FIELD TECHNIQUES FOR BIOLOGICAL ASSESSMENT: ASSESSMENT OF POTENTIAL HIBERNACULA AND SWARMING/STAGING HABITAT

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Abstract

The Indiana bat (*Myotis sodalis*) is protected under the Endangered Species Act wherever it is found, including underground mines, which may be used as winter hibernacula. Because mines are unsafe to enter, use can be determined by sampling entrances during autumn swarming and spring staging. Assessing the potential for use begins with determining whether mines/portals are present. Maps or other documents may be available or a search of the property may be required. Next, it is important to learn about the mine. Bats are more likely to use large, complex systems than small, simple systems. Determine the number of entrances, their size, and their vertical relationship to one another. How much time has passed since closure? Inspect the entrance. Is there evidence of instability, flooding, airflow, use by bats, or lack of use? Would use make bats susceptible to predation? Is there suitable habitat and drinking water nearby? If the mine is potentially suitable for bats, sampling with a trap or mist net should be completed in autumn or spring. Sampling should be for two nights, from dusk and continuing for five hours, with temperatures above 10°C during the first two hours and above 0°C during the rest of sampling. Sampling may be supplemented with a bat detector. Interpretation of the data must not only include the presence/absence of endangered bats, but also whether the mine provides suitable wintering habitat. Very limited captures of Indiana bats and other species may not be indicative of a hibernaculum. Captures of large numbers of bats, regardless of whether Indiana bats are caught, is strong evidence that the mine provides suitable winter habitat.

Introduction

Listing of the Indiana bat (*Myotis sodalis*) under the Endangered Species Act entitles the species to protection wherever it is found. The range encompasses much of the eastern forests between the Appalachian Mountains and the prairies of the plains States. During summer, the Indiana bat forms maternity colonies in wooded areas, typically under the exfoliating bark of live, dead, or dying trees. In winter, the natural habitat for hibernation is in limestone caverns; however, some types of man-made structures, such as inactive underground mines, may provide sites suitable for hibernation. Hibernacula with large populations of bats are concentrated in Missouri, Indiana, and Kentucky, while hibernacula with smaller populations are found in many parts of the range.

Hibernating Indiana bats can often be found and counted in caves, either by measuring areas of bat cluster or by counting individual bats in the cave or from photographs. These techniques provide a direct indication of the importance of each hibernaculum for the species. Some mines, particularly limestone mines, can also be entered; however, entering many mines, including coal mines, is an unacceptable risk. Therefore, an alternate method of assessing use by hibernating Indiana bats is important when mines that may serve as hibernacula will be closed or destroyed.

Use of mines can be determined by sampling entrances in autumn when Indiana bats arrive for hibernation and in spring when they depart. Autumn swarming is a term used to describe a seasonal activity of microchiropterans at hibernacula in North America (Cope and Humphrey 1977) and Europe (Parsons et al. 2003). It is the use and visitation of hibernacula and nearby habitats in late summer and early autumn, and for many species it is associated with the opportunity for sexes to meet and mate. In autumn, Indiana bats swarm at caves used as hibernacula, although individuals probably come and go throughout the autumn season. Spring staging is often used to describe the departure of bats from hibernacula and can be thought of in general terms as the reverse of swarming. During this time, bats apparently remain near hibernacula for a few days before leaving for summer maternity areas. They may use this time to help prepare for migration.

Assessing Mine Portals for Use

Assessing mine portals for potential use by hibernating bats using through spring and autumn sampling involves a series of questions, which are addressed in the following sections.

Are Portals Present?

While intuitive, the question "*Are mines/portals present on the property?*" can be overlooked or presence/absence is assumed. Often, this information is available from maps of past mining activities from public and private sources. Often, this information has been incorporated into the decision-making process for many activities, but has not been applied to the question of whether bats may be present. Put simply, engineers and miners may not be aware that the information is important to concerns for natural resources and endangered species.

Sometimes, a site inspection may be necessary to determine whether portals are present or to verify information from other sources. Many portals to underground voids are associated with coal seams at specific elevations, which may help streamline efforts to locate portals. Auger holes are also associated with exposed seams. However, portals may be at other elevations if associated with entrances to move air mine that have collapsed. Field efforts can also be made more efficient by looking for old facilities, equipment, tailings, or other evidence of past activities. Once portals, or potential portals, are identified, it is important to determine their status. Are they open, and have they always been open? Were they closed but have slumped open, and if so, is there any indication of when this occurred?

What is Known About the Mine?

Mine entrances/portals do not exist in isolation - there is also a void. It is important to learn what you can about the mine. Was it large or small? Are/were there multiple entrances? Are there maps? What is the time since closure?

The morphology of a mine or cave strongly affects its suitability for hibernation (Humphrey 1978) by affecting airflow and thus corresponding hibernaculum temperatures. Large complex caves and mines offer more opportunities for the combination of characteristics needed to support airflow while remaining thermally stable. These systems typically allow airflow to cool the cave, but the volume and complexity of the hibernaculum buffers temperature changes so they do not occur too quickly. Multiple openings often contribute to airflow, especially if they are at different elevations, typically with cooler air entering at the lower elevation and warmer air exiting from the higher opening. Entrances that are side by side may do less to cool the mine than entrances on opposite sides of the mine. The size of the entrance, or entrances, can also affect airflow and suitability of the mine as a hibernaculum.

The time since last activity may provide a clue as to the potential for use by bats. Bats may be more likely to find and use suitable mines as time of inactivity increases. In Ohio, nearly 10,000 Indiana bats were found in a limestone mine about 15 years after mining operations ceased, although other types of activities had continued in the mine (Brack unpub. data).

Complete a Portal Examination

The entrance(s) to the mine may help provide information about use of the mine by bats. Are entrance passages horizontal, sloped, or vertical? (Use a spot light to see into the mine without entering it.) Vertical or sloped passages are often associated with airflow. Is there airflow into or out of the mine? Is the entrance stable? If the entrance is collapsed shut, it may obstruct airflow or may be impassable by bats, but a collapsed entrance may still allow airflow if bats can get into the mine via other portals. Is the entrance flooded or is there evidence of past flooding? Passages that flood may kill bats or be impassible to bats even if portions of the mine do not flood. What is the temperature inside the entrance relative to outside temperatures? (Use a point-and-shoot infrared thermometer to take a temperature without entering the mine.) A large difference in temperatures may be another indication of air movement.

Is there evidence the portal has been used by bats? The presence of guano or insect remains indicates probable use by bats. These may be very hard to find, requiring a careful, detailed search of flat surfaces such as stones, leaves (living or dead), or open, dry ground is required. Is there evidence that use by bats has not occurred? A profusion of intact spider webs or cobwebs indicates a lack of bat passage. Would use of the portal make bats susceptible to

predation? Is there evidence of predation, such as tracks, scat, or the remains of bats that have been eaten? Does vegetation or a ledge at the entrance provide a site that predators could use to catch bats? Does vegetation obscure the entrance, making passage difficult or reducing airflow? Is habitat near the entrance suitable for bats, including roosting and foraging habitat (woodlands or other natural habitat) and is there a source of drinkable water nearby?

Direct Sampling

If the portal(s) and mine system are potentially suitable for bats, then direct sampling should be completed during suitable weather in autumn or spring. Watching the entrance at dusk may help determine whether bats are using the mine, but it will not identify species and bat activity cannot be determined after dusk. Bats entering and exiting the mine can be caught for identification using a bat trap or mist net at the entrance. Two nights of trapping, starting at dusk and continuing for five hours, is the typical level of sampling effort. If there is reason to suspect that many bats use the entrance, trapping is preferable to netting, as there is less potential for injuring bats. Portions of the entrance not covered by the trap or net should be closed off with bird exclusion netting.

The timing of sampling should be coordinated with the local field office of the U.S. Fish and Wildlife Service, as staging and swarming seasons may vary with latitude and elevation. In general, female Indiana bats leave hibernacula earlier in spring (beginning in mid-April) than do males (peak of departure in early May). Limited mating may occur in spring (Hall 1962). Spring sampling is typically completed late March through early May. During autumn swarming, the abundance of females increases and decreases with the season, but males are always more common (Cope and Humphrey 1977; LaVal and LaVal 1980). The number of swarming females peaks in September. By late September, many females are hibernating, while many males remain active until mid-October or later, apparently in an effort to breed late-arriving females. Early during autumn swarming, Indiana bats often visit hibernacula at night, but do not day roost there. As the autumn season progresses more bats roost in hibernacula.

Temperature and precipitation likely influence swarming chronology and the level of nightly activity; rain depresses swarming activity in Europe (Parsons et al. 2003). Large, wet cold-weather systems may be part of the seasonal cycle driving timing of swarming (Brack unpub. data). As a result, sampling should not be completed on nights of sustained precipitation, or when temperatures fall below 10°C during the first two hours of sampling or below 0°C during the rest of sampling. It is important to begin sampling promptly at dusk, or shortly before if bat activity begins earlier. As the autumn season progresses, nightly activity begins earlier in the evening (Brack unpub. data; Parsons et al. 2003).

Spring sampling is often more constrained than autumn sampling because the season is shorter and there are more days of unsuitable weather. Large weather systems can delay sampling for many days. In addition, latitude and elevation affect seasonal and daily temperatures.

A bat detector can be used to supplement data obtained from trapping and netting, but when it is too dangerous to approach the entrance, use of bat detectors may be the only suitable form of sampling. Typically, the detector is pointed at the entrance to see what is exiting and entering the mine. Nevertheless, it may detect bats that are not using the portal. A few bats can produce many, many calls. If a detector is used in conjunction with a trap or net and nothing is heard or caught, it may provide sufficient data to eliminate a second night of trapping.

Interpreting Field Data

While a survey will reveal whether or not endangered bats were caught, interpretation of capture data may not be as clear-cut. The question is not only whether endangered bats were caught, but whether the mine provides suitable wintering habitat and whether that habitat is occupied.

Little is known about bats during the spring and autumn migration/transient period. Indiana bats may visit mines during this period but not hibernate in them during winter. It is probable that bats use a variety of roosts, including trees, caves, mines, holes of various types, and possibly a variety of non-traditional roosts, during migration. Bats migrating from hibernacula in southeastern New York to summer maternity sites roosted in trees on a building in a gap between a cinderblock wall and a joist under an elevated deck (Sanders and Chenger, unpub. tech. report), as well as in the siding of a house and in trees of suburban yards (Hicks pers. comm.). In late summer, a juvenile Indiana bat was found in central Indiana on the side of a building that had a rough cement exterior (Brack unpub. data). In northern Ohio, several Indiana bats have been caught in autumn in sandstone crevices that likely serves as

a migratory stop-over (Summit County Metro Parks unpub. tech. report). During migration, other species of bats have been found in a variety of unlikely locations, including ships at sea, log piles, and rodent holes in treeless areas (Brack and Carter 1985). In addition, bats undoubtedly "explore or sample" a variety of situations and habitats, including mines, that are not currently suitable for use.

Caves and mines that provide suitable hibernacula for the Indiana bat are often suitable for other species of bats (Brack et al. 2003; Stihler and Brack 1992). Therefore a large concentration of bats of mixed species indicates that the mine is probably suitable for hibernation and therefore more likely to harbor Indiana bats - now or in the future. In this case, failure to catch Indiana bats does not mean the mine is not suitable for the Indiana bat, and loss of suitable habitat can constitute harm or harassment.

Regulatory decisions will be made based on the presence/absence of the Indiana bat, the number of bats, and probably the number of species and species diversity. Consequently, interpretation of field data must be made with caution. Capture of a single Indiana bat when only a few bats are caught is probably not indicative of a hibernaculum – and instead is indicative of another type of use. The capture of many bats (especially of several species), but not an Indiana bat, is probably indicative of a suitable hibernaculum. When interpretation of the data may not be clear, it is wise to contact the U.S. Fish and Wildlife Service (and State resource agency as appropriate) to ascertain whether additional sampling while still in the field would be helpful. This may save time and money.

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