult is off the nest. Both Dr. Shaffer, his students, and colleagues, have previous experience capturing boobies and other seabirds with noose-poles, so they are familiar with these techniques. Our experience working on boobies at Palmyra Atoll, Lehua islet, and at Tern Island show that when released after being equipped or recaptured, boobies returned back to their nest within 5 to 20 min. The total mass of the data loggers used represents 1.5-2.3% of bird body mass, i.e. well below the 5% maximum generally recommended for seabirds (BBL guidelines). If we determine that our activities are too disruptive (i.e. causing nest abandonment) or if natural breeding failure is wide-spread, we will terminate our captures and suspend our study until we can fully evaluate the cause of the failure.

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? Our previous research has provided new insight into the ecological role that seabirds (i.e. albatrosses) play in the ocean environment (see publications and ongoing projects provided below), particularly at the PMNM. Given that the Northwest Hawaiian Islands are the population center for several major seabird species, the seabirds that reside here are major consumers of resources inside and outside the Monument, but the deposition of their guano is a major link between trophic transfer and energy flux in oceanic and terrestrial ecosystems. Our studies should provide a broader understanding of booby's role within the Monument ecosystem in terms of resource utilization and nutrient flux. The data we collect will also have direct implications for interpreting the proximate factors that influence population dynamics. For example, there are strong connections between oceanic conditions and the reproductive success and long term evolutionary life history of marine top predators (Pinaud and Weimerskirch 2002). Thus, by studying where the tracked birds go, how they behave, and how successful they are (in terms of mass gain), and our comparisons between the tracking data and remotely sensed oceanography, we should be able to provide the Monument managers with a greater knowledge about the dynamic interaction between oceanic condition, foraging ecology, and population dynamics. Our studies also provide a unique opportunity for education and outreach, which is a goal of the Monument. Our TOPP program has already highlighted the albatross research we have conducted at Tern Island and Midway Atoll NWR on our award winning website. Furthermore, we have also worked with nationally recognized media outlets (see National Geographic

Magazine, December 2007), to increase the visibility of the National Wildlife Refuge system and to promote greater awareness of the conservation and protection of natural resources within the Monument. Our research program also enhances the fundamental knowledge of seabirds from a cultural viewpoint because seabirds are so iconic within Native Hawaiian culture and folklore. The results of our research show how seabirds like albatrosses and boobies travel the open ocean in search of food much like the Native Hawaiians so we believe that there would be a strong cultural interest in our work. Consequently, we are keenly aware of the cultural and historical significance of the Northwest Hawaiian Islands and respect the resources to minimize our impact on these islands. Dr. Shaffer also has first hand experience working at other culturally sensitive sites in New Zealand. Dr. Shaffer obtained the approval and blessing of tribal elders of the Rakiura Maori to study Titi (or sooty shearwaters) at Whenua Hou (Codfish Island) in New Zealand. The tribal elders and community were fascinated by our studies that documented the amazing travels of their sacred birds.

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.

To date, only a few studies exist that have tagged boobies with tracking devices (Anderson and Ricklefs 1987; Ballance 1995; Weimerskirch et al. 2005, 2006; Young et al. 2010) and none of these were within Hawaiian waters. Booby colonies are prolific within the Northwest Hawaiian Islands and are therefore major top predators within Monument waters. Consequently, our studies would provide the Refuge/Monument managers with a greater understanding about the habitat use of boobies within Monument waters because this species' foraging range is truly within the Monument zone. We might find that certain areas of the Monument are more important to the boobies than others, which could affect future management decisions within the Monument. Furthermore, basic monitoring such as banding and nest counts only provide information about abundance and breeding success. However, this information does not provide information about how the birds use the resources within the Monument or which local feeding zones in the Monument may be more critical for their continued population growth and/or maintenance. Moreover, the proposed research complements our existing program on albatrosses because it provides a more enhanced view of ecosystem functioning by examination of multiple species from the same island within the Monument. By tagging individuals from monitored booby colonies, such as on Tern where individuals are from a known age-class, we can look at foraging behavior in a demographic context as well as in the context of oceanographic conditions, adding a new dimension to our analyses at TOPP. The Monument, and specifically Tern Island and Midway Atoll NWR, provides a platform from which researchers can access these pelagic species while they are "island-bound" during the breeding season. This is the only time where it is possible to examine animal distribution in connection with 1) breeding performance, 2) population demographics, 3) population comparisons of banded individuals, and 4) character attributes of individuals like known breeding status, age, sex, and colony origin. All of these attributes add greatly to our ecological interpretation and understanding of ecosystem dynamics. This study is also critical for understanding how boobies adapt to perturbations in their environment, and how changes in oceanography affect booby foraging strategies, and ultimately their reproductive output in a given year. These analyses will allow us to make informed predictions about what larger-scale environmental changes, such as

El Nino Southern Oscillation events, or possibly global climate change, may have on booby populations in the future.

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

The adverse impact of our research upon individual boobies is minimal and is limited to a cost of increased short-term stress in a few handled individuals. The positive impact of our research, in terms of potential conservation measures and management strategies for the species, is, however, monumental. Until innovation and technology gave researchers access to miniature tracking devices, seabird research was limited to colony-based island studies and off-shore sightings. With the advent of satellite and GPS tagging, we can now piece together an intimate picture of how seabirds use the marine environment. By examining the foraging patterns of boobies within the Monument, we hope to gain considerable knowledge about important foraging areas within the Monument, and how they are affected by varying oceanographic conditions. By combining the movement patterns of both albatross and boobies, we will be able to see how two major marine predators with very different foraging strategies exploit the marine environment both within and outside Monument waters, and how they react to interannual variation in oceanic conditions. The findings of this research could have huge implications on management decisions in terms of protecting sensitive habitat and managing for conflict with fisheries. As noted previously, our research is sponsored by TOPP, which has an outreach program to educate and involve the community about scientific research and marine conservation. We also take great care to minimize our foot print on the island by using the minimum number of personnel at field sites and in the minimum amount of time we feel is required to conduct our research in a safe and efficient manner. Finally, we always try to balance using the fewest number of animals possible while still obtaining ecologically meaningful and statistically powerful results. Overall, the knowledge we obtain about boobies from our research will help to ensure their longterm protection as a resource to be cherished and respected in a cultural sense as well as their role in the marine ecosystem of the Northwest Hawaiian Islands. As top marine predators, they also serve as sentinals of ocean health and our research promotes greater understanding of this concept at a minimal cost to the Monument.

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

Ideally, we plan to study the boobies during the early phases of breeding (i.e. egg incubation to small chicks), and once we have our desired number of logged trips (up to 20 individuals from EACH species PER season PER site), we will cease tagging for the season. However, given that boobies are less synchronous than other seabird species, we may find birds at various stages of breeding simultaneously. Also, environmental conditions influence the timing of breeding so it is possible that the timing of our work will be influenced by these natural factors. Nevertheless, we plan to conduct this research after finishing with our albatross studies (mid-Feb to early April) so we will already be at the field site to conduct this research. No additional travel to the field sites would be required to conduct the study.

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

Melinda Conners, one of the proposed technician for the 2010-11 season, was on Tern Island Jan-Mar 2008 and Dec 2009-April 2010 conducting the field work for her doctoral thesis. Therefore, she is very experienced with the field techniques that would be required for the upcoming field season and is also conscious of the need to minimize any potential impact on the Monument's resources. Melinda's graduate advisor, Dr. Shaffer has extensive experience studying Red-footed, Masked, and Brown boobies at Palmyra Atoll, Red-footed and Brown boobies at Lehua islet, Hawaii, and Brown and Blue-footed boobies in Baja California, Mexico. In addition, Dr. Shaffer has over 12 years of experience studying the foraging ecology of albatrosses and petrels around the world and has personally conducted three field efforts in the Northwest Hawaiian Islands NWR complex. He has also managed the research program on albatrosses and boobies at Tern Island and Midway Atoll since its beginning (Dec 2002 at Tern and June 2006 at Midway). Therefore, he is very familiar with the logistical requirements as well as the cultural, historical, and biological significance of Monument resources. Dr. Shaffer is also acutely aware of the ecological impact this work may have on the Monument's natural and cultural resources, and he and his students take great care to minimize deleterious effects on the fauna, flora, and historical sites of the islands. He will ensure that research results from this work will be published in a timely manner while giving proper acknowledgement to the Monument and Refuge Complex system. As a way to mitigate the impacts on the resources of the Northwest Hawaiian Islands, Dr. Shaffer and his students continuously evaluate and modify their protocols to accommodate new regulations, restrictions, and to minimize any deleterious effects that our research may cause. We also modify our protocols to accommodate changes in equipment (e.g. improved attachment techniques) or methods that improve results and reduce impacts.

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. Dr. Shaffer has funds from UCSC and SJSU combined (\$10,000) with contracts from NOAA (\$14,000 contract to Shaffer) and USFWS (\$53,100 contract to Shaffer). The preceding amounts include indirect costs (i.e. overhead) which does not specifically go towards the research. In addition to these funds, there is approximately \$35,000 in matching equipment and supplies for this research, which include GPS and banding supplies, and expendable supplies for the research. Given our prior experience working in the Northwest Hawaiian Islands combined with our continuous refinement of protocols and methods used during our research activities, we believe we can minimize the need for mitigating measures within the Monument.

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.

Although we refine when needed, we continue to use the same general methods from our booby studies during the past several years at Tern Island, Palmyra Atoll, and Lehua islet, which have proven to be highly successful and from which we are starting to gather a tremendous database. As previously explained in detail, not only do our methods provide us with an extensive amount of data, but they do so at a minimal cost to individual birds and Monument resources. We also design our studies to provide meaningful and statistically powerful results using the lowest number of individuals. We will remove from the colonies all field equipment and materials not

in use at the end of the field season. In addition, all methods and protocols used in this research activity have been approved by the Institutional Animal Care and Use Committees at UCSC and SJSU.

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

N/A

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

Given that we have had an ongoing research program within the Monument since 2002, we believe that our researchers have the knowledge, experience, and sensitivity to be respectful stewards of the natural/cultural/historical resources within the Monument. Furthermore, our research activities and purported outcomes are consistent with and mutually beneficial for the Monument to manage and maintain viable booby populations. We have previously compiled with all permit requirements and submitted detailed reports on our activities. We have also provided images and unpublished data from our research to both NOAA (Alaska) and USFWS (Hawaii and Oregon) and are happy to continue to do so upon request.

8. Procedures/Methods:

We propose to use 20-30g GPS data loggers to examine the foraging ecology of adult Red-footed, Masked, AND Brown Boobies breeding at Tern Island AND Midway Atoll NWR during the breeding season (see Collection Table for details on numbers of birds studied). Because Red-footed boobies nest in bushes and small trees, these birds will be captured with a noose-pole or by hand. Masked and Brown boobies nest on the ground and will be captured by hand or with a hoop net at their nests. All bird handling will be done in close proximity to a bird's nest and will take place in the late afternoon or early evening to minimize colony disturbance and flushing. We will handle no bird more than twice (for deployment and recapture). At each capture, all birds will be weighed and a stainless steel identification band will be placed on any birds not already banded. Bands will be obtained from the Refuge Staff or directly from the USGS Bird Banding Lab. Boobies will then be fitted with a GPS data logger taped to the ventral side of the central 3-4 tail feathers using adhesive tape. These GPS units record a location at 1 to 10 sec intervals and are the same devices that we currently deploy on the albatrosses and have also used on other booby species. Each deployment with a GPS logger will be for 1 day however birds sometimes remain at sea for two days (Weimerskirch et al. 2004; Young et al. 2010). The GPS loggers represent 1.5-2.3% of bird body mass (species dependent), i.e. well below the 5% maximum generally recommended for seabirds (BBL guidelines). Each bird will be captured twice (once to tag the bird and once to remove the tags) and will be released on site each time. During EACH capture, we request to collect 0.5 mL of blood (i.e. 1 mL total per bird) from a brachial or tarsal vessel using aseptic techniques to quantify stress and reproductive hormone levels (e.g. corticosterone, prolactin) before AND after foraging. During recapture, we request to collect up to 3 body contour feathers for quantification of stable isotopes. Lastly, it is common for boobies to regurgitate food when handled. Therefore, we request to collect one diet sample

during the recapture of EACH tracked bird to evaluate the diet following our tracking activity. These samples would only be collected opportunistically. See Collections Table for details.

Special Logistical Considerations for conducting research on boobies at Midway Atoll NWR. Because there are no sizeable booby colonies on Sand Island, we would need to conduct our research at Eastern Island where there are no permanent dwellings. Boats are not allowed to be on the water at night so we would likely need to stay on Eastern overnight (possibly two nights - one for deployment and another for recovery the following evening) because we conduct our deployments in the evening when birds are back from foraging. We will work with the Refuge staff on the logistical requirements. Its possible that we would only need to work and then sleep on Eastern and then return to Sand Island the following morning.

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:

Red-footed Booby; Masked Booby; Brown Booby

Scientific name:

Sula sula; *Sula dactylatra*; *Sula leucogaster*

& size of specimens:

Up to 3 body contour feathers plucked from EACH tracked bird and up to 1 mL of blood collected using aseptic techniques from brachial or tarsal vessel from EACH tracked bird. Up to 1 diet sample (regurgitant) collected from EACH tracked bird.

Collection location:

Within the breeding colony at each site, likely near the birds' nest

Whole Organism Partial Organism

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

The feathers will be used to measure stable isotope quantities (e.g. Nitrogen and Carbon) to evaluate the long term signal of proximate diet. Blood samples will be used to determine corticosterone levels, which are indicative of long term stress. All samples are destroyed in the process of their respective analyses. Diet samples (regurgitants) will be examined for specific identification of prey type by mass, abundance, and frequency. Samples will either be saved and archived or disposed of in waste receptacles.

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

N/A

- General site/location for collections:

N/A

- 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?

The feathers will be sealed in plastic ziplock bags and the blood samples will be stored in plastic screw cap vials. Diet samples (regurgitants) will be frozen on site and stored for transport of island. All samples will be transported off the island on a USFWS scheduled flight and brought to the laboratory of Dr. Shaffer at SJSU. There students will conduct sample analyses.

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

We have been collecting these samples since the start of our program (2008-09). To our knowledge, no replication of this work is occurring within the Monument because the samples are unique to each bird. Nevertheless, we are always happy to share our samples (or data) through collaborative efforts with other investigators. We have provided tracking data to several collaborators: Dr. Rob Suryan (Oregon State University), Dr. Cleo Small, BirdLife International.

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

No special gear is required to collect feather samples. The feathers are plucked from the bird. All blood samples will be collected using a 25 ga. needle and syringe from a vessel on the tarsus or wing using standard aseptic techniques. Regurgitants are collected off the ground and stored in ziplock bags. All supplies will be transported off the island and disposed of at SJSU. Tracking data will be collected following methods described above.

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

None.

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

None.

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

All previous samples or data are currently in (or are already completed) analysis stage. Nevertheless, if we find some potentially interesting results before the study is complete, we will proceed with publication promptly. These data will also be used for comparison to similar data collected at other colonies around the Pacific. Dr. Shaffer has studied boobies in Mexico, Palmyra Atoll, and Lehua islet, Hawaii. Therefore, we have an opportunity to conduct a larger population analysis using these data collected in the NWHI. Furthermore, the data may also be used as part of the doctoral thesis of Melinda.

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

Weimerskirch, H., Shaffer, S.A., Tremblay, Y., Costa, D.P., Gadenne, H., Kato, A., Ropert-Coudert, Y., Sato, K., Aurioules, D. (2009) Species and sex specific differences in foraging behaviour and foraging zones in two sympatric boobies. *Marine Ecology Progress Series* 391, 267-278

Young, H.S., Shaffer, S.A., McCauley, D.J., Foley, D.G., Dirzo, R. and Block, B.A. (2010) Resource partitioning by sympatric boobies in the Central Pacific Ocean. *Marine Ecology Progress Series* 403, 291-301.

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