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:
NOAA/Inouye Regional Center
NOS/ONMS/PMNM/Attn: Permit Coordinator
1845 Wasp Blvd, Building 176
Honolulu, HI 96818
nwhipermit@noaa.gov
PHONE: (808) 725-5800 FAX: (808) 455-3093

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 Shaffer
Affiliation: San Jose State University

Permit Category: Research
Proposed Activity Dates: 01 January 2021 - 31 December 2025
Proposed Method of Entry (Vessel/Plane): Plane or vessel
Proposed Locations: Midway Atoll NWR

Estimated number of individuals (including Applicant) to be covered under this permit: 8

Estimated number of days in the Monument: Approximately 75 days per year. The bulk of research will be conducted during a 2-6 week long period on site, starting in early December through April. This time frame coincides with the first half of the albatross breeding season and the first few months of breeding for boobies and frigatebirds. I am also requesting a 2-3 week window in June/July to deploy tracking devices on albatross fledglings. The timing and freqency of visits will depend on availability of flights or ship transport to the islands, USFWS schedules, and weather. Note that the number of days in the Monument is likely to be an overestimate depending on funding levels and personnel availability.

Description of proposed activities: (complete these sentences):

a.) The proposed activity would…

Research on albatrosses:

1) Characterize the interactions (frequency, duration, and at sea location) of albatrosses with fishing vessels based upon our ability to obtain vessel radar signals from foraging albatrosses equipped with high resolution GPS tracking devices, 2) add to our long-term monitoring of Laysan and black-footed albatrosses at sea behavior by the addition of five more years of data, 3) obtain feather or blood samples for analysis of stable isotope (Carbon & Nitrogen) signatures to infer proximate diet, and 4) to study fledgling albatross dispersal from the Northwest Hawaiian Islands.

Research on boobies and frigatebirds:

Continue research previously approved in PMNM-2016-003. I will continue to study the foraging ecology of Red-footed, Brown, and Masked boobies as well as Great Frigatebirds by monitoring 1) the movement patterns, at-sea distribution, and habitat use of breeding birds from Midway Atoll using GPS data loggers, 2) the diet of boobies and frigatebirds 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. I have been involved in comparative studies of these species elsewhere (e.g. Lehua Island, Palmyra Atoll, and Baja California) so these data would be compare to behavior of birds in these regions.

b.) To accomplish this activity we would ….

Research on albatrosses:
We would deploy GPS tracking tags (including purpose built radar-detecting tags) in combination with activity loggers and geolocating archival loggers on up to 60 breeding Laysan albatrosses AND on up to 60 breeding black-footed albatrosses during the incubation phase AND up to 60 of EACH albatross species during the brooding phase in EACH breeding season (see Collection Table). In summary, we propose to study up to 120 adult individuals of each species in each breeding season. In all likelihood, our numbers of individuals will be much lower because of limitations on tracking tags, funding, number of personnel in the field, etc.

When possible, albatross 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). When possiable, EACH bird will be weighed and up to 1 mL of blood sampled for isotopic analysis and genetic profiling. We will conduct post-hoc analyses to compare isotopic signatures from feathers to estimate trophic structure of diet between species. In June/July we would deploy tracking tags on up to 60 albatross fledglings (30 on each species) in each year.

Research on boobies and frigatebirds:
We would deploy 20 g GPS loggers on up to 30 breeding individuals of each species (less of Brown boobies) during the incubation, chick-brooding, OR chick-rearing phases. 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 1 mL of blood, weigh the bird, and collect up to 4 body feathers during recovery. In addition, we would opportunistically collect any diet samples regurgitated by the bird during handling. 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 …

Research on albatrosses:

This research provides the PMNM specific and useful information on the occurrence of fishing activity within the PMNM, describe drivers of albatross-fisheries interactions, and assess and develop recommendations for enhancing bycatch mitigation in the region. Specifically, our goals for this research include 1) surveillance of potential illegal fishing activities within PMNM waters and the adjacent high seas regions from an albatrosses perspective; 2) targeted assessment of mechanisms that create or drive fine-scale albatross-vessel interactions of breeding black-footed and Laysan albatross during periods of highest overlap in distribution with tuna longline fleets (Nov.-May); 3) assessing the effectiveness of long-line night setting as a preventative measure for albatross bycatch through analysis of albatross movements and vessel activity during day and nighttime periods; 4) quantifying fishing pressure along the PMNM boundary and determine if there is a PMNM 'edge effect' that influences albatross interactions; and 5) propose dynamic bycatch mitigation schemes informed by this fine-scale analysis, and evaluate their implementation feasibility and effectiveness. Finally, the continuation of the long-term tracking dataset will be a critical asset for answering pressing questions about albatross ecology and conservation needs, a key component of ecosystem-based management.

Research on boobies and frigatebirds:

This research provides the Refuge/Monument managers with a greater understanding of the habitat use by boobies and frigatebirds within the Monument, because the foraging ranges of all three booby species' are within Monument waters (~50-200 km from the colony; Young et al. 2015; Gilmour et al. 2018), in contrast to our study on albatross which forage predominantly outside of the Monument. Frigatebirds are known to forage within and outside Monument waters (Gilmour et al. 2012). Thus, these studies would enhance our understanding of resources utilization by species that breed and predominately feed within the Papahanaumokuakea Marine National Monument. We may find that certain sectors of the Monument are more important to the boobies and frigatebirds than others, which could dictate further management, protection, or study. The boobies and frigatebirds are also unique in that they relay 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 and frigatebirds could also provide information about the abundance of sub-surface predators within Monument waters. Finally, like the albatrosses, boobies and frigatebirds are abundant within the Monument, numbering several thousands pairs (specifically Red-footed boobies). As such, they act as a conduit between the marine and terrestrial environements by transfering nutrients between ecosystems. Therefore, Red-footed boobies and Great frigatebirds, 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 for albatross research:

Understanding what drives the interactions between albatross and fisheries operations can offer resource managers new perspectives on strategies to reduce negative encounters, thereby promoting ocean management and albatross conservation. Albatross populations worldwide have been severely impacted by mortalities from long-line fisheries interactions where birds consume bait, become hooked, and then drown. Although albatross can be attracted to fishing vessels, simple overlap between albatross and fisheries distributions does not specifically equate to negative interactions for all individuals. Thus, individual-based perspectives can offer insights into the conditions under which albatross approach fishing vessels, and hence reveal intrinsic bird characteristics and/or situational behavior that can be applied in a management context. A fine-scale, individual-based approach is particularly relevant for the large populations of black-footed and Laysan albatross breeding within the Papahānaumokuākea Marine National Monument (PMNM) to help mitigate population impacts from this environmental stressor. These species often forage on fisheries derived resources and are thus susceptible to bycatch mortality from longline vessels. Bycatch of black-footed albatross by US fishing fleets in both Alaska and Hawai'i has increased in recent years, but it is unknown to what extent bycatch by the international fleets is impacting these populations.

Where and when fishing vessels operate is traditionally considered confidential information. However, using vessel monitoring systems (i.e., Automatic Identification System; AIS), Global Fishing Watch (GFW, https://globalfishingwatch.org/) has shed light on the distribution and movement patterns of fishing fleets in near-real time. Moreover, GFW uses proprietary algorithms to identify gear-specific fishing activities based on vessel speed, direction, distribution, and fishing time. Paired with albatross GPS tracks this dataset offers a powerful oppurtunity to understand alabtross encounters with legal (AIS active) vessels. Unfortunately, some operators disable AIS. Hence, the deployment of radar detecting biologging tags on albatross can fill this critical information gap. We aim to combine radar detections from the back of an albatross and GFW data to estimate the number of "dark" vessels and thus characterize the prevalence of illegal fishers inside or near monument boundaries. Illegal fisheries have negative impacts across multiple trophic levels, including target (e.g. tuna) and non-target (e.g., seabirds, turtles) species. Some fishers also may 'ride the line' by setting along the boundaries of marine protected areas or national exclusive economic boundaries, creating an 'edge effect' that can influence the distribution of mobile species like albatross, thereby increasing exposure to bycatch risk. This next phase of research will provide critical information on the prevalence of illegal fishing activity within and near the PMNM that managers can use to ensure protection of PMNM waters, and inform drivers of albatross-fisheries dynamics to support management of breeding populations within the PMNM.

Background on studies of boobies and frigatebirds:
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 (Kappes et al. 2010). 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 (Thorne et al. 205 & 2016). 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 (Weimerskirch 2007). The present study investigates this by remotely tracking boobies and frigatebirds at sea and comparing bird locations and behaviour to oceanic conditions to determine and/or evaluate "hotspot" regions around the Monument and surrounding seascape (e.g. Young et al. 2015).

Biological productivity is known to be low in tropical/subtropical seas; however, many seabird species breed prolifically on islands throughout tropical and subtropical latitudes (Gilmour et al. 2019). For example, there are large colonies of boobies and frigatebirds on several islands within the Northwest Hawaiian Island chain (Harrison 1990). Recent studies on boobies (Young et al. 2010, 2015; Gilmour et al. 2018) show that foraging ranges from breeding colonies can be extensive (up to a few hundred km). 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 (Weimerskirch et al. 2005, 2009). 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 (Ballance et al. 1997, Weimerskirch et al. 2005). This trophic interaction makes boobies even more interesting bio-indicators of marine ecosystems because fisheries can influence this relationship but many questions about the nature this relationship remain. 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) and Great frigatebirds 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 and frigatebirds 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.

The only tracking studies conducted on boobies or frigatebirds in the NWHI have occurred at Tern Island, French Frigate Shoals (Gilmour et al. 2012 & 2018; Young et al. 2015). Our work shows that red-footed (33%) and masked boobies (17%) travel and forage outside Monument waters (see Table 2 in Young et al. 2015). Overall, both booby species spent about the same proportion of time (ca. 45%) and activity (ca. 31%) outside the Monument (Young et al. 2015). In contrast, the same species studied at another Marine National Monument (Palmyra

Atoll) foraged almost exclusively within Monument waters. This was especially true of masked boobies where foraging ranges were considerably shorter (34 km vs. 84 km; Palmyra vs. Tern respectively) and all birds remained within the Monument. This suggest that population level differences in foraging ecology vary by island (Young et al. 2015). Despite our previous effort, only one island population within the NWHI have been studied so we have no idea whether population level differences occur in colonies that are closer in geographic proximity and that share similar marine habitats (e.g. Tern vs. Midway Atoll). Finally, we were able to identify important marine habitats based upon the frequency of visitations by the boobies. For example, Brooks Banks (northwest of Tern Island) are a series of shoals that both red-footed and masked boobies visited repeatedly by several individuals (Young et al. 2015). These shallow shoals likely faciliate the aggregation of predatory fish, sharks, and dolphins that boobies sometimes rely to enhance foraging opportunities.

Data sharing:
All tracking and associated metadata for each seabird species studied will be deposited in the Global Seabird Tracking Database, hosted by BirdLife International in the UK. We have already deposited the majority of our previous data in this database, which has been used in numerous reports, outreach activities, governmental assessment, and scientific publications. Tracking data will also be deposited in the Animal Telemetry Network (ATN). The ATN is part of the Integrated Ocean Observing System. Data is viewable to the public in near real time via an online portal (https://portal.atn.ioos.us).

Outreach:
To date, our research program in the PMNM has published over 25 peer-reviewed papers. Research on this project has also supported several doctoral students and one postdoctoral researcher. We also co-wrote a chapter in a technical report published by NOAA. Our team has given over 60 presentations at conferences, university seminars, local special interest groups (e.g. bird clubs), and government sponsored meetings since 2003. We have also provided data or analyzed products (e.g. maps or figures) to USFWS and PMNM staff for outreach and reports. For the NFWF albatross fisheries interaction project we plan to coordinate outreach efforts with the Monument's education specialists at Mokupapapa Discovery CenterDiscovery Center (Hilo, HI) and coordinate social media posts with the NOAA Sanctuary Office for the Monument.

Section A - Applicant Information

1. Applicant

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

Title: Professor of Biology

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]

Phone: [redacted]

Fax: [redacted]

Email: [redacted]

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

3. Affiliation (institution/agency/organization directly related to the proposed project):
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):
Dr. Rachael Orben, Oregon State University - field researcher
Dr. Leigh Torres, Oregon State University - field researcher
Dr. Henri Weimerskirch, CEBC-CNRS, France - field researcher
Dr. Lesley Thorne, Stony Brook University - field researcher
At any given time, only 1-3 researchers will enter the Monument to conduct the research. Once determined, the Monument will be notified who will be traveling to the Monument before entry. This project is also collaborative in nature in that we will work closely with the refuge biologists and USFWS staff researchers on planning, logistics, and data sharing.

Section B: Project Information

5a. Project location(s):

		Ocean Based	
☐ Nihoa Island	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Necker Island (Mokumanamana)	☐ Land-based	☐ Shallow water	☐ Deep water
☐ French Frigate Shoals	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Gardner Pinnacles	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Maro Reef			
☐ Laysan Island	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Lisianski Island, Neva Shoal	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Pearl and Hermes Atoll	☐ Land-based	☐ Shallow water	☐ Deep water
☒ Midway Atoll	☒ Land-based	☐ Shallow water	☐ Deep water
☐ Kure Atoll	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Other			

☐ Remaining ashore on any island or atoll (with the exception of Midway & Kure Atolls and Field Camp staff on other islands/atolls) between sunset and sunrise.

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

Location Description:
Designated seabird breeding colonies on Sand or Eastern Islands, Midway Atoll NWR.

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:***

Research on albatrosses:

The main purpose of our research effort is to provide the Monument with a more informed scope of albatross interactions with fishing vessels. The secondary purpose is to continue albatross biologging studies to better understand linkages between at-sea behavior and distributions with changing climate and oceanographic processes.

Fisheries interactions can be negative for albatrosses when they are taken as bycatch, but can also be positive as birds scavenge for food. Interactions to date have mostly been quantified by counting bycaught birds and from fisheries observer reports. We know little about the mechanisms that trigger or drive these interactions, or the frequency of interactions with international or illegal vessels that do not report bycatch. Teaming up with Global Fishing Watch, we will characterize the interactions between albatrosses and fishing vessels. Radar-detecting GPS tags will record the location and duration of encounters with vessels. The GFW team will retrospectively evaluate the vessel type and the fishing activity from both radar-detecting and regular GPS tags. When combining this information with remotely sensed environmental conditions, we can more fully model the factors that contributed to the interactions. By understanding the scope of the problem, the PMNM will have more information to enhance policy and management decisions that facilitate resource protection of the Monument. In addition, we plan to deploy similar devices that transmit the data so tag recovery is not imperative for data acquisition. These tracking devices would be used to evaluate the interactions of adults and fledglings with fishing vessels over a longer time period (3-8 months). Tissue samples (feathers and blood) will be used as a proxy of diet and molecular sexing of individual that are tracked to provide a more complete picture of the ecological interactions of the albatrosses and their environment.

Research on boobies and frigate birds:

Boobies and frigatebirds offer a stark contrast to our research on albatrosses, because boobies and frigatebirds 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 and frigatebirds 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 and frigatebirds are truly (sub)tropical compared to albatrosses which forage in more productive waters at higher latitudes. Consequently, we expect boobies and frigatebirds 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 & 2015) and only two of these (Young et al. 2015; Gilmour et al. 2018) were conducted within Hawaiian waters. There is even less known about frigatebirds (Weimerskirch et al. 2002; 2005, 2016; and a few others), especially from NWHI (Gilmour et al 2012). 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 reponse hormone that is elecited during times when food is more scare and animals have to fast more often. Thus, these samples could be critical for understanding how boobies cope with varabilility in food in Monument waters.

*Considering the purpose of the proposed activities, do you intend to film / photograph federally protected species? Yes ☒ No ☐

For a list of terrestrial species protected under the Endangered Species Act visit:
http://www.fws.gov/endangered/
For a list of marine species protected under the Endangered Species Act visit:
http://www.nmfs.noaa.gov/pr/species/esa/
For information about species protected under the Marine Mammal Protection Act visit:
http://www.nmfs.noaa.gov/pr/laws/mmpa/

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 Papahanaumokuakea 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 protocals 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.

With regard to our research on seabirds within the PMNM, we 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 or debris) are temporary only. Each bird is handled as minimally as possible and with awareness of the increased stress associated with being handled by humans. Despite the

inevitability of some amount of stress on the bird from handling time, in our experience, most individuals recover quickly when returned to their nest.

The total mass of biologging tags to be deployed is 1.5-3% of a birds' body mass, which is well below the recommended maximum of 5%. To ease capture and avoid disturbance, boobies and frigatebirds are captured with a noose-pole or by hand. Once caught, individuals are carefully lifted out of the tree (Red-footed boobies or Great frigatebirds) 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 or hand capture, 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 minutes.

Our tag losses since 2002 have been less than 2% and nest abandonment from research activities that we know of is less than 1%. Given the exceptional tag recovery rates, we have no reason to believe that our tags have caused any significant mortality or morbidity to the study albatrosses. Nevertheless, as done previously, we will compare the duration of foraging trips of equipped birds with a control group to test for any effects of gear and handling time on our experimental group. We will continually evaluate handling time to refine field methods to make this process as streamlined as possiable. Though other seabirds like auks appear to be susceptible to adverse effects from the attachment of gear, researchers have deployed tracking devices on other albatrosses, cormorants and sulids with no significant adverse effects (Phillips et al. 2003, Daunt et al. 2006, Hamer et al. 2007).

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 research has provided new insight into the ecological role that seabirds play in the ocean environment (see publications and ongoing projects provided below). Given the importance of the Northwest Hawaiian Islands as breeding centers for seabirds that are major consumers of marine resources, the deposition of their fecal material is a major link between trophic transfer and energy flux of oceanic and terrestrial ecosystems. Given that seabirds forage extensively across the Pacific, and in many cases well outside the Monument (albatrosses and frigatebirds), our data provide a broader view of the seabirds' role within the Monument (boobies), and the North Pacific ecosystem that ultimately inflences the Hawaiian Islands. Our data have direct implications on 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; Thorne et al. 2015, 2016). Our data have provided critical information for determining overlap with fisheries operations (Zydelis et al. 2011, Wren et al. 2019), which is a major conservation issue for albatrosses. Our new approach using radar-detecting GPS tags on albatrosses will contribute new

information that will enhance conservation strategies for albatrosses at sea. Our research and studies of individual at-sea behavior and movements was deemed essential to monitor albatross populations (see USFWS Albatross Action Plan, Naughton et al. 2007). We have highlighted the research we have conducted at Tern Island and Midway Atoll NWR on our award winning website as well as working with nationally recognized media outlets (see National Geographic Magazine, December 2007), which increases the visibility of the National Wildlife Refuge system and promotes greater awareness of the conservation and protection of natural resources within the Monument. Our datasets provide a unique opportunity for education and outreach. Our research program also enhances the fundamental knowledge of seabirds from a cultural viewpoint because seabirds are so iconic within Hawaiian culture and folklore. The results of our research show how albatrosses travel the open ocean much like early Hawaiian explorers so we believe that there will be a strong cultrual 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. He 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.

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.
Laysan and black-footed albatrosses are important top predators in the North Pacific Ocean ecosystem, and according to the Monument Management Plan, greater than 98 percent of the world's Laysan and black-footed albatrosses breed inside the Monument. The Monument, and specifically Tern Island, Midway Atoll NWR, and Laysan Island, provide a platform from which researchers can access these highly 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. Other studies have captured albatrosses at sea and have attached satellite transmitters during the post-breeding period, but these studies often lack any of the demographic information that we deem significant. Additionally, at sea captures of these species can be more stressful for birds than capturing them from their nest sites.

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 & 2015; Gilmour et al. 2018) or frigatebirds (Weimerskirch et al. 2002, 2004, 2010, 2016; Gilmour et al 2012, 2019) and only two of these were within Hawaiian waters (Gilmour et al. 2012; Young et al. 2015). 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.

A unique facet of our tracking effort at Tern Island (and what we aim to develop on Midway Atoll) has been the ability to integrate animal distribution data across consecutive years

to determine whether inter-annual variation in oceanographic habitat affects seabird behavior (Kappes 2009, Kappes et al. 2010 & 2015). These analyses are critical for understanding how albatrosses adapt to perturbations in their environment, and how changes in oceanography affect albatross foraging strategies, and ultimately their reproductive output in a given year (Thorne et al. 2015 & 2016). 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 (Hazen et al. 2013), may have on albatross 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?
As mentioned above, the adverse impact of our research upon individual seabirds is minimal and is limited to a cost of increased stress on a handful of 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. To understand the ecology of pelagic seabirds that exploit vast areas of the North Pacific, both within and outside the Monument, it is critical to understand the movement patterns and foraging behavior of these species, from multiple breeding colonies and of different age classes, and to examine how their movement patterns respond to inter-annual variation in oceanographic conditions. The findings of this research could have huge implications on management decisions for the conservation of many species, in terms of protecting sensitive habitat and managing conflicts with fisheries for marine resources and incidental take as bycatch. As noted previously, our research incorporates aspects of outreach 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. 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 seabirds 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, seabirds 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.
To understand how albatrosses interact with fishing vessels, it is critical to study their movements throughout the breeding cycle (including both the incubating and brooding phases), because their foraging behavior changes dramatically between phases as they adjust their efffort to suit the demands of self feeding only during the incubation phase versus self feeding and chick provision during the brooding and chick rearing phase. The change in behavior usually results from a change in their distribution (Kappes et al. 2015), which influences their overlap with fishing vessels and the proximity to PMNM waters (Wren et al. 2019). Overall, we will attempt to overlap our research activities for all the designated species to minimize individual flights and entries into the PMNM. For example, by targeting a 2-6 week window between early December

through April, we can adjust the overlap based on specific planned activities. In addition, we request only a few weeks in the summer to tag fledgling albatrosses. The fledging process can take place over a month or more as chicks leave the beach. Therefore, a few weeks for this effort is enough of a window to affix tags for a single deployment for each followed bird.

f. Provide information demonstrating that you are qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.
Dr. Shaffer has over 20 years of experience studying the foraging ecology of albatrosses, petrels, boobies, and gulls around the world and has personally conducted seven field efforts in the Hawaiian Islands NWR complex (Tern Island 2006; Midway Atoll 2006, 2010, 2011, 2012, 2013, 2016). He has also managed a research program on albatrosses at Tern Island and Midway Atolll 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 and biological significance of the Monument. 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, his students, and colleagues will 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 and his colleagues (Project PI - Dr. Rachael Orben) were recently awarded 30 months ($216k) of funding from the National Fish and Wildlife Foundation's Papahānaumokuākea Research and Conservation Fund to support the costs of conducting this research. In addition to the funding from NFWF, we have in excess of $300k in matching fundings to support this project. Dr. Shaffer is also part of a team that is planning to submit a proposal to the National Science Foundation. 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 previous seabird studies at Tern Island and Midway Atoll NWR, which have proven to be highly successful and from which we are starting to gather a tremendous dataset. 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 SJSU and partner institutions.

i. Has your vessel 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 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 seabird populations. We have previously complied with all permit requirements and submitted detailed reports on our activities. We have also provided images and unpublished data from our research to NOAA (Alaska), PMNM, and USFWS (Hawaii and Oregon) and are happy to continue to do so upon request.

8. Procedures/Methods:
Specific to albatross research:
Biologging tags and activity data loggers will be attached using methods employed in our previous field seasons. Essentially, biologging tags will be taped to feathers on the dorsal region between the scapula and a data logger (<4g) will be zip-tied and glued to a plastic darvic leg band placed around the bird's tarsus. The total mass a bird will carry is up to 70 g or about 1.5-3% of bird body mass. Birds are weighed upon capture to insure that this criteria is met. Annually, up to 120 adults of each species will be equipped with Argos linked radar detecting GPS tags that transmit data and will remain attached for 3-8 months until the attachment fails or the feather are molted (or in a less likely scenerio, are recaptured). For these tags the attachment to the feathers will use both tape and superglue. For the majority of birds upon recapture, all equipment and tape will be removed. Given that our equipment and methods will be replicated from our previous field efforts, we do not anticipate any logistical changes to our tracking protocols.

To evaluate the success of foraging excursions, we request to weigh all birds with a spring balance before and after a trip to sea. We also request the ability to deploy radar-detecting GPS tags on fledgling albatrosses (June/July). We have conducted three previous field efforts of this kind and have tracked fledglings over 200 days (Gutowsky et al. 2014). This information is critical because in their naïve state, fledglings are suspected of interacting with more fishing vessels. This research would be a continuation of our previously permitted work (PMNM-2015-004). We also request to sample up to 5 body contour feathers and up to 1 mL of blood from each tracked individual (adults and fledglings) to determine the sex using molecular techniques and for measurement of stable isotopes. When breeding, most birds will be captured upon return from 1-3 foraging trips, all equipment will be removed, and they will be reweighed. Using aseptic techniques, blood will be collected from the tarsus using a 1 mL syringe to collect

approximately 1 mL of blood. After collection, direct pressure will be applied to the site of collection until bleeding ceases. Birds are then released next to their nest and will be visually observed for several minutes after release to ensure that no complications have arisen. Blood samples will be stored in vials filled and then frozen until analyzes are conducted back in the lab of Dr. Shaffer.

Specific to research on boobies and frigatebirds:
We propose to use 20g GPS data loggers to examine the foraging ecology of adult Red-footed, Masked, Brown Boobies AND Great Frigatebirds breeding at Midway Atoll NWR during the breeding season (e.g. PMNM-2016-003). Because Red-footed boobies and frigatebirds 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 and frigatebirds 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 & 2015). 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 asceptic techniques to quantify stress and reproductive hormone levels (e.g. corticosterone, prolactin). During recapture, we request to collect up to 4 body contour feathers for quantification of stable isotopes. Lastly, it is common for boobies and frigatebirds to regurgitate food when handled. Therefore, we request to collect one diet sample during the recapture of EACH tracked bird to evalute the diet following our tracking activity. These samples would only be collected opportunistically.

All work will be performed in collaboration and coordinated with refuge staff as has been done in previous years.

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:
Laysan Albatross; Black-footed Albatross; Red-footed Booby; Masked Booby; Brown Booby; Great Frigatebird

Scientific name:
Phoebastria immutabilis; Phoebastria nigripes; Sula sula; Sula dactylatra; Sula leucogaster; Fregata minor

& size of specimens:
Up to 5 body contour feathers plucked from EACH tracked bird and up to 1 mL of blood collected using asceptic techniques from a blood vessel on the tarsus (i.e. lower leg) or wing of EACH tracked bird. These are both routine procedures, with minimal risk and stress. In addition, we request to collect opportunitic diet samples (regurgitants) from individual birds.

Collection location:
Within the breeding colony, likely near a 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 proximate diet. Blood samples will be used to determine gender using molecular techniques, stress hormones; breeding diet via isotopic analysis, using a range of lab techniques, including mass spectrometry. All samples are destroyed in the process of their respective analyses.

9c. Will the organisms be kept alive after collection? ☐ **Yes** ☐ **No**
N/A

• General site/location for collections:
In the breeding colony, near the nest of the captured bird.

• 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?
Yes, birds will be released near their nest after equipment removal (except fledgling albatrosses).

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 glass vacutainers or plastic vials. All samples will be transported off the island on a USFWS scheduled flight.

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 (2002). To our knowledge, no replication of this work is ocurring because the samples are unique to each bird and we are examining differences across years. Nevertheless, we are always happy to share our samples (or data) through collaborative efforts with other investigators. In the past, we've shared blood samples with Dr. Lindsay Young of Pacific Rim Conservation and recently, we sent blood and feather samples to Wieteke Holthuijzen (Northern Illinois University) so she can evaluate molecular markers for comparison to mouse samples collected from Midway Atoll NWR for the mouse eradication effort. We have also shared tracking data with several collaborators: Dr. Rob Suryan (Oregon State University/NOAA), Dr. Rebecca Lewison (San Diego State University), and Dr. Simon Hoyle (Secretariat of the Pacific Community and IATTC), Dr. Cleo Small, BirdLife International, and several others. Dr. Shaffer has also been collaborating with Dr. Hillary Young (UC Santa Barbara) on projects related to the foraging ecology of boobies and frigatebirds at Palmyra Atoll. To our knowledge, no replication of this work is ocurring 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.

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 asceptic techniques. 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:
Two papers are currently in review (Orben et al. & Conners et al.) and another is in data analysis stage (Conners et al.). We envision at least two publications to result from the proposed research using the radar-detecting GPS tags. Data analysis will commence as soon as possiable in order to continually refine analytical approches, but publications specific to the NFWF albatross-fisheries interaction project will likely be written in late 2022. The final report for that project is currently

expected to be completed in December 2022 Furthermore, we anticiapate additional collaborative papers to stem from this effort.

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

1) Shaffer, S. A. Costa, D. P., Suryan, R. M., Hyrenbach, K. D. 2004. North Pacific: breeding and non-breeding. In Global Procellariiform Tracking Workshop Report (ed J. P. Croxall). BirdLife International. Cambridge, pp. 47-49.

2) Shaffer, S. A., Tremblay, Y., Awkerman, J. A., Henry, R. W., Teo, S. L. H., Anderson, D. J., Croll, D. A., Block, B. A., and Costa, D. P. 2005. Comparison of light- and SST-based geolocation with satellite telemetry in free-ranging albatrosses. Marine Biology 147: 833-843.

3) Tremblay, Y., Shaffer, S. A., Fowler, S. L., Kuhn, C. E., McDonald, B. I., Weise, M. J., Bost, C. -A., Weimerskirch, H., Crocker, D. E., Goebel, M. E., Costa, D. P. 2006. Interpolation of animal tracking data in a fluid environment. Journal of Experimental Biology 209: 128-140.

4) Robinson, P. W., Y. Tremblay, D. E. Crocker, M. A. Kappes, C. E. Kuhn, S. A. Shaffer, S. E. Simmons, and D. P. Costa. 2007. A comparison of indirect measures of feeding behaviour based on ARGOS tracking data. Deep Sea Research Part II: Topical Studies in Oceanography 54:356-368.

5) Suryan, R.M., Anderson, D.J., Shaffer, S.A., Roby, D.D., Tremblay, Y., Costa, D.P., Sato, F., and Ozaki, K. (2008) Wind, waves, and wing loading: Their relative importance to the at-sea distribution and movements of North and Central Pacific albatrosses. PLoS One 3(12): e4016. doi:10.1371/journal.pone.0004016.

6) Burger, A.E. and Shaffer S.A. (2008) Perspectives in Ornithology: Application of tracking and data-logging technology in research and conservation of seabirds. Auk 125(2), 253-264.

7) Tremblay, Y. Sophie, B., Henry, R.W., Kappes, M.A., Costa, D.P., and Shaffer, S.A. (2009). Analytical Approaches to Investigate Seabird-Environment Interactions: a review. Marine Ecology Progress Series 391, 153-163.

8) Kappes, M.A. (2009) Comparative foraging ecology and energetics of albatrosses. Doctoral Dissertation, University of California Santa Cruz, CA, p. 173.

9) Kappes, M.A., Shaffer, S.A., Tremblay, Y., Foley, D.G., Palacios, D.M., Robinson, P.W., Bograd, S.J., and Costa, D.P. (2010) Hawaiian albatrosses track interannual variability of marine habitats in the North Pacific. Progress in Oceanography 86, 246-260.

10) Shaffer, S.A. (2011) A review of seabird energetics using the doubly labeled water method. Comparative Biochemistry and Physiology 158: 315-322.

11) Žydelis, R, Lewison, R.L., Shaffer, S.A., Moore, J.E., Boustany, A.M., Roberts, J.J., Sims, M., Dunn, D.C., Best, B.D., Tremblay, Y., Kappes, M.A., Costa, D.C., Crowder, L.D. (2011) Dynamic habitat models: Using telemetry data to understand fisheries bycatch. Proceedings of the Royal Society of London B, 278: 3191-3200,

12) Block, B.A., Jonsen, I.D., Jorgensen, S.J., Winship, A.J., Shaffer, S.A., Bograd, S.J., Hazen, E.L., Foley, D.G., Breed, G.A., Harrison, A.-L., Ganong, J.E., Swithenbank, A., Castleton, M., Dewar, H., Mate, B.R., Shillinger, G.L., Schaefer, K.M., Benson, S.R., Henry, R.W. and Costa, D.P. (2011) Tracking Apex Marine Predator Movements in a Dynamic Ocean. Nature, 475: 86-90

13) Winship, A.J., Jorgensen, S.J., Shaffer, S.A., Jonsen, I.D., Robinson, P.W., Costa, D.P., and Block, B.A. (2012) State-space framework for estimating measurement error from double-tagging telemetry experiments. Methods in Ecology and Evolution, 3: 291-302.

14) Hazen, E.L., Jorgensen, S., Rykaczewski, R., Bograd, S.J., Foley, D.G., Jonsen, I.D., Shaffer, S.A., Dunne, J., Crowder, L.J., Costa, D.P., Block, B.A. (2013) Predicted habitat shifts in Pacific top predators in a changing climate. Nature Climate Change, 3: 234-238.

15) Maxwell, S.M., Hazen, E.L., Bograd, S.J., Halpern, B.S., Breed, G.A., Nickel, B., Teutschel, N.M., Crowder, L.B., Benson, S., Dutton, P.H., Bailey, H., Kappes, M.A., Kuhn, C.E., Weise, M.J., Mate, B., Shaffer, S.A., Hassrick, J.L., Henry, R.W., Irvine, L., McDonald, B.I., Robinson, P.W., Block, B.A., and Costa, D.P. (2013) Cumulative human impacts on marine predators. Nature Communications 4, 2688-2697.

16) Gutowsky, S.E., Tremblay, Y., Kappes, M.A., Flint, E.N., Klavitter, J., Laniawe, L., Christenson, B., Costa, D.P., and Shaffer, S.A. (2014). Divergent post-breeding distribution and habitat associations of fledgling and adult Black-footed Albatrosses Phoebastria nigripes in the North Pacific. Ibis 156: 60-72.

17) Gutowsky, S.E., Gutowsky, L.F.G., Jonsen, I.D., Leonard, M.L., Naughton, M.B., Romano, R.D., and Shaffer, S.A. (2014). Daily activity budgets reveal semi-flightless 'reduced activity stage' at-sea during post-breeding in Hawaiian albatrosses. Movement Ecology 2: 1-14.

18) Kappes, M.A., Shaffer, S.A., Tremblay, Y., Foley, D.G., Palacios, D.M., Bograd, S.J., and Costa, D.P. (2015) Reproductive constraints influence habitat accessibility, segregation, and preference of sympatric albatross species. Movement Ecology 3: 34 (pp. 1-24).

19) Conners, M.G., Hazen, E.L., Costa, D.P., and Shaffer, S.A. (2015) Shadowed by scale: subtle behavioral niche partitioning in two sympatric, tropical breeding albatross species. Movement Ecology 3: 28 (pp. 1-20).

20) Thorne, L.H., Hazen, E.L., Bograd, S.J., Foley, D.G., Conners, M.G., Kappes, M.A., Kim, H.M., Tremblay, Y., Costa, D.P., and Shaffer, S.A. (2015) Foraging behavior links climate variability and reproduction in North Pacific albatrosses. Movement Ecology 3: 27 (pp. 1-15).

21) Gutowsky, S.E., Leonard, M.L., Conners, M.G., Shaffer, S.A., and Jonsen, I.D. (2015). Individual-level variation and higher-level interpretations of space use in wide-ranging species: An albatross case study of sampling effects. Frontiers in Marine Sciences 2: 3 (pp. 1-17).

22) Thorne, L.H., Conners, M.G., Hazen, E.L., Bograd, S.J., Antolos, M., Costa, D.P., and Shaffer, S.A. (2016) Effects of El Niño-driven changes in wind patterns on North Pacific albatrosses. Journal of the Royal Society Interface 13: 20160196 (pp. 1-13).

23) Antolos, M, Shaffer, S.A., Weimerskirch, H., Tremblay, Y., and Costa, D.P. (2017) Foraging behavior and energetics of albatrosses in contrasting breeding environments. Frontiers in Marine Science 4: 414 (pp. 1-12).

24) Conners, M.G., Goetsch, C., Budge, S.M., Walker, W.A., Mitani, Y., Costa, D.P., and Shaffer, S.A. (2018) Fisheries exploitation by albatross quantified with lipid analysis. Frontiers in Marine Science 5: 113 (pp. 1-16).

25) Harrison, A.-L., Costa, D.P., Winship, A.J., Benson, S.R., Bograd, S.J., Carlisle, A.B., Dewar, H., Dutton, P.H., Jorgensen, S.J., Antolos, M., Kohin, S., Mate, B.R. , Robinson, P.W., Schaefer, K.M., Shaffer, S.A., Shillinger, G.L., Simmons, S.E., Weng, K.C., Gjerde, K.M., and Block, B.A. (2018) The political biogeography of migratory marine predators. Nature Ecology & Evolution 2(10): 1571-1578.

26) Gilmour, M.E., Trefry, S.A., Lamborg, C., Fleishman, A.B., Young, H.S., Shaffer, S.A. (2019) Tropical seabirds sample broad scale patterns of marine contaminants. Science of the Total Environment 691: 631-645.

27) Wren, J.L.K., Shaffer, S.A., Polovina, J.J. (2019) Variations in black-footed albatross sightings in a North Pacific transitional area due to changes in fleet dynamics and oceanography 2006-2017. Deep-Sea Research Part II, Topical Studies in Oceanography 169-170: 104605 (pp. 1-9).

28) Young, H.S., Maxwell, S.M., Conners, M.G., and Shaffer, S.A. (2015) Pelagic marine protected areas protect foraging habitat for multiple breeding seabirds in the central Pacific. Biological Conservation 181: 226-235.

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.

DocuSigned by:
Scott Shaffer
44B6B3BBB6D34EA...

8/5/2020

Signature Date

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

NOAA/Inouye Regional Center
NOS/ONMS/PMNM/Attn: Permit Coordinator
1845 Wasp Blvd, Building 176
Honolulu, HI 96818
FAX: (808) 455-3093

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