3rd North American Pika Conference

Notes from the Working Group Discussions

APRIL 17-18, 2015 ● AMERICAN MOUNTAINEERING CENTER ● GOLDEN, COLORADO

Following are the notes from the various working group sessions. Please contact the working group lead if you would like to be added to a particular working group(s). Also note that both the Population Genetics and the Citizen Science groups have formed their own "Google Groups" that you can join. Information for joining is provided with the groups' discussion notes.

POPULATION GENETICS AND POPULATION GENOMICS WORKING GROUP

(N. American pikas—*O. princeps & O. collaris*)

Lead: Mike Russello, michael.russello@ubc.ca

*Join the Pika Genetics Working Group Forum:
https://groups.google.com/forum/#!forum/pika-genetics (*You must request permission to join the group and once you are a member of the group you can approve others' requests to join.)*

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Knowledge Gaps:
Individual-level

- Inbreeding –
  - What specific genomic regions might be more or less tolerant to inbreeding?
  - Adaptation to climatic factors
  - Inbreeding avoidance

    - Different levels of scale and inbreeding avoidance
    - Mostly we've got a fairly specialized study (Bodie case study), but little idea about rest of range
        - Duplicate study design and mix in NGS
    - Isolation is increasing
    - Quantification of inbreeding
        - Chris Ray's student – looking at the genomics
- Do we know what we think we know about American pika breeding systems? How does this relate to inbreeding
    - Facultatitively monogamous?
    - Mothers and fetuses?
    - Programs like Cervus – Taking advantage of existing resources
- Individual fitness
    - Survival and reproductive success
    - Stress hormones, genomics, and physiology (link between CORT variability and genomic variability)
    - Integrating genetics and physiological considerations for assessing individual fitness

Site Level

- Movement of individuals
    - Are these representative of pikas across their range?
        - We don't know.
        - Considerations on pattern
            - Connectivity patterns among different parts of range?
            - Mary's had a few students
            - IBD across the whole range – Jessica Castillo has some data
                - Some parks with 50 samples
                - Most opportunistically collected
                - Some detailed site-level studies for looking at connectivity
                    - Bodie
                    - Lisel, Matt, North Cascades
                    - BC
                    - Not representative of entire distribution
                    - Crater Lake and Yosemite (Castillo)
- Different levels of resolution
- What are our population boundaries?

Among Site

- Connectivity at different spatial scales (huge focus)
    - Pattern? And Process? Do existing studies reflect habitat connectivity for Pikas
    - What can we infer about underlying mechanisms?
        - Aspect comes out most frequently (Castillo) – always N facing
            - Further priority – bring out mechanistic explanations for connectivity

Need & Objectives:

Phylogeography

- Galbreath work framing major lineages
- Some of range-wide discussion – points outside of major lineages – priority?
- Do we need to refine our phylogeography knowledge with intermediate and novel sites
    - Conservation
- Marginal populations – not a priority for phylogeography, but
- Mind the gap – what's going on in the gap between American Pikas and Collared Pikas
- Ability to detect and use adaptive variation vs. traditional methods
    - Hybridization factor

Responses to Climate Change

- ability for species to adapt in place?
- which regions of the genome are under selection in a warming world?
- how can we study local adaptation using genetic/genomic approaches?
- integrate adaptive genetic variation in to conservation genetic approaches
- Matt: 3 tiers
    - Potential for behavioral modifications and phenotypic plasticity
    - Changes in gene expression
    - Potential for genomic/genetic change

Targeted genes and GWAS (genome-wide association studies) -> standardization

- Genomic assays for comparative purposes
- Standing variation and putatively adaptive -? How to define and is it helpful?

Methodologically – what we know about different loci and/or gene regions

- Model for how sharing and building a network
- Assay samples from different points of range
- Serve as a model for species-specific researchers

Short-term Goals/Tasks:

Comprehensive review – discuss knowledge-wide about what we know. Each study, case-study wise, but in terms of what we know across the range. Review effort to summarize everything together. State of the knowledge and a path forward.

- genetics one stand-alone
- e.g., target *Mammal Review* (?) – how population shrinks or expands over recent years, etc.

Sample Collection protocols (scat, hair, tissue, and blood)

Transplants to improve local diversity and reduce inbreeding (needs?)

- Come up with a statement about how we feel about translocation
- Can we repopulate?
- Great Basin vs. Sierra
- Hybrid fitness?
- Why?

- Levels of isolation, w/in site variation, standing variation, what does identifying putatively adaptive variation at any one site get us? What are we measuring? How can we validate it? How can we use it?
  - Need a clear path forward
- GAP – ability to detect and use adaptive variation to understand population responses

Targeted study on GB subspp. -> assess genetic distinctiveness

- Connectivity patterns in the Great Basin vs. Sierra, etc. (isolation by distance)
  - Site-level vs. representative

Long-term Goals/Tasks:

Where genetics can help? Climate change world? Leading edge, lagging edge? Priorities in the core?

- fill in gaps in leading/lagging edge
- most interesting adaptations at edge
- representative or a relict
- how limited their dispersal is, if there is validity pikas would be ideal to address it?
- Is it worth prioritizing work on one sub-species over another?
  - Great Basin and Sierra Nevada are same sub-species
  - Genetically they're not dissimilar
    - Example for the other sub-species, and how it gives foresight to the ones that are experiencing climate change down the road?
    - Targeted studies for lineage-specific questions
  - ESA decision – great basin not distinct enough? Is this really true?
    - Assess whether GB pikas represent a Distinct Population Segment

Have patterns-do existing studies reflect connectivity (vs. case studies) and mechanisms?

- Uncovering mechanisms of connectivity (landscape-level)

Quantifying the role of drift and selection – drift should greatly outweigh selection

- Look at this in RMNP – where two subspecies come together
  - Different genetic history, same environmental conditions
    - Behavior
    - Physiology
    - Otherwise
      - Challenge – one SSP at N. Boundary and one at S. Boundary
        - Potential different constraints – both at their limits but maybe at different ends of the spectrum.
  - Sample along elevational gradients
    - Factor out phylogeny
    - Determine whether local adaptation is happening
- Net effect of changes in gene expression and multiple mutations across the genome
- Patterns of LD across the genome

Genomics
Important Gaps

- Lack of a reference genome
- Lagomics consortium
    - Big push to get at least one *Ochotona* genome assembled
- Identifying adaptation
- Studying local adaptation
- Full annotated genome
- Gene flow – finer spatial resolution
- New options for analytical approaches
- New approach for inferring N_e from genetic data
    - Thousands of SNPs highly effective estimates
        - Estimate drift across regions
- Temporal component
    - aDNA - valuable contribution. Historical (antique) DNA from populations
    - ancient DNA vs. historic DNA (museum specimen resources)

Phylogenetics

- species delimitation
- loci across and within species (adaptive)

HEALTH AND PHYSIOLOGY WORKING GROUP

Lead: Jennifer Wilkening, jennifer.wilkening@colorado.edu

Participants: Johann Varner, April Craighead, Sara McLaughlin, Carly Wickhem, Chris Ray

Gaps in knowledge
Disease, Stress measurement, Genetic issues related to health and physiology, Winter physiology

Needs and Objectives

- SOP for disposition of dead pikas – necropsy
- Identify labs interested in analyzing the samples already available (Shipley – diet analysis)
- Characterize effect of fiber on GCM for comparison among pops
- Suggest topics and locations where winter physiology could be studied

Short-term goals/tasks

- SOP for disposition of dead pikas – necropsy
- Draft trapping protocol
- Draft sampling protocol – include various genetic and physiological sample handling/prep/storage issues
- GCM sampling and analysis protocol
- GC sampling and analysis protocol
- Send protocols/approvals to Mackenzie for curation

Long-term goals/tasks

- Synthesis paper on physiological study methods and frontiers
- Paper on issues surrounding assisted migration
- Identify labs interested in analyzing samples
- Ensure that physiological data align with available data on covariates

Notes on gaps

Disease: So little is known that It might be most informative to initiate broad studies based on samples collected opportunistically, so our notes focus on ease of acquiring samples and notes on samples already available

- Fleas – need to trap pikas to obtain, because pika "nests" are not accessible; so, not easy for broad studies; however, C Ray has collected a long time-series of fleas in CO and MT, and a ms is in prep (Patrick Foley et al.)
- Ticks – rare on pikas; see Fleas on ease of study; C Ray has collected a few and sent them to Janet Foley's lab for analysis
- Gut microbes – Kevin Kohl is studying DNA extracts from pika caecal feces (contact Jo Varner); other gut gut parasites could be studied using ceacal or fecal pellets which can both be sampled non-invasively; C Ray has many fresh-frozen samples available; if samples cannot be frozen fresh, they can be stored in a vial of "RNA Later" which preserves nucleic acids for about 1 month
- Hanta virus – requires blood sampling; serum/plasma is commonly used for detection of HV; C Ray says contact Rebecca Eisen at Centers for Disease Control in Ft Collins, because it may be possible to detect HV from blotting paper (Nobuto strips) which could be drenched w/blood from a pika's ear where it would bleed after scraping off earmites; still, requires trapping
- Earmites – may carry severl blood pathogens and may also be informative in genetic studies of pika movement; no one has studied these; C Ray has attempted to find someone interested in analyzing her many samples (stored in alcohol and frozen); requires trapping because earmites are sedentary on pikas and cannot be collected from haypiles, etc.
- Blood - Tara Roth, a PhD student in Janet Foley's lab, is analyzing about 2 dozen plasma and whole-blood samples from C Ray's CO and MT collections, to look for several pathogens
- Carcasses – as more groups begin to trap pikas, there will be more mortalities and opportunities for necropsy and other studies; we should suggest a standard operating procedure for submission of carcasses for necropsy and additional analyses, plus eventual distribution to a curated collection
- Captivity – much could be learned from captive individuals; it would be interesting to have a student collate what has been published (including gray lit.) on the varied success of the various pika studies that have involved captivity: someone affiliated w/the Denver Zoo published 2 notes on the poor success of their pika enclosure, the PhD theses of H. Robert Krear (1965) and Denise Dearing (1995) which are both available electronically, publications by MacArthur and Wang (1973, 1974), and someone should interview Preston Somers (C Ray has notes from an interview circa 2010, but more could be learned)

Stress metrics:

- GCM (glucocorticoid metabolites in fecal samples measure "chronic" stress or stress over the last 12-48 hours) – varies w/diet and especially w/fiber in diet; to characterize this might require a feeding trial (cost-benefit not good?); so, GCM is best for longitudinal studies or comparative studies within a region of relatively low variation in available forage
- GC (glucocorticoids like cortisol and corticosterone in blood samples measure "acute" stressors acting 3 minutes to x hours prior to sampling) – can be measured via blood sampling; for other methods, contact Matt Waterson
- Hair – hair samples and be used to isolate stable isotopes of C (identifies whether C3 or C4 plants are dominant in the diet), N (trophic position) and O (water source); later we learned that Matt Waterson is planning a study of corticosterone isolated from hair samples along 2 elevational gradients (C Ray will provide paired hair and fecal samples for validation)
- Scat – GCM should be analyzed more broadly and tracked over time, so we need an SOP for scat collection/storage/analysis; plant DNA could also be isolated from scat, but J Varner tried this with limited success (couldn't amplify moss, but could detect spinach)
- Cytochrome C – variation in this highly conserved protein allows pika populations endemic to higher elevations to tolerate hypoxia, so genetic info on cytochrome C could aid in planning for assisted migration; requires trapping or perhaps hair-snaring if snares can be adapted to pull growing (instead of shed) hairs from the pika (could follicles be obtained from cheek-rub snares?); earlier, Liesl Erb mentioned that carbon monoxide inhibits e-transport chain and may affect ability for pikas to tolerate hypoxia, which might be a problem for pikas even at lower elevations, and S McLaughlin mentioned that NEON has carbon monoxide data;

Winter physiology:
Most selection appears to occur during winter and winter physiology was identified as the biggest gap in our understanding of pika health; not sure to what extent the research of Ed West filled this gap (his dissertation does not appear to address this, but he at one pika symposium or conference he presented a talk on pika physiology that seemed distinct from the work described in his dissertation abstract and quite relevant to pika physiology)
Requires captive studies or (better yet) internal or collar-based data-loggers and perhaps camera or acoustic traps

FIELD METHODS WORKING GROUP

Lead: Mackenzie Jeffress, mrjeffress@ndow.org

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Thanks, Kris, for taking great notes!

Knowledge Gaps:

- Need a website – this will hopefully be addressed by NAPC Steering Team (Embere Hall)
- Standardized protocols (should be on website)
    - Trapping – how to increase success (e.g., pre-baiting, trap placement)
    - Handling – anesthesia (when to use/not use), measurements, samples to take, notes on parasites and disease, how to handle injured animals that need to be euthanized
        - Could work with the Health and Physiology Working Group on many of these aspects
    - Marking – Types of marks used (ear tags, PIT tags?)
    - How to get permits
    - Protocols for describing and quantifying behaviors
    - Additional protocols identified in previous working group meetings include:
        - Temperature sensor deployment and placement
            - Chris Ray has one
        - Anesthesia and handling protocols (cross-listed with pika health working group).
        - Biological sampling collection and storage
            - Fecal sample collection (for genetic analysis) protocol from Jessica Castillo
        - Personnel safety for pika work, a checklist including (where needed) kneepads, rainwear, safety stuff like flashlight/2-way radio/compass, whatever people use in their systems plus things like working with a buddy and safe work on talus
            - NPS has this as an SOP in the Jeffress et al. (2011) Pika Monitoring Protocol
        - Site occupancy surveys using direct and indirect evidence of species presence
            - occupancy surveys at different geographic scales (i.e., one mountain range vs. statewide surveys).
            - Quite a few versions of these out there to grab
        - Mapping talus? Or collecting habitat variables?
            - standardized habitat description protocol – Are we calling the similar habitat types the same thing?
        - Could use a protocol for aging and interpreting sign.

- How to sex a pika?

Needs and Objectives:

- Occupancy survey protocols – what is out there, which aspects are important to keep constant, vs
- Trapping/handling protocols
- Protocols for camera trapping, audio recording
- Protocols for placement of iButtons – depts., etc.

Short-term Goals/Tasks:

1. Trapping, handling, marking protocol document with literature cited
    a. **Cheryl** will start draft – outline, then see who can help with various sections. **Kris** and **Max** have previous pika trapping experience and others in the larger consortium could be asked to contribute
    b. Include tips, pitfalls/problems to avoid
    c. Will initiate with email and if need be, follow-up conference call
    d. **Mackenzie** will put together example trapping and handling protocols from other species
    e. Document could be reviewed and endorsed by the NAPC team
    f. Eventually try to publish – museum or technical report?
2. **All** – keep track of any pika data forms and protocols and send to **Mackenzie** for compiling
        i. This can include videos/YouTube links (sexing video, etc.)
        ii. Also, if possible, include a brief description of the source of the protocol, data form, etc. and who might be the contact for the project
        iii. We should also make sure that the author(s) is/are okay with sharing the document(s) before making available on the web
        iv. Mackenzie will send link for sharing all of this information via Dropbox
3. Identify additional working group members to add. Will plan to start with email but could consider using Google Groups?

Long-term Goals/Tasks:

1. Wish-list: Behavioral observations protocol – **Max** will work on in the meantime
2. Publish the trapping/handling/marking document
3. Maintain these protocols on the website
4. Connect with Health and Physiology on issues like samples to take, parasites, disease
5. How to identify potential habitat via remote sensing

Suggestion made by the larger group at the reporting out: Ask other researchers for their permit and IACUC information.

CLIMATE WORKING GROUP

Lead: Erik Beever, EBeever@usgs.gov

In attendance:

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Anna Chalfoun, U. WY & USGS, AChalfou@uwo.edu
Erik Beever (led the meeting), USGS & MT S.U., EBeever@usgs.gov

Knowledge Gaps:

- To what degree is the rate of change in interstitial refugia decoupled from rate of change in ambient temps, meso-climate, and macroclimate, in different contexts (e.g., shallow talus, deep talus, rock-ice features, moss-covered talus, lava flows, etc.)?
- What's the role of RH in pika distribution, survival, fecundity, etc.?
- Given IACUC realities and restrictions, what designs and experimental approaches can we use to better understand climate-animal relationships, and increase confidence in our conclusions?
- How do we tease apart the contributing roles of all the factors that covary with elevation? I.e., we know that it isn't elevation per se that affects pika distribution and abundance, but to what degree to changes in temperature, RH, precipitation, O_2 concentration, etc. affect those?
- Does the relative importance of certain climatic variables change as elevation increases? I.e., might distribution be locally determined on the lower-elevation boundary of pika occupancy by heat stress, but by cold stress or lack of vegetation at the upper end? If so, does this vary across the species' geographic range?
- What are the fitness implications (e.g., survival, fecundity) of varying climates, and foraging strategies, behavioral plasticity, and other responses to climate variability and change? Unless we understand the fitness implications of these responses, it is difficult to build mechanistic models of climate-wildlife relationships.
- At the tails of temperature histograms at a site over 1 or many years, what is the relative role of reaching the 95th percentile temp vs. the 97th vs. the 99.5th percentile temperature, interstitially? This will obviously change with the magnitude of temperature refugium (i.e., difference between ambient and subsurface temps), but how acute does temperature or drought have to be, to cause pika extirpations … or even declines in abundance?
- Which metrics of climate *variability* are most important for pikas, and within what temporal windows should these be envisioned? This is a real frontier…

Needs and Objectives:

Needs

- LiDAR connections with microclimate data
- More places t correlate gridded datasets with sensor-level data
- In which topographic and climatic contexts can downscaling be most useful?
- In progress (EAB): high-resolution radiant skin temperature matched with sensor data collected every 30 sec

Objectives:

None identified …

Short-term Goals and Tasks:

- Concatenate a general list of where microclimate sensors are located, across the range of *O. princeps*. {*post-hoc Q from Erik B.: does this only include sensors down in the talus?*}
  - Purpose would be to fill information gaps, understand biases in the spatial distribution of sensors, help with linking sensors to gridded climate data, etc.

- Alice Henderson volunteered to create an Excel-based list of sensor networks, perhaps with a GUI interface

Long-term Goals and Tasks:

- Coordinate pika-relevant temperatures with coarser gridded datasets such as PRISM

EDUCATION, OUTREACH & CITIZEN SCIENCE WORKING GROUP

Lead: Johanna Varner, JohannaVarner@gmail.com

*Join the Pika Citizen Science Group Forum: https://groups.google.com/forum/#!forum/pika-cit-sci (*You must request permission to join the group and once you are a member of the group you can approve others' requests to join.)*

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Other members who may still be interested in this subcommittee:
Nifer Wilkening, Lucas Moyer-Horner, Embere Hall, Megan Mueller, Leslie Rodman

Knowledge Gaps (or Challenges) that we identified:

- Areas with high density of citizen science programs are located in places with lots of willing volunteers (e.g., Bozeman, Denver, Portland) and not necessarily in areas with highest conservation priority (e.g., southern Utah, New Mexico, or Great Basin)
- K-12 engagement is often limited by issues of liability and timing of the school year. This also requires a teacher to be a "champion" to help address logistics and maintain enthusiasm in the classroom.
- It can be challenging to connect to audiences that don't already engage with science and nature – how do we reach out to underserved audiences in science? Is this feasible given the geographical and technical realities of pika research?
- There are challenges inherent in engaging volunteers in pika research: e.g., study sites can be difficult to access, need to set realistic expectations for volunteers.

Needs and Objectives of this subcommittee

- FUNDING is a big need – most researchers think of citizen science as "free data", but resources are required to orchestrate and maintain these programs.
    - Coordination capacity is often limited.
- Volunteer dropout rates can be high. How can we maintain volunteer commitment to collecting data, following a training event?
    - We need to create a sense of community among volunteers (via Facebook, blog sites, or sharing of stories).
    - We need to improve and maintain connections between staff and volunteers via follow-up messages and planned events.
- Citizen-generated data can be difficult to analyze:
    - Absence observations are often of lower confidence with citizens.
    - Collection protocols vary across projects, giving rise to data compatibility issues.

Short-term Goals/Tasks

1. Broader impacts examples & templates: Provide other pika researchers with information to include citizen science coordination staff and resources as budget line-items in future grant proposals.
2. Establish a communication option or group for pika citizen science coordinators to share stories and lessons learned, or to pose questions.

Long-term Goals/Tasks

1. Develop an IRB protocol for evaluating the effects of citizen science participation on volunteers themselves
2. Interface with environmental educators to develop assessment tools/instruments that can be used to compare across projects.

DISTRIBUTION AND HABITAT WORKING GROUP

Lead: Kris Ernest?

Knowledge Gaps

- How do the different factors co-vary? Even correlates may vary across scales or the range
- Anthropogenic vs natural habitat: are they equal in utility and in longevity?
- How should species interactions play into distribution models and habitat use?
    - Does predation play a significant role in distribution?
- Effects of habitat on colonization and extinction rates

Needs and Objectives

- identify appropriate climate metrics at different scales
    - across environmental gradients in their range
    - quantify variably important features
- better quantify how pikas use the landscape
    - Esp. those climate and landscape features that drive connectivity
    - need to reframe the "bioclimatic envelope"?
        - what sort of areas can be suitable, even as short-term refuge?

        - may be useful to compare the habitats that we have been calling "unusual"
- Improve/standardize modeling
    - How to use presence vs absence (and/or pseudo-absences)?
        - How can they be used in different types of models?
    - Which predictor variables are best suited to different types of models?
    - which potential suites of models are suited to eg. maxent, max like, SEMs
    - Potential gap in differences for occupancy detection
- develop a method for quantifying interactions with predators, competitors (e.g., woodrats, marmots)
    - must also consider detection probabilities for those species

Short-term goals/Tasks:

- better standardize method for detecting occupancy, new or existing protocols
    - Make note of methods' limitations and under what circumstances each is acceptable
- Share more data on occupancy, maybe fine-scale climate factors
    - Potential issues, obviously
- Encourage interspecific considerations:
    - make a list of species that researchers are making note of in their studies
    - Define key species that are likely to affect pikas or are common across the range

Long-term goals/Tasks:

- Map talus extent over a very large scale (range-wide)
    - Also map alternative (non-talus) habitats and connectivity
- How to model forb:gram ratios across broader scales
- Identify climate metrics at different scales and different places
    - Redefine bioclimatic envelope
    - Prioritize studies

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RESEARCH AND REVIEW WORKING GROUP

Lead: Hayley Lanier? (hlanier@uwyo.edu)

Knowledge Gaps

- Identifying the role of this committee
    - Biggest problem is the overlap – could it be reviewing the protocols of other committees? Reviewing? Standardizing?
    - list of desired protocols (last time)
    - Mapping research efforts?
    - Reviewing protocols
    - Status of research
    - Field method protocol implementation
    - Preparing for other petitions?
- Review – when people come to NAPC and ask about the American Pika, have a committee that knows about what is known
    - Review that request
    - Be the point committee on that

Needs and Objectives

Suggestion:

- goals or suggestions for data collection for future research
- database? collection? Weebly website?
    - Might be useful for looking for volunteers
- General view of the fact that this group wasn't organized, and could be better prepared for the next listing petition.
    - Nifer – FWS has lost the push to consider pika listing
    - If the change in taxonomy, what happens to the listing
    - Point – not a lot of studies?
- Since the listing decision, more is known from the Rockies and across the range
    - more mechanistic understanding of vulnerability over short and medium time scales
    - Genetics – is this a DPS?
    - Remain vigilant and prepare for the potential re-listing of pikas

Short-term Goal/Task

- revised outline from 2010 (update) – 3 month by August 1st
    - update objectives and subheadings
- get a database of different pika studies or projects online
    - in EndNote Online
- revisit whether we can do anything with the sensor data and similar opportunities. How could we combine the knowledge and results from multiple studies without having folks feel concerned about data integrity?

Long-term Goal & Task

- state of the knowledge research paper, or an 'opportunities' paper
    - Nifer is heading up a review paper on what the state of the knowledge is for pikas
    - Key piece is that it's already happening, and a MS is already around, what can be done of added value?
    - Opportunities paper instead of an updated 'what is known'
        - Sections could be identified and written by each committee
        - Capitalize on what's been done in last few years?
        - Enough new information that we can review
            - What does this teach us about this broader phenomena? Not the story of the pika.
            - Is the pika a good model species for particular types of questions?

Two relevant documents (Chris Ray)

NA Pika Research DB
Synthesis Sensor Survey and Call