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Protocol for Surveying Bat Use of Lava Tube Caves during Winter in Craters of the Moon National Monument and Preserve, Standard Operating Procedures

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National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Protocol for surveying bat use of lava tube caves during winter in Craters of the Moon National Monument and Preserve

Standard Operating Procedures

Natural Resource Report NPS/UCBN/NRR—2017/1378

ON THE COVER
Long-eared myotis (*Myotis evotis*) exiting a lava tube cave in Craters of the Moon National Monument and Preserve, Idaho
Photograph by: Michael Durham, reproduced with permission.

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Standard Operating Procedures

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Background

The Upper Columbia Basin Network I&M program and Craters of the Moon National Monument and Preserve are collaborating to monitor winter bat use in Arco Tunnel, which is a safely accessed cave in the northern portion of the monument that consistently has been found with the largest number of bats (~30/year) among the set of caves recently inventoried. The standard operating procedures documented here and the methods described in the associated protocol narrative will also be used to periodically inventory other caves within the monument and surrounding preserve as park resources and safety (winter environmental and accessibility) conditions permit. This protocol addresses the survey objective to regularly count bats in Arco Tunnel during winter (January-March) and in other caves as environmental conditions and staff resources allow.

Standard Operating Procedure 1: Preparation for Cave Surveying

Version 1.0

Change History

Original Version #	Date of Revision	Revised By	Changes	Justification	Page #'s Affected	New Version #

1. Version numbers increase incrementally by tenths (e.g., version 1.1, version 1.2, …etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 …). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number.

2. Notify the UCBN Project Lead and Data Manager of any changes to the SOP so that the new version number can be incorporated in the Metadata of the project database.

3. Post new versions on the internet and forward copies to all individuals with a previous version of the SOP.

Purpose

This SOP describes the step-by-step procedures for preparing for field work and for preparing and organizing field equipment prior to the personnel training and entry into the field. Adequate preparation of equipment for the field and is crucial to a successful monitoring program.

Annual Review

At the end of the field season in March each year, the CRMO Project Lead and UCBN supporting staff should review the entire protocol, including SOPs, in preparation for the next field season to begin addressing any changes needed for the following season. A safety review should be completed to address any outstanding safety concerns. A review of the memorandum of understanding (see Appendix 1 of this SOP) between CRMO and UCBN should be made and necessary changes made to reflect updated roles and responsibilities. Revisions to SOPs should be completed as part of the annual reporting and close-out process.

A vital aspect of successful monitoring includes an annual review of updated white-nose syndrome decontamination protocols provided by the US Fish and Wildlife Service (http://www.whitenosesyndrome.org/topics/decontamination). This may require changes to equipment and survey methodology. Therefore, ample time should be provided between this annual review in fall and the beginning of the winter survey period to accommodate changes and updates to SOPs.

Arranging Overnight Facilities and Research Permits

Arrangements for lodging at CRMO should be made as early as possible prior to the field season. Field crew members have typically stayed in park housing at CRMO and it is imperative to secure arrangements in advance. However, lodging is also available in the town of Arco.

Field surveys are conducted by park staff, therefore research permits are not currently used with the project. However, for surveys conducted by entities not affiliated with the park, permits can be requested through the NPS research permit and reporting system (https://irma.nps.gov/rprs/Home). Requests are coordinated through CRMO's Integrated Resource Management chief.

Survey Locations

All data pertaining to the location and resource knowledge of Arco Tunnel, and all other known CRMO caves, are stored with the project Access database at CRMO and UCBN offices. Cave maps are linked to cave records within the database, and can be viewed directly within the database, or independently as digital image files. Paper copies of maps are also stored onsite at CRMO. Coordinates for uploading to GPS units and for use in GIS are not provided here to protect cave resources, but are maintained in multiple digital formats (e.g., project Access database, spreadsheets, GIS shapefiles) and in hard copy form in CRMO park headquarters and at the UCBN office. Each of these caves is accessible and safe for entry without the requirement for special caving gear and ropes. Information about individual caves can be found in CRMO and UCBN office archives. A map of Arco Tunnel is shown in Figure 1.

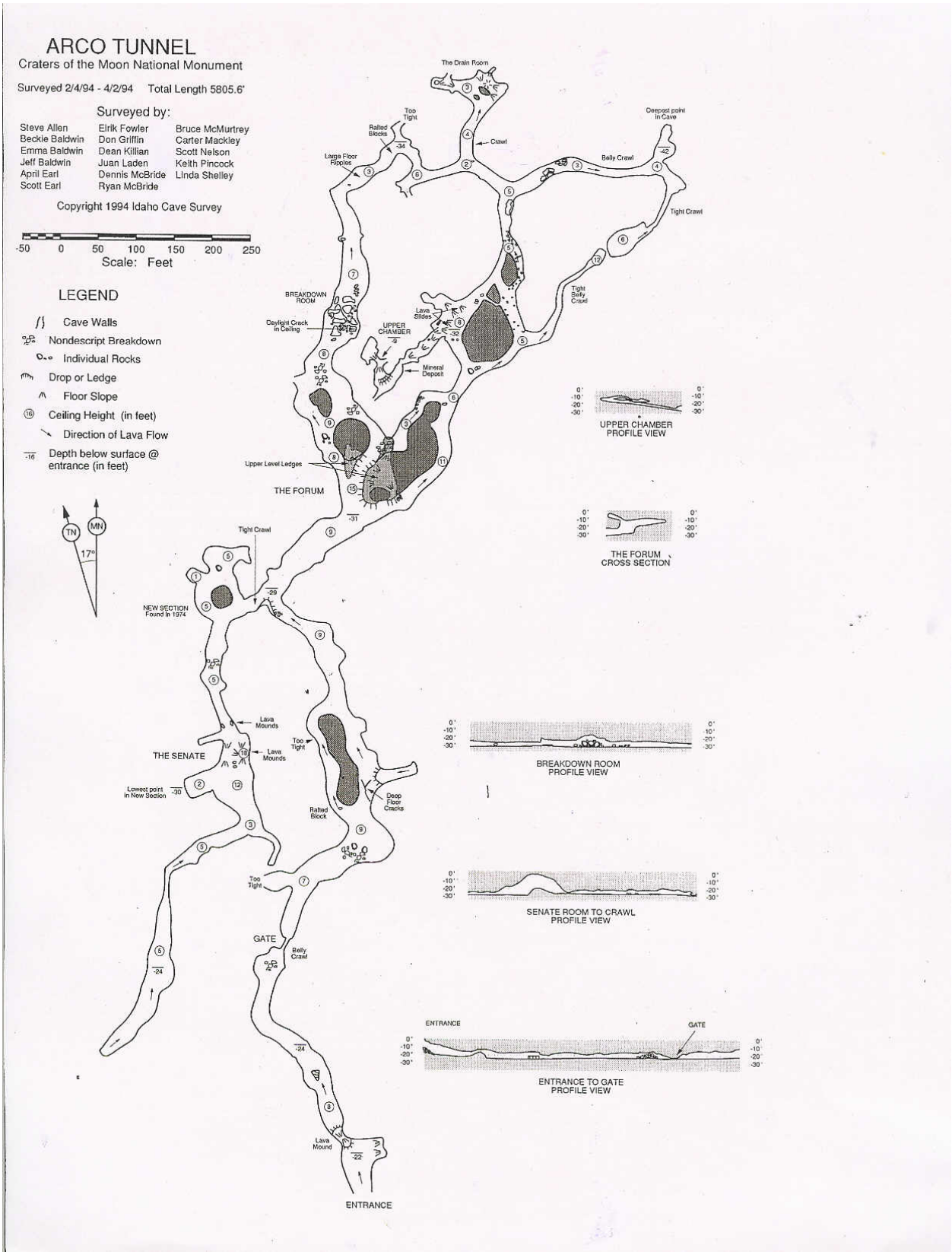

Figure 1. Map of Arco Tunnel.

Auxiliary Cave and Hibernacula Surveys

CRMO's database of caves is a constantly changing body of work that is comprised of both paper and digital cave files, maps, trip reports, and pictures. Only a portion of caves that are present on the monument have been mapped and documented in a uniform manner consistent with the present curation standards, meaning that some caves have nothing more than GPS coordinates associated with them, while others have been professionally surveyed and catalogued. Due to the nature of work performed by CRMO staff, new caves are added to the database regularly during related and unrelated work in the field. If a new cave is found, GPS coordinates and a photo of the cave entrance should be taken and given to the CRMO Resource Management Chief, who will schedule times for surveying these new caves if time and resources are available. GPS coordinates and a photo of the cave entrance should be taken if possible and given to the CRMO Project Lead. Caves that are of interest for their suitability as hibernacula may also be surveyed in the winter as an auxiliary hibernacula survey in order to gather as much data as possible when in the field. All auxiliary hibernacula surveys will be performed in the same manner as Arco Tunnel.

Scheduling and Organizing Field Work

Fieldwork should be scheduled well in advance in order to secure the necessary staff to complete sampling in a timely and efficient manner. Arco Tunnel will be surveyed within the first full calendar week of February. Auxiliary surveys should be scheduled to occur between January 1 and March 15. This ensures temporal stability in the monitoring program, constrains data to the same year, and also to allow time for CRMO employees to attend to other responsibilities. While this doesn't account for potential movement of bats between hibernacula, caves of close proximity tend to be surveyed on the same day in the event that auxiliary surveys can occur. Hiring tasks are minimal because staffing of the hibernacula survey crew usually draws from available CRMO staff. The CRMO Project Lead is responsible for coordinating this planning and determining when to reschedule survey attempts due to inclement weather conditions such as extreme cold events or severe fog.

Equipment Preparation

An inventory of existing equipment, needed repairs identified, and construction or purchases of additional equipment should be made at the end of each field season, and addressed in the intervening time. The required equipment is listed in Table 1. All equipment should be cleaned at the beginning of each field season even if it was cleaned at the end of the previous season. Note that disinfecting wipes and spray and other decontamination equipment may change over time as US Fish and Wildlife decontamination protocols evolve. These protocols can be found at: http://www.whitenosesyndrome.org/topics/decontamination.

Table 1. Equipment list for monitoring bat hibernacula in CRMO.

Equipment Type	**Equipment Description**
Decontamination Equipment	Coverall suit
	Plastic trash bags
	Gallon zip-lock bags
	Rubber boots or boot covers
	Shower caps (optional)
	Disinfecting wipes or spray
	Hand warmers
Personal Protective Equipment	Warm winter clothing
	Caving helmet
	Dust mask
	Snowshoes and trekking poles
	Kneepads/Elbow pads
	Gloves
	Headlamp with spare batteries (50 or more lumens)
	Flashlight with spare batteries (50 or more lumens)
	At least one other source of light (50 or more lumens)
	At least 2 forms of communication (see SOP #6)
	“Yak tracks” or other slip-on traction device (optional dependent on conditions)
	First aid kit/Winter survival kit
	Compass
	Large capacity backpack
Survey Equipment	Laser thermometer
	Kestrel pocket weather meter
	Binoculars
	Laser pointers
	Spotlights (for caves with high ceilings)
	Mechanical pencils and clip board
	Bat identification reference
	Laminated arrows
	GPS with spare batteries
	Digital camera
	Paper cave maps (write in rain)
	Blank paper (if mapping/remapping)
	Measuring tape/reel (if mapping/remapping)
	White boards/dry erase markers

All of the equipment listed here is provided by CRMO to participating survey staff except for personal clothing. The bat identification reference materials include regional photographic and dichotomous keys kept in the CRMO and UCBN libraries, including Verts and Carraway (1998).

Training of Surveyors

The technical expertise, knowledge, skills, and abilities required of field crew are relatively minimal for this protocol in order to ensure long-term sustainability. No specialized caving skills and equipment are required other than the mandatory use of helmets and headlamps (i.e., no rope work is required). Surveyors may encounter tight crawls and other restrictive settings, and comfort in that environment is critical. Winter backcountry travel is required, including safe operation of snowmobiles. Snowmobile operator training is provided by CRMO staff. Training of crew members is conducted in "real-time" by the CRMO Project Lead, with less experienced members assisting the CRMO Project Lead to complete surveys. Typically the survey crew will only consist of the CRMO Project Lead and another CRMO staff. Use of the GPS to locate waypoints and navigate to cave entrances is discussed in SOP #2 and should also be reviewed and practiced before commencing fieldwork. Procedures for cave surveys are detailed in SOP #3. Procedures for data management are in SOP #4. Safety protocols can be found in SOP #5. These SOPs should be used as training manuals and hard copies can be provided to each technician for reference during the survey event. Note that field SOPs are not meant to be stand-alone training manuals replacing the thorough documentation available for GPS units and bat survey and identification techniques. Training personnel should refer to these SOPs as a guide and seek out additional information in the suggested reading and through hands-on training courses provided by NPS and outside sources. A list of technical references for bat identification and survey methodology is provided at the end of this SOP.

The most technically challenging aspect of this protocol is identification of bats to species. Many of the species that occur in Idaho are cryptic in coloration and other distinguishing characteristics. This is especially the case for several *Myotis* species within winter range of CRMO. Digital photographs of bats can be used to assist in species identification, and guidance for taking photographs can be found in SOP #3. Photographs can then be stored in the data management working directory and linked to cluster count records in the database (see SOP #4 for additional details). The most easily identified and most prolific bat known to hibernate at CRMO is the Townsend's big-eared bats, which have distinctively long ears that are typically curled against the body during torpor, but may also be unfurled (Figure 2). Because several species of myotis are morphologically similar (Jacobs et al. 2006, Weller et al. 2007, Rodhouse et al. 2008), identification of myotis bats is not an expectation of this protocol, and will be lumped into a *Myotis* spp. group. Myotis bats generally have smaller, cat-like muzzles and shorter ears (Figure 3). All other unidentified bats will be labelled as "unknown". More photos of other myotis bats can be found in the CRMO directory and also at Bat Conservation International's website (http://www.batcon.org/resources/media-education/species-profiles). Technical keys are available in Verts and Carraway (1998) and Nagorsen and Brigham (1993) that work well for bats of Idaho, although many characteristics are not accessible to observers during winter hibernacula surveys because bats cannot be handled or inspected closely.

Figure 2. Townsend's big-eared bats individually and in a cluster (*Corynorhinus townsendii*) hibernating in CRMO. Note the curled ears and two distinctive nose lumps. They can range in pelage (fur) from blonde to brown.

Figure 3. Examples of myotis species hibernating at CRMO both individually and in a cluster. Myotis generally have cat-like muzzles, small ears, and a range of pelage from blonde to grey.

Preparation of Navigation and Field Data Management Equipment

1) The cave access point locations must be uploaded to GPS units following procedures outlined in SOP #2. At least one back-up GPS unit should also be available and also have all necessary files pre-loaded.

2) Be sure to completely charge all GPS units, radios, and digital cameras, as well as backup batteries, prior to departure for the field.

3) Cave maps must be printed on to waterproof paper, such as rite-in-the-rain products (http://www.rainwriter.com/).

4) Provide each party with at least one compass and map caves to be surveyed.

Miscellaneous Preparatory and Post-field Season Notes

1) Analysis and reporting of previous year's data is necessary before starting a new field effort. This is covered in SOP #4, data management. Update SOPs as necessary.

2) Before entering caves, review environmental information of each to properly prepare for survey days. Approximate survey times, sensitive features, and safety information pertinent to each cave should be reviewed in CRMO's cave database.

3) Crews should be vigilant to maintain a low impact when working in CRMO cave environments. Make sure to be respectful, pack out all trash, and minimize noise and disturbance in caves. Do not break off or pick up and remove cave geologic features. Disruption of bat hibernation in particular should be avoided.

4) Safety is a vital consideration. Each year the project Job Hazard Analysis (JHA) should be reviewed and updated if necessary. All crewmembers must review the JHA (SOP #6) and Green-Amber-Red (GAR) risk analysis exercise prior to beginning fieldwork. The general safety plan (SOP #6) should be reviewed during training, and a tailgate safety meeting should be conducted with all involved field personnel and where specific park hazards, emergency contact information and park emergency procedures are reviewed. A brief review of the severity, probability, and exposure risks ("SPE" risk analysis) should also be conducted during the tailgate meeting. Park safety protocols must be reviewed and adhered to. Communications between surveyors and office staff will be facilitated with 2-way radios. Cell phones may be used in addition to two-way radios but coverage is spotty at best. The survey team must check in with park contacts periodically during field work to keep abreast of developing safety information, and to provide park staff with locations of operation. Make sure each team member knows where vehicle keys are to be stored during field operations and emergency contact and operation procedures for the park. Communication among team members within caves can be facilitated with white boards and dry erase markers and laminated cardboard arrows. These tools can be used to indicate time and direction of travel into and out of cave passages, reducing confusion and increasing efficiency of cave surveys.

5) After the field season be sure to clean and organize all non-electronic equipment and store in well labeled plastic bins in CRMO headquarters. Some of this equipment will be used by other park projects so it is essential that it is well organized. Remove batteries from GPS units and any other electronic tools requiring long-term winter storage.

CRMO Hibernacula Survey Data Sheet

Cave: _____ Cave #: _____ Total Zones:___

Date: _____ Start time: _____ Stop time: _____

Remarks: _____

Crew Lead/Observers:_____

Mark individuals, clusters, and environmental observations in individual rows.

Record bats hibernating individually with tally marks. Use a whole number to denote the number of individuals within a cluster.

Record temperature and humidity up to three times per zone. Measure temperature and humidity in immediate space of bats, if present.

Zone	Species	Cluster	Count	Ceiling temp (^{o}C)	Air temp (^{o}C)	Comments (dead bats, flying bats, guano, etc.)	Photo number

Species Code	Scientific Name (Common name)	Species Code	Scientific Name (Common name)
ANPA	*Antrozous pallidus* (Pallid bat)	MYLU	*Myotis lucifugus* (Little brown bat)
CACI	*Myotis californicus or Myotis ciliolabrum* (see others)	MYSP	Myotis species
COTO	*Corynorhinus townsendii* (Townsend's big-eared bat)	MYTH	*Myotis thysanodes* (Fringed myotis)
EPFU	*Eptesicus fuscus* (Big brown bat)	MYVO	*Myotis volans* (Long-legged myotis)
LABL	*Lasiurus blossevillii* (Desert red bat)	MYYU	*Myotis yumanensis* (Yuma myotis)
LACI	*Lasiurus cinereus* (Hoary bat)	PAHE	*Parastrellus Hesperus* (Western pipistrelle)
LANO	*Lasionycteris noctivagans* (Silver-haired bat)	TABR	*Tadarida brasiliensis* (Brazilian free-tailed bat)
LONG	*Myotis evotis or M. thysanodes* (see others)	MYEV	*Myotis evotis* (Long-eared myotis)
MYCA	*Myotis californicus* (California myotis)	YULU	*Myotis lucifugus* or *Myotis yumanensis*
MYCI	*Myotis ciliolabrum* (Western small-footed bat)	UNKN	Unknown

References

Nagorsen, D. W., and R. M. Brigham. 1993. The bats of British Columbia. UBC Press, Vancouver, British Columbia, Canada.

Verts, B. J., and L. N. Carraway. 1998. Land mammals of Oregon. University of California Press, Berkeley.

Appendix 1. Memorandum of understanding for CRMO and UCBN roles and responsibilities. Signed copies are on file with UCBN and CRMO office.

MEMORANDUM OF UNDERSTANDING

Implementation of Bat Monitoring Protocol

at Craters of the Moon National Monument and Preserve

This memorandum of understanding (MOU) is entered into by and between the Upper Columbia Basin I&M Network (UCBN) and Craters of the Moon National Monument and Preserve (CRMO).

I. Background and Purpose

The purpose of this MOU is to establish roles and responsibilities for long-term monitoring of bat hibernacula resources at CRMO. In the Upper Columbia Basin Network monitoring plan (https://irma.nps.gov/DataStore/Reference/Profile/649166) bats are identified as a high priority "vital sign." The UCBN Inventory and Monitoring program and the CRMO Integrated Resource Management (IRM) program collaborated in development of a bat monitoring protocol focusing on bat counts in winter hibernation sites within lava tube caves [Rodhouse et al. version 1.0, May 2016]. Long-term monitoring of significant cave hibernacula sites, such as the Arco Tunnel cave, will provide valuable information on the status of bats within CRMO, and contribute to the scientific understanding of localized fluctuations in bat use of winter hibernacula in caves and to detection of diseases such as white nose syndrome.

II. Description of Roles and Responsibilities

The UCBN I&M program will continue to provide data management, data analysis, and reporting assistance to the CRMO IRM bat monitoring program. This assistance includes strategies and tools for data collection and data entry, database development and support, statistical analysis of bat monitoring data, and development of summary reports and of manuscripts for publication in scientific journals. CRMO IRM will in a timely manner inform UCBN of its ongoing capacity to conduct field work, provide logistical and safety support of field work, enter and verify bat monitoring data in the protocol database, and collaborate with UCBN staff and other collaborators on data analysis and reporting. CRMO IRM will monitor the Arco Tunnel hibernaculum according to the monitoring protocol in effect at the time of monitoring, and provide resulting data to UCBN. CRMO IRM will complete monitoring and related tasks for additional sites to the extent possible given CRMO IRM's annual workload and field schedules, staff, facility, and equipment needs, and costs and budget considerations. UCBN will invite CRMO IRM staff to co-author summary reports and manuscripts for publication in scientific journals where CRMO data will be presented.

III. Periodic Assessment of the Bat Monitoring Protocol

The UCBN and CRMO IRM programs will mutually assess the bat monitoring protocol no later than one month after the end of field data collection each year to determine any needed modifications to sampling methods, sampling sites, and sampling frequency. Changes will be documented by the UCBN I&M program in the bat monitoring protocol which is published in the NPS Natural Resource Report series. In addition, every five years, the UCBN I&M and CRMO IRM programs will mutually assess how well the data analysis and reporting products are meeting the bat monitoring protocol objectives. These periodic assessments will involve CRMO IRM staff and may result in adjustments to monitoring objectives, methods, and statistical analysis strategies.

IV. General Provisions

Term of Agreement. This agreement will remain in effect throughout the duration of the NPS Inventory and Monitoring Program. Any signatory may withdraw from the agreement upon notification of all other signatories. No further amendment to the agreement would be required for this action.

Amendments. Any signatories may propose changes to this agreement. Any change will be in the form of an amendment and will not take effect until all signatories have agreed to and signed the amendment.

Periodic Review. The signatories and/or the UCBN Board of Directors will review this agreement at least every five years to assess its adequacy, effectiveness, and continuing need. CRMO IRM staff will be invited to participate in any periodic review.

V. Approval Signatures

We the following agree to the terms of the above-described agreement.

_____ _____

Program Manager, Upper Columbia Basin Network Date

_____ _____

Superintendent, Craters of the Moon National Monument and Preserve Date

Standard Operating Procedure 2: Finding GPS Waypoints

Version 1.0

Change History

Original Version #	Date of Revision	Revised By	Changes	Justification	Page #'s Affected	New Version #

4. Version numbers increase incrementally by tenths (e.g., version 1.1, version 1.2, …etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 …). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number.

5. Notify the UCBN Project Lead and Data Manager of any changes to the SOP so that the new version number can be incorporated in the Metadata of the project database.

6. Post new versions on the internet and forward copies to all individuals with a previous version of the SOP. A list will be maintained in an appendix at the end of this document.

Purpose

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 Manuel. Garmin International, Olathe, Kansas. Available online at http://www8.garmin.com/support/userManual.jsp

Before the Field

Preparation is essential 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. For the bat hibernacula monitoring protocol, locations of the 33 monitored caves are known by the CRMO Project Lead and other CRMO natural resources staff, although navigation using GPS is still necessary, particularly during winter when snow cover can cause confusion.

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 the 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 World Geodetic System 1984 (WGS84) datum. With the Garmin MAP76CSx, use the Units Setup Menu to select the position format and map datum.

Table 2. Map datum and Transverse Mercator projection for CRMO.

Park	Datum	Projection	Linear Unit
CRMO	NAD 1983	UTM Zone 12N	Meters

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. With the 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:
Lastly, fully charge the batteries and remember to take spares. The Garmin Map76 units use 2 (AA) batteries and can fail on battery power quickly and without warning. Spare batteries should always be carried into the field to ensure safety and to avoid lost work time. Remember to shut down units while surveying to save battery life.

Loading Waypoints:
Upload cave entrance locations as waypoints to the Garmin Map76CSx as waypoints with 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. 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. 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.

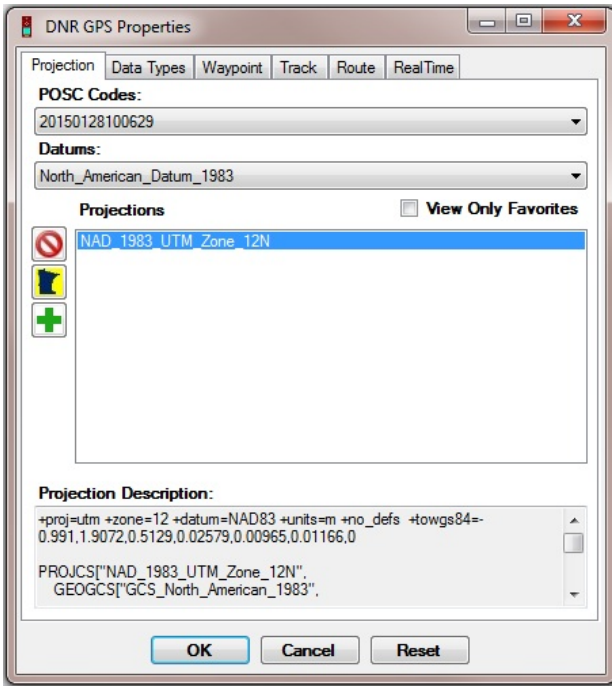

Figure 4. Screenshot from DNRGarmin used to set the correct map projection.

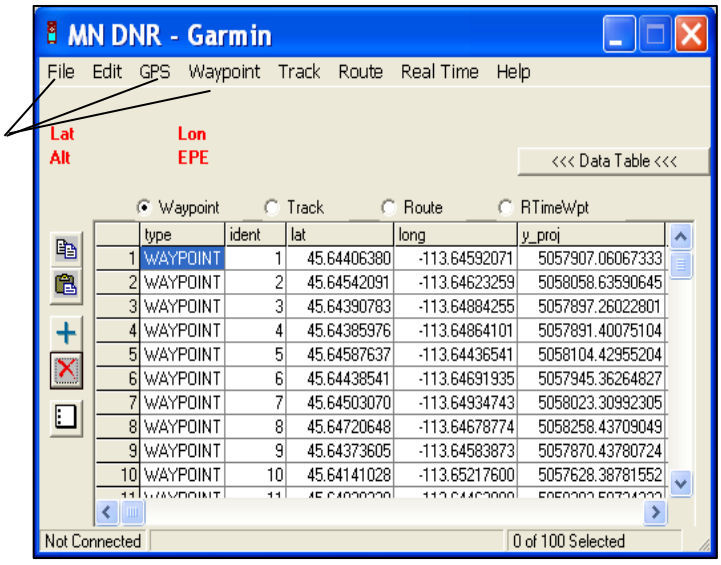

Figure 5. Screenshot from DNRGarmin used to view and upload selected waypoints.

In the Field

Monitoring Location Error

Ideally, you would be able to set thresholds for the maximum PDOP (Position Dilution of Precision) allowed as well as 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 by using the Satellite Main Page (Figure 6).

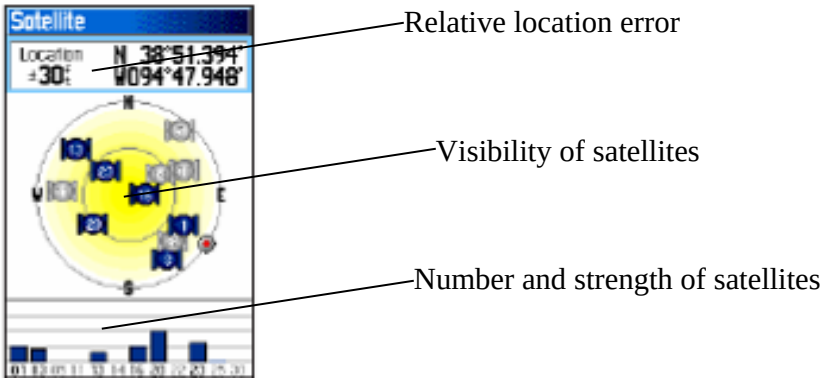

Figure 6. Screenshot from GPS unit showing satellite information.

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. Note that often the menu is set to 'Find by Nearest' and if the desired point is not near, no points will be displayed (although because sample locations are clustered in a spatially balanced design this may be the most efficient setting for locating sample points). To change this setting, go to the waypoint menu, push the menu button, and select 'Find by Name.'

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 (Figure 7) and, holding the GPS level, walk in the direction indicated by the compass until the 'Dist to Dest' window reads zero.

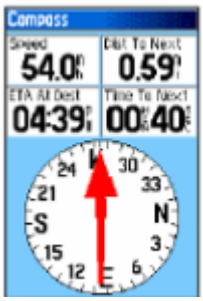

Figure 7. Screenshot from GPS unit compass page for navigation to a waypoint.

Creating New Waypoints

A location of interest can be marked and recorded by creating a new waypoint. This is useful for recording the locations of cave entrances and other topographic features that might be useful for navigation during periods of heavy snow cover.

After the Field

Downloading Waypoints

After completion of fieldwork, download any waypoints from the GPS unit. Connect the GPS unit to the com port of your computer via the supplied cable. Turn on the GPS unit by pressing the power button and open the DNR Garmin software on your computer. From the DNR Garmin menu click ‘Waypoints’, then select ‘Download’ from the drop down menu. The waypoints from the GPS should now appear as a table in DNR Garmin, which can be saved to a file. Unplug the GPS unit from the computer.

Deleting Waypoints

After downloading waypoints to the computer, delete any waypoints on the GPS units. 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

Standard Operating Procedure 3: Conducting Cave Surveys

Version 1.0

Change History

Original Version #	Date of Revision	Revised By	Changes	Justification	Page #'s Affected	New Version #

7. Version numbers increase incrementally by tenths (e.g., version 1.1, version 1.2, …etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 …). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number.

8. Notify the UCBN Project Lead and Data Manager of any changes to the SOP so that the new version number can be incorporated in the Metadata of the project database.

Post new versions on the internet and forward copies to all individuals with a previous version of the SOP. A list will be maintained in an appendix at the end of this document.

Purpose

The purpose of this SOP is to describe the step-by-step procedures for surveying caves for winter bat use. The content of this SOP is to be used after the field crew has arrived safely at the cave entrance and has followed decontamination steps. It also addresses decontamination between cave visits and decontamination at the end of a field day.

Introduction

Minimizing disturbance to hibernating bats is a critical component of conducting surveys. Disturbance can disrupt the natural arousal cycle of bats and force them to burn essential energy reserves. In extreme cases, disturbance may even cause bats to abandon a hibernaculum. To minimize disturbance, surveyors must remain as quiet as possible while traveling through the cave, taking care to avoid unnecessary talking or tipping broken and unstable lava blocks. Approaching bats should be done only when necessary, to confirm species identification or to conduct an accurate count of a cluster; in many cases, binoculars can be used in place of being in close proximity to bats. In general, surveyors must always attempt to minimize the amount of time spent in the cave, while balancing the need to move cautiously through the cave and spend adequate time searching to ensure survey quality. During surveys, if bats show signs of disturbance, such as flying or actively unfurling ears, surveyors should proceed with caution and be attentive to increasing levels of disturbance. If a large number of bats begin flying, such that an accurate survey cannot be conducted, the count should be abandoned and surveyors should immediately exit the cave, returning at a later date. Any data from the abandoned survey will be used if a resurvey does not occur, and a comment indicating the circumstances will be added to the data sheet. Surveyors should avoid talking while in the cave by exchanging information prior to cave entry and creating a set of nonverbal techniques for communication. If needed, surveyors should communicate in low voices (not whispers) when exchanging information; however, it is more important to communicate clearly than to risk miscommunication by being too quiet. Speaking clearly when locating bats and exchanging data, while limiting unnecessary communication will ultimately make surveys more accurate and efficient, while still minimizing overall noise disruption.

Conducting the Survey

1. Near the entrance, suit up with caving gear and prepare the survey equipment. Assign roles; a single surveyor per group serves as the data recorder. Additional surveyors may serve as spotters and counters.

2. Refer to the cave map to determine the most efficient survey route. If sensitive resources are in the cave, such as mineral deposits, communicate that information and make a plan to avoid the features.

3. Discuss communication plans for within the cave, where parties will split/meet up, etc.

4. Record the time of entry and ambient temperature on the cave map. If the cave map indicates that the cave is divided into more than 1 zone, prepare a route that will allow for complete searching of one zone at a time.

5. Radio in to your pre-arranged park contact that you are entering the cave. Enter the cave, moving cautiously and staying as quiet as possible.

6. If multiple surveyors are present, split the passage evenly. If surveying solo, proceed down and across passages to ensure all areas are checked. For large caves, if surveyors/teams split up make sure each team carries with them dry erase boards to indicate where they may have deviated from the established path, the individuals taking the deviation, and the time and direction of travel.

7. When traveling through the cave be cautious of touching low ceilings and walls, and stop often to search thoroughly. It is paramount that bats are not bumped. Move slowly and ensure that all parts of cave walls are scanned. It is often necessary to turn around and scan the ceiling from different directions in order to see into alcoves and cracks

8. In each zone, record ceiling, air temperature, and humidity up to three times, regardless of bat occupancy. For air temperature, use a Kestrel Pocket Weather meter and a laser thermometer on a piece of paper held away from surveyors' bodies to avoid artificial temperature increase due to body heat. Use the Kestral unit for measuring humidity.

9. When bats are observed, clearly communicate to all surveyors to ensure that all bats are being counted and no duplicates are being recorded. Use laser pointers to assist communication by clearly indicating which bat or cluster of bats is being counted or pointed out. Minimize time spent near bats to a little as possible; avoid shining lights directly on them unless absolutely necessary.

10. When bats are observed, record temperatures and humidity as close to the bats as possible without disturbing them. Use the laser thermometer to measure ceiling temperatures adjacent to a bat cluster, being careful not to touch bats with the laser. Record each individual bat or cluster separately on the data sheet with the appropriate zone. Clusters are defined by bat-to-bat contact. A solitary bat is recorded as an individual.

11. Whenever possible, use binoculars to confirm species identifications and conduct cluster counts instead of approaching bats. Binoculars are also helpful at close range to ensure accuracy of cluster counts.

12. If identification of bat species is of any question, take a picture. Ensure that artificial camera sounds are muted and the flash is on before taking any pictures. The first picture will be of the cave map, with an indication of the bat's/cluster's location. The second picture will be of the bat/cluster. For perspective, hold the camera about 2 feet away from the bat(s). Maneuver the camera as to take a clear image of the bat's face and ears.

13. For clusters that are large enough that an accurate count is difficult and/or identification is not possible, use a camera with flash to capture a photo of the cluster. If necessary, use a spotlight to help illuminate bats for photography. Attempt to take photos that look straight on at the faces of the bats, which makes photo counting easier.

14. When the survey is complete, ensure the data sheet is filled out entirely and exit the cave quickly, maintaining safe and cautious movement.

15. Radio in that your party has exited the cave.

16. If travelling to another cave, decontaminate shoes before putting snowshoes back on.

Decontamination Procedures

Decontamination standards are maintained and updated by the USFWS. The newest standards can be found on their website (http://www.fws.gov/midwest/endangered/mammals/BatDisinfectionProtocol.html). These should be reviewed at the beginning of each field season, and all gear should be decontaminated before each field season to the most recent standards put forth. Since field methods and decontamination information change, this protocol will not give a detailed set of instructions. Rather, this section will provide guidance that can be applied to more individualized field methods.

Due to the number of caves to be surveyed and the vicinity of cave entrances to each other at CRMO, decontamination of gear between cave visits is necessary when cave entrances are >1 mile apart, but not if they are within a 1 mile radius. In most cases, more than one cave will be visited in a field day, and equipment that enters the cave environment (helmets, gloves, Kestrel unit, etc.) must be kept separate from other items that is not exposed to the cave interior (radio, GPS, spare layers, etc) during travel between caves. This will be done using heavy duty plastic trash bags, or the items can remain on the surveyor, for example in their pockets. Care should be taken for less obvious items, such as cave maps or writing utensils, which are difficult to decontaminate or also are used later in the office setting.

At the end of the surveys and before returning from the field, remove all contaminated clothing and equipment and place them into a plastic trash bag. Place cave maps and data sheets into gallon ziplock bags so the information can be viewed without having to reopen the bag. Decontaminate shoes, and snowshoes, if being used.

Upon returning to the field, all gear that was exposed to the cave environment or stored in the same container as contaminated gear must be decontaminated. If cave clothing or gear is also dirty or muddy, wash clothing on hottest available settings before decontaminating. As facilities and available equipment change both seasonally and yearly, check with the CRMO Project Lead for specific questions regarding site-specific methods. Do not open bag when inputting data into the database. A copy should be reproduced and stored at within the CRMO cave filing system according to direction from the CRMO Project Lead, and contaminated cave data sheets should be disposed of with other contaminated materials that will not be reused, like trash bags.

Quality Assurance of Large Cluster Counts

Attempting to accurately count bats in large clusters can be difficult. Photographs can be used in an office setting to confirm counts. Use of computer software can aid counting. One recommended method for counting a photographed cluster is to use ArcGIS software, following steps described below and is illustrated in Figure 8:

1. Open ArcMap and add a cluster photo to the dataframe.

2. Create a ‘point’ shapefile or feature class, and start an editing session for that layer.

3. Using the “create new feature” tool, click each individual bat to create a new point. Focus on the noses of the bats when possible.

4. After clicking each bat, open the attribute table for the layer to view the number of points created; this number is the cluster count.

5. Repeat the above steps for each cluster photo. The points created on the previous photo can simply be deleted, and the blank point layer will then be ready for the new photo.

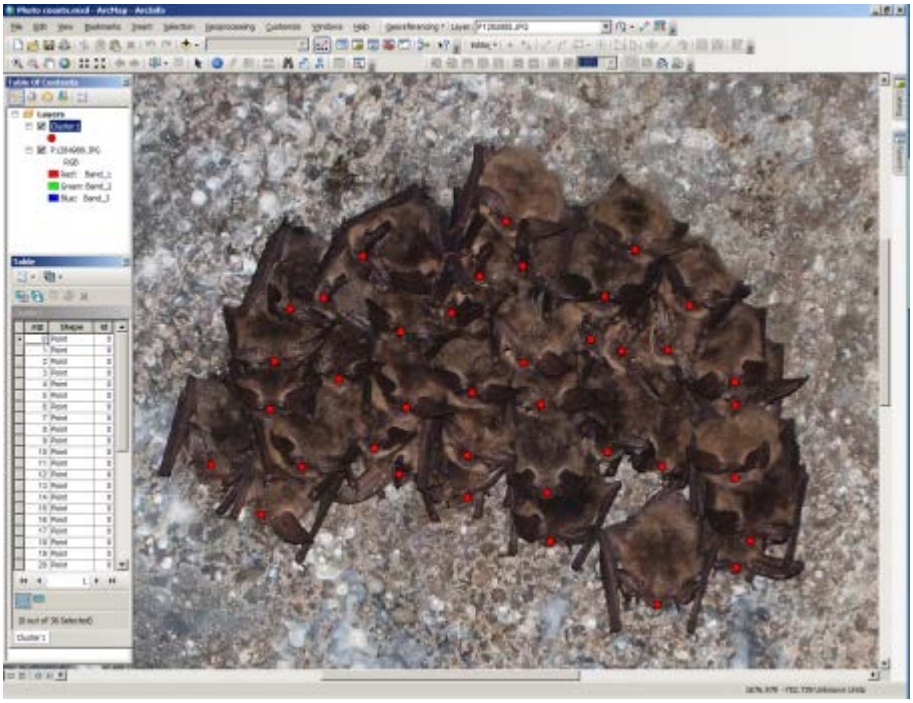

Figure 8. Screen capture illustrating use of ArcGIS for counting cluster photos (38 bats).

Standard Operating Procedure 4: Data Management

Version 1.0

Change History

Original Version #	Date of Revision	Revised By	Changes	Justification	Page #'s Affected	New Version #

9. Version numbers increase incrementally by tenths (e.g., version 1.1, version 1.2, …etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 …). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number.

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Post new versions on the internet and forward copies to all individuals with a previous version of the SOP. A list will be maintained in an appendix at the end of this document.

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.

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.

Purpose

This SOP provides instructions on archiving survey photos and also provides documentation for the project database UCBN_Hibernacula_Bat_Survey.mdb and provides instructions for the development, maintenance, archiving, and distribution of the database or datasets. The database model is described in detail, including definitions of all input and computed data fields. Procedures for data certification, data archiving, QA/QC, and handling of sensitive information are also provided. Yearly data management tasks are presented, including the scheduled timing of those various tasks.

Storing Survey Photos

Photos taken during surveys will be stored within the CRMO network. Photos that contain bats will be titled using survey information. “Cave Name_MM-DD-YY_zone_#_Species code (cluster)_1-x”. For example, a photo from a survey of Arco Tunnel on January 20, 2015of the 4th Townsend’s big-eared bat found in zone 2 would be labelled, “Arco_Tunnel_1-20-15_zone_2_COTO_4.” If there are multiple pictures of the same bat, an alphabetical signifier (a-z) can be added to the end. If the photo is of a cluster, the title will contain the word “cluster” after the species code, but it is not

Photos of bats will be added to the bat survey database in addition to the environmental data being gathered. Photos must be housed within the same folder as the database, within a folder labelled, “Bat_Photos.” Because the database will not link photos if they are housed within folders within “Bat_Photos,” it is imperative that the naming convention is followed, and the photo names contain all necessary identifying information.

Database Model

The UCBN hibernacula bat survey database has been developed within Microsoft Access and conforms to the standards of version 3.2 of the Natural Resource Database Template (NRDT). The database consists of a user interface front-end (holding user forms for data entry, review, and export) that is linked to a back-end database file (holding the core protocol data tables). The general data management strategy employs a “working copy” of the database (used to enter the current season‘s data, conduct error-checking, and perform validation) and a “master version” of the database, which stores all validated data and facilitates multi-year analyses by providing specific data summaries and export formats. A physical data model for the UCBN hibernacula bat survey database shows the relationships among the core data tables, lookup tables, and cross reference tables (Figure 9).

The core data tables in the UCBN hibernacula bat survey database are “tbl_Sites”, “tbl_Locations”, “tbl_Events”, “tbl_Zones” and “tbl_Bat_Counts”. There are several additional tables used for cross

referencing zones “xref_Zones_Events” to field events and hazards “xref_Locations_Hazards” to cave locations. The survey data tables are supported by lookup tables that hold code values (e.g., species codes, cave type, contacts and hazard types) and definitions of those codes. The “tbl_Sites” stores park unit name and park unit code. “tbl_Locations” stores all the cave location, descriptive and physical information. The “tbl_Events” table, storing general information about the survey like time of event, links the cave data “tbl_locations” to the bat data “tbl_Bat_Counts” and to a cross reference table that stores data about the contacts associated with each survey. Table “tbl_Bat_Counts” stores the information for the bat species, counts, photo info and links to “tbl_Temp”. Table “tbl_Temp” fields are for ceiling and air temperatures and humidity values per event count. To retain information about environmental suitability of a cave for hibernacula tables tbl_SuitEnvCriteria” and utlu_EnvCriteriaterian about environme about environmentatlu_Suitability” contains the rating used when evaluating cave suitability. The protocol version in use at the time of data import data entry is also linked to “tbl_Events”band revisions to the UCBN hibernacula bat survey database will be captured in metadata tables ntbl_Db_Meta” and “tbl_Db_Revisions”.

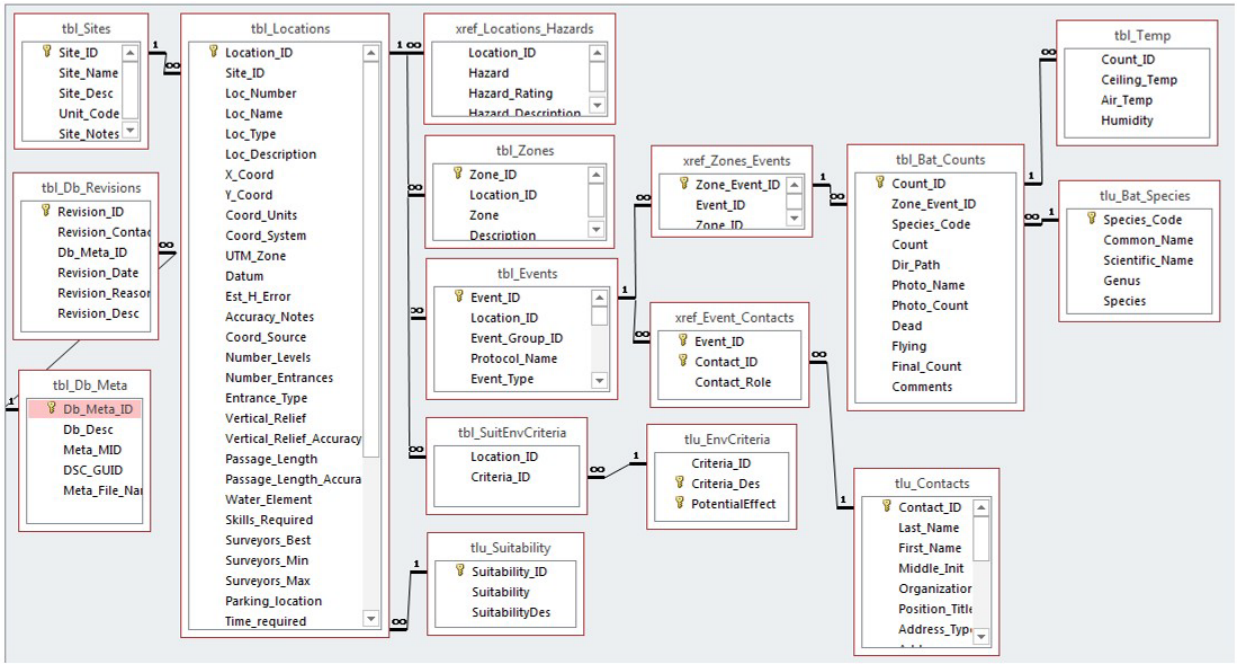

Figure 9. The CRMO Bat hibernacula monitoring database data model.

Data Dictionary

The following data dictionary provides a table description for every table contained in the UCBN hibernacula bat database back-end file. For each table, a field name, type, format and description are provided.

Table 3a. Sites table with data fields from the hibernacula bat database. Table name: *tbl_Sites*: A site is a Park.

Field Name	Type	Format	Description
Site_ID	Text	Up to 50 characters	M. Site identifier (Site_ID)
Site_Desc	Text	Up to 255 characters	M. Description for a site (Site_Desc)
Site_Name	Text	Up to 100 characters	M. Unique name or code for a site (Site_Name)
Site_Notes	Memo	Up to 255 characters	MA. General notes on the site (Site_Notes)
Unit_Code	Text	4-letter code	M. Park, Monument or Network code (Unit_Code)

Table 3b. Locations table with data fields from the hibernacula bat database. Table name: *tbl_Locations*: Cave location and physical information.

Field Name	Type	Format	Field Description
Location_ID	Text	Up to 50 characters	Primary key, Location identifier
Accuracy_Notes	Text	Up to 255 characters	Positional accuracy notes
Bat_location	Memo	Up to 255 characters	Description of the locations
Coord_Source	Text	Up to 255 characters	The source of the GIS X and Y coordinates, i.e., shapefile,
Coord_System	Text	Up to 50 characters	Coordinate system (e.g., UTM)
Coord_Units	Text	Up to 50 characters	Coordinate distance units
Datum	Text	Up to 50 characters	Datum of mapping ellipsoid
Dir_Path	Text	Up to 255 characters	Directory path to the cave maps
Entrance_Type	Text	1-letter code	Type of cave entrance, i.e., L=Large Horizontal (>10x10),
Est_H_Error	Single	Numeric	Estimated horizontal accuracy
File_Name	Text	Up to 255 characters	File Name of cave map
Loc_Description	Text	Up to 255 characters	More specific description about the type of cave (shelter in sink, branching tube, etc.)
Loc_Monitored?	Boolean	Yes/No	Is the cave being monitored for bats?
Loc_Monitored_Rationale	Memo	Up to 255 characters	The reason why the cave is or is not being monitored for bats.

Table 3b. Locations table with data fields from the hibernacula bat database. Table name: *tbl_Locations*: Cave location and physical information (continued).

Field Name	Type	Format	Field Description
Loc_Name	Text	Up to 100 characters	Name of the location, i.e., cave name
Loc_Notes	Memo	Up to 255 characters	General notes on the location
Loc_Number	Single	Numeric	Identification number unique to this cave
Loc_Type	Text	1-letter code	Type of cave, i.e., P= Primary Tube, T=Small Tube, B=Blister,
Number_Entrances	Text	Numeric	Number of entrances into the cave. Include all types.
Number_Levels	Text	Numeric	Number of visible levels. If multiple levels of unknown number, enter >1, >2, etc.
Overview	Memo	Up to 255 characters	Cave desciption and recommended survey route, including obstacles such as crawls and climbs.
Parking_location	Text	Up to 255 characters	Where to park to begin hiking to the site.
Passage_Length_Accuracy	Text	1-letter code	Was the total length of the cave measured or estimated? i.e., E = Estimated, M = Measured
Root_Path	Text	Up to 255 characters	The root path for the linked map file. This will change upon re-linking of database.
Site_ID	Text	Up to 50 characters	Link to tbl_Sites
Skills_Required	Text	1-letter code	Type of skills required to conduct cave survey, i.e., N= None, , R= Ropework, O=Other
Special_equip	Text	Up to 255 characters	Non-standard equipment necessary for the survey
Suitability_ID	Long Integer	Numeric	Link to tlu_Suitability table (foreign key)
Surveyors_Best	Long Integer	Numeric	The ideal recommended number of personnel based on safety, efficiency, cave size, and disturbance considerations.
Surveyors_Max	Long Integer	Numeric	The maximum recommended number of personnel based on safety, efficiency, cave size, and disturbance considerations.

Table 3b. Locations table with data fields from the hibernacula bat database. Table name: *tbl_Locations*: Cave location and physical information (continued).

Field Name	Type	Format	Field Description
Surveyors_Min	Long Integer	Numeric	The minimum recommended number of personnel based on safety, efficiency, cave size, and disturbance considerations.
Time_required	Text	Up to 255 characters	The approximate time required to complete the survey, including round trip.
Unit_Code	Text	4-letter code	Park, Monument or Network code
Updated_Date	Text	Up to 50 characters	Date of entry or last change
UTM_Zone	Text	3-character code	UTM Zone (e.g., 12N)
Vertical_Relief	Single	Numeric	Longest floor-to-ceiling height (in feet)
Vertical_Relief_ Accuracy	Text	1-letter code	Was the vertical relief measured or approximated?, i.e., M=Measured, A=Approximated
Water_Element	Text	1-letter code	The water element in the cave, i.e., A=Arid, D=Dripping, M=Moist earth, P=Pool.
X_Coord	Double	Numeric	X coordinate of the cave entrance
Y_Coord	Double	Numeric	Y coordinate of the cave entrance

Table 3c. Zones table with data fields from the hibernacula bat database. Table name: *tbl_Zones*: Cave zone and zone description information.

Field Name	Type	Format	Description
Zone_ID	Text	Up to 50 characters	Primary key, Unique record identifier.
Description	Memo	Up to 255 characters	Description of zones to aid surveyors in recognizing zone transitions.
Location_ID	Text	Up to 50 characters	Link to tbl_Locations
Zone	Text	Numeric	Zone number, i.e. 1, 2, 3, etc

Table 3d. Events table with data fields from the hibernacula bat database. Table name: *tbl_Events:* An event is a surveying occurrence at a cave.

Field Name	Type	Format	Description
Event_ID	Text	Up to 50 characters	Primary key, Event identifier
Certified	Boolean	Yes/No	Whether the data has been certified
Certified_By	Text	Up to 50 characters	Person who certified data for accuracy and completeness
Certified_Date	Date/Time	mm/dd/yyyy	Date on which data were certified
Entered_By	Text	Up to 50 characters	Person who entered the data for this event
Entered_Date	Date/Time	mm/dd/yyyy	Date on which data entry occurred
Event_Notes	Memo	Up to 255 characters	General notes on the event
Location_ID	Text	Up to 50 characters	Link to tbl_Locations
Protocol_Name	Text	Up to 100 characters	The name or code of the protocol governing the event
Start_Date	Date/Time	Mm/dd/yyyy	Starting date for the event
Start_Time	Date/Time	24-HR Time	Starting time for the event
Stop_Time	Date/Time	24-HR Time	Stopping time for the event
Updated_By	Text	Up to 50 characters	Person who made the most recent updates
Updated_Date	Date/Time	mm/dd/yyyy	Date of the most recent edits
Verified	Boolean	Yes/No	Whether the data has been verified
Verified_By	Text	Up to 50 characters	Person who verified accurate data transcription
Verified_Date	Date/Time	mm/dd/yyyy	Date on which data were verified

Table 3e. Bat counts table with data fields from the hibernacula bat database. Table name: *tbl_Bat_Counts*: Hibernacula bat survey count information.

Field Name	Type	Format	Description
Count_ID	Text	Up to 50 characters	Primary key, Unique row identifier.
Comments	Memo	Up to 255 characters	Comments about the count.
Count	Long Integer	Numeric	Bat or cluster count.
Dead	Boolean	Yes/No	Were dead bats present?

Table 3e. Bat counts table with data fields from the hibernacula bat database. Table name: *tbl_Bat_Counts*: Hibernacula bat survey count information, continued.

Field Name	Type	Format	Description
Count	Long Integer	Numeric	Bat or cluster count.
Dead	Boolean	Yes/No	Were dead bats present?
Final_Count	Long Integer	Numeric	The final count of the bat cluster. If a photo is taken, the count from the photo is used, not the estimate.
Flying	Boolean	Yes/No	Were any flying bats present?
Photo_Cluster	Boolean	Yes/No	Is this an estimated count of photographed clusters?
Photo_Count	Long Integer	Numeric	If a photo was taken, the count in the photo.
Photo_No	Text	Up to 255 characters	The photo identifier.
Species_Code	Text	4-letter code	Link to tlu_Bat_Species.
Temp	Boolean	Yes/No	Was a temperature reading taken?
Zone_Event_ID	Text	Up to 255 characters	Link to xref_Zones_Events.

Table 3f. Suitability table with data fields from the hibernacula bat database. Table name: *tlu_Suitability*: Lookup table contains the ratings used when evaluating if a location (i.e. Cave) is suitable for Hibernacula.

Field Name	Type	Format	Description
Suitability_ID	AutoNumber	Numeric	Hibernacula suitability ID (Primary Key)
Suitability	Short Text	Up to 30 characters	Hibernacula cave suitability rating
SuitabilityDes	Short Text	Up to 30 characters	Description of suitability rating

Table 3g. Suitability criteria table with data fields from the hibernacula bat database. Table name: *tbl_SuitEnvCriteria*: Table contains the criteria used in the assessment of a locations (i.e. Cave) suitability for hibernacula

Field Name	Type	Format	Description
Location_ID	Short Text	Up to 50 characters	Location ID (Foreign key tbl_Locations)
Criteria_ID	Number	Long Integer	Suitability Criteria ID (Foreign key tlu_Criteria)

Table 3g. Suitability criteria table with data fields from the hibernacula bat database. Table name: *tbl_SuitEnvCriteria*: Table contains the criteria used in the assessment of a locations (i.e. Cave) suitability for hibernacula (continued)

Field Name	Type	Format	Description
Criteria_ID	AutoNumber	Long Integer	Suitability Criteria ID (Primary Key)
Criteria_Des	Short Text	Up to 50 characters	Suitability Criteria Description
PotentialEffect	Short Text	20	Defines if the environmental attribute is considered as Positive, Negative or Unknown for hibernacula occurrance

Table 3h. Temperature table with data fields from the hibernacula bat database. Table name: *tbl_Temp*: Cave temperature data associated with an event.

Field Name	Type	Format	Description
Air_Temp	Double	Numeric	Air temp (°C)
Ceiling_Temp	Double	Numeric	Ceiling temp (°C)
Count_ID	Text	Up to 255 characters	Link to tbl_Bat_Counts
Humidity	Double	Numeric	Relative Humidity

Table 3i. Zones/events table with data fields from the hibernacula bat database. Table name: *xref_Zones_Events*; Cross-reference table between zones and survey events

Field Name	Type	Format	Description
Zone_Event_ID	Text	Up to 50 characters	Link to tbl_Zones
Event_ID	Text	Up to 50 characters	Link to tbl_Events
Zone_ID	Text	Up to 50 characters	Link to tbl_Zones

Table 3j. Survey events/contacts table with data fields from the hibernacula bat database. Table name: *xref_Events_Contacts*: Cross-reference table between survey events and contacts.

Field Name	Type	Format	Description
Contact_ID	Text	Up to 50 characters	M. Link to tlu_Contacts (Contact_ID)
Contact_Role	Text	Up to 50 characters	MA. The contact's role in the protocol (Cnt_Role)
Event_ID	Text	Up to 50 characters	M. Link to tbl_Events (Event_ID)

Table 3k. Cave locations/hazards table with data fields from the hibernacula bat database. Table name: *xref_Locations_Hazards*: Cross-reference table between cave locations and hazards.

Field Name	Type	Format	Description
Hazard	Text	Up to 5 characters	Type of hazards present in cave, i.e., C= Confusing Passages, V=Vertical Drops, L= Loose Rocks, W=Stationary Water, O=Other, N=None, from tlu_Enumerations
Hazard_Description	Text	Up to 255 characters	Elaboration of the hazards present
Hazard_Rating	Text	Up to 16 characters	The hazard rating based on Idaho Cave Survey guidelines
Location_ID	Text	Up to 50 characters	Link to tbl_Locations

Table 3l. Bat species table with data fields from the hibernacula bat database. Table name: *tlu_Bat_Species*: Bat species look up table.

Field Name	Type	Format	Description
Species_Code	Text	4-letter code	Four-Letter (1st two letters of Genus and 1st two letters of Species) code for species obs.
Common_Name	Text	Up to 75 characters	Name in general use within a community.
Genus	Text	Up to 75 characters	Genus (plural: genera), low-level taxonomic rank.
Scientific_Name	Text	Up to 75 characters	The first part of the name identifies the genus to which the species belongs; the second part identifies the species within the genus
Species	Text	Up to 75 characters	Species observed

Table 3m. Contacts table with data fields from the hibernacula bat database. Table name: tlu_Contacts: Contact data for project-related personnel.

Field Name	Type	Format	Description
Contact_ID	Text	Up to 50 characters	Primary key, M. Contact identifier (Contact_ID)
First_Name	Text	Up to 50 characters	M. First name (Cnt_First)
Last_Name	Text	Up to 50 characters	M. Last name (Cnt_Last)
Middle_Init	Text	Up to 4 characters	M. Middle initial (Cnt_MI)

Table 3n. Enumerations table with data fields from the hibernacula bat database. Table name: *tlu_Enumerations*: Enumerated lookup table including cave types, hazards,etc.

Field Name	Type	Format	Description
Enum_Group	Text	Up to 50 characters	M. Category for lookup value (Enum_Group)
Enum_Code	Text	Up to 50 characters	M. Code for lookup values (Enum_Code)
Enum_Description	Memo	Up to 255 characters	M. Lookup value description (Enum_Desc)
Sort_Order	Integer	Numeric	O. Order in which to sort lookup values (Sort_Order)

Table 3o. Metadata table with data fields from the hibernacula bat database. Table name: *tbl_Db_Meta:* Database description and links to I &M metadata tools.

Field Name	Type	Format	Description
Db_Meta_ID	Text	Up to 50 characters	M. Local primary key (Db_Meta_ID)
Db_Desc	Memo	Up to 255 characters	M. Description of the database purpose (Db_Desc)
DSC_GUID	Text	Up to 50 characters	M. Link to I&M Dataset Catalog desktop metadata tool
Meta_File_Name	Text	Up to 50 characters	O. Name of the metadata file that describes this NRDT data
Meta_MID	Text	Up to 255 characters	M. Link to NPS Data Store (Meta_MID)

Table 3p. Revisions table with data fields from the hibernacula bat database. Table name: *tbl_Db_Revisions*: Database revision history data.

Field Name	Type	Format	Description
Revision_ID	Text	Up to 50 characters	M. Database revision (version) number or code (Rev_ID)
Db_Meta_ID	Text	Up to 50 characters	M. Link to tbl_DB_Meta (Db_Meta_ID)
Revision_Contact_ID	Text	Up to 50 characters	MA. Link to tlu_Contacts (Rev_Cnt_ID)
Revision_Date	Date/Time	Mm/dd/yyyy	M. Database revision date (Rev_Date)
Revision_Deesc	Memo	Up to 255 characters	M. Revision description (Rev_Desc)
Revision_Reason	Memo	Up to 255 characters	M. Reason for the database revision (Rev_Reason)

Data Entry

All protocol field data is to be recorded on copies of the cave maps. The database survey data entry form was built initially to resemble the layout of the original paper field sheet, and has built-in quality assurance components such as pick lists to standardize entries and validation rules to prevent illogical data entries or omissions. All pertinent data is recorded and marked at the sampling location in the cave. The Project Leads will have their own working copy of the database in which to enter the survey data from the field sheets each season, shortly after completion of field work. The UCBN will provide database administration and maintenance as well as maintaining a copy of the annually updated master database. Data entry should be viewed as an important step in the overall QA/QC process, and care should be taken to review both the input from the paper forms and the resulting entries in the database.

Associated photos from the survey will also be stored in the same directory at CRMO. They will also be linked to the database and included in the metadata. The titles should all follow the format, "YYYYMMDD_LocName_Zone_SpeciesCode_[Cluster]_Number". Photos will be labeled with "cluster" only if there are two or more bats in contact. In the event that there are more than one individual of the same species in the same zone, numerical signifiers at the end of the title will signify this. Multiple pictures of the same bat will be signified with alphanumerical signifiers.

Quality Review

After the data have been entered and processed, they will be reviewed by the Project Lead for quality, completeness, and logical consistency. The working database application facilitates this process through pre-built queries that display, in a spreadsheet format, both raw data records and summarized data allowing the user to find and examine data outliers and illogical values. The user may then fix these problems and document the fixes, using the front-end application to re-open the problematic survey record, correct data discrepancies, and document corrections in the survey remarks field. Not all errors and inconsistencies can be fixed, in which case the persistent errors are then documented and included in the metadata and certification report.

After the quality review has been completed and the metadata information compiled, the Project Lead can certify the current season's data as described below. Once the current season's data has been certified, the datasets are merged into the master database application. The UCBN will manage and archive the master database.

Metadata Procedures

Data documentation is a critical step in ensuring that data sets remain 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 the hibernacula bat survey data will conform to Federal Geographic Data Committee (FGDC) standards and NPS guidelines when applicable and will contain all components of supporting information such that the data may be confidently manipulated, analyzed, and synthesized.

Metadata information is built within the Hibernacula database with tables and fields having definition. However it is still desirable to explicitly create stand-alone accompanying eXtensible markup language (XML) metadata files that will accompany both the front-end and back end database files.

Metadata Creation and Updating

It is necessary to create/update XML data files for the front-end and back-end DBs (one per front-end and back-end certified dataset). Initial XML metadata templates have been created for the front-end DB, and the full back-end DB and for a public back-end DB(cave coordinates removed) and are located on the UCBN server at:
“VitalSign_Protocols\Bats\3_Implement\Data_Management\MetaData (see Figure 10)

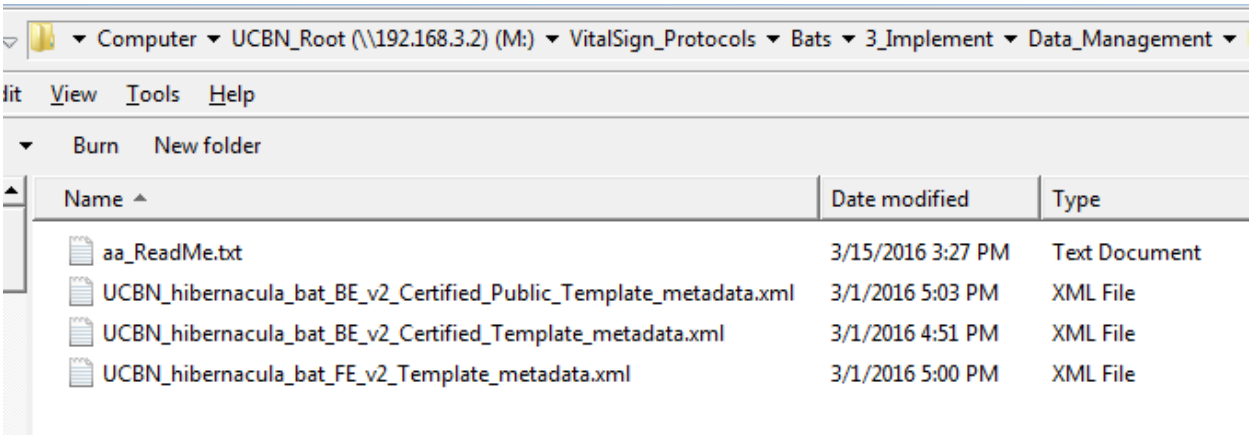

Figure 10. Hibernacula monitoring XML (metadata) template location on the UCBN server, for front-end and back-end databases.

While initial metadata files have been created the Protocol Lead and Data Manager will need to work collaboratively to update the XML templates to reflect the location, range of data collection, contact information, etc. Updates to XML data can be made in numerous software package including notepad ++, notepad, wordpad, XML editor etc. A screen shot of the Hibernacula back-end XML template is shown in Figure 11.

Updated XML files should be archived in the same location as the annually certified database files on the UCBN server:

Hibernacula DBs:
VitalSign_Protocols\Bats\4_Close\Certified_Data_GIS_Metadata\Database\{Year}

As changes/updates are made to the WQ Monitoring Station and Instrumentation front-end and back-end DBs it may necessary to update the front-end and back-end templates. A tool for automated harvesting of Access database information and creation of XML files is the NPS Database Metadata Extractor MS Access Add-In tool (National Park Service 2012). The metadata tool and a step by step user guide to perform this metadata harvest can be found at:
https://irma.nps.gov/DataStore/Reference/Profile/2182070.

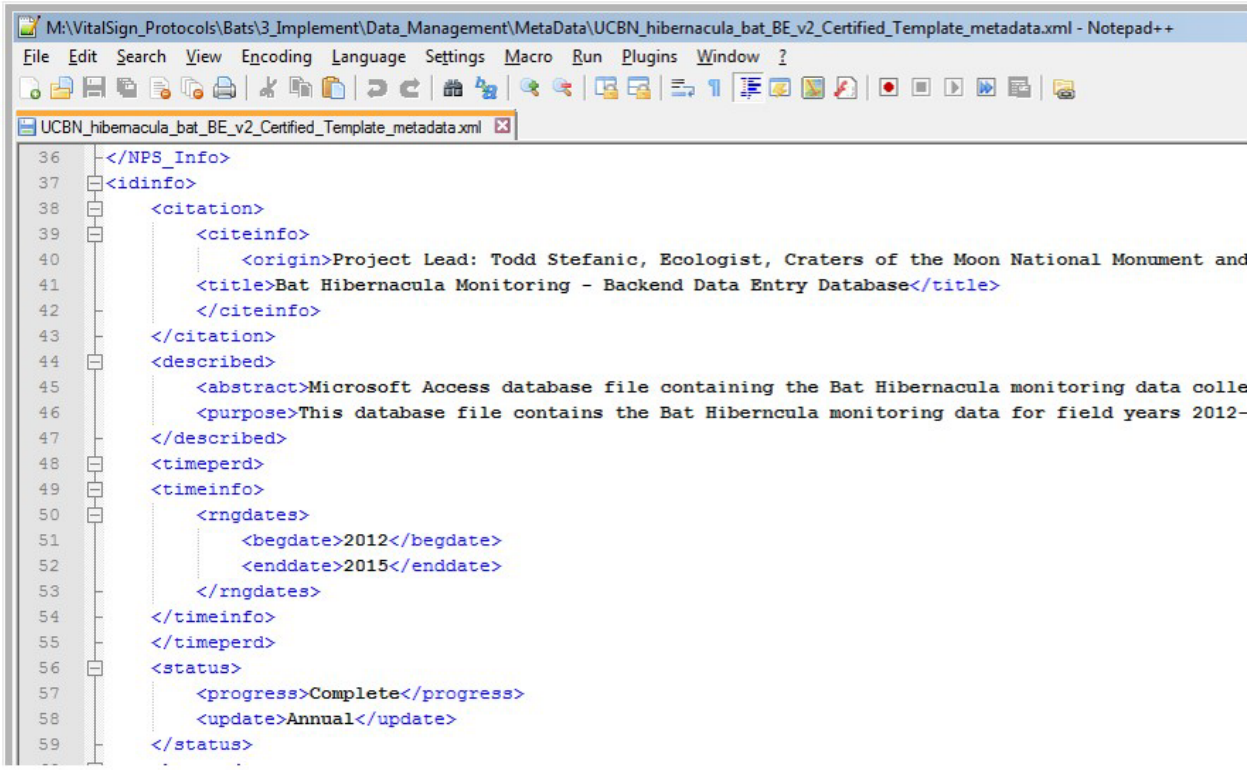

Figure 11. Hibernacula back-end access database XML metadata template screen shot with in the NotePad++ software.

Sensitive Information

Metadata development includes determining if the data contain sensitive information such as specific locations of rare, threatened, or endangered species. In some cases, it may be necessary to restrict access to data containing sensitive information, except where a written confidentiality agreement is in place. The Project Lead and Park Resource Manager should work together to identify any sensitive information in the data. Their findings should be documented and communicated to the Data Manager.

Locations of the lava tube caves in Craters of the Moon National Monument are considered sensitive and are not available to the public. These locations are stored in the database; therefore care should be taken to remove the cave location coordinates from the database prior to any release to the public. Publically released hibernacula databases will have all cave location information removed ("X_Coord" and "Y_Coord" fields in the "tbl_Locations" table).

Data Certification and Delivery

Data certification is a benchmark in the project information management process that confirms 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 UCBN hibernacula bat survey database will provide data review queries that enable the database user to examine both raw data records and summarized data in order to identify any data outliers or illogical values; as well providing a quality assurance check box in the database data entry form to be updated when data has been verified and certified. Once the box is checked, the person who verified or certified the data, as well as the date, will automatically be populated. The certified data and updated metadata should be delivered at the end of each season to the identified Data Manager for the park as well as the UCBN Data Manager.

Data Certification Steps

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

1) Complete data quality review and certification procedures to ensure data for the monitoring year are complete and accurate.

2) Create a compressed file (using WinZip or similar software) and add the front-end and backend database files, completed metadata, scanned field data forms, and any summary spreadsheets, and submit to the UCBN Data Manager.

3) Complete and submit data certification forms and season closeout check list documents (e.g., summation of database records for which errors were corrected, for which errors cannot be corrected, etc.) to the UCBN Data Manager.

4) Submit any geospatial data files created for the current year's data.

5) 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: Bat_2013_certified_backend.mdb, Bat_2013_cert_report.doc

Upon receiving the certification materials of: 1) compressed file with database's and associated files, and 2) data certification and close out forms, the Data Manager will check them in, and store them on the UCBN file server.

Certified database zip files will be stored on the local UCBN server by year at:
- VitalSign_Protocols\Bats\4_Close\Certified_Data_GIS_Metadata\Database\{Year}

Data Certification (Figure 12) and Season Closeout forms (Figure 13) will be stored on the local UCBN server by year at:
- VitalSign_Protocols\Bats\4_Close\Data_Certification_Forms\{Year}

Templates of the Data Certification and Season Closeout forms are located on the local UCBN server at:
- VitalSign_Protocols\Bats\4_Close\Data_Certification_Forms\templates

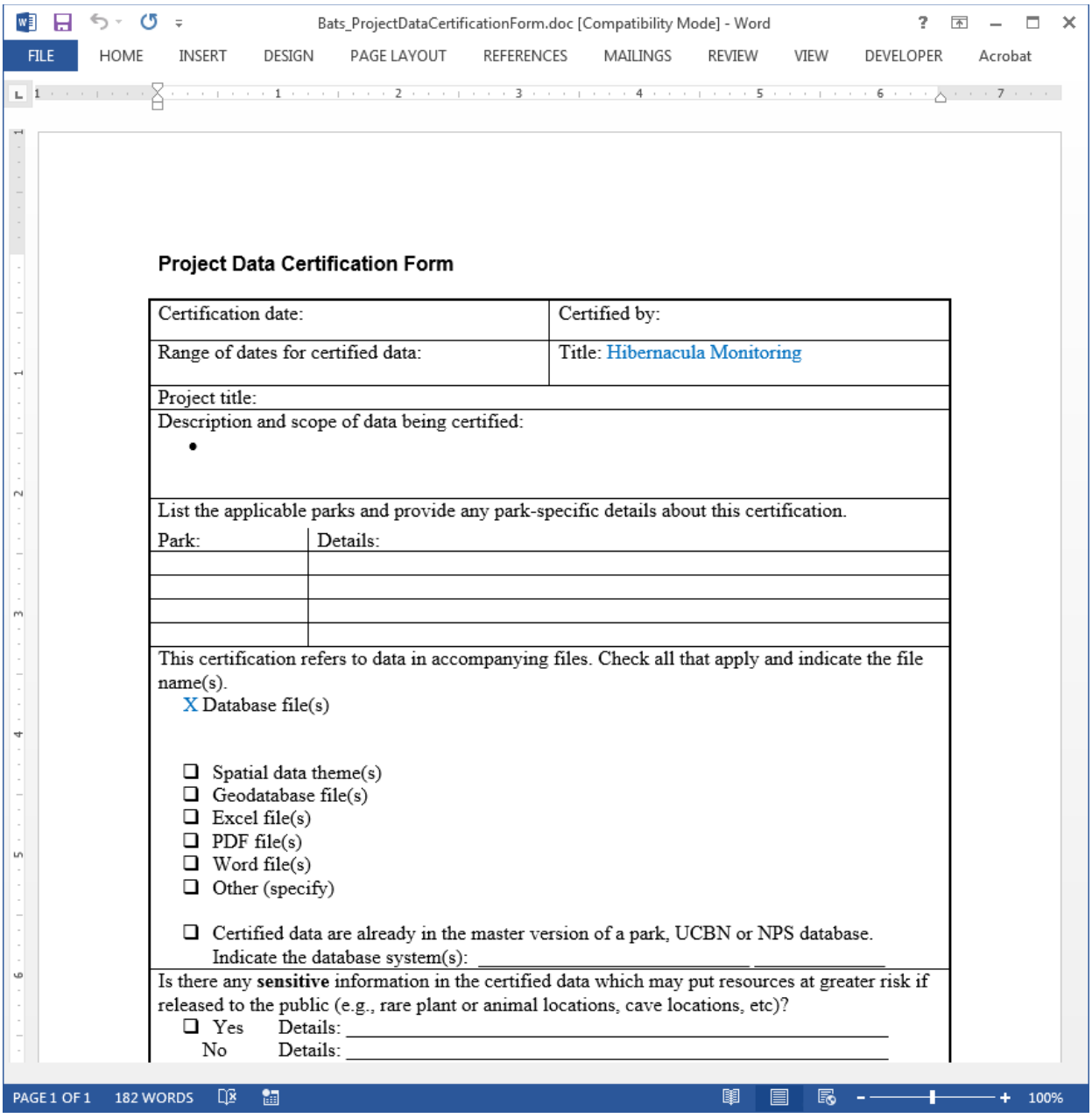

Figure 12. Data Certification Form template screen shot

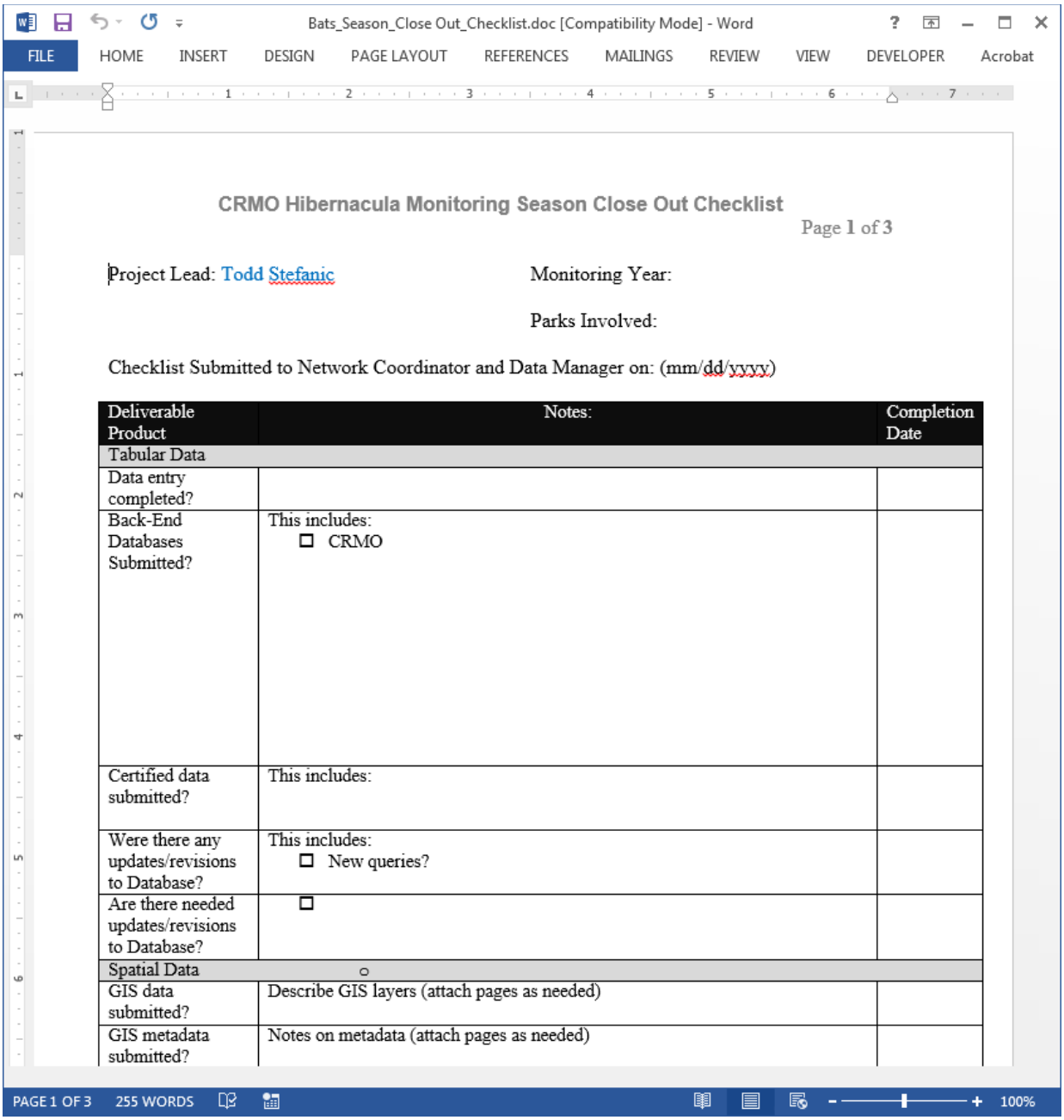

Figure 13. Season closeout template screen shot.

Data Archiving

Paper cave maps, if used for recording data, will be archived indefinitely according to NPS policy and network Data Management Plans. In general, original paper data sheets will be archived and photocopied or scanned versions will be stored on the network digital file server(s).

Digital datasets generally are stored indefinitely, with local copies stored on UCBN file server and master datasets posted to the national Integrated Resource Management Application (IRMA) system. Upon certification, data and reports will be archived on the UCBN server, and all non-sensitive information posted to UCBN website. Each year, after all certified records have been merged into the master database, the project master database excluding sensitive information will be archived and posted to the national web-accessible IRMA system thereby making it readily available to all networks and parks.

Certified Data Archival to IRMA:

To post the certified data to IRMA (https://irma.nps.gov/Portal), within IRMA create a "clone" of the previous monitoring year's certified IRMA reference. Using the cloned reference it will be necessary to upload the certified databases and associated files (zip file), as well as the bat photos and map photos (in separate zip files). A screen shot of the certified 2015 database reference (# 2225062) is shown in Figure 14, with the red circle identifying the button used to create a clone reference.

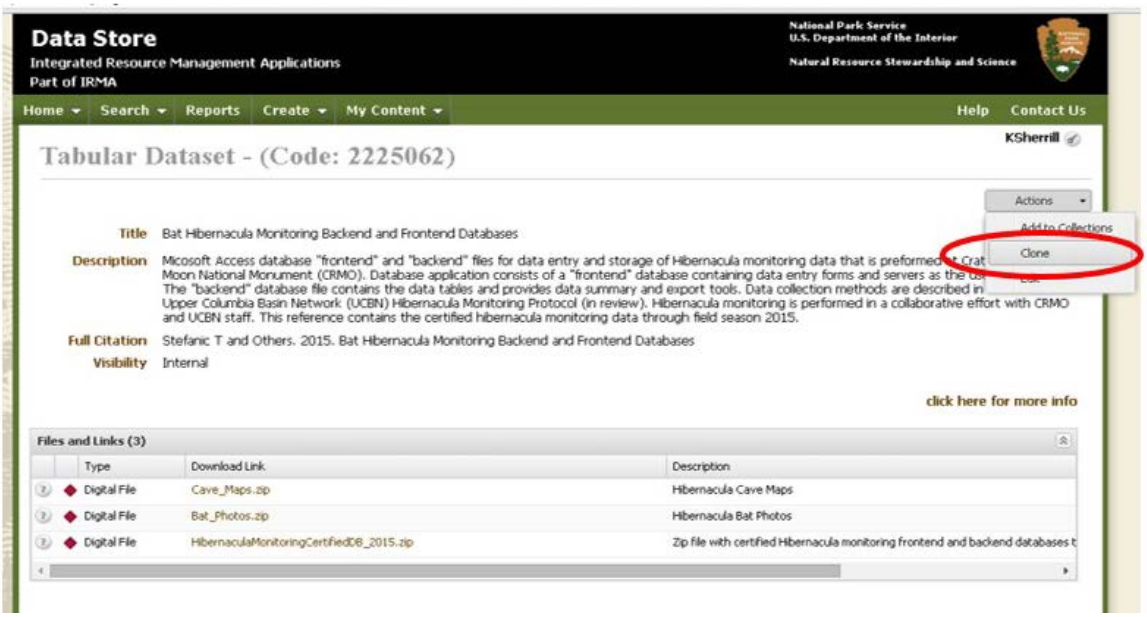

Figure 14. Screen shot of the certified 2015 database reference, and the button used to create a "cloned" reference.

To facilitate "line of sight" transparency with previous Hibernacula references the "Version History" and "Cross-Reference" tabs should be used.

Tab - "Version History" should be used to define the previous year's certified DB reference (e.g. 2015 certified DB reference # 2225062)

Tab – “Cross-Reference” should point to the reference with the hibernacula monitoring protocol.

Lastly for the “cloned” reference it is necessary to define the following reference information:

- File Permissions: If uploading the full database with X and Y coordinate information it is essential to set the Permissions – Reference Access Level to: “Internal”, and File Access Level to either: Internal” or “Specific Individuals”, see screen shot in figure X, of the IRMA permissions interface (Figure 15).

- Publish Date: {Monitoring Year – e.g. 2015)

- Content Begin Date: {Date of oldest monitoring record in database}

- Content End Data: {Date of most recent monitoring record in database}

- Description: Update as appropriate with current dates, etc.

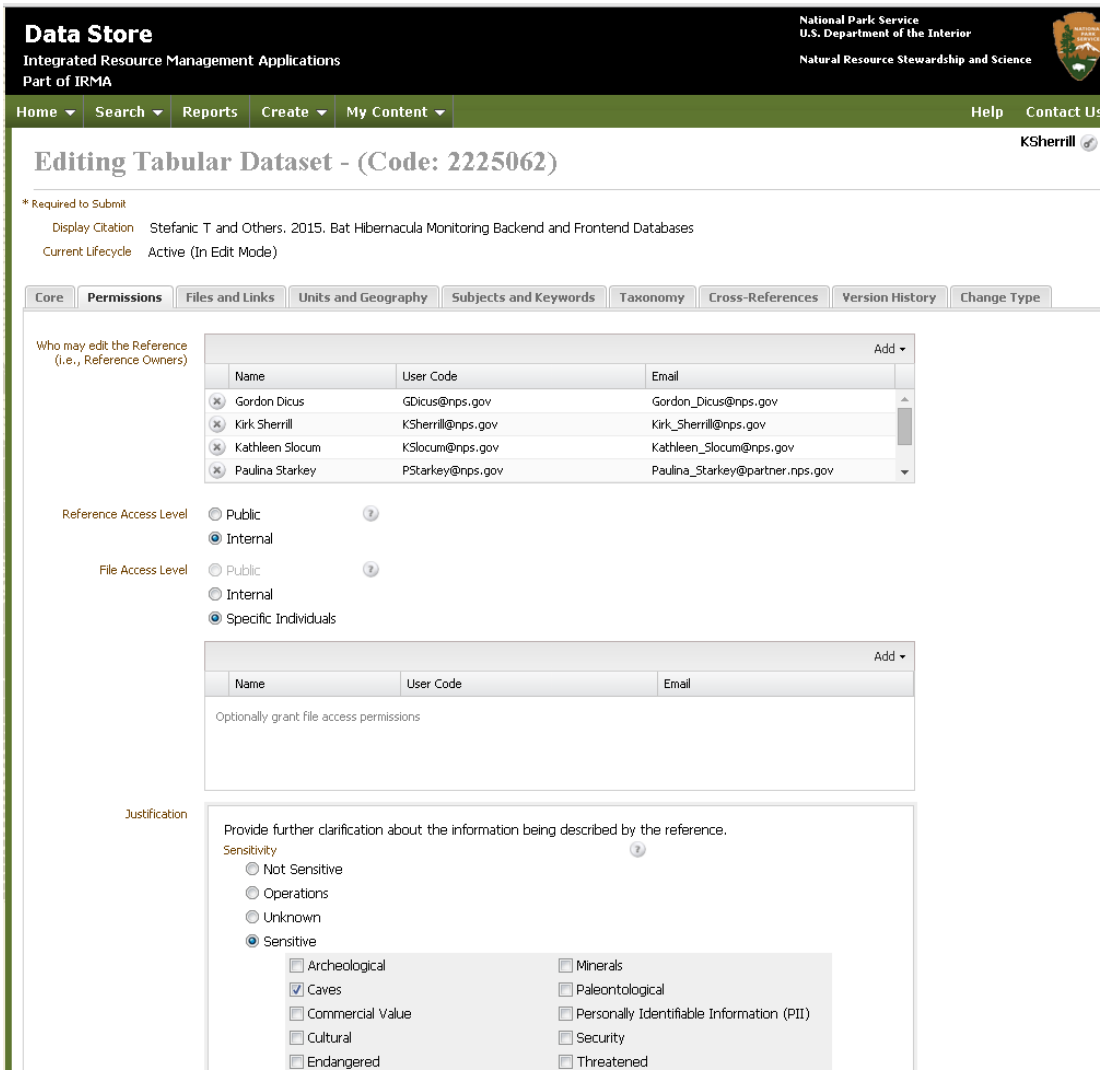

Figure 15. Screen shot of the IRMA permissions interface.

Directory Structure

The project directory structure for organizing documents and data associated with this protocol will follow guidelines and policies established by the UCBN. These directives can be found in the network‘s Data Management Plan. The project directory structure 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. Additional subfolders may be added as needed, but a strong emphasis must be placed on keeping the structure as simple and logical as possible.

Standard Operating Procedure 5: Safety

Version 1.0

Change History

Original Version #	Date of Revision	Revised By	Changes	Justification	Page #'s Affected	New Version #

11. Version numbers increase incrementally by tenths (e.g., version 1.1, version 1.2, …etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 …). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number.

12. Notify the UCBN Project Lead and Data Manager of any changes to the SOP so that the new version number can be incorporated in the Metadata of the project database.

Post new versions on the internet and forward copies to all individuals with a previous version of the SOP. A list will be maintained in an appendix at the end of this document.

Purpose

This SOP describes recommended safety practices and emergency contact information. It includes safety procedures required before start of field work, including review and signing of job hazards analyses by each crew member.

Introduction and Objectives

This SOP provides safety information, checklists, and forms for personnel involved with field activities. This SOP should be used in conjunction with more comprehensive CRMO safety procedures. This SOP summarizes basic safety information and procedures, but does not comprehensively cover every safety issue. This SOP is intended to engage all personnel and to provide a foundation for an on-going open and dynamic process for addressing field safety. The CRMO Project Lead is responsible for updating this SOP to keep it current. Park safety officers should be consulted to ensure that crews comply with all park-specific safety policies. The snowmobiling JHA included in this protocol is meant only for passengers, as personnel who wish to operate snowmobiles at CRMO are required to have training and take a test. The CRMO safety officer is responsible for administering this training.

Safety of field personnel is always the first concern in conducting a field survey program. This is particularly true for winter surveys of caves. This is inherently dangerous work. Selection of caves in the vicinity of the Monument headquarters helps mitigate some exposure. However, there are still very substantial risks and crew members need to practice conservative, thoughtful decision-making and operational leadership. Field work requires an awareness of potential hazards and knowledge of basic safety procedures. Field personnel routinely come in direct and indirect contact with environmental hazards such as sub-freezing temperature, snow and rugged terrain leading to and within caves. Over-snow travel, especially over lava, is dangerous. Use of trekking poles to prod for unseen dangers under the snow is highly recommended. Advanced planning can reduce or eliminate many safety hazards and better prepare staff for dealing with risks.

Roles and Responsibilities

The following roles and responsibilities are adapted from the NPSafe program. In addition, we have incorporated principles from Operational Leadership to empower all employees to take responsibility for safety and wellness. The CRMO Project Lead must be trained in Operational Leadership (OL) and will apply OL principles in assessing risk and managing field crew safety. CRMO safety standards will be used while executing this protocol, and all participants in the survey, regardless of affiliation, will adhere to them. According to these principles, the CRMO Project Lead is responsible for setting the standards, articulating the standards to crew members, and following and enforcing the standards. All participating team members are responsible for knowing, understanding, following, and encouraging others to follow the standards. Standards include the standard operating procedures specific to this protocol as well as overall safety standards for the Monument.

CRMO Project Lead – Wildlife Biologist

- Communicate and demonstrate operational leadership principles clearly and continually.
- Train and supervise crew member safety training and performance.

- Incorporate safety as a critical element in employee performance plans.
- Incorporate safety into all decision-making processes.
- Ensure all crew members are aware of the job hazards.
- Incorporate principles from operational leadership to help all crew members take responsibility for safety, understand human error and accident causation, manage stress, evaluate risk, maximize situational awareness, make appropriate decisions, communicate effectively, and be assertive regarding safety in the workplace.
- Ensure all employees understand their roles and responsibilities in implementing a safety program.
    - Lead periodic to frequent de-briefings or after action reviews to identify risks, near misses, weak signals, and any other concerns that may compromise field safety.

Crew Members

- Collaborate with CRMO Project Lead to review and sign Job Hazard Analyses and Monument safety guidelines, and review, implement, and use safety and health orientation checklists.
- Incorporate safety into all decision-making processes and job tasks.
- Understand roles and responsibilities in implementing a safety program.
- Awareness of and control over job hazards.
- Identify and report hazards to CRMO Project Lead and/or other Monument staff as necessary.
- Apply principles from operational leadership to understand human error and accident causation, manage stress, evaluate risk, maximize situational awareness, make appropriate decisions, communicate effectively and be assertive regarding safety in the workplace.
- Participate in periodic to frequent de-briefings or after action reviews to identify risks, near misses, weak signals, and any other concerns that may compromise field safety.

General Safety Preparation

It is necessary for the CRMO Project Lead to begin safety preparations and training well before the field season begins to allow adequate time for thorough understanding of field procedures and to obtain any additional training, such as first aid and CPR. Field crews must be familiar with the general safety protocol in the following sections and complete any required training before starting field work.

Weather and Field Gear

Winter field work in CRMO can involve challenging weather extremes. Cold snowy weather can be encountered. It is essential to the success of the program that all field staff and associates are well

prepared for weather extremes. Good winter gear, clothes for a range of temperatures, and snow boots are essential.

First Aid and CPR

Training in basic first aid and CPR is required for the CRMO Project Lead, and is strongly recommended for all crew members. Certification is valid for two years. Monument staff should make arrangements for those needing training prior to the field season.

Automobile and Snowmobile Safety

Road travel to access jump-off points for cave access is primarily along the CRMO loop road, which has good speed control and is relatively safe. However, some driving along Hwy 93 along the northern boundary of the Monument is required, and vehicle speeds typically exceed 60 mph. Defensive driving is of utmost importance here. Snowmobile travel is necessary for some cave access. Snowmobile operator training is mandatory for all crew members that operate snowmobiles, delivered by the CRMO safety officer. It is incumbent upon field staff to drive responsibly and to monitor fatigue while driving. Employees should pull over to rest when necessary. Vehicle keys will be kept with vehicles at all times.

Field Communications

The CRMO Project Lead will direct field communication strategies, including training all participating team members in CRMO radio operation and communication protocols. Use of a dry erase board and laminated cardboard arrows has been used successfully during pilot testing of the protocol for quiet communication inside caves, particularly when surveying the large caves like Arco Tunnel. Cell phone coverage is spotty across the Monument but may be used for communication as well.

Job Hazards Analyses

[Begins on Next Page]

CRMO JOB HAZARD ANALYSIS			
Job Description: ***Caving Activities*** [outside of developed caves area and regularly traveled roads, trails]			Date of last review/update: 2/10/2014
Division with primary responsibility for this JHA: *Resources*	Last updated by: Todd Stefanic	Reviewed by:	Approved by: John Apel
Required standards & general notes	Employees will not enter back country caves alone. <u>DO NOT ENTER</u> if cave is closed, gated or posted no entry. If these areas must be entered secure authorization from Chief of Resources or the Superintendent		
Required personal protective equipment	Radio and/or cell phone, first-aid kit, long-sleeved shirt, sturdy foot wear (at least ankle high boots), long pants, helmets, leather gloves, ski/trekking poles to prod for unseen cracks/ crevices / holes under the snow, knee pads (if cave will require crawling), caving helmet, appropriate amount of drinking water, 3 sources of light per person, GPS and/or compass (not necessary for "front country caves"), winter survival kit (during winter months), for large confusing caves: some type of high visibility marker and a writing instrument (see confusing passages section below)		
Other Required tools & equipment	White Nose Syndrome outerwear (Tyvek or cloth coveralls, rubber gloves, rubber boots or boot covers, shower caps, etc) and decontamination products. Garbage bags to put soiled / disposable outerwear in. See WNS Response Plan for latest decontamination procedures)		
Activity	Potential Hazards	Safe Action or Procedure	
Travel to and between caves	Becoming lost or stranded without any park contact knowing your whereabouts	Employees shall submit a trip itinerary to their supervisor and receive approval for the planned travel. If going outside of developed areas, initiate back country tracking with their supervisor and/or the Visitor Center Front Desk. Back country tracking will include: (at minimum) • A radio call or cell phone call prior to the start of the travel. • A radio call, cell phone call, or S.P.O.T. check-in at predetermined intervals (not to exceed 1 hour,) during the travel and/or task (if possible check-in before entering each cave and after exit). This will be done so a park contact can maintain an awareness of employees' location, health, and safety during the task and/or travel. • A time table for trying to establish contact should contact fail to be made during one or more of the "check-ins". • A time table for initiating SAR (Search and Rescue) should contact fail to be made. • A radio call or cell phone call once the operator has safely returned to the CRMO base area or highway to stop back country tracking. Individuals or groups planning to return after normal office hours must pre-arrange a "safe return" notification to someone who can initiate a response if the individual or group is overdue by more than two hours.	

Working in Confined Spaces	Claustrophobia or panic attack	If you are claustrophobic DO NOT ENTER CAVES. Many people do not realize they are claustrophobic until after cave entry. If nervousness or panic feeling develop exit the cave immediately. If more than one person is in cave, a calm individual should accompany the nervous individual to surface. (A panicked person will likely need help to remain calm and alert for dangers).
Exploring caves with a dark zone	Dark conditions	A minimum of three light sources should be carried. 50 or more lumens per light is recommended. Primary light should be a headlamp. Check lights before leaving the office. Carry extra batteries. Pen lights, Mini-Mag lights etc. don't work well in caves. They may be OK for your 3rd light backup but not as the primary light.
Traveling over uneven, rocky, slippery surfaces and/or loose rubble	Injury from slips, trips and falls	Long pants, long sleeves should be worn while in cave. Boots should always be worn while in or hiking to the cave. Whenever possible avoid ledges or areas on floor that are ice covered. If you have to cross ice covered areas maintain 3 points of contact. Avoid areas with loose rubble on ceiling or walls. Move slowly & deliberately across steep or rough areas. Use solid rocks for handholds when they are available. Check footholds before using them. Avoid moss beds. If they must be crossed step gently on areas with the least amount of moss cover. If mosses are wet they may need to be avoided and the cave entered at a different time.
	Scratching or abrasions of skin on rocks. Knee injury while crawling.	Always wear gloves while in cave. If the passage requires crawling wear knee pads.
Winter Caving: Working in cold / wet conditions Snowmobiling to work area Travel across snow and/or ice in area with deep cracks and holes	Hypothermia Injury/ death from collision, impact roll-over etc. Injury from slips, trips and falls.	Be aware of weather conditions and forecast. Dress for worst case scenario. Wear durable and warm clothes in caves. Have a winter survival kit with you. Stay dry; avoid getting "sweated up", water features and/or dripping water. Whenever possible avoid walking over ice. See Snowmobile JHA and SOPs Use snowshoes or skis if snow depth warrants. Stay as close as possible to main trail to avoid open lava flow. Travel in pairs and with a park radio or phone. Look for safest route to cave.
Exploring deep caves with poor circulation / limited oxygen	Asphyxiation	Deep caves may have poor air circulation and low oxygen. If you start to have trouble breathing, remain calm and exit immediately.
Working in areas with low ceilings	Collision with low ceilings, stalactites etc.	Wear helmets and be aware of where the ceiling is and what type of features the cave has (stalactites etc.). Remember that cave helmets add 1 inch to a person's height.

Encounters with cave dwelling animals and /or their droppings	Animal bites or scratches or subsequent Infection and/or disease transmission Venomous animals can be encountered at cave entrances and in the twilight zone Animal dropping can transmit disease	If bats, rodents or other animals are encountered DO NOT APPROACH OR ATTEMPT TO HANDLE. Do not put hand or fingers in crevices that you cannot see into. If Great Horned Owls (or other birds of prey) are nesting in cave do not approach. These are aggressive nest defenders and may attack. If snakes, spiders, scorpions or other animals are encountered, DO NOT APPROACH OR ATTEMPT TO HANDLE. If large numbers of bats are known to occupy the cave, DO NOT ENTER without authorization from Chief of Resources or the Superintendent. If a large concentration of bats is found exit cave and report to resources staff.
Working in Caves with multiple and/or confusing passages (*i.e.* Arco Tunnel)	Becoming "turned around" or lost within a cave	Do not enter this type of cave without carrying a map. If possible enter this type of cave the first time with someone with experience in the cave. If surveyors split up (Arco Tunnel) teams will wait to meet up with other teams at zone intersections or other pre-arranged locations or will leave a highly visible marker with the time, direction of travel and their intentions written on it to inform other teams of their whereabouts and intentions.
Working in caves with tight crawls	Becoming stuck in tight spaces	Do not attempt tight crawls unless necessary. If in doubt do not try it. For Arco Tunnel: There is a tight crawl of 11.5 inches to access the main passages. If you don't fit, do not enter cave .The Senate Room access passage is 9.5 inches. If you don't fit, do not enter that cave zone.
Caves with small (≤15') vertical drops requiring ropes for either entry or egress	Falling Inability to egress	DO NOT ENTER these caves without equipment for this work. If access to these caves is necessary, safety instructions and briefing by qualified personnel will occur prior to entry.
Large Caves with vertical access requiring repelling or ropes for either entry or egress	Falling Inability to egress	DO NOT ENTER these caves without special authorization and training and leadership of a person with experience and equipment for this work. If access to these caves is necessary, safety instructions and briefing by qualified personnel will occur prior to entry.

Signed_____	Title: Superintendent	Date_____

Signed_____ Date_____

Signed_____ Date_____

Signed_____ Date_____

Signed_____ Date_____

Signed_____ Date_____

Signed_____ Date_____

Signed_____ Date_____

U.S. Department of the Interior	**1. WORK PROJECT/ACTIVITY**	**2. LOCATION**	**3. UNIT**
National Park Service	***Snowmobile Operation***	Craters of the Moon National Monument and Preserve	
JOB HAZARD ANALYSIS	**4. NAME OF ANALYST**	**5. JOB TITLE**	**6. DATE PREPARED**
References-FSH 6709.11 and 12 (Instructions on Reverse)	Todd Stefanic, Darren Parsons, David Durbin & Paul Schut	Wildlife Biologist / Maintenance Mechanic/ Fee Supervisor/ Maintenance Worker	11-19-2012 Revised 12-12-13 (Stefanic) Revised 11/4/2014 (Buckley)
7. TASKS/PROCEDURES	**8. HAZARDS**	**9. ABATEMENT ACTIONS Engineering Controls * Substitution * Administrative Controls * PPE**	
Qualifications	Unqualified operators may injure themselves or damage equipment	Only employees who have completed the required training and practical demonstrations listed in the Snowmobile SOP's and Snowmobile Operators Task Book will be allowed to operate the snowmobiles. All passengers will receive a brief "how-to" operate demonstration in case the operator becomes incapacitated	
Submit trip itinerary to your supervisor and/or grooming manager.	Without your itinerary your Supervisor and/or grooming manager won't know when to expect you back or where to look for you if get into trouble and don't return. Weather	All snowmobile operators will submit their trip itineraries to their supervisor and/or the Snowmobile Coordinator before starting the snowmobiles. Check in times will be arranged with Supervisors, Snowmobile Coordinator, or the Visitor Center to ensure operator safety throughout the project. Supervisors or the Snowmobile Coordinator may disapprove snowmobile operation if they feel it's unsafe for any reason (i.e. weather, remoteness, operator fitness/fatigue, etc…). Check the weather forecast before submitting itinerary	
Gather/wear appropriate PPE (Personal Protective Equipment).	Slips, Trips and Falls while performing inspection. Damage to equipment or injury to operator may occur if equipment isn't properly inspected. Machine may break down if not	Snowmobiles will be inspected for the following items befor the snowmobiles move: 1. Snowmobile manufacturer's operating manual and tool kit. 2. First aid kit 3. Flashlight or headlamp	

	inspected	with extra batteries and bulb 4. Shovel and snowshoes Operators will consider bringing a GPS unit with extra batteries, a map and compass, sunscreen, a supply of water, energy food, and matches if traveling in the back-country or as requested by their Supervisors. Operators will need to be aware of ice built up around snowmachines and grooming equipment. Consider wearing some sort of traction device (i.e. yacktracks) if necessary. Before starting the snowmobiles, operators will check the following: 1. Throttle (it should freely return to the idle or closed position) 2. Snowmobile (it should be positioned in a clear space free of people or objects) 3. Fuel, oil and battery 4. Ski assemblies and rods 5. Drive belt 6. General mechanical conditions (walk around Snowmobile and Grooming Equipment and inspect for missing or loose parts). 7. Handlebars (they should turn both ways) 8. Emergency kit 9. Personal items kit 10. Safety equipment	
Snowmobile start and warm up.	Gas Overflow. Failure to start. Damage to equipment may occur if operated before properly warmed up.	Keep an eye on fuel nozzle while refueling. If fueling from a jerry can, use a proper spout vs. opening lid and us a funnel if necessary. Never smoke while fueling. If trailering, make sure machine(s) start before traveling. Sleds should not be moved until the temperature warning light on the gauge of the sleds shuts off, indicating the engine is warm enough to be put under a load.	

		Be aware of where your hands / feet are positioned, use proper lifting techniques Before loading sleds on any trailer the trailer will be secured to the proper sized ball hitch on a truck. Set parking brake on vehicle. Locking pins should be in place to secure the hitch and emergency chains will be fastened and crossed.	
Load/unload snowmobiles if transporting to other areas of work.		**Operators will wear all appropriate PPE while loading or unloading snowmobiles.** **Only operators who have completed loading/unloading portion of their Task Books will be allowed to load or unload snowmobiles.** **Operators will inspect bed of trailer for ice which may make stopping difficult.** **Operators will use caution while applying throttle during loading procedure to prevent collision with the front of the trailer or driving off the trailer.** **Snowmobiles will be secured both front and back with 3 inch ratcheting tie-downs.**	
Operating snowmobile		Always travel on the side of the trail farthest from the groomed ski track, keep speed down especially around corners or in limited visibility conditions When it is necessary for two people to be transported on one snowmobile, the snowmobile must be designed and constructed as a 2-up machine. Do not exceed manufactures weight limit. Passenger will wear the same PPE required for driver. Passenger must get a safety briefing and “how to” if not certified to operate snowmobile. Whenever possible two machines should be used when going out into the field. When traveling alone, you must follow established SOP and/or	

		backcountry JHA. If you stop on a main trail, move to the side of the trail before stopping. Anticipate traffic approaching from behind. Pay attention to the riders ahead of you and allow for stopping distances. Flash your brake lights several times if you intend to stop. Hold up hand as a signal. Always allow adequate stopping distance based on ground cover conditions. Do not leave the engine running when parked. Turn engine off, and set the parking brake. If the machine does not have a parking brake, secure it against movement. Snowmobile must be rated by the manufacturer for towing and proper towing package must be procured and used with the specific snowmobile. When towing a sleigh, follow manufacturer recommendations for sleigh type and weight limitations. Always use a ridged hitch--not a chain or rope. Remove drive belt of machine being towed. If no one is available to ride disabled machine for steering and breaking a rigid tow bar should be used.	
/s/	**11.TITLE**	**12.DATE**	
(Previous edition is obsolete)			
Signed: _____	**SUPERINTENDENT**		

Signed_____ Date_____

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CRMO JOB HAZARD GUIDELINE			
Job Description: ***Backcountry Work* (includes day trips or overnight)*** *Travel outside of the developed zone, off paved highways or north end road outside of developed areas.			Date of last update: 4/07/2014
Division with primary responsibility for this JHA: Resource Management	Last updated by: John Apel	Reviewed by: Supt., CRMO RM staff, Cooperators (EPMT, I&M, etc.)	Approved by: *Dan Buckley; 7/5/2015*

Required standards & general notes	Employees work in groups of two or more and they report to prearranged park contact at preplanned intervals (at least daily) by radio, SPOT device, or cell phone when working. In any situations where employees work alone; check-in by radio, SPOT device, or cell phone must be done at pre-determined times to a prearranged park contact. The number of contacts depends on the anticipated travel time. For durations up to half a day, one prearranged contact (mid-morning or mid-afternoon); for a full day, three contacts (mid-morning, noon, mid-afternoon). Park contact must know destination and route and return date/time and this information is posted on RM Office Check-out Board. Communication must consist of a status update and any anticipated deviations from route or return time. Unexpected deviations in work plans require additional contacts. Individuals or groups planning to work and/or return before and/or after normal office hours (8 am - 5 pm) must pre-arrange a "safe return" notification to prearranged contact (in park or at home) who will be responsible for initiating a response if the individual or group is overdue by more than two hours.	
Required personal protective equipment	Radio and/or cell phone or SPOT/ResQLink device, appropriate footwear, and first-aid kit.	
Typical tools & equipment	Backpack (or rucksack if traveling by stock), cold and wet-weather gear, long pants, appropriate foot wear (at least ankle high boots for rugged off trail areas), tent*, adequate sleeping bag and pad*, sun protection (hat, bandana, and/or sun block), food and food preparation equipment*, appropriate amount of drinking water (2-4 quarts/day depending upon temperatures), pack weight (less than 1/3 of body weight), mosquito repellent, compass/GPS and map, and light source.	
Activity	**Potential Hazards**	**Safe Action or Procedure**
Backpacking with heavy loads	Heavy loads	Carry no more than 1/3 of your body weight while traveling in the backcountry.
	Load instability	When carrying heavy loads, pack the gear so that heavy equipment is carried low on your back to increase stability. Consider using hiking poles.
	Excessive loads	Assess equipment needs to ensure only required equipment is being carried.
	Muscular pain & soreness	Start slowly to ensure muscle groups are given adequate time to warm up. Use stretching exercises before starting.
	Fatigue	Take frequent breaks for food & water.

	Back strain	Lift loads with your legs to avoid back injuries.
Hiking on steep or rough terrain off trail	Steep slopes & poor footing (falls)	Move slowly & deliberately across steep or rough areas. Use trees & solid rocks for handholds when they are available. Check footholds before using them. Fall into the slope if you slip or slide. Have a companion spot you from a more secure location. Never be above or below someone on a loose or unstable slope.
Hiking on steep or rough terrain off trail (*continued*)	Footing	Plan routes to avoid aa flows when possible. Utilize smoother lava flows or open cinder areas when possible. Use hiking pole(s) to help stabilize. Be aware of the ground surface in front of you - watch for slick, sloped & unstable areas surfaced by loose rock. Be aware of loose cinder areas or wet lava. Dense brush often creates a tripping hazard. Provide adequate spacing between individuals if traveling in a group. Do not multi-task by walking across rough terrain while attempting to locate and/or use water bottles, radios, GPS, cameras, etc.
	Open cracks	Avoid by going around or by finding a location where the crack narrows to a point where it can be safely stepped over. Members of a party should move across such cracks one at a time. With heavier the pack loads, the wider and deeper cracks; much more caution should be applied.
Driving on steep or rough terrain	Hazardous conditions / obstacles	See Driving Motor Vehicles JHA. Pre-plan to ensure the right vehicle is used for the work; use 4X4 capabilities BEFORE they are necessary. Use a spotter if ground clearance is limited. Coordinate hand signals before using them.
	Other vehicles	Approach at a safe speed; maintain heightened awareness around blind curves and road dips. Pull well off roadway in a cleared area to allow safe passage. The best area may be behind you. Be the first to pull over if other driver is descending a hill.
Route finding	Hazardous obstacles	Plan routes to avoid or limit exposure to known hazards such as AA lava, steep slopes, open cracks, dense brush, etc.
	Disorientation	Ensure all personnel are knowledgeable with map & compass as well as GPS usage. Be aware that compass accuracy can be affected by as much as 20 degrees due to local geology.
		Keep track of current position & location of prominent landmarks with frequent map updates. All members of the party should be capable of describing their location and the route to their starting and/or planned ending point. Look behind you often to ensure an effective egress.
		When available, stick to established trails.
Inclement weather	Unfamiliarity with current & forecasted weather	Obtain weather forecasts prior to beginning back country travel & monitor weather broadcasts via radio during trip.
	Inappropriate gear for the conditions	Assess anticipated routes, elevations, & weather conditions when planning what gear to carry.

		Carry rain gear, a warm hat, gloves, & a warm jacket when traveling in the backcountry during the winter and shoulder seasons.
	Thunderstorms	There is NO safe place outside during a thunderstorm. Second to an enclosed building, an enclosed vehicle is the safest place to be. Return to your vehicle before the storm hits.
		Avoid exposed ridge tops and stay away from trees if thunderstorms are approaching or developing nearby. Do not camp on an exposed hilltop or high ridge if thunder storms are in the forecast.
Inclement weather ***(continued)***	Thunderstorms (*cont*.)	If hair begins to stand up, immediately minimize exposure by moving to lower elevations away from isolated trees & crouch down on the balls of your feet to reduce ground contact.
	White outs	In the event of white out conditions, immediately seek shelter & wait for conditions to improve. Do not attempt to "feel your way" over the lava.
	Hypothermia	Layer your clothing such that it will be easy to regulate your body temperature by adding or subtracting layers.
	Heat stress	Drink plenty of liquids, keep hydrated, & take frequent breaks for snacks & water.
Camp cleanliness & health	Contamination of shared food	Wash hands thoroughly using soap or hand sanitizer before handling food, dishes, utensils, etc.
	Contamination of shared water	Wash hands before gathering and/or filtering water; avoid contaminating filtered water with unfiltered water at source.
	Contamination of anything common (i.e., tools, dishes, paperwork, etc)	Wash hands (especially after using the bathroom) before handling anything common to the crew.
	Bathroom habits in the backcountry	Leave-no-trace principles. Before touching anything common, WASH!
	Wildlife	Properly store food, thoroughly wash dishes and keep a clean camp area.

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Standard Operating Procedure 6: Protocol Revision

Version 1.0

Change History

Original Version #	Date of Revision	Revised By	Changes	Justification	Page #'s Affected	New Version #

13. Version numbers increase incrementally by tenths (e.g., version 1.1, version 1.2, …etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 …). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number.

14. Notify the UCBN Project Lead and Data Manager of any changes to the SOP so that the new version number can be incorporated in the Metadata of the project database.

Post new versions on the internet and forward copies to all individuals with a previous version of the SOP. A list will be maintained in an appendix at the end of this document.

Purpose

This SOP describes the recommended practices for revision of the narrative and SOPs and provides a history of the protocol development process.

Procedures

This survey protocol is an actively evaluated and updated document that reflects the latest procedures of the park hibernacula inventory and 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 CRMO Project Lead, with support and consultation from the UCBN I&M team, on an annual basis in association with season close-out. The narrative as well as each SOP has a change 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, 1.2, 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.

Timing

SOPs can be changed at any time, however it is often most convenient for the changes to be made during reporting and project close-out and to take effect at the beginning of the next calendar year. Changing an SOP during a data collection period should be avoided. However, testing of proposed new methodologies with the existing approaches is highly desirable and provides invaluable information necessary for evaluating whether the new methods are superior and how their measurements will correlate with the previous methods.

Instructions

The following procedures will ensure that both minor and major revisions to this document will align with the monitoring protocol and data management.

1. Discuss proposed changes prior to making modifications. It is important to that the CRMO Project Lead and UCBN I&M team, particularly the UCBN Ecologist and Data Manager, work closely to review and implement proposed changes and revisions to the protocol.
2. After all relevant parties agree to a particular set of changes, make the agreed-upon changes in the appropriate protocol document. Note that a change in one area of the document may necessitate other changes elsewhere in the protocol. For example, a change in the narrative may require changes to several SOPs; similarly, renumbering an SOP may mean changing document references in several other documents. Also, the project task list and other appendices may need to be updated to reflect changes in timing or responsibilities for the various project tasks.
3. Document all edits in the Change History Log embedded in the protocol narrative and each SOP. Log changes only in the document being edited (i.e., if there is a change to an SOP, log those changes only in that document and not in the narrative). Record the date of the changes (i.e., the date on which all changes were finalized), author of the revision, the change and the

paragraph(s) and page(s) where changes are made, and briefly the reason for making the changes, and the new version number. Version numbers increase incrementally by tenths (e.g., version 1.1, 1.2) for minor changes. To ensure that minor errors noted or recommendations are not lost, changes should be made within 30 days of when they are noted, once the team has reviewed and approved the recommended changes. Major revisions will be designated with the next whole number (e.g., version 2.0, 3.0). Record the previous version number, date of revision, and author of revision; identify paragraphs and pages where changes are made, rationale for revisions, and the new version number.

4. Circulate the changed document for internal review among the Monument and Network staff.
5. Upon ratification and finalizing changes:
   a) Ensure that the version date (last saved date field code in the document header) and file name are updated properly throughout the document.
   b) Make a copy of each changed file to the protocol archive folder (i.e., a subfolder under the Protocol folder in the project workspace).
   c) The copied files will be renamed by appending the revision date in YYYYMMDD format. In this manner, the revision date becomes the version number and this copy becomes the "versioned" copy to be archived and distributed.
   d) The current, primary version of the document (i.e., not the versioned document just copied and renamed) does not have a date stamp associated with it.
   e) To avoid unplanned edits to the document, reset the document to read-only by right-clicking on the document in Windows Explorer and checking the appropriate box in the Properties popup.
   f) Inform the Data Manager so the new version number(s) can be incorporated into the project metadata.
6. As appropriate, create PDF files of the versioned documents to post to the Internet and share with others. These PDF files will have the same name and be made from the versioned copy of the file.
7. Send a digital copy of the revised monitoring protocol to CRMO and UCBN I&M offices. The revised monitoring protocol should also be forwarded to all individuals who had been using a previous version of the affected document. Ensure that field staff has a hardcopy of the new version.
8. The UCBN Data Manager will place a copy of the revised protocol in the proper folder on the Network server.
9. The UCBN Data Manager who will post the revised version and update the associated records in the proper I&M databases, including the NPS Data Store, UCBN website, and the Protocol database.

Development History

Table 4 summarizes the development process and major events leading to the initial approval of the CRMO bat hibernacula survey protocol (version 1.0) for implementation.

Table 4. Protocol development history.

Date	Development Step	Documentation
January 2013	Protocol development initiated by UCBN and CRMO after initial pilot testing of LABE methodology provided by Shawn Thomas.	See annual report by Stefanic and Rodhouse (2013)
December 2013	Draft protocol narrative circulated to CRMO and UCBN staff for review	
February 2014	Complete draft of protocol narrative and SOPs circulated to CRMO and UCBN staff for final review.	
March 2014	Version 1.0 protocol submitted for peer review to PWR I&M Program Manager (Latham) and PWR Protocol Review Coordinator (Bakker).	Protocol is available upon request.
January 2015	Peer review comments provided to UCBN	
May 2016	Revised protocol submitted to PWR I&M Program Manager (Garrett) for review and approval	
September 2016	Protocol approved by PWR I&M Program Manager pending minor edits	
January 2017	Protocol published in NRR series	

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

NPS 131/136132, January 2017

National Park Service
U.S. Department of the Interior

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