National Park Service
U.S. Department of the Interior

Natural Resource Program Center

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

Standard Operating Procedures Version 1.0
(Appendix to Narrative Version 1.0)

Natural Resource Report NPS/UCBN/NRR—2011/XXX

ON THE COVER
American pika (*Ochotona princeps*) at Craters of the Moon NM&P
Photograph by: Douglass Owen

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Natural Resource Report NPS/UCBN/NRR—2011/XXX

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January 2011

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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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:

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: Standard operating procedures version 1.0. Natural Resource Report NPS/UCBN/NRR—2011/XXX. National Park Service, Fort Collins, Colorado.

NPS XXXXXX, January 2011

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American Pika Monitoring Protocol

Standard Operating Procedure (SOP) 1: Preparations for the Field Season

Version 1.0, January 2011

Change History

Version #	Date	Revised by	Changes	Justification

Note: This SOP describes the step-by-step procedures for preparing for field work including organization of field equipment prior to the initiation of personnel training and entry into the field. Field time is expensive, both in time and money. Adequate field and equipment preparation is crucial to a successful monitoring program.

Suggested Reading

Kincaid, T., T. Olsen, D. Stevens, C. Platt, D. White, and R. Remington. 2009. *spsurvey*: Spatial survey design and analysis. R package version 2.1. Available from http://www.epa.gov/nheerl/arm/ (accessed 18 November 2010).

Stevens, D. L., and A. R. Olsen. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association 99:262-278.

Theobald, D. M., D. L. Stevens, D. White, N. S. Urquhart, A. R. Olsen, J. B. Norman. 2007. Using GIS to generate spatially-balanced random survey designs for natural resource applications. Environmental Management 40:134-146.

Annual Review

Project Leads, key network and/or park staff should conduct an annual review of the protocol and SOPs prior to spring preparations. This is a central element to season close-out procedures. Review should include training and field procedures, recruitment of participating field surveyors, data management, analysis, and reporting, as well as fundamental design issues. Most importantly, careful consideration should be made of the resulting analyses and the overall confidence in results. The adequacy of sampling effort must be evaluated. Any necessary changes should be made to the protocol and SOPs with enough time to circulate updated material to key staff.

Review the List of Spatially-Balanced Sampling Locations

Important Note: Pika sampling locations have been drawn using the Generalized Random Tessellation Stratified (GRTS) spatially-balanced sampling algorithm (Stevens and Olsen 2004, Theobald et al. 2007, Kincaid et al. 2009). In order for the spatial balance of the sample to be maintained, the suite of sites included in the sample must follow the GRTS ordered list provided as output (sites can be moved slightly, or offset, in the field if necessary, as is described in SOP # 4 of this protocol). SOP # 8 provides an example table of GRTS locations, IDs, and inclusion probabilities. To view the maps and coordinates of sampling locations, which are stored as shapefiles, use the Network pika project GIS. The *spsurvey* package (Kincaid et al. 2009, available online at http://www.epa.gov/nheerl/arm/ or http://www.R-project.org) in the R statistical software and environment (version 2.11.0, 2010; R Development Core team, Vienna, Austria, available on-line at http://www.R-project.org) was used to generate GRTS sampling locations. Example R code for drawing GRTS samples is available from the network pika project directory (see SOP # 5 for directory structure and on the CD version of this protocol).

The list of sample sites should be reviewed ahead of the field work to ensure that an adequate number of sites are scheduled for each stratum and that plenty of oversamples are available for when site replacement is necessary. Given that sites are permanent, we expect the frequency of site replacement to decrease substantially after the first 2 years of implementation. However, given that sample frames may be adjusted or desired sample sizes may change, this review should occur before every sampling season. It is important to track the evaluation of each site and any sampling frame change so that inclusion probabilities can be recalculated to support the use of design-based status estimators and properly weighted trend analyses.

Scheduling and Organizing Field Work

Due to financial and logistical constraints, this protocol was created to allow for a great deal of flexibility in scheduling and requires nominal time of few staff members. Additionally, the use of Student Conservation Association (SCA) interns, volunteers and citizen scientists for field data collection is encouraged. The field work schedule should be created in late winter/early spring. The Project Lead will coordinate this planning, including reservation of lodging and/or camp sites (if necessary) for the park’s field crew. A minimum of two people working for 4 weeks (plus 2 weeks for training and data entry) each sampling season must be available in order to complete the field data collection in one park. The field surveyors will be provided with the following information:

- A paper map displaying the sites to be surveyed (see SOP # 8 for an example).
- List of Easting and Northing coordinates for each survey site (see SOP # 8 for an example).

- GPS units loaded with the survey site coordinates.
- Field data collection sheets (see SOP # 8).

Equipment List and Preparation

The following equipment should be assembled each spring, and sufficient time must be allowed to order replacement equipment. Much of the miscellaneous equipment is optional and may need to be provided by the surveyor. The amounts of individual items required are not included here, as they may change according to the number of field surveyors available.

Navigation, Observation, and Recording Equipment

- GPS unit pre-loaded with survey site location waypoints
- Spare batteries for the GPS unit
- Survey data sheets (SOP # 8)
- Vegetation cover estimation sheets (SOP # 8)
- Maps and list of survey site locations (examples in SOP # 8)
- Park map
- Backup copies of data entry forms
- Mechanical pencils and clip boards
- Two 25-m or 50-m (or 100’) measuring tapes
- Write-on aluminum tree tags (site markers)
- Extra bailing wire
- Wire cutters
- Camera with extra battery
- Compass

Miscellaneous Equipment

- Leather gloves
- Headlamp or flashlight
- Daypack
- Sunscreen, hat
- Water bottles, food
- First aid kits
- 2-way handheld radios and spare radio batteries
- Digital camera
- Hand sanitizer

Preparation of Navigation and Observation Equipment

1) Charge all GPS units and cameras prior to departure for the field. Carry backup batteries for the electronics during field work.

2) Paper data sheets should be prepared and printed on to Rite-in-the-Rain paper if rain is likely to occur. Extra copies of the field data sheets should also be provided.

3) Prepare a realistic schedule of events in advance of survey crew arrival and circulate this schedule to all participants ahead of time to manage expectations and ensure timely arrival.

4) Apply for a research permit (http://science.nature.nps.gov/research/ac/ResearchIndex) well ahead of the field season, as early as February/March.
    a. By March, the Project Lead also needs to complete a wilderness Minimum Requirement Analysis (MRA) for any surveys conducted in proposed or designated wilderness in LAVO.

5) If participants are off-site, arrange with the park staff for crew arrival and housing during field season.

6) Safety is an important but easily overlooked consideration. The safety plan and Job Hazard Analysis (SOP # 7) should be reviewed before the field crew begins field work. Make sure all surveyors know where vehicle keys are to be stored during field operations, the location of the nearest pay phone and/or cellular phone coverage opportunity, and emergency contact and operation procedures for the park.

7) Hard copies of all field-relevant SOPs and survey site location maps should be prepared and made available to the surveyors for the duration of the survey period.

Post-field Season Care of Navigation and Observation Equipment
After the field season, clean and organize all non-electronic equipment and store in well-labeled plastic bins in the designated area (i.e., UCBN office for CRMO or Park Resource Manager's office for CLRA, LABE, and LAVO). Remove batteries from GPS units requiring long-term winter storage.

American Pika Monitoring Protocol

Standard Operating Procedure (SOP) 2: Training Observers

Version 1.0, January 2011

Change History

Version #	Date	Revised by	Changes	Justification

Note: This SOP describes the step-by-step procedures for organizing and training field personnel.

Suggested Reading

Elbroch, M. 2003. Mammal tracks and sign: A guide to North American species. Stackpole Books. Mechanicsburg, PA.

Morrison, S. F., and D. S. Hik. 2008. When? Where? And for how long? Census design considerations for an alpine lagomorph, the collared pika (*Ochotona collaris*). Pages 103-113 *in* P. C. Alves, N. Ferrand, and K. Hacklander, editors. Lagomorph Biology: Evolution, Ecology, and Conservation. Springer-Verlag, Berlin.

Smith, A. T., and M. L. Weston. 1990. *Ochotona princeps*. Mammalian Species 352:1-8.

Introduction

This SOP describes the training of the field crew prior to field surveys including overview of field data collection, data recording, and the importance of correct identification of pikas and their sign.

Procedures

Each field survey team should be provided with a complete set of observation equipment, a hard copy of each of the relevant field SOPs for reference during training and field operations, a hard copy map of the park as well as map indicating the sites to be surveyed (see SOP # 8). A park may be interested in the collection of additional information (e.g., scat samples for genetic analysis, evidence of other species, incidental pika sightings) during pika surveys. If this is the case, these details should be discussed during training and any additional supplies and training should be provided at this time.

Equipment Operation

Operation of GPS units is outlined in SOP # 3.

Measuring and Recording Site Characteristics

Vegetation cover will be visually estimated and recorded in percent of the total 12-m radius circle for each of six habitat categories: rock (including all lava), bare ground (including dirt, litter, and dead and down vegetation), forb (all non-graminoid flowering herbaceous plants), grass (graminoids [grasses and sedges]), shrubs (woody plants), and trees. Cover estimates within each category will not exceed 100% but total estimates summed across all categories may exceed 100%. Table 1 presents the modified Daubenmire cover classes to be used for each category. Modification was done so that the sparsely vegetated pika habitat could be more appropriately characterized. Crews should be reminded to carefully mark “T”s and “1”s as they could be misread and that 100% should only be used for sites completely composed of rock.

Table 1. Daubenmire’s cover classes (modified with ‘trace’ and ‘100%’ classes added) used for estimating vegetation cover in 12-m radius circular plots surrounding pika sample point centers.

Cover Class	Range	Midpoint
0	0%	0%
T	Trace <1%	0.5%
1	<5%	2.5%
2	5-25%	15%
3	25-50%	37.5%
4	50-75%	62.5%
5	75-95%	85%
6	95-100%	97.5%
7	100%	100%

The recommended steps for estimating cover visually are as follows:

1) First, select one of the indicators for estimation; usually it is best to select one of the indicators which have obvious and fairly high cover values. For pika surveys, this is most often rock. It is also helpful, especially for tree cover, to estimate the cover by imagining that one is looking down on the plot from above.

2) Decide whether cover is > or <50% cover.

3) If cover is less than 50%, then determine whether cover is > or <25%. If cover is > 25% then the cover rank is 3.

4) If cover is <25% then determine whether cover is >5% or <5%. If cover is >5% then cover rank is 2.

5) If cover is <5%, then determine whether cover is >1% or <1%. If cover is >1% then cover rank is 1.

6) If cover is <1%, then determine whether the cover is present at all. If it is present, the rank is T (trace). If not present, the rank is 0.

7) In a similar fashion, if cover is >50%, keep splitting between the largest next cover division until a rank is assigned.

8) The visual cover estimation guide (SOP # 8) also can be used to aid cover class determination.

Field Operations

1) The Project Lead will be in charge of training surveyors, coordinating survey efforts and collecting completed data forms each day. This person should be available to troubleshoot and reassign new equipment as needed.

2) Definitions for key field terms are presented in Table 2 and should be reviewed during training.

3) Training can be accomplished in one day. The survey crew should be assembled at the beginning for a review of concepts and techniques. Basic pika and pika sign identification should be reviewed as well as identification of other similar species, either by using real examples (if available) or by using a field guide. Furthermore, the crew should review proper GPS, camera, and compass use, habitat measurements, and data recording procedures.

4) Following group introductory material, surveyors should practice locating survey sites with GPSs and maps. The field crew should practice making observations and performing data entry. To facilitate this, extra field data entry sheets should be made available and training should occur where there is ample opportunity for pika detections (at non-survey sites only).

5) The field crew should also calibrate estimates of vegetation cover (see above). Repeatability is an important issue and needs to be assessed throughout the field season. Evaluation of repeatability should be done as part of the training and calibration in cover estimation.

6) Once this portion of training is complete, reassemble into the full group and review questions and concerns. Each surveyor must be comfortable and confident in the methods.

Table 2. Important field definitions for monitoring pikas.

Term	Definition
Aural Detection	Observer heard a pika call.
Scat	Animal excrement (see description and photos for further details).
Haypile	Cuttings of forbs, shrubs, grass, or other vegetation piled near or within a rock cavity by a pika. Used as a winter food source.
Target Population	Strictly speaking, the target population to which we desire to make inference to is the population of available pika habitat (lava, talus) in parks. We then make inferences about the proportion of habitat occupied by pikas, a fundamental attribute of park pika populations.
Sampling Frame	The physical (mapped) representation of the target population. This is always imperfect and sampling frame errors and procedures for addressing them must be addressed in training.

Pika and Pika Sign Identification

From: Smith and Weston (1990), Elbroch (2003), and C. Ray (University of Colorado – Boulder, Research Associate, pers. comm, 2010)

Physical *(see Figure 1)*

- Weight: 121-176 g
- Length: 162 – 216 mm
  - Pikas range (juvenile to adult) from the size of a golfball to the size of a softball
- Grayish to cinnamon-brown, often richly colored with tawny or ochraceous highlights (pelage color can vary with subspecies and season)
- Ears notably circular in outline
- No external (visible) tail
- Egg-shaped body
- Slight sexual dimorphism (only visible in hand)

Call (*sound clip of a pika call can be found at http://www.cmiae.org/Resources/trek-pika.php and will be provided on the CD copy of this protocol*)

- Short call
  - May be an alarm call to alert others of predators or a territory defense call
  - Alarm calls are generally repetitive short calls
- Long call or song
  - Given during the breeding season only by males
  - Staccato and nearly continuous string of chirps lasting several seconds, usually followed by one or more short calls
- Note: Call dialects may vary by region so it is important for observers to be familiar with pika calls at the park(s) they are working in

Scat

- Used for marking purposes
- Often found near entrances to rock cavities with regular urine stains
- 2-3 mm in diameter (roughly the size of peppercorns)
- 2 forms:
  1. Fecal pellets: Very small round pellets (see Figures 2, 4, and 5)
  2. Caecal scat: Initially a soft, dark green to black scat (toothpaste like) but quickly dries hard; less common (see Figure 6)
- *Fresh fecal pellets:* dark brown in color, may contain green plant material when opened, often stuck together in small mounds by dried urine and mucus (Figure 2, 4, and 6)
- *Old fecal pellets:* grey, dry, and scattered (Figure 5)

Haypiles *(see Figures 1-3)*

- Composed of clippings of shrubs, forbs, grasses and other vegetation
- Fresh haypiles typically have green (chlorophyll) remaining in plant matter
  - May contain small woody debris but may be distinguished from woodrat middens by the lack of sticks larger in diameter than a pencil
- Old haypiles will have only brown, "weathered" plant matter

Similar species present within the parks (see Elbroch 2003 for further details and pictures):

- Bushy-tailed woodrats (*Neotoma cinerea*) are common in CRLA, CRMO, LABE, and LAVO (LABE also has Dusky-footed woodrat). Woodrats are larger (250-600 g) than pika with a flat, bushy tail and white around the feet. Woodrats also have a more elongated face and body than a pika. Woodrat scat can be found in the same location as pika scat but can be differentiated because it is tubular and larger (3-5 mm in diameter, 8-16 mm long) than pika scat.
- Pygmy rabbits (*Brachylagus idahoensis*) are uncommon in CRMO and not present in the other parks. Being found often in sagebrush stands with friable soil, pygmy rabbits usually occupy different habitat than pikas. Physically, pygmy rabbits are larger (246-462 g) than pikas with elongated ears rather than circular. Pygmy rabbit pellets are slightly larger (3-7 mm in diameter; more "pea"-sized) than pika pellets ("peppercorn"-sized) and though they are more rounded they appear slightly squashed (not perfectly round), and tend to be concentrated near burrow entrances (which are often holes in soil).
- Mountain cottontails (*Sylvilagus nuttallii*) are common in CRLA, CRMO, LABE, and LAVO. Mountain cottontails are much larger (700-1200 g) than pikas and have elongated ears.
- Yellow-bellied marmots (*Marmot flaviventris*) look nothing like a pika but have a similar call and scat can be found in similar areas. However, yellow-bellied marmots have much larger and elongated scat than pika scat.

Figure 1. Photo of a pika above a fresh haypile (Note: Haypiles may not always be this obvious).

Figure 2. Photo of fresh pika scat (and urine) and an old haypile with some new material added (Note: this would be ranked as a “fresh haypile” because of the new material).

Figure 3. Photo of an old pika haypile.

Figure 4. Photo of fresh pika scat (<8 days old).

Figure 5. Photo of old pika scat (exact age unknown). Note one large cottontail fecal pellet has also been deposited, and is circled.

Figure 6. Fresh pika scat in the less-solid, black form. This type of scat is rarely encountered.

American Pika Monitoring Protocol

Standard Operating Procedure (SOP) 3: Finding GPS Waypoints

Version 1.0, January 2011

Change History

Version #	Date	Revised by	Changes	Justification

Note: The purpose of this SOP is to describe the procedures necessary to navigate to sampling locations using GPS units, particularly the Garmin Map 76CSx. Information on GPS specifications and settings are also included. This SOP is not intended as a substitute user's guide for GPS units. Please consult the appropriate user's guide for more detailed information on unit functionality.

Suggested Reading

Garmin. 2005. GPSMAP 76CSx Owner's Manual. Garmin International, Olathe, KS. Available online at http://www.garmin.com/products/manual.jsp?product=010-00469-00

Introduction

The purpose of this SOP is to describe the procedures necessary to navigate to waypoints using GPS units, particularly Garmin Map 76CSx. Information on GPS specifications and settings are also included. This is not intended as a substitute user's guide for GPS units. Please consult the appropriate user's guide for more detailed information on unit functionality.

The following flowchart provides a general overview of steps addressed in this SOP:

Pre-Field

1. Using Trimble's Preplanning Software
2. Setting GPS Specifications
3. Loading waypoints

↓

In the Field

4. Monitor settings
5. Selecting and navigating to a waypoint

↓

Post-Field

6. Deleting unnecessary waypoints. Because survey sites are permanent in the pika protocol, there is usually no need to delete waypoints – simply leave them for next sampling period.

Before the Field

Preparation is key to successful field work, particularly when that field work relies on GPS data collection or navigation. The baseline GPS constellation consists of 24 satellites that orbit the earth approximately every 12 hours. The position and time signals transmitted by these satellites are used by GPS receivers to triangulate a location on Earth. While this process is subject to various sources of error, pre-planning can minimize the impacts.

Using Trimble's Preplanning Software

Trimble offers a free stand-alone program that determines visibility for GPS, GLONASS, and WAAS satellites. The software can be downloaded from http://www.trimble.com/planningsoftware.html. Make sure to also download the Ephemeris file (current.ssf).

1) Use the Station Editor to select the location, date, and time of data collection (Figure 7).

2) Import current .ssf file and check the satellite information. Select those satellites of interest. Default is all.

3) Create graphs.

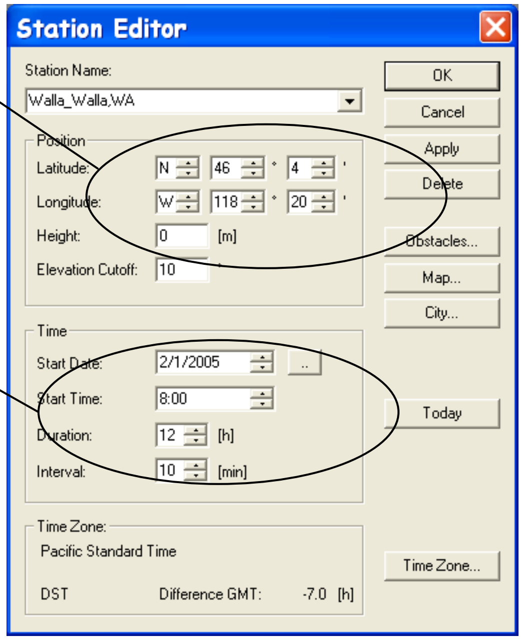

Figure 7. Station Editor in Trimble's preplanning software highlighting position and time.

As long as it doesn't compromise the best times to determine productivity, look for the time of day when the most satellites are available and the PDOP (Position Dilution of Precision) is lowest. PDOP is the measurement of error introduced by satellite orientation or geometry and can be easily minimized through the timing of field data collection.

Setting GPS Specifications

Verify Time: Time synchronization of the GPS receiver and GPS satellites is critical for the most accurate data collection and navigation. With Garmin MAP76CSx, use the Time Setup Menu to set the time format, zone, and to conform to Daylight Savings Time.

Verify Projection and Datum: All GPS positioning information is referenced to the North American Datum (NAD83). In the case of pika monitoring, select UTM Zone 10 NAD83 for CRLA, LABE, and LAVO and UTM Zone 12 NAD83 for CRMO. With Garmin MAP76CSx, use the Units Setup Menu to select the position format and map datum.

Enable WAAS: Enabling WAAS (Wide Area Augmentation System) allows for real-time correction of GPS coordinates as long as the WAAS satellites are in view. Due to the fixed position of these satellites over the equator, signal reception is best in open areas with a clear view of the southern sky, and at times, sampling under a heavy conifer canopy can be problematic. With Garmin MAP76CSx, use the System Setup Menu to enable WAAS.

Calibrate the Compass: The internal compass in the Garmin MAP76CSx should be calibrated prior to each use for increased accuracy in navigation. Use the Calibration Setup Menu to calibrate the compass. Follow the directions on screen.

Batteries: Fully charge the batteries and remember to take spares! The Garmin Map76 units tend to fail on battery power quickly and without warning.

Loading Waypoints: Obtain the latest shape or dBase file for survey locations from the UCBN or Access database. Uploading these locations to the Garmin Map76CSx as waypoints is simplified by using DNRGarmin, a freeware program developed and maintained by the Minnesota Department of Natural Resources. The program can be downloaded from http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html. The site has information on the application, including installation guidelines and documentation.

To upload waypoints to the Garmin Map76CSx, connect the GPS unit to the PC and open DNRGarmin. DNRGarmin should display your GPS unit and say connect. If it does not, go to GPS and open port.

Use the File Menu to set the correct projection (i.e., Zone 10 for CRLA, LABE, and LAVO and Zone 12 for CRMO points; all with the datum as NAD83; Figure 8, left). Next go to load data in the File Menu and select your shapefile or dBase file of interest. You can delete and or edit points, add comments, etc., if necessary (Figure 8, right). Use the GPS Menu to open the port to the GPS unit. Then, use the Waypoint Menu to upload the points to the GPS unit.

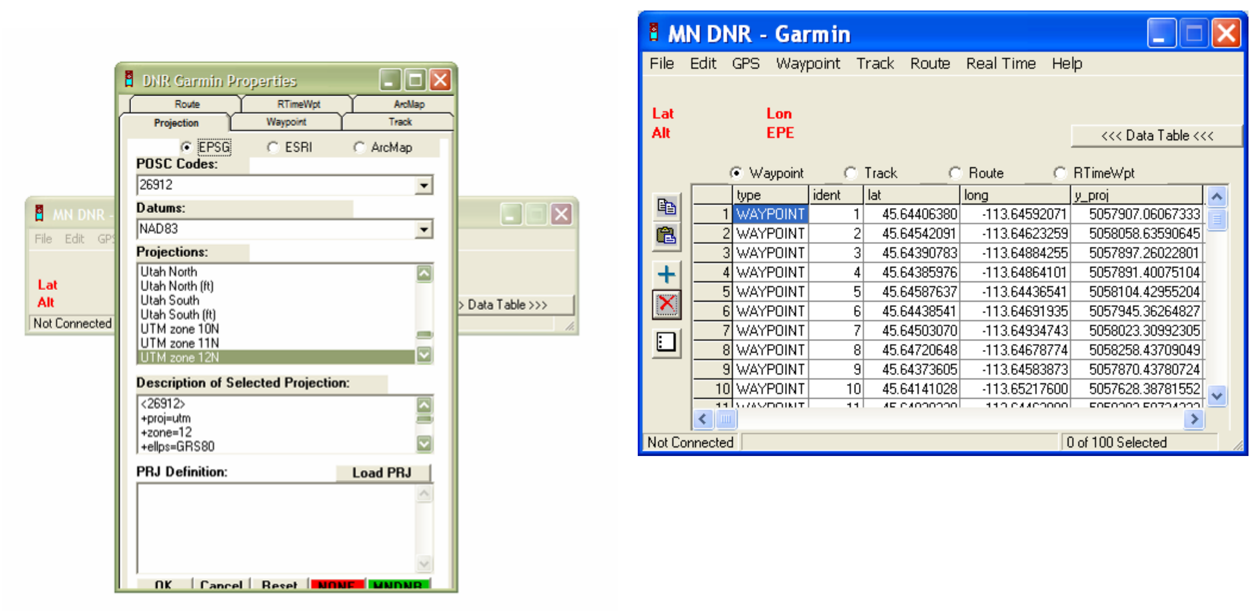

Figure 8. Screenshot from DNRGarmin used to set the correct map projection (left). Screenshot from DNRGarmin used to view and upload selected waypoints (right).

In the Field

Monitor Location Error

Ideally, you would be able to set thresholds for the maximum PDOP allowed and the minimum number of satellites. While you cannot set these values in the Garmin MAP76CSx, you can monitor the satellite strength and relative location error on the Satellite Main Page (Figure 9).

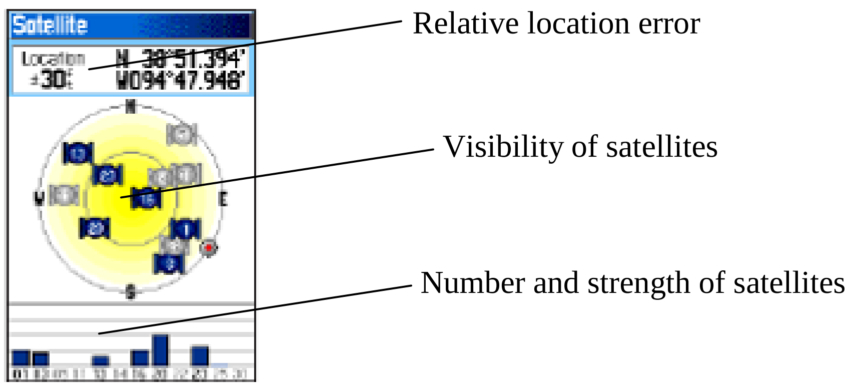

Figure 9. Satellite main page of Garmin unit.

These values should all be monitored frequently during data collection and navigation. The maximum relative location error allowed should be set prior to beginning field work. For the pika monitoring protocol, the maximum location error allowed is 5 m. If a GPS unit is used that allows for user-defined PDOP thresholds, the maximum should be set at 6.

Selecting and Navigating to Waypoints

With Garmin Map76CSx, use the Find Menu to search for a waypoint of interest. Select 'Find by Name' and scroll to the point ID of interest. Conversely, you can select the waypoints icon and scroll to the Point ID of interest. Paper maps will also be provided to aid in locating sites.

Once selected, the items information page for the waypoint opens, allowing you to show the item on the map (by selecting Map) or create a route to the point (select GoTo). Select GoTo to navigate to the point. You can use the 'Page' button to switch through various pages, select the Compass page and, holding the GPS level, walk in the direction indicted by the compass until the 'Dist to Dest' window reads zero (Figure 10).

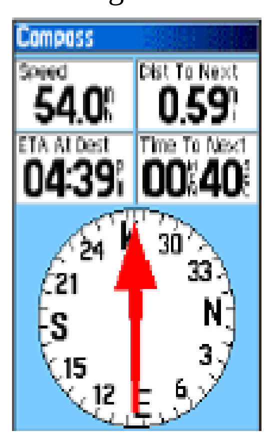

Figure 10. Compass page of Garmin unit.

After the Field

Delete Waypoints (if desired)

In the case of pika monitoring it is not necessary to delete waypoints that are stored on the GPS unit because site locations are permanent and will be re-visited during the next sampling season. If you need to delete temporary waypoints from the GPS unit, go to the Find Waypoints page, select Menu – Delete – All waypoints. Remove batteries from units before any long-term winter storage to prevent corrosion and leakage.

American Pika Monitoring Protocol

Standard Operating Procedure (SOP) 4: Locating, Establishing, and Surveying Sites

Version 1.0, January 2011

Change History

Version #	Date	Revised by	Changes	Justification

Note: This SOP describes the step-by-step procedures for locating, establishing, and conducting surveys for purposes of long-term monitoring of pika.

Introduction

This SOP begins by providing general locations and driving directions to the four parks. This information will be useful for the UCBN crew traveling to CRMO and for the arrival of any new field crew members to the individual parks. It also gives step-by-step directions on how to locate, set-up, and collect data at a survey site.

Driving Directions

Park visits by outside personnel (e.g., UCBN staff) should always begin at the headquarters unless otherwise arranged with park staff. If necessary, arrangements for park lodging or camping must be made with park staff. Check-in with park staff is essential before accessing the park to begin work and should be done daily when feasible. There are challenges to driving and accessing areas of these parks and these should be considered before each field season.

CRLA

CRLA is located in southern Oregon (Figure 11). The park can be accessed from the north (coming from Roseburg or Bend) via Route 138. The west entrance can be accessed from Medford by traveling north and east on Route 62, while the south entrance (from Klamath Falls) can be reached via Route 97 north to Route 62 traveling north and west.

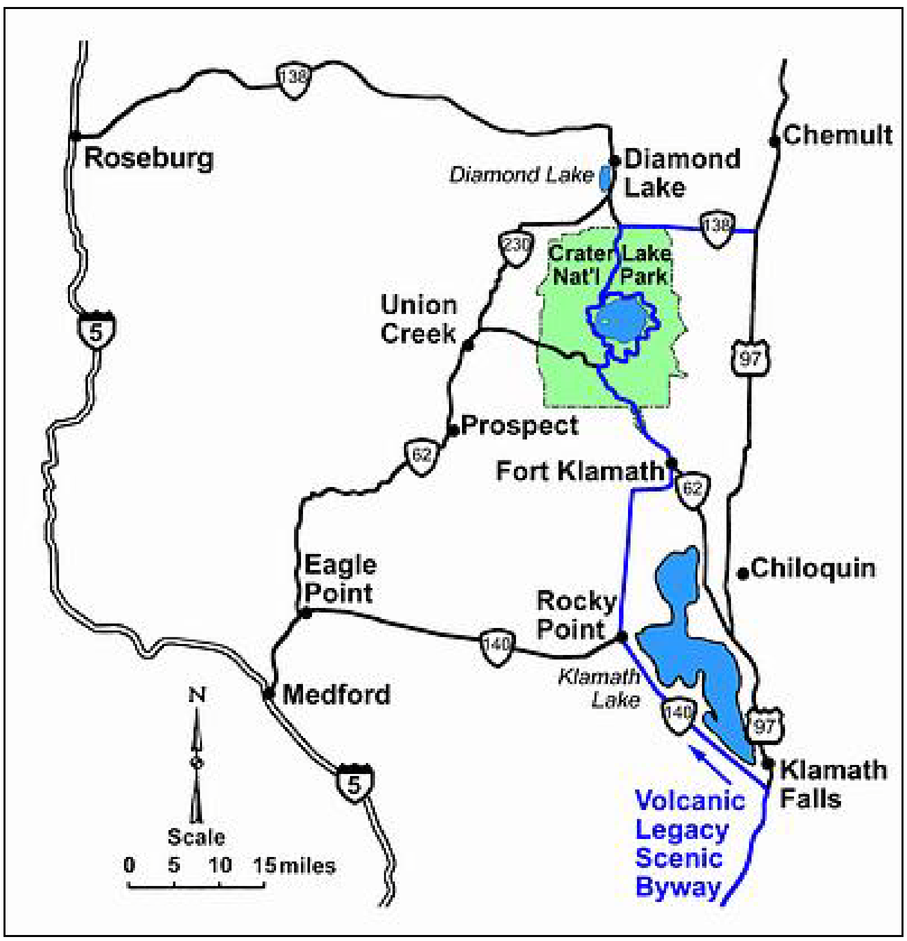

Figure 11. Location of Crater Lake National Park in southern Oregon.

CRMO

CRMO is a vast park that spans over 500,000 acres between Highway 93 and the Snake River north of Interstate 86. The park headquarters is located along Highway 93 on the north end of the Monument and Preserve, approximately 30 miles northeast of Carey, Idaho, and 18 miles west of Arco, Idaho (Figure 12). The majority of sampling sites are accessed off of Highway 93 and from the park loop road which begins and ends at the visitor center. However, the eastern area of the sampling frame is accessed from the Minidoka-Arco Road, which is undeveloped and requires backcountry preparation. All travel on to backcountry roads should be conducted only after making contact with park resource management staff and receiving adequate training and debriefing. Vehicle breakdowns, wildfire risk, and inclement weather all need to be accounted for, with appropriate equipment accompanying the field vehicle at all times.

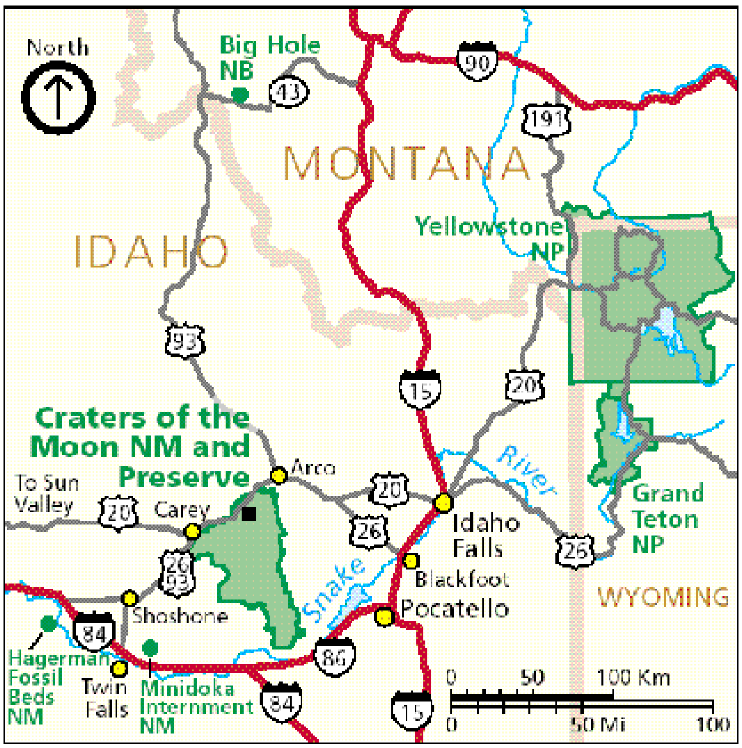

Figure 12. Location of Craters of the Moon National Monument and Preserve in eastern Idaho.

LABE

LABE is located in northeastern California (Figure 13). To access the monument from I-5, take U.S. 97 north at Weed and then turn right on California Hwy. 161, also known as Stateline Road, as shown by large signs. Travel east on CA 161 through the Lower Klamath National Wildlife Refuge to Hill Road. Turn right on Hill Road at the Westside Market, following Monument signs. Travel south on Hill Road approximately 10 miles until you enter the Monument. To access from the north (Klamath Falls area), take Oregon Hwy. 39 south approximately 20 miles until it enters the town of Merrill, OR. Approximately one mile south of Merrill, turn right (south) on Malone Road. Travel south on Malone Road approximately 2 miles until you reach Stateline Road 161. Then follow the same directions as above. Finally, for those traveling east on California Hwy. 299 from Redding or Lassen National Volcanic Park, turn north at Bieber on

Hackamore / Lookout Road to California Hwy. 139. Travel north on CA 139 until meeting directional signs that will direct you to the Monument at a left turn. Please note, the south entrance into the park is paved, but in very poor repair. Drive slowly and carefully around the potholes.

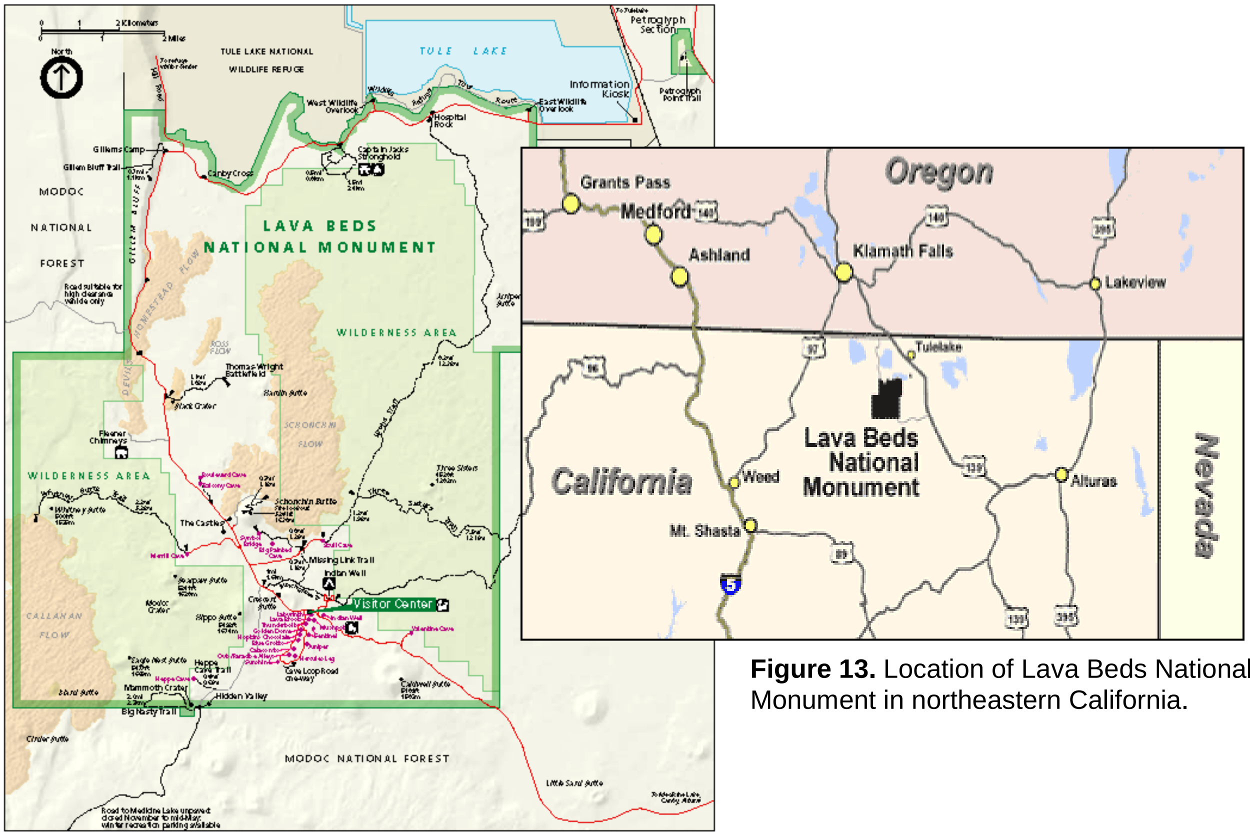

Figure 13. Location of Lava Beds National Monument in northeastern California.

LAVO

LAVO is located in northeastern California (Figure 14). The park is located approximately 50 miles east of Redding, 45 miles east of Red Bluff, and 180 miles west of Reno. There are five separate entrances to the park, and one Main Park Road which runs North-South through the park.

The northwest entrance (Manzanita Lake) can be accessed via east-west Highway 44. The northeast entrance to Butte Lake is a dirt road off of Highway 44 east of Old Station. The southeast entrance to Juniper Lake is a partially paved road north of Chester off Highway 36. The southcentral entrance to Warner Valley is a partially paved road north of Chester off Highway 36 (follow the signs to Drakesbad Guest Ranch). The other main entrance from the Southwest can be accessed via east-west Highway 36. The Main Park Road, which is called Highway 89 outside of the park boundary, runs between the Northwest (Manzanita Lake) park entrance and the Southwest park entrance.

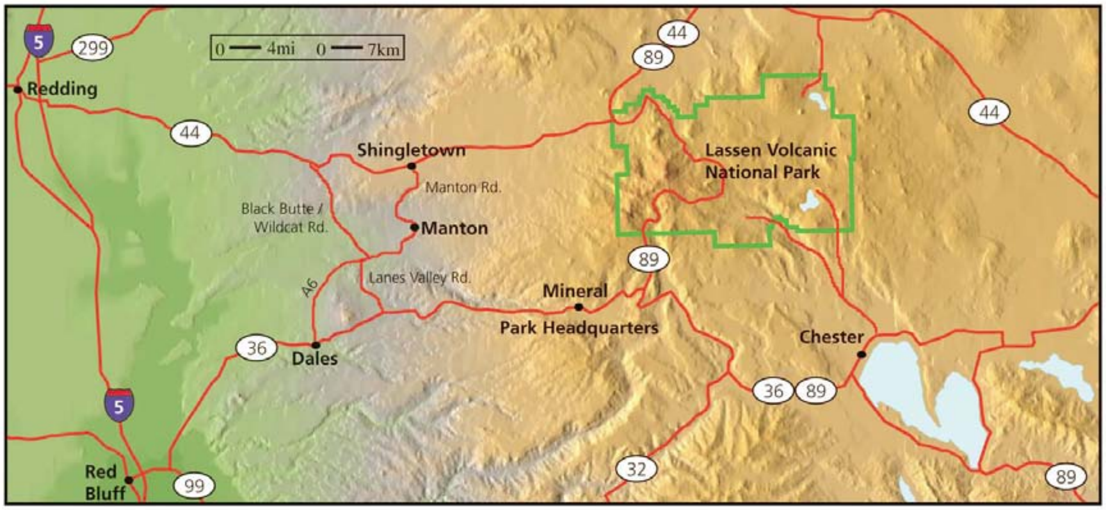

Figure 14. Location of Lassen Volcanic National Park in California.

Procedures for Locating Survey Sites

1) Prior to entry into the field, survey points should be organized into routes for each field survey team. For example, if two survey teams are available for sampling, points should be organized into efficient clusters of 8-10 such that one cluster can be completed in one day by one team. Plans for rugged areas with extensive travel should include fewer sites surveyed per day. Follow SOP # 3 "Finding GPS Waypoints" for instructions on pre-loading sampling point coordinates for field navigation.

2) Arrange a debriefing meeting with the Project Lead and park points-of-contact, such as the park chief of resources or resource biologist. Review the survey plan and discuss daily schedules and check-in/check-out procedures. Discuss safety and any emerging concerns, such as inclement weather, road conditions, and fire hazards.
   a. Also, don't forget to clean vehicles, boots, and clothing of weeds before heading into a new park area.

3) To locate a survey site, go through the steps outlined in SOP # 3 "Finding GPS Waypoints" to initiate navigation to a waypoint. Ensure that you are navigating to the correct point, according to the Site ID #.
   a. For first time surveyed sites (without a site marker): Once the GPS unit registers "zero" distance to the waypoint or otherwise indicates the point has been reached exactly, stop immediately and establish the site center. The navigators need to ignore any possible sign of pika activity and rely on the GPS unit in order to eliminate selection bias.
   b. For established sites (with a site marker): Navigate to the waypoint and once the GPS unit registers within 5 m of the waypoint, begin to look for the site marker. Use directions from previous surveys to hone in on the marker. If after 10 minutes the marker cannot be found, use the above procedure for first time surveys to

establish a new site center. Make note of the new marker placement on the data form.

4) Once the site center has been established, lay-out 24 m for both measuring tapes in opposite directions with the 12-m marks placed on the waypoint location (site center). This will establish the search area for the 12-m radius plot (Figure 15).

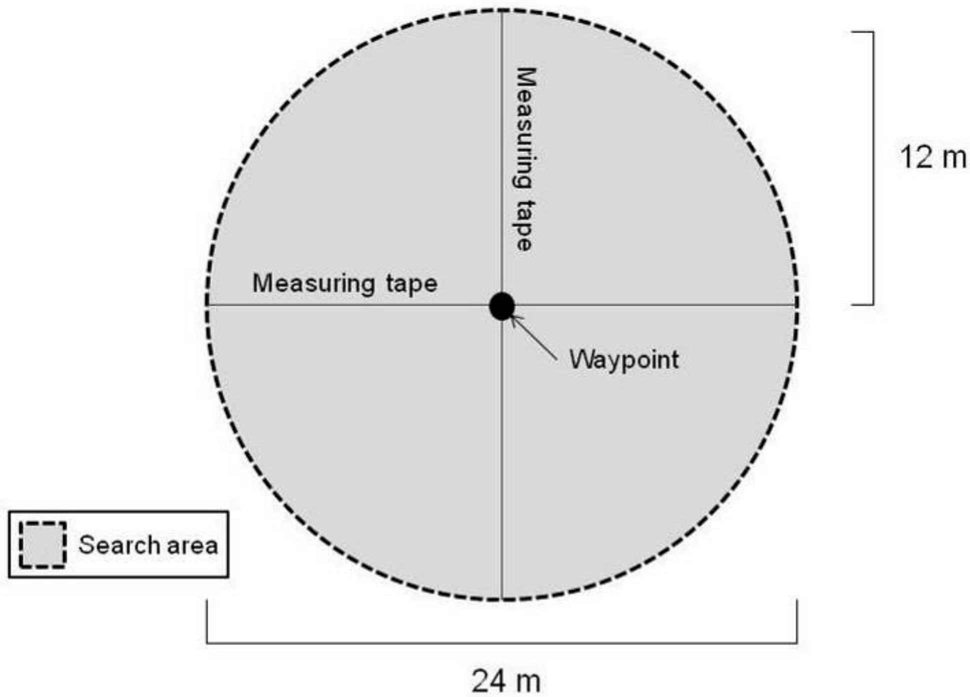

Figure 15. Diagram of the 12-m radius plot setup used for pika monitoring.

Site Add/Move/Drop Procedure

Refer to the following checklist below for determining whether a survey site should be dropped. If a site meets one or more of these criteria, it should be dropped and replaced with the next oversample in the oversample list.

Rejection criteria:

- Outside park boundary
- Dangerous/prohibitively difficult to work on (e.g., slope >35°)
- On road or trail
- The site contains < 10% target habitat. Target habitat includes talus, lava, outcrops or other forms of creviced rock that can provide shelter for pikas. Note that scree or collections of small rocks (< 6 inches across) do not provide sufficient shelter for pikas. If the proportion of target habitat within the site can be increased to ≥10% by moving the site <25 m, see "Moving a site" (below).
- Other circumstances – detail this in the notes of the data form

Moving a site:

- If a site contains <10% target habitat, it should be offset or dropped. Target habitat is defined as any rocky substrate with a fractured surface (i.e., talus, lava, outcrops or other forms of creviced rock that can provide shelter for pikas). For example, a slope of scree with small rock (the kind of slope that is hard to walk up because it keeps sliding out; < 6 inches across) is not target habitat.
- Move the site center a random distance (1-25 m; ≤2x site radius) in a random direction (azimuth) if sufficient target habitat is available in all directions from the site center (see SOP # 8 for a random distance and azimuth sheet). If target habitat is not available in all distances/directions, try each distance and azimuth combo in order on the list until one of the directions contains target habitat.
- Document the procedure in the notes field, beginning with "offset" so that the notes field can be queried from the database and be sure to record the new site center coordinates in the notes field.
- If sufficient habitat (insufficient = <10% target habitat) is not available within 25 m in any direction, the site must be dropped, and replaced from the oversample list. Document drops with the first word "drop" in the notes field on the data form and enter this into the database to enable queries.

In order to maintain the desirable properties of the GRTS sample (e.g., spatial balance, valid inclusion probabilities), sites need to be included in the sample in the same order as it is presented in the GRTS table (see SOP # 8, Table 6 for an example). The points are also given a site ID as a feature of the GRTS function output in R, and the ID order should be followed. Therefore, if a site is inaccessible, then it should be dropped and the next site in that stratum on the list from the oversample should be used. For example if a Panel 1 site from stratum 1 is dropped and no oversamples from stratum 1 have yet been surveyed, then the first oversample from stratum 1 on the list should be used as the replacement. Anticipate that some sites will be dropped, particularly during the first two years of implementation when sampling frame errors have not been entirely resolved. Allow time at the end of each survey period to pick up replacement points. Because of the GRTS spatially-balanced design, replacement points will not necessarily be near dropped sites. Over time, some replacement sites will be necessary, and a larger sample size may become desirable and achievable, in which case the same strict order should be followed.

Data Collection

1) Once the site is established, the surveyors should record the Site ID, observer names, arrival time, and date on the data form (SOP # 8). Any mistakes on the data form should be crossed out, rather than erased.

2) The surveyors should then sit quietly, looking and listening for pikas within the plot for 2 minutes. Once this is complete, the surveyors can begin the search for evidence of pika activity. The surveyors should start their searches at opposite edges of the plot, avoiding being upslope of each other, working toward the other end. When the survey is complete, both surveyors should have each searched the entire plot. Surveys should not end until both observers have looked under every big surface rock (>0.5 m in largest dimension) or large crevice within the site, which usually takes anywhere from 15-35 minutes,

depending on the complexity of the structure at the site. This will involve kneeling down and looking underneath ledges and in crevices. Therefore, leather gloves are strongly encouraged and a flashlight can be used to look in dark crevices. All evidence of pika activity encountered (including the time, type, and distance to site center) should be recorded and any questions of sign age should be answered collectively as a team. Only detections that the observers can confidently identify as pika should be recorded so as to minimize the probability of false presences. Special attention should be given to aural detections to ensure that they were made within the plot. Given the nature of occupancy modeling, it is important to err on the side of caution to avoid false positive detections. IF a call is heard near the boundary of the plot and it cannot be ascertained positively that it was within the plot, a determination should be made that it is outside the plot.

3) Once the search is complete, the surveyors should record the "stop search time" and collectively estimate vegetation cover. Care should be taken to fill in any missing fields in the data form. If no pika sign was encountered, then a line should be place through the detection table on the data form.

    a. If this is the first time the site has been surveyed or if the site marker is missing the site center will need to be marked (see "Marking Sites").

4) The surveyors should then take at least two photos at every site. For each photo, the observers should record the camera number/ID, the photo name/number assigned by the camera, the distance from site center, and the azimuth to site center.

    a. A photo of the site center should be taken that allows an unobstructed view of the tag and a roughly 5-m area around the tag.
    b. 1-2 photos of each site should be taken from a distance or vantage outside the site toward site center that will provide a good visual record of the site, its habitat features, and any conspicuous features that may assist with relocation in the future.
    c. Photos can be difficult to manage so field crew leaders must make sure to stay organized. Initial file names (i.e., photo number assigned by the camera) should be recorded on the data form in the field and the final file name (Park code_Plot ID_Photo number) recorded on the form when renamed and entered into the database. Photos should be downloaded and renamed on a daily basis.

5) The surveyors should then double-check data entry before moving on to the next site.

Marking Sites

Each site will be marked with aluminum tree tags (such as those found at www.nationalband.com/) and photographed to assist in future relocation (Figure 16).

The tag should include the following information:

- Site ID
- Date
- "NPS PIKA PROJECT: PLEASE DO NOT REMOVE"

Tree tags should be wired to rocks and placed as close to site center as possible. Additional bailing wire may be used to allow the tag to be secured to a rock located at site center. If no suitable rock is available, place a rock at site center and secure the tag with wire. Tags may also be hung between rocks when necessary. If a park does not want the markers to be visible, the marker may be offset from site center. If this is the case, be sure to note this and the distance/direction to site center on the data form. In areas of high human use or sites located near trails, place the tag so it is out of sight from the trail (e.g., hang it in a rock crevice or facing away from the area of human activity). If a tree tag from a previously marked site is missing, a new marker will need to be set.

Figure 16. Image of aluminum tree tag markers (left) and a marker placed at a pika survey site (right).

- On the data sheet, include a brief description of the site and site center. Describe any trees, vegetation, or other identifying markers in the site and their distance and direction from site center. Remember that the sites will be revisited in the future so a good description of the site will be useful for relocation.

American Pika Monitoring Protocol

Standard Operating Procedure (SOP) 5: Data Management

Version 1.0, January 2011

Change History

Version #	Date	Revised by	Changes	Justification

Note: This SOP provides documentation for the pika monitoring database and provides instructions for the development, maintenance, archiving, and distribution of the database or datasets. It also includes instructions for backing up field data to project PCs and, eventually, to the working project database.

Suggested Reading

Dicus, G. H., and L. K. Garrett. 2008. Upper Columbia Basin Network data management plan. Natural Resource Report NPS/UCBN/NRR-2007/020. National Park Service, Ft. Collins, CO.

Garrett, L. K., T. J. Rodhouse, G. H. Dicus, C. C. Caudill, and M. R. Shardlow. 2007. Upper Columbia Basin Network vital signs monitoring plan. Natural Resource Report NPS/UCBN/NRR—2007/002. National Park Service, Fort Collins, CO.

National Park Service. 2007. Natural Resource Database Template Version 3.2 documentation. Natural Resource Program Center, Office of Inventory, Monitoring, and Evaluation, Fort Collins, CO.

Database Model

The pika protocol database has been developed within Microsoft Access. The database structure conforms to the standards of version 3.2 of the Natural Resource Database Template (NRDT), and consists of a user interface front-end (holding user forms for data import, entry, review, and export) that is linked to a back-end database file (holding the core pika data tables). The general data management strategy will employ both a "working copy" of the database (used to import/enter the current season's data, then conduct error-checking and validation) and a "master version" of the database (used to store all validated data, to facilitate multi-year analyses, and to provide specific data report and export formats). The pika protocol database can also be depicted as a physical data model of linked core data tables, lookup tables, and cross reference tables (Figure 17).

The primary core tables in the pika database are the tbl_Locations and tbl_Events tables and two plot data tables (tbl_EvData_PlotObs and tbl_EvData_PlotDetection). These core tables are supported by a set of lookup tables that hold codes and definitions (e.g., pika detection codes and percent cover classes for vegetation types). The locations table stores the unique physical location information for each pika sampling site, and includes measurements of elevation, slope, and aspect derived from 10-meter digital elevation models (DEMs) analyzed using ArcGIS software (ESRI, Inc., www.esri.com). The events table, storing information about sampling visits to a given site, links to all involved field observers (via the xref_Events_Contacts table) and to all of the sampling data (via the tbl_EvData_PlotObs,and tbl_EvData_PlotDetection tables). The protocol version in use at the time of data collection is linked to tbl_Events through use of a tlu_Protocol_Ver lookup table, and revisions to the pika protocol database will be captured in two metadata tables, tbl_Db_Meta and tbl_Db_Revisions.

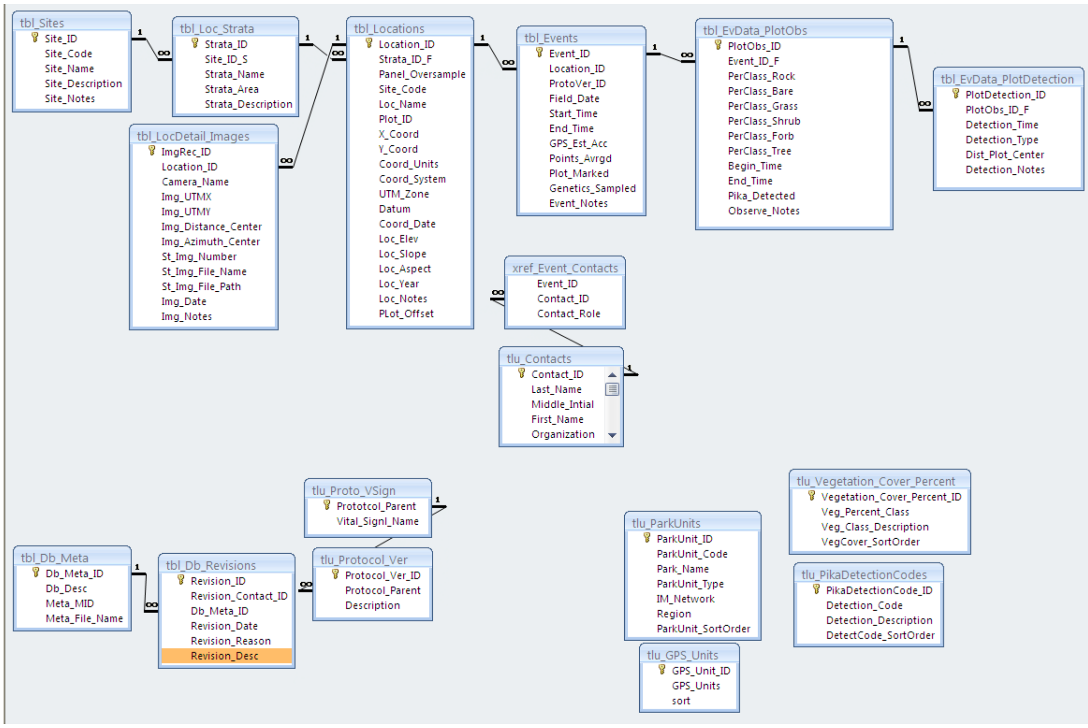

Figure 17. The pika monitoring protocol database model.

Database Dictionary

The following data dictionary provides a table description for every table contained in the pika protocol database back-end file, and, for each table, provides each field name, the field type, the field size, and the field description.

Table: tbl_Sites

Description: Table stores descriptive data for Sites. Sites are the delineated Sample Frames in which pika monitoring occurs. Linked 1:Many to tbl_Loc_Strata.

Field Name	Field Type	Size	Field Description
Site_ID	ReplicationID	16	Primary key, uniquely identifying each tbl_Sites record
Site_Code	Text	12	Park unit code (Park or Park sub-unit, from tlu_ParkUnits)
Site_Name	Text	70	Unique name for a site (constructed from UnitCode and SampleFrame)
Site_Description	Text	255	Description for a site, if applicable
Site_Notes	Text	255	General notes on the site, if applicable

Table: tbl_Loc_Strata

Description: Table stores descriptive data for sampling Strata within Sites (Sample Frames). Linked 1:Many to tbl_Locations.

Field Name	Field Type	Size	Field Description
Strata_ID	ReplicationID	16	Primary key, uniquely identifying each tbl_Loc_Strata record
Site_ID_S	ReplicationID	16	Link to tbl_Sites (foreign key)
Strata_Name	Text	70	Unique name for a strata (constructed from SiteID and StrataName)
Strata_Area	Single	8	Area (meters squared) covered by the strata
Strata_Notes	Text	255	General notes on the strata, if applicable

Table: tbl_Locations

Description: Table stores sampling Location data. Locations are plots sampled for pika evidence. Linked 1:Many to tbl_Events, and 1:Many to tbl_LocDetail_Images.

Field Name	Field Type	Size	Field Description
Location_ID	ReplicationID	16	Primary key, uniquely identifying each tbl_Locations record
Strata_ID_F	ReplicationID	16	Link to tbl_Loc_Strata (foreign key)
Panel_Oversample	Text	50	Indicates whether Plot is considered a primary (Panel) sampling site or a secondary (Oversample) site
Site_Code	Text	12	Park unit code (Park or Park sub-unit, from tlu_ParkUnits)
Loc_Name	Text	50	Unique name for the Location (constructed from SiteID, PlotID, and Year of sampling)
Plot_ID	Text	12	Plot number (created when plots drawn in GIS)
X_Coord	Double	8	X coordinate of Plot
Y_Coord	Double	8	Y coordinate of Plot

Coord_Units	Text	10	Coordinate distance units (e.g., meters)
Coord_System	Text	50	Coordinate system
UTM_Zone	Text	50	UTM Zone
Datum	Text	50	Datum of mapping ellipsoid
Coord_Date	Date/Time	10	Date of Plot coordinates creation (within GIS)
Loc_Elev	Single	8	Elevation of Plot location (from GIS, using DEM)
Loc_Slope	Single	8	Slope at Plot location (from GIS, using DEM)
Loc_Aspect	Single	8	Aspect at Plot location (from GIS, using DEM)
Loc_Year	Long Integer	4	Year that Plot was created (drawn within GIS)
Loc_Notes	Text	255	General notes on the location, if applicable
Plot_Offset	Text	255	Notes regarding offset of Plot location, if applicable

Table: tbl_LocDetail_Images

Description: Table stores data for photos of Plots. Linked Many:1 to tbl_Locations.

Field Name	Field Type	Size	Field Description
ImgRec_ID	ReplicationID	16	Primary key, uniquely identifying each tbl_LocDetail_Images record
Location_ID	ReplicationID	16	Link to tbl_Locations (foreign key)
Camera_Name	Text	150	Name of contact person taking image
Img_UTMX	Double	8	X coordinate of image location
Img_UTMY	Double	8	Y coordinate of image location
Img_Distance_Center	Single	8	Distance (meters) of image location from Plot center
Img_Azimuth_Center	Single	8	Azimuth (degrees) from image location to Plot center
Img_Number	Text	150	Photo Number, if applicable
Img_File_Name	Text	255	Name of Image file (e.g., LocName_Date with Date in yyyymmdd format).
Img_File_Path	Text	255	File location Path of Image file
Img_Date	Date/Time	10	Date on which Photo taken
Img_Notes	Text	255	Notes regarding Photo, if applicable

Table: tbl_Events

Description: Table stores sampling Event data. Linked Many:1 to tbl_Locations, and linked to the field data tables (tbl_EvData_PlotObs, tbl_EvData_PlotDetection, and tbl_PlotObsData_Other_Species).

Field Name	Field Type	Size	Field Description
Event_ID	ReplicationID	16	Primary key, uniquely identifying each tbl_Events record
Location_ID	ReplicationID	16	Link to tbl_Locations (foreign key)
ProtoVer_ID	Text	10	Link to tlu_Protocol_Ver (indicates the Protocol version in use at time of Event)
Field_Date	Date/Time	10	Date of sampling Event
Start_Time	Date/Time	6	Start time (24 hour format) of sampling Event

End_Time	Date/Time	6	End time (24 hour format) of sampling Event
GPS_Est_Acc	Text	150	Estimated accuracy of field GPS location
Points_Avrgd	Yes/No	4	GPS point averaging used in field (Yes/No)
Plot_Marked	Yes/No	4	Plot marked during this Event (Yes/No)
Event_Notes	Text	255	Event notes (Plot-specific notes recorded during Event)

Table: xref_Event_Contacts

Description: Cross-reference table between tbl_Events and tlu_Contacts, allowing one or more contact persons to be associated with a given sampling Event.

Field Name	Field Type	Size	Field Description
Event_ID	ReplicationID	16	Link to tbl_Events
Contact_ID	ReplicationID	16	Link to tlu_Contacts
Contact_Role	Text	50	The contact's role in collection of field data

Table: tbl_EvData_PlotObs

Description: Table stores plot observation data. Uses cover class codes from tlu_Vegetation_Cover_Percent. Linked Many:1 to tbl_Events.

Field Name	Field Type	Size	Field Description
PlotObs_ID	ReplicationID	16	Primary key, uniquely identifying each tbl_EvData_PlotObs record
Event_ID_F	ReplicationID	16	Link to tbl_Events (foreign key)
PerClass_Rock	Single	8	Percent cover class (from tlu_Vegetation_Cover_Percent) for rock
PerClass_Bare	Single	8	Percent cover class (from tlu_Vegetation_Cover_Percent) for bare ground
PerClass_Grass	Single	8	Percent cover class (from tlu_Vegetation_Cover_Percent) for grasses
PerClass_Shrub	Single	8	Percent cover class (from tlu_Vegetation_Cover_Percent) for shrubs
PerClass_Forb	Single	8	Percent cover class (from tlu_Vegetation_Cover_Percent) for forbs
PerClass_Tree	Single	8	Percent cover class (from tlu_Vegetation_Cover_Percent) for trees
Begin_Time	Date/Time	6	Start time (24 hour format) of Plot field data collection
End_Time	Date/Time	6	End time (24 hour format) of Plot field data collection
Pika_Detected	Yes/No	4	Yes/No field indicating whether or not Pika was detected at Plot
Observe_Notes	Text	255	Comments regarding the plot observation

Table: tbl_EvData_PlotDetection

Description: Table stores plot detection (pika presence) data. Uses detection codes from tlu_PikaDetectionCodes. Linked Many:1 to tbl_EvData_PlotObs.

Field Name	Field Type	Size	Field Description
PlotDetection_ID	ReplicationID	16	Primary key, uniquely identifying each tbl_EvData_PlotDetection record
PlotObs_ID_F	ReplicationID	16	Link to tbl_EvData_PlotObs (foreign key)
Detection_Time	Date/Time	6	Time (24 hour format) of Pika detection
Detection_Type	Text	20	Pika Detection Code (from tlu_PikaDetectionCodes)
Dist_Plot_Center	Single	8	Distance to Plot Center from Detection location
Detection_Notes	Text	255	Notes regarding the pika detection observation

Table: tlu_PikaDetectionCodes

Description: Lookup table storing pika detection codes and descriptions for determining pika presence at plots.

Field Name	Field Type	Size	Field Description
PikaDetectionCode_ID	ReplicationID	16	Primary key, uniquely identifying each tlu_PikaDetectionCodes record
Detection_Code	Text	15	Code used for Pika Detection Description
Detection_Description	Text	255	Description of Pika Detection (i.e., fresh haypile, fresh scat, etc.)
DetectCode_SortOrder	Long Integer	4	Sort Order for controlling the sort order in database forms

Table: tlu_Vegetation_Cover_Percent

Description: Lookup table storing percent cover classes and descriptions for vegetation cover types.

Field Name	Field Type	Size	Field Description
Vegetation_Cover_Percent_ID	ReplicationID	16	Primary key, uniquely identifying each tlu_Vegetation_Cover_Percent record
Veg_Percent_Class	Text	15	Code used for Vegetation Percent Cover class
Veg_Class_Description	Text	255	Description of Vegetation Percent Cover class
VegCover_SortOrder	Long Integer	4	Sort Order for controlling the sort order in database forms

Table: tlu_ParkUnits

Description: Lookup table storing Park Unit codes and descriptions for associating a Park Unit with each sample frame (Site).

Field Name	Field Type	Size	Field Description
ParkUnit_ID	ReplicationID	16	Primary key, uniquely identifying each tlu_ParkUnits record
ParkUnit_Code	Text	15	Park Unit Code (Park or Park sub-unit)
ParkUnit_Descript	Text	255	Description of Park Unit
ParkUnit_SortOrder	Long Integer	4	Sort Order for controlling sort order in database forms

Table: tlu_Contacts

Description: Lookup table storing person contact data for associating project personnel with individual sampling Events.

Field Name	Field Type	Size	Field Description
Contact_ID	ReplicationID	16	Primary key, uniquely identifying each tlu_Contacts record
Last_Name	Text	50	Last name (Cnt_Last)
First_Name	Text	50	First name (Cnt_First)
Middle_Init	Text	4	Middle initial (Cnt_MI)
Organization	Text	50	Organization or employer (cntorg)
Position_Title	Text	50	Title or position description (cntpos)
Address_Type	Text	50	Address (mailing, physical, both) type (addrtype)
Address	Text	150	Street address (cntaddr)
Address2	Text	150	Address line 2, suite, apartment number (Cnt_Addr2)
City	Text	50	City or town (city)
State_Code	Text	4	State or province (state)
Zip_Code	Text	15	Zip code (postal)
Country	Text	50	Country (country)
Email_Address	Text	150	E-mail address (cntemail)
Work_Phone	Text	50	Phone number (cntvoice)
Work_Extension	Text	50	Phone extension (Work_Ext)
Contact_Notes	Text	255	Contact notes (Cnt_Notes)

Table: tlu_Proto_VSign

Description: Lookup table of Vital Sign and Protocol. Linked 1:Many to tlu_Protocol_Ver.

Field Name	Field Type	Size	Field Description
Prototcol_Parent	Text	10	Primary key. Four letter code to identify each vital sign protocol (i.e., PIKA for Pika Vital Sign).
Vital_Signl_Name	Text	150	Full Name of associated Vital Sign

Table: tlu_Protocol_Ver

Description: Lookup table of Protocol versions, linked to tbl_Events in order to associate a Protocol version with each individual sampling Event.

Field Name	Field Type	Size	Field Description
Protocol_Ver_ID	Text	10	Primary key. Four letter Protocol Parent code plus version (e.g., PIKA_1_0, SAGE_2_3, etc.).
Prototcol_Parent	Text	10	Link to tlu_Proto_VSign (foreign key). Protocol four letter abbreviation (e.g., PIKA for Pika protocol).
Protocol_Descript	Memo	NA	Description of this Protocol Version

Table: tbl_DB_Meta

Description: Database description and links to I&M metadata tools.

Field Name	Field Type	Size	Field Description
DB_Meta_ID	ReplicationID	16	Local primary key
Db_Desc	Memo	NA	Description of database purpose
Meta_MID	ReplicationID	16	Link to Metadata record
Meta_File_Name	Text	255	Filename of Metadata record

Table: tbl_DB_Revisions

Description: Database revision history data.

Field Nam	Field Type	Size	Field Description
Revision_ID	Text	50	Database revision (version) number or code
Revision_Contact_ID	ReplicationID	16	Link to tlu_Contacts
DB_Meta_ID	ReplicationID	16	Link to tbl_DB_Meta
Revision_Date	Date/Time	8	Database revision date
Revision_Reason	Memo	NA	Reason for the database revision
Revision_Desc	Memo	NA	Revision description

Data Entry

Field data collection will be accomplished using paper datasheets. Data will be transferred from paper datasheets into the Pika database as soon after data collection as is practical. Data entry forms in the Pika database are patterned after the structure of the paper datasheet, and the database has built-in quality assurance components such as pick lists and validation rules to test for missing data or illogical combinations. Data entry should be viewed as an important step in the overall QA/QC process, and care should be taken to review all data while the observers are in the field.

Quality Review

After the data have been entered and processed, they need to be reviewed by the Project Lead for quality, completeness, and logical consistency. The working database application will facilitate this process by showing the results of pre-built queries that check for data integrity, data outliers and missing values, and illogical values. The user may then fix these problems and document the fixes. Not all errors and inconsistencies can be fixed, in which case the resulting errors are then documented and included in the metadata and certification report.

Metadata Procedures

Data documentation is a critical step toward ensuring that data sets are useable for their intended purposes well into the future. This involves the development of metadata, which can be defined as structured information about the content, quality, and condition of data. Additionally, metadata provide the means to catalog data sets within intranet and internet systems, making data available to a broad range of potential users. Metadata for all UCBN monitoring data will conform to Federal Geographic Data Committee (FGDC) and NPS guidelines and will contain all components of supporting information such that the data may be confidently manipulated, analyzed, and synthesized. For long-term projects such as this one, metadata creation is most time consuming the first time it is developed – after which most information remains static from one year to the next. Metadata records in subsequent years then only need to be updated to reflect current publications, references, taxonomic conventions, contact information, data disposition and quality, and to describe any changes in collection methods, analysis approaches or quality assurance for the project.

Specific procedures for metadata development and posting are outlined in the UCBN Data Management Plan. In general, the Project Lead and the Data Manager (or Data Technician) will work together to create and update an FGDC- and NPS-compliant metadata record in XML format. The Project Lead should update the metadata content as changes to the protocol are made, and each year as additional data are accumulated. Edits within the document should be tracked so that any changes are obvious to those who will use it to update the XML metadata file. At the conclusion of the field season, the Project Lead will be responsible for providing a completed, up-to-date metadata questionnaire form (available as an appendix of the UCBN Data Management Plan and on the UCBN website at http://science.nature.nps.gov/im/units/ucbn/datamgmt/) to the Data Manager. The Data Manager will facilitate metadata development by creating and parsing metadata records, and by posting such records to national clearinghouses as described below.

Sensitive Information

Part of metadata development includes determining whether or not the data include any sensitive information, which includes specific locations of rare, threatened, or endangered species. Prior to completing metadata, the Project Lead and/or Park Resource Manager should work identify any sensitive information in the data. Their findings should be documented and communicated to the Data Manager. At this time, we do not anticipate that information collected in the pika monitoring program will be considered sensitive.

Data Certification and Delivery

Data certification is a benchmark in the project information management process that indicates that 1) the data are complete for the period of record; 2) they have undergone and passed the quality assurance checks; and 3) that they are appropriately documented and in a condition for archiving, posting, and distribution. Certification is not intended to imply that the data are completely free of errors or inconsistencies, which may not have been detected during quality assurance reviews.

To ensure that only data of the highest possible quality are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. The Project Lead is primarily responsible for completing certification. The completed form, certified data, and updated metadata should be delivered to the Data Manager as outlined in the following steps and in Table 3.

Data Certification Steps

To package the certification materials for delivery, the Project Lead should follow these steps:

1) Complete all data quality review procedures, and ensure that the data is as complete and accurate as possible. Create a metadata file or complete a metadata questionnaire form.

2) Create a compressed file (using WinZip® or similar software) and add the back-end database file to that file. Note: The front-end application does not contain project data and as such should not be included in the delivery file.

3) Add the completed metadata to the compressed file.

4) Add a certification summary (e.g., summation of database records for which errors were corrected, for which errors cannot be corrected, etc.) to the compressed file. Data product certification forms are available in the UCBN Data Management Plan, which is available on the UCBN website (http://science.nature.nps.gov/im/units/ucbn/datamgmt/).

5) Add any geospatial data files created for the current year's data.

6) All file names – except for image files and geospatial data files – should include the project code and the year or span of years for the data being certified. For example: PIKA_2009_certified.mdb, PIKA_2009_cert_report.doc.

7) The compressed file may then be delivered (typically via FTP site or CD/DVD disk) to the appropriate Data Manager or Data Steward.

Upon receiving the certification materials, the Data Manager or Data Steward will check them in, store them in appropriate centralized repositories, upload the certified data to the master project database, and update the project GIS data sets with any geospatial data that are submitted. Upon notification that the year's data have been uploaded and processed successfully, the Project Lead may then proceed with data summarization, analysis and reporting.

Data Archiving

Paper data sheets will be stored by the UCBN for CRMO and park staff for CRLA, LABE, and LAVO to facilitate resolution of any QA/QC issues that may be discovered in the master database. After 5 years, the paper data sheets will be transferred to the appropriate park or regional museum staff for official archiving. The UCBN will maintain the master database for all four parks as the official record of protocol data, following procedures established in the UCBN Data Management Plan (Dicus and Garrett 2007) to ensure the master database is properly archived and remains compatible with applicable software.

Once the annual data certification has been completed, the pika database and related reports will be archived on the UCBN and/or park server, posted to the UCBN and/or park website, and posted to the national web-accessible secure Natural Resource Information Portal (NRInfo) application hosted by the NPS Washington Areas Support Office (WASO) or National I&M program. The NRInfo application incorporates functionality previously handled by separate databases into a single web interface that comprises:

- The master database for natural resource bibliographic references

- The master database for biodiversity information including species occurrences and physical or written evidence for the occurrence (i.e., references, vouchers, and observations)
- A centralized data repository with a graphical search interface.

A review of archive and expendable data products will be undertaken by the Project Lead and Data Manager during season close-out each year. An example of an expendable data product is an intermediate draft of an annual report that was saved during report preparation.

Directory Structure Recommendations

The following directory structure will be used to store and archive all information related to the pika monitoring project on the UCBN and/or park file server. This is a generic structure that should provide a foundation and a minimum standard of organization and consistency. The goal is to organize all project materials in an efficient hierarchical structure that reflects the life cycle and workflow of the project. Toward this goal, all subfolders are organized into four primary project folders that reflect life cycle stages (initiate, plan, implement, and close). Additional subfolders may be added as needed, but a strong emphasis must be placed on keeping the structure as simple and logical as possible. The four primary project folders and their standard subfolders are presented below.

\Initiate – Store information about the initiation of the project here, including proposals, contract agreements, relevant e-mails, etc.

- **\Agreements_Contracts**
- **\Meetings_Correspondence**
- **\Proposals**

\Plan – Store information about the planning phase of the project here, including monitoring objectives, protocol development summaries, conceptual models, protocol and SOP drafts, study plans, and research permits.

- **\Conceptual_Models**
- **\Data_Mng_Models**
- **\Equipment**
- **\Meetings_Correspondence**
- **\Monitoring_Objectives**
- **\Protocol_Develop_Summary**
- **\Protocol_SOP_Drafts**
- **\Research_Permits**
- **\Study_Plans**

\Implement – Store information about the implementation phase of the project here, including data management documents and draft products, data analysis documents and draft products, project photos, and relevant correspondence.

- **\Data_Analysis**
- **\Data_Management**
    - **\Data_Dictionary**
        - **\PDA_Forms**
    - **\Database_Working**
    - **\Download_Files**

\GPS_Files
\Datalogger_Files
\GIS_Data_Working
\Map_Products
\Templates
\Features
\Geodatabases
\Meetings_Coorespondence
\Photos
\Final
\Originals
\Working

\Close – Store finalized documents and products from the close-out phase of the project (on either an annual basis or a final project close-out basis) here, including final reports, certified data and GIS products, and presentations.

\Certified_Data_GIS_Metadata
\Final_Reports
\Annual_Reports
\Investigator_Annual_Reports
\Protocol_SOP_Final
\Other_Final_Deliverables
\Presentations

Schedule of Data Management Tasks

Table 3. The yearly pika monitoring data management task list. This table identifies tasks by project stage, indicates who is responsible for the task, and establishes the timing for its execution.

Project Stage	Task Description	Responsibility	Timing
Preparation	Notify Data Manager of needs (field maps, GPS support, training)	Project Lead	ASAP, before Feb 1
	Prepare field maps and field forms	Project Lead / Data Manager	by April 1
	Provide database for upcoming data entry	Data Manager	Mid-April
	Train field crew in survey protocol	Project Lead	June
Data acquisition	Collect survey data	Project Lead	July-Oct.
Data entry & processing	Enter data into protocol database, and review data entry accuracy	Data Technician and Project Lead	Monthly
Quality review	Quality review and data validation using database tools	Project Lead / Data Manager	Monthly; complete by Oct
Metadata	Identify any sensitive information contained in the dataset	Project Lead	Oct/Nov
	Update project metadata records	Project Lead / Data Manager	November
Data certification	Certify the season’s data	Project Lead / Data Manager	November
Data delivery	Deliver certified data and updated metadata to park and UCBN Data Manager	Project Lead	November
	Upload certified data into master project database and store data (e.g., UCBN Digital Library[1])	Data Manager	November

Project Stage	Task Description	Responsibility	Timing
	Notify Project Lead of uploaded data ready for analysis and reporting	Data Manager	November
	Update project GIS datasets, layers and associated metadata records	Data Manager	November
	Finalize, parse and store metadata records (e.g., UCBN Digital Library[1])	Data Manager	By Dec 1
Data analysis	Status and trend analyses	Project Lead / Data Analyst	December
Product development	Acquire the proper report template from the NPS website, create annual report	Data Analyst	Dec – Jan
	Screen all reports and data products for sensitive information	Project Lead / Data Analyst	Dec – Jan
	Submit draft report to Project Lead / Network Coordinator for review	Data Analyst / Data Manager	Jan
	Review report for formatting and completeness, notify Project Lead of approval or need for changes	Network Coordinator	Jan
	Deliver completed report to Network Coordinator / Data Manager	Project Lead	Feb
	Deliver other products according to the delivery schedule and instructions	Project Lead	Feb
Posting & distribution	Create NRInfo [3] record(s), and link digital reports	Data Manager	Feb
	Update NRInfo [4] species records according to data observations	Data Manager	Feb
	Submit certified data and GIS data sets to NRInfo [2]	Data Manager	Feb
	Store final products in UCBN Digital Library[1]	Data Manager	Feb
Archival & records management	Review, clean-up, and store and/or dispose of project files according to UCBN Data Management Plan guidelines	Project Lead	Feb
	Meet to discuss the recent field season, and document any needed changes to field sampling protocols or the working database	Project Lead, Park Resource Managers, Data Manager, and key UCBN staff	Jan – Feb
Season close-out	Discuss and document needed changes to analysis and reporting procedures	Project Lead, Park Resource Managers, Data Manager, and key UCBN staff	Jan - Feb

[1] The UCBN Digital Library is a hierarchical digital filing system stored on the UCBN file server. Network users have read-only access to these files, except where information sensitivity may preclude general access.
[2] Natural Resource Information Portal (NRInfo) is a clearinghouse for natural resource data and metadata (http://nrinfo.nps.gov). Only non-sensitive information will be publically viewable. Refer to the protocol section on sensitive information for details.
[3] Bibliographic citations are managed within the national Natural Resource Information Portal (NRInfo) application, which facilitates user citation searches on author, title, keywords, etc. (http://nrinfo.nps.gov). Only non-sensitive information will be publically viewable.
[4] Park-specific species lists and observation data are managed within the national Natural Resource Information Portal (NRInfo) application.

Standard Operating Procedure (SOP) 6: Data Summary, Analysis, and Reporting

Version 1.0, January 2011

Change History

Version #	Date	Revised by	Changes	Justification

Suggested Reading

Agresti, A. 2007. An introduction to categorical data analysis. 2nd Edition. John Wiley and Sons, New York, NY.

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Maindonald, J., and W. J. Braun. 2007. Data analysis and graphics using R – an example-based approach. Cambridge University Press, UK.

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Nichols, J. D., T. Boulinier, J. E. Hines, K. H. Pollock, and J. R. Sauer. 1998. Estimating rates of local species extinction, colonization, and turnover in animal communities. Ecological Applications 8:1213-1225.

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Thompson, S. K. 2002. Sampling. 2nd Edition. John Wiley and Sons, New York, NY.

Introduction

This SOP describes analytical procedures for developing summary information that will be reported in annual and 5-year trend reports. The first trend report will be produced 4 years after the first field season in which the final, peer-reviewed and approved version of this protocol is implemented. The analysis sections of this SOP include basic summary procedures that will quickly be completed following each field season for use in park and network annual reports. More complex modeling procedures are also included and are intended for use by park and network staff, or consulting statisticians, with sufficient training and experience in quantitative data analysis. Comprehensive model-based analyses should occur in conjunction with 5-year trend reports, but may also occur more frequently. The parks and UCBN will explore funding opportunities for a task agreement with a university or an interagency agreement with USGS to accomplish the more comprehensive and complex analyses.

The statistical methods outlined below are described for implementation with the statistical freeware R, an open source version of S-Plus. R is a powerful system for statistical computations and graphics, which runs on Windows, Unix, and Mac computers. R is a combination of a statistics package and a programming language. It can be downloaded for free from http://www.r-project.org/ . The R Wiki provides an online forum http://wiki.rproject.org/rwiki/doku.php and documentation. R is one of the analytical environments of choice for the Upper Columbia Basin Network and is in widespread use throughout the NPS Inventory and Monitoring Program. Regular R training courses are provided to NPS staff on-line sponsored by USGS (http://www.fort.usgs.gov/brdscience/learnR.htm). Two additional free software packages that may also be useful include PRESENCE (http://www.mbr-pwrc.usgs.gov/software/presence.html), available from the USGS, and WinBUGS (http://www.mrc-bsu.cam.ac.uk/bugs/winbugs/contents.shtml), available from the United Kingdom Medical Research Center. PRESENCE supports fitting of single- and multi-season occupancy models using maximum likelihood. This package will not work well with single-visit data, however. WinBUGS supports fitting of occupancy models using a Bayesian Markov chain Monte Carlo approach, is tremendously flexible, and is an optimal environment for approaching complex hierarchical models. WinBUGS can be called directly from R and an example is included in this SOP. Computational code for procedures outlined in this SOP written for R statistical language and environment are provided on the CD that accompanies this manual or by request from the UCBN. All analytical code is stored on the UCBN NAS drive under Pika/Implement/Data_Analysis/RCode. Direct references to R commands in the text are distinguished by `Courier New Font` rather than Times New Roman, with arguments for the commands noted by closed parentheses `()`.

Power Analysis

Given the recent extirpations of pikas from some parts of its range and concerns about population declines in response to climate change, we have approached the question of sample size from the perspective of acquiring precise annual estimates of occupancy, and on detecting declines rather than increases in occupancy, although our protocol will support change detection in both directions. Also, we have carefully considered the practical limitations facing the four parks and network that ultimately determine how many sites can be surveyed in a given year. For status we used a simple formula (Equation 1) from Elzinga et al. 1998 to determine the sample size required for a specific margin of error (confidence interval half-width) for estimates of Ψ, the proportion of sites occupied (alternatively notated as p in Elzinga et al. 1998).

$$n = \frac{z^2(\Psi * (1-\Psi))}{d^2} \quad (1)$$

In this equation, 1.64 is the 90% confidence interval multiplier from a standard normal distribution for z, d is the margin of error, which is 1.64 × the standard error for Ψ, and Ψ, the proportion of sites occupied, is set equal to 0.5 to provide the most conservative estimate of necessary sample size. Therefore, a sample size of 50 will provide an estimate of Ψ with a standard error of 0.07 when the proportion of sites occupied is 50%. Precision will improve under any scenario when site occupancy differs from 50%. Under the same scenario, a sample size of 100 will yield a standard error of $\leq$0.05. These results are matched by an analogous equation provided by MacKenzie et al. (2006).

The following R script will enable duplication of this procedure:

```
#File:Pika\\3_implement\\Rcode\\UCBN_Pika_SampleSize-Power_20090903.R
#Purpose:Sample size and power equations for pika
#Contact: Tom Rodhouse, Tom_Rodhouse@nps.gov
#Updated: September 3, 2009
******************************************************************************
#Simple status estimator for proportion of sites occupied, using the equation
#from Elzinga et al. 1998.

#First the function
status.n<-function(Z,p,q,d){
n=(Z^2*p*q)/d^2
print(n)}

#Second, the input
Z=1.64 # 90% alpha
p=0.5 #proportion of sites occupied or “psi”
#use 0.5 because that is most conservative
q=1-p
d=0.082 # This is the the margin of error
# 1/2 CI. So this would yield an SE of 0.05 for a 90% CI (.05*1.64 = .082)

#Third, the output
status.n(Z,p,q,d)

#Using MacKenzie et al.(2006) equation p 167
(p*(1-p))/((d/Z)^2)
*****************************************************************************
```

We have also considered power to detect a 25% occupancy decline for fixed sample sizes using 2-year comparisons (“step-trend”) of annual estimates of Ψ with an equation from Ramsey and Schafer (1997). Give the concern over detecting a decline, we used a conservative starting proportion (0.5) and a Type I error (α or false-change error) of 0.1, thus minimizing preservationist’s risk (as opposed to 0.05, for example). This exercise suggested a sample size of 85 would be sufficient. The 25% decline is considered a “practically significant difference” following the approach outlined by Ramsey and Schafer (1997), and ensures that the 90% confidence interval will not simultaneously include 1 and the odds ratio of occupancy proportions.

The following R script will enable duplication of this procedure:

```
#File:Pika\\3_implement\\Rcode\\UCBN_Pika_SampleSize-Power_20090903.R
#Purpose:Sample size and power equations for pika
#Contact: Tom Rodhouse, Tom_Rodhouse@nps.gov
#Updated: September 3, 2009
*****************************************************************************
#For a step trend, using the equation from Ramsey and Schafer (1997)

#First the function
StepTrendProp<-function(per,pi0,a){
pi1<-(1+per)*pi0
if(max(pi1)>1) return('Percent change results in proportion >1') else{
R<-(pi1*(1-pi0))/((1-pi1)*pi0) #odds ratio
z1<-(qnorm(1-a/2)^2)/(log(R)^2)
z2<-(1/(pi0*(1-pi0)))+(1/(pi1*(1-pi1)))
nn<-z1*z2 # sample size
return(nn,R)}}

#Second, the input
per<--0.25 #desired change in the odds of site occupancy
pi0<-.1 #Starting proportion, 0.5 is conservative
alpha<-.1 # Here we go with an alpha of 10%, given the concern over detecting
#a decline (minimizing preservationist's risk)

#Third, the output
out.pika<-StepTrendProp(per,pi0,alpha)
out.pika
$nn #Returns the estimated required sample size for given inputs

*****************************************************************************
```

Given these two analyses, a consideration of practical constraints, and recognition that increased model complexity (e.g., with elevation and year covariates) will require larger sample sizes, we have chosen to sample a minimum of 100 permanent sites in each park sampling frame during each survey period, revisited annually during the initial 3-year implementation period, and annually or less frequently thereafter. Additional power calculations to consider more complex long-term scenarios have not been taken, largely due to the uncertainty concerning how multi-season hierarchical occupancy models should be parameterized to estimate power (MacKenzie et al. 2006, Royle and Dorazio 2008). We note, however, that MacKenzie et al. (2006) showed that the power to detect trend using a simple “implicit-dynamics” occupancy model, as measured by the coefficient of variation of Ψ, differed markedly among sample sizes of 50, 100, and 200 during the first four years of study, but converged rapidly after four years, and were identical after eight years.

Annual Status Analysis

Status results will be summarized by the park’s Project Lead after each year of data collection. Standard summary information will be presented for each sampling frame at each park with content similar to that shown in Table 4, and will include the number of sites surveyed, number of occupied sites, and proportion of sites occupied. The primary status metric of interest will be estimates of the proportion of sites occupied, or Ψ for each park. Estimation of Ψ and its standard error are straightforward and easily accomplished promptly at the end of each survey period using standard design-unbiased estimators for a stratified random sample. Use of the "local" GRTS variance estimator (Stevens and Olsen 2003) can be used to take advantage of the spatially-balanced sampling design and obtain more precise estimates of uncertainty. A simple estimate of Ψ for an unstratified sampling design (equal sample unit inclusion probabilities) is obtained by dividing the number of occupied sites within a given survey period (year) by the total of sites surveyed (*n*). To estimate the standard error of Ψ, the following equation can be used.

$$SE(\hat{\Psi}) = \sqrt{\frac{\Psi * (1 - \Psi)}{n}} \qquad (2)$$

Table 4. Hypothetical example of annual summary information for the pika populations at each park.

Annual Pika Survey Results – Crater Lake	2010
Number of Sites Surveyed	80
Number of Occupied Sites	42
Proportion of Sites Occupied (Ψ)	0.52
Site Turnover (% from 2009 to 2010)	15

Because we used a stratified sampling design, it is necessary to account for the strata of different sizes (areas). The following code demonstrates how to calculate means and variances for stratified random samples, following equations from Thompson (2002):

```
#File:Pika\\3_implement\\Rcode\\UCBN_ExampleStatus_Estimators.R
#Purpose:To demonstrate stratified random sampling estimators
#Contact: Tom Rodhouse, Tom_Rodhouse@nps.gov
#Updated: November 15, 2009
*****************************************************************************
y <- c(1,0,0,1,1,0,1,1,1,1) #example vector of pika detection observations
st<-c(rep(1,5),rep(2,5)) #Strata membership
N<-50 #Area of frame
N1<-15 #Area of lower elevation portion of frame (for 2 strata example)
N2<-35 #Area of upper elevation portion of frame
n1<-tapply(y,st,length)[1] #sample size of strata 1
n2<-tapply(y,st,length)[2] #sample size of strata 2
n1<-5 #sample size of strata 1
n2<-5 #sample size of strata 2
ybar.st<-sum(tapply(y,st,mean)[1]*N1,tapply(y,st,mean)[2]*N2)/N # stratified
estimate of the mean
#Variance estimate; see Thompson 2002 or Elzinga et al. 1998
term1<-1/(N^2)
term2<-(N1^2)*((N1-n1)/N1)*(var(y[1:5])/n1)
term3<-(N2^2)*((N2-n2)/N2)*(var(y[6:10])/n2)
var.st<-term1*(term2+term3) #the variance of the stratified random sample

#Since a stratified random sample is a special case of the Horvitz-Thompson
#estimator, which is used in the GRTS code – compare the following results
#with the above results.
```

```
Library(TeachingSampling)#need to load this R library from the CRAN website
pi <- c(rep((n1/N1),5),rep((n2/N2),5)) #Create a vector of inclusion
#probabilities. The inverse of these are the GRTS weights.
E.piPS(y,pi)[1:2]/c(N,N^2) #Provides H-T estimates for mean and variance of
#the mean
****************************************************************************
```

Note that the stratified random sample estimator is a special case of the more general Horvitz-Thompson estimator used for unequal probability samples (Thompson 2002). The Horvitz-Thompson estimator for both the mean (Equation 3) and variance (not shown, see Thompson 2002) can be accessed from the R spsurvey library, which supports both GRTS sample draws and analysis of data generated from GRTS samples (Kincaid 2008; http://www.epa.gov/nheerl/arm/analysispages/software.htm). A weighted estimate of the mean is

$$\hat{\Psi}_{\pi} = \sum_{i=1}^{n} \frac{y_i / \pi_i}{\hat{N}}, \tag{3}$$

where y_i's are the occurrence observations, π_i's are the sample unit inclusion probabilities, and $\hat{N}$ is the estimate of the total number of possible sample units, generally analogous to the area of the sampling frame. $\hat{N}$ is obtained by summing all of the inverse inclusion probabilities (i.e., $\frac{1}{n/N}$). The inverse inclusion probabilities are the GRTS weights provided in output from the `grts()` function, and can be found in the sample unit tables (see SOP # 8 Table 6 for an example). Note that if sites are dropped and added (from the oversample list), the GRTS weights need to be adjusted using the `adjwt()` function called within `grts()`. Initial GRTS weights for site *i* in strata *h* are calculated as $w_i = A_h/n_h$ (or N/n), where A_h is the area of strata *h* and n_h is the desired sample size for strata *h*. Adjusted weights are calculated as $w'_i = w_i * (A_h/\Sigma wi)$, the initial weights multiplied by the area of strata *h* divided by the sum of the initial weights.

The following script is for use with the *spsurvey* library in R and can be used to obtain Horvitz-Thompson mean and variance estimates for categorical (including binomial 1's and 0's) data, and also supports estimation of variance using the locally-weighted estimator developed by Stevens and Olsen (2003). Note that the local GRTS variance estimator yields a 30% reduction in variance!

```
#File:Pika\\3_implement\\Rcode\\UCBN_Pika_H-T_GRTS_Estimators.R
#Purpose:To demonstrate weighted Horvitz-Thompson estimators and local GRTS
#variance estimator; Example data from 2007-2007 CRMO pika inventory - 4
#frames, each with different areas and sample sizes, hence weights, which
#are computed as n/N, where n is realized sample size and N is the frame
#area. Reference is GRTS User's Guide written by Thomas Kincaid, 2008,
#available #on-line
#at:(http://www.epa.gov/nheerl/arm/analysispages/software.htm)
#Contact: Tom Rodhouse, Tom_Rodhouse@nps.gov
#Updated: November 15, 2009
****************************************************************************
#Set working directory accordingly
#load spsurvey library, available from EPA EMAP website (see URL above)
library(spsurvey)
```

```
temp<-read.table("CRMO_PikaInventory_WeightedData.txt",header=T) # sample
data available from UCBN upon request
names(temp)
[1] "Index"      "Frame"      "Site"       "UTMX"       "UTMY"
[6] "Total_Detect" "Elevation"  "Weights"
DesignStatus<-temp
sites <- rep(TRUE,nrow(DesignStatus))
mysites<-data.frame(siteID=DesignStatus$Site,Active=rep(TRUE,
length(DesignStatus$Site)))
mysubpop<-data.frame(siteID=DesignStatus$Site,Frame=DesignStatus$Frame)
mydatacont<-
data.frame(siteID=DesignStatus$Site,Data=DesignStatus$Total_Detect)
mysupport<-rep(1,nrow(DesignStatus))
mydesign<-
data.frame(siteID=DesignStatus$Site,wgt=DesignStatus$Weights,xcoord=DesignSta
tus$UTMX,ycoord=DesignStatus$UTMY,support=mysupport)

#One way to generate results is with cont.analysis() function
out<-
cont.analysis(sites=mysites,design=mydesign,subpop=mysubpop,data.cont=mydatac
ont,vartype="SRS",popcorrect=F)
#Another way to do this is with the total.est() function
#Demonstrated first for the simple random sample Horvitz-Thompson variance
estimator ("SRS")
total<-
total.est(DesignStatus$Total_Dete,wgt=DesignStatus$Weights,x=DesignStatus$UTM
X,y=DesignStatus$UTMY,popcorrect=F,
support=mysupport,vartype="SRS")
       Statistic NResp     Estimate     StdError     LCB95Pct     UCB95Pct
1          Total   144 2207.6944444 3.034214e+02 1612.9993362 2802.3895526
2           Mean   144    0.3950071 4.622022e-02    0.3044171    0.4855970
3       Variance   144    0.2389765 9.707331e-03    0.2199505    0.2580025
4 Std. Deviation   144    0.4888522 9.928698e-03    0.4693923    0.5083121
#Demonstrated second for the local GRTS variance estimator. Note the narrower
confidence interval here!
total<-
total.est(DesignStatus$Total_Dete,wgt=DesignStatus$Weights,x=DesignStatus$UTM
X,y=DesignStatus$UTMY,popcorrect=F,
support=mysupport,vartype="Local")
       Statistic NResp     Estimate     StdError     LCB95Pct     UCB95Pct
1          Total   144 2207.6944444 1.707357e+02 1873.0585701 2542.3303187
2           Mean   144    0.3950071 3.054853e-02    0.3351330    0.4548811
3       Variance   144    0.2389765 6.415908e-03    0.2264015    0.2515514
4 Std. Deviation   144    0.4888522 6.562216e-03    0.4759905    0.5017139
#Note that the point estimate of the mean (psi, or proportion of area
occupied)
#is different from an assumption of equal inclusion probabilities
mean(DesignStatus$Total_Detect)
[1] 0.3125 #instead of 0.395
*****************************************************************************
```

In addition to status estimates of occupancy, site turnover from the previous year and the direction of turnover, in terms of extinction and colonization, will also be summarized by simply calculating the percentage of sites that changed occupancy status from the previous year (e.g., from occupied to unoccupied, or vice versa). Hierarchical occupancy models (MacKenzie et al.

2006, Royle and Dorazio 2008) will be employed to establish baseline relationships of occupancy patterns along the elevational gradients both within and among the four parks. For example, Figure 18 illustrates the modeled relationship between site occupancy probabilities (Ψ) and elevation observed at CRMO, by lava type. This type of approach will be modified to address occupancy-elevation trends among parks, rather than as shown here for lava type. These models can easily be modified to estimate detection probabilities, in the event that becomes of interest.

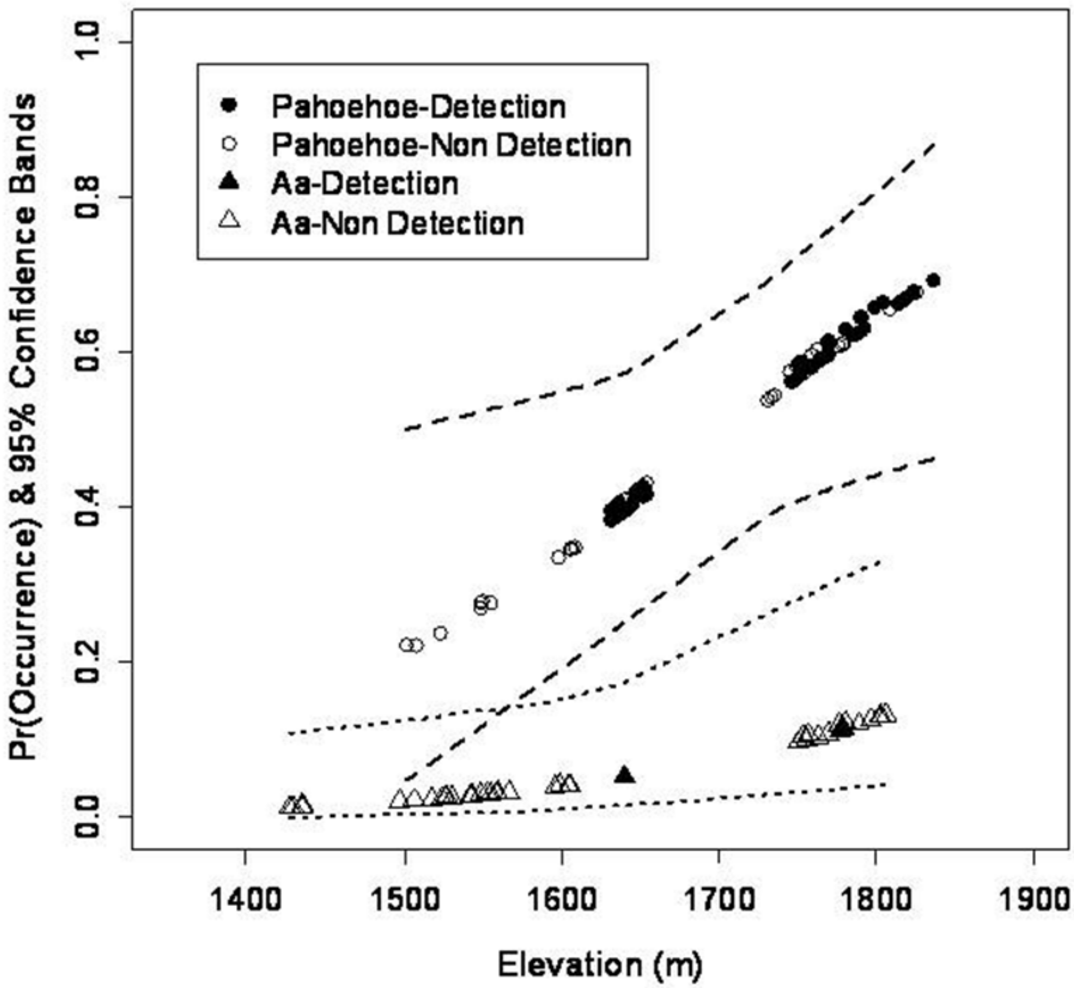


Figure 18. Modeled site occupancy probabilities (Ψ) and 95% confidence intervals for those estimated probabilities as they were observed along the CRMO elevational gradient. Probabilities were classed by lava type (“aa” and “pahoehoe”, see protocol narrative glossary) and color coded by observed detection status. Data were obtained from the 2007-2009 pika inventory conducted by the UCBN.

A basic non-hierarchical logistic regression model can be employed to look at within-park annual estimates of Ψ as a function of elevation. For example, the model represented in equation 4 can be implemented with the `lm()` or `lrm()` functions in R.

$$\hat{\Psi} = \frac{\exp(\beta_0 + \beta_1 * elevation)}{1 + \exp(\beta_0 + \beta_1 * elevation)} \quad (4)$$

The following R script illustrates how to do this using CRMO inventory data:

```
#File:Pika\\3_implement\\Rcode\\UCBN_Example_LRM_Estimator.R
#Purpose:To demonstrate use of logistic regression to evaluate the effects of
#elevation and other explanatory variables on pika site occupancy
#probabilities
#Contact: Tom Rodhouse, Tom_Rodhouse@nps.gov
#Updated: November 15, 2009
*****************************************************************************
temp<-read.table("CRMO_PikaInventory_WeightedData.txt",header=T) # sample
data available from UCBN upon request
names(temp)
[1] "Index"      "Frame"      "Site"       "UTMX"       "UTMY"
[6] "Total_Detect" "Elevation"  "Weights"

library(Design)

lrm(Total_Detect~(scale(Elevation)),data=temp)
#Output begins below, commented with #'s
Logistic Regression Model
lrm(formula = Total_Dete ~ (scale(Elevation)), data = temp) #Elevation scaled
#to standard deviations from mean
Frequencies of Responses #Psi is 45/(99+45) = 0.3125
 0  1
99 45
#Diagnostic criteria - P is the p-value for the likelihood ratio test,
#C is the area under the ROC curve, R2 is the Nagelkerke's adjusted R^2
coefficient of determination
       Obs  Max Deriv Model L.R.       d.f.          P          C        Dxy
       144      2e-10       9.05          1     0.0026      0.644      0.288
     Gamma      Tau-a         R2      Brier
      0.29      0.125      0.086      0.205

             Coef    S.E.   Wald Z P
Intercept    -0.8539 0.1911 -4.47  0.0000
Elevation[1]  0.5822 0.2043  2.85  0.0044
#Interpreted as an exp(0.5822)=1.78 increase in odds of pika site
#occupancy for each 1 std dev increase in elevation
mean(temp$Elevation) # 1679 m
sd(temp$Elevation) # 108.7 m
sd.elev=1679+108.7 #1787.7
#Probability of pika occurrence at 1787 m is almost 1.5 times that at mean
#elevation
exp(-0.8539+(0.5822*1))/(1+(exp(-0.8539+(0.5822*1)))) #Psi-hat is 0.43
exp(-0.8539+(0.5822*0))/(1+(exp(-0.8539+(0.5822*0)))) #Psi-hat is 0.29
*****************************************************************************
```

To incorporate the fixed effect of each park, equation 4 can be modified slightly and considered a hierarchical generalized linear mixed model. The R library lme4 can be used to fit this model. An example might be scripted as, `psi<glmer(Total_Detect~Park+Elevation+(Elevation|Park)+(1|Park),family=binomial)`, which would allow different intercepts to be estimated for each park and different elevation coefficients to be estimated for each park, in addition to an overall estimate of the effect of elevation.

Trend Analysis

A park's analysis and reporting of change detection will be conducted by the Project Lead after 2 years of protocol implementation. Simple graphical tools will be used to display changes in pika site occupancy over time. For example, a simple line graph of annual occupancy (Ψ) estimates can be effective, as is illustrated in Figure 19. Additional information, such as confidence intervals for Ψ, may also be included in such a figure to show the uncertainty surrounding estimates.

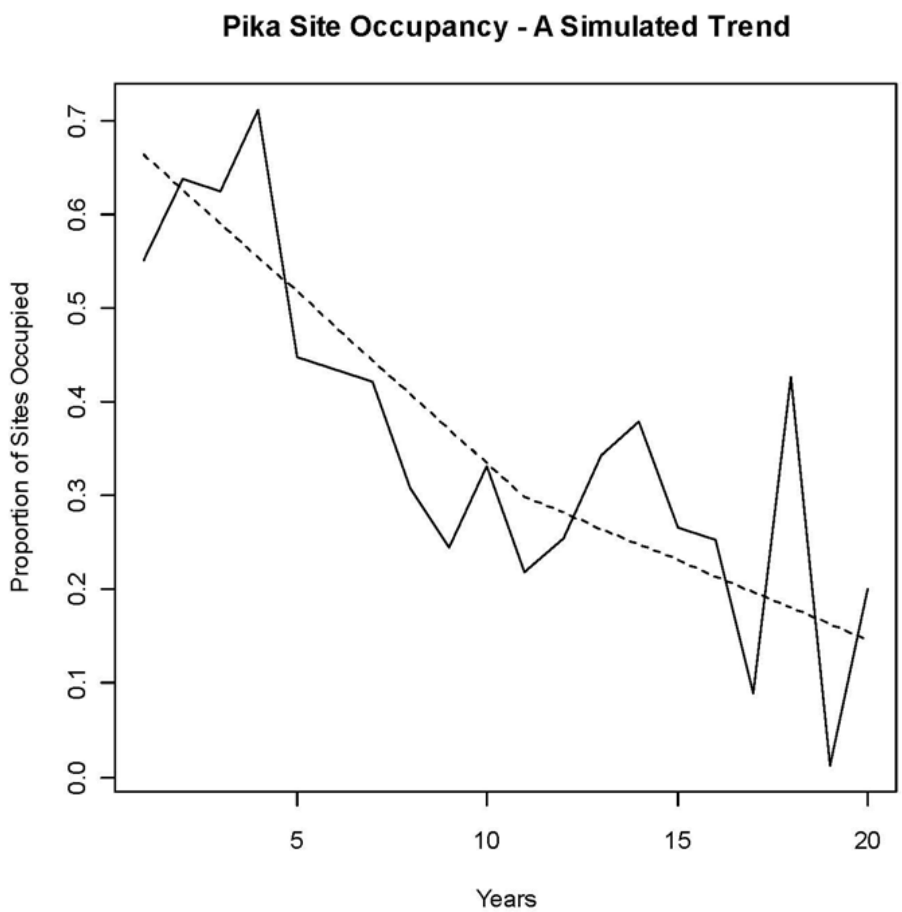


Figure 19. A simulated 25% decline in pika site occupancy over 20 years, with a stochastic component introduced by drawing from a binomial error distribution, provides a realistic illustration of how pika observation data may be presented over time. A locally-weighted scatterplot-smoothing line ("loess" line) is also shown as a dashed line to provide a non-parametric estimate of trend.

Simple estimates of change in the proportion of sites occupied between any two years ("step trend") will be accomplished by comparing the two proportions, following an approach described by Ramsey and Schafer (1997), and which was employed in the Power Analysis section. Parameters that estimate the magnitude of change in occupancy patterns and dynamics over time will be estimated with multi-season hierarchical occupancy models, which will support estimates both within and among parks, following methods outlined by MacKenzie et al. (2006) and Royle and Dorazio (2008). For example, our basic logistic regression model takes the form

$$\hat{\Psi}_{itk} = \frac{\exp(\beta_{0_{ik}} + \beta_{1_k} * elevation + \beta_{2_{ik}} * year_t)}{1 + \exp(\beta_{0_{ik}} + \beta_{1_k} * elevation + \beta_{2_{ik}} * year_t)} \quad (5)$$

where *i* indexes the site, *t* indexes year, and *k* indexes the park. Here the estimated trend for the occupancy parameter Ψ will be allowed to vary along the elevational gradient and among parks. This model can be decomposed into several hierarchical levels which address the probability distribution of possible values for each observation (i.e., "occupied" or "unoccupied"), and for each parameter estimate (β), which are themselves composed of park-specific and overall probability distributions, enabling estimates of regional and park-specific trends. Figure 20 illustrates graphically how this scenario might actually be presented in the future. Referring to model 5 above, each of these trends would be estimated from the back-transformed ("exponentiated") β_2 parameter estimates, interpreted as the annual effect on site occupancy probabilities, after accounting for elevation.

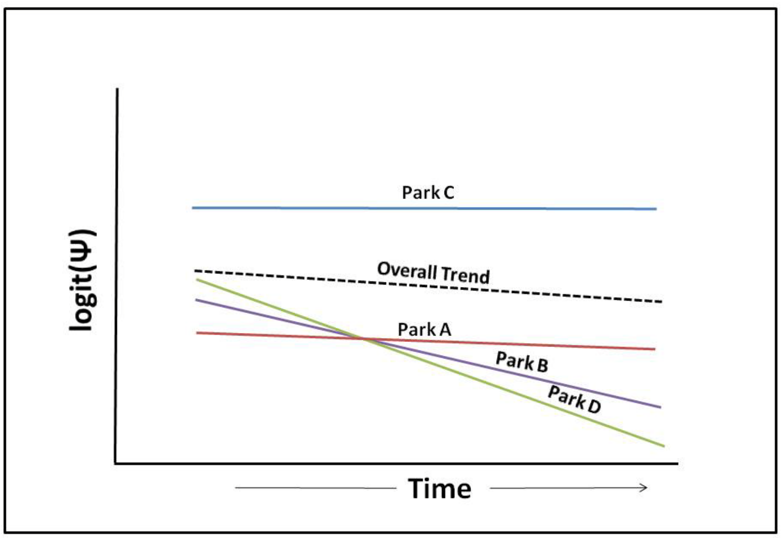


Figure 20. A hypothetical hierarchy of trend estimates in the proportion of sites occupied by pikas within and among parks.

An orthodox mixed-model approach similar to what was demonstrated in the Status Analysis section could be taken to fit such a model. However, as hierarchical complexity increases, so do the challenges in using maximum likelihood or variants (e.g., restricted maximum likelihood) to estimate model parameters. A Bayesian approach using a Markov chain Monte Carlo (MCMC) method has several inherent advantages in this regard, and has become the approach of choice for occupancy modeling, as demonstrated by MacKenzie et al. (2006) and Royle and Dorazio (2008). One important advantage is that additional parameters of interest, such as extinction and colonization, or, if necessary, detection, are more easily obtained from a Bayesian hierarchical occupancy model. Occupancy dynamics parameters for local site extinction and local site colonization will become estimable after 3 years of data have been collected. These parameters will be estimated within the context of covariate effects in the same logistic regression framework as was presented for occupancy.

In the multi-season occupancy modeling context (MacKenzie et al. 2006, Royle and Dorazio 2008), local site extinction ("epsilon" ε) is defined as the probability that a site previously occupied becomes unoccupied. Conversely, local site colonization ("gamma" γ) is the probability that a site previously unoccupied becomes occupied. These parameters estimate first-order Markovian occupancy state "transitions", and will provide insights into the site occupancy dynamics occurring within and among parks over time. Site persistence ("phi" φ) is defined as the probability that a site previously occupied remains occupied. Site gain (τ), defined as the probability that an occupied site is a newly occupied site, can also be recursively derived from occupancy model output, as was shown by Nichols et al. (1998) and Royle and Dorazio (2008). Finally, λ ("lambda"), the rate of change in occupancy, can be estimated as the ratio of Ψ estimates from any 2 years. A linear trend in Ψ over time (e.g., logit(Ψ)=β_0+β_1(year)) can be estimated by including ln(λ), the natural log of the odds ratio, as the slope, assuming a linear trend with constant slope is in fact present. Note that the Markov process model describes a very different relationship between pika occupancy and time than the linear model presented in equation 5. Given the high rate of annual site turnover reported for pikas (e.g., > 15%; Southwick et al. 1986, Peacock and Smith 1997, Rodhouse et al. 2010), this may be a more appropriate model for describing the occupancy dynamics of pikas, particularly during the first few years of implementation before linear trends emerge (e.g., a steady decline over many years).

The following example will illustrate the multi-season Markov modeling approach, generally. Additional details will be provided in an updated version of this SOP once sufficient amounts of data have been collected. An excellent presentation of this approach is presented by Royle and Dorazio (2008, in particular chapter 9). To begin, let Ψ_t, represent the probability of occupancy at year t. Subsequent occupancy states are then determined conditional on previous occupancy states (t-1) as a function of $\Psi_{t-1} * \varphi_{t-1} + (1-\Psi_{t-1}) * \gamma_{t-1}$. This statement reads as "the probability of occupancy in the previous year times the probability that the previously occupied site will persist, plus the probability that the site was unoccupied in the previous year times the probability of recolonization in the previous year". Depending on the actual occupancy state in the previous year, the probability for Ψ_t will either be φ_{t-1} or γ_{t-1}. Site gain (τ_t) at time t can then be estimated by equation 6.

$$\frac{\gamma_{t-1} * (1-\Psi_{t-1})}{\gamma_{t-1} * (1-\Psi_{t-1}) + \phi_{t-1} * \Psi_{t-1}} \qquad (6)$$

The following R script, modified from Royle and Dorazio (2008), shows how these parameters are estimated following a Bayesian approach, in which the software package WinBUGS is called from R to implement the MCMC procedure. This script will support status and initial trend analyses during the first 3-5 years of implementation. A modified parameterization for long-term trends will be developed subsequently. Data used for this example are generated from a simulation function called `data.sim()`, and input values can be changed to explore the procedure. Note that the input values in `data.sim()` are reflected in subsequent estimates, as expected. For this example, data were simulated over 4 years, with 100 sites. The initial occupancy probability was 0.5, site survival () was high, set at 0.9. Conversely, colonization () was low, at 0.2, reflecting a biologically plausible scenario for the philopatric and sedentary pikas. Output parameter estimates from WinBUGS is included at the end of the script. Note that the parameter estimates for psi, gamma, and phi (site gain) reflect well the actual values uses to generate the data.

```
#File:Pika\\3_implement\\Rcode\\UCBN_Pika_ExampleR2WinBUGS_MultiSeason.R
#Purpose:To demonstrate use of Bayesian hierarchical approach to pika site
#occupancy, extinction, recolonization,
#and turnover across all 4 parks
#Modified from Royle and Dorazio (2008) crossbill example Ch 9
#Contact: Tom Rodhouse, Tom_Rodhouse@nps.gov
#Updated: November 15, 2009
*****************************************************************************
# this script fits the same multi-season model given in Panel 9.1 for the
#crossbill data example,
# Royle and Dorazio (2008).  The model assumes p = 1.  The survey consists of
# 1 replicate sample.
# Data are simulated using function data.sim, which mimics the Markovian
#probability function
# that is used to estimate psi values based on psi(t-1)
############################################################################
#Begin Data simulation
library(mc2d)
yrs<-4
n<-100
init<-0.5
surv<-0.9
col<-0.2
data<-matrix(0,nrow=n,ncol=yrs)
data<-as.data.frame(data)
data.sim<-function(n,init,surv,col){
data<-matrix(0,nrow=n,ncol=yrs)
data[,1]<-rbern(n,init)
data[,2]<-rbern(n,ifelse(data[,1]==1,surv,col))
data[,3]<-rbern(n,ifelse(data[,2]==1,surv,col))
data[,4]<-rbern(n,ifelse(data[,3]==1,surv,col))
return(data)
}
temp<-data.sim(n,init,surv,col)
temp
#############################################################################
#Begin occupancy model input
ni=6000
nb=2000
nt=1
nc=3
#library("R2WinBUGS")

sink("model.txt")
cat("
model{

psi~dunif(0,1)
for(i in 1:(nyear-1)){
gamma[i]~dunif(0,1)
```

```
phi[i]~dunif(0,1)
}

for(i in 1:nsite){
z[i,1]~dbern(psi)
for(t in 2:nyear){
muZ[i,t]<- z[i,t-1]*phi[t-1] + (1-z[i,t-1])*gamma[t-1]
z[i,t]~dbern(muZ[i,t])
}
}

lambda[1]<-psivec[2]/psivec[1]
lambda[2]<-psivec[3]/psivec[2]
lambda[3]<-psivec[4]/psivec[3]

psivec[1]<-psi
for(t in 2:nyear){
psivec[t]<-psivec[t-1]*phi[t-1] + (1-psivec[t-1])*gamma[t-1]
gain[t-1]<- ((1 - psivec[t-1]) * gamma[t-1])/( (1 - psivec[t-1]) * gamma[t-1]
+ phi[t-1]*psivec[t-1])
}
}
",fill=TRUE)
sink()

z<-temp

nsite<-dim(z)[1]
nrep<-1
nyear<-4
data <- list ( "z","nsite","nyear")
gst<-runif(3)
inits <- function()
  list (gamma=gst)
parameters <- c("gamma","phi","gain","psivec","lambda")
out <- bugs (data, inits, parameters, "model.txt", n.thin=nt,n.chains=nc,
n.burnin=nb,n.iter=ni,debug=FALSE)
out
################################################################################
#Output - NOTE that psivec[1] reflects initial psi used in data.sim, gamma's
#and phi's are also consistent with known inputs for data.sim

Inference for Bugs model at "model.txt", fit using WinBUGS,
 3 chains, each with 6000 iterations (first 2000 discarded)
 n.sims = 12000 iterations saved
             mean  sd  2.5%   25%   50%   75% 97.5% Rhat n.eff
gamma[1]      0.3 0.1   0.2   0.2   0.3   0.3   0.4    1 12000
gamma[2]      0.2 0.1   0.1   0.1   0.2   0.2   0.3    1 12000
gamma[3]      0.2 0.1   0.1   0.2   0.2   0.3   0.4    1 12000
phi[1]        0.9 0.0   0.8   0.9   0.9   0.9   1.0    1  4100
phi[2]        1.0 0.0   0.9   1.0   1.0   1.0   1.0    1  2500
phi[3]        0.9 0.0   0.8   0.9   0.9   0.9   1.0    1  7800
gain[1]   0.2 0.1   0.1   0.2   0.2   0.3   0.3    1 12000
gain[2]   0.1 0.0   0.1   0.1   0.1   0.1   0.2    1 12000
gain[3]   0.1 0.0   0.1   0.1   0.1   0.2   0.2    1 12000
psivec[1]     0.5 0.0   0.4   0.5   0.5   0.5   0.6    1 11000
psivec[2]     0.6 0.0   0.5   0.6   0.6   0.6   0.7    1  8200
```

```
psivec[3]      0.6 0.0   0.6   0.6   0.6   0.7   0.7     1 12000
psivec[4]      0.7 0.0   0.6   0.6   0.7   0.7   0.8     1  8200
lambda[1]      1.2 0.1   1.0   1.1   1.2   1.2   1.4     1 12000
lambda[2]      1.1 0.1   1.0   1.1   1.1   1.1   1.2     1  2800
lambda[3]      1.0 0.1   0.9   1.0   1.0   1.1   1.2     1  9900
deviance     356.2 3.8 350.8 353.5 355.5 358.2 365.2     1 12000
******************************************************************************
```

Reporting

A summary will be produced annually, with a more detailed status and trend report produced every five years. The annual summary will:

- List project personnel and their roles.
- List sites surveyed during the current year.
- Provide a summary of the number of occupied sites and unoccupied sites.
- Provide status and trend (after 2015) estimates for the pika populations in the park.
- Provide maps of sites symbolizing pika presence.
- Evaluate data quality and identify any data quality concerns and/or deviations from protocols that affect data quality and interpretability.
- Evaluate and identify suggested or required changes to the protocol.

The annual summary report will be developed in the Natural Resource Data Series (NRDS) format. In addition to the annual report, a 1-2 page resource brief will be prepared for superintendents and distributed to park resource and interpretive staff for distribution to interested visitors. An example resource brief is shown in Figure 21. An NPS template for producing maps with ESRI ArcGIS or ArcView software is available at http://imgis.nps.gov/templates.html.

A more in-depth status and trend analysis and report will be produced approximately every five years, or as the importance of emerging information warrants. This report will provide greater analytical and interpretive detail, and will evaluate the relevance of findings to long-term management goals. The report should also evaluate operational aspects of the monitoring program, such as whether the observation period remains appropriate. The timing of the site surveys could conceivably change over time in response to climate change.

Annual reports will use the NPS Natural Resource Publications Natural Resource Data Series (NRDS) template and 5-year analyses of status and trend will use the Natural Resource Technical Report (NRTR) template; both are pre-formatted Microsoft Word template documents based on current NPS formatting standards. These templates, guidelines for their use and documentation of the NPS publication standards are available at the following address: http://www.nature.nps.gov/publications/NRPM/index.cfm.

Upper Columbia Basin Network
Resource Brief

Inventory & Monitoring
National Park Service
U.S. Department of the Interior

Pika Research and Monitoring at Craters of the Moon

An American pika at CRMO
Photo: Doug Owen, NPS

Importance: Species Vulnerable to Climate Change

The American pika (*Ochotona princeps*) is considered an indicator species for detecting ecological effects of climate change. Results from recent studies suggest that in some areas pikas are being lost from lower elevations in response to increased warming, and thus, their suitable habitat is being reduced. The National Park Service has a unique opportunity to assess the vulnerability of pikas to climate change and monitor pika population trends over time. Craters of the Moon National Monument & Preserve (CRMO) provides unique, low-elevation pika habitat and is one of eight National Park Service units included in a 3-year research project titled "Pikas in Peril." Additionally, the Upper Columbia Basin Network (UCBN) has developed a long-term pika monitoring protocol, which is being implemented in CRMO and 3 other Pacific West Region parks.

Objectives

"Pikas in Peril" research

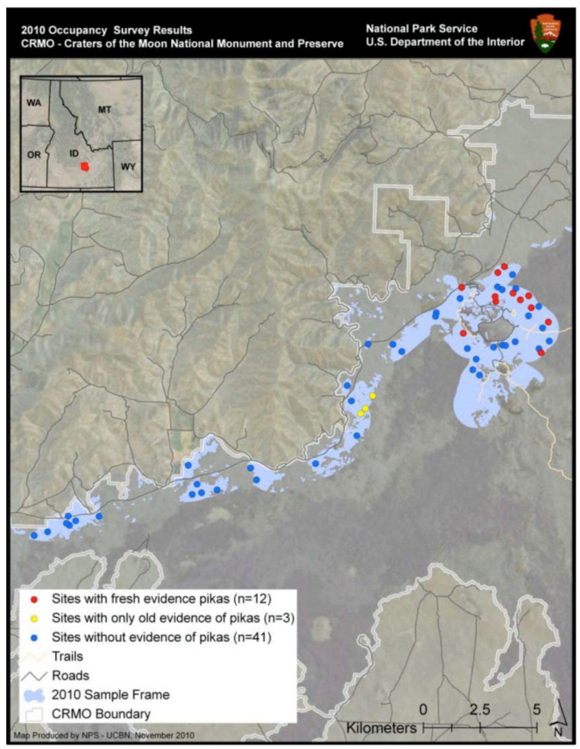
1. Document pika occurrence patterns and predict pika distribution across the eight park units.
2. Measure gene flow and model connectivity of pika populations within five park units (CRMO included).
3. Project climate change effects on the future distribution, connectivity and vulnerability of pika populations in each park unit.

Pika monitoring

1. Determine current patterns of pika site occupancy in the four parks.
2. Determine trends in pika site occupancy patterns in the four parks.

Methods and Preliminary Results

In 2010, research and monitoring methods were merged into a single survey effort. In July and September, 56 randomly-selected sites (12-m radius circular plots) were searched for evidence of pika occupancy in the form of visual encounters, calls, fresh fecal pellets, and fresh food caches found within the site. Pikas occupied 12 (21%) sites surveyed and occupied sites continue to most often be found in the higher elevation, pahoehoe areas. Eleven fresh fecal pellet samples were collected for genetic analysis.



Map of 2010 occupancy survey results for Craters of the Moon NM&P

Timeline and Future Plans

Data analysis will continue fall and winter 2010. Surveys of new sites and resurveys of current sites are scheduled for 2011 with a final research project report due in 2012. Furthermore, these sites will be monitored over time to detect trends in pika site occupancy using the revised UCBN pika monitoring protocol, which was submitted for approval in November 2010. Further details and results from these efforts will be available on the websites listed below.

Contact Information

Mackenzie Jeffress, University of Idaho / Upper Columbia Basin I&M Network, jeffress@uidaho.edu

"Pikas in Peril" research: http://science.nature.nps.gov/im/units/ucbn/monitor/pika/pika_peril/index.cfm **November 2010**
Pika monitoring: http://science.nature.nps.gov/im/units/ucbn/monitor/pika/pika.cfm

Figure 21. Pika monitoring resource brief (November 2010).

Schedule for Pika Monitoring Project Deliverables

Table 5. Schedule for pika monitoring project deliverables.

Deliverable Product	Primary Responsibility	Target Date	Destination
Pika location data	Project Lead	October 1 (or no later than 2 weeks after completion of field work)	Park and/or UCBN Digital Library[1]
Raw data files	Project Lead	October 1 (or no later than 2 weeks after completion of field work)	Park and/or UCBN Digital Library[1]
Photographs (select, quality images for long-term storage)	Project Lead	October 1 (or no later than 2 weeks after completion of field work)	Park and/or UCBN Digital Library[1]
Certified working database and geospatial data with draft metadata	Project Lead with Data Manager assistance	October 1 (or no later than 2 weeks after completion of field work)	Master project database and GIS data sets, copy to UCBN Digital Library[1], and post to NRInfo
Full metadata (parsed XML)	Data Manager	December 15	NRInfo [2], UCBN Digital Library[1]
Resource Brief	Project Lead	November 1	Park , Park Website, and/or UCBN Website
Annual Report (for internal purposes)	Project Lead	January 15, following year	NRInfo[3], Park and/or UCBN Digital Library[1], printout to park collections, NRPS website[4]
5-year analysis report	Project Lead	Every 5 years by January 2016	NRInfo[3], Park and/or UCBN Digital Library[1], printout to park collections, NRPS website[4]
Other publications	NPS Lead, Project Lead, Data Manager	As completed	NatureBib[3], UCBN Digital Library[1], printout to park collections
Other records	NPS Lead and Project Lead	As completed	retain according to UCBN Data Management Plan guidelines

[1] The UCBN Digital Library is a hierarchical digital filing system stored on the UCBN file server. Network users have read-only access to these files, except where information sensitivity may preclude general access.
[2] Natural Resource Information Portal (NRInfo) is a clearinghouse for natural resource data and metadata (http://nrinfo.nps.gov). Only non-sensitive information will be publically viewable. Refer to the protocol section on sensitive information for details.
[3] Bibliographic citations are managed within the national Natural Resource Information Portal (NRInfo) application, which facilitates user citation searches on author, title, keywords, etc. (http://nrinfo.nps.gov). Only non-sensitive information will be publically viewable.
[4] NPS Natural Resource Publication Management Website, available at: http://www.nature.nps.gov/publications/nrpm/.

American Pika Monitoring Protocol

Standard Operating Procedure (SOP) 7: Field Safety and Job Hazard Analysis

Version 1.0, January 2011

Change History

Version #	Date	Revised by	Changes	Justification

Note: This SOP describes recommended safety practices, emergency contact information, and a job hazard analysis for the pika protocol.

Introduction

Encountering hazardous situations is possible in pika monitoring activities, and all surveyors need to be aware of these risks and take adequate precautions. A primary goal of the UCBN and NPS parks is to ensure the safety of its staff and associates while conducting inventory and monitoring activities in the parks. Risks include working in rugged and isolated environments, hiking over rough terrain, extreme weather, and hazardous fire conditions. Emergency contact information is provided in a following section of this SOP, and first aid kits and 2-way radios will be provided to field surveyors. Cell phones should be carried in vehicles, when available, although coverage is spotty in most park areas. In addition to following these SOP, surveyors must complete and review a Job Hazard Analysis and follow safety guidelines in place for each park, which may include tailgate safety sessions, backcountry travel and check-in procedures.

Weather and Field Gear

Field work in these parks can bring with it challenging weather extremes. In the early summer and early fall, cold, rain, and snow are possible. Later in the summer the weather can be very hot (>100° F). Though surveys should not be conducted during or shortly after rain or snow events, the weather can change quickly and it is important to the success of the program that field surveyors are well prepared for weather extremes. Good rain gear, warm clothes, sunhats, sunscreen, and plenty of water are essential field gear. Gloves are also strongly encouraged as searching for pika sign may involve looking under ledges and in crevices on hands and knees and many of these rock types are rough and sharp. It is also recommended to wear lightweight long-sleeve clothing as protection from insects and sun. Given that these surveys are conducted on often rough and uneven rock, it is also important to always wear boots with excellent ankle support, during field sampling. Tennis shoes are not appropriate for this type of field work. Additionally, all loose items, such as sunglasses, pens, and cameras, should be secured while traveling to and conducting surveys.

In 2009, Idaho, Oregon, and California all reported cases of West Nile Virus infection in humans. This is a mosquito-borne virus that can have serious impacts on human health. The U.S. Center for Disease Control website for this disease contains up-to-date information on location of outbreaks and prevention tips. The web address is as follows: http://www.cdc.gov/ncidod/dvbid/westnile/. Given this concern, mosquito repellant and again, protective clothing (i.e., long sleeves) are necessary for all field surveyors. Given that this protocol does not require handling of the animal, the risk of plague transmission is relatively low. Nevertheless, surveyors should check for ticks and other insects often. Additionally, since hantavirus breaks down quickly in sunlight and surveys are being conducted in an open air environment, the risk of contracting the virus is also relatively low. However, surveyors should avoid handling scat without the leather gloves and wash/sanitize their hands often.

Safety Precautions

These parks are extremely rugged and remote. Steep slopes and cliffs and broken lava and talus expanses are routinely encountered. While sampling frames exclude slopes over 35°, these areas may need to be traversed when traveling between sites. Conservative decision making is imperative. An injury, even a minor one, could cause a substantial interruption in field schedules and overall monitoring program progress. Minor injuries can become serious life-threatening incidents if complications such as cold weather and long distances back to a vehicle are present. Be prepared!

Field schedules, particularly when long travel distances are involved, often end after normal working hours. A clear communication procedure must be established between all surveyors and the Project Lead. Cell phone coverage at park sites is intermittent and should not be relied upon in case of an emergency. Arrange to call a primary park contact, even at home, upon safe return if after park hours. Park radios may be issued as a means for field personnel to be able to contact the park, or, after hours, a BLM or Forest Service dispatch office in case of serious emergency. Check with the park contact for radio availability and use procedures.

Additional inherent risks with implementing this protocol include the following:

Backcountry roads and trails – Accessing sample sites may require travel on secondary roads that are graveled or dirt, and some sites require hiking. Some access roads are not well maintained and high vegetation growing up through roads can block view of rocks or other objects that can damage vehicles. Vegetated roads can also pose serious fire hazards when driving over them with hot vehicles. Fire protection equipment must be maintained in working condition and be available in work vehicles at all times. It is incumbent upon field surveyors to maintain regular contact with Park staff to review developing hazards.

Activities during sampling – Locating pika survey sites will require hiking over rugged and steep terrain. While an effort has been made to reduce exposure to unsafe terrain with restricted sampling frames, exposure to some rugged terrain is unavoidable. It is incumbent upon field personnel to make conservative decisions and choose safest routes possible to access sampling areas. This may require longer travel times in order to circumvent risky terrain. Consequently, this may reduce the number of sites surveyed in a day. Safety is more important than productivity, and the NPS wants all participants to use good judgment. Proper field gear, including good footwear, long pants, gloves, sun and rain protection, adequate food and water, and a flashlight will help mitigate many of the risks encountered in the field.

Emergency Contact Information

Having established lines of communication and a check-in/check-out procedure are essential to ensure timely assistance can be provided in case of a mishap or delay. A routine will be established where UCBN field staff will contact park staff to notify them of the time and location of work in each park using email or other written forms of communication. In addition, it is advisable to leave a written travel plan with UCBN staff or other NPS staff. This plan should include the time and location of work and return times. Park managers and UCBN staff (if involved) should be notified if plans have been modified. The following section contains emergency contact information for each park. Field surveyors may obtain a field radio programmed for the applicable radio frequencies used by each park and BLM/USFS district where they will be working. Cell phones should be carried when working in parks with adequate cell phone coverage.

CRLA

If you need an officer, **contact** park dispatch on a handheld radio or at (541) 594-3060. CRLA has trained EMTs and an ambulance available. If you cannot reach dispatch, contact the Umatilla County Sheriff's Department in Crater Lake @ (541) 966-3600. If you have an **emergency**, please call 911. The Shady Cove Medical Center in Shady Cove, OR (21990 Highway 62; 541-878-2022), can handle minor trauma and non-life threatening injuries. The closest hospitals are the Sky Lakes Medical Center in Klamath Falls, OR (541-274-6176; approx. 60 miles from park), and Providence Emergency Department in Medford, OR (541-732-5000; approx. 80 miles from park).

CRMO
If you need an officer, **contact** the law enforcement rangers @ radio 200, 202, 203 or (208) 527-1321 or 1322. The visitor center at radio # 300 or phone (208) 527-1300 can relay information to rangers as well. If rangers are unavailable or unreachable the Butte County Sheriff's Office in Arco @ (208) 527-8553 monitors NPS radios and can be reached by calling Butte County. If you have an **emergency**, please call 911. The closest medical center capable of emergency services is the Lost Rivers Medical Center in Arco, ID (551 Highland Dr.; 208-527-8206). Another medical center is available between Hailey and Ketchum approx. 60 miles northwest of the park visitor center (St. Luke's Wood River Medical Center, 706 S. Main St.; 208-727-8800).

LABE
If you need an officer, **contact** the Siskiyou County Sheriff's Office in Yreka @ (530) 842-8300. If you have an **emergency**, please call 911. The closest hospital is Sky Lakes Medical Center in Klamath Falls, OR (541-274-6176), approx. 1 hour from the park.

LAVO
If you need an officer, **contact** the Shasta County Sheriff's Department in Shingletown @ (530) 474-1037. If you have an **emergency**, contact Lassen Dispatch by radio or phone (209-379-1992) or call 911. The following medical centers are capable of emergency services:

- Chester
    - Seneca District Hospital, 130 Brentwood Drive, 530-258-2151
- Red Bluff
    - St. Elizabeth Hospital, 2550 Sister Mary Columbia Drive, 530-529-8000
- Redding
    - Redding Medical Center, 1100 Butte Street,530-244-5400
      Mercy Medical Center, 2175 Rosaline Avenue, 530-225-6000

Job Hazard Analysis
The Project Lead will, in conjunction with his/her supervisor (and, if appropriate, other knowledgeable persons), develop a Job Hazard Analysis (JHA) of the task to be performed within each park. At the beginning of each sampling season all personnel will review the appropriate JHA and make modifications as necessary. Once reviewed and finalized, the JHA worksheet must be signed by all field personnel. The procedure to be used for writing a JHA is presented in NPS Reference Manual #50B, Occupational Safety and Health Program (NPS 1999) and an example JHA developed for 2010 field work in all 4 parks is presented on the following pages.

<table>
<tr><td colspan="2">JOB HAZARD ANALYSIS</td><td>Date:</td><td>New: X
Revised:</td></tr>
<tr><td>Park Units:
CRLA, CRMO, LABE, LAVO</td><td>Division:</td><td>Branch:</td><td>Location:</td></tr>
<tr><td colspan="2">Job Title:
Pika surveyor</td><td>JHA Number:</td><td>Page _1_ of _5_</td></tr>
<tr><td>Job Performed By:</td><td>Analysis By:</td><td>Supervisor:
Mackenzie Jeffress</td><td>Approved By:</td></tr>
<tr><td>Required Standards and General Notes</td><td colspan="3">Read the entire UCBN pika monitoring protocol, including SOP #7: Field Safety. Drive and hike carefully. Bring all necessary equipment to the field.</td></tr>
<tr><td>Required Personnel Protective Equipment</td><td colspan="3">Sturdy hiking boots, long pants, warm clothing / hat, rain gear, sunscreen, sunglasses, food, insect repellent, full water bottles, gloves, first aid kit.</td></tr>
<tr><td>Recommended or Optional Equipment</td><td colspan="3">High-visibility safety road vests, two or more traffic cones, trekking poles, bear deterrent spray</td></tr>
<tr><td>Tools and Equipment</td><td colspan="3">Field data sheets, clipboard, pencils, compass, maps, GPS unit, park radio, flashlight, emergency contact information and a copy of the pika monitoring protocol.</td></tr>
<tr><th>Sequence of Job Steps</th><th>Potential Hazards</th><th colspan="2">Safe Action or Procedure</th></tr>
<tr><td>Accessing the survey site</td><td></td><td colspan="2"></td></tr>
<tr><td>1. Access by car</td><td>1a. Car accidents</td><td colspan="2">WEAR SEATBELTS AT ALL TIMES WHEN VEHICLE IS MOVING. Drive only on established roads, follow all driving laws, and park in a location that will not obstruct traffic. Traffic cones may be useful to warn other drivers if the vehicle is parked on the edge of the road. Do not talk on a cell phone or text while driving. NPS employees and volunteers are prohibited from using a cell phone while driving, even if used with a hands-free device.</td></tr>
<tr><td></td><td>1b. Narrow or unimproved roads with bumpy or “washboard” surfaces</td><td colspan="2">Maintain a safe speed (this if often below the legal speed limit) for the road condition. Stay clear to the right, especially on curves, and drive with headlights on at all times. When turning around on mountain roads always “face the danger” (versus backing toward the cliff edge). The passenger should get out and spot for driver when backing up.</td></tr>
<tr><td></td><td>1c. Driving with limited visibility</td><td colspan="2">Maintain windshield cleaner fluid level and clean both sides of windows regularly (remember back window). Slow down. If blinded by sun or dust, proceed slowly or pullover and wait for hazard to pass. Keep to the right hand side of the road and drive with your lights on. Allow at least four seconds between you and the vehicle ahead of you to allow stopping time.</td></tr>
</table>

	1d. Sharp rocks on edge or in middle of road	Get out and move sharp rocks out of the road. Reduce speed in places with large amounts of rockfall. Make sure tires are properly inflated and check tread and walls regularly for damage. Make sure tire jack fits the vehicle and all parts are in the vehicle.
	1e. Large animals crossing or standing in roads	Slow down where animals might be present to allow for reaction time. Do not swerve abruptly to avoid hitting an animal; if necessary it is better to ride out the impact.
	1f. Fatigue	Be aware of signs of fatigue- pull over and rest! Take a short nap, eat a snack or have a partner drive; do not take chances by continuing to drive. Communicate with any passangers.
	1g. Inclement weather	Keep informed on the current weather - check www.weather.com or www.wrh.noaa.gov. Avoid travel and attempt to reschedule field work if inclement weather is forecasted.
	1h. Fallen trees on road	For small trees, try and remove tree. For large trees, notify support crew to remove tree.
	1i. Others driving on the road	Drive slowly and keep to the right! If you encounter an unusual situation, contact your partner to inform and notify a park ranger. Avoid confrontational situations with other people- let the proper authorities handle it!
	1j. Fire ignition from vehicle undercarriage/catalytic converter	Avoid driving over vegetated two-track roads, monitor accumulated vegetation underneath vehicle, and carry fire prevention and extinguishing equipment at all times.
2. Access by hiking	2a. Steep, rugged, and slippery terrain can cause falling, slipping, tripping, and rock fall	Proper footwear is VERY important- wear fitting boots with slip-resistant soles with tops well above the ankle. Tennis shoes are not acceptable. Try to walk on established trails. If trails are unavailable, assess terrain conditions to find safe route. Avoid thick vegetation and bank edges. Move slowly and deliberately across steep areas. Use trees and solid rocks for handholds when they are available. Check footholds before using them. Trekking poles may be helpful to increase stability in uneven terrain. Fall into the slope if you slip or slide. Have a companion spot you from a more secure location. Plan to cross snow or ice fields late in the day for better footing. Cross streams early before flow increases due to increased run-off. Never be above or below someone on a loose or unstable slope. Cross any fences carefully.
	2b. Disorientation	Ensure all personnel are knowledgeable with map and compass as well as GPS usage. Keep track of current position, vehicle location, and location of prominent landmarks with frequent map updates. Whenever possible, stick to established trails.

3. Encountering noxious plants, animals, and people	3a. Poison ivy/poison oak	Make sure you can identify poison ivy/poison oak and avoid densely vegetated riparian areas. Wear long sleeves, avoid sitting with arms resting on knees, use Tecnu lotion (or similar) to prevent exposure; and wash with soap immediately after returning from the field. If possible, bring an extra set of clothes and shoes to change into after coming out of field; wash field clothes separately from other laundry.
	3b. Bees/Wasps/Hornets	Determine if you are allergic to bee stings. If so; ensure that you carry prescribed medication to prevent anaphylactic shock; carry a bee sting kit or Benadryl or other antihistamine. Be aware of the ground where you step- some hornets build nests in the ground at the base of trees or shrubs, or in rotten logs- watch for bees buzzing in and out of holes or around ground level.
	3c. Ticks	If bitten by a tick, remove it (grasp tick with tweezers at head and pull straight out) and fill out an accident report in the event that symptoms of Lyme disease appear eventually.
	3d. Mosquitoes	Wear bug repellent and long sleeve shirt to prevent bites. Be aware of West Nile Virus symptoms.
	3e. Rattlesnakes	Avoid rattlesnakes by inspecting the ground near logs before stepping over them. Avoid placing hands on rock ledges or other natural hoists without visually inspecting them first. In the unlikely event you are bitten by a rattlesnake, stay calm, sit still, and call and wait for help.
	3f. Encounters with large wildlife (e.g., bear, mountain lion, moose)	If you encounter wildlife, keep your distance and change directions. If a black bear charges, look big, raise your arms, and stand your ground. As soon as the bear backs away, you should as well. In the unlikely event that a bear does make contact with you, roll into a ball, face down with your hands over your neck. If the bear continues its aggression, bear experts advise that you fight back. Bear deterrent spray may be carried but be sure to know how to use it before carrying it as a line of defense. If you encounter a mountain lion, do not run away but rather look big and make loud, firm noises. In the unlikely event that a lion does attack you, fight back!
	3g. Encounters with strangers	Report uncomfortable encounters with strangers in the park to a supervisor/park ranger as soon as possible. Report apparent illegal activity to a park ranger. Do not get into a confrontation with other people in the park. Do not cross onto private property without first obtaining permission from the landowner.
4. Exposure to environmental variables	4a. Sunburn / heat stress	To prevent sunburn, use 30+ or greater SFP sunscreen and lip balm; and wear a hat, sunglasses, and shirt. Drink plenty of liquids, keep hydrated, and take frequent breaks for snacks and water.

	4b. Inclement weather	Obtain weather forecasts daily. Always carry rain gear, a warm hat, gloves, and a warm jacket. Move to lower elevations away from tall trees as storms approach.
	4c. Giardia	Giardia may be present in the parks. Do not drink from any stream, river, lake, or pond unless the water has been properly filtered or treated.
Once on site, the surveyor will survey the site		
5. Hiking and searching	5a. Steep, rugged, and slippery terrain can cause falling, slipping, tripping, and rock fall	Proper footwear is VERY important- wear boots with slip-resistant soles with tops well above the ankle. Tennis shoes are not acceptable. Use trees and solid rocks for handholds when they are available. Check footholds before using them. Fall into the slope if you slip or slide. Never be above or below someone on a loose or unstable slope.
	5b. Sharp rocks	Surveys occur on talus and lava, which are often comprised of sharp, jagged rocks. Wear gloves to protect your hands and be careful when kneeling. Watch out for overhead rocks when standing up.
	5c. Hantavirus	Although hantavirus breaks down quickly in sunlight and the risk of contracting the disease is low, avoid sticking your head inside the crevices and avoid sniffing or disturbing unknown rodent feces.
Leaving the site		
6. Returning by hiking	6a. Steep, rugged, and slippery terrain can cause falling, slipping, tripping	Proper footwear is VERY important- wear fitting boots with slip-resistant soles with tops well above the ankle. Tennis shoes are not acceptable. Try to walk on established trails. If trails are unavailable, assess terrain conditions to find safe route. Avoid thick vegetation and bank edges. Move slowly and deliberately across steep areas. Use trees and solid rocks for handholds when they are available. Check footholds before using them. Trekking poles may be helpful to increase stability in uneven terrain. Fall into the slope if you slip or slide. Have a companion spot you from a more secure location. Plan to cross snow or ice fields late in the day for better footing. Cross streams early before flow increases due to increased run-off. Never be above or below someone on a loose or unstable slope. Cross any fences carefully.
7. Returning by car	7a. Car accidents	WEAR SEATBELTS AT ALL TIMES WHEN VEHICLE IS MOVING. Drive only on established roads; follow all driving laws; park in a location that will not obstruct traffic.

JHA Instructions

The JHA shall identify the location of the work project or activity, the name of Volunteer(s) involved in the process, the date(s) of acknowledgment, and the name of the appropriate supervisor approving the JHA. The supervisor acknowledges that volunteers have read and understand the contents, have received the required training, and are qualified to perform the work project or activity.

Identify all tasks and procedures associated with the work project or activity that have potential to cause injury or illness to personnel and damage to property or material. Include emergency evacuation procedures (EEP).

Identify all known or suspect hazards associated with each respective task/procedure listed. For example:

a. Research past accidents/incidents.
b. Research the Health and Safety Code, or other appropriate literature.
c. Discuss the work project/activity with participants.
d. Observe the work project/activity.
e. A combination of the above.

Emergency Evacuation Instructions

Work supervisors and volunteers are responsible for developing and discussing field emergency evacuation procedures (EEP) and alternatives in the event a volunteer(s) becomes seriously ill or injured at the worksite.

Be prepared to provide the following information:
a. Nature of the accident or injury (avoid using victim's name).
b. Type of assistance needed, if any (ground, air, or water evacuation).
c. Location of accident or injury, best access route into the worksite (road name/number), Identifiable ground/air landmarks.
d. Radio frequencies.
e. Contact person.
f. Local hazards to ground vehicles or aviation.
g. Weather conditions (wind speed & direction, visibility, temperature).
h. Topography.
i. Number of individuals to be transported.
j. Estimated weight of individuals for air/water evacuation.

The items listed above serve only as guidelines for the development of emergency evacuation procedures.

JHA and Emergency Evacuation Procedures Acknowledgment

I, the undersigned volunteer, acknowledge participation in the development of this JHA (as applicable) and accompanying emergency evacuation procedures. I have read them thoroughly and understand the provisions of these documents:

PRINT NAME	SIGNATURE	DATE

American Pika Monitoring Protocol

Standard Operating Procedure (SOP) 8: Field Reference Manual

Version 1.0, January 2011

Change History

Version #	Date	Revised by	Changes	Justification

Note: This frequently updated SOP serves as the location and assembly mechanism for developing a park-specific Field Reference Manual for each pika crew member. It includes current field form, sample maps, UTM coordinates for sampling locations in the GRTS sequential order, ocular cover guides, and other vital information not already presented in previous SOPs. Contents of the manual should include:

A sturdy ring-bound Field Reference Manual that easily fits into a daypack will be provided to each field technician with the following:

- Field data entry form and instructions
- Sampling maps identifying clusters of proximal sample points, access locations, and other key travel information for the park where they will be sampling (e.g., Figure 22)
- Ocular cover estimation guide (Figure 23)
- List of GRTS design pika sample locations with coordinates for park where they will be working
- Random distance and azimuth table for offsetting sites (e.g., Table 7)
- Field-relevant SOPs (SOP # 1-4)
- Rite-in-the-Rain note paper

UCBN PIKA MONITORING FIELD FORM - 2010

Park:	Site ID:	Date::	Observer 1:	Observer 2:

Arrival time:	Begin time for scat/hay search:	End time for scat/hay search:	Departure time:

Pika sign (types = **P**ika **S**ighting, **P**ika **C**all, **F**resh **H**aypile, **O**ld **H**aypile, **F**resh **S**cat, **O**ld **S**cat)

	Time (24-hr)	Sign type (PS, PC, FH, OH, FS, OS)	Distance (m) from plot center	Notes
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Photos: *if need space for additional photos or a plot sketch, use the notes section or the edge of the data form.)*

1. Camera ID: Initial name: ________
   Dist. to center (m): Az. to center : ______
   Photo Description: ___
   Final name: .jpg
1. Camera ID: Initial name: ________
   Dist. to center (m): Az. to center : ______
   Photo Description: ___
   Final name: .jpg

Site marker:

Site marker found: YES NO

New marker set: YES* NO

If yes, include location description in the notes

Vegetation cover (% class) in plot	Rock:	Bare:	Grass:	Forb:	Shrub:	Tree:

Notes (i.e., coordinates if the site is offset, etc.):

Pika Monitoring Field Form Instructions

Each item refers to a field on the data sheet:

1. **Park code** (4-digit code for the National Park Service unit).

2. **Site ID** (name of selected location; should be a 3 digit number).

3. **Names of observers**; first initial. + full last name (e.g., M. Jeffress).

4. **Date** of survey (e.g., 04 Jul 2010).

5. **Times of day** that bracket the survey period.

    - record the arrival time first, and record departure time just before leaving the site.
    - use military/24 hour (00:00 – 24:00).
    - record multiple start/end times if survey was interrupted (total time should reflect time spent at the site).
    - record the start and end time of a concerted search for scat/haypiles.

6. ***Before recording auxiliary plot data,* take 2 minutes to observe the plot, remaining motionless and silent; immediately after this observation period, search for pika sign.**

    - Record **start time for survey.**
    - record **details for each pika detection**; details should include:

        i. the exact **time** when the sign was encountered.

        ii. the **type of sign**, using the categories given on the data sheet; note that "fresh" hay or scat would contain at least some visible chlorophyll—some green tint—and some flexibility/plasticity, while "old" hay or scat would contain little (hay) or no (scat) visible chlorophyll and would be brittle; in cases where this judgment is difficult to make, explain the problem in a note (see SOP # 2).

        iii. if you see or hear a pika, record your best estimate of the **distance between the plot center and the evidence/detection**.

7. Record **end-time for survey**; this may not be the same as departure time.

8. Visually estimate and record the percent class of **vegetation cover** of the total 12-m radius circle for each of six categories: rock (including all lava), bare ground (including dirt, mineral soil, and litter), forb (all non-graminoid flowering herbaceous plants), grass (graminoids [grasses and sedges]), shrub (woody plants), and trees.

- Cover estimates within each category will not exceed 100% but total estimates summed across all categories may exceed 100%.

- Classes include 0, T, and 1-7 (see SOP # 2).

9. **Take 2 digital pictures** of the site – preferably one close up of the site marker and one at the edge of the site (i.e., ~12 m from the plot center). Record the camera #, initial photo file name/number, and a description of the photo including azimuth to plot center and distance to plot center. Be sure to also record the final file name when files are downloaded, renamed and linked into the database.

10. Note whether or not the previous s**ite marker** was found. If this is the first time the site has been surveyed, cross out this question. Also not whether or not a **new marker** was set. A new marker may be necessary because the original marker could not be found or was damaged.

11. **End-time for the survey (departure time)**, after searching the plot completely and recording all auxiliary data; do not end the search until you've looked under every big surface rock (>0.5 m in largest dimension) within the site; note also that you may continue to see or hear pikas after this time, and you should continue to record details of pika sightings and calls, along with the time(s) of these detections.

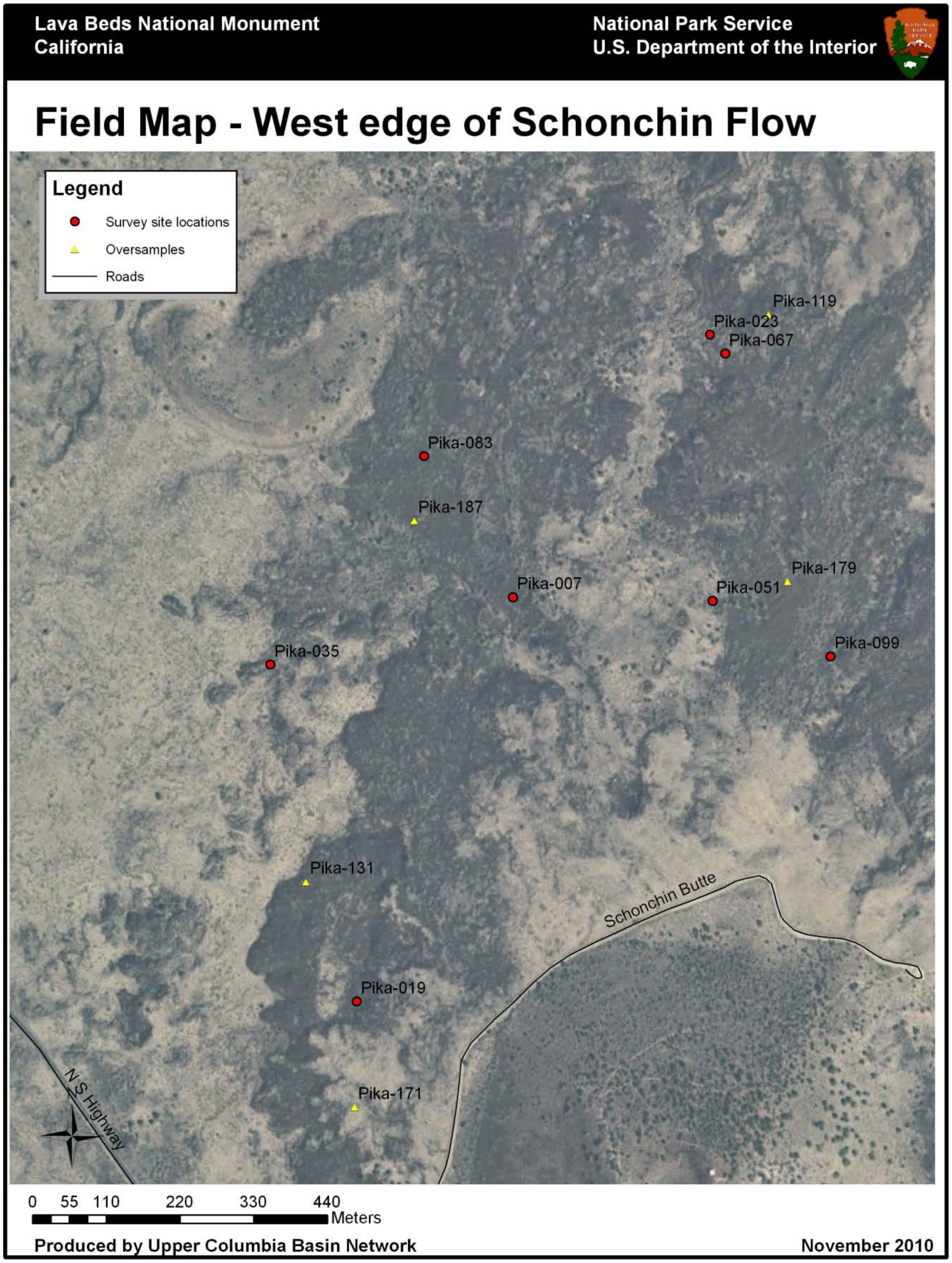


Figure 22. Example of a field map for the Schonchin Flow area of LABE. Several maps should be created for each park and details, such as parking pullouts, should be added as they become available.

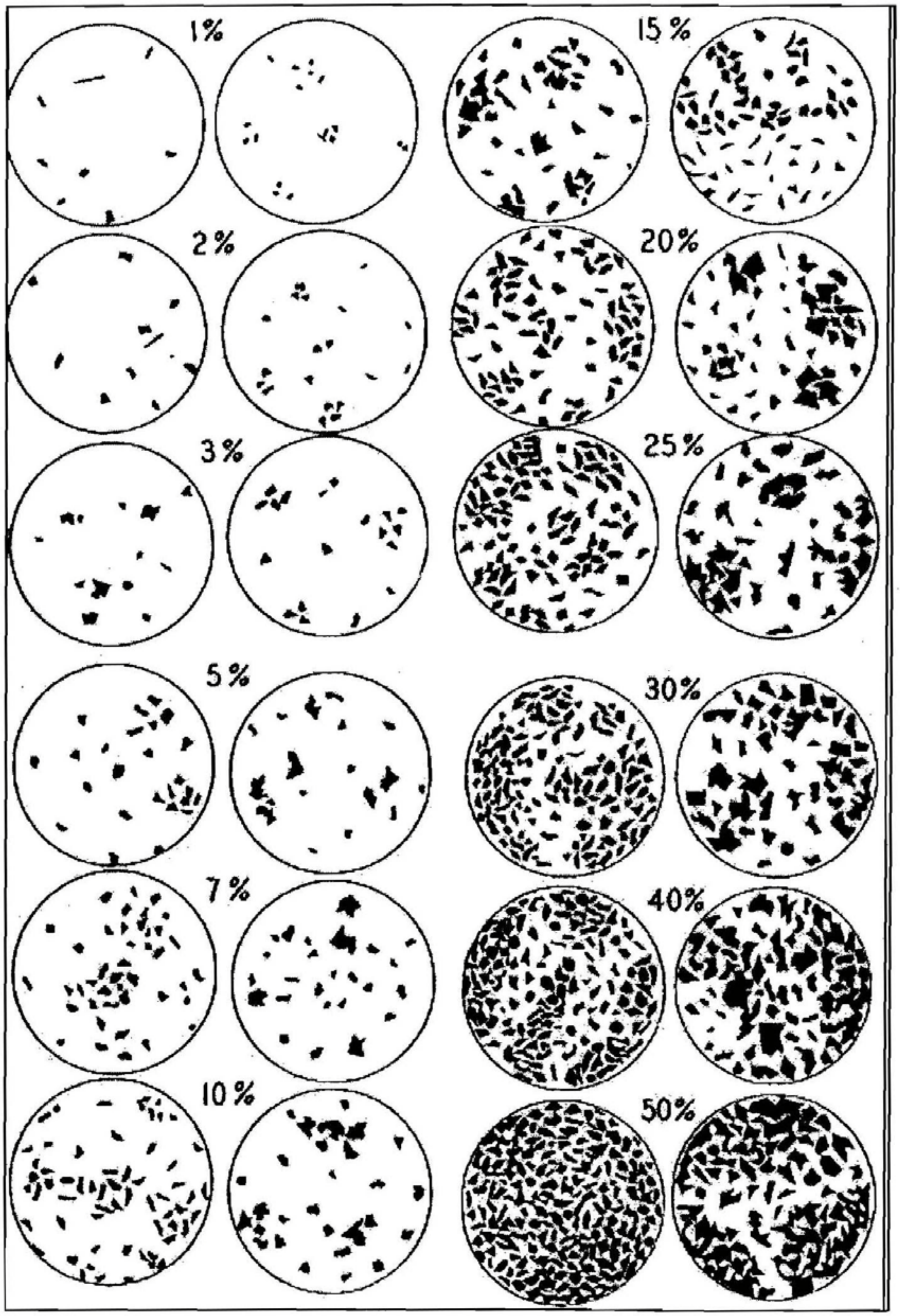


Figure 23. Ocular cover estimation guide for circular plots.

Table 6. Example of a list of GRTS design pika sample locations for CRLA. The coordinates are in UTM Zone 10, and the datum is NAD 83. Table includes 100 primary locations (Panel 1) and 100 oversample locations. If a site is dropped, it should be replaced with the first oversample listed in that stratum. These park-specific tables should be carried by the surveyors while in the field.

Site ID	UTM X (Easting)	UTM Y (Northing)	Stratum	GRTS Weight	Panel	Elevation (m)
Pika-001	577739	4756425	2	130361.0	Panel 1	2102
Pika-002	566894	4755763	3	161267.1	Panel 1	2241
Pika-003	571135	4761042	1	117151.2	Panel 1	2064
Pika-004	570440	4750292	1	117151.2	Panel 1	2034
Pika-005	578182	4753733	4	67449.7	Panel 1	2407
Pika-006	567136	4755698	3	161267.1	Panel 1	2270
Pika-007	569473	4759088	2	130361.0	Panel 1	2151
Pika-008	567735	4753267	3	161267.1	Panel 1	2198
Pika-009	577297	4752032	3	161267.1	Panel 1	2189
Pika-010	567501	4756399	3	161267.1	Panel 1	2247
Pika-011	569220	4758160	3	161267.1	Panel 1	2189
Pika-012	573723	4750112	2	130361.0	Panel 1	2138
Pika-013	579840	4752937	4	67449.7	Panel 1	2412
Pika-014	567544	4754652	3	161267.1	Panel 1	2340
Pika-015	575912	4747417	1	117151.2	Panel 1	2068
Pika-016	574860	4749264	4	67449.7	Panel 1	2337
Pika-017	579986	4753728	3	161267.1	Panel 1	2243
Pika-018	568141	4756464	3	161267.1	Panel 1	2291
Pika-019	569908	4760148	1	117151.2	Panel 1	2032
Pika-020	571021	4750453	2	130361.0	Panel 1	2108
Pika-021	577866	4754139	4	67449.7	Panel 1	2377
Pika-022	567403	4756118	4	67449.7	Panel 1	2321
Pika-023	570064	4760035	1	117151.2	Panel 1	2060
Pika-024	569744	4751340	2	130361.0	Panel 1	2161
Pika-025	576712	4751463	3	161267.1	Panel 1	2238
Pika-026	569038	4757201	3	161267.1	Panel 1	2221
Pika-027	575073	4748116	3	161267.1	Panel 1	2240
Pika-028	575027	4750834	4	67449.7	Panel 1	2382
Pika-029	576089	4747667	1	117151.2	Panel 1	2035
Pika-030	567069	4755447	3	161267.1	Panel 1	2243
Pika-031	572243	4748347	2	130361.0	Panel 1	2127
Pika-032	570915	4746480	1	117151.2	Panel 1	1833
Pika-033	578943	4754368	3	161267.1	Panel 1	2287
Pika-034	567437	4756964	2	130361.0	Panel 1	2175
Pika-035	570531	4758281	4	67449.7	Panel 1	2428
Pika-036	570369	4750359	1	117151.2	Panel 1	2054
Pika-037	577465	4753563	4	67449.7	Panel 1	2344
Pika-038	568046	4756681	3	161267.1	Panel 1	2246
Pika-039	570900	4759691	1	117151.2	Panel 1	2046
Pika-040	571685	4750376	3	161267.1	Panel 1	2371
Pika-041	576568	4749824	1	117151.2	Panel 1	2095
Pika-042	568388	4757571	2	130361.0	Panel 1	2146
Pika-043	573819	4748652	1	117151.2	Panel 1	2016
Pika-044	574587	4749999	4	67449.7	Panel 1	2424
Pika-045	571015	4768269	1	117151.2	Panel 1	1855
Pika-046	567380	4753505	2	130361.0	Panel 1	2123
Pika-047	572299	4747596	1	117151.2	Panel 1	2056

Site ID	UTM X (Easting)	UTM Y (Northing)	Stratum	GRTS Weight	Panel	Elevation (m)
Pika-048	570889	4748411	1	117151.2	Panel 1	1931
Pika-049	578270	4753891	3	161267.1	Panel 1	2373
Pika-050	567771	4757194	2	130361.0	Panel 1	2168
Pika-051	570668	4758600	4	67449.7	Panel 1	2350
Pika-052	569840	4749776	2	130361.0	Panel 1	2103
Pika-053	578167	4753080	3	161267.1	Panel 1	2298
Pika-054	567675	4756361	3	161267.1	Panel 1	2272
Pika-055	570097	4758184	4	67449.7	Panel 1	2387
Pika-056	573182	4749416	2	130361.0	Panel 1	2158
Pika-057	579791	4752642	3	161267.1	Panel 1	2456
Pika-058	569160	4757813	3	161267.1	Panel 1	2190
Pika-059	575498	4746793	1	117151.2	Panel 1	2007
Pika-060	575122	4749322	4	67449.7	Panel 1	2323
Pika-061	565975	4754510	1	117151.2	Panel 1	2091
Pika-062	572177	4758938	2	130361.0	Panel 1	2139
Pika-063	572675	4748296	2	130361.0	Panel 1	2116
Pika-064	568337	4744755	1	117151.2	Panel 1	1921
Pika-065	577761	4753540	4	67449.7	Panel 1	2373
Pika-066	567031	4756009	3	161267.1	Panel 1	2332
Pika-067	569318	4759289	1	117151.2	Panel 1	2094
Pika-068	568594	4751951	2	130361.0	Panel 1	2184
Pika-069	579224	4752928	3	161267.1	Panel 1	2354
Pika-070	567389	4755025	3	161267.1	Panel 1	2301
Pika-071	571684	4748846	2	130361.0	Panel 1	2152
Pika-072	574732	4749767	4	67449.7	Panel 1	2405
Pika-073	577633	4754046	4	67449.7	Panel 1	2404
Pika-074	567475	4755773	3	161267.1	Panel 1	2343
Pika-075	570731	4759267	3	161267.1	Panel 1	2198
Pika-076	570587	4751178	2	130361.0	Panel 1	2161
Pika-077	576061	4747337	1	117151.2	Panel 1	2044
Pika-078	567137	4755174	3	161267.1	Panel 1	2222
Pika-079	572421	4748644	2	130361.0	Panel 1	2146
Pika-080	568219	4747305	1	117151.2	Panel 1	1989
Pika-081	578854	4754020	4	67449.7	Panel 1	2318
Pika-082	567244	4757108	2	130361.0	Panel 1	2155
Pika-083	570696	4758410	4	67449.7	Panel 1	2394
Pika-084	570300	4750812	2	130361.0	Panel 1	2135
Pika-085	577485	4754594	3	161267.1	Panel 1	2339
Pika-086	567960	4756175	4	67449.7	Panel 1	2358
Pika-087	569415	4758294	3	161267.1	Panel 1	2195
Pika-088	573457	4749845	2	130361.0	Panel 1	2136
Pika-089	576613	4750687	1	117151.2	Panel 1	1951
Pika-090	568570	4757084	3	161267.1	Panel 1	2217
Pika-091	574796	4748831	3	161267.1	Panel 1	2277
Pika-092	573823	4750400	2	130361.0	Panel 1	2182
Pika-093	571256	4767389	1	117151.2	Panel 1	1830
Pika-094	567795	4753784	2	130361.0	Panel 1	2180
Pika-095	573257	4748474	2	130361.0	Panel 1	2163
Pika-096	569004	4745508	1	117151.2	Panel 1	1811
Pika-097	578868	4753851	4	67449.7	Panel 1	2331
Pika-098	567778	4756950	3	161267.1	Panel 1	2203
Pika-099	570826	4758825	3	161267.1	Panel 1	2297

Site ID	UTM X (Easting)	UTM Y (Northing)	Stratum	GRTS Weight	Panel	Elevation (m)
Pika-100	568094	4752643	2	130361.0	Panel 1	2178
Pika-101	*577524*	*4753258*	*3*	*161267.1*	*Over Sample*	*2303*
Pika-102	*567613*	*4756023*	*4*	*67449.7*	*Over Sample*	*2343*
Pika-103	*569272*	*4758682*	*2*	*130361.0*	*Over Sample*	*2160*
Pika-104	*572878*	*4749692*	*3*	*161267.1*	*Over Sample*	*2343*
Pika-105	*580232*	*4753312*	*3*	*161267.1*	*Over Sample*	*2414*
Pika-106	*567593*	*4755420*	*3*	*161267.1*	*Over Sample*	*2334*
Pika-107	*575152*	*4747389*	*3*	*161267.1*	*Over Sample*	*2216*
Pika-108	*575079*	*4748906*	*4*	*67449.7*	*Over Sample*	*2304*
Pika-109	*566078*	*4755209*	*1*	*117151.2*	*Over Sample*	*2050*
Pika-110	*571594*	*4759388*	*2*	*130361.0*	*Over Sample*	*2120*
Pika-111	*573740*	*4747435*	*1*	*117151.2*	*Over Sample*	*1893*
Pika-112	*569205*	*4743919*	*1*	*117151.2*	*Over Sample*	*1810*
Pika-113	*576586*	*4757365*	*1*	*117151.2*	*Over Sample*	*2090*
Pika-114	*566880*	*4756089*	*4*	*67449.7*	*Over Sample*	*2317*
Pika-115	*569978*	*4760793*	*1*	*117151.2*	*Over Sample*	*1969*
Pika-116	*570575*	*4750179*	*1*	*117151.2*	*Over Sample*	*1998*
Pika-117	*578171*	*4754125*	*4*	*67449.7*	*Over Sample*	*2352*
Pika-118	*567081*	*4756050*	*3*	*161267.1*	*Over Sample*	*2338*
Pika-119	*569665*	*4759308*	*2*	*130361.0*	*Over Sample*	*2137*
Pika-120	*568438*	*4751897*	*2*	*130361.0*	*Over Sample*	*2152*
Pika-121	*577684*	*4751905*	*2*	*130361.0*	*Over Sample*	*2154*
Pika-122	*567216*	*4756176*	*3*	*161267.1*	*Over Sample*	*2295*
Pika-123	*569223*	*4759019*	*2*	*130361.0*	*Over Sample*	*2132*
Pika-124	*575632*	*4751488*	*1*	*117151.2*	*Over Sample*	*2036*
Pika-125	*578511*	*4753277*	*3*	*161267.1*	*Over Sample*	*2329*
Pika-126	*567489*	*4755216*	*3*	*161267.1*	*Over Sample*	*2276*
Pika-127	*571926*	*4748241*	*2*	*130361.0*	*Over Sample*	*2103*
Pika-128	*574833*	*4749437*	*4*	*67449.7*	*Over Sample*	*2349*
Pika-129	*579549*	*4753475*	*3*	*161267.1*	*Over Sample*	*2312*
Pika-130	*568130*	*4757329*	*2*	*130361.0*	*Over Sample*	*2173*
Pika-131	*570187*	*4760521*	*1*	*117151.2*	*Over Sample*	*1986*
Pika-132	*571214*	*4749711*	*3*	*161267.1*	*Over Sample*	*2202*
Pika-133	*577512*	*4753669*	*4*	*67449.7*	*Over Sample*	*2367*
Pika-134	*567332*	*4755666*	*3*	*161267.1*	*Over Sample*	*2309*
Pika-135	*570867*	*4759901*	*1*	*117151.2*	*Over Sample*	*2036*
Pika-136	*571722*	*4750048*	*4*	*67449.7*	*Over Sample*	*2313*
Pika-137	*577114*	*4753219*	*3*	*161267.1*	*Over Sample*	*2258*
Pika-138	*568447*	*4757627*	*2*	*130361.0*	*Over Sample*	*2143*
Pika-139	*575045*	*4748612*	*3*	*161267.1*	*Over Sample*	*2265*
Pika-140	*575906*	*4750620*	*1*	*117151.2*	*Over Sample*	*1987*
Pika-141	*577608*	*4748633*	*1*	*117151.2*	*Over Sample*	*1887*
Pika-142	*567645*	*4754465*	*3*	*161267.1*	*Over Sample*	*2252*
Pika-143	*572607*	*4748283*	*2*	*130361.0*	*Over Sample*	*2115*
Pika-144	*570491*	*4748255*	*1*	*117151.2*	*Over Sample*	*1915*
Pika-145	*577568*	*4755489*	*2*	*130361.0*	*Over Sample*	*2175*
Pika-146	*567732*	*4756539*	*3*	*161267.1*	*Over Sample*	*2258*
Pika-147	*570305*	*4758136*	*4*	*67449.7*	*Over Sample*	*2433*
Pika-148	*573089*	*4749256*	*2*	*130361.0*	*Over Sample*	*2184*
Pika-149	*565953*	*4754440*	*1*	*117151.2*	*Over Sample*	*2092*
Pika-150	*569393*	*4757586*	*3*	*161267.1*	*Over Sample*	*2230*
Pika-151	*572709*	*4747983*	*1*	*117151.2*	*Over Sample*	*2080*

Site ID	UTM X (Easting)	UTM Y (Northing)	Stratum	GRTS Weight	Panel	Elevation (m)
Pika-152	*569182*	*4745213*	*1*	*117151.2*	*Over Sample*	*1807*
Pika-153	*577838*	*4751477*	*2*	*130361.0*	*Over Sample*	*2134*
Pika-154	*567927*	*4756135*	*4*	*67449.7*	*Over Sample*	*2358*
Pika-155	*569562*	*4758955*	*2*	*130361.0*	*Over Sample*	*2180*
Pika-156	*573221*	*4749192*	*2*	*130361.0*	*Over Sample*	*2122*
Pika-157	*566808*	*4755374*	*3*	*161267.1*	*Over Sample*	*2193*
Pika-158	*575921*	*4757968*	*1*	*117151.2*	*Over Sample*	*2072*
Pika-159	*572878*	*4747599*	*1*	*117151.2*	*Over Sample*	*2036*
Pika-160	*565549*	*4747827*	*1*	*117151.2*	*Over Sample*	*1837*
Pika-161	*576908*	*4757196*	*1*	*117151.2*	*Over Sample*	*2074*
Pika-162	*568247*	*4756338*	*4*	*67449.7*	*Over Sample*	*2321*
Pika-163	*570242*	*4760292*	*1*	*117151.2*	*Over Sample*	*2012*
Pika-164	*570863*	*4750811*	*2*	*130361.0*	*Over Sample*	*2136*
Pika-165	*576735*	*4751674*	*3*	*161267.1*	*Over Sample*	*2256*
Pika-166	*567334*	*4756530*	*3*	*161267.1*	*Over Sample*	*2209*
Pika-167	*575472*	*4746574*	*1*	*117151.2*	*Over Sample*	*1944*
Pika-168	*575273*	*4751003*	*4*	*67449.7*	*Over Sample*	*2328*
Pika-169	*578357*	*4755169*	*3*	*161267.1*	*Over Sample*	*2236*
Pika-170	*567581*	*4757434*	*2*	*130361.0*	*Over Sample*	*2117*
Pika-171	*569549*	*4760539*	*1*	*117151.2*	*Over Sample*	*1978*
Pika-172	*570753*	*4748945*	*1*	*117151.2*	*Over Sample*	*1939*
Pika-173	*576705*	*4752702*	*3*	*161267.1*	*Over Sample*	*2260*
Pika-174	*568194*	*4757814*	*2*	*130361.0*	*Over Sample*	*2108*
Pika-175	*574024*	*4747655*	*1*	*117151.2*	*Over Sample*	*1974*
Pika-176	*574846*	*4750748*	*4*	*67449.7*	*Over Sample*	*2434*
Pika-177	*578417*	*4753413*	*4*	*67449.7*	*Over Sample*	*2375*
Pika-178	*567144*	*4756992*	*2*	*130361.0*	*Over Sample*	*2145*
Pika-179	*570896*	*4758639*	*4*	*67449.7*	*Over Sample*	*2332*
Pika-180	*569527*	*4750327*	*2*	*130361.0*	*Over Sample*	*2142*
Pika-181	*579556*	*4752576*	*3*	*161267.1*	*Over Sample*	*2447*
Pika-182	*568596*	*4756767*	*3*	*161267.1*	*Over Sample*	*2272*
Pika-183	*575623*	*4747022*	*1*	*117151.2*	*Over Sample*	*2093*
Pika-184	*574955*	*4749215*	*4*	*67449.7*	*Over Sample*	*2319*
Pika-185	*578423*	*4754002*	*3*	*161267.1*	*Over Sample*	*2304*
Pika-186	*568091*	*4757153*	*2*	*130361.0*	*Over Sample*	*2185*
Pika-187	*570522*	*4758592*	*4*	*67449.7*	*Over Sample*	*2347*
Pika-188	*567202*	*4753133*	*2*	*130361.0*	*Over Sample*	*2147*
Pika-189	*577727*	*4751802*	*2*	*130361.0*	*Over Sample*	*2148*
Pika-190	*567719*	*4755610*	*4*	*67449.7*	*Over Sample*	*2382*
Pika-191	*569218*	*4758452*	*2*	*130361.0*	*Over Sample*	*2157*
Pika-192	*572793*	*4749979*	*4*	*67449.7*	*Over Sample*	*2388*
Pika-193	*579636*	*4753004*	*3*	*161267.1*	*Over Sample*	*2346*
Pika-194	*567656*	*4755101*	*3*	*161267.1*	*Over Sample*	*2302*
Pika-195	*575757*	*4747497*	*1*	*117151.2*	*Over Sample*	*2092*
Pika-196	*573910*	*4748882*	*1*	*117151.2*	*Over Sample*	*2010*
Pika-197	*566946*	*4756266*	*3*	*161267.1*	*Over Sample*	*2249*
Pika-198	*568913*	*4760265*	*1*	*117151.2*	*Over Sample*	*2054*
Pika-199	*571229*	*4750766*	*3*	*161267.1*	*Over Sample*	*2325*
Pika-200	*565880*	*4747758*	*1*	*117151.2*	*Over Sample*	*1879*

Table 7. Example sheet for random distances and azimuths to use when offsetting a site. Additional sheets can be generated at the following website: http://www.randomizer.org/form.htm.

Distance (m)	Azimuth (°)		Distance (m)	Azimuth (°)		Distance (m)	Azimuth (°)
2	70		22	204		4	242
23	337		3	131		14	117
7	196		19	42		24	137
24	91		7	337		5	261
16	126		12	6		17	289
10	210		1	335		12	74
8	46		6	66		15	103
10	148		24	74		18	188
11	237		11	65		15	178
5	317		21	91		3	231
9	118		16	180		16	102
12	223		12	128		1	203
9	41		10	61		7	11
19	227		2	22		8	322
18	82		6	137		12	21
5	96		18	286		12	261
23	187		16	67		23	247
8	52		12	198		7	140
23	323		14	259		15	217
5	344		8	246		14	96
9	78		5	112		3	153
14	174		19	348		12	229
12	20		1	86		24	2
21	76		13	99		20	107
6	275		19	86		3	287
22	221		20	342		2	299
14	138		23	304		5	260
14	175		25	72		4	311
14	244		16	131		20	170
25	357		15	101		25	6

* Start at the top left; cross them off as you use them.

Allowable distance: 1-25 m   Azimuth: 1-360 (°)

American Pika Monitoring Protocol

Standard Operating Procedure (SOP) 9: Revising the Protocol

Version 1.0, January 2011

Change History

Version #	Date	Revised by	Changes	Justification

Note: This SOP describes the recommended protocol revision practices and provides a history and documentation of the protocol development and revision process.

Procedures

This monitoring protocol is an actively evaluated and updated document that reflects the latest procedures of the monitoring program. Revisions are expected, and can involve only minor changes with little overall impact or occasional major revisions and course corrections. Evaluation and revision of the protocol is directed by the Project Lead on an annual basis in association with season close-out. Any revisions should be coordinated with the UCBN Project Lead and key UCBN staff so as maintain a single working version of the protocol for all four parks. The narrative and each SOP has a revision history log whereby changes can be recorded. Older versions of the narrative and SOPs should be archived to ensure proper legacy of past work is maintained. Each revision will require the updating of the version number. Minor changes are recorded as decimal numbers (e.g. 1.0, 1.1, etc…). Major changes are recorded as a change in the primary number of the protocol version (e.g. 1.0, 2.0, 3.0, etc…). In some cases, major revisions to the protocol may prompt the need for additional peer-review. The UCBN Project Lead will coordinate this with the Regional I&M Program Coordinator.

Development and Revision History Log

Table 8. Protocol development and revision history log. This table summarizes the major events leading to the development and revision of the pika monitoring protocol (Version 1.0).

Date	Development Step	Documentation
2007-2009	Inventory and pilot data collected at CRMO by UCBN and park staff	Inventory results presented in a Resource Brief (see UCBN website)
February 2009	Implementation plan drafted by Lisa Garrett (UCBN) and approved by Jay Goldsmith (PWR) and resource managers from the 4-park protocol	On file – PWR and UCBN offices
April 2009	Proposal funded from NRPP and UCBN funding for protocol development	
May 2009	Task agreement written and funding obligated	PNW CESU Task Agreement #J8W07090006
July 2009	University of Idaho Research Associate hired to develop a monitoring protocol for American Pika in 4 Pacific West Region parks	
November 2009	A Protocol Development Summary (PDS) was developed and submitted to Dr. Jim Agree requesting a formal peer review for the pika protocol in December 2009.	Protocol Development Summary
December 2009	A complete draft of the Pika Monitoring Protocol Narrative and SOPs (version 1.0) were submitted to UCBN and resource management staff for internal and external review	Draft Pika Monitoring Protocol Narrative and SOPs
December 2009	A complete set of documents containing the Pika Monitoring Protocol Narrative and SOPs (version 1.0) were submitted to Dr. Jim Agee and Regional Coordinator Dr. Penny Latham for external peer review.	Pika Monitoring Protocol Narrative and SOPs
April 2010	Peer review comments provided to UCBN by Dr. Jim Agee	Comments available from UCBN
November 2010	Revision "roadmap" detailing revisions and revised final draft protocol narrative and SOPs provided to Dr. Jim Agee and Dr. Penny Latham.	Final draft Pika Monitoring Protocol Narrative and SOPs

Protocol Development Summary (November 2010)

Protocol: American pika

Parks Where Protocol Will Be Implemented: Crater Lake National Park (CRLA), Craters of the Moon National Monument and Preserve (CRMO), Lava Beds National Monument (LABE), and Lassen Volcanic National Park (LAVO)

Justification/Issues Being Addressed:
The American pika (*Ochotona princeps*), a small mammal related to rabbits and hares (Order Lagomorpha), inhabits montane rocky environments of western North America from British Columbia south to the southern Great Basin (Hall 1981). Recently, localized extirpations and range contractions of populations have been documented in the Great Basin (Beever et al. 2003, Grayson 2005) and Yosemite National Park (Moritz et al. 2008). Several authors hypothesize that the mechanism for this range contraction is increased summer warming and decreased snowfall resulting from accelerated climate change, and they further note that given the current predictions of climate change over the next century, the risk of significant population losses is now considerable (Beever et al. 2003, Wagner et al. 2003, Grayson 2005, Parmesan 2006, Beever et al. 2010). The species was recently considered for listing under the Endangered Species Act (USFWS 2009). Although the decision was to not list the American pika as endangered or threatened, the USFWS acknowledged the potential threat to the long-term survival of the species and called for further data on the status, trends, and determinants of distribution for further listing considerations and management (USFWS 2010).

Pikas are charismatic inhabitants of subalpine talus slopes, such as those found at Crater Lake National Park (CRLA) in Oregon and Lassen Volcanic National Park (LAVO) in California. Pikas do not have the ability to tolerate heat, and extended exposure to temperatures of only 80°F can be fatal (Smith 1974, Smith and Weston 1990). Therefore, the subspecies found in the lower latitudes are generally restricted to higher elevations, and in the Great Basin, the species is rarely found below 2500 m (Smith and Weston 1990, Beever et al. 2003, Beever et al. 2008). However, two park sites with lower elevation pika populations are Craters of the Moon National Monument and Preserve (CRMO) in Idaho and Lava Beds National Monument (LABE) in northern California (Beever 2002, Ray and Beever *unpublished report*, Rodhouse et al. 2010). The extensive horizontal lava flows, deep boulder piles, and crevices in the lava flows found at these two parks provide thermal refugia as well as pathways for dispersal over habitat that might otherwise be classified as inhospitable.

A pika survey conducted in LABE from 2005-2006 found that a large proportion (80%) of surveyed areas was occupied by pikas (Ray and Beever *unpublished report*). These findings are significant given the relatively low elevation (<1500 m) and hot climate of the Monument. CRMO also contains lava flow habitats that range from approximately 1200-2000 m, and recent inventory work there found a much lower probability of occurrence (0.2) across the study area (Rodhouse et al. 2010). Habitat models from the CRMO inventory suggest that pikas are restricted to the northernmost, upper elevations in the park above 1600 m. Less information is available for pika populations in the two higher elevation parks included in our protocol development effort, CRLA (approx. 1800 m) and LAVO (approx. 2100 m), although historic records and recent searches for the species suggest that large populations occur there as well.

Four park units in the Pacific West Region and the Upper Columbia Basin Network (UCBN) have formed a partnership to complete outstanding pika inventories in CRLA and LAVO and to develop a long-term monitoring protocol for pikas following common methods that support comparative analyses. The UCBN is collaborating with CRLA, CRMO, LABE, and LAVO to develop a long-term pika monitoring protocol, which may also be of use to other national park units with pika populations. The UCBN plans to fund and implement the monitoring at CRMO while the individual parks plan to fund and implement monitoring at the park level. Long-term monitoring of pikas in these four parks will provide urgently needed information on population trends and will serve as an early-warning system for declining populations. Because each of these four parks provide large amounts of potential habitat, they may become increasingly important as long-term refugia, furthering the need for a well-established monitoring program. Our protocol will provide status and trend information for each park within the context of elevation, a proxy for the physiological stresses directly related to climate change and implicated in pika range contraction. It will also address rates of site turnover (i.e., local site extinction and site colonization), which is necessary to adequately evaluate the long-term probability of the species' persistence in parks. Finally, our protocol will enable park managers to identify critical park areas that support pikas or may support them in the future, and to develop appropriate management strategies for those areas.

Specific Monitoring Questions and Objectives to be Addressed by the Protocol:
Monitoring questions addressed by this protocol include:

- What are the current spatial patterns of pika site occupancy in the four parks?
- What are the trends in pika site occupancy patterns in the four parks?
- Does the status and trend in pika site occupancy patterns vary along the elevational gradient within and among parks?

Monitoring objectives addressed by this protocol include:

1) Determine current patterns of pika site occupancy in CRLA, CRMO, LABE, and LAVO along park elevational gradients.
   Justification*: Pikas are territorial, conspicuous, and easily detected, making them ideal candidates for presence-absence surveys. Occupancy models can be used to identify important habitat covariates making this approach cost-effective given the vast area of potential habitat at these parks.*

2) Determine trends in pika site occupancy patterns in CLRA, CRMO, LABE, and LAVO along park elevational gradients.
   Justification: *Currently little information is known concerning the trends in pika populations at CRLA, CRMO, LABE, and LAVO. Site occupancy is a credible, cost-effective measure of change and examining the change on the proportion of sites occupied and site turnover provides insight into the patterns in site occupancy over time.*

Basic Approach:
The UCBN is developing an occupancy modeling-based approach to pika monitoring following methods outlined by Mackenzie et al. (2006) and Royle and Dorazio (2008) in which trends in percent of area occupied, local extinction and colonization rates, and detectability parameters will be estimated over time. Because pika detectability has been demonstrated to be ≈ 1 in recent low-elevation studies (Ray and Beever *unpublished report*, Beever et al. 2008, Rodhouse et al. 2010) and has generally been assumed 1 for previous studies that census local populations (e.g., Smith 1974, Smith and Gilpin 1997), we will evaluate detection probability during the protocol pilot testing, but anticipate using a simple logistic regression occupancy modeling approach with no inclusion of detection model parameters. A model-based approach to estimating status and trend for pika populations is appropriate because it allows for inclusion of key environmental predictor variables, particularly elevation, providing an ideal framework for testing hypotheses about environmental drivers of pika population dynamics and for improving the precision of trend estimates. Simple analyses of occupancy status during annual summaries will include summaries of the proportion of sites occupied within each park. Occupancy of sites will be determined by surveying for pikas (visual), alarm or social calls (aural), fresh haypiles, and fresh scat following methods established by Smith (1974) and applied more recently in LABE (Ray and Beever *unpublished report*) and CRMO inventories (Rodhouse et al. 2010). Old haypiles and old scat will be interpreted as past use of the site but not used to reflect current site occupancy. The inclusion of indirect sign increases detectability substantially and improves the efficiency and sustainability of long-term monitoring. The use of indirect sign has been used widely for studies of other mammals in addition to pikas (Heinemeyer et al. 2008). Pika surveys will occur at sample locations selected through a spatially-balanced sampling procedure known as the Generalize Random Tessellation Stratified (GRTS) approach (Stevens and Olsen 2004). Each survey site will consist of a 12-m radius survey plot, and generally one survey per site per season will be sufficient. However, if an evaluation of detection probability is warranted, two surveys per site per season will be required.

Principle Investigators and NPS Lead:
Protocol development is being achieved through a cooperative agreement with the Department of Fish and Wildlife Resources, College of Natural Resources, University of Idaho (975 W. Sixth Street, Moscow, Idaho, 83844, 1-208-885-6434).
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Development, Schedule and Expected Interim Products:
A draft pika monitoring protocol was submitted for peer review in December 2009. The peer-reviewed protocol was used in CRLA, CRMO, LABE and LAVO June-September 2010 as a pilot test of the protocol as well as to collect data for a NPS-funded research project titled "Pikas in Peril". The protocol reviews and changes inspired by the 2010 field season were used to revise the protocol, which will be submitted for final approval in January 2011. Annual monitoring reports for CRLA, CRMO, LABE, and LAVO will be submitted to the parks by December 2011.

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NPS XXXXXX, January 2011

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