Energetics Alone Is Insufficient for Conservation Recommendations for Hibernating Bats

Justin G. Boyles¹ and Virgil Brack, Jr.²

¹Cooperative Wildlife Research Laboratory and Department of Zoology, Southern Illinois University, Carbondale 62901;
²Environmental Solutions and Innovations, 4525 Este Avenue, Cincinnati, OH 45232
E-mail: jgboyles@siu.edu

We read with concern a new paper on winter energetics of the Indiana bat (Myotis sodalis) by Day and Tomasi (2013). These authors calculate winter energy budgets for hibernating Indiana bats using standard laboratory procedures. They rely heavily on older laboratory-based scientific literature but fail to include many relevant field studies, thus giving, we would argue, an outdated view of hibernation by cavernicolous bats. This alone is of little concern, but they then base conservation recommendations on this outdated and incomplete information, which may have serious implications for management of cavernicolous bats and the caves they inhabit.

Briefly, Day and Tomasi use measurements of metabolic rate of individually hibernating and euthermic bats and patterns of body temperature from bats in small groups. Several methodological problems may influence their calculations of winter energy budgets. For example, it is unlikely that patterns of body temperature of individuals within each group are independent (Czenze et al., 2013). Further, measuring the metabolic cost of an arousal, one component of hibernation, by an individual bat is questionable, because evidence suggests that the main reason for clustering is to lessen the cost of arousal (Boyles et al., 2008) and not to buffer against fluctuations in ambient temperatures, as suggested by Day and Tomasi and older literature (Twente, 1955). Although these issues may affect the accuracy of their energy-budget estimates, they are not the major problem with the study.

Day and Tomasi focus almost exclusively on energetic costs of hibernation to reach the conclusion that “Indiana bats should occupy winter hibernacula that provide a mean temperature of 3°–6°C.” They briefly mention, but largely ignore, a quickly growing body of literature suggesting that many factors affect depth and length of hibernation and, in turn, the initial choice of a hibernaculum and ultimately the actual hibernating location within a site (e.g., French, 2000; Humphries et al., 2003; Munro et al., 2005; Boyles et al., 2007; Wojciechowski et al., 2007; Zervanos et al., 2010; Jonasson and Willis, 2011). This exclusion leads Day and Tomasi to state that “hibernacula that provide these conditions [i.e., mean temperatures of 3–6°C] deserve extra protection.” This is a conservation recommendation that is not only unwarranted but may be harmful to overall management of...
the Indiana bat. For example, Brack (2007) reported that essentially no Indiana bats hibernate in areas that meet Day and Tomasi’s suggested temperature range in a growing population in Ohio (growing at least before white-nose syndrome [WNS] was found there). In addition, Boyles et al. (2008) reported that clusters of hibernating Indiana bats occur between 6.2 and 12.8°C in six caves in southern Indiana, including several caves that contain some of the largest known colonies of Indiana bats.

This is not to say that Indiana bats will not choose temperatures between 3 and 6°C, but rather that it is apparent that Indiana bats elect to hibernate at a wide range of ambient temperatures. Take, as one example, Wyandotte Cave, Indiana, which is a large, thermally stable cave system with mid-winter temperatures that warm slowly and predictably with distance into the cave. During decades of winter disturbance by humans, most Indiana bats clustered in a passage called Washington Avenue, which is an area with very high ceilings that presumably would serve to reduce the impact of human disturbance. Between 2002, when new regulations ended all winter disturbances, and 2009, when the last survey of bats occurred before the discovery of WNS in the cave, the number of Indiana bats hibernating in Wyandotte Cave increased by 50%, from 30,000 to 45,000 bats (Brack et al., 2009). These bats were distributed over a substantial area of the cave with 20% anterior to Washington Avenue (2–5°C), 29.3% in Washington Avenue (5–7.2°C), and 50% posterior to Washington Avenue (9–13°C). Managing this cave to maximize areas with microclimates between 3 and 6°C would be a mistake, because it would disrupt the thermal continuum that clearly is valuable to this species. Our experience suggests that such a pattern of broad distribution with temperature is not unique to this particular cave.

We suggest that no conservation actions be based on protecting hibernacula that contain a specific and limited range of temperatures (e.g., 3–6°C), which is a hallmark of bat management that is based on old, incomplete data. Instead, hibernacula with the widest possible range of stable temperatures should be protected. Larger, more complex cave/mine systems have a wider range of stable temperatures than smaller hibernacula. Likewise, the range of temperatures available within hibernacula will likely vary across the geographic range of the Indiana bat. Protection of caves and mines with the widest possible range of environmental conditions in an area means that hibernacula are available to meet requirements of all individuals in a population (Boyles et al., 2007). We believe that the more modern management approach that we suggest is supported by the current understanding of the physiology, ecology, and behavior of hibernation, and we suggest that simplistic management of hibernacula, based on a single factor influencing hibernation, is harmful to bat conservation as a whole.

Literature Cited


