

**COAL MINING PROJECTS and INDIANA BATS  
SPECIES-SPECIFIC PROTECTIVE MEASURES<sup>1</sup>**  
(September 2009)

Sections 4(d) and 9 of the Federal Endangered Species Act prohibit the taking of listed species of fish and wildlife without a special exemption. Under the terms of §§7(b)(4) and 7(o)(2) of the Act, a taking that is incidental to and not intended as part of the agency action is not a prohibited taking if the taking is in compliance with the terms and conditions of the incidental take statement in a Fish and Wildlife Service biological opinion. In 1996, the Service issued a biological opinion to the Federal Office of Surface Mining on the approval and implementation of surface coal mining and reclamation operations under State and Federal regulatory programs adopted pursuant to the Surface Mining Control and Reclamation Act of 1977 (SMCRA). To be exempt from the take prohibitions of §9 of the Act, the SMCRA regulatory authorities must comply with the terms and conditions of the 1996 biological opinion, which require 1) implementation and compliance with species-specific protective measures; 2) quantification of take, whenever possible; and 3) notification to the Service when dead or injured individuals of a listed species are found. Species-specific protective measures must be included in and enforceable under the State mining permit.

To minimize adverse effects on Indiana bats, permit applicants will develop and implement a Protection and Enhancement Plan<sup>2</sup> that includes species-specific protective measures. The measures below are based on the *Range-wide Indiana Bat Protection and Enhancement Plan Guidelines*<sup>3</sup>, and therefore, suffice for the protection and enhancement plan required pursuant to PA Code §87.84, specifically as that plan relates to the Indiana bat. These measures are also consistent with the requirements of §87.138 (Protection of fish, wildlife and related environmental values). Incorporation of these measures<sup>4</sup> into Pennsylvania Department of Environmental Protection (PA DEP) mining permits will ensure that incidental take resulting from mining projects is in compliance with the terms and conditions of the 1996 biological opinion, and therefore not considered a prohibited taking.

1. **Protection and Enhancement Plan (PEP).** When mining projects are proposed within known summer or swarming habitat, consult with PA DEP and the Service on a case-by-case basis to determine whether project-specific implementation of the measures listed below is sufficient to avoid, minimize, and compensate for potential adverse effects on Indiana bats and their habitat. Individual projects will include an Indiana Bat Protection

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<sup>1</sup> These guidelines apply in Pennsylvania and have been mutually agreed upon by the Office of Surface Mining, Pennsylvania Department of Environmental Protection and U.S. Fish and Wildlife Service.

<sup>2</sup> The attached flowchart depicts the project-screening procedures for coal mining projects in Pennsylvania, and will assist project applicants and PA DEP in determining when a PEP is required.

<sup>3</sup> U.S. Fish and Wildlife Service, Interstate Mining Compact Commission, and Office of Surface Mining. July 2009. *Range-wide Indiana Bat Protection and Enhancement Plan Guidelines*. 40 pp.

<sup>4</sup> These 16 species-specific protective measures are an abbreviated summary of those detailed in the range-wide guidelines, and step the most relevant of those measures down to Pennsylvania. Additional avoidance, minimization, and compensation measures are detailed in the range-wide guidelines and may be implemented by applicants, as appropriate, on a project-specific basis.

and Enhancement Plan that addresses each of the measures below and details (through maps and a project description) how these measures will be implemented on a project-specific basis. Provide a copy of the draft PEP to the PA DEP and the Service for review and comment.

2. **Forest Impacts.** To minimize impacts to foraging and roosting Indiana bats, avoid or minimize impacts to forests, woodlots and forested fence rows. On-site avoidance of forest impacts can reduce the amount of off-site forest habitat compensation needed.

The PEP should include a map showing the project location, and a figure depicting the location and size of the permit area, the location and amount of forest habitat in the permit area, and the location and amount of forest habitat that will be removed or disturbed. The figure should also depict the location of wetlands and streams, and indicate which will be affected by the project and which will be undisturbed by any mining-related activities.

3. **Maternity Roosts.** Avoid direct and indirect impacts to known, primary maternity roosts.
4. **Known Hibernacula.** Caves and abandoned mine portals may serve as winter or roosting habitat for a variety of bat species, including Indiana bats. Therefore, prior to conducting any tree-clearing or mining on the project site, identify and survey all caves and abandoned mine portals (see *Cave and Mine Portal Surveys*). Submit the survey report to the Fish and Wildlife Service and Pennsylvania Game Commission for review and concurrence, along with the PEP.

Avoid direct and indirect impacts to all known Indiana bat hibernacula. Maintain at least a 0.5-mile, no-disturbance buffer around known hibernacula, and avoid blasting and forest removal within this buffer.

5. **Riparian Corridors.** The integrity of all riparian corridors should be maintained to the extent possible<sup>5</sup>. To minimize impacts to foraging bats, avoid affecting streams and wetlands, and leave at least a 50-foot buffer along each side of the stream and around wetlands. Where PA DEP has granted a stream buffer zone variance, impacts to riparian corridors should be minimized. Maintaining the maximum length of natural riparian zones and corridors is preferred. Restore and/or maintain natural riparian vegetation on the banks of streams, lakes, and other wetland areas. When restoring streams and associated riparian zones, the tree planting mix must include at least six tree species from the Tree Species List found in the *Range-wide Indiana Bat Protection and Enhancement Plan Guidelines*. To promote diversity, no more than 20 percent of any individual tree species may be included in the planting mixture.

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<sup>5</sup> The PEP should detail whether there will be impacts to wetlands and/or streams, and if so, to what extent and where.

6. **Seasonal Tree-cutting Restriction.**
  - a. Known Swarming Habitat<sup>6,7</sup>. Tree-cutting will only occur between November 15 and March 31 within a 10-mile radius of Indiana bat hibernacula.
  - b. Known Summer Habitat<sup>8</sup>. Tree-cutting will only occur between October 15 and March 31 in summer habitat.
7. **Staged Tree Removal.** Plan timber removal activities so that tree-clearing occurs one season prior to planned mining. This will ensure that forest clearing will occur only as needed to allow for mining that is anticipated to occur in the near future.
8. **Hazardous Materials.** Follow strict guidelines dictating the use and handling of hazardous materials and other contaminants, to minimize the potential for onsite or downstream impacts to water quality and/or the bat prey base. Project-specific spill prevention, control, and countermeasures (SPCC) plans are required by the U.S. Environmental Protection Agency, and the mining company will make these available upon request.
9. **Erosion and Sedimentation Controls.** Implement comprehensive sediment and erosion control measures in accordance with approved PADEP and U.S. Army Corps of Engineers permits for the project to minimize downstream impacts to waterways. Project-specific erosion and sediment control plans will be used and the mining company will make these available upon request.
10. **Post-mining land use**<sup>9</sup>. With the exception of Coal Refuse Disposal Sites, the post-mining land use will be “wildlife habitat” within 1) 10 miles of Indiana bat hibernacula, 2) 2.5 miles of Indiana bat maternity roosts and male capture records, 3) 5 miles of Indiana bat female or juvenile summer capture records, and 4) any areas where Indiana bats are assumed to be present.

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<sup>6</sup> "Known swarming habitat" refers to "suitable habitat" located within 10 miles of an Indiana bat hibernaculum. Due to the tendency by male Indiana bats to spend the summer months near hibernacula, swarming habitat is likely to be used as summer habitat as well.

<sup>7</sup> "Suitable habitat" (summer or swarming) for Indiana bats consists of the variety of forested/wooded habitats where they roost, forage and travel. This includes forested blocks as well as linear features such as fencerows, riparian forests and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Isolated trees are considered suitable habitat when they exhibit the characteristics of a suitable roost tree.

<sup>8</sup> "Known summer habitat" refers to "suitable habitat" located within 5 miles of a female or juvenile Indiana bat capture record, or 2.5 miles of an Indiana bat maternity roost or male capture record.

<sup>9</sup> See footnote #11.

11. **Habitat Restoration/Forest Reclamation**<sup>10</sup>. Where the post-mining land use is “wildlife habitat”, reforest at least 90% of the forest habitat that was or will be lost<sup>11</sup>. Include travel corridors and stream buffer zones in the areas to be re-forested. Replant with a minimum of six different tree species from the Tree Species List found in the *Range-wide Indiana Bat Protection and Enhancement Plan Guidelines*. A minimum of four species identified as “exfoliating bark species” on the Tree Species List must be planted and equal at least 40 percent of the minimum stems per acre for final bond release. To promote diversity, no more than 20 percent of any individual tree species may be included in the planting mixture. Stocking success will be at least 400 live woody stems per acre at bond release, with no more than 50 stems per acre of black locust. Forest reclamation will be implemented in accordance with the methods detailed in the Forest Reclamation Advisories published by the Appalachian Regional Reforestation Initiative (<http://arri.osmre.gov/FRA.htm>).
12. **Herbaceous Ground Cover**. The use of native species is required when establishing the herbaceous ground cover in areas with “wildlife habitat” as the post-mining land use. If the applicant proposes to use non-native herbaceous species, they must be compatible with tree planting, non-invasive, slow-growing, and beneficial to wildlife.
13. **Watering Areas**<sup>12</sup>. High quality, accessible water is very important to the Indiana bat. Concurrent with or prior to tree planting on the site post-mining, create and enhance open water sources (*e.g.*, wetlands, small depressions). Watering areas need to be created in the form of shallow water depressions designed to provide water during the driest months of the year. One water area should be created or restored for each 50 acres of mining area<sup>13</sup>. These depressions should be situated immediately adjacent to existing trees (*e.g.*, usually along permit boundaries) in order to take advantage of habitat that bats can use as escape cover. The techniques described in Thomas R. Biebighauser’s “A Guide to Creating Vernal Ponds,” published by the USDA Forest Service, are highly recommended for the creation of adequate watering areas (<http://herpcenter.ipfw.edu/outreach/VernalPonds/VernalPondGuide.pdf>). In some cases, it may be possible to convert sedimentation control ponds to suitable watering areas, provided they meet the criteria listed above.
14. **Habitat Compensation**. In some cases, the long-term habitat needs of the Indiana bat may not be provided for on-site through implementation of measures #10-13 because 1) establishment of woody vegetation and watering areas is not appropriate post-mining

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<sup>10</sup> Reforestation (tree planting) does not apply on Coal Refuse Disposal Sites.

<sup>11</sup> If the landowner’s long-term plans for the property do not include retaining and protecting the replanted forest for the many decades necessary to meet the long-term habitat needs of Indiana bats, the mining company has the option of selecting a different PMLU (*e.g.*, a PMLU that results in site restoration, but not to primarily forest habitat). Regardless, the PEP needs to address PMLU and site restoration – explaining what is proposed and why.

<sup>12</sup> This measure does not apply on Coal Refuse Disposal Sites.

<sup>13</sup> If forested riparian corridors in the permit area will be protected and buffered against mining impacts, the creation of watering areas may not be necessary. This will be evaluated on a case-by-case basis.

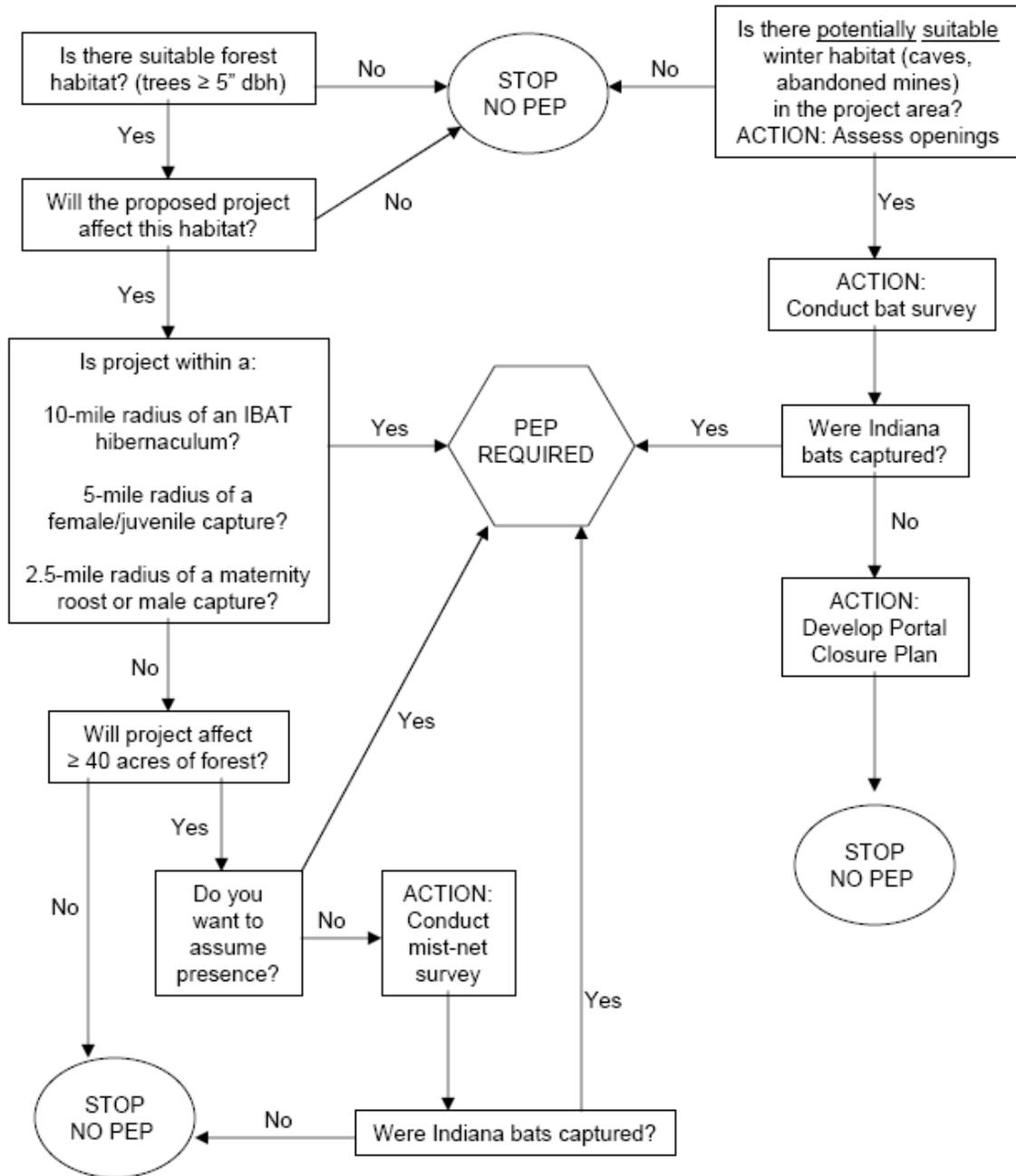
(e.g., the site is a coal refuse disposal area); 2) business or applicant considerations may preclude implementation of measures #10-13; or 3) the landowner's long-term plans for the property do not include retaining and conserving replanted forests for the many decades necessary to meet the long-term habitat needs of the Indiana bat. In those cases, off-site habitat compensation can provide for the long-term habitat needs of the Indiana bat. Document how, when, and where this will be accomplished. Various tools are available to achieve permanent protection of off-site habitat to meet the long-term habitat needs of the Indiana bat, including a) acquiring or otherwise providing protection to known or potential Indiana bat habitat in fee simple or through permanent conservation easements, b) buying credits from an approved Indiana bat conservation bank, c) ensuring the protection of other off-permit Indiana bat habitat through land donation, acquisition, easement, or perpetual trust agreement, and d) making an in-lieu-fee contribution to the Indiana Bat Conservation Fund (IBCF).

15. **Take Reporting**<sup>14</sup>. Any dead or injured Indiana bats must be reported to the Fish and Wildlife Service and Pennsylvania Game Commission within 48 hours of discovery.
16. Applicants may propose other appropriate temporary or long-term measures that may enhance and/or restore habitat for the Indiana bat. Additional avoidance and minimization measures are detailed in the *Range-wide Indiana Bat Protection and Enhancement Plan Guidelines* (2009).

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<sup>14</sup> Take reporting is required, pursuant to the Terms and Conditions of the 1996 Biological Opinion.

**PROJECT SCREENING AND PEP DETERMINATION  
FOR MINING PROJECTS IN PENNSYLVANIA**



## CALCULATION SHEET FOR INDIANA BAT HABITAT COMPENSATION

USFWS Project # \_\_\_\_\_ Date \_\_\_\_\_

Project Name: \_\_\_\_\_

Project Location (township and county): \_\_\_\_\_

Project Type: \_\_\_\_\_ DEP permit # \_\_\_\_\_

Hibernaculum and/or Maternity Colony Affected: \_\_\_\_\_

**Table 1. Calculation of Compensation Acres**

IMPACT TYPE	IMPACT ACRES	MULTIPLIER <sup>15</sup>	COMPENSATION ACRES
<b>Summer Habitat Loss<sup>16</sup></b>			
Known maternity habitat		1.5	
Known non-maternity habitat		1.0	
Potential habitat <sup>17</sup>		0.5	
<b>Swarming Habitat Loss<sup>18</sup></b>			
P2 or P3		1.5	
P4		1.0	
<b>Overlapping Habitat Loss<sup>19</sup></b>			
Known maternity and swarming habitat occur together: choose highest multiplier from above (maternity or swarming) for the impact, and add 1.0 to the multiplier			

<sup>15</sup> Multiplier assumes permanent habitat protection will occur in accordance with the *Indiana Bat Mitigation Guidance for Pennsylvania*.

<sup>16</sup> Loss of known summer habitat assumes such loss will occur when bats are NOT present (i.e., between October 15 and March 31).

<sup>17</sup> For coal mining projects having forest impacts  $\geq 40$  acres, applicants can either conduct mist-net surveys in accordance with the Service's mist-netting guidance OR assume presence of Indiana bats. When assuming presence, a seasonal restriction will apply, along with a 0.5:1 compensation ratio for forest impacts. Non-coal projects are evaluated on a case-by-case basis.

<sup>18</sup> Swarming habitat is suitable habitat within a 10-mile radius of Indiana bat hibernacula. Loss of swarming habitat assumes such loss will occur when bats are NOT present (i.e., between November 15 and March 31).

<sup>19</sup> Loss of summer and swarming habitat assumes such loss will occur when bats are NOT present (i.e., between October 15 and March 31).

**Table 2. Calculation of Deposit when using the Indiana Bat Conservation Fund**

Location of Impact (County)	Compensation Acres (from Table 1)	Cost/Acre <sup>1</sup>	IBCF Deposit <sup>2</sup>
Adams		TBD	
Armstrong/Butler		\$2060	
Beaver/Lawrence		\$2320	
Bedford		TBD	
Berks		TBD	
Blair		TBD	
Centre		TBD	
Fayette		\$1519	
Greene		\$1223	
Huntingdon		TBD	
Luzerne		\$3716	
Mifflin		TBD	
Somerset		\$2247	
Washington		\$2760	
York		TBD	
Other areas (not listed above)		TBD	

**NOTE:** Deposits to the IBCF are due at or within two (2) weeks of permit issuance. Provide documentation of the deposit to the USFWS and the permitting agency (*e.g.*, PA DEP). An escrow account has been set up at the following institution to receive IBCF deposits.<sup>3</sup>

First Commonwealth Bank – Trust Division  
 Attn: Brenda Alabran  
 614 Philadelphia Street  
 PO Box 698  
 Indiana, Pennsylvania 15701  
 724-463-6580 (phone)

Designate the deposit for: Indiana Bat Conservation Fund (Acct #710621004)

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**USFWS use only**

Recovery Area to be credited with the above IBCF Deposit: \_\_\_\_\_

<sup>1</sup> Revised March 2011. Cost/acre subject to change, based on a periodic re-evaluation of land comparable values by the Pennsylvania Game Commission. Cost per acre reflects land cost per acre, plus 20% for expenses associated with land acquisition (*e.g.*, comparable values search, title search, transfer taxes, land survey, recording fees, *etc.*)

<sup>2</sup> Multiply the number of Compensation Acres by the Cost/Acre to determine the amount to be submitted to the Indiana Bat Conservation Fund.

<sup>3</sup> If you choose to set up an escrow account at another institution, do so in coordination with the Pennsylvania Game Commission.

## CAVE AND MINE PORTAL SURVEYS

All caves and portals in the project area should be evaluated by appropriately permitted and trained biologists for characteristics that may indicate potential use by bats (see criteria below). If caves/portals in the project area appear to have suitable bat habitat characteristics, a bat survey will be necessary.

### **Criteria for Determining Whether Abandoned Coal Mines or Caves Provide Potentially Suitable Bat Habitat** (Developed by Cal Butchkoski, Pennsylvania Game Commission)

In general, openings can be dismissed from bat surveys when:

1. There is only one horizontal opening less than 6 inches in diameter, and no or very little airflow is detected.
2. Vertical shafts <1 foot in diameter.
3. Passage continues less than 50 feet and terminates with no fissures that bats can access.
4. Mines that are prone to flooding, collapsed shut and completely sealed, or otherwise inaccessible to bats.
5. Openings which have occurred recently (within 1 year) due to subsidence.

*Additional notes: Bats can access mines via old open buildings such as a fan house. Foliage and other vegetation in front of mine openings do not stop use by bats. They can navigate through foliage. Collapsed entrances with multiple crevices between boulders etc. are accessible to bats and should be sampled. Collapses completely sealed with fine soil are of course inaccessible to bats.*

### **Bat Surveys of Caves and Mines**

Sites that are determined to be safe for entry to conduct winter bat counts (primarily caves and stable hard rock mines) will be coordinated with the Pennsylvania Game Commission, Wildlife Diversity Section and scheduled for interior surveys between January 1 and March 10.

In cases where interior surveys are not safe<sup>4</sup> or possible, the following procedures apply. Bat surveys of portal and cave entrances must be conducted between September 15 and October 31, unless alternative dates are approved by the Fish and Wildlife Service. Surveys will be conducted for at least two nights, beginning ½ hour before sunset and continuing for at least 5 hours. If the minimum external air temperature falls below 10°C, the survey should be postponed until acceptable temperatures are attained. Otherwise, sampling period, weather conditions, and equipment should comply with those specified in the Service's Indiana bat mist-net guidelines. In addition, harp traps may be used to survey potential hibernacula where the

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<sup>4</sup> Entry of abandoned underground mines is prohibited by federal MSHA regulation 30CFR 75.202. Entry of any mine is only for certified miners or by State approval. Entry of abandoned underground mines can be extremely dangerous because of the potential for ceiling collapse and presence of toxic gases. Safety or health problems may occur as a result of entering abandoned underground mines. The U.S. Fish and Wildlife Service does not authorize or regulate this activity.

cave or portal configurations are suitable and where open areas at the sides and top of traps can be enclosed. Entrances to caves or portals should be entirely enclosed by the survey gear.

In cases where one team of surveyors cannot feasibly sample all caves or portals in one night, a modified method may be used. This method may only be used in association with caves and portals that are known to be interconnected. During use of this modified method, half of the interconnected openings are netted on the first night. The other half of the openings are completely blocked using plastic or other material. On the second night, this is reversed. Caves and portals that are completely isolated do not need to be netted simultaneously.

Bat surveys will be conducted by qualified bat surveyors (list available from the Service), and survey results will be submitted to the Fish and Wildlife Service and Pennsylvania Game Commission for review and approval. Inclusion of a surveyor's name on the list of qualified surveyors does not constitute an endorsement by the Service or any other federal or state agency.

## Indiana Bat Mist-Netting Guidelines

### RATIONALE

A typical mist-net survey is an attempt to determine presence or probable absence of the species; it does not provide sufficient data to determine population size or structure. Following these guidelines will standardize procedures for mist netting. It will help maximize the potential for capture of Indiana bats at a minimum acceptable level of effort. Although capture of bats confirms their presence, failure to catch bats does not absolutely confirm their absence. Netting effort as extensive as outlined below usually is sufficient to capture Indiana bats if they are present. However, there have been instances in which additional effort yielded detection when the standard effort did not.

Some mist-netting projects will require modification (or clarification) of these guidelines; these situations must be resolved through coordination with the Fish and Wildlife Service Field Office responsible for the state in which your project occurs. Consultation with the Field Office is always recommended, particularly for large-scale netting efforts.

The Service accepts the results of these surveys to determine presence for the purposes of Section 7 consultation. Survey results are valid for at least two years.<sup>1</sup>

### NETTING SEASON: May 15 - August 15

May 15-August 15 are acceptable limits for documenting the presence of summer populations of Indiana bats, especially maternity colonies. (However, see Kiser and MacGregor 2005 for precautions regarding early-season surveys between May 15 and June 1, as well as late-season surveys between August 1 and August 15). Capture of reproductive adult females (i.e., pregnant, lactating, or post-lactating) and/or young of the year during May 15-August 15 indicates that a nursery colony is active in the area. Outside these dates, data cannot be used to document the presence or probable absence of summer populations.

### EQUIPMENT

Mist nets to be used for Indiana bat surveys should be the finest, lowest visibility mesh commercially available: 1) In the past, this was 1 ply, 40 denier monofilament—denoted 40/1; 2) Currently, monofilament is not available, and the finest on the market is 2 ply, 50 denier nylon denoted 50/2; 3). The finest mesh size available is approximately 38 mm (~1 1/2 in).

No specific hardware is required. There are many suitable systems of ropes and/or poles to hold nets. The system of Gardner et al. (1989) has been widely used. See NET PLACEMENT below for minimum net heights, habitats, and other netting requirements that affect the choice of hardware.

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<sup>1</sup> The Service's Pennsylvania Field Office considers mist-net survey results to be valid for five years, consistent with the *Range-wide Indiana Bat Protection and Enhancement Plan Guidelines (2009)*.

## NET PLACEMENT

Potential travel corridors such as streams or logging trails typically are the most effective places to net. Place nets approximately perpendicular across the corridor. Nets should fill the corridor from side to side and from stream (or ground) level up to the overhanging canopy. A typical set is 7 m high consisting of three or more nets stacked on top one another and up to 20 m wide. (Nets of different width may be used as the situation dictates).

Occasionally it may be desirable to net where there is no good corridor. Take caution to get nets up into the canopy. The typical equipment described in the section above may be inadequate for these situations, requiring innovation on the part of the researchers.

Exercise safety precautions when placing nets. Poles and nets must be clear of overhead wires.

See Kiser and MacGregor (2005) for additional discussion of net placement.

## RECOMMENDED NET SITE SPACING

Stream and other linear corridors – one net site per km (0.6 mi) of stream or corridor.

Non-corridor study areas – two net sites per square km of habitat (equivalent to one net site per 123 acres).

The Service Field Office responsible for the state in which your project occurs should be consulted during survey design to resolve issues related to net site spacing for specific projects.

## MINIMUM LEVEL OF EFFORT<sup>2</sup>

Netting at each site should include at least four net nights, consisting of: 1) a minimum of two net locations at each site (at least 30 m apart, especially in linear habitat such as a stream corridor); and 2) a minimum of two nights of netting (i.e., two net locations for two nights = four net nights per site). A “net night” is defined as one net set up for one night. The sample period should begin at sunset and continue for at least 5 hours (longer sample periods may improve success). For purposes of determining presence or probable absence of Indiana bats, four net

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<sup>2</sup> In Pennsylvania, the following radio-telemetry guidelines apply. Fit all adult Indiana bats (males and females) with radio transmitters. If both juvenile Indiana bats and adult females are captured at a particular net site, fit the adult females with transmitters (as well as any adult males), but not the juveniles. If only juvenile Indiana bats are captured at a particular net site, fit them with transmitters. It is recommended that the transmitter and adhesive not exceed 5% of the bat's body weight. The lightest transmitter to accomplish the task should be used, especially for pregnant females and newly volant young. Under no circumstances shall the total weight of the package exceed 0.8 grams or 10% of the bat's body weight, whichever is less. Identify day roost trees for each transmittered bat for at least 6 days, along with exit counts. Conduct exit counts of all identified roost trees for at least 3 days. Collect standard roost tree data, including tree species, dbh, condition (dead, live, dying), % bark cover, GPS coordinates, and description of surrounding habitat. Documentation of foraging habitat use may also be recommended, depending on the anticipated effects of the proposed project on Indiana bats and their habitat. Qualified biologists are encouraged to continue radio-tracking bats for the life of each transmitter. This will generate better data related to Indiana bat foraging and roosting behavior with respect to the project site and will further assist applicants and the Service in completing ESA consultation or coordination. Submit study results to the Fish and Wildlife Service and Pennsylvania Game Commission for review and concurrence.

nights at a site are not required if Indiana bats are caught sooner (i.e., if Indiana bats are caught on the first night of netting, a second night is not required for purposes of documenting presence).

## CHECKING NETS

Each net should be checked approximately every 10 minutes. Some researchers prefer continuous monitoring (with or without an electronic bat detector); care must be taken to avoid noise and movement near the nets if this technique is used. When monitoring the site continuously with a bat detector, bats can be detected immediately when they are captured in the net. Prompt removal from the net decreases stress on the bat and potential for the bat to escape (MacCarthy et al. 2006). Monitoring the net with a bat detector also allows the researcher to assess the effectiveness of their net placement (i.e., if bats are active near the nets but avoiding capture); this may allow for adjustments that will increase netting success on subsequent nights. There should be no disturbance near the nets, other than to check nets and remove bats.

## WEATHER AND LIGHT CONDITIONS

Severe weather adversely affects capture of bats. If Indiana bats are caught during weather extremes, it is probably because they are at the site and active despite inclement weather. On the other hand, if bats are not caught, it may be that bats are at the site but inactive due to the weather. Negative results combined with any of the following weather conditions throughout all or most of a sampling period are likely to require additional netting: 1) precipitation; 2) temperatures below 10°C; and/or 3) strong winds (use good judgment-- moving nets are more likely to be detected by bats). Further, consider human safety when netting during adverse weather.

It is typically best to set nets under the canopy where they are out of moonlight, particularly when the moon is ½-full or greater. Areas illuminated by artificial light sources should also be avoided.

## DOCUMENTATION OF *MYOTIS SODALIS* CAPTURES

Photo documentation of *M. sodalis* captured during mist netting is not required, but is encouraged.<sup>3</sup> Photos taken of a bat's head, calcar, tragus, toe hairs, etc. using a macro lens or a digital camera's macro-mode are often diagnostic and aid in validating the record.

If a bat from the genus *Myotis* is captured during mist netting that cannot be readily identified to the species level, species can be verified through fecal DNA analysis. Collect one or more fecal pellets (i.e., guano) from the bat in question by placing it temporarily in a holding bag (15 minutes is usually sufficient, no more than 30 minutes is recommended). The pellet (or pellets) collected should be placed in a 1.5 ml vial with silica gel desiccant; pellets from each individual bat should be stored in separate vials. Samples should be stored out of direct light. Samples should be shipped to Dr. Jan Zinck, Department of Biology, Portland State University, 630 SW Mill St., Portland, Oregon, 97201 for subsequent fecal DNA analysis to assign or confirm the specimens' identification to the species level. The current cost for sequencing is approximately

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<sup>3</sup> In Pennsylvania, photo-documentation of Indiana bats is required.

\$50 per individual pellet of guano. Contact Dr. Zinck (e-mail: zinckj@pdx.edu) prior to shipping samples. To our knowledge, this is the only lab that currently provides this service. Any additional information (or additional sources) on this technique will be made available on the Indiana bat webpage on the Service's Region 3 website ([www.fws.gov/midwest](http://www.fws.gov/midwest)).

#### REFERENCES TO CONSULT REGARDING MIST NETTING

Gardner, J. E., J. D. Garner, and J. E. Hofmann. 1989. A portable mist-netting system for capturing bats with emphasis on *Myotis sodalis* (Indiana bat). *Bat Research News* 30:1-8.

Kiser, J.D. and J.R. MacGregor. 2005. Indiana bat (*Myotis sodalis*) mist net surveys for coal mining activities. Pp. 169-172 in K.C. Vories and A. Harrington (eds.), *The Proceedings of the Indiana bat and coal mining: a technical interactive forum* Office of Surface Mining, U.S. Department of the Interior, Alton, IL. Available at: <http://www.mcrcc.osmre.gov/PDF/Forums/Bat%20Indiana/2-1.pdf>. (Accessed October 27, 2006).

MacCarthy, K.A., T.C. Carter, B.J. Steffen, and G.A. Feldhamer. 2006. Efficacy of the mist-net protocol for Indiana bats: A video analysis. *Northeastern Naturalist* 13:25-28.

Murray K., E. Britzke, B. Hadley, and L. Robbins. 1999. Surveying bat communities: a comparison between mist nets and the Anabat II bat detector system. *Acta Chiropterologica* 1(1):105-12.

Murray, K.L., J.G. Boyle, J.C. Timpone, M.N. Miller, and L.W. Robbins. 2003. A test of the sampling protocol for Indiana bats. *Bat Research News* 44(1):25.

Robbins, L.W., K.L. Murray, J.G. Boyles, J.C. Timpone, M.N. Miller, and S.A. Kelly. 2003. Capture and detection of five species using Indiana bat protocol. Abstracts of papers presented at the 33rd annual North American symposium on bat research held 8-11 October 2003 in Lincoln, NE. *Bat Research News* 44(4):165.