National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Analysis of Proposed Rock Quarrying and Trail Improvement Impacts on American Pikas in Grand Teton National Park

Natural Resource Technical Report NPS/UCBN/NRTR—2013/756

ON THE COVER
Pika in talus near Jenny Lake, Grand Teton National Park
Photograph by Clint Epps

Analysis of Proposed Rock Quarrying and Trail Improvement Impacts on American Pikas in Grand Teton National Park

Natural Resource Technical Report NPS/UCBN/NRTR—2013/756

Clinton W. Epps[1], Donelle Schwalm[1], Jessica Castillo[1], Thomas J. Rodhouse[2], Mackenzie Jeffress[3], and Chris Ray[4]

[1]Oregon State University
Department of Fisheries and Wildlife
Nash Hall Room 104
Corvallis, OR 97331

[2]National Park Service
63059 Deschutes Market Road
Bend, OR 97701

[3]Nevada Department of Wildlife
60 Youth Center Road
Elko, NV 89801

[4]University of Colorado
UCB 334 / EE Biology
Boulder, CO 80309

June 2013

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Technical Report Series is used to disseminate results of scientific studies in the physical, biological, and social sciences for both the advancement of science and the achievement of the National Park Service mission. The series provides contributors with a forum for displaying comprehensive data that are often deleted from journals because of page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from the Upper Columbia Basin Network website (http://www.nature.nps.gov/im/units/ucbn/) and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/nrpm/).

Please cite this publication as:

Epps, C. W., D. Schwalm, J. Castillo, T. J. Rodhouse, M. Jeffress, and C. Ray. 2013. Analysis of proposed rock quarrying and trail improvement impacts on American pikas in Grand Teton National Park. Natural Resource Technical Report NPS/UCBN/NRTR—2013/756. National Park Service, Fort Collins, Colorado.

NPS 136/121238, June 2013

Contents

Figures

Abstract

This brief report provides an assessment of the potential impacts on the American pika (*Ochotona princeps*) population in Grand Teton National Park (GRTE) from a proposed trail improvement and rock removal effort near Jenny Lake. We used data collected in GRTE during 2010-2012 as part of the "Pikas in Peril" research project funded by the National Park Service's climate change response program. The assessment was based on a specific scenario that was under consideration during winter 2012/2013 for removing rock from select locations to the west of Jenny Lake. Our assessment should not be interpreted out of this context, and cannot be used to infer impacts under different scenarios that may evolve over the course of the planning process. Under the proposed scenario, our results do not suggest that the proposed rock removal areas threaten pika populations locally or park-wide. However, they do imply a need for careful monitoring if the quarrying proceeds, given that 1) the impacts of such disturbance on pikas are not well understood; 2) the pikas in the area exhibit a unique genetic signature; 3) the area shows signs of isolation from other pika habitat; and 4) the affected area represents high quality habitat in an important, low elevation setting. We therefore encourage managers to minimize the intensity, duration and area of disturbance. We further recommend that the rate of territory abandonment and changes in population density be tracked as the quarrying proceeds. If feasible, it would also be useful to assess mortality rates during rock removal, as well as patterns of territory reestablishment for surviving pikas. Monitoring of pikas in GRTE using the NPS protocol (Jeffress et al. 2011) that is being used in other parks would provide this information over time. Ideally, pika surveys will be conducted in advance of quarrying to guide the final decisions about where quarrying should occur. Areas of particularly high concentrations of pika activity should be avoided.

Acknowledgments

We thank the staff from Grand Teton for assisting with this project and for providing timely guidance and feedback on the contents of this report. The data used for this assessment were collected as part of the project entitled: Pikas in peril: multiregional vulernability assessment of a climate-sensitive sentinel species. This project was funded by the NPS Climate Change Response Program, PMIS#163377.

Introduction

The Pikas in Peril (PIP) project is dedicated to providing information to aid conservation of American pikas (*Ochotona princeps*) at each of the eight national parks included in the project, including Grand Teton National Park (GRTE; Garrett et al. 2011). In winter 2012/2013, the PIP team was asked to evaluate the potential impacts on the pika population from proposed rock removal areas (hereafter "quarries", although we note these are not large-scale mining operations associated with the typical usage of the term) in the Jenny Lake area of the Park (Figure 1). The potential quarry locations were selected by GRTE after a walk-through survey was conducted to identify areas with relatively low levels of pika activity. The proposed quarries were identified as potential source locations to supply material for trail improvements. Our evaluation was based on the specific configuration of proposed quarries provided to us by Park staff and mapped in Figure 1, and from our assessment of pika occupancy (Jeffress et al. 2013) and our ongoing analysis of genetic diversity, structure, and gene flow within GRTE. Specifically, we investigated 1) the predicted suitability of the habitat likely to be disturbed by quarrying in the context of other habitat at GRTE; 2) the maximum distance at which dispersal among habitat patches is likely to occur; 3) the relative isolation of the affected habitat from other suitable habitat using the maximum dispersal distance to define isolation; and 4) whether pikas in the affected area show any evidence of genetic differentiation from pikas in other areas in GRTE. Note that our assessment was based on the specific scenario of proposed quarries displayed in Figure 1. Our assessment should not be interpreted out of this context, and cannot be used to infer impacts under different scenarios that may evolve over the course of the planning process. This is particularly true for scenarios that involve larger and more disruptive rock removal work.

Methods

Predicted pika occupancy analysis

We conducted pika surveys between late June and early November in 2010 and 2011 at 184 plots placed within suitable pika habitat (largely rock talus) in GRTE using a stratified random sampling design (Figure 1). At each 12-m plot, we assessed pika occupancy based on visual and/or aural detection, and active searching for pika sign (e.g., fresh scat and/or hay piles), and classified the plot as occupied or not occupied based on our observations. Using ArcGIS, we recorded a series of bioclimatic and topographic metrics believed to influence pika survival and population persistence. These included maximum temperature in July (acute heat stress), mean temperature from the warmest 3-month quarter (chronic heat stress), minimum temperature in January (acute cold stress), annual precipitation, elevation, potential insolation (incident solar radiation), and topographic position.

We used the pika occupancy survey results and associated bioclimatic and topographic metrics to model the relationship between climate, topography, and pika occurrence in GRTE (see general methodology reported in Jeffress et al. 2013). We then used this model to generate a map of predicted pika occurrence in GRTE (Figure 1). Here, we used the predicted likelihood of pika occupancy as a measure of habitat quality.

In addition, GRTE's wildlife crew surveyed for pika along the trail on the west side of Jenny Lake on September 13 and 14, 2012. The crew surveyed talus areas within 100 yards of the Jenny Lake trail in the half mile stretch south of the west side boat dock. They searched for and recorded pika and pika sign, including scat piles with over 100 pellets and fresh hay piles. Over 100 locations were identified as containing pika and/or pika sign. The park identified potential quarry locations in areas with relatively little or no pika activity or sign.

Analysis of gene flow, genetic diversity and isolation

We collected 384 pika fecal samples during occupancy surveys (described above) as well as during targeted search efforts. We extracted DNA from the majority of those samples, and successfully genotyped 188 unique individuals at 21 microsatellite loci. We then evaluated genetic diversity, gene flow, and population structure within GRTE. We assessed population structure using a Bayesian clustering analysis implemented in the program STRUCTURE (Pritchard et al. 2000).

Results and Discussion

Preliminary results from this analysis indicate the talus where proposed quarries occur is high quality pika habitat (Figure 1). Where quarrying is proposed, the predicted likelihood of occupancy in any location within suitable talus habitat ranges between 60%-62%, while the maximum value observed anywhere in the park is 74%. The location of the Jenny Lake population is also noteworthy, as it occurs at very low elevation. Our analysis has found elevation to be a major driver of pika habitat quality at GRTE, with the best-quality habitat in this cold and wet park currently occurring at lower elevation (contrary to expectation in other parts of the pika's range, where lower elevation habitats appear more extinction-prone; see Jeffress et al. 2013). However, while the Jenny Lake area does represent high quality habitat, all known potential habitat within a 4-km radius (determined to be the likely maximum dispersal distance of pikas in GRTE; see Figure 3) of the proposed quarries is of comparable suitability. Furthermore, the proposed quarries represent a small proportion of the total known habitat available to pikas locally, and do not appear likely to interrupt population connectivity in the area. Together, these observations imply that the areas where quarrying is proposed do not necessarily represent habitat which is otherwise rare or of unusually high value to the local pika population. Our investigation of climate change impacts on pika in this park (one of the ultimate goals of the Pikas in Peril project) is still underway and cannot yet be used to offer insight here. However, as climate change is expected to influence habitats for most species differently depending on elevation, we urge caution when disturbing these important low-elevation habitats.

Genetic diversity, measured by average allelic richness across microsatellite loci (A) and expected heterozygosity (He), is relatively high in GRTE (A = 9.02, He = 0.72) as compared to two of our other study sites where we have finalized genetic diversity estimates: Crater Lake National Park in the Cascade Range of southern Oregon (A = 5.39, He = 0.54) and the Hart Sheldon National Wildlife Refuge Complex in the Great Basin of Oregon and Nevada (A = 4.42, He = 0.47). The high genetic diversity at GRTE implies that the pika population is large, relatively stable, and well-connected across the park.

We found that individuals from within the area proposed for quarry form a relatively distinct grouping, as compared to the individuals immediately surrounding the area and beyond (Figure 2). This suggests that individuals in this area may be somewhat genetically isolated from the surrounding areas. This is further supported by the presence of two unique microsatellite alleles within this cluster of individuals that are found nowhere else in the park. Microsatellites are neutral genetic markers and are therefore most useful in quantifying relatedness among individuals or groups of individuals and thus revealing patterns of gene flow. Microsatellites used in this analysis cannot provide information pertaining to selection or adaptive significance. Therefore, the presence of unique alleles in this cluster of individuals should only be interpreted as support for the hypothesis that gene flow is somewhat restricted between pikas in the habitats in or near the proposed quarry site and pikas in other parts of the park.

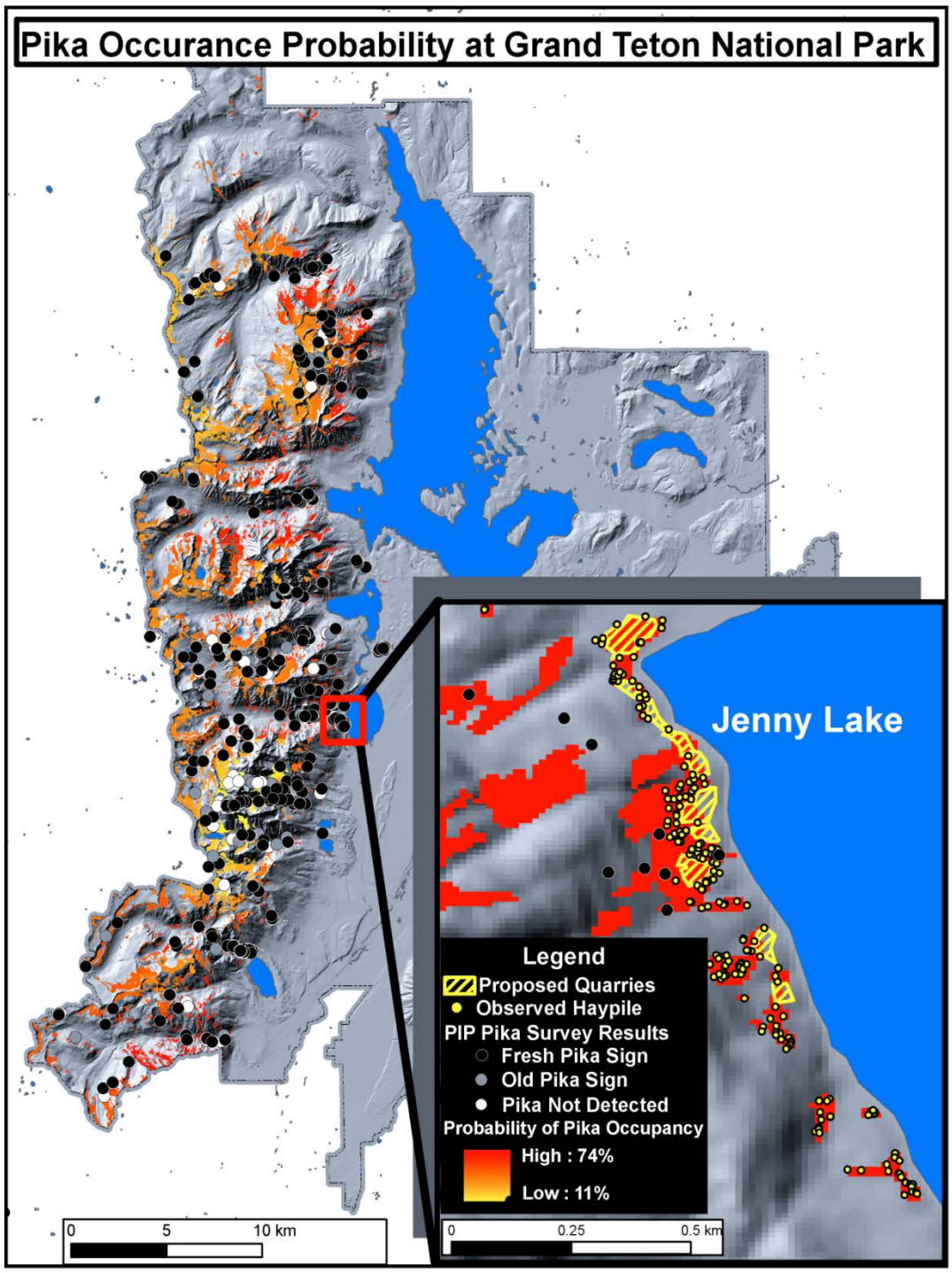

Figure 1. Predicted probability of pika occurrence at Grand Teton National Park. Pika habitat patches along Jenny Lake (inset), which includes portions of the proposed quarries, have some of the highest predicted occupancy values observed in the park.

Across GRTE, when we plotted genetic distance versus geographic distance between individuals, we observed that genetic distance among individuals increased sharply until a distance of approximately 4 km, after which genetic distance reached a plateau (Figure 3). This analysis suggests that pikas rarely disperse beyond that distance, and therefore defines a threshold distance for determining whether particular habitat patches are isolated. Based on this threshold definition, the habitat patches near Jenny Lake where quarrying will occur are not likely to be completely isolated, as there is abundant, high quality pika habitat within 4 km of the affected area. Pika habitat throughout the Teton Range appears to be well-connected, with inter-patch distances commonly < 4 km. However, we know of at least one geographically isolated habitat patch east of the Teton Range near Leigh Lake (Figure 2). This small cluster of individuals also exhibits a unique genetic signature and signs of genetic isolation. The low elevation populations on the eastern slope of the Teton Range may therefore be a source of at least occasional immigrants to the population southeast of Leigh Lake as well as other small, isolated, yet-undiscovered populations.

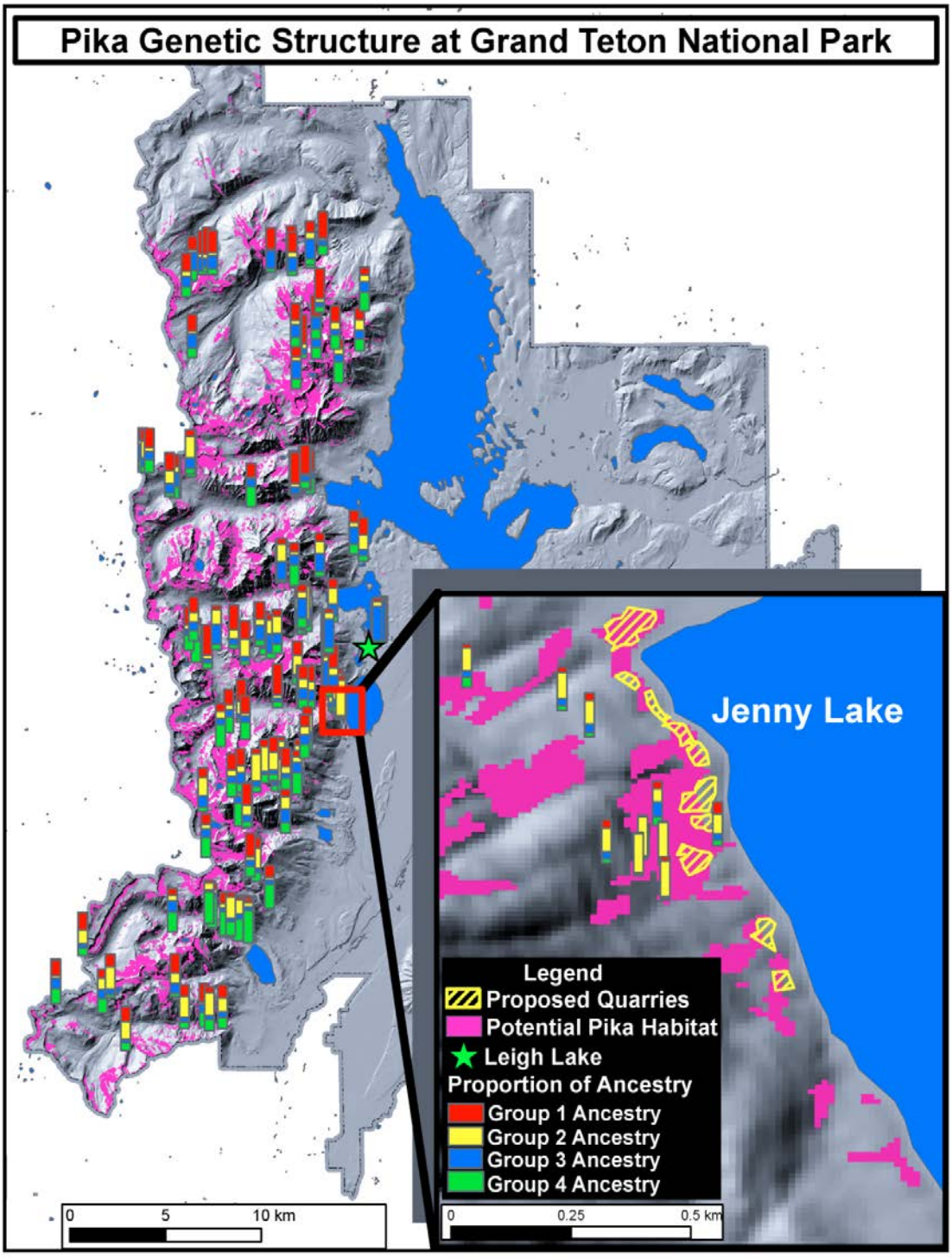

Figure 2. Genetic structure in the pika population at Grand Teton National Park. We observed 4 genetic groups. Individuals with a high proportion of ancestry associated with Group 2, in yellow, are largely associated with pikas in the Jenny Lake area (inset). Likewise, the other three genetic groups are underrepresented within this cluster of individuals. This implies that pika in this area may be isolated. Another nearby population near Leigh Lake that shows even stronger signature of isolation is indicated with a green star.

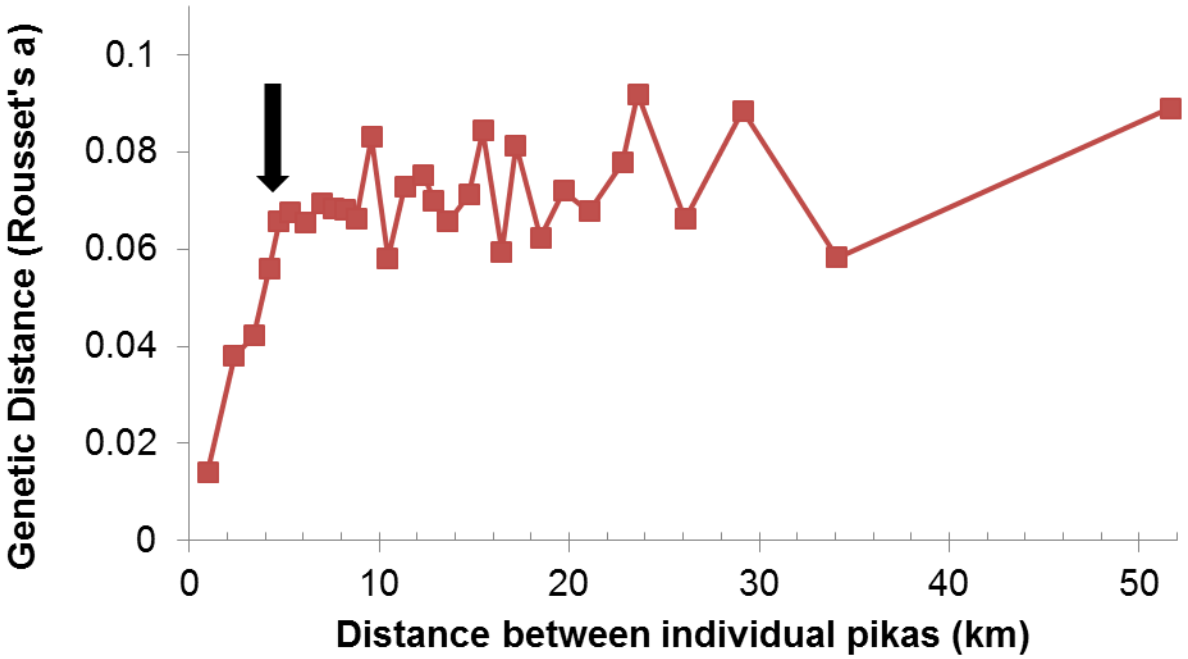

Figure 3. Relationship between genetic distance (Rousset's a) and geographic distance for 188 individual pikas sampled in Grand Teton National Park (analyzed in program SpaGeDi). Each point above represents the averages for all comparisons among individual pikas that fall within a particular distance class (e.g., 0-1.5 km). Genetic distance between individuals is expected to increase with geographic distance until a threshold is reached; that threshold is expected to reflect maximum dispersal distance. Here, genetic distance increased at distances up to ~4 km (black arrow) and then reached a plateau; significant spatial autocorrelation of alleles was detectable only at <4 km. That finding was robust when the analysis was repeated using different-sized distance classes. Thus, ~4 km represents the likely maximum distance that pikas successfully disperse in Grand Teton National Park.

Conclusions

Our results do not suggest that the specific arrangement of proposed quarries provided to us by GRTE staff threaten pika populations locally or park-wide. However, they do imply a need for careful monitoring if the quarrying proceeds, given that 1) the impacts of such disturbance on pikas are not well understood; 2) the pikas in this area exhibit a unique genetic signature; 3) the area shows signs of isolation from other pika habitat; and 4) the affected area represents high quality habitat in an important, low elevation setting. We therefore encourage managers to minimize the intensity, duration and area of disturbance. We further recommend that the rate of territory abandonment and changes in population density be tracked as the quarrying proceeds. If feasible, it would also be useful to assess mortality rates during rock removal, as well as patterns of territory reestablishment for surviving pikas. Monitoring of pikas in GRTE using the NPS protocol (Jeffress et al. 2011) that is being used in other parks would provide this information over time, particularly if additional sample plots were established in the area of interest. Ideally, pika surveys will be conducted in advance of quarrying to guide the final decisions about where quarrying should occur. Areas of particularly high concentrations of pika activity should be avoided.

Literature Cited

Garrett, L., M. R. Jeffress, M. Britten, C. W. Epps, C. Ray, and S. Wolff. 2011. Pikas in peril: multiregional vulnerability assessment of a climate-sensitive sentinel species. Park Science 28:9-13.

Jeffress, M. R., T. J. Rodhouse, C. Ray, S. Wolff, and C. W. Epps. 2013. The idiosyncrasies of place: geographic variation in the climate-distribution relationships of the American pika. Ecological Applications 23: *in press*.

Jeffress, M. R., J. Apel, L. K. Garrett, G. Holm, D. Larson, N. Nordensten, and T. J. Rodhouse. 2011. Monitoring the American pika (Ochotona princeps) in the Pacific West Region - Crater Lake National Park, Craters of the Moon National Monument and Preserve, Lassen Volcanic National Park, and Lava Beds National Monument: Narrative Version 1.0. Natural Resource Report NPS/UCBN/NRR—2011/336. National Park Service, Fort Collins, Colorado.

Pritchard, J. K., M. Stephens, and P. Donnelly. 2000. Inference of population structure using multilocus genotype data. Genetics 155:94-959.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 136/121238, June 2013

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov