#1

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 returned. Additional attachments are not permitted.

Title of project: Investigation Distribution and Abundance of American Pikas at Bandelier National Monument to Illuminate How and Why Change is Occurring	Park(s) In which research is to be conducted: Bandelier National Monument
Name, address, and phone number of principal investigator, (PI)(s): Erik Beever, Research Ecologist USGS Northern Rocky Mtn. Science Center 2327 University Ave., Ste. 2 Bozeman, MT 59715 ofc: +1 (406) 994-7670 cel: +1 (530) 410-9631	Payee information - individual name and address or Institution's name and address required: Scott McFarland Bandelier National Monument 15 Entrance Rd. Los Alamos, NM 87544
Is this a multiyear project? YES Total amount requested: This year $ $7500 If multiyear project, estimated amount: 2nd year $ Year 2, 2019 3rd year $ $7500	Desired start date: Project May 2018; Year 2: April 2019 Note: Not prior to October 1st
Project duration: 3 years (2018-2021; fieldwork ends late 2020 Project final completion date: April, 2021 (see research guidelines)	
Name(s) of research participant(s) who will acquire advanced degree(s) as a result of working on this project, if any:	Product(s) of research (articles, theses, maps, checklists, etc.) in addition to final report to WNPA (see research guidelines): Information from study will be included with information from other areas across the western USA in numerous peer-reviewed publications. Glossy project fact sheet (1-2 pgs., in both English and Spanish), a poster to display in the VC, and a web-based summary blog or video (also in English and Spanish).

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

The American pika (Ochotona princeps) has been widely heralded as a model species to address numerous topics at the nexus of basic and applied ecology, to provide insights into species responses that have relevance across the animal kingdom. These include topics such as local-extinction dynamics, movement and persistence of a species across a network of isolated patches (i.e., metapopulation dynamics), and wildlife-climate relationships. Pikas are a highly charismatic mammal (voted 2nd-Cutest Mammal in North America, in an open online vote) that typically inhabits rocky talus slopes and lava flows at high elevations across western N. America. Entities have twice petitioned for pikas to receive state and federal listing under the Endangered Species Act, but lack of trend data and other factors have precluded any such listing.

The proposed research complements the PI's research on American pikas since 1994, in areas spanning nine NPS units, 32 National Forests, and numerous BLM-, USFWS-, and state-administered units. This project is part of a broader research effort to better understand the current and recent-past distribution and abundance of pikas across northern NM, and importantly, to identify the climatic and other factors that may be governing any changes (to inform possible climate-adaptation management and conservation actions). Because pikas are diurnal, live in easily defined (rocky talus) habitat, and are easily (usually >90%) detected when they are present, they not only facilitate inexpensive investigation of their status and trends, but also make the incorporation of assistance by park staff and trained volunteers a feasible option. BAND represents an ideal laboratory to assess how species will fare amidst increasing drought and increasing frequency of extreme-weather events, which are both predicted for the southwestern USA, in the coming years. In Year 2, we plan to a) build on our noteworthy field results from Year 1; b) improve our ability to understand how and why pika distributional changes are happening, and c) begin to share project results through BAND interpretive efforts to many types of audiences.

(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 2017, funding was received from the Friends of Bandelier to ensure the study was able to happen. There are no NPS-based funding sources for this type of project.

2) This project ranks highly for natural-resource projects that are occurring in Bandelier National Monument.

3) The park did not request the initial study in 2016. The initial research was funded by other entities for the first year. In 2017, funding was received from Friends of Bandelier to continue the research, at the park's request. The park would like to see the research continue into the future.

4) American pikas are globally considered to be an indicator species for the ways in which climate changes can affect mountain-dwelling species. In Bandelier, American pikas are found in very limited areas known as felsenmeers, another name for rocky talus. We know from the first three years of population studies that pika numbers within the park are very small and the chances of long-term survival of pikas here may be very uncertain. We need to continue to monitor pika populations within Bandelier to see if these small rabbit relatives adapt or perish. By interpreting our greater understanding of the pika's survival outcome to the public, everyone may gain a greater understanding of the impacts of climate change, worldwide as well as locally.

5) American pikas are just one of many species that could be impacted by climate change, and their ability to adapt or perish may provide insight into how other species will fare in the future. This could greatly impact how resource management deals with at-risk species found within the park.

6) Years 2 and 3 of WNPA funding are critical to move the Year 1 and previous results into conservation-management actions, because those years are critical in helping us understand how and why pika declines are continuing to occur.

(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.

In BAND, in addition to the broader-effort goals across NM, we are seeking to identify 1) whether management actions may help avert the loss of pikas from BAND, and 2) which lessons of pattern and anomaly (for example, fine-scale refuges facilitating persistence at unexpectedly low elevations) can be transferred to other parks that have species at their southern or lower-elevation distributional limit that may be lost due to continuing global change. Using very-high-resolution imagery, in early 2016 we identified 19 areas in BAND that might be physically suitable for pikas (see map at http://caltopo.com/m/PQM6). Surveys of all 19 patches in 2016 indicated that 5 patches were unsuitable (rock diameters were far too small or large), and pikas currently occupied 5 of 14 patches (35.7%), and previously occupied another 4 of the remaining 9 patches (28.6% of total). More-thorough investigations in BAND in 2017 found another two patches, and saw current occupancy fall to 25% (4 of 16 patches), and former occupancy increase to 50% (8/16 patches). Sampling in 2018 (Year 1 funding) showed only 2 of 19 patches (including 3 newly-found patches) currently pika-occupied, and a total of only 3 individuals were detected. Evidence of past pika occupancy has now been detected at all but 1 of the 19 patches in BAND (i.e., 88.9% loss). Years 2 and 3 of funding are critical because 1) we may witness the loss of a charismatic mammal from another NPS unit of the Southwest (this funding will literally enable us to determine whether (and if so, when) it may happen, and 2) it will allow us to more definitively identify the mechanisms underlying pika declines in BAND and northern NM.

Although we use probabilistic survey designs such as GRTS or access-constrained approaches in larger parks and more-remote management units, in BAND we can sample all patches comprehensively. The research generally follows methods honed over 24 years (e.g., Beever 1999 through Beever et al. 2016), and adopts methods that are widely used by ecologists. Two surveyors visit each patch 1-3 times, in the first or last 4 hours of daylight. We survey along line transects with paired observers and distance sampling to quantify detectability and minimize the number of pikas that we 'miss', yet also avoid double-counting of pika individuals. Pika sightings, calls, and fresh haypiles denote locations of current pika occurrence, whereas old pika fecal pellets or haypiles denote past pika occupancy. All such locations are recorded with handheld GPS units having accuracy of 3-7 m (WAAS-enabled), and data on vegetation cover, local topography, elevation, and other relevant variables are recorded for each location. We effectively walk elevational contours across each felsenmeer (talus) patch, and use increased density of searches until we find some pika evidence. For patches that are no longer occupied by pikas, we use radiocarbon dating of the old pika fecal (poop) pellets to estimate when pikas last were present in the patch, following methods of Millar et al. (2014). Radiocarbon dating is done by a laboratory collective at Michigan Technological University, which allows for analyses at costs that are less than one-third of the cost, anywhere else (yet having exactly the same precision in results). The ability to be able to simultaneously survey for current and past occupancy of a given mammal species is extremely rare, as is the high detectability (>90% of the time) that American pikas have been shown to exhibit. Identifying which of our competing hypotheses regarding why pika distribution is changing (using information-theoretic approaches) involves using gridded weather-data products (PRISM, SPEI, other drought-relevant metrics), long-term weather stations, and (to quantify pika-relevant conditions down in talus interstices) compact microclimate sensors (see iButtons in Budget).

Other than the radiocarbon-dating analyses that are performed at MTU (as indicated above), no special facilities are needed. Data entry and QA/QC by the field volunteers can occur either in park offices, or at another (remote) location; they will be reviewed electronically by the PI. Field sites are all mapped, in the context of the broader suite of sites for northern New Mexico, at http://caltopo.com/m/PQM6 . Purple outline indicates clearly suitable talus for pikas, whereas yellow borders indicate that patches thusly indicated require in-situ verification to ensure that they are physically suitable for pika occupancy (i.e., rock diameters are generally between 0.2 – 1.0 m, to ensure that there are interstices). For more in-depth details on the field and analytical methods, please see Beever et al. (2010, 2011, 2013, 2016).

(2) CONCISE STATEMENT OF RESEARCH OBJECTIVES, DESIGN, AND METHODOLOGY (Cont'd):

(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 potential extirpation (i.e., local extinction) of species affects many park management decisions. By seeing how pika populations respond to being on the brink of extirpation (Year 1 results documented only 3 individuals in two talus patches), we may gain further knowledge of how and why a species may or may not survive in park landscapes, into the future. This knowledge will help to inform a broad range of management decisions into the future. Using interpretation, the park in turn informs the public so they can be aware of which factors affect survival of a species and the role that humans may play in that outcome. At this point, we don't know if this will be a story of hope or one of caution. It is amazing that pikas have survived in Bandelier to the present, considering landscape-altering fires and overall warming of the continent and pikas' apparently limited ability to adapt to these changes. Our contextualization of pikas' status and trend across northern NM provides a broader, richer understanding that we can use to better inform BAND conservation-management decisions regarding pikas and other conservation-sensitive species.

More-specific examples of how research results from this project inform resource management in BAND include: a) the BAND Superintendent offered to consider defending pika-appropriate talus patches from the effects of prescribed fires (and the consequent loss of herbaceous forage, adjacent to talus edges, in the short term after fires), using park fire crews; b) explicit incorporation of measuring cover of non-native plant species in our surveys, to inform other BAND efforts; and c) testing of the effects of acute-heat stress during summer as a potential mechanism underlying distributional change; among others.

The resulting interpretive product from this research will be a visual display for the visitor center focusing on the life-and-death struggle of these small, very cute and endearing animals. As more data are gathered and the story plays out, the display will be updated. A list of other animals/plants that also are living on the brink within Bandelier, but expanded to include ones that might live in the visitors' backyards, will be incorporated. Also, the park will initiate:

- interpretive programming, both formal and informal, personal and non-personal, about the pika
- plush pikas for sale in the WNPA sales outlet to inform public about ongoing research and to allow for visitors to contribute to continuing study efforts, if part of the proceeds are used towards this research.
- public outreach via a citizen-science projects and programs for both the public to participate in as volunteers and for us to provide information to visitors and surrounding communities.

(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.

Erik Beever is considered an expert on American pikas in western North America. Erik is a research landscape ecologist with the USGS in Bozeman, MT. He has written 32 professional publications on American pikas and mountain environments since 2000. Erik has 24 yrs of experience investigating Ochotona princeps, with data taken from all 10 U.S. states and 2 Canadian provinces within the species' geographic range plus 2.5 years of experience observing O. collaris (the collared pika) in Alaska. Erik was sought as the sole federal scientist (and first choice, among all researchers) to assist the USFWS in informing a judgment on the ESA listing of Ochotona princeps (2008-2010), and provided assistance and professional review of the California DFG's documents for considering species listing (2008-2012). Erik is an invited Member of the World Lagomorph Society (since its inception: 2010 – Present), IUCN Species Survival Commission - Lagomorph Specialist Group, Mountain Research Initiative (2009 – Present), Consortium for Integrated Climate Research in Western Mountains (CIRMOUNT; 2009 – Present), and IUCN Protected Areas Specialist Group (2010 – Present). He also delivered 192 (including 98 invited) technical presentations related to pika research, to local and international audiences, 1995-2018. Importantly for the WNPA research, Erik has worked closely not only with BAND over three years, but also with a broad suite of federal, state, university, and NGO biologists interested in northern New Mexico during that time.

Erik was invited twice to be a part of the NPS' "Pikas in Peril" research project, but his previous USGS supervisor (different position) would not allow his participation. Erik was invited as the keynote speaker for the inaugural North American Pika Consortium conference (2010). Subsequently, he was selected as the Lead of the Research and [Scientific] Review Sub- Committee, for the Consortium.

Erik has worked closely with land managers, conservation practitioners, and diverse interest groups with pikas, contemporary climate change, and other contentious natural-resource issues continuously since 1994 (specifically with pikas: USFWS, USFS, BLM, USDA-NRCS, National Park Service, Fish & Game agencies from several states, numerous conservation NGOs, public-outreach and education groups). Erik has worked with the Associated Press [March 2009, July 2003] and other reporters, columnists, independent writers, outreach staff, and program directors (e.g., of NGOs, institutes, etc.) to describe, interpret, and communicate the results and importance of his research on Ochotona princeps in literally thousands of media outlets (2003–Present). Among numerous others, outlets have included journals Science (NewsFocus; 2004), Nature Climate Change (2011), Frontiers in Ecology and the Environment (2011), BioScience (2004, 2010), Conservation Magazine (2010), newspapers New York Times, Washington Post, Los Angeles Times, The Daily Telegraph [London, UK], The Guardian [London, UK], USA Today, television BBC, ABC News (Nightly News with Charles Gibson), Discovery Channel, Animal Planet, and magazines National Geographic, Outside, Rock and Ice, etc.

Erik has performed WNPA-funded research only in Year 1 of this project, in 2018. In addition, he has received 25 grants totaling $1.86M for research on contemporary climate change, patterns of species vulnerability, and adaptive capacity, 1994 – Present.

Budget for New Research Proposal

Project title and submitting park: Investigation Distribution and Abundance of American Pikas at Bandelier National Monument to Illuminate How and Why Change is Occurring

Personnel

PRINCIPAL INVESTIGATOR(S)	Funds requested from WNPA	Cash or in-kind contribution (Please specify which type and source.)
1 Erik Beever	$2,300	
2		
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 Geoscientist in the Parks Intern or Mosaics in Science Intern	$1,150	
2		
3		
4		
5		
TOTAL PERSONNEL COSTS	$3,450	

EQUIPMENT COSTS (List item and dollar amounts for those items costing more than $100 each on next page.) $1,300

TRAVEL AND SUBSISTENCE (Itemize on next page.) $1700

OTHER COSTS

1 Supplies and material		
2 Consulting services	$1,050 (Pellet dating)	
3 Computer services		
4 Subcontracts (Itemize on next page.)		
TOTAL PERSONNEL COSTS	$4,050	

TOTAL PERSONNEL COSTS $7500
If multiyear project, summarize estimated subsequent year(s) budget(s) on next page.

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

USGS-NOROCK provides no operating expenses to Dr. Beever and because he must also cover 10-20% of his salary for each fiscal year, we have included a modest amount (i.e., one-fourth of the actual time he will dedicate to the project, each year) for his salary. He will organize all research aspects of the project, and will analyze the data, and write or supervise the writing of all peer-reviewed products for the research. He will also travel to BAND each of the project years (the majority of the "TRAVEL AND SUBSISTENCE" funds will be used to cover his travel to and from BAND. We expect 3-6 days of fieldwork in BAND, depending on the caliber, learning curve, and fitness of the volunteers and/or interns.

Erik, who is fluent in Spanish, will also perform the translation of educational materials into Spanish, a commonly spoken language across New Mexico. VIPs and/or interns will assist Dr. Beever in sampling all patches for pika occurrence and abundance, and will enter and double-check all of the field data (templates already exist, to facilitate this). Volunteers/interns will have to prepare for fieldwork by learning the local woody plants and reading several articles about pika biology before-hand, and will be given hands-on training on all the specific field methods, at the start of the field campaign. Sally King will continue to work on interpretive products for the project. For Years 2 (2019) and 3 (2020), Scott McFarland will be the local director of logistics and implementation for the project, and will facilitate all NPS administration of the project funds. Additionally, he will be responsible for recruitment and hiring of volunteers and/or interns. Sally King will also catalyze interest in and distribution of educational materials to a variety of audiences, locally and further afield. Other BAND staff will help in interpretation of the project results by providing feedback and relevant materials that will be useful throughout the project, and especially when we write up educational interpretive materials and peer-reviewed publications.

Equipment Budget: $1,300

Item	Quantity	Cost Per Unit	Total
Rangefinder: Opti-Logic Insight model	2	$325	$650
Compasses: Suunto, MC-2 model)	3	$68	$204
Binocuiars	2	$75	$150
High-intensity (tactical) flashlights	4	$45	$180
Misc. (clipboards, evelopes, tweezers, etc.)	1	$116	$116

Travel and Subsistence: $1,700

Item	Quantity	Cost Per Unit	Total
Erik Beever Travel	1	$1,000	$1,000
Volunteer Per diem ($20 per individual, per day)	35	$20	$700

A special note for researchers and the park superintendent:
WNPA is the funder of this grant on behalf of 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 (e.g., park access, laws, safety, protocols, etc.) and uses of the research, data, and its products (e.g., release of information, publication, intellectual property, etc.) rest in the hands of NPS and are the responsibility of NPS. Researchers and NPS should clarify any questions or assumptions before accepting the grant.
Due to several factors, ALL WNPA grants are for ONE YEAR ONLY (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.

Erik Beever — Signature of Principal Investigator(s) — Date: 31 Aug 2018

Signature of Park Superintendent — Date: 8/30/18

Signature of Chief of Interpretation — Date: 8.31.18

For WNPA Use Only

WNPA Research Committee Review: Action and Date:

Amount Granted:

Progress Report after Year 1 funding for "*Investigating Distribution and Abundance of American Pikas at Bandelier National Monument to Illuminate How and Why Change is Occurring*" project

Year 1 accomplishments:

- ✓ Selection, hiring, and training of four VIPs, to complement efforts of PI in an inexpensive manner
- ✓ Updated online map of talus patches (by adding patches) that exist across NM, at CalTopo.com/m/PQM6
- ✓ Surveyed pikas, other bird and mammal species, and vegetation at 150 talus patches across N. NM
- ✓ Re-surveyed all 19 talus patches in BAND, including 3 patches not previously surveyed
- ✓ Downloaded data from the few already-deployed sensors; deployed microclimate sensor at each patch
- ✓ PI met several times w/ interpretive staff of BAND, to discuss interpretive plans and strategies
- ✓ PI updated text on pika-related pages of Monument's website to reflect project results
- ✓ Re-surveyed 68 patches surveyed in 2016 and/or 2017, to assess effects of this year's severe drought
- ✓ Entered occupancy status (currently, previously, or never) data for all 150 patches; ran patch-level summary analyses; contracted an individual to enter finer-scale data to elucidate mechanisms
- ✓ At patches that were previously pika-occupied but not currently occupied, collected old fecal pellets of pikas, for radiocarbon dating (to estimate how recently each patch lost its pika occupancy)
- ✓ With $10K of non-WNPA funds, PI bought 800-m-resolution, daily PRISM climate data for 1993-2017
- ✓ Pikas in BAND (& also across NM) have been featured in presentations by PI locally (Los Alamos), and at national- and international-level scientific conferences; outreach will continue to expand

Year 1 Results:

- ➢ In BAND, surveys to date show that 18 of the Monument's 19 talus patches unequivocally had pika occupancy, previously (as shown by our encounter of old pika pellets at all 18, & old haypiles at some)
- ➢ Of those 18 patches, only 2 are currently pika-occupied; patterns indicated loss of pikas from 3 patches that were occupied in 2017 (confirmed by multiple surveys), & re-colonization of a patch occupied in 2017 but not in 2016. In 2016, 5 patches were pika-occupied; in 2017, 4 patches were pika-occupied.
- ➢ Abundance of pikas in BAND mirrored declines in patch occupancy by pikas: we detected only 3 pika individuals in 2018, which was down from 5 individuals in 2017 and 7-9 individuals in 2016.
- ➢ Sampling beyond BAND provided a broader context for BAND's results: of the 150 patches surveyed, 58 were currently pika-occupied, 70 were formerly pika-occupied, 19 had no pika evidence whatsoever, and 3 were physically not truly pika habitat (i.e., incorrect rock diameters, no interstices)
- ➢ We detected evidence of *past* pika occupancy down to 2406 m; as of 2018, across all of northern NM, 60.1% of patches at ≤3,105 m with any kind of pika evidence were **not** currently occupied by pikas
- ➢ Across the 68 patches surveyed in 2016, 2017, or both and re-surveyed in 2018, among those that were pika-occupied in previous years, 28.1% switched to having only old pika evidence. In contrast, among patches that had had (in 2016 or 2017) either no evidence or only past pika evidence, pika status changed to currently occupied at only 13.9% of those patches (<1/2 of the percentage).

Late 2017 and early 2018 produced the most-exceptional drought conditions in the USA, across northern NM. Such conditions produced extreme fire risk, which nearly prevented our sampling. Because VIPs' schedules were largely fixed, we performed surveys during 3-23 June 2018. In addition to training 4 VIPs (who hailed from 4 different U.S. states) to full understanding of all field techniques, the PI also trained another 12 citizen scientists, to more fully extend project efforts. Because of the rapidity with which changes in BAND pikas are occurring, we plan to create the 1) glossy, two-page fact sheet and 2) visual display for the VC, after the completion of next year's field sampling (envisioned for June 2019). Much

still remains to be learned, but we are pursuing analyses of ecological water availability as potential drivers of both status and trend, in pika abundance and distribution. For years 2 and 3 of WNPA funding, we will be changing our requested budget to $7,500., to more accurately reflect the costs of accomplishing project goals. Year 1 required significant subsidization of WNPA funds by the PI (hundreds of hours, plus funds noted above) and by the park.