

New research proposal to Western National Parks Association (WNPA)

The information supplied should be limited to the space provided and submitted on these forms. A proposal received in any other format will be discarded. Additional attachments are not permitted.

<p>Title of project: Understanding a Decade of Dietary Competition in Two Endemic Island Carnivores: Implications for Conservation, Resilience, and Persistence</p>	<p>Park(s) in which research is to be conducted: Channel Islands National Park</p>
<p>Name, address, and phone number of principal investigator (PI)(s): Dr. Seth Newsome, Center for Stable Isotopes 219 Yale Boulevard NE, Albuquerque, NM, 87131 831-566-3276 Juliann Schamel, Channel Islands National Park 1901 Spinnaker Drive, Ventura, CA, 93001 909-534-2456</p>	<p>Payee information (individual name and address or institution's name and address required): Juliann Schamel Channel Islands National Park 1901 Spinnaker Drive Ventura, CA, 93001 909-534-2456</p>
<p>Is this a multiyear project? <input checked="" type="radio"/> YES NO <input type="radio"/></p> <p>Total amount requested: This year \$ <u>9,995</u></p> <p>If multiyear project, estimated amount: Second year \$ <u>10,000</u> Third year \$ <u>10,000</u></p>	<p>Desired start date: <u>November 1, 2019</u></p> <p>Note: no earlier than October 15, 2019</p>
<p>Project duration: Project final completion date: <u>December 30, 2021</u> (see research guidelines)</p>	
<p>Name(s) of research participant(s) who will acquire advanced degree(s) as a result of working on this project, if any:</p>	<p>Product(s) of research (articles, theses, maps, checklists, etc.) in addition to final report to WNPA (see research guidelines): Peer-reviewed publications, Presentations at conferences, Channel Island isotope data submitted to IsoBank</p>

Abstract to be provided by PI(s). Do not exceed the half-page space provided below.

California's Santa Rosa Island, part of Channel Islands National Park, is home to not one, but two endemic carnivores: the Channel Island fox and the Channel Island spotted skunk. The island fox had a recent brush with extinction, and after two decades of dedicated efforts was removed from the Endangered Species List in 2016. Meanwhile, the endemic island spotted skunk has experienced a precipitous decline since 2013 and is currently at the lowest density ever recorded. This decline may be due in part to competition with, and predation by, the island fox. As the island fox population recovered, detections of the island spotted skunk have declined in tandem, on both islands where the species co-exist. The ecology of the island skunk has not been studied on Santa Rosa Island.

This project uses stable isotope analysis of island fox and skunk whiskers collected from 2011-present to assess seasonal diet at the individual level across a variety of habitats. Data from these whiskers will also allow us to investigate niche overlap, competition, and predation between the two species. Our goal is to produce results that can be used by island managers to determine which conservation actions would be most effective to protect the island skunk. Species conservation can be tricky when two conservation-reliant species compete with each other for minimal resources; basic ecological knowledge of each species is an invaluable tool. For example, we do not know whether the fox and skunk simply compete for the same food, or the fox directly predate on the skunk. The management actions for these two scenarios would be very different. Our objectives are to: 1) Identify habitats and dietary items that support successful reproduction and recruitment in both species, particularly in times of drought, 2) Determine the mechanisms of competition between the two species (exploitative and/or interference), 3) Determine the extent of niche overlap and dietary flexibility

(1) JUSTIFICATION (to be provided by submitting park): This section should specify the following: 1) Are NPS-appropriated funds available for the project (yes/no)? 2) Where does this project rank in the submitting park's research priorities for all funding sources? 3) Was this proposal solicited by the park? If not, why is this project important to the park? 4) How will this research enrich visitors' understanding of the park? 5) What are the implications for resource management?

1) In 2018, Seth and Juliann were awarded an outside grant from the Satch Krantz Conservation Fund to explore the efficacy of this project to address management concerns within the park. NPS funds are not available at this time, but CHIS has provided in-kind support through field staff and volunteers who perform the fieldwork portion of the research.

2) The endemic island spotted skunk is a vital natural resource to our park. It exists only on Santa Rosa and Santa Cruz Islands. Conserving our endemic species for future generations is a top priority for the park.

3) The park did not request the initial study, which was initiated and funded by outside entities. However, the park has supported this study through sample collection since 2010, and would like to see this research continue. This project uses an irreproducible set of existing samples to provide insight into a pressing conservation concern - the recent precipitous decline of the island spotted skunk. The legwork has already been completed; all that remains is to secure funding for sample analysis in order to unlock the data inside. As the only two terrestrial mammalian predators, island fox and island spotted skunk are significant natural resources and both play an important role in island ecosystem dynamics - the island fox was chosen as a key indicator species for one of NPS's flagship Inventory & Monitoring Programs. The island spotted skunk, on the other hand, has received very little attention from the scientific community. The island skunk has no formal protections, and we know little about its ecological needs and relationships. Both of these mammalian carnivores are at inherent risk, being island endemics. It is imperative that we address basic research questions investigating island carnivore resource requirements and ecological interactions in order to inform our management decisions and to conserve these endemic species and the ecosystems with which they interact.

4) The island fox is a well-known gem of Channel Islands National Park (CHIS). The island spotted skunk is even rarer, but less well-known. Most visitors are not aware of this endemic species. The outreach materials produced by this project will highlight the island spotted skunk and its role in the ecosystem, the importance of long-term monitoring, the details that make island chains both incredible hotspots for biodiversity (high endemism) and also challenging places for species conservation, and why islands are a fantastic natural laboratory for understanding ecological relationships. It will also produce fun and engaging activities to spark interest in one of science's most feared branches - chemistry.

5) CHIS is unique in that the majority of species which live on each island live nowhere else on earth. The stakes for species conservation are high - local extinction means world-wide extinction. There is concern about the current status of the island spotted skunk, and if management action becomes necessary to protect the skunk, it is vital that we understand what type of protection would be effective. This project will provide several critical insights:

1) The nature of the competitive relationship between island fox and island spotted skunk. For example, if foxes are preying upon skunks and preventing reproduction and recruitment, then artificial burrows that provide protection to reproducing female skunks and kits may be the most effective protection. However, if foxes are not preying on skunk but are instead competing for the same food sources, then habitat restoration that provides more protection and enhances the population of preferred skunk prey items, particularly during drought conditions, may be the most effective action.

2) Important seasonal prey items during drought conditions. The Channel Islands are predicted to experience a hotter, drier climate in the future, with longer periods of drought. Island species cannot migrate to more suitable habitat as climate changes; they must adapt to where they live, or die. Understanding which food sources were important during the 2012-17 drought will enable the park to plan for supporting our endemic species through future droughts.

3) The capacity for dietary flexibility in each species. This will help the park understand each species' capacity to adapt to a changing island landscape in the future. Dietary specialists will have a more difficult time adapting to change in the ecosystem and may require conservation actions to support their persistence.

This information is also important to The Nature Conservancy, which owns the only other island where island skunk exist. TNC is hosting several research projects to learn more about island skunk ecology, but this whisker sample set is one-of-a-kind and will provide critical information that is impossible to address through any other method at this time.

(2) CONCISE STATEMENT OF RESEARCH OBJECTIVES, DESIGN, AND METHODOLOGY: This section should include the facilities and sites to be used. Note: limit this section to the two pages provided.

The Channel Island chain off the coast of California is uniquely home to two endemic mammalian carnivores - the island fox and island spotted skunk. The island fox persists on six of the islands, where it is the top terrestrial predator and has been identified as a keystone species by the California Department of Fish & Wildlife and the National Park Service. The island skunk persists on only two islands - Santa Rosa and Santa Cruz.

Being island endemics, the island fox and island spotted skunk are inherently at risk of extinction. The island fox faced near-extinction in the late 1990s due to hyper-predation by golden eagles. In just a few years, this newly arrived predator reduced the fox population on Santa Rosa from over 2,000 to just 15 individuals. The last remaining foxes were brought into captivity and the eagles were translocated back to the mainland. The island fox was saved by the quick, resourceful, and collaborative efforts of government organizations, nonprofits, and zoos. This is a fantastic illustration of both the inherent risk to island endemics and the power of collaborative efforts to save a species. During this time, there was a scramble to address knowledge gaps in island fox ecology in order to inform conservation efforts.

While the island fox has recovered, and was federally de-listed in 2016, long-term monitoring on Santa Rosa shows island skunk density at the lowest ever recorded since the inception of monitoring in 2009. While 173 individual skunks were captured in 2013, only 9 were captured in 2018 with the same trapping effort (1,296 trap nights). Interestingly, as the fox population increased with recovery, the skunk population has decreased in tandem. This trend has been recorded on both islands where fox and skunk co-exist, and implies a likely competitive relationship, with the fox the dominant competitor. However, the precise mechanisms of competition are unknown, making it difficult for island managers to address the needs of each species. Understanding of the nature of this relationship is imperative if management actions become necessary to ensure the persistence of the island skunk. Because the island fox and island spotted skunk remain at risk, we would like to address knowledge gaps to inform future conservation efforts: 1) the dietary requirements of each species for successful reproduction, recruitment, and persistence, particularly in times of drought, 2) the nature of the competition between the two species, and 3) the dietary flexibility of each species and its capacity for resilience in a changing environment. Unlike mainland species, island species cannot migrate to escape a changing ecosystem. They must be able to adapt to the island system, or perish. We strive to understand the role that intra-guild resource competition, predation, and drought has played in skunk population decline. The island skunk remains essentially unstudied, with only two research publications from Santa Cruz Island, and none from Santa Rosa. Results will be shared with our close collaborative partner, The Nature Conservancy, which manages 76% of Santa Cruz Island, to ensure best management actions to preserve and protect island spotted skunk and island fox on both islands.

Organisms can compete for resources across three niche dimensions: space (habitat), time (temporal), and food (diet). Ellie Bolas (UC-Davis) is currently researching habitat and temporal dimensions of Santa Rosa Island carnivore niche partitioning. Our complementary project addresses the dietary dimension of niche overlap between island fox and island spotted skunk.

Understanding an animal's seasonal dietary needs is fundamental to understanding its basic ecology, relationship with other species, and role in the larger ecosystem. This information is vital to land managers who aim to preserve the habitats and ecosystems that support key species, particularly in the rapidly changing climate we are experiencing today. Southern California is predicted to experience hotter, drier weather patterns in the future. As a result, we are interested in what resources the island fox and skunk relied upon during the recent 2012-2017 drought, to inform future habitat

(2) CONCISE STATEMENT OF RESEARCH OBJECTIVES, DESIGN, AND METHODOLOGY (continued):

Animals can also compete directly, via exploitative or interference competition. There is anecdotal evidence of fox predation on skunks (exploitation), but this has never been quantified. Isotope analysis provides a method to detect such predation, if it is occurring. If it is, this has major implications for skunk conservation management. For example, it is possible that foxes do not kill adult skunks, but do predate upon skunk kits in the den, as has been shown with Tasmanian devils (predator) and feral cats (prey) in Tasmania. When foxes provision their pups, they bring home the largest prey possible. On the islands, this would be skunks or skunk kits. Predation upon breeding females and young skunks could significantly impact the skunk population's ability to persist, and artificial dens or some other type of protection may be required. However, if foxes are not directly preying on skunks, then artificial dens may be a waste of time, money, and resources. This study offers a method to investigate this question for the first time.

Finally, understanding the skunk's capacity for dietary flexibility will help us predict its resilience and ability to adapt and persist in a changing landscape on its island home. Dietary specialists have a more difficult time adapting to new situations and are at greater risk of extinction. We will investigate the skunk's dietary response to variables in its environment in order to assess its dietary breadth and flexibility under these conditions: intra-species competition (high skunk density), inter-species competition (high fox density), and drought.

This project expands on a previous scat-based diet study of the island fox by using stable isotope analysis of carbon and nitrogen in whisker samples. It is the first study of island spotted skunk diet. Stable isotope analysis of organic tissue reveals the origin and pathway of individual nitrogen and carbon atoms as they move through the food web, and can therefore be used to identify dietary composition when a consumer's isotopic signature is plotted over that of its potential prey. When investigating diet, stable isotope analysis complements scat analysis in three ways: 1) isotope data from sub-sampled whiskers generates a detailed, longitudinal, individualized record of diet spanning 4-6 months, rather than the single snapshot of a scat, 2) isotope analysis can detect dietary items that leave no trace in scat, and 3) whisker tissue is identified to an individual with additional data (age, sex, location [habitat], reproductive status, weight, body condition, etc.). This combination makes stable isotope analysis a powerful tool for exploring a breadth of questions in island foodweb ecology and trophic interactions.

We will use whiskers collected non-invasively from island fox and skunk at long-term NPS trapping sites in five main habitats on Santa Rosa Island (preliminary analysis showed that fox diet differs by habitat type). Using samples collected from 2011-present, we will: 1) assess the strength of dietary niche overlap and competition in island fox and skunk, 2) look for evidence of fox predation on skunks, 3) identify seasonal dietary items that were important during the 2012-2017 drought, and 4) investigate the diet of the island spotted skunk in abundance (2011-2014) and rarity (2016-2019) to understand its preferred prey and capacity for dietary flexibility.

In order to assess island carnivore diet, we must also analyze stable isotope values of potential prey items, to create a 'prey space map.' This will document the stable isotope signatures of many organisms on the Channel Islands - including vertebrates, invertebrates, and plants. This data, along with the fox and skunk data, will be submitted to IsoBank and available for future collaborative studies in food web ecology and energy flow dynamics on the islands.

Study Design: This study is designed to address multiple questions simultaneously. We will analyze 10-15 fox and 10-15 skunk whiskers collected during the same season and year from each of five habitats, for a total of 30-45 samples per species per site. We will analyze samples from 2011, when fox was rare and skunk abundant, samples from 2014, when neither species was rare, and from 2018 when the fox was abundant and skunk rare. This design allows us to investigate seasonal intra- and inter-species competition in these scenarios, and to look for evidence of fox predation on skunks. These timeframes also cover drought and non-drought conditions. We predict that with the fox as the dominant competitor, the skunk's dietary niche may have shifted towards less-desirable food items. Understanding each species' capacity for dietary flexibility will provide insight into the species' resilience in a changing landscape.

Lab analysis of samples will be performed at the Center for Stable Isotopes, University of New Mexico. For carbon and nitrogen analysis, cleaned whiskers are sub-sampled into 0.2 mg segments. Each whisker contains approximately 4-6 months of dietary information, which has been integrated into the growing whisker tissue; each

(3) CONCISE STATEMENT OF HOW YOUR RESEARCH CAN ENHANCE THE INTERPRETIVE MISSION OF THE PARK: Also include one paragraph describing the plan for an interpretation-related product of the research. Use this page only.

The story of the island fox and island spotted skunk has many threads that weave together. These are some we would like to highlight in our interpretation products:

- 1) Long-Term Inventory & Monitoring Program: underlining the importance and value of the long-term Inventory & Monitoring Program, for which Channel Islands National Park was one of the flagship parks. The island fox decline was only detected because of this long-term monitoring; the island spotted skunk decline was documented in the same way. The collection of the decade-long set of whiskers specimens on which this project is based was made possible by the long-term monitoring activities on Santa Rosa Island. Such programs are extremely valuable for learning about the natural variation within the park's ecosystem, which in turn provides critical knowledge and context when making management decisions. The I&M Program has collected a rare, robust dataset with incredibly detailed knowledge about the island's carnivore populations. This scaffolding allows scientists to study and understand complicated ecological theories such as competition, dietary flexibility, and individual specialization, which are usually nearly impossible to study in the field. It is a researcher's dream!
- 2) Ecology and Natural History of the Island Skunk: Although most visitor's are familiar with the story of the island fox, and seeing one in the wild is a highlight of their visit, many are surprised to learn that Santa Rosa Island is also home to an endemic island spotted skunk. One goal of our project is the highlight the island spotted skunk and bring it into the eyes and minds of the public, along with the knowledge we gain about its natural history and relationship with the fox.
- 3) Islands as Natural Laboratories: The Channel Islands are quite unique in being home to two endemic island mammalian carnivores. Most island chains do not even have one. This not only makes Santa Rosa Island a unique and special place to visit, it also offers scientists an opportunity to study research questions about ecological theories like competition within a simplified system, and to increase our understanding of how competition impacts the lives and persistence of sympatric species. This study would be much, much harder (perhaps impossible) to perform in a mainland ecosystem, where the greater diversity of species and myriad interactions and variables would make it too difficult to tease apart details with any accuracy or certainty. Thus, Santa Rosa Island is special not only for the species it supports who call it home, but also for the incredible value that it offers to researchers to advance collective knowledge about how ecosystems function and what ecological interactions may be important to consider for future conservation efforts.
- 4) The Use of Stable Isotope Analysis in Ecology and Conservation: Furry, adorable foxes and skunks are a great way to get the public engaged in... chemistry! While stable isotope research is chemistry-heavy and may seem inaccessible, the charismatic and relatable island fox and island spotted skunk provide the perfect ambassadors for describing and engaging the public in the wonderful (invisible) world of isotopes and what they can teach us about the world we live in. Every physical thing on earth is made up of isotopes, including us humans, and we can perform stable isotope analysis on ourselves in addition to island carnivores (forensic anthropologists do just that). Samples of our hair or fingernails can be analyzed to tell us what we've been eating, where we've traveled, and where the water we drank came from!

We plan to share results and information about this research through many avenues. Some ideas include:

- 1) Results will be shared with CHIS and TNC staff at a brown bag lunch presentation, report and meeting with the Interp Division, a presentation at the 2020 California Island Symposium and other symposia as appropriate, 2020 Channel Islands Skunk Conservation Summit organized by TNC, and formal and informal public outreach
- 2) Our team has an active collaboration with nonprofit Friends of the Island Fox, for whom we have provided video, blog posts, and articles on island fox ecology, research, and life on the island. We are currently working with FIF to produce a short video (10 minutes) on endemic island carnivores (fox and skunk), the role of competition in ecology, and the use of stable isotope analysis in conservation research. This video will be geared towards the general public and played at FIF booths, and available on the NPS and FIF website. Photos and blogs of the research will be shared this way as well.
- 3) We would like to work with CHIS Education Coordinator Monique Navarro to create a lesson which can be integrated into the fantastic outreach programs that she coordinates with thousands of local elementary students every year. This lesson might end up in the form of a game - use stable isotopes to figure out who ate their veggies and who ate marshmallows instead! (for example), and then to figure out what island wildlife are eating.
- 4) We would like to engage students from CSU-Channel Islands research station on Santa Rosa Island in this research

(4) QUALIFICATIONS OF THE PI(S) CONDUCTING THE RESEARCH: Use this page only. List only those qualifications directly related to this grant request. Include a list of other WNPA-funded research conducted by this PI.

Dr. Seth Newsome is an animal ecologist and conservation biologist who specializes in the application of stable isotope analysis to address critical conservation questions that cannot be answered through other methods. He is an Associate Professor in the Biology Department at the University of New Mexico. In 2014, Seth established the Center for Stable Isotopes at UNM, where he serves as the Associate Director. Through the Center, Seth addresses a myriad of research questions related to mammalian conservation around the world. In 2010, Seth initiated the collection of island fox whisker samples through collaboration with CHIS and its long-term monitoring of the species in order to assess seasonal and habitat differences in the (then-endangered) island fox. This preliminary study revealed that diet differed among habitat types on the islands. In addition to his work with island fox, Seth has collaborated with NPS, The Nature Conservancy, NOAA, and The Institute for Wildlife Studies on research into the ecology and conservation of bald eagles, sea otters, and pinnipeds on the Channel Islands. Seth has been awarded over 50 research grants during his career, and has published more than 100 publications in peer-reviewed scientific journals. He is a co-PI on the IsoBank project, which received NSF funding in 2018. This project will create a centralized repository for world-wide isotopic data similar to what GenBank does for genetic data. The goal of IsoBank is to allow researchers to share isotopic data to facilitate more comprehensive research. All data produced from this project will be submitted to IsoBank.

Juliann Schamel is a Lead Terrestrial Vertebrate Monitoring Technician for Channel Islands National Park, and has been working on the Channel Islands with island fox and island spotted skunk since 2014. She also conducts annual monitoring of the island's endemic reptiles and amphibians, deer mice, bats, and breeding land birds. Juliann acts as the Volunteer Coordinator for the program, and introduces several enthusiastic individuals to fieldwork on the Channel Islands every season, as well as engaging students from California State University Channel Islands from the research station on Santa Rosa. In 2016, she began working with Dr. Seth Newsome to analyze island fox whisker samples. In 2018, they were able to analyze a preliminary set of island spotted skunk whiskers with the support of the Satch Krantz Conservation Grant. In 2018, Juliann was also awarded the first Research Grant from nonprofit Friends of the Island Fox, to support island fox diet research on San Miguel Island.

Juliann has a Bachelor's Degree in Ecology and Nature Writing from Stanford University. With a background in carnivore and island ecology, Juliann is involved in research on island carnivores with collaborators in Iceland (arctic fox), Tasmania (Tasmanian devil and spotted-tailed quoll), and the Channel Islands. Her professional interests and background bridge primary scientific research and successful scientific communication and public engagement. She has published in peer-reviewed journals, popular magazines, and on websites. Juliann taught for 4 years for Los Angeles County Outdoor Science School, and for 3 years as a Teaching Assistant for a university-level Wildlands Studies program in Tasmania focused on Tasmanian Devil conservation. She enjoys the creation of hands-on, interactive, engaging learning materials.

Neither Seth nor Juliann have previously conducted WNPA-funded research.

Budget for New Research Proposal

Project title and submitting park: Understanding a Decade of Dietary Resource Competition in Two Endemic Island Carniv
Channel Islands National Park

PERSONNEL EXPENSES

PRINCIPAL INVESTIGATOR(S)	Funds requested from WNPA	Cash or in-kind contribution (Please specify which type and source.)
1 Seth Newsome	\$0	
2 Juliann Schamel	\$0	
3		

OTHER PERSONNEL (Specify number in brackets. Specify duties to be performed to earn funds on next page.)	Funds requested from WNPA	Cash or in-kind contribution (Please specify which type and source.)
1 Center for Stable Isotopes Lab Technician	\$2,260	matching in-kind \$2,260
2 GS-5 Biological Science Technician \$19.73/hr X 432hr		in-kind NPS, \$8,523.36
3 Volunteer-in-the-Parks (3)		
4		
5		
TOTAL PERSONNEL COSTS	\$2,260	\$10,783.36

OTHER EXPENSES

OTHER COSTS

1 Supplies and material	\$0	in-kind UNM, \$7,735
2 Consulting services	\$0	in kind UNM/NPS
3 Computer services	\$0	non required
4 Subcontracts (itemize on next page.)	\$7735	
5 Equipment (itemize equipment costing more than \$100 each on next page)	\$0	in-kind J. Schamel, \$100
6 Travel and subsistence (itemize on next page)	\$0	in-kind NPS, \$5,710.20
TOTAL OTHER COSTS	\$7,735	\$13,545.20

TOTAL PROJECT COSTS **\$9,995** **\$24,328.56**

If multiyear project, summarize estimated subsequent year(s) budget(s) on next page.

COSTS (continued): Be sure to explain here the duties that will be performed by any funded individual.

Personnel Expenses: Laboratory preparation of samples will be performed by CSI lab technician at a rate of \$20/hour. The CSI will donate a matching one hour of time for every one hour that is funded:

113 hours X \$20/hour = \$2,260 requested funds from WNPA
113 hours X \$20/hour = \$2,260 matching funds from CSI

Supplies and Materials: for sample preparation and analysis will be donated by CSI at a cost of \$7,735 in-kind donation

Subcontracts: The remaining requested funds from WNPA will be used to cover the cost of sample analysis on the mass spectrometer. This is a fixed cost that cannot be covered by in-kind donation. Each whisker is sub-sampled into 0.2mg segments for seasonal diet assessment. The sample cost is \$7/sub-sample. Each fox whisker contains approximately 10 sub-samples and costs \$70. Each skunk whisker contains approximately 3 sub-samples and costs \$21. We have included 85 fox and 85 skunk samples in the FY2020 proposal for \$7,735.

Travel and Subsistence: Donated in-kind by Channel Islands National Park (this has already been completed)

(two GS-5 technicians and three volunteers, 8 days/year for three years)
Roundtrip to SRI on IPCO is \$114/pp = X 5 persons X 3 trips X \$114 = \$1,710
Truck use on SRI \$20/day = X 7 day X 3 trips X \$20 = \$420
Food \$20/day/pp = 8 days X 5 persons X 3 trips X \$20 = \$2,400
Housing \$11.24/night/pp = 7 nights X 5 persons X 3 trips X \$11.24 = \$1,180.20

We have applied as a potential multi-year project. The budget for future years would cover similar costs (lab technician and sample analysis), eventually allowing for the analysis of all samples outlined in the Study Design (10-15 fox and 10-15 skunk whiskers from 5 habitats across three different years, 2011, 2014, and 2018).

A special note for researchers and the park superintendent:

WNPA is the funder of this grant on behalf of the NPS, and WNPA monitors progress, administers the payment schedule, and determines successful completion or default.

All other decisions regarding the conduct of this research grant (park access, laws, safety, protocols, etc.) and uses of the research, data, and its products (release of information, publication, intellectual property, etc.) rest in the hands of the NPS and are the responsibility of the NPS. Researchers and the NPS should clarify any questions or assumptions before accepting the grant.

Due to several factors, all WNPA grants are for ONE (1) YEAR ONLY; however we welcome and will carefully consider applications for second or third years following a successful first year.

Best wishes and hopes for a successful project. Thank you from WNPA.

I have read and agree to abide by the research guidelines in effect at the time of this application

Sean Paulson *Julian Schramel*
Signature of Principal Investigator(s)

8/20/2019
Date

Oliver Kim *(acting)*
Signature of Park Superintendent

8/29/19
Date

Signature of Chief of Interpretation

Date

For WNPA use only

WNPA Research Committee Review Action and Date:

Amount Granted