

A large maternity colony of 85 Bechstein's bats (*Myotis bechsteinii*) in an invasive tree, the red oak (*Quercus rubra*)

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The Bechstein's bat (*Myotis bechsteinii*, Kuhl 1818) is considered to be one of the rarest bat species in Flanders. The species is an outspoken woodland-specialist, and is regarded as an index species for old-growth deciduous forests (Schlapp 1990, Dietz & Pir 2009). The Bechstein's bat shows a complex social behaviour. During the summer breeding season, the sexes live separated from each other. The bats inhabit tree cavities (mostly old woodpecker holes) and, if present, artificial bat boxes (Baagøe 2001). Females form maternity colonies of generally 15 to 45 individuals and show almost complete natal philopatry (Kerth et al. 2002). Mitochondrial DNA shows that these colonies are closed societies, consisting of only a few matrilineal lines (Kerth & van Schaik 2012). Bechstein's bat colonies are complex fission-fusion societies, in which the colony splits up in subgroups of changing composition, that later merge again (Kerth & König 1999, Kerth et al. 2011). Colonies switch their day-roosts (on average) every 2-3 days and can use up to 50 different day-roosts (some of them frequently) during a summer season (Reckardt & Kerth 2007, Dietz & Pir 2011). Male Bechstein's bats live solitary and disperse during

their first year (Kerth et al. 2002).

The species is listed as 'endangered' on the Flemish Red list of threatened mammal species (Maes et al. 2014), and as 'near threatened' on the European Red list (Hutson et al. 2008), placing it among the most endangered European bats. Consequently, the Bechstein's bat is listed in the Annex II and IV of the European Habitat Directive. Member states must thus implement special conservation plans and protect habitats where the species is known to occur. Furthermore, member states are obligated to report on the distribution, population size and trend of this species every six years.

Until recently very little was known about the distribution or population size of the Bechstein's bat in Flanders. During a large field study in the southern part of Limburg in 2011, ten colonies were found by catching bats in ancient deciduous forests (during summer) and at swarming locations (early September), and tracking females to their day-roosts (Janssen & Dekeukeleire 2012). These are the only known colonies in Flanders. However, population numbers are still unclear.

One of the forest fragments where a Bech-

Table 1. Measurements, age and sex of the Bechstein's bat caught at the Nietelbroeken; fa = forearm length. The individual caught on 20 August 2013 was radio-tagged.

Capture date	Sex	fa (mm)	mass (g)	Age and breeding condition
19 August 2013	Female	44.6	10.2	Adult, post-lactating
19 August 2013	Female	43.5	9.8	Adult, post-lactating
19 August 2013	Female	42.8	11.2	Juvenile
19 August 2013	Female	43.6	6	Juvenile
20 August 2013	Female	42.6	9	Juvenile

stein's bat colony was found is the Nietelbroeken (figure 1). In 2011, a juvenile and an adult post-lactating female Bechstein's could be radio-tracked back to a cavity in a common ash (*Fraxinus excelsior*) in this nature reserve (Janssen & Dekeukeleire 2012). The Nietelbroeken is situated in Diepenbeek (Province of Limburg, Belgium) and consists of a small 25 ha deciduous forest, surrounded by grasslands and arable lands. The forest is one of the few ancient forests in the region (i.e. a forest fragment that has been continuously wooded since at least ca. 1775 (De Keersmaecker et al. 2001)). The forest stands are generally between 30 and 90 years old and are dominated by pedunculate oak (*Quercus robur*) and common ash, with an understory of hazel (*Corylus avellana*) and European hornbeam (*Carpinus betulus*). However, a considerable part of the tree layer consists of red oaks (*Quercus rubra*), planted for timber production. This tree species is an invasive alien in Belgium, and has a strong negative impact on the forest biodiversity, reducing the diversity of forest plants and arthropods (Gossner 2004, Branquart et al. 2007, Chmura 2013). Consequently, a management plan to eradicate the species is currently under preparation. However, cutting down old red oaks can potentially have negative effects for the conservation of species roosting in tree cavities. Red oaks show more cavities compared to native oaks of the same age, and older red oaks thus often contain tree cavities suitable for roosting bats (Lefevre 2011). Exact knowledge about the roost locations of bats is therefore of vital importance

for the conservation of the Bechstein's bat in this area.

In August 2013, a preliminary study was carried out to investigate the colony size and find day roosts of Bechstein's bats in the Nietelbroeken. On the 19th and the 20th of August, bats were caught using mist nets (Ecotone, Poland) and an acoustic lure (UltraSound-Gate Player-BL Light, Avisoft Gbr. Germany) at two different sites within the forest. Using an acoustic lure has been shown to improve capture rates (Hill & Greenaway 2005, Goiti et al. 2007). Five Bechstein's bats were caught (table 1), of which a juvenile individual was radio tagged with a 0.35 g VHF transmitter with a 12 cm antenna (Telemetrie-Service-Dessau, Dessau, Germany). The transmitter was attached onto the back of the bat using medical glue (Sauer Hautkleber 50.01, Manfred Sauer GmbH, Germany), and weighed less than 5% of the bat body mass, as advised by Aldridge & Bringham (1988).

The roost site of this bat was located the next day in a red oak in a mixed forest stand. The tree had an old woodpecker hole at the west side at a height of ca. 5 m (figure 2). On the evening of the 22th of August, emerging bats were counted using a night vision camera with an external IR-lamp (Sony SCR-SR90). We counted 85 emerging individuals (figure 4), which all could be visually identified as being Bechstein's bats. The first individual left the roost site at 21:07, 19 minutes after sunset. The tagged bat didn't use any other roosts in the four days the area was visited.

This group is one of the largest known colo-

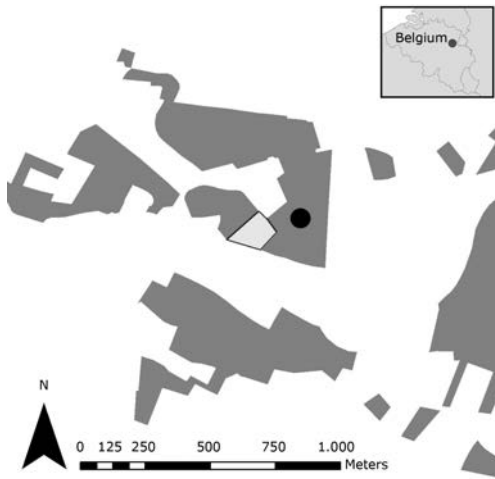


Figure 1. Map of the Nietelbroeken, showing the forest cover (dark grey), including the monotonous red oak stand (light grey). The roost site of the 85 Bechstein's bats is indicated by a black dot.

nies of the species in Western Europe. However, census counts of Bechstein's bat colonies are difficult. Due to the fission-fusion behaviour, i.e. the frequent splitting in subgroups that later merge again, the colony group is most often divided across several roost sites (Kerth et al. 2011). Thus, emerging counts of one roost do not necessarily give a correct estimate of the complete colony size. Furthermore, a part of the counted group most certainly consisted of juvenile bats. In one well-studied colony in the United Kingdom, over the last 14 years, an annual average of 57% of the females reared a young (C. Morris, personal communication).

But even if these factors are taken into account, the observed group is very large compared to other reported colony sizes for the species. Baagøe (2001) mentions maximum reported numbers of 47 to 51 individuals. In France, colonies of up to 80 individuals have rarely been observed (Arthur & Lemaire 2009). Dietz & Pir (2009) found twelve colonies in Luxembourg, with the number of females ranging between 20 and 70 individuals (mean 34 ± 18.1). In the United Kingdom numbers of 130 adult bats and 124 bats (adults

+ juveniles, in one Schwegler hibernation box) are reported (C. Morris and D. Whitby, personal communication).

The planned restoration of a 1.5 ha young (<50 years old) monotonous red oak stand (figure 3) to a structurally diverse forest stand with native tree species would indeed increase the area of suitable foraging habitat for Bechstein's bats. Red oaks exhibit a poor arthropod community with regard to activity, density and diversity in comparison to indigenous tree species, particularly in Coleoptera, Lepidoptera and Heteroptera (Gossner 2004, Csóka & Szabóky 2005, van Nieuwerkerken et al. 2012). These groups form an important part of the diet of Bechstein's bats (Siemers & Swift 2006, Wolz 2013). However, as our observation indicates, red oaks can be important roost sites for bats. We therefore strongly advise to first get a more precise insight in the currently used day-roosts of this colony.

In the event of forestry works care must be taken to avoid direct casualties by monitoring which roosts are occupied by bats before and during these works. The removal of old trees of invasive species from a forest should preferentially be spread over multiple years. In this particular case, we do not expect the number of (potential future) roost sites to decline strongly with the planned restoration. The forest stand in question is young (<50 years), and many old trees (both native species and red oaks) are present in the mixed stands in the other parts of the forest.

Our finding shows that, despite their negative impact on the forest biodiversity, invasive tree species such as the red oak can be important roost sites for threatened bat species. Managers must take this into account, and examine the impact on the local bat populations before cutting down invasive tree species.

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Figure 2. The Bechstein's bat roost (indicated by a black arrow) in a red oak and the surrounding mixed forest. *Photo: René Janssen.*



Figure 3. This monotonous stand of red oak in the Nietelbroeken is planned to be restored to a more diverse forest stand with native tree species. *Photo: René Janssen.*

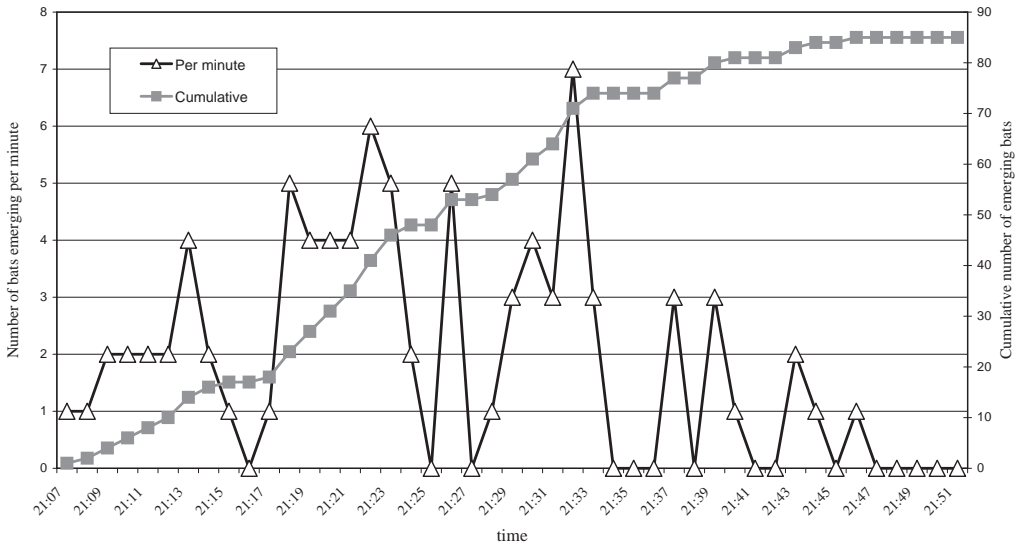


Figure 4. The emergence (per minute and cumulative) of Bechstein's bats on the evening of 22 August 2013.

gian) province of Limburg (Likona). We would like to thank Colin Morris (The Vincent Wildlife Trust) and Bram Conings for their help with the fieldwork. Jos Ramaekers (Natuurpunt), Luc Crevecoeur (Likona) and Kris Boers (Natuurpunt) are thanked for their kind cooperation. Furthermore, we would like to thank the two anonymous reviewers for useful comments on the first draft of the manuscript.

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Samenvatting

Vondst van een grote kolonie van 85 Bechsteins vlemuisen (*Myotis bechsteinii*) in een Amerikaanse eik (*Quercus rubra*), een invasieve exoot

De Bechsteins vlemuis is één van de zeldzaamste vlemuissoorten in Vlaanderen. Eén van de tien gekende kolonies in Vlaanderen bevindt zich in De Nietelbroeken (Diepenbeek, Limburg). Dit bosgebied bestaat voornamelijk uit zomereik en es. Een deel bestaat echter ook uit Amerikaanse eiken, een invasieve exoot met negatieve invloed op flora- en arthropodendiversiteit. Er zijn dan ook plannen om dit deel om te vormen tot een gemengd loofbos met inheemse soorten. Het kappen van oude Amerikaanse eiken kan echter nega-

tieve gevolgen hebben voor vleermuizen die deze boomsoort als verblijfplaats gebruiken. In 2013 werd, om dit aspect beter te kunnen beoordelen, een verkennend onderzoek uitgevoerd. De verblijfplaats bevond zich in een oud spechtengat in een Amerikaanse eik, in een gemengd bosperceel. De volgende avond konden 85 uitvliegers geteld worden, hetgeen deze kolonie tot één van de grootste gekende kolonies van de Bechsteins vleermuis in West-Europa maakt. De geplande omvorming van monotone percelen Amerikaanse eik zal het jachtgebied van de vleermuizen uit-

breiden, aangezien inheemse boomsoorten meer insecten huisvesten, zowel naar diversiteit toe als naar abundantie. Beheerders moeten echter rekening houden met de rol van Amerikaanse eiken als verblijfplaats voor vleermuizen. Bij het omvormen van bosbestanden met exoten alsmede bij het kappen van geïsoleerd staande exoten wordt daarom geadviseerd eerst de invloed van deze kapwerken op de lokale vleermuispopulaties te onderzoeken.

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