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Local concentration of foraging noctule bats (*Nyctalus noctula*) as a possible tool to assess the density of bats in large forest complexes

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Abstract: Concentrations of at least 600 hunting noctule bats *Nyctalus noctula* were observed over the artificial shallow reservoir Siemianówka in eastern Poland. The observation indicates that noctule bats concentrate hunting during the presence of vast amounts of insects over the reservoir. We suggest that the high concentrations of noctule bats provide a potential tool for the estimation of local population size or density in large forest complexes.

Key words: Aerial hawking bats, density of bats, breeding colonies, feeding grounds

High concentrations of bats are usually observed in the vicinity of caves that are inhabited by large colonies (Betke et al., 2008; Horn and Kunz, 2008). Concentrations of species that roost in smaller groups (such as tree-dwelling bats) and are distributed over a larger area are less common. Although mechanisms or conditions leading to such concentrations are not well understood, communal migration and/or feeding on large insect swarms might be the most common explanations (Safi and Kerth, 2007; Dechmann et al., 2009).

The nocturnal activity of bats means that visual counting is extremely difficult. Ultrasound monitoring is not reliable and only provides general information about bat activity. These methodological constraints make it difficult to count bats, and the presence of large concentrations can therefore be easily missed by observers. During our study, we observed concentrations of hunting noctule bats, *Nyctalus noctula*, feeding at the artificial shallow reservoir of Siemianówka (details below). The aim of this article is to describe possible reasons for such events and to evaluate their usefulness for estimation of bat density in nearby forests.

Our study took place on the edge of the shallow and eutrophic reservoir Siemianówka, situated in eastern Poland (52°55′19.09″N, 23°51′31.11″E, Figure 1). It contains 32.5 km^2 of water and is located on the edges of Białowieża Forest and Knyszyńska Forest (Figure 1). Observations started on 2 July 2012, just before sunset (2000 to 2100 hours) and in good light conditions. Bats were counted by experienced observers (MP, MB) 3–4 times in dozens using binoculars with a magnification of 10 × 50 (for the methodical details, see also NORDECO and DENR, 2001); however, not all individuals were counted due to the size of the reservoir and the decreased visibility of the most distant animals. Counted bats were clearly visible from the bank of the lake, mainly towards the east (Figure 1). Identification of noctule bats was based on hunting behavior, size, and photographic evidence. A second census was done on 13 July 2012 (all authors), first before sunset (2000 to 2100 hours) as described above. After sunset, echolocation calls were also recorded (Avisoft UltraSoundGate running Avisoft-Recorder software, sampling rate 384 kHz, 16 bit; Avisoft) and later analyzed in Sas Lab Pro. Visual observation, pictures, video records, and voice recordings confirmed observations of noctule bats (Obrist et al., 2004; Walters et al., 2012). Leisler's bats, *Nyctalus leisleri*, are also present in the region, and can be mistaken for noctule bats (Russo and Jones, 2002; Obrist et al., 2004; Ruczyński et al., 2010). However, discrimination based on QCF echolocation calls suggests that only noctule bats were observed.

The presence of insects was documented using a digital camera with flash (Sony DSC-HX7V), directed vertically toward the sky. Insects were clearly visible as white dots on the picture (Figure 2). Average daily temperatures were recorded to describe climatic conditions before and after

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Figure 1. Study area. Observation point (red dot) near Siemianówka Reservoir (blue). Buffer zones (5, 10, 15, 20, 25 km) for cover area from which bats may fly to Siemianówka Lake.

observations to evaluate possible reasons for the large aggregation of bats (data from the meteorological station IBS PAN, Białowieża).

Because noctule bats are able to fly long distances to feeding grounds more than 20 km away (Mackie and Racey, 2007), buffer zones around observation points were established at the radii of 5, 10, 15, 20, and 25 km (Figure 1). We calculated the area of the forest cover in each of these zones. Based on the forest cover and number of bats observed, we calculated the minimum density of bats for each zone and the possible range of density of noctule bats in forests near the Siemianówka Reservoir. Forest cover was measured in ArcGIS using satellite maps (Corine Land Cover Database, European Environment Agency, http://www.eea.europa.eu/).

The first census on 2 July 2012 counted approximately 600 noctule bats, compared to 300 during the second census. The large aggregation of bats was preceded by days with low ambient temperatures, which rose rapidly 3 days before the observation (Figure 3). At the time of observation, a vast number of swarming insects was also recorded, creating "chimney-like" aggregations (based on this typical behavior, most probably chironomid dipterans). During the second census, the temperature was lower (Figure 3), but bats also started hunting before sunset (around 15 min prior). There were no noticeable insect aggregations seen, but we still observed many insects in the air (Figure 2). Our observation indicates that noctule bats assemble for hunting during the appearance of vast numbers of insects over the reservoir. We suggest several complementary explanations for the unusual concentration of bats. Siemianówka Reservoir is a large, shallow, and nutrient-rich reservoir that may favor large concentrations of insects (Scheffer et al., 2006). The extremely high concentration of insects attracts bats from the neighboring forests, and possibly even from greater distances, because the potential ratio of benefits to commuting costs will be high. Species such as the fast-flying noctule bat, which hunts in open space and uses patchily distributed food resources, may benefit in particular (Rydell and Petersons, 1998). The beginning of July is an important period in their year, when energetic demands on females (still lactating) and juveniles (end of growth) are high (Speakman, 2008). Benefits of feeding in such locations therefore seem to be high. The activity of noctule bats even before sunset suggests high energetic demands during this period (Kunz et al., 1995). In this case, the low temperature observed before the first census could also have been important and may have increased the energy deficit; thus, the later concentration of bats in optimal food patches showed similar behavior to that of swallows (McCarty, 1997).

Figure 2. Insects (white dots) in camera flash at the observation point (lens directed vertically into the sky).

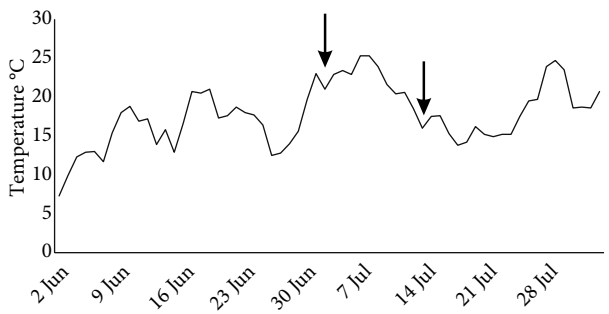

Figure 3. Fluctuation in daily temperature 1 month before and after the first observation (2 July 2012). Black arrows show dates of the first and second controls.

The average number of individuals in 1 roost tree in Białowieża Forest is estimated at 30 individuals (Ruczyński, unpublished data), which suggests that animals from as many as 20 colonies were hunting above the reservoir. Our observation provides evidence that food patches are utilized by many groups of noctule bats that are probably unrelated. The estimated minimum density of this species in forests varies from 0.55 ind./km^2 in a 25-km buffer to 24.8 ind./km^2 of forest in a 5-km buffer (0.82 ind./km^2, 20-km buffer; 1.63 ind./km^2, 15-km buffer; 3.89 ind./km^2, 10-km buffer). A density of 24.8 ind./km^2 seems to be high but is still much lower than noted for parks in urban areas, where there can be 24 individuals per hectare of forest (Červený and Bürger, 1989). Where the density equals 0.55 ind./km^2, individuals may be underestimated due to only a small fraction of bats being counted. Additionally, it is possible that not all bats living within a radius of 25 km commute to Siemianówka. We therefore suspect that the actual density of noctule bats is closer to 25 ind./km^2 than to 0.5 ind/km^2 of forest, which corresponds to the density observed by Gaisler et al. (1979) in Bohemia (Czech Republic). Current data nonetheless suggest that the density of noctule bats in large forest complexes is probably much lower than that observed in small, isolated parks (Červený and Bürger, 1989).

We conclude that the aggregation of noctule bats in one location was connected with the high concentration of available prey above the reservoir and the high energetic demands of bats during the lactation period. The importance of eutrophic reservoirs for the breeding success of noctule bats could therefore be greater than previously thought. We suggest that a census of noctule bats in places of their concentration could be a useful method for estimation of their population size.

References

Betke M, Hirsh DE, Makris NC, McCracken GF, Procopio M, Hristov NI, Tang S, Bagchi A, Reichard JD, Horn JW et al. (2008). Thermal imaging reveals significantly smaller Brazilian free-tailed bat colonies than previously estimated. J Mammal 89: 18–24.

Červený J, Bürger P (1989). Density and structure of bat community occupying an old park (Žihobce, Czechoslovakia). In: Hanák V, Horácek I, Gaisler J, editors. European Bat Research Symposium 1987. Prague, Czech Republic: Charles University Press, pp. 475–488.

Dechmann DKN, Heucke SL, Giuggioli L, Safi K, Voigt CC, Wikelski M (2009). Experimental evidence for group hunting via eavesdropping in echolocating bats. Proc R Soc Lond B Biol Sci 276: 2721–2728.

Gaisler J, Hanák V, Dungel J (1979). A contribution to the population ecology of *Nyctalus noctula* (Mammalia: Chirotera). Act Sci Nat Brno 13: 1–38.

Horn JW, Kunz TH (2008). Analyzing NEXRAD Doppler radar images to assess nightly dispersal patterns and population trends in Brazilian free-tailed bats (*Tadarida brasiliensis*). Integr Comp Biol 48: 24–39.

Kunz TH, Whitaker JO, Wadanoli MD (1995). Dietary energetics of the insectivorous Mexican free-tailed bat (*Tadarda brasilensis*) during pregnancy and lactation. Oecologia 101: 407–415.

Mackie LJ, Racey PA (2007). Habitat use varies with reproductive state in noctule bats (*Nyctalus noctula*): implications for conservation. Biol Conserv 140: 70–77.

McCarty JP (1997). Aquatic community characteristics influence the foraging patterns of tree swallows. Condor 99: 2010–2013.

NORDECO and DENR (2001). BMS Manual Supplement on Method for Counting Waterbirds. Manila, the Philippines: DENR, and Copenhagen, Denmark: NORDECO.

Obrist MK, Boesch R, Flückiger PF (2004). Variability in echolocation call design of 26 Swiss bat species: consequences, limits and options for automated field identification with a synergetic pattern recognition approach. Mammal 68: 307–322.

Ruczyński I, Nicholls B, MacLeod CD, Racey PA (2010). Selection of roosting habitats by *Nyctalus noctula* and *Nyctalus leisleri* in Białowieża Forest—adaptive response to forest management? Forest Ecol Manag 259: 1633–1641.

Russo D, Jones G (2002). Identification of twenty-two bat species (Mammalia: Chiroptera) from Italy by analysis of time-expanded recordings of echolocation calls. J Zool Lond 258: 91–103.

Rydell J, Petersons G (1998). The diet of the noctule bat *Nyctalus noctula* in Latvia. Z Saugetierkd 63: 79–83.

Safi K, Kerth G (2007). Natural history miscellany: comparative analyses suggest that information transfer promoted sociality in male bats in the temperate zone. Am Natural 170: 465–472.

Scheffer M, van Geest GJ, Zimmer K, Jeppesen E, Sondergaard M, Butler MG, Hanson MA, Declerck S, De Meester L (2006). Small habitat size and isolation can promote species richness: second-order effects on biodiversity in shallow lakes and ponds. Oikos 112: 227–231.

Speakman JR (2008). The physiological costs of reproduction in small mammals. Philos T R Soc B 363: 375–398.

Walters CL, Freeman R, Collen A, Dietz C, Fenton MB, Jones G, Obrist MK, Puechmaille S J, Sattler T, Siemers BM et al. (2012). A continental-scale tool for acoustic identification of European bats. J App Ecol 49: 1064–1074.