Chapter Nine
Bat Monitoring Protocol

IOWA BAT MONITORING:

Bat detections will be done primarily using ANABAT (or other recording devices) detectors. At least 2 detectors should be deployed at suitable habitat locations for 3 occasions during the season, for a total of 6-9 nights of recording bat calls per year per detector.

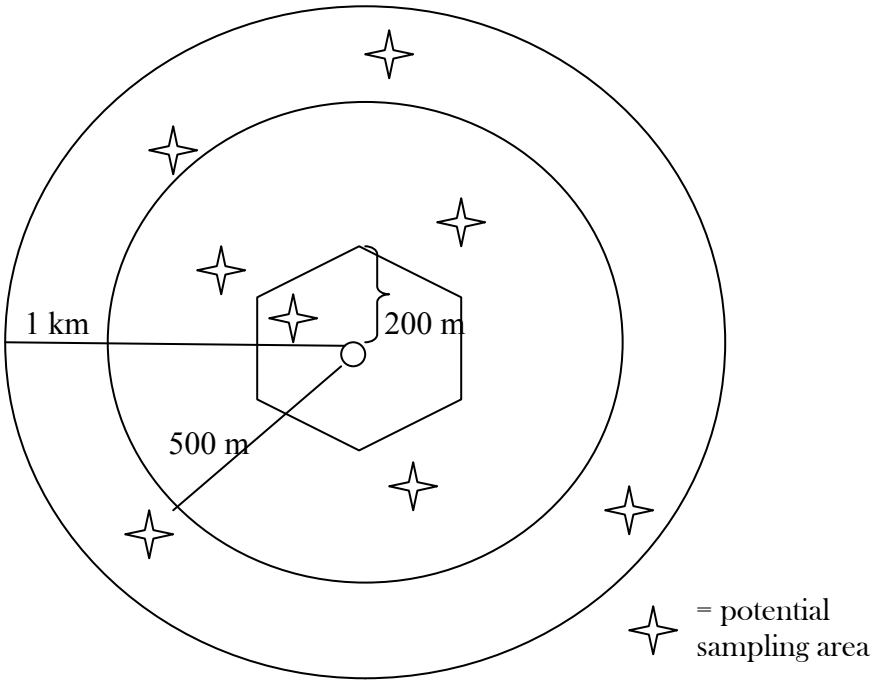
To establish regional keys for the ANABAT detectors, bats will be captured at different locations and the calls recorded using the detectors. Calls should be recorded both directly into the detector and also through the weather protection covers for the detectors. Mist nets will be the primary method used to capture bats. Suitable habitats will be chosen from aerial photos or GIS database within a 1 km^2 area with the center of the area also being the center of the permanent hexagonal sampling plot. The USFWS (1999) recovery plan for the Indiana bat suggests that no more than 1 net site per 1 km of stream be used, and no more than 2 net sites per 1 km^2 be used. In either case, it suggests that nets should be spaced at least 30 m apart.

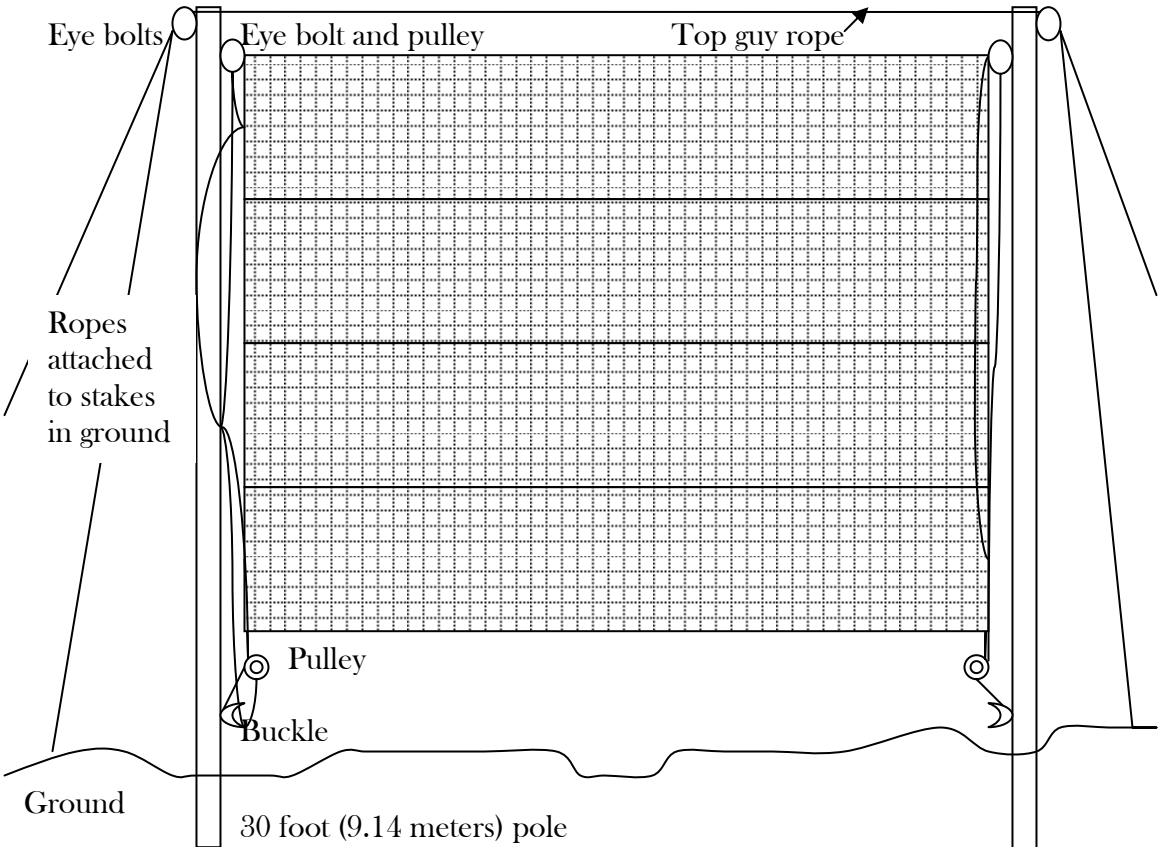
The most promising habitat should be chosen for net placement. Ideally, the nets would be placed over water but under a closed canopy to increase capture probability. These sites can be either 'high quality' (streams, ponds, & lakes), 'moderate quality' (meadows), or 'lower quality' (roads & canopy openings in forests). Streams and ponds are the best habitats to sample as many bats forage over water, resulting in potential clusters of individuals. The road or canopy openings within a forest should help funnel bats that do not forage over water. Once the sampling sites have been randomly selected, a field visit should be done to ensure that the habitat is the correct one (as chosen from aerial photos or GIS database during the selection process). This visit can coincide with other work on the site. For example, when doing point counts for birds or trapping for small mammals, make not of potentially good habitat to trap bats at that location.

SURVEY METHODS:

Each area is surveyed at least three times during the summer season (May 15 through August 15), with at least a week separating the visits. Indiana bats, a federally endangered species, detected outside of this timeframe may be transient or migratory (USFWS 1999). Two to three ANABAT detectors should be deployed for 1-3 nights at each site. Detectors should be moved between suitable habitats each night, such that as many habitats as possible can be sampled during the 1-3 night timeframe. This process should be repeated 3 times during the summer season resulting in at least 6 nights and up to 9 nights of ANABAT deployment.

During the first year(s) of the program, trapping with mist nets will be conducted on a regular basis to ensure that adequate calls are collected from bats of known species. Throughout the remainder of the program, trapping will be done as necessary to determine species when calls cannot be identified.





Four nets (7 ft x 30 ft) stacked on top of each other suspended between 1" galvanized steel poles on a pulley and rope system to the other pole.

At each location chosen for sampling, between 2 and 5 mist nets (depending upon area to be covered & number of technicians) are used. Nets are opened at sunset and operated for 3.5 to 5 hours, being checked frequently, at least every 20 minutes (USFWS 1999). Leaving bats in nets can result in injury to the bat or the bat chewing through the net and escaping (MacCarthy et al. 2006). Care should be taken to prevent any unnecessary disturbance near the net site which may influence capture probability.

Net mesh size should be the smallest available, approximately 38 mm (1 ½" x 1 ½") openings, although 50 mm (2" x 2") can also be used. Nets should be placed such that they stretch perpendicularly across the corridor opening. Nets should cross the corridor/stream completely and reach from the stream/ground level to the canopy. This set-up often includes 3 nets stacked such that the nets reach a height of 7 m.

Inclement weather conditions, including temperature below 10^{0}C, rain, and strong winds should halt or prevent trapping efforts. Bats may also avoid nets or be less active on bright moonlit nights (USFWS 1999).

Information recorded at each location will include ambient temperature (if temperature changes significantly during the 3.5 to 5 hours of net operation, this needs to be recorded as well), wind, and cloud cover. Information on each captured bat to be recorded includes: time of capture and net of capture, species, reproductive status, age, and forearm length. The ear, thumb, tragus, and foot length should all be recorded and the calcar should be checked to determine keel.

HABITAT AND PLANT SPECIES COMPOSITION DATA COLLECTION:
Environmental variables such as air temperature, wind speed, and other weather conditions should be recorded at the time of the survey on the bat capture data sheet. A habitat data collection plot should be established at every hexagonal point location.

See chapter 19 for information on terrestrial habitat and plant composition measurements, and chapter 20 for information on aquatic measurements. As the same areas will be searched for all species of greatest conservation need, habitat data collection instructions are included in these chapters. All data collection technicians should coordinate with other crews to ensure that all needed habitat data is collected.

However, in addition to the above data, potential roosting sites seen on the property should be noted on the data sheet. These will most likely be caves, hollow trees, large dead trees with loose bark, etc.

EQUIPMENT LIST:

For ANABAT detection:	ANABAT Equipment
	Weather proofing equipment
	Extra batteries
	Extra data memory cards
For trapping:	Headlamp
	Batteries
	GPS unit

Compass
Kestrel thermometer/wind gauge
Flagging
Standard field kit: Clip board, pencils, ruler, small scissors, Sharpie markers, hand sanitizer, & data sheets, nail polish or spray paint.
Waders &/or duck boots
3 10-meter poles (easier to transport if in 3 sections) with appropriate eye bolts and buckles
4 pulleys to run the ropes attached to the nets through
Ropes – 30 foot (9.14 m) for top guy rope
60 ft (18.29 m) ropes between pulleys to attach nets to
4 50 ft (15.24 m) ropes to attach top of poles to ground (or trees)
Stakes
Stake driving device to make a 'pole hole'
Bat mist nets (4 shelves, 38 mm mesh, length= 7 ft high x 30 ft long)
Clips (should be attached to each mist net loop) to aid net movement
Bat holding bags (e.g. small cotton, GSA 'mailing bags' 8x10 inches)
Sunrise/sunset chart
Batting or gold gloves (leather)
Field guides
Night vision scope
Digital camera

STAFF & TRAINNING:
ANABATs can be deployed by any field crew. A computer person will be needed to analyze calls recorded with the ANABAT detectors.

Trapping staff will be trained by an experienced bat biologist as to best placement of nets, safe handling techniques, correct measurements, and species identification. In addition, training should include 1) field guide use and id, and 2) trips to University museums to discuss defining species characteristics. Since these are delicate animals, technicians with mist net experience or bat experience should be given preference for hiring.

DATA QUALITY & MANAGEMENT:

ANABAT

Correct equipment set up is crucial to ensure that the calls are actually being recorded and stored. As the calls are automatically recorded by the ANABAT, it will be easy to store the data for future scrutiny. All calls should be kept on suitable electronic storage (CDs, memory stick, etc). For species identification purposes, these calls will be compared to calls of known individuals to determine species.

Trapping

All trapping technicians will be trained as to the proper selection of monitoring habitats, net set up (proper placement and tension), determining when to stop surveying based upon wind or precipitation. Crew members could be rotated among crews (if possible) to reduce the

potential for identification or 'escape of animal' bias. Alternatively, entire crews could be rotated among sites (so no 1 crew surveys the same site twice) to reduce potential bias in net placement within sampling areas.

As *Myotis* species, in particular, are difficult to distinguish, morphological measurements are critical for these captures. The measurements will allow the supervisor or data entry person to determine whether the measurements fall within the correct range for the species as which it was identified. Field supervisors should accompany crews on a rotating basis to check techniques.

At the end of each survey, field crews should review data sheets to ensure all information is present. At the end of the week, the field crew leader should review the data sheets for ID, escape and mortality rates, and legibility.

DATA ANALYSIS:
The basic information should allow the creation of a species list for each site, and data should at least be used to estimate the proportion of sites occupied using program PRESENCE. See chapter 5 (Data Analysis) for more information.

SAFETY CONSIDERATIONS:
All personnel that will be handling bats need to have the pre-exposure rabies vaccination series.

The bat survey technicians should work in groups of at least 2, as this work will be done late at night, after hours for most businesses. These technicians should also carry a cell phone or radio, GPS unit, maps, and first aid kit, in addition to flashlights or headlamps and possibly a hard hat if working in a forested or rocky area. These crews should also have a sign in/sign out system so that someone is aware of their locations and status.

TARGET SPECIES:
The following list of target species represents the species of greatest conservation concern as chosen by the Steering committee for the Iowa Comprehensive Wildlife Conservation Plan (Zohrer et al. 2005). Distribution maps for these species can be found in the Distribution and Biogeography of Mammals of Iowa (Bowles 1975) and also in Iowa GAP (Kane et al. 2003). Appendix 1 contains a list of additional, more common, bat species which should also be encountered during the monitoring efforts.

Target bat species:

Common Name	Scientific Name	Habitat
Evening bat	*Nycticeius humeralis*	Forest, riparian
Indiana bat	*Myotis sodalis*	Forest, upland, & riparian
Northern myotis	*Myotis septentrionalis*	Forest

ADDITIONAL METHODS FOR SPECIAL LOCATIONS:
The following are additional techniques which may be implemented at certain sites *in addition* to the core methods described above. These could be used in areas where there are known populations of species of concern or when supplemental funding has been acquired for a given

area. However, the basic core protocol must still be followed to allow for comparison of all sites, both across the state of Iowa and also for a regional comparison, provided that other states or areas are following the same protocol.

Roost Site Monitoring

If the target species have potential roost sites (bridges, caves, etc) within the sampling unit, it may be beneficial to monitor these in addition to mist netting at habitat locations. Field visits will be needed to search for potential roost sites and determine the best location to watch bats exit the roost. If cave-like structures are identified, 2 or more observers watch the site and count the number of bats leaving using hand held counters. If species cannot be identified as they exit, additional techniques will have to be utilized to capture bats as they leave (or search the cave). Roost under bridges can be inspected using a flashlight with a red filter at least 3 hours after sunset. Attempts can be made to count the number of bats seen and if species identification cannot be made, attempts to catch an individual of each un-identified species/cluster will need to be made. Remember, it's the species that is of interest more than the number of individuals so emphasis is on species identification. In either case, at least 2 visits separated by 1 week need to be made to each potential roost site.

LITERATURE CITED:

Bowles, JB. 1975. Distribution and Biogeography of Mammals of Iowa. Texas Tech Press, Lubbock, TX.

Kane, KL, EE Klaas, KL Anderson, PD Brown, and RL McNeely. 2003. The Iowa Gap Analysis Project Final Report. Iowa Cooperative Fish and Wildlife Research Unit, Iowa State University, Ames, Iowa.

MacCarthy, KA, TC Carter, BJ Steffen, and GA Feldhamer. 2006. *Efficacy of the Mist-net Protocol for Indiana Bats: A Video Analysis*. Northeastern Naturalist. 13(1): 25-28.

Manley, PN, B Van Horne, JK Roth, WJ Zielinski, MM McKenzie, TJ Weller, FW Wackerly, and C Hargis. 2004. Multiple Species Inventory and Monitoring Technical Guide. Review Draft. USDA Forest Service, Washington Office, Ecosystem Management Coordination Staff, Wildlife Fish Watershed Air Research Staff.

U.S. Fish and Wildlife Service. 1999. *Agency Draft Indiana Bat (Myotis sodalis) Revised Recovery Plan*. Fort Snelling, Minnesota. 53pp.

Zohrer et al. 2005. The Iowa Comprehensive Wildlife Conservation Plan.

Bat mist net trapping. DATE:_____ OBS._____ LOCATION:_____ pg ___of____

Start time:_____End Time:_____ Start temp (C):____ End temp (C):____%clouds:____Rain:_____Wind speed:_____

NOTES ON NET SIZE & CONFIGURATION:_____
_____

Sex: F- Female, M- Male, U- unknown; Re. st. = Reproductive status: P=Pregnant (female), L=lactating (female), PR=post-repro, NR=Non-repro, U=unknown, DT=Descended testicles (male), ND=not descended (male); Age: A=adult, J=juvenile; The calcar is checked to determine keel presence.

Time				Net #	Species					Sex	Re. st.	Age	Forearm (mm)			Ear (mm)		Thumb (mm)		Foot (mm)		Keel Y/N	Trg.	Comments, other measurements

Data entered by:_____Checked by:_____

If habitat data has been collected as part of another sampling protocol, the following information should still be collected during mist netting:

MAP: Diagram trapping location within the 26 acre plot, include water source/net site placement, net configuration and numbers, net length and height, and a North arrow. Also indicate potential roosting locations such as caves, hollow snags, bridges, etc....

Habitat:
Water type:_____Diameter or distance across:_____
Other trapping habitat (road, trail, etc):_____
Percent of emergent vegetative cover in water body being trapped:_____
Turbidity (clear, semi-clear, murky):_____Water depth:_____
Distance to forest edge:_____
Comments:_____
_____
_____
_____

Notes on other species encountered:

Data entered by:_____Checked by:_____