Utah Bat Monitoring Protocol

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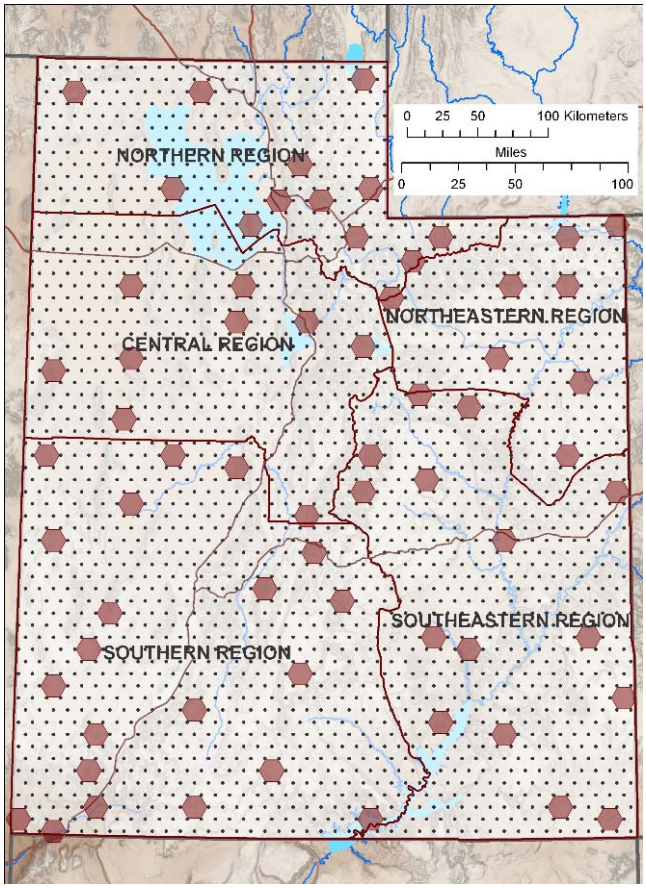

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INTRODUCTION

Many bat populations in North America are thought to be declining (Stebbings 1980, McCracken 1988, Richter et al.1993, Tudge 1994, Altingham 1996). The International Union for Conservation of Nature (IUCN) lists 10% of microchiroptera species as threatened (Mickleburgh et al. 2002). The combination of slow reproduction, natural rarity and genetic isolation make bats susceptible to population and range declines (Racey and Entwistle 2003). Of 45 bat species in the United States, six are listed as federally endangered and 19 are former candidates for listing (Code of Federal Regulations 1991; USFWS 2008). Of Utah's 18 species, 6 are Tier II Species of Concern in the Utah Comprehensive Wildlife Conservation Strategy (UDWR 2005). These apparent declines in bat populations may be attributed, in part, to loss of suitable habitat due to increased human recreational activity (caving and climbing), mine closure programs, urbanization and the lack of information on population level trends (Humphrey and Kunz 1976; UDWR 2005). The status of bat population trends can be assessed through landscape level monitoring of bat species and communities (Weller 2008). Understanding landscape level population trends allows managers to detect population or range changes and mitigate them (Bat Conservation Trust 2004). A long-term landscape level monitoring program will provide for the continued conservation of bat populations and communities (Racey and Entwistle 2003; Duchamp et al. 2007).

Landscape based models provide an estimate of bat community and species presence, and provide a useful bat conservation tool (Jaberg and Guisan 2001). Monitoring bats based on landscape-scale habitat features accounts for the broad scale influences of habitat on bat abundance and species distribution (Jaberg and Guisan 2001, Duchamp et al. 2007, Duff and

Morrell 2007). Landscape level bat monitoring programs have been developed across the United States, Canada, and the United Kingdom (Hendricks and Maxwell 2005; Arnett 2007; Ford et al. 2005; Nagorsen and Brigham 1993; Stebbings and Griffith 1986).

We developed a landscape level bat monitoring protocol to meet Department of Defense and Utah Division of Wildlife Resources bat management goals (SIKES ACT, UDWR 2005; Oliver et al. draft). We conducted a thorough review of refereed and government report based literature pertaining to landscape level bat monitoring. We also utilized academic resources in Utah. Specifically, we consulted with: Dr. John Bissonette, Utah State University, who has 40 years experience in design and implementation of landscape scale monitoring of vertebrates; Dr. Frank Howe an avian ecologist, familiar with the existing wildlife monitoring GIS Grid in Utah and 20 years experience with large scale monitoring of highly mobile organisms;. Dr. David Koons, a population ecologist at Utah State University (USU) experienced with occupancy model based data analysis; Dr. Mary Conner, a population ecologist at USU specializing in metapopulation level monitoring and statistical rigor and suitability of occupancy model analysis: Dr. Mike Wolfe, Utah State University, who has 30 years experience monitoring wildlife populations in Utah; Dr. Kevin Bunnell, Utah Mammals Coordinator at UDWR, who provided a power analysis and management perspective; and Dr. James MacMahon, former president of the Ecological Society of America, who consulted on overall project design and scientific rigor of the protocol. The combination of literature review and expert consultation led to the creation of a Utah specific bat monitoring protocol.

Studies in Montana, Oregon, Washington, California, West Virginia, and Hawaii indicate that occupancy based models provide an estimate of bat species and community distribution. Pat Ormsbee's BATGRID in the Pacific Northwest created the first regional scale

occupancy monitoring program and influenced the development of other monitoring programs in the western U.S. In a study in Montana sample units were stratified by five USFS Ranger Districts (Hendricks and Maxwell 2005). They selected 5 sample units (10 x 10 km) within strata and surveyed each twice at different locations within the sample unit (Hendricks and Maxwell 2005). Hendricks and Maxwell recommended continued sampling stratified by ecoregion or Ranger District. Hendricks and Maxwell (2005) noted that the Oregon Bat Grid provided a suitable monitoring program with protocol modifications. A landscape scale bat monitoring program in the Cascade Range of Oregon also used a presence absence framework (Arnett 2007). Arnett (2007) stratified sample units with three forest densities, 12 sample units each. Sample locations consisted of 4.8 km diameter and a water source equal to or less than 20 x 20 m^2. In Oregon bat species distributions were related to landscape level habitat factors such as elevation and roost density (Arnett 2007). A study in West Virginia was also based within a presence absence framework (Ford et al. 2005). This study consisted of 63 sample sites surveyed with acoustic techniques only. Ford et al. (2005) detected associations between landscape scale habitat variables and the occurrence of bat species and communities. In Hawaii a pilot project also based in the use of acoustic detectors only, indicated that reliable occupancy estimates were not attained until 15 sample units or visits per strata (Gorresen et al.2007). A multiple species monitoring study in Washington, Oregon and California was stratified by four forest and reserve conditions (old growth forest) (Weller 2008). Sample cells within condition were 5.5 km hexagonal cells, and a total of 51 cells were sampled in two locations (>500 m apart) twice for a total of 204 sample units. Weller (2008) used a combination of acoustic and capture methods focused on small ponds or low gradient streams. Weller (2008) calculated detection probabilities for 8 species between 0.24 (long-eared myotis) and 0.53 (California myotis), and occupancy

estimates from 0.59 (Yuma myotis) to 0.78 (California myotis). These estimates are the first for occupancy and detection of bats at a regional scale (Weller 2008). All of these studies used an occupancy based logistic regression analysis with presence absence data.

Hendricks and Maxwell (2005) found that improper use of equipment by poorly trained personnel resulted in underutilized acoustic data, and they recommend significant training on devices prior to field use. Hendricks and Maxwell (2005) also recommend standardization of net effort and multiple visits to all sample units. They found a positive curvilinear relationship between net-hours and number of species, 40-50 net-hours is the asymptote of this relationship. The full species list was obtained by a mean 2.6 hours of net set. In Arnett's (2007) study he observed that the small number of suitable ponds within sample units limited the findings of the study. Weller's research (2008) found that detection and occupancy estimates could be improved markedly by increasing sample visits per sample cell to six. Weller (2008) also noted that rare species may not be detected at suitable levels ($p<0.15$) and thus could not be included in the covariate models (Weller 2008). Weller (2008) also recommends that sampling sites within sample cells should be > 500 m apart.

Studies such as these indicate that monitoring bats at a landscape level requires ecological stratification with at least 15 sample units per strata, and that using acoustic and mist netting methods in combination increases detection probabilities and the accuracy of occupancy estimates. These studies also recommend standardization of methods to increase detectability, including: sampling for 40-50 net-hours per site, net sets of at least 2.6 hours duration, and 6 sampling visits per sample cell. We designed a monitoring protocol based on these recommendations and expert opinion, which fits into the management objectives of the Department of Defense and the State of Utah.

We propose an occupancy model based protocol that is carried out every three years across Utah. This three year approach is being implemented to deal with inevitable funding shortfalls and differing management priorities for agencies across the state. This protocol is designed with the realization that data collection cannot be supported annually on a statewide scale. If properly applied, however, the methods selected for implementation will provide sufficient data and power to adequately assess the status of bats in Utah. The first year of the proposed monitoring protocol will produce a simple occupancy model that can be used to determine the covariate relationships of species. A second iteration of the model (sampling in year four) will allow for not only a covariate analysis but also a stage (age and sex ratio change) analysis. We can compare survey periods across years to evaluate the age and sex structure of bat populations creating a multiple stage robust occupancy model. Further iterations of the protocol will allow for population level evaluation of bat species in Utah, and even estimations of population status. This proposed protocol will maintain the proactive management of bat species in Utah created by the funding received by the DoD Legacy Program (07-346, 08-346 and 09-346). This model approach assumes: 1) Occupancy status does not change between survey periods. While reproduction occurs across survey periods it should not affect species presence/absence just state (adult, sub-adult or Juvenile); 2) Occupancy across sites can be modeled with covariates, thus environmental variables associated with bat occurrence will also be collected, and; 3) detection of species at sites are independent. In order to meet these assumptions and monitor bats in Utah we developed 6 objectives: 1) determine species specific geographic ranges; 2) determine species distribution in a spatial landscape; 3) monitor metapopulation dynamics; 4) evaluate bat community species richness; 5) monitor the presence or absence of disease within bat populations; and 6) estimate population change across time.

METHODS

General

The occupancy based monitoring protocol is stratified by 5 ecoregions (Colorado Plateau shrublands, Great Basin shrub steppe, Wasatch and Uinta montane forests, Mojave Desert and Wyoming Basin shrub steppe). Within three ecoregions (Colorado Plateau shrublands, Great Basin shrub steppe, and Wasatch and Uinta montane forests) 20, 20 X 20 km (hexagonal) sampling cells were randomly selected and an observer selected water source within each cell will serve as the sampling site (Fig. 1). This sampling design is based within the framework of Utah's existing Tesselated Grid, which serves as the monitoring base for many other mammalian and avian species in the state. The two smaller ecoregions (Mojave Desert and Wyoming Basin shrub steppe) had only enough area for 2 and 3 of the above cells randomly selected, respectively (Fig. 1). To assure independence, all sampling cells are at least 20 km from the next nearest cell (that is, there are at least six unsampled cells surrounding each selected cell). Survey sites consist of between 4 and 400 m^2 of open water on less than a 4% slope. This size restriction was incorporated to augment detectability and enable high net coverage per unit area. The smaller the netting area the more likely a species that is present will be detected (captured at the site). Along with the netting survey an acoustic survey will be conducted. The acoustic survey will be conducted greater than 500 m from the netting survey site, as recommended for a second survey site by Weller (2008). Within the 3 large ecoregions (Colorado Plateau shrublands, Great Basin shrub steppe, and Wasatch and Uinta montane forests) each sample point will be visited 3 times per warm season to evaluate population demographic trends and create 3 distinct sampling periods: gravid, pregnant females prior to partition (May); lactating, females nursing young (June); and volant, juveniles capable of flight (July-August). Sampling order will be informed

with degree day estimates for each of the selected sample cells. Each survey cell will host an acoustic and capture based survey site for a total of 3 visits and 6 sample visits (3 mist net visits + 3 acoustic visits) per year per sample cell. The sampling sites in the two smaller ecoregions (Mojave Desert and Wyoming Basin shrub steppe) will be visited twice during the periods described (total of 6 visits / year; 12 sample visits) above to increase the detectability of rare species in these ecoregions. If fully implemented, a total 60 site visits will be made each in the Colorado Plateau, Great Basin, and Wasatch and Uinta ecoregions, 9 site visits in the Wyoming Basin ecoregion and 6 site visits in the Mojave Desert ecoregion: a total of 390 sample visits (195 capture and 195 acoustic surveyes) every three years. Sampling periods will provide an estimate of occupancy within sites, ecoregions and, in Utah, it will also provide an estimation of detection probability and occupancy across time and space. All data will be used to create a logistic regression based covariate model using program MARK® or Presence®.

Monitoring visits will consist of setting mist nets from sunset to 0100h (UBCC netting protocol; forthcoming) and supplemental acoustic monitoring (forthcoming). Periods within year and site will then be used to calculate the probability that a site is occupied. For this first iteration, we can assume a detection probability as low as 0.15 and an occupancy probability as low as 0.50. While these estimates are simulated at this stage they are very similar to those found by Weller (2008). A calculated detection probability will be possible after the first year's data is analyzed. For each species within each stratum (ecoregion) a species presence will be recorded as a "1", absence as a "0", and no record as a "." (Table 1). This format enables the incorporation of all other data collected within the state outside of this protocol and between iterations of the protocol. For example, a single visit with a detection in the first period would be recorded as "1 . ." and visits (with detections) in only the first and third period only would be recorded as "1 . 1".

This design allows the integration of all bat data collected within each stratum (ecoregion) into the occupancy model. Any bat data collected within each stratum can be recorded and added to the occupancy model within year. A second survey year will provide data for both a robust occupancy model and a multiple species stage occupancy model across years within periods. This requires the same basic data format. The difference is in the functions carried out in program MARK® or Presence®.

Data will be collected using the protocols developed by the Utah Bat Conservation Cooperative (UBCC). All sample site characteristics and bat capture data will be compiled and recorded on the data form described in Tables 2, 3 and 4. The intent of this data form is that after each survey for each site two (acoustic and capture) forms will be updated using the UBCC data forms (Appendix I) for each site. Table 2 is the back of the bat occupancy data form. Each species observed at the site will be recorded as a "1", if a species is not observed a "0" will be recorded, and if a site is not visited in a sample period a "." will be recorded for each species. Table 3 provides the basis for the covariate occupancy analysis and consists of three data types; locational, survey site, and local habitat data. Locational data provides a geo-reference for the site that can be used to create spatially explicit variable sets. Survey site data enables a comparison of bat occupancy and survey site characteristics. And local habitat data provides a landscape level variable set that will be used in covariate model construction. A description of each variable on the data sheet in Table 3 is provided in Table 4.

Capture Site (Utah Bat Conservation Cooperative)

Bats are capable of recognizing and avoiding nets, therefore nets should be set in locations and arrangements that enable the highest possible capture rate. Placement can be used

to restrict flight corridors where the net covers the only way through. Nets can also be set in rows whereby bats avoid the first net and are captured in the second. Bat activity tends to increase with temperature. In Utah surveys, are generally most productive between June and mid-September.

Generally, at least two people are needed to run a mist net station. If a high capture rate is expected, make sure there is an adequate number of trained personnel to efficiently run the station. Use two people to set up the mist nets. One person can hold the pole and net while the other places the pre-arranged, end-loops over the pole and anchors the pole with cord. Tie the cord to any nearby object stout enough to hold both the pole and net, or to stakes driven into the ground for that purpose.

When anchoring the poles that hold the net, the top three end-loops should be placed above the anchor cord, and the bottom two loops below the anchor cord. Occasionally, the terrain may warrant more net area below the anchor cord (such as across a small ravine, where the poles are on slopes). Under these conditions, three panel end-loops are placed below the anchor cord. Spread the nets taut enough so that a 2.5 cm bag droop occurs in each of the net's panels. The net itself should be stretched tight. As the evening progresses, the rise in humidity will cause the net to droop, so make periodic adjustments to keep the net taut.

Open nets just before dark or when bats are first observed flying. Keep net sets closed until that time to minimize the chance of capturing birds. The nets should be checked as often as every 5 min. The longer bats are left in the nets the more tangled they become, increasing the bat's chance of injury. When placing nets over, water special consideration is needed to ensure that bats don't drown in the nets. Keep nets open until 0100h. Much of the bat activity at water sources occurs in the first half of the night.

Due to widely documented risk of Rabies, all field crew members handling bats should have full pre-rabies exposure vaccinations. Also, to protect hands from bat teeth, wear thin leather gloves whenever handling bats. In the intervals between checking the nets, bat extraction, and data collection, flashlights should be off, and noise levels kept to a minimum to avoid disturbing bats. When a bat is caught in the net, quickly move to extract it before it can escape or become further entangled. Determine from which side of the net the bat entered. Immobilize the bat with a gloved hand and carefully remove the net strands from head, body, and wings. Be especially careful with the fragile wing membrane and bones. A dental pick is a useful tool to pinpoint and remove individual mist-net strands.

After removing the bat from the net, place it in a cloth bag for transfer to the processing station. Hang the cloth bag from a branch in a sheltered spot. Process and release all bats as quickly as possible, especially lactating females, or any females caught during the maternity season. On colder evenings, the stress of capture and handling may render some bats unable to fly away. If that occurs, put the bat back into the cloth bag and place it in a warm spot (e.g. inside of a coat or in a warm vehicle). Check on the bat periodically and release it when it regains the energy to fly.

After net closure and removal of the equipment to the next netting site equipment should be cleaned. Net poles, stakes, wading boots and any other equipment that has come in contact with water or mud should be inspected and any remaining mud or vegetative material should be removed and the equipment cleaned with a 10% bleach solution. Bat measuring equipment such as dental picks, rulers, calipers and any other tools which come in direct contact with bats should be cleaned with isopropyl alcohol. Bat collection bags should only be used at the designated sites

for each bag set and laundered as often as possible. These cleaning measures will reduce the threat of the spread of invasive aquatic organisms and bat borne diseases.

Acoustic Site (Utah Bat Conservation Cooperative)

Acoustic surveys will be located at least 500 m from the capture survey site and take place during the same time period. These surveys will record ultrasonic bat echolocations and are used to document bat activity and in some case identify species present. Acoustic data will be collected passively where a detector is placed in a fixed location (greater than 500 m from net set) to record the ultrasonic calls of bats passing by. The duration of the survey should be from one hour before sunset to after 0100h at each survey site. Binary Acoustic bat detectors will be used with a remote battery pack. The bat detector will be attached to a rebar stake driven into the ground. Detector should be attached to the rebar stake at least 4 feet from the soil surface with a vertical orientation. The power source will be a single 12 volt car battery which will be charged once a week. Data will be downloaded from the bat detector once per day on the supplied 4 thumb drives. Data from the thumb drives should be downloaded weekly and concentrated with the sensitive species biologist within each region. Data should then be submitted to data analyst on a monthly basis.

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FIGURES and TABLES

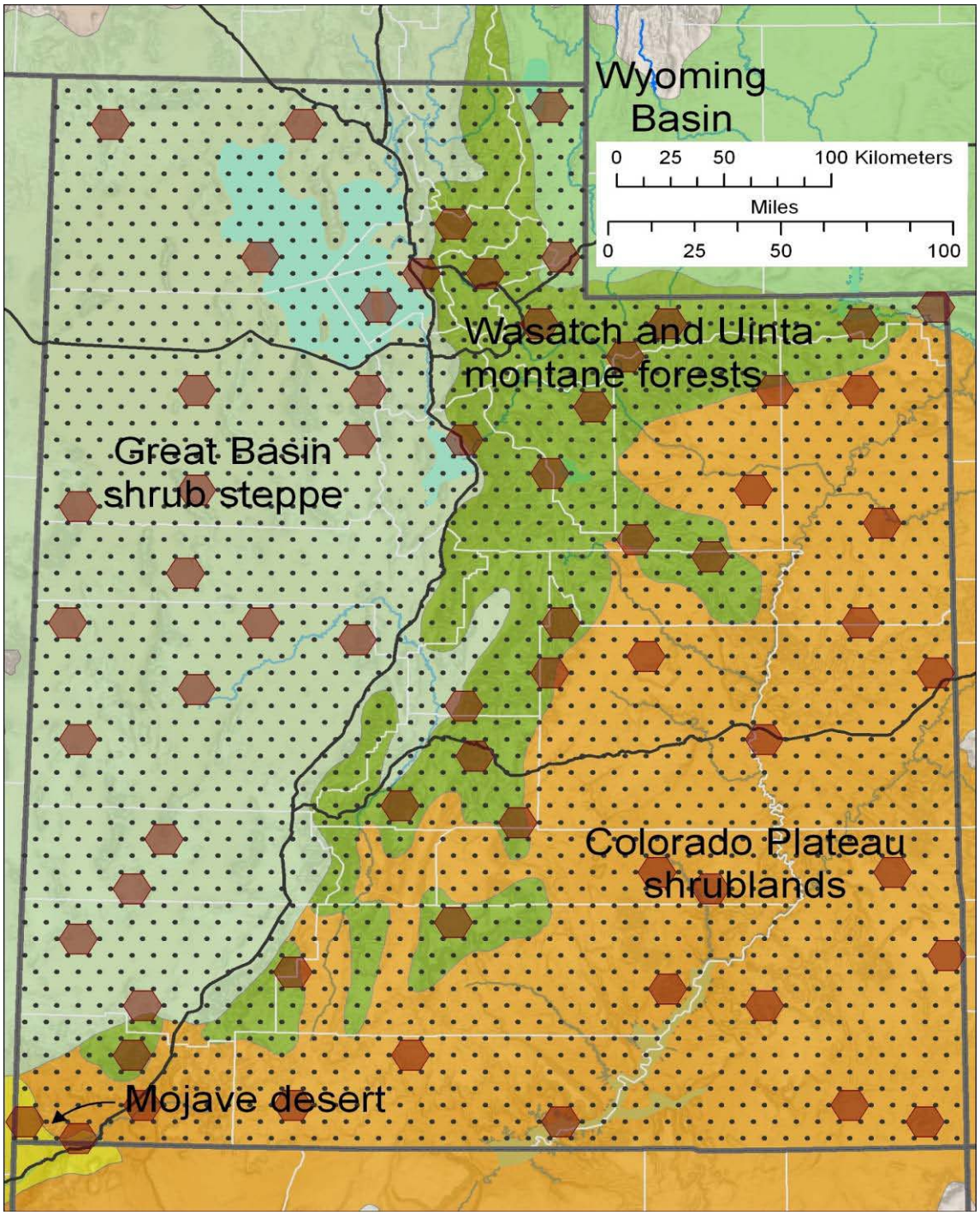


Figure 1. Map of Utah's five ecoregions and randomly selected sampling locations within each ecoregion.

Table 1. Simulated presence/absence data for a single species within a single ecoregion across 20 survey sites. This will be the final data format prior to analysis with program MARK®.

	Ecoregion		
Site #	May	June	July
1	1	1	0
2	1	1	0
3	1	1	1
4	1	0	1
5	1	0	0
6	1	0	0
7	0	0	0
8	0	0	0
9	1	0	1
10	1	1	0
11	1	0	0
12	1	0	0
13	1	0	0
14	1	0	0
15	1	1	0
16	1	1	0
17	1	1	0
18	1	0	0
19	1	1	1
20	1	0	0

Table 2. Example data sheet (back page) for 19 bat species, code refers to the species code identifier.

[redacted]

Table 3. Example data sheet (front) for 19 bat species.

Utah Bat Occupancy Site Description Data Sheet

Legacy III Bat Monitoring Program

Survey Visit (circle one)**:** 1 2 3 **Survey Type** (circle one)**:** Acoustic or Capture

Survey Date:_____ **Survey Time** (military)**:** Start _____ End _____

Moon Phase:

Site Location

Site #:_____

Ecoregion:_____

Utm Coordinates: Datum Used (NAD 83 Preferred):_____ Utm N_____ Utm E _____

Elevation (m)**:**

Site Description

Water Source Type (circle one most appropriate)**:** Artificial: Earthen Tank, Guzzler, Trough, or Stock Tank N/A

Natural: Stream, Oxbow, Back Water, or Natural Spring N/A

Water Source Parameters (m)**:** Length: _____ Width: _____ Depth: _____ Perimeter: _____

Obstruction of Surface Water (circle one)**:** Vegetation, Wire, or Other _____

Other Taxa in Area (list species observed within 1 km)**:**

invertebrates _____

birds _____

fish _____

mammals _____

Human Disturbance Level (circle one in each category)**:** High, Medium, or Low

Timing of Disturbance: Continuous, Intermittent or Rare

Description of Disturbance: _____

Local Habitat Description

Land Cover Type

Land Form: _____

Soil Type: _____

Canopy (circle one)**:** Forest, Woodland, Mountain Brush, Brush, Grass, or Invasive Forb

Understory (circle one)**:** Mountain Brush, Brush, Grass, Invasive Forb, or Bare Soil

Geology (circle one)**:** Igneous, Metamorphic, or Sedimentary

Adjacent Potential Roosts (within 10km)**:** Foliage, Tree, Crevice, Cave, Mine, Bridge, or Other

Distance to each from above (km):

Drawing of Net Set

^

N

Table 4. Explanations of field for the covariate data sheet (Tables 2 and 3).

Site Location

Ecoregion

World Wildlife Fund designated ecoregions (Colorado Plateau shrublands, Great Basin sagebrush steppe, Mojave Desert and the combined Wasatch and Uinta montane forest and Wyoming Basin shrub steppe).

Site #

A unique identifier between 1 and 20 within each ecoregion.

UTM

The Universal Transverse Mercator (**UTM**) coordinate system, X and Y values.

Moon Phase

New Moon - The Moon's unilluminated side is facing the Earth. The Moon is not visible (except during a solar eclipse).

Waxing Crescent - The Moon appears to be partly but less than one-half illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated is increasing.

First Quarter - One-half of the Moon appears to be illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated is increasing.

Waxing Gibbous - The Moon appears to be more than one-half but not fully illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated is increasing.

Full Moon - The Moon's illuminated side is facing the Earth. The Moon appears to be completely illuminated by direct sunlight.

Waning Gibbous - The Moon appears to be more than one-half but not fully illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated is decreasing.

Last Quarter - One-half of the Moon appears to be illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated is decreasing.

Waning Crescent - The Moon appears to be partly but less than one-half illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated is decreasing.

Elevation

Elevation in meters.

Netting Site Description

Type

1) **Earthen Tank**: Manmade pond with water available at ground level only.
2) **Guzzler**: State or federally maintained wildlife guzzler, water at ground level only.
3) **Trough**: Traditional rectangular cattle or sheep watering troughs, accessible water is above ground level.
4) **Tank**: Cattle or sheep round tank, accessible water is above ground level.
5) **Stream**: Low order flowing water source
6) **Oxbow**: Slow flowing water in a higher order water source
7) **Backwater**; Standing water disconnected from adjacent flowing water
8) **Misc**.: Any other type of water site, be specific.

Water Source

This is a broader description of the sampled water source based on the **length** and **width** at the broadest point, **depth** at the center, and a measured **perimeter**.

Obstruction

Obstruction is the presence of any obstruction on or near the water surface which may affect bat watering behavior. **Vegetation** obstructions include moss/algae on water surface and any standing vegetation in or above the water site. A second category of obstruction is **wire** or associated man-made articles across the water surface. Estimate the percentage cover for each obstruction category

Other Taxa

All other organism observed using the area should be recorded (common name and detection method) and categorized as a mammal, amphibian, reptile or bird. List all species sign observed with 100 m of the net site during the sampling periods.

Human Disturbance

Human disturbance describes the level and timing of human activity near the survey site. The level of disturbance has three classes; high, medium and low. Urban and developed areas and the like should be categorized as **high** disturbance. Non-developed wildlands with high human recreational or management based impacts should be categorized as **medium**. Sites with **low** disturbance levels are those that retain some native vegetation adjacent to the water source and a low impact of grazing practices or recreational activities. The timing of human disturbance also has three classes; continuous, intermittent and rare.

Local Habitat Description

Land cover

Land cover refers to the Southwest Regional Gap Analysis Project (ReGAP) land cover types (Appendix II). Each site may fall into several land cover types.

Land form

Land form refers to the Southwest Regional Gap Analysis Project (ReGAP) land form types (Appendix II). Each site may fall into several land form types.

Canopy

Canopy refers to the top most layer of vegetation dominant within the local habitat. The **forest** canopy type refers to deciduous or coniferous forests such as cottonwood or spruce fir. **Woodland** canopy types references pinyon-juniper woodlands. **Mountain brush** canopy type is characterizied by gambel oak, mountain mahogany, maple or associated brush. **Brush canopy** refers to sagebrush or creosote shrubland canopy cover. **Grass** refers to an overstory or monoculture of grass.

Understory

Mountain brush, brush and grass are also used as understory types. Two addition types: **Invasive forb** and **bare soil** dominated understory.

Soil type

Soil type refers to the Natural Resource Conservation Service soil survey for the site

Geology

Geology refers to the dominant rock type adjacent to the survey site.

Adjacent potential roosts

Any bat roosting habitat within 10 km of the survey site which may provide bat roosting habitat. **Crevice** habitat refers to any cracks wider than 2cm, **mine** habitat refers to any apparent underground mining features, **cave** habitat refers to any natural underground features, **foliage** habitat is the presence of broad leaved and conifer roosting opportunities, **tree** roosts refers to the nearest standing dead tree (snag), **bridge** habitat refers to the nearest roadway and culvert bridge and **human structures** refers to any other manmade potential roosting sites. The **distance** to each of the potential roosts described above should be estimated in miles.

APPENDICES

Appendix I. UBCC Capture Data Sheet (front).

Bat Survey Data Form

1. Page ____ of ____

2. Date: _____ 3. Capture Location: _____ 4. County/State: _____

5. Habitat/Site Description: _____ 6. Photographs: N ____ S_____ E ____ W _____

7. UTM Coordinates (NAD83): ☐☐☐☐☐☐ E ☐☐☐☐☐☐☐ N 8. Zone: ☐☐☐ 9. Elevation (m): _____

10. Accuracy (circle): <30m <300m <3km 11. Team Lead: _____ 12. Other Team Members: _____

13. Methods Used: a) Mist Nets (# nets) _____ b) Harp Net (# nets) _____ a/b) Sum All Net Lengths (m) _____ Total Net Area (m^2) _____

c) Acoustic Detector Method (circle): No Acoustic Remote/Stationary Hand Release Transect Other ____ Detector Type (Brand, Model): _____

d) Data logger (data type/N) _____ (interval in minutes) _____ Notes: _____

15.	START	Hour 1	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7	Hour 8	Hour 9	END	Total
16. Time (24 hr):												
17. Net/Trap Status:	/	/	/	/	/	/	/	/	/	/	/	/
18. Detector Status:												
19. Logger Status:												
20. Temp (°C):												
21. Wind:												
22. Weather:												
23. Moon:												

24. Bat No.	25. Time (24 hr)	26. Temp (°C)	27. Species	28. FA (mm)	29. Ear (mm)	30. Tragus Shape	31. Keel (Y/N)	32. Gender (M/F)	33. Reproductive Status	34. Age (Juv/ Sub/Ad)	35. Wing Score (0, 1, 2, 3/P)	36. Photo? (Y/N/#)	37. Mark? (Y/N)	38. Weight (g) "Tared"	39. Notes

ARE ALL THE FIELDS FILLED OUT COMPLETELY? PLEASE INITIAL:_____

Appendix II. UBCC Capture Data Sheet (back).

Field Descriptions for Bat Survey Data Form

1. **Page__ of __:** Fill in the first blank with the current page number and the second blank with the total number of pages used during the survey period (ex. Page 2 of 3).
2. **Date:** The Day, Month, and 4 digit Year the survey was conducted (23 June 2005).
3. **Capture Location:** The 'common' name of the site being surveyed (ex. Nirvana Pond or Selman's Ranch House).
4. **County/State:** The County and State in which the survey is being conducted (ex. Box Elder County, UT).
5. **Habitat/Site Description:** Short, simple description of surroundings and dominant and secondary vegetation within one mile of survey site. Description should also include the characteristics that caused the site to be selected (ex. presence of a stock pond, mine shaft, roost, etc.) and ownership of the land if known (USFS, state, private, etc.)
6. **Photographs:** Take one photograph in each cardinal direction (N,S,E,W) from the location the Coordinates were recorded (see #7). Note number of photograph if digital and applicable. Future photographs should always be taken from the same location to simplify historical comparisons.
7. **UTM Coordinates:** Record easterly (6 digit) and northerly (7 digit) UTM coordinates of the survey site using a GPS unit in NAD83.
8. **Zone:** Record the UTM Zone as 11N, 12N, 13N, or Unknown.
9. **Elevation (m):** Use a GPS unit to record the Elevation (in meters) at the same location the site's Coordinates were taken (see #7).
10. **Accuracy:** Record accuracy of coordinates as <30 m (determined from GPS), <300 m (determined from USGS topomap), <3 km (determined from vague description, historical data, or TRS), or Unknown.
11. **Team Lead:** Record the full name and affiliation of the individual responsible for the data on the field form (completeness and accuracy); insuring questions regarding this survey can be directed to that person.
12. **Other Team Members:** Record the first and last names of any other individuals conducting the survey; include professional affiliations (ex. USFWS, USFS, TNC, etc.)
13. **Methods Used:** Indicate methods (nets/traps/detectors) used during the current survey. **Mist Nets**: mark the number of nets used; mark "0" if none were used. **Harp Net**: Mark number of harp traps used; mark "0" if none were used. **Sum All Net Lengths**: record harp & mist net overall lengths. **Total Net Area:** calculate surface area of harp & mist nets in square meters [surface area = height (m) x sum length of all nets open (m)]. **Acoustic Detector Method**: mark the type of survey completed as No Acoustic (no acoustic devices were used), Remote/Stationary (remote set-up left on and alone at site), Hand Release (used by biologist in hand for hand release calls and other bats seen during mist netting), Transect (if walking transect using a protocol was conducted with acoustic device), or Other. **Data Logger**: If a data logger is being used, note the type of data it is collecting (temperature, humidity, barometric pressure, other, or none) and the intervals to which it is set to collect data (ex. 5 min.).
15. **Start; Hour 1…:** Status of Fields 13-20 should be recorded at the Start of the survey period and each consecutive 60 minutes after until the end of the survey. Uneven starting or ending times of either the nets, data loggers, or detectors should be recorded in the Hour column closest to the event. The actual time for each event will be recorded in Field 13. END should include data for the end time of the survey even if not on an hour. **Total** is total number of hours net/trap, detector, and logger were active/on.
16. **Time:** Actual time that the status of Fields 14 thru 20 are recorded.
17. **Net/Trap Status:** Record whether nets or harp traps are 'O'pen or 'C'losed at time in Field 13. (ex. 'O / C' = open trap & closed trap; 'NA / O' = not using nets / open harp trap)
18. **Detector Status:** Recorded whether an ultrasonic detector is 'Active' or 'Not Active' at time in Field 13.
19. **Logger Status:** Recorded whether a data logger is 'Active' or 'Not Active' at time in Field 13.
20. **Temp (°C):** Record the temperature in degrees Celsius at time in Field 13.
21. **Wind:** Use MPH categories as determined from the Beaufort Wind Scale. 1) *0-1 MPH*: Calm; smoke rises vertically. 2) *1-3* MPH: Direction of wind shown by smoke drift, but not by wind vanes. 3) *4-7* MPH: Wind felt on face, leaves rustle, ordinary vane moved by wind. 4) *8-12* MPH: Leaves and small twigs in constant, gentle motion; wind extends light flag. 5) *13-18* MPH: Raises dust and loose paper; small branches are moved. In most situations winds in categories 3, 4,and 5 will not be conducive to operating mist nets.
22. **Weather:** Record the dominant weather over the last hour: 1*) Clear*: 0-10% cloud cover. 2) *Partly*: 10%-50% cloud cover. 3) *Cloudy*: 50%-100% cloud cover. 4) *Precip:* some amount of precipitation fell.
23. **Moon:** Record phase of moon as: 1) *None*: Either a new moon, or it hasn't risen yet. 2) *Crescent*: 0-25% lit. 3) *Half:* 25-75% lit. 4) *Full*: 75-100% lit. 5) *Obscured*: Obscured by cloud cover.
24. **Bat No.:** Number the bats as they are caught (ex. 1, 2,3 …).
25. **Time (24 hr):** The time the bat *was caught*, not the time it was processed (ex. 2234).
26. **Temp (°C):** The temperature in degrees Celsius when the bat *was caught*, not when it was being processed.
27. **Species:** Use a dichotomous bat key for the area the survey is being conducted to help identify bats to species. It is likely that characters in addition to the Fields below will be needed for proper identification.

28. **FA (mm):** The length of the forearm in millimeters. The forearm is defined as the length between the elbow and the distal side of the wrist (Figure 1).
29. **Ear (mm):** The length of the ear in millimeters. The ear length is measured from the notch on the base of the ear to the ear's tip (Figure 2).
30. **Tragus Shape:** Note the shape of the tragus as either 1) Long and Pointed (Figure 3a) or 2) Short and Rounded (Figure 3b). Especially useful to determine identification of Pipestrelles.
31. **Keel:** Note the 1) Presence or 2) Absence of a flap of skin hanging loose off the posterior edge of the calcar (Figure 4a & b).
32. **Gender:** Record the sex of the bat as 1) Male or 2) Female. Evidence of sex is best obtained from the genitalia, with the males possessing a well developed penis.
33. **Reproductive Status:** Record the reproductive status of the Males as either 1) Reproductive – one or both testes have descended or 2) Non-reproductive – neither testes are descended. For the Female note evidence of 1) Lactating – nipples are pink and enlarged, hair surrounding the nipple is worn. 2) Post-lactating – nipples wrinkly and dark hair has often grown back. 3) Pregnant – presence of unborn fetus evident. 4) Non-reproductive – nipples very small and well haired.
34. **Age:** Record as either 1) Juvenile [non-volant + A in Fig. 5], 2) Sub-adult [volant + A in Fig. 5], or 3) Adult [B in Fig. 5]. Phalangeal joints are best observed by shining the joints from behind with a head lamp.
35. **Wing Score:** Record the wing damage. Score damage as 0) no damage, 1) light damage, 2) moderate damage, 3) heavy damage, then add a P for any physical damage with description in notes. (Example: 1/P light splotching and a physical tear in membrane. Refer to Reichard 2008 for further explanation of scoring.
36. **Photo?:** Record whether a photograph was taken of the bat with a Yes (Y) or (N). Note number of photograph if digital and applicable.
37. **Mark?:** Record whether the animal was marked before release with a Yes (Y) or No (N). Note method of marking in the Notes (ex. Marker, band, tattoo, freeze brand, etc.)
38. **Weight:** The total weight of the bat minus the weight of the bag in grams.
39. **Notes:** To be used to record observations or actions of this particular bat not accounted for by the data sheet (ex. parasite load, marking method, previously marked, injuries, capture method, etc.)

Figure 1:

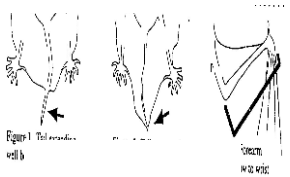


Figure 2:

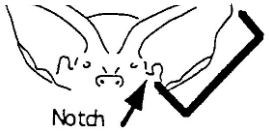


Figure 3: Tragus shape

Figure 4: Keeled calcar

a) Present b) Absent

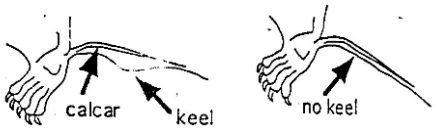
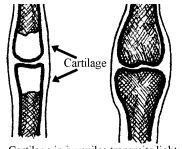


Figure 5: Age

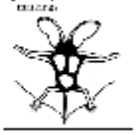


Cartilage in juveniles transmits light; appears whitish when backlit.

Appendix III. Dichotomous Key for the Bats of Utah.

DICHOTOMOUS KEY FOR THE BATS OF UTAH

Authored by: Chris Witt, Adam Kozlowski, and George Oliver
Figures by: Adam Kozlowski
Last edited: 25 July 2007

FIGURE	STEP	DIAGNOSTIC
	1	a. Tail extends beyond rear edge of uropatagium (interfemoral membrane) by more than 5 mm [Figure 1]. GO TO: 2 **FAMILY: Molossidae** b. Tail does not extend beyond rear edge of uropatagium or only slightly (≤5 mm) [Figure 2]. GO TO: 3 **FAMILY: Vespertilionidae**
	2	a. Ears do not join at the base, small bumps are present along the ear's front edge. Ears barely extend past the shout when laid forward. Tail generally does not extend >25 mm past interfemoral membrane; usually extends ~19 mm. Fur is generally uni-colored, darkish gray/brown, species often exudes strong, musty odor. **BRAZILIAN FREE-TAILED BAT** *(Tadarida brasiliensis)* b. Ears join at the base, small bumps along the front edges of the ear are not present [Figure 3]. Ears extend well beyond the snout when laid forward. Tail generally extends at least 25 mm past interfemoral membrane. Fur is bi-colored, almost white at its base, distal color ranges from reddish-brown to black. **BIG FREE-TAILED BAT** *(Nyctinomops macrotis)*
	3	a. Ears longer than 25 mm [Figure 4]. GO TO: 4 b. Ears shorter than 25 mm. GO TO: 7
	4	a. Three conspicuous white spots present on back, one on each shoulder and one on lower back; [Figure 5]. Ears are pink. **SPOTTED BAT** *(Euderma maculatum)* b. Three dorsal spots not present. GO TO: 5
	5	a. Ears clearly separated at base; dorsal pelage is light brown to yellow, hairs lighter at base. **PALLID BAT** *(Antrozous pallidus)* b. Ears joined at base. GO TO: 6
	6	a. Each ear has lappet (flap of skin) near its base anteriorly, which extends forward toward snout [Figure 6]. Muzzle does not have well-defined dermal glands [Figure 7]. **ALLEN'S BIG-EARED BAT** *(Idionycteris phyllotis)* b. Ears do not have basal lappets (flaps of skin) extending anteriorly. Muzzle does have a well-defined pair dermal glands. **TOWNSEND'S BIG-EARED BAT** *(Corynorhinus townsendii)*
	7	a. Uropatagium (interfemoral membrane) heavily furred dorsally. GO TO: 8 b. Uropatagium (interfemoral membrane) not heavily furred dorsally. GO TO: 10
	8	a. Weight is generally greater than 20 g; Light colored ears distinctly edged in black. Dorsal pelage pale yellow/brown at base, black/dark brown in middle and white/cream at tip. **HOARY BAT** *(Lasiurus cinereus)* b. Weight is generally less than 20 g. Dorsal pelage is not pale yellow/brown at base, black/dark brown in middle and white/cream at tip. GO TO: 9
	9	a. Fur color is dark brown to black with silver/white tips, giving a frosted appearance. **SILVERED-HAIRED BAT** *(Lasionyceris noctivagans)* b. Fur color is not dark brown to black with silver/white tips, rather it is brick red to rust on upperparts with pale undersides. **WESTERN RED BAT** *(Lasiurus blossevillii)*
	10	a. Tragus short (<6 mm), blunt, rounded, and curved [Figure 8]. GO TO: 11 b. Tragus long (>6 mm), pointed, and straight [Figure 9]. GO TO: 12

11 a. Forearm >40 mm (42 – 52); ears extend outward; mass greater than 11 g.
BIG BROWN BAT *(Eptesicus fuscus)*

b. Forearm <40 mm (28 – 33); mass less than 11 g.
WESTERN PIPISTRELLE *(Pipistrellus hesperus)*

12 a. Ears blackish and extend 4mm or more past end of snout when pressed forward.
LONG-EARED MYOTIS *(Myotis evotis)*

b. Ears extend less than 4 mm past end of snout when pressed forward.
GO TO: 13

13 a. Uropatagium (interfemoral membrane) has conspicuous fringe of hairs on its posterior edge; [Figure 10]. Fringe often accompanied by lighter skin pigmentation on uropatagium's trailing edge.
FRINGED MYOTIS ***(Myotis thysanodes)***

b. Uropatagium (interfemoral membrane) does not have conspicuous fringe of hairs (but may be very sparsely haired).
GO TO: 14

14 a. Underside of wing has long, dense fur extending outward from body to a line between elbow and knee [Figure 11]. Tibia is ≥ 2.5X the length of the hind foot.
LONG-LEGGED MYOTIS *(Myotis volans)*

b. Underside of wing does not have long, dense fur between elbow and knee.
GO TO: 15

15 a. Calcar keel is not well developed or is absent [Figure 12].
GO TO: 16

b. Calcar keel is present and well developed [Figure 13].
GO TO: 17

16 a. Fur of dorsal region is dull.
Forearm is generally less than 36 mm.
No keel on calcar.
Skull rises more abruptly from snout.
Ventral hairs black at base, light cream at tips.
YUMA MYOTIS *(Myotis yumanensis)*

b. Fur of dorsal region is glossy and long, longest dorsal hairs –10 mm.
Forearm length 34 – 41mm.
May have poorly developed keel on calcar.
Snout to skull transition gradual.
Hairs on toes project beyond claws.
LITTLE BROWN MYOTIS *(Myotis lucifugus)*

17 a. Naked part of snout top is as wide as it is long (square) [Figure 14].
Tail does not extend beyond uropatagium.
Forehead rises steeply and abrubtly from rostrum.
Face, ears, and wings are not black and do not contrast sharply with pelage color.
CALIFORNIA MYOTIS *(Myotis californicus)*

b. Naked part of snout top is 1.5X the nostril width (rectangular) [Figure 15].
Tail often extends 1.5-2.5 mm beyond uropatagium.
Forehead rises gradually from rostrum.
Face, ears, and wings are black, often contrastingsharply with pale pelage.
WESTERN SMALL-FOOTED MYOTIS *(Myotis ciliolabrum)*

CHARACTERS USEFUL IN DISTINGUISHING UTAH'S SPECIES OF *MYOTIS*

Species	Body Mass (g)	Forearm (mm)	Ear (mm)	Keel on Calcar	Special Characteristics
californicus	3 – 6	29 – 36	9 – 15	Well developed	See step 17 to differentiate.
ciliolabrum	4 – 6	30 – 36	13 – 21	Well developed	See step 17 to differentiate.
yumanensis	4 – 7	32 – 36	12 –15	None	See step 16 to differentiate.
lucifugus	5 – 7	34 – 41	11 – 15	None	See step 16 to differentiate.
evotis	5 – 8	37 – 40	20 – 24	Poor	Ear length is distinctive among *Myotis*.
thysanodes	5 –7	39 – 46	16 – 20	Poor to None	Short, dense hairs on trailing edge of tail.
volans	6 – 10	37 – 42	10 – 15	Well developed	Fur on wing between elbow and knee. Tibia is ≥2.5X the length of the hind foot.

Appendix IV. Recommend Equipment List for Bat Surveys.

List of Materials for Conducting Bat Surveys within the Utah Bat Monitoring Protocol Framework

Mist nets (4)	2.6m x 2.6m, 2.6m x 9m, 2.6m x 12m, and 2.6m x 18m; 38mm mesh, 50 denier/2 ply nylon. http://www.avinet.com/avi6_page.taf?fs=1&view=home
Poles (8)	Two 1.5-m (5-ft) segments joined by a sleeve for each end of the net (total of 4 segments). These can be built easily enough from two different diameters of electrical conduit so that they fit together. A small bolt through the smaller diameter pole near its end keeps it from sliding all the way through (sword and scabbard design).
Anchor cord for poles	Strong string or cord (2mm cord works great, usually carried by local outdoor/climbing store) a minimum of 20 feet in length.
Stakes (16 small, 4 large)	Twelve, heavy duty nail like stakes 8 in or longer for rope anchors. Four, 4 foot rebar stakes to support net poles.
Sledge Hammer	4 lb hammer to pound in all stakes.
Millimeter ruler	Flexible plastic, 150 mm (6 in) is sufficient. Cutting the end off so it is even with the “0” mark makes for easier use.
Scales (2-3)	35 g Pesola spring scale. [If your weigh bag is heavy (greater than 10 grams, i.e. cloth) you may want to also carry a 60g scale]. (Purchase online from Ben Meadows).

Zip-lock storage bags	For containing bats while weighing. Do not zip the bag closed while it is occupied. Quart capacity will suffice for most bats.
Small Cloth bags	Small cloth bags with a string closure and paper label to store bats in for short periods of time. Soil sample bags (4 X 6 in) work well (Purchase from Ben Meadows).
Headlamp	This frees both hands for handling bats. We recommend Petzel® DUO 14 because it enables the user to use both an LED and super bright Halogen light.
Handheld flashlight	Small light that can sit in bat kits to assist with aging bats.
Leather gloves	Light-weight for dexterity. Deerskin gloves are very good, with the exception of handling large *Eumops* spp. (Recommend baseball batting gloves or golf gloves. Find some that fit relatively tight and have full leather on and between thumb and forefinger).
Watch	To note the time of capture. (Small, Indiglo travel alarm; stands up and is easy to read at night).
Clipboard	For holding data forms. (Enclosed case ones are nice for holding pens, rulers, dichotomous keys, etc.).
Data forms	Both the UBCC and Utah Bat monitoring protocol data forms (Tables 2, 3 and 4, and Appendix I, II).
Pencils	To complete data forms.

Marker: light-colored,	A RED or BLACK Sharpie marker to color the bat between the shoulder blades to detect recaptures.
Camera, film, and flash	For voucher pictures. (Digital point and shoots work great).
Thermohygrometer	Portable. (Kestrel 3000 handheld weather stations online from Ambientweather. The Kestrels measure windspeed, temperature and humidity at the push of a button).
Data Logger	Automatically records ambient temperatures and humidity throughout the night at 5 minute intervals. (Recommend Hobo Pro Data Logger Temp/RH Model H08-032-08 and Boxcar Software; http://www.onsetcomp.com/Products/Product_Pages/HOBO_H08/hobo_pro_family_loggers.html).
Acoustic Equipment	Binary Acoustic equipment; recording equipment, 12 volt car battery, 3 foot rebar stake, waterproof backpack, and four thumb drives.
Bat Key	Dichotomous Utah key (Appendix III).
GPS Unit (1)	For recording the UTM location and elevation of the survey finding your way back to a historical survey site.
Simple, clear Tackle organizer (1)	Useful to help coordinate batteries, toothpicks, markers, pencils, pencil lead, knife, tweezers, etc. Clear design makes it easy to take inventory after each survey.
Wooden Toothpicks	Useful for the delicate job of getting the bats out of the net; also disposable. Dental picks also work well make certain any net removal tool has been dulled to avoid damaging any bat membranes.

Waders	Hip and/or chest waders to aid in net set up and getting bats out of the net.
Measuring Tape	To measure the size and depth of the water site.
Camp Chairs	To rest between net checks.
Batteries:	Make certain to have back up batteries for ALL field equipment.
Work Table	Collapsible and portable. To aid in bat measuring.
Clorox Wipes	Used to aid in equipment cleaning.
Bleach	Used to aid in equipment cleaning.
Spray Bottle	Used to aid in equipment cleaning.
Paper Towels	Used to aid in equipment cleaning.
Hand Sanitizer	Used to aid in equipment cleaning.
Wash Buckets	Used to aid in equipment cleaning.

Appendix V. Acoustic Field Set-Up Protocol: Binary Acoustics Equipment and Recording.

Acoustic Field Set-Up Protocol:
Binary Acoustic Equipment and Recording
06 January 2010

1. Device Setup
    a. Battery connection
        i. Wire the battery monitoring box (charge controller) (Figure 1).
            1. Connect the positive and negative wires from the battery alligator clips (make sure battery is disconnected). The monitoring box has a picture of a battery with "+" and "-" symbols connect wiring accordingly. Next connect the recorder device power plug to the monitor port with a picture of a device and the corresponding "+" and "-" symbols. Attach the alligator clips to the corresponding battery terminals. If the device is wired correctly the digital display on the battery monitor will illuminate. If display fails to illuminate repeat this wiring step.
    b. Recorder/Receiver connection (Figure 2)
        i. Connect the FR125 (field recorder) to the Crystal Fontz LCD display screen via the USB port on the back of the FR125 (either port will work).
        ii. Connect the FR125 (field recorder) to the AR125 (acoustic receiver) with the supplied USB cable. The port on the AR125 is located on the back on the device and the USB port on the FR125 is adjacent to the LCD display screen port.
        iii. Connect the power source (via the charge controller) to the FR125 (field recorder). The power port is on the opposite side of the unit from the USB ports. The AR125 draws power through the FR125 which is connected to the battery via the charge controller. A green light should illuminate next to the power port on the FR125 indicating power is being received by the FR125.
2. Device Configuration
    a. After the steps above are followed, the LCD display screen should illuminate and boot-up (may take up to a minute). The **Main Menu** will appear. To navigate through the menu use the up, down, left and right arrows. To select an option use the enter ☑ key to escape from an option use the ☒ key.
        i. Arrow down to the **Time** option and Select ☑.
            1. Select ☑ **Date.** Enter current date in the format Month:Day:Year. ☑ when finished.
            2. Select ☑ **Time**. Enter current time based on 2400 clock. ☑ when finished.
            3. Select ☑ **Save**.
            4. Return ☒ to the **Main Menu**
        ii. Select ☑ **Status**.
            1. Select ☑ **State**
                a. Select ☑ Running
            2. Select ☑**PwrSave**
                a. Select ☑ On

3. Select ☑ **Mode**
    a. Select ☑ Trig
4. Select ☑ **Input**
    a. Select ☑ USB
5. Select ☑ **Format**
    a. Select ☑ wav
6. Select ☑ **File Name**
    a. File name should consist of the protocol site number (1 thru 65), period number (A for June timeframe, B for July timeframe, or C for August timeframe) and within period repeat for double samples (1 or 2). For example 1A2 is site 1 period 1 (June-ish) within period visit 2. A site that does not require two within period visits is named for the site and period number only 1A refers to site 1 period 1 (June-ish).
7. Do Not Select **Comment**
8. Select ☑ **TStamp**
    a. Select ☑ On
9. Return ☒ to the **Main Menu**

iii. Select ☑ **Settings**.

1. Select ☑ **Vol**
    a. Set to 80 (this setting is for earphones only it will not impact recording levels).
2. Select ☑ **Gain**
    a. Set to 25 (this setting is for earphones only it will not impact recording levels).
3. Select ☑ **Thresh**
    a. Set to 18.0 (snapshot trigger threshold).
4. Select ☑ **TE**
    a. Set to 10.0 (detector time expansion).
5. Select ☑ **Dur**
    a. Set to 15.0 (snapshot duration).
6. Select ☑ **Idle**
    a. Set to 3.0 (idle time out duration before end).
7. Select ☑ **Delay**
    a. Set to 0.0 (minimum delay between snapshots).
8. Select ☑ **Low F**
    a. Set to 5.0 (low frequency cutoff).
9. Select ☑ **High F**
    a. Set to 90.0 (high frequency cutoff).
10. Return ☒ to the **Main Menu**

iv. Select ☑ **Program 1**.

1. Select ☑ **Enable**, Switch to On (enables the recorder to run/record at preset start time and end time)
2. Select ☑ **Start Time**; enter desired start time (Utah Monitoring Protocol starts at 2100).

3. Select ☑ **Stop Time**; enter desired end time (Utah Monitoring Protocol ends at 0100).
4. Return ☒ to the **Main Menu**

v. Do Not Select **Program 2** unless you want to have the device record during another set of pre-determined times. Follow the same steps as in **Program 1** to set. Utah Monitoring Protocol calls for recordings between 2100 and 0100.

vi. Do Not Select **File Xfer.** Function only used to transfer files from the key pad to a secondary storage device. Under the Utah Monitoring Protocol we will not use this function.

vii. Do Not Select **Show Log.** This shows the status of the hard drive

viii. Select ☑ **Power**

1. Set to Reboot
2. Wait for FR125 to Reboot. This could take up to a minute.

b. Unplug LCD Crystal Fontz display screen (after the Reboot process has completed) from the USB port on the back of the FR125.

c. Plug in a Thumb Drive (at least 2MB) to the now empty USB port the LCD display screen was plugged into on the FR125 (Figure 3). Data is now being recorded according to the **Program 1** that was set.

3. Field Set-Up/Device Orientation
   a. Place AR125 on a tripod or rubber band-it to a stake (Figure 4). Aim the recorder at an angle between 90° (Figure 5) and 180° from the ground to catch a majority of passing bats (location dependent). This protocol recommends a 180° angle because it better enables the device to record high-flying bats not easily caught in mist nets.
   b. Place FR125, charge controller, and as much of the cords as possible into a container (small mammals will chew through the cords though most often only if the device is left out for more than one night; consider using cord protectors). Backpacks have been provided (Figure 7). Other options are fine too; a cooler was suggested with the plug removed for the cords.
4. Device Dismantling
   a. Disconnect the AR125 from the FR125 by unplugging the connecting USB cable
   b. Remove thumb drive
   c. Disconnect the battery
   d. Upload data to local device. Send copies of data to Joel Diamond via established protocols.

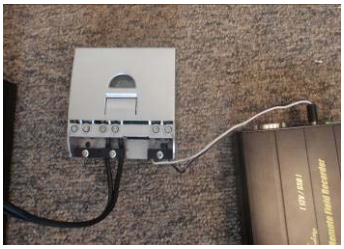


Figure 1. Battery monitoring box (charge controller) wire connection.

Figure 2. Initial acoustic set-up with LCD display screen attached.

Figure 3. Final acoustic set-up with thumb drive attached.

Figure 4. Rubber-banding AR125 to stake works well (Petterssons device shown).

Figure 5. AR125 on tripod at 90° angle.

Figure 6. Example of weatherproof housing for the AR125.

Figure 7. Final field set-up using the stake method with backpack.