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Report of the IWG on Conservation and Management of Critical Feeding Areas and Commuting Routes

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Terms of reference
Referring to the resolution 4.9, point 4: Foraging habitats; to produce a synthesis of methods used to study the critical feeding areas and commuting routes and to produce guidance for the national guidelines for bat habitat conservation.

Work carried out after the 14th AC meeting
Since the last advisory committee meeting the working group has prepared the species accounts part of the guidance document. Most species are now covered. Writing of the general parts of the guidance has been started as well, though several chapters are still to be completed. Draft version of the guidance is attached to this report.

Work to be carried out
The working group needs to write the remaining parts of the guidance and produce tables to summarize findings from the species accounts. Recommendations concerning the usage of antiparasitic drugs for livestock and their effects to bat prey and how this information could be included in the guidance document will be discussed with the working group dealing with antiparasitic drugs. A resolution to be presented to the Meeting of Parties was prepared in the AC15.

DRAFT: Guidance document on conservation and management of critical feeding areas

1. Introduction

World-wide, habitat loss has been identified as the single most important cause of biodiversity loss. Whilst much attention focuses on global biodiversity hot-spots, such as tropical rain forest and coral reefs, it is unfortunately true that biodiversity loss continues even in Europe, where much of the landscape is already heavily influenced by human activities. Farming and forestry are by far the largest land-users in Europe and thus their wise use of land is very important in global and national efforts to halt and reverse biodiversity loss. In addition, the development of the built environment and its associated infrastructure, such as the road network, can have a significant impact on biodiversity, not only through direct land-take but also through less obvious effects such as light and noise pollution, disturbance and alterations to the local climate.

Bats are an important component of mammalian biodiversity in Europe, second only to rodents, and have certainly suffered declines in the past, though the historical lack of interest in these species means that we have very little information about past populations. As long-lived, slow-breeding species at the top of the food chain, they are quite vulnerable to environmental change and can recover only slowly from population crashes. In addition, their colonial habits make them unusually vulnerable to both natural disasters and human persecution, as a large proportion of the local population can be found together in one place at certain times of the year.

Until recently, much conservation effort for bats focused on protecting their roosting sites, as these are where bats are at their most vulnerable to disturbance or persecution. There is also some evidence, from studies on artificial roosts, that a lack of suitable roosting sites can be a limiting factor for some bat populations, particular those species with specialist roosting requirements. Eurobats has already published guidance on the conservation and management of bat roosts in a variety of situations.

However, protecting bat roosts alone is not enough to ensure the conservation of bat populations. Outside the roost, bats need suitable habitats where they can hunt and find sufficient food of the right sort, as well as routes that allow them to travel between roost and hunting areas. Until quite recently, very little was known about the movement of bats beyond the roost, but this knowledge gap has been changed dramatically by the development of bat detectors, radiotracking and other technical devices. These new research methods have allowed us to follow bats from their roost and determine how far they fly and the sorts of habitats they need for hunting. Our knowledge of the needs and habits of individual species is increasing all the time and we are now in a position to be able to offer some advice about the conservation and management of bats' feeding areas.

This guidance, which draws on the latest scientific information, should help foresters, farmers and other land-managers to take the needs of bats into account during their operations and so make a positive contribution to the conservation of these threatened animals. It should also help regulatory authorities ensure that agriculture and forestry regulations and support schemes are designed in such a way as to ensure the conservation of these protected species. As this guidance is intended to cover the whole of the Eurobats area, it may need supplementing with national guidance which takes local farming and forestry practices into account and ensures that the guidance is locally relevant.

2. Why conserve and manage bat habitats

The need to conserve bats as an important component of biodiversity is widely recognised and bats are now legally protected by every Eurobats Party and Range State. Although it has taken time to change, many countries can now report more favourable public attitudes to bats, though some problems remain. In many European countries, for example all EU Member States, the bats' roosts are also protected, though this protection rarely extends much beyond the roost and its immediate vicinity.

As major predators of insects and other invertebrates, the health of our bat populations is a good indicator of the health of our countryside; fewer flying insects means fewer bats. Their value as an indicator of biodiversity is already recognised in the UK and they may soon be adopted as an indicator at the EU level.

Bat use a wide variety of habitats, both natural and managed, to hunt in, though some are clearly more important than others. As bats can be found almost everywhere, strictly protecting their foraging habitats, which could include both farmland and villages, is not a practical option in most cases, though bats do benefit from the protection of habitats for other reasons, such as National Parks. If bats are to survive as an important component of biodiversity, other mechanisms must be used to ensure that the habitats they use for hunting and the linkages they use to move across the countryside are maintained in good condition.

3. What is an important feeding area or commuting route

to be completed

4. How to protect important feeding habitats?

to be completed

5. Species by species guidance

Egyptian fruit bat (*Rousettus aegyptiacus)*

Naked-rumped tomb bat (*Taphozous nudiventris*)

Feeding habitats and areas

Foraging areas and habits are unknown. They hunt at a considerable height and over a fairly straight and constant trajectory. The main information on diet come from Rajasthan (Advani 1980) where there are huge seasonal variations. Winter: Coleoptera (53.4%), Dictyoptera, Orthoptera; Summer: Coleoptera (16.2%), winged Isoptera, Lepidoptera, Orthoptera, Hymenoptera, Neuroptera. Monsoon: winged Isoptera, Coleoptera, Dctyoptera, Lepidoptera. Post-monsoon: Coleoptera (38.7%), Dictyoptera, Orthoptera. They forage on the cotton worm *Spodoptera littoralis* in July - August in Egypt (Madkour 1977).

Critical feeding areas

Unknown.

Commuting routes

Naked-rumped tomb bats display swift, strong and usually high flight, they are thought to travel considerable distances from their roost when hunting (Harrison & Bates 1991).

Conservation and management of critical feeding areas

References

Advani, R., 1980. Observations on feeding ecology and behaviour of the Kutch sheath tailed bat, Taphozous kachhensis kachhensis in Rajasthan. Z. angew. Zool., 67(3) : 279-285.

Harrison, D.L. & Bates, P.J.J., 1991. The Mammals of Arabia. Harrison Zool. Mus., Sevenoaks, 354p.

Madkour, G., 1977. Further observations on bats (Chiroptera) of Egypt. Agr. Res. Rev., 55 : 173-184.

Blasius's horseshoe bat (*Rhinolophus blasii)*

to be completed

Mediterranean horseshoe bat (*Rhinolophus euryale*)

Feeding habitats and areas

Mediterranean horseshoe bats typically hunt in structurally heterogeneous broadleaved woodlands and forests as well as riparian vegetation (Russo et al., 2002; 2005), where they often feed on small moths – but other prey may seasonally become important (Goiti et al., 2004). They seem well adapted to foraging in mosaic landscapes, such as those made of woodland patches interspersed with olive groves (Russo et al., 2002), or edge habitats such as hedgerows and woodland edges (Goiti et al., 2008). Although plantations of broadleaved trees (*Eucalyptus*) may be used for foraging (Russo et al., 2005), those of conifers are typically avoided (Russo et al., 2002).

Foraging distances vary largely according to productivity of available habitats, sex, age class and reproductive season. Lactating females have been found to move more than non-lactating ones to reach their foraging sites. In optimal landscapes of Southern Italy, distances up to 5 km are recorded during lactation, with a mean distance of 2.2 km (Russo et al., 2002). Longer maximum distances, of ca. 9 km, have been measured in the Iberian peninsula (Russo et al., 2005; Goiti et al., 2006), and more recently in France (13 km, Némoz & Brisorgueil. 2008). Males have been found to move less to reach foraging areas (mean 1.9 km; Goiti et al., 2006), but this may be due to more frequent roost switching which may increase proximity to favoured feeding habitat. Newly volant juveniles flow on average 2.6 km (Goiti et al., 2006).

Critical feeding areas

Broadleaved woodland, mosaic landscapes of woody vegetation, riparian vegetation

Commuting routes

Mediterranean horseshoe bats follow hedgerows and other natural linear landscape features (e.g. vegetation corridors, riparian vegetation) as commuting landmarks. They detour to avoid urban settlements and lit up areas.

Conservation and management of critical feeding areas

- attention paid especially to management of areas within 5-10 km from nursing roosts
- avoid reforestation with conifers – prefer broadleaved species, particularly those native to the area

- avoid interruption of critical commuting routes by limiting growth of urban areas, roads and illumination
- favour traditional management of agricultural landscapes and avoid pesticide spreading by encouraging e.g. traditional or organic farming
- favouring landscape heterogeneity does not mean encouraging fragmentation! Habitat corridors, hedgerows, tree lines, stepping stones and in general a high landscape connectivity should be preserved.

References

Goiti, U., Aihartza, J. & Garin, I. 2004: Diet and prey selection in the Mediterranean horseshoe bat Rhinolophus euryale (Chiroptera, Rhinolophidae) during the pre-breeding season. – Mammalia 68: 397-402.

Goiti, U., Aihartza, J. R., Almenar, D., Salsamendi, E. & Garin, I. 2006: Seasonal foraging by Rhinolophus euryale (Rhinolophidae) in an Atlantic rural landscape in northern Iberian Peninsula. – Acta Chiropterologica 8: 141-155

Goiti, U., Garin, I., Almenar, D., Salsamendi, E. & Aihartza, J. R. 2008: Foraging by Mediterranean horseshoe bats (Rhinolophus euryale) in relation to prey distribution and edge habitat. – Journal of Mammalogy 89: 493-502.

Némoz, M. & Brisorgueil, A., 2008. Connaissance et conservation des gîtes et habitats de chasse de 3 Chiroptères cavernicoles. S.F.E.P.M., Toulouse, 104p.

Russo, D., Jones, G. & Migliozzi, A. 2002: Habitat selection by the Mediterranean horseshoe bat, in a rural area of southern Italy and implications for conservation. – Biological Conservation 107: 71-81.

Russo, D., Almenar, D., Aihartza, J., Goiti U., Salsamendi, E. & Garin, I. 2005: Habitat selection in sympatric Rhinolophus mehelyi and R. euryale (Chiroptera: Rhinolophidae) in Spain. - Journal of Zoology, London 266: 327-332.

Greater horseshoe bat (*Rhinolophus ferrumequinum*)

Feeding habitats and areas

Greater horseshoe bats hunt in traditional natural landscapes around their maternity colonies. While in the UK the species seems to prefer to a large percentage cattle grazed pastures with hedgerows as feeding habitats (Duvergé & Jones 1994, Duvergé 1994, Ransome & Hutson 2000), the species shows in Central and Western Europe beside the use of extensive used green land a higher preference to broadleaved forest habitats and broadleaved forest edges, extensive orchards, hedges and riparian vegetation. Arable land is avoided. (ASHG 1994, Pir 1994, Pir et al 2004).

The mean foraging distances are varying with the physiological reproductive status, the age and foraging strategy of the bats as with the seasons and weather conditions. Greater horseshoe bats may forage from the immediate surroundings of the colony up to a radius of 14 km radius around the maternity roost (Duvergé 1996). In the UK the mean hunting areas seem to be at a greater distance to the colony. In Central and Western Europe the mean foraging distances for juveniles was 1,8 km and for lactating females up to 4,5 km from the maternity roost (Pir et al. 2004).

In one night a female greater horseshoe bat can visit up to 2-11 different hunting areas (mean size 6-7ha) (Ransome & Hutson 2000, Bontadina 2002) using different hunting strategies. The presence of a great number of night roosts seems to be important in rhinolophoid bat species.

Critical feeding areas

Broadleaved woodland, broadleaved woodland edges, hedges, orchards, cattle grazed pasture, extensive meadows, scrubs and riparian vegetation

Commuting routes

Greater horseshoe bats are using natural linear landscape features as hedges, tree rows, orchards, forest edges and forest tracks and riparian vegetation for commuting flight to their foraging areas. Streets are crossed at a low height of approximate 0,80-1m. Greater horseshoe bats prefer crossing streets and places with a closed tree canopy.

Conservation and management of critical feeding areas

- Special conservation management measures within urban areas of nursing colonies up to a radius of 1,8 km to enhance insect availability for juveniles
- Conservation management measures (extensive cattle grazing …) within a radius of 4.5 km (up to 12km for the UK) to enhance insect availability for lactating females
- Coniferous forests should be transformed in broadleaved habitats within the foraging areas of greater horseshoe bats
- Preservation of broadleaved forest edges, orchards and hedges with hanging branches for perch hunting
- Avoid interruption of critical commuting routes by limiting growth of urban areas and roads bypasses
- Conveying the transformation of arable land in extensive pastures and meadows
- Favour traditional management of agricultural landscapes and avoid pesticide spreading by encouraging e.g. traditional or organic farming
- Favouring landscape with a high natural heterogeneity: habitat corridors, hedgerows, tree lines and other natural stepping stones and in general high landscape connectivity should be preserved.
- Avoid the use of ivermectin or similar products as antiparasitic drugs in cattle stock farming within the hunting areas to preserve the coprophageous fauna of dung

References

Arbeitsgruppe zum Schutz der Hufeisennasen Graubündens (ASHG) (1994): Jagdhabitatwahl und nächtliche Aufenthaltsgebiete der Grossen Hufeisennase (*Rhinolophus ferrumequinum*) im Raum Castrisch/GR. - Unveröff. Bericht ASHG, Sagogn, Schweiz: 102pp.

Bontadina, F.; A. Beck; S. Gloor; T. Hotz; M. Lutz & Mühlethaler E. 1995: Jagt die Große Hufeisennase *Rhinolophus ferrumequinum* im Wald? - Grundlagen zum Schutz von Jagdgebieten der letzten größeren Kolonie der Schweiz. - Der Ornithologische Beobachter **92**: 325-327.

Bontadina, F.; T. Hotz; S. Gloor; A. Beck; M. Lutz & E. Mühlethaler (ASHG) 1997: Schutz von Jagdgebieten von *Rhinolophus ferrumequinum*: Umsetzung einer Telemetrie-Studie in einem Alpental der Schweiz. - Tagungsband: ‚Zur Situation der Hufeisennasen in Europa' Nebra 26.-28. Mai 1995; IFA Verlag: 33-39.

Bontadina, F. 2002: Conservation ecology in the horseshoe bats *Rhinolophus ferrumequinum* and *Rhinolophus hipposideros*. – PhD thesis University of Bern (CH).

Duvergé, P.L. 1996: Foraging activity, habitat use, development of juveniles and diet of the greater horseshoe bat (*Rhinolophus ferrumequinum* Schreber 1774) in south-west England. – Dissertation University of Bristol: 310pp.

Duvergé, P.L. & Jones G. 1994: Greater horseshoe bats - Activity, foraging behaviour and habitat use. - British Wildlife **6**: 69-77.

Pir, J. 1994: Etho-ökologische Untersuchung einer Wochenstubenkolonie der Grossen Hufeisennase (*Rhinolophus ferrumequinum* Schreber, 1774) in Luxemburg. – Diplomarbeit J.-L. Universität Giessen: 90pp.

Pir, J.B. & Brinkmann, R. & P. Boye P. 2004: Grosse Hufeisennase - *Rhinolophus ferrumequinum* (SCHREBER, 1774). In: Das europäische Schutzgebietssystem Natura 2000. - Ökologie und Verbreitung von Arten der FFH-Richtlinie in Deutschland. Band 2; Wirbeltiere. Schriftenreihe für Landschaftspflege und Naturschutz, Bonn, Heft 69/Bd 2: 593-601.

Ransome, R.D. & Hutson, A.M. 2000: Action Plan for the Conservation of the Greater horseshoe bat in Europe (*Rhinolophus ferrumequinum*). – Nature and Environment 109, Council of Europe, Strasbourg: 53pp.

Ransome, R.D. 1996: The Management of Feeding Areas for the Greater horseshoe Bats. – English Bature Research Report **174**, English Nature, Peterborough: 74pp.

Ransome, R.D. 1997: The management of greater horseshoe bat feeding areas to enhance population levels. - English Nature Research Reports No 241, Lowlands Team, English Nature: 63pp.

Lesser horseshoe bat (*Rhinolophus hipposideros)*

Foraging habitats and areas

The Lesser horseshoe bat is a true forest bat (Bontadina *et al* 2002; Reiter 2004). It forages in all types of woodlands, even coniferous ones, with a clear preference for deciduous and riparian forests, along hedgerows and tree lines, and also along edges of pond and lakes when they are lined by vegetation.

Mean foraging areas: 12 km² for 50-100 individuals (Roué & Barataud 1999); 6,3 ha/ind. (Beuneux *et al.* 2008)

The distance of foraging areas from the nursery roost varies from a few hundred meters up to 8 km (Schofield 1996; Beuneux *et al.* 2008) but it is usually between 1 and 2,5 km.

Critical feeding areas

Riparian woodlands, wooded ravines and a network of habitats with deciduous woods, interspersed with ponds or brooks, small pastures, scrubs and hedgerows).

Commuting routes

The Lesser horseshoe bat commutes always along linear features such as rivers, ravines, hedgerows and tree lines to avoid predators. These features need to be linked to the roost. It may cross open land but only under cover of darkness.

Conservation and management of critical feeding areas

- Roosts must be connected to foraging habitats by linear protecting structures (hedges, tree lines). The conservation of these features or the plantation of new ones is necessary.
- Avoid fragmenting foraging habitats.
- To avoid cutting off commuting routes, unlit passages should be provided either over the road (green bridges) or under it (tunnel).
- Maintenance of a traditional land use (small pastures, extensive crops and orchards).
- Conserve night roosts near feeding areas (Knight & Jones 2009).

References

Beuneux G., Levadoux D. & Dubos T. (2008). Le Petit rhinolophe (*Rhinolophus hipposideros*) en Corse : bilan de 3 années d'étude de ses territoires de chasse par suivi télémétrique. *Symbioses* (N.S.) 21 : 41-49.

Bontadina F., Schofield H. & Naef-Daenzer B. (2002). Radio-tracking reveals that lesser horseshoe bats (*Rhinolophus hipposideros*) forage in woodlands. J. Zool. 258: 281-290.

Knight T. & Jones G. (2009). Importance of night roosts for bat conservation: roosting behaviour of the lesser horseshoe bat *Rhinolophus hipposideros*. Endangered Species Research, preprint online.

Reiter G. (2004). The importance of woodland for lesser horseshoe bats *Rhinolophus hipposideros* in Austria. Mammalia 68: 403-410

Roué S. & Barataud M. (coord.), (1999). Habitats et activité de chasse des Chiroptères menacés en Europe : synthèse des connaissances actuelles en vue d'une gestion conservatrice. Le Rhinolophe, vol. spec .2 : 5-17.

Schofield H. W. (1996). The ecology and conservation of *Rhinolophus hipposideros* the Lesser horseshoe bat. Ph. D. Thesis, Univ. Aberdeen: 198 p.

Mehely's horseshoe bat (*Rhinolophus mehelyi*)

Feeding habitats and areas

Foraging habitats of Mehely's horseshoe bats include a variety of woodlands that differ structurally, from open savannah-like woodlands to dense broadleaved and riparian forests. Traditional olive groves and eucalyptus plantations may temporally be important foraging habitats (Rainho 2005, Russo et al. 2005, Salsamendi 2010). Foraging activity seems closely related with habitat patches associated with water, sites where abundance of moths is higher – the main prey of Mehely's horseshoe bats (Rainho 2007, Salsamendi et al. 2008, Salsamendi 2010). Foraging areas and foraging distances differ largely between individuals, probably according to the availability of profitable foraging habitats around roosting sites. Mean foraging distances during lactation vary from 3.3 km to 19.2 km. Maximum individual foraging distances of 29 km have been recorded in southern Iberian Peninsula (Rainho 2005, Salsamendi 2010). Mean foraging areas range from 0.6 km^2 to 4.5 km^2 (Russo et al. 2005, Salsamendi 2010).

Critical feeding areas

Woodlands with diverse structural complexity and close to water bodies near nursing roosts, should be strictly protected.

Commuting routes

Mehely's horseshoe bats commute mainly by following rivers and valleys, flying through or near to riparian vegetation, woodlands edges and tree lines.

Conservation and management of critical feeding areas

- attention should be paid especially to management of areas within 12-15 km from nursing roosts.
- promote landscape diversity favouring woodland types with diverse structural complexity.
- promote the development of natural landscape linear elements as commuting routes to reach profitable foraging habitats.
- preservation or construction of a net of small water bodies (e.g. wetlands) near nursing roosts should be contemplated in threatened populations.

- avoid the use of pesticides and insecticides in foraging areas and encourage traditional land management.

References

Rainho, A. 2005: How does land use change affect colonial bats? A methodology to compare alternative land use scenarios. –MSc Thesis, School of GeoSciences, Edinburgh. 33 pp.

Rainho, A. 2007: Summer foraging habitats of bats in a Mediterranean region of the Iberian Peninsula. – Acta Chiropterologica, 9: 171-181.

Russo, D., Almenar, D., Ahiartza, J., Goiti, U., Salsamendi, E. & Garin, I. 2005: Habitat selection in sympatric Rhinolophus mehelyi and R. euryale (Mammalia: Chiroptera). – Journal of Zoology, London, 266: 327-332.

Salsamendi, E., Garin, I., Almenar, D., Goiti, U., Napal, M. & Aihartza, J. 2008: Diet and prey selection in Mehely's horseshoe bat Rhinolophus mehelyi (Chiroptera, Rhinolophidae) in the south-western Iberian Peninsula. Acta Chiropterologica, 10: 279-286.

Salsamendi, E. 2010: Foraging Ecology in the Mehely's Horseshoe Bat: from Resource Preferences to Competitive Interactions. PhD Thesis, University of the Basque Country, Leioa. viii + 99 pp.

(Western) Barbastelle bat (*Barbastella barbastellus*)

Feeding habitats and areas

Often roosting in mature forest stands (Russo et al., 2004; 2005), the barbastelle bat is quite flexible in terms of foraging preferences. Although forest remains a chief foraging habitat (Sierro and Arlettaz, 1997; Sierro, 1999), vegetation edges and mosaics as well as wetland are also frequently used (Russ, 1999). Forages and commutes above canopy, ca 2-4 m above tree crowns (Sierro and Arlettaz, 1997), but may also forage below it, along forest trails and roads, as well as in forest gaps (D. Russo, pers. obs.). A fast species, may cover long distances in short times. In the UK, foraging sites have been recorded at maximum distances of over 25 km from roosting areas (Warren, 2008). Even 4-week juveniles may fly 7 km from their roosts (Warren, 2008). Individual home ranges recorded in Switzerland averaged 8.8 ha, but according to long commuting distances recorded elsewhere, it is likely that home ranges may be locally much wider. Avoids open woodland on stony outcrops and rocky slopes, human settlements and open habitats such as meadowland (Sierro and Arlettaz, 1997; Sierro, 1999).

Critical feeding areas

Richly structured forests, wooded riparian valleys.

Commuting routes

Although it may cross open areas, forest corridors and edges seem important as commuting landmarks.

Conservation and management of critical feeding areas

- Large areas of highly structured forest should be preserved
- Unmanaged forest patches with numerous dead trees should be retained in forested landscapes or near wetland to favour proximity between foraging and roosting quarters
- Tall riparian vegetation should be carefully preserved

- Forest continuity should be favoured by promoting corridors connecting networks of important sites
- Although the available information on distances travelled and home range size is far from sufficient, there is evidence that long distances are covered, so management of foraging sites should take place within at least 10 km from main roosting areas or more
- Preserve small ponds, cattle troughs and other water sources in forest, along its edges as well as in pastures bordered by woody vegetation: these are frequently used by barbastelles for drinking.

References

Russ, J. 1999: The Bats of Britain and Ireland. Echolocation calls, sound analysis, and species identification. – Powys: Alana Books.

Russo, D. 2003: Dead trees mean life to Italian barbastelle bats. – Ecologia Mediterranea 29: 258-260.

Russo, D., Cistrone L., Jones G. & Mazzoleni S. 2004: Roost selection by barbastelle bats (Barbastella barbastellus, Chiroptera: Vespertilionidae) in beech woodlands of central Italy: consequences for conservation. – Biological Conservation 117: 73-81.

Russo, D., Cistrone L. & Jones, G (2005). Spatial and temporal patterns of roost use by tree-dwelling barbastelle bats, Barbastella barbastellus. – Ecography 28: 769-776.

Sierro, A. 1999: Habitat selection by barbastelle bats (Barbastella barbastellus) in the Swiss Alps. – Journal of zoology, London 248: 429-432.

Sierro, A. & Arlettaz, R. 1997: Barbastelle bats (Barbastella barbastellus) specialize in the predation of moths: implications for foraging tactics and conservation. – Acta Oecologica 18: 91-106

Warren, J. 2008. The tree bat. – Eweb magazine issue 16 (available at www.ewebmagazine.co.uk)

Eastern barbastelle bat (*Barbastella leucomelas)*

Eptesicus bottae

Northern bat (*Eptesicus nilssonii*)

Feeding habitats and areas

Northern bats are highly flexible in their foraging behaviour. Habitats include farmland as well as forest, where they fly in open spaces like forest glades and clear cuts, along forest edge and tree lines, and over water and along riverine tree stands; also in urban parks and suburban gardens. The densest populations occur where the foraging habitat is most diverse, such as in small farmland areas with deciduous woodlands, and near lakes (Rydell 1993). Large open fields, pastures and young spruce plantations are avoided as feeding habitat (Rydell 1986a). The flight path while hunting is typically straight or slightly curved at a height of 5–10 m, often at tree top height, but ranging from 2 to more than 50 m (Rydell 1993). Females often establish small (about 100 m^2) feeding territories in places where insects are abundant, for example along forest edge or around isolated trees in open farmland, which are used by the same individual night after night (Rydell 1986b, 1993). Females mostly hunt close to the colony (within 600

m), and utilize lakes and wetlands in particular. When insect density decreases they may shift to hunting sites up to 4–5 km from the colony. After weaning, they can fly probably more than 30 km to visit deciduous woodland and eutrophic lakes (de Jong 1994). In spring and late summer/autumn northern bats often hunt for insects near artificial light sources such as street lights (Rydell 1991, 1992).

Critical feeding areas
Water bodies, deciduous forest near water and other areas with high insect abundance within 5 km of colonies are important for lactating females, particularly in regions with otherwise low insect production such as the boreal coniferous forest (de Jong & Ahlén 1991, de Jong 1994).

Commuting routes
Linear landscape elements is relatively unimportant, and northern bats often take the shortest route between hunting sites or between roosts and hunting sites (de Jong 1994).

Conservation and management of critical feeding areas
Attention should be paid especially to management of areas with high insect production within a distance of 5 km from maternity colonies.

References

de Jong, J. 1994. Habitat use, home-range and activity pattern of the northern bat, Eptesicus nilssoni, in a hemiboreal coniferous forest. – Mammalia 58(4): 535–548.

de Jong, J. & Ahlén, I. 1991. Factors affecting the distribution pattern of bats in Uppland, central Sweden. – Holarctic Ecology 14(2): 92–96.

Rydell, J. 1986a. Foraging and diet of the northern bat Eptesicus nilssoni in Sweden. – Holarctic Ecology 9(4): 272–276.

Rydell, J. 1986b. Feeding territoriality in female northern bats, Eptesicus nilssoni. – Ethology 72: 329–337.

Rydell, J. 1991. Seasonal use of illuminated areas by foraging northern bats Eptesicus nilssoni. – Holarctic Ecology 14(3): 203–207.

Rydell, J. 1992. Exploitation of insects around streetlamps by bats in Sweden. – Functional Ecology 6(6): 744–750.

Rydell, J. 1993. Eptesicus nilssonii. – Mammalian Species 430: 1–7.

Serotine bat (*Eptesicus serotinus)*

Feeding habitats and areas
The serotine bat can be defined as an edge and open area specialist. It is well able to glean insects from vegetation or the ground, but the predominant foraging strategy is aerial hawking. It usually forages close around trees, particularly the canopy, often touching the vegetation. In open pasture it can fly close to the ground or up to 20 m, with sudden steep dives. The species often feeds along roads and around street lamps. The distance to foraging sites can be as far as 5-7 km, but usually they spent around 90 % of their foraging time at distances below 2 km from the maternity roost. A high percentage of traditional feeding sites is used by the colonies in subsequent years (Catto et al., 1996; Harbusch, 2003; Kervyn 2001).

Faecal analyses of the serotine bat in different parts of its european distribution area showed that this bat forages predominantly for Coleoptera (e.g. *Aphodius,* Melolonthinae, *Necrophorus*), Lepidoptera, Diptera, Trichoptera, Hemiptera and Hymenoptera (Beck, 1995; Catto et al., 1994; Gerber et al., 1996; Kervyn, 2001; Labee & Voûte, 1983; Robinson & Stebbings, 1993). In all studies, dung beetles (and other dung fauna) are of major importance to this (and other) bat species.

Serotine bats select their foraging habitats according to the absolute densities and variety of their preferred prey taxa. These main prey taxa are associated with semi-open and open habitats such as meadows and cattle pastures with tree groups, hedges or woodland edges (Harbusch, 2003).

Critical feeding areas:
The most important feeding areas are those in a distance of up to 2 km around the maternity roost, since lactating females need abundant and preferred food at close distance. These are usually unimproved pastures with tree groups or hedgerows, as well as deciduous woodlands in a mosaic with grassland.

Commuting routes:
The importance of commuting routes is not as high as is smaller species since the serotine bat is able to fly straight and in higher altitudes (up to 50 m) to their foraging grounds. However linear landscape elements such as hedgerows are used when available as commuting route.

Conservation and management of critical feeding habitats
1. The conservation of unimproved, permanent and extensively used pasture in a radius of up to 2 km around the roost is vital for the survival of adults and juvenile serotine bats of a maternity colony. Grassland management should best be organic, thus avoiding pesticide use.
2. Park-like landscape structures such as tree groups within grassland or extensively used orchards should be promoted to increase the sources of key insect prey taxa. The use of insecticides in orchard management should be discouraged.
3. Deciduous woodlands, especially those close to maternity colonies, should be conserved and promoted. Coniferous stands should be replaced by deciduous trees. Woodland borders adjacent to grassland should include a broad range of locally characteristic shrubs. Clearings within woodlands should be left to natural succession, thus enhancing the growth of flowering plants.
4. The use of avermectins on cattle on pasture close to the maternity roost should be restricted to early spring and autumn, when the animals are confined.
5. Local planning of green spaces within settlement areas should promote unbuilt areas, such as gardens, parks or fallow land.
(Harbusch, 2003, Kervyn, 2001; Robinson & Stebbings 1994, 1997)

References:

Beck, A. (1995): Fecal analyses of european bat species. – Myotis 32/33: 109 – 119.

Catto, C.M.C., Hutson, A.M., P.A. Racey (1994): The diet of Eptesicus serotinus in southern England. – Folia Zool. 43: 307 – 314.

Catto, C.M.C., A.M. Hutson, P.A. Racey, P.J. Stephenson (1996): Foraging behaviour and habitat use of the serotine bat (Eptesicus serotinus) in southern England. – J. Zool. Lond. 238: 623 –633.

Gerber, E., M. Haffner, V. Ziswiler (1996): Vergleichende Nahrungsanalyse bei der Breitflügelfledermaus Eptesicus serotinus (Schreber, 1774) (Mammalia: Chiroptera) in verschiedenen Regionen der Schweiz. – Myotis 34: 35 – 43.

Harbusch, C., 2003: Aspects of the ecology of Serotine Bats (Eptesicus serotinus, Schreber 1774) in Contrasting Landscapes in Southwest Germany and Luxembourg. – PhD thesis, University of Aberdeen, U.K., 217 pp.

Kervyn, T. (2001): Ecology and ethology of the Serotine bat, Eptesicus serotinus (Chiroptera, Vespertilionidae): Perspectives for the conservation of bats. – PhD thesis, University of Liège, Belgium, 164 pp.

Labee A.H. & A.M. Voûte (1983): Voedselkeuze van een kolonie laatvliegers, Eptesicus serotinus (SCHREBER, 1774). – Lutra 26: 12 – 19.

Robinson, M.F., R.E. Stebbings (1993): Food of the serotine bat Eptesicus serotinus – is faecal analysis a valid qualitative and quantitative technique. – J. Zool. Lond. 231: 239 – 248.

Robinson, M.F. & R.E. Stebbings (1994): Changing land-use in south Cambridgeshire: its effect on serotine bats. – Nature in Cambridgeshire 36: 62 – 69.

Robinson, M. F. & R.E. Stebbings (1997a): Home range and habitat use by the serotine bat Eptesicus serotinus, in England. – J. Zool. Lond. 243: 117 – 136.

Savi's pipistrelle bat (*Hypsugo savii*)

Feeding habitats and areas

A generalist forager, associated with a wide range of landscapes and also markedly synanthropic. May be observed feeding in many habitats, including riparian habitats, forest edges, farmland and urban settlements (Russo & Jones, 2003), also in mountainous areas over 1000 m a.s.l. In Southern Italy, it has been found to forage less in artificial conifer plantations (Russo and Jones, 2003). Hunts frequently around street lamps, especially those emitting white light which prove more attractive for insect prey. No information on distances travelled is available, but according to wing morphology foraging should mainly occur within a few km from the roosts.

Critical feeding areas

None in particular, albeit riparian habitats, traditionally managed farmland and "green areas" in urban settlements such as parks and gardens may be especially important.

Commuting routes

As pipistrelle bats (Verboom & Huitema, 1997), may follow hedgerows or commute along woodland edges, but frequently crosses open spaces.

Conservation and management of critical feeding areas

- Preservation of riparian habitats and low-intensity agriculture, promoting spatial and temporal heterogeneity
- Reduction of pesticide spreading
- Establishment and appropriate management of gardens and parks in built-up areas
- Avoidance of reforestation with conifers, at least outside the ecological and biogeographical original areas of these trees e.g. along many Mediterranean coasts.

References

Russo, D. & Jones, G. 2003: Use of foraging habitats by bats (Mammalia: Chiroptera) in a Mediterranean area determined by acoustic surveys: conservation implications. Ecography 26: 197-209.

Verboom, B. & Huitema, H. 1997: The importance of linear landscape elements for the pipistrelle Pipistrellus pipistrellus and the serotine bat Eptesicus serotinus. – Landscape Ecology 12: 117-125.

Lesser mouse-eared bat (*Myotis blythii (oxygnathus)*)

Foraging habitats and areas

Steppe and non-cut meadows. The species prefers dense steppe vegetation than sparse xeric grassland and avoids forests (Arlettaz 1995). Myotis blythii forages also in wet meadows which present more insects than pastures (Güttinger et al. 1998).

Mean foraging areas 38,1±11 ha. Mean altitude of foraging areas: 1012+317 m, the highest being at 2000 m a.s.l. (Arlettaz 1995).

The mean distance of foraging areas from the nursery roost is 4-7 km (Dietz *et al*. 2007) and the furthest feeding grounds are at 10,9 km (Güttinger *et al*. 1998) and 22 km (Groupe Chiroptères de Provence *pers. comm*.).

Critical feeding areas

Grasslands with sufficient vegetation to host a great variety of insects.

Commuting routes

Unknown ?

Conservation and management of critical feeding areas

Management recommendations should focus on the fact that pastures should not be overgrazed, nor treated with pesticides. On dry grasslands, extensive grazing is recommended to avoid the development of encroaching woody vegetation.

References

Arlettaz R., 1995. Myotis myotis and Myotis blythii, ecology of the sibling mouse-eared bats. 206 p. Horus Publishers, Martigny, Switzerland.

Roué S. Y. & Barataud M. (1999). Habitats et activité nocturne des chiroptères menacés en Europe : synthèse des connaissances en vue d'une gestion conservatrice. Le Rhinolophe, N. Spec. 2: 99-104.

Dietz, C., von Helversen, O. & Nill, D., 2007. Handbuch der Fledermäuse Europas und Nordwestafrikas. Kosmos Verlag, Stuttgart, Germany, pp. 252-259.

Güttinger R., Lustenberger J., Beck A. & Weber V. (1998). Traditionally cultivated wetland meadows as foraging habitat of the grass-gleaning Lesser mouse-eared bat (Myotis blythii). Myotis 36: 41-49

Alcathoe whiskered bat (*Myotis alcathoe)*

Steppe whiskered bat (*Myotis aurascens)*

Bechstein's bat (*Myotis bechsteinii*)

Feeding habitats and areas

Myotis bechsteinii prefers old open deciduous forests (Kerth et al. 2002). It has been found also in highly structured coniferous forests as the structure of the forest is more important than the tree species in the stand (Albrecht et al. 2002). It favours windthrow gaps as their important amount of dead wood and herbaceous plants allow the development of saproxylic insects which are numerous in its diet (Barataud et al. 2005). In areas with isolated woodlands, *Myotis bechsteinii* forages also in agricultural landscape providing that it finds a mosaïc of habitats: pastures, hedgerows, parks, old trees, old extensive orchards (Lüttman et al. 2003, Barataud et al. 2005, Schofield & Morris 2000), but the size of the activity area is greater in a fragmented woodland habitat than in a large block of forest (Kerth et al 2002, Albrecht et al. 2002, Greenaway & Hill 2005). Younger woodlands with some older stands are also used, provided that they present a closed but clear canopy and an understorey with different vertical structures (Dietz & Pir 2009).

Critical feeding areas

Large blocks of old deciduous and richly structured forests with clearings, windthrow gaps and a lot of dead wood are critical feeding areas for Bechstein's bat.

Commuting routes

Outside forests Myotis bechsteinii crosses open areas in direct flight.

Conservation and management of critical feeding areas

- Large areas of highly structured forest should be preserved.
- Unmanaged forest patches presenting numerous trees with cavities and windthrow gaps should be retained in forested landscapes.
- Clear cutting of large areas of high forest is to be avoided as Myotis bechsteinii has difficulties to adapt to important changes in its environment.
- Forest continuity should be favoured by promoting corridors connecting networks of important sites.
- Bat friendly management of woodlands within 2 km of the roosts is necessary.
- Spraying of pesticides in forests should be banned.

References

Albrecht K., Hammer M. & Holzhaider J. (2002). Telemetrische Untersuchungen zum Nahrungshabitatanspruch der Bechsteinfledermaus (Myotis bechsteinii) in Nadelwäldern bei Amberg in der Oberpflaz. Bundesamt für Naturschutz, Bonn, Schriftenr. Landschaftspflege Naturschutz, 71: 109-130

Barataud M., Grandemange F., Duranel A. & Lugon A. (2005). Etude d'une colonie de mise bas de Myotis bechsteinii Kuhl, 1817 – Sélection des gîtes et des habitats de chasse, régime alimentaire, implications dans la gestion de l'habitat forestier. Unpublished report, 34 p.

Dietz M. & Pir J. B. (2009). Distribution and habitat selection of Myotis bechsteinii in Luxembourg: implications for forest management and conservation. Folia Zool.: 58(3): 327–340.

Fitzsimons P., Hill D. & Greenaway F. (2002). Patterns of habitat use by female Bechstein's bats (Myotis bechsteinii) from a maternity colony in a British woodland. Unpublished report, 20p.

Kerth G., Wagner M., Weissmann K. & König B. (2002). Habitat- und Quartiernutzung bei der Bechsteinfledermaus: Hinweise für den Artenschutz. Schriftenr. Bundesamt für Naturschutz, Bonn, Schriftenr.Landschaftspflege Naturschutz, 71: 99-108

Lüttmann J., Weishaar M. & Gessner B. (2003). Nächtliche Aufenthalsgebiete und Jagdverhalten von Kolonien der Bechsteinfledermaus (Myotis bechsteinii) im Gutland. Dendrocopos 30: 17-27.

Schofield H. & Morris C. (2000). Ranging behaviour and habitat preferences of female Bechstein's bat, Myotis bechsteinii (Kuhl, 1818) in summer. The Vincent Wildlife Trust, unpublished report, 26 p.

Brandt's bat (*Myotis brandtii)*

Feeding habitats and areas

Myotis brandtii feeds in woodlands and above and among stagnant water and rivers and streams. In the south of Europe, the species can only be found in mountainous woodlands. It is hardly ever found in urbanised habitats. (Taake, 1984; Tupinier, 2004; Dietz et al., 2004)

Critical feeding areas

Large blocks of old woods, at stagnant waters, riparian habitats, treelines, small woodlands and hedges (Taake, 1984; Racey, 1998; Meschede & Heller, 2000; Dense & Rahmel, 2002; Tupinier, 2004; Dietz et al., 2004). In Germany, radiotracked females used 2 to 13 different feeding areas (Meschede et al., 2000; Dense and Rahmlel, 2002).

The species hunts up in areas from 1.5 km up to 10 km from its roost (Dense & Rahmel, 2002).

Commuting routes

Ekman & De Jong (1996) showed that M. brandtii often was absent on isolated patches of woodland within an agricultural landscape, nor on islands in lakes, indicating that the species does not readily cross open areas like crop fields or lakes. Individuals use fixed routes along wood lanes, hedges, or woodland edges (Dense & Rahmel, 2002).

Conservation and management of critical feeding areas

- maintenance of corridors between roosts and foraging habitats;
- conservation of woodlands and riparian zones in the vicinity of the roost;

References

Dense, C. & Rahmel, U. (2002): Untersuchungen zur Habitatnutzung der Großen Bartfledermaus (Myotis brandtii) im nordwestlichen Niedersachsen. In: Meschede, A., Heller, K.-G. & Boye, P. (eds.): Ökologie, Wanderungen und Genetik von Fledermäusen in Wäldern – Untersuchungen als Grundlage für den Fledermausschutz. - Münster (Landwirtschaftsverlag) - Schriftenreihe für Landschaftspflege und Naturschutz 71: 51-68.

Dietz, C., O. Von Helversen & D. Nill, 2007. Handbuch der Fledermäuse Europas und Westafrikas. Kosmos, Stuttgart.

Ekman, M. & de Jong, J. (1994). Local patterns of distribution and resource utilization of four bat species (Myotis brandti, Eptesicus nilssoni, Plecotus auritus and Pipistrellus pipistrellus) in patchy and continuous environments. Journal of Zoology 238:571-580

Glushkova Yu.V., Borissenko A.V., Sitnikova E.F., Fedutin I.D. (2004). Towards the bat fauna of Nerusso-Desnyanskoe Polesye (Bryansk Region) Plecotus et al. 7:22-30. (in Russian)

Meschede, A., K.-G. Heller & R. Leitl, 2000. Ökologie und Schutz von Fledermäusen in Wäldern. Schriftenreihe für Landschaftspflege und Naturschutz 66. Bundesamt für Naturschutz, Bonn.

Racey, P.A. (1998). The importance of the riparian environment as a habitat for British bats. Symposium zoological Society. London. In: N. Dunstone & ML Gorman (eds.). Behaviour and Ecology of Riparian Mammals. Cambridge University Press, Cambridge: 69-91.

Taake, K.-H. (1984): Strukturelle Unterschiede zwischen den Sommerhabitaten von Kleiner und Großer Bartfledermaus (Myotis mystacinus und M. brandti) in Westfalen. Nyctalus 2: 16-32.

Tupinier, Y., 2004. Myotis brandtii (Eversmann, 1845) – Große Bartfledermans (Brandtfledermaus). In: Niethammer & Krapp (eds.). Handbuch der Säugetiere Europas. Band 4, Teil II. Aula Verlag, Wiebelsheim: 345-368.

Long-fingered bat (*Myotis capaccinii*)

Feeding habitats and areas

A wetland specialist, typically forages in riparian habitats and over lakes (Russo and Jones, 2003), preferring calm waters bordered by well-developed riparian vegetation and large (over 5m) inter-bank distances (Biscardi et al., 2007). A trawling bat, forages low over water surface from which catches its prey (often represented by chironomids). Interestingly, it persists on some Mediterranean islands where surface water habitats are very rare. In at least one of such cases (Zakynthos) has been found to switch to forested foraging habitats (Davy et al., 2007)

In Central Italy, Biscardi et al. (2007) observed a mean distance from roost to foraging sites of 7.5 km, with a maximum of ca 21 km. Foraging activity drops on very windy nights, so trees bordering water sites are also valuable to shelter feeding areas (Russo and Jones, 2003).

Critical feeding areas

Riparian sites characterised by large inter-bank distances, clean, calm water and trees along both banks.

Commuting routes

Often follows water courses but may cross open areas.

Conservation and management of critical feeding areas

Preserve or restore riparian vegetation, especially in the areas surrounding main cave roosts, but also over longer distances (> 15 km) from them, given the species' high mobility

- Counter general factors leading to deterioration of riparian ecosystems, including pollution, channelisation, dredging, and damming.

References

Almenar, D., Aihartza, J., Goiti, U., Salsamendi, E. & Garin, I. 2006: Habitat selection and spatial use by the trawling bat Myotis capaccinii (Bonaparte, 1837). – Acta Chiropterologica 8: 157-167.

Biscardi S., Russo, D., Casciani V., Cesarini D., Mei M. & Boitani L. 2007: Foraging requirements of the endangered long-fingered bat (Myotis capaccinii): the influence of micro-habitat structure, water quality and prey type. – Journal of Zoology (London) 273: 372-381.

Davy, C.M., Russo, D., & Fenton M.B. 2007: Use of native woodlands and traditional olive groves by foraging bats on a Mediterranean island: consequences for conservation. Journal of Zoology (London) 273: 397-405.

Russo, D., & Jones, G. 2003: Use of foraging habitats by bats (Mammalia: Chiroptera) in a Mediterranean area determined by acoustic surveys: conservation implications. Ecography 26: 197-209.

Pond bat (*Myotis dasycneme*)

Feeding habitats and areas

Buildings, such as houses and churches, are predominantly used as 'summer roosts'. Pond bats can fly up to 15 kilometres from their roost and even 25 kilometres during spring and autumn (Haarsma & Tuitert 2009). Although they are specialized in trawling insects from the water surface, they are quite flexible in terms of foraging habitat. The species is most abundant in habitats with a combination of lakes, a dense network of waterways, marshland and meadows. Although they are know to hunt mostly abose bigger water bodies and slow flowing rivers, in Holland, they have observed to be spending 25% of their night hunting above meadows (Haarsma et al., pers. comm.). During periods of extreme weather conditions, such as sudden rainfall and high wind speeds (>4 Bft) they have been observed hunting along hedgerows and in woodland. There is not (yet) much published data on radio tracking studies on pond bats available. In Poland feeding areas are located 2.2 - 4.8 km from the nursery roost (Kokurewicz & Furmankiewicz (in Ciechanowski et al. 2007), in Holland feeding area's are located on average 8 km from maternity roosts and 12 km from male roosts (Haarsma unpublished data). In Germany (Dense & Rahmel unpublished data) males and females are also known exhibit sexual segregation in size of home range. Pond bats prey mostly on small Dipterans such as Chironomids and Culicidae, but also moths and beetles (Britton et al. 1997; Sommer & Sommer 1997). The diet of pond bats differs significant from Daubentons bats (Krueger unpublished data).

Critical feeding areas

Lakes, waterways and other water bodies but also marshland and to a lesser extent meadows form critical feeding areas. Habitats with high insect production, especially during spring and autumn are especially important for reproducing females and their offspring.

Commuting routes

Linear waterbodies, such as canals and rivers, as well as other linear elements such as tree lines and hedgerows are used as commuting routes (Verboom et al. 1999). If commuting routes cross unlit roads, pond bats tend to cross these fairly low (approximately 1 metre above the ground) which can cause traffic accidents.

Conservation and management of critical feeding areas

- attention paid especially on management of water bodies in distance of ~ 0,5 kms from nursery roosts. Pond bats often display pre-swarming behaviour above water (social function).
- attention paid especially on management of linear water bodies in distance of <6 kms from nursery roosts, as they form key habitat (both as commuting routes and as feeding habitat).

- reduction of light levels near water bodies is important as pond bats are disturbed by the light itself (Kuiper et all 2007) as well as by the reduced insect abundance on the water. High illumination levels are easily softened with tree lines along water bodies (Protection of such tree lines is also important).
- water management in pond bat habitats should aim to conserve the edges of water bodies. A natural bank (gradual transient between land and water, if possible with reed vegetation) has a higher insect production then a steep bank. Further steps should be taken to prevent the accumulation of duckweeds (Lemnaceae) (continuous displacement of water, no drainage of polluted water into important water bodies).

References

Britton, A.R.C, Jones, G. & Rayner, J.M.V 1997: Flight performance, echolocation and foraging behaviour in pond bats, Myotis dasycneme (Chiroptera: Vespertilionidae). - J. Zool. 241: 503 - 522.

Ciechanowski, M., Sachanowicz, K. & Kokurewicz. T. 2007: Rare or underestimated? - The distribution and abundance of the pond bat (Myotis dasycneme) in Poland. - Lutra 50 (2): 107-134

Haarsma, A.-J. & Tuitert, D.A.H 2009: An overview and evaluation of methodologies for locating the summer roosts of pond bats (Myotis dasycneme) in the Netherlands. - Lutra 2009 52 (1): 47-64

Sommer R., Sommer S. (1997). Ergebnisse zur kotanalyse bei teichfledermäusen, Myotis dasycneme (Boie, 1825). Myotis, 35,103-107.

Verboom, B, Boonman, A.M. & Limpens, H.J.G.A. 1999: Acoustic perception of landscape elements by the pond bat (Myotis dasycneme). - J. Zool. Lond. 1999: 248, 59 - 66.

Daubenton's bat (*Myotis daubentonii*)

Feeding habitats and areas

Daubenton's bats forage mainly above water bodies of both flowing and stagnant water. Feeding areas are usually at a maximum distance of 2 – 5 kilometres from the roosts (Arnold et al. 1998, Dietz et al. 2006) – but may occasionally be as far as 10 kilometres away from the roost. Females tend to forage closer to their roost than males (Encarnação et al. 2005). Foraging areas of pregnant and lactating females are typically small while after weaning of the young also females use larger areas (Dietz et al. 2007). Females show high fidelity to good quality foraging areas (Kapfer et al. 2008) even though they might change the roost quite often.

Critical feeding areas

Ponds and other water bodies with high insect production near roosts are important especially for lactating females.

Commuting routes

Daubenton's bats use e.g. rivers and tree lines as commuting routes (Downs & Racey 2006).

Conservation and management of critical feeding areas

- attention paid especially on management of areas in distance of ~ 2 kms from nursing roosts
- tree lines and other commuting routes saved

References

Arnold, A., Brown, M. Becker, N. & Storch, V. 1998: On the ecology of Daubenton's bats (Myotis daubentonii) in south-western Germany. – Carolinea 56: 103 – 110.

Bogdanowitz, W. 1994: Myotis daubentonii. – Mammalian Species 475: 1 – 9.

Dietz, M., Encarnação, J.A. & Kalko, E. 2006: Small scale distribution patterns of female and male Daubenton's bats (Myotis daubentonii) 2006: – Acta Chiropterologica 8(2): 403 – 415.

Dietz, M. & Kalko, E.K.V. 2007: Reproduction affects flight activity in female and male Daubenton's bats, Myotis daubentonii: – Can. J. Zool. 85(5): 653 – 664.

Downs, N.C. & Racey, P.A. 2006: The use by bats of habitat features in mixed farmland in Scotland. – Acta Chiropterologica 8(1): 169 – 185.

Encarnação, J.A., Kierdorf, U., Holweg, D., Jasnoch, U. & Wolters, V. 2005: Sex-related differences in roost-site selection by Daubenton's bats Myotis daubentonii during the nursery period. – Mammal Rev. 35(3&4): 285 – 294.

Kapfer, G., Rigota, T., Holsbeekc, L. & Aron, S. 2008: Roost and hunting site fidelity of female and juvenile Daubenton's bat Myotis daubentonii (Kuhl, 1817) (Chiroptera: Vespertilionidae). – Mamm. Biol. 73 (4): 267 – 275.

Geoffroy's bat (*Myotis emarginatus*)

Feeding habitats and areas

Geoffroy's bats are "flexible specialists" in terms of feeding preferences. May feed in forest habitats (Krull et al., 1991; Demel et al., 2004; Flaquer et al., 2008) as well traditionally managed farmland, olive groves (Flaquer et al., 2008) and riparian areas (Russo & Jones, 2003). In the northern part of its range (Germany, Netherlands) it feeds in cow sheds and stables (Krull et al. 1999, Brinkman et al. 2003, Dekker et al. subm.). Prey is either gleaned from substrate or caught on the wing. Adults forage further than juveniles (3.4 vs. 1.8 km; Flaquer et al., 2008), with maximum distances from roosts of over 6.5 km.

Critical feeding areas

Forests, traditional farmland and riparian habitats, stables.

Commuting routes

Prefer sheltered routes in forests; may cross urban settlements but major roads and open areas are avoided (Flaquer et al., 2008). In the north, it uses tree lanes to move from roost to feeding areas (Brinkmann et al. 2003, Dekker et al. subm,).

Conservation and management of critical feeding areas

- Preserve richly structured woodland, traditionally farmed habitats with a high landscape heterogeneity, riparian vegetation and cattle stables.
- Favour connections between roosts and foraging areas by creating or preserving forest corridors, hedgerows, and tree lines
- The species benefits from low-intensity agriculture, promoting spatial and temporal heterogeneity and reducing pesticide spreading

References

Brinkmann, R., E. Hensle & C. Steck. 2001. Artenschutzprojekt Wimperfledermaus. Untersuchungen zu Quartieren und Jagdhabitaten der Freiburger Wimper-

fledermauskolonie als Grundlage für Schutz- und Entwicklungs- maßnahmen. Guttachten in Auftrag der Landesanhalt für Umweltschutz, Freiburg, Germany.

Dekker, J.J.A., J.R. Regelink, E.A. Jansen, R. Brinkmann & H.J.G.A. Limpens, submitted. Spatial behaviour and habitat use of female Geoffroy's bats Myotis emarginatus at it's two northernmost maternity roosts.

Demel, S., Holzhaider,J., Kriner, E. & Zahn, A. 2004: Foraging areas of the notch-eared bat, Myotis emarginatus, inUpper Bavaria, Germany. – P. 65, in Programme and abstracts for the 13th Bat International Research Conference, Poland, Mikołajki, 23–27 August 2004. Museum and Institute of Zoology PAS, Warszawa, 120 pp.

Flaquer, C., Puig-Montserrat, X., Burgas, A. & Russo, D. 2008. Habitat selection by Geoffroy's bats (Myotis emarginatus) in a rural Mediterranean landscape: implications for conservation. – Acta Chiropterologica 10: 61-67.

Krull, D., Schumm, A., Metzner, W. & Neuweiler, G. 1991: Foraging areas and foraging behaviour in the notch-eared bat, Myotis emarginatus (Vespertilionidae). – Behavioral Ecology and Sociobiology 28: 247–253.

Russo, D. & Jones, G. 2003: Use of foraging habitats by bats (Mammalia: Chiroptera) in a Mediterranean area determined by acoustic surveys: conservation implications. – Ecography 26: 197-209.

Armenian whiskered bat (*Myotis hajastanicus)*

Greater mouse-eared bat (*Myotis myotis*)

Foraging habitats and areas

A ground gleaning bat which shows a preference for deciduous or mixed open woodlands with sparse or no understorey, grazed woods, olive groves; forages also above freshly cut meadows, harvested fields, intensive cultivated orchards. Found also above the illuminated area of street lamps (Barataud 1992).
Foraging areas at a maximum distance of 25 km from roost (Arlettaz in Roué & Barataud 1999) but usually 5-15 km.
Size of foraging areas: min. 100 - 1,000 ha (mean size 350 ha in Portugal)

Critical feeding areas

Open deciduous woodlands with no vegetation on the ground are essential for the species.

Commuting routes

tbc

Conservation and management of critical feeding areas

- no use of pesticides in agriculture and forestry within the home range of a nursery;
- maintenance of corridors between roosts and foraging habitats;
- conservation of woodlands with no understoreys in the vicinity of the roost;
- maintenance of forest alleys clear of vegetation.

References

Arlettaz, R., 1995. Myotis myotis and Myotis blythii, ecology of the sibling mouse-eared bats. 206 p. Horus Publishers, Martigny, Switzerland.

Barataud, M., 1993. L'activité crépusculaire et nocturne de 18 espèces de chiroptères, révélée par marquage luminescent et suivi acoustique. Le Rhinolophe, 9: 23-57.

Dietz, C., von Helversen, O. & Nill, D., 2007. Handbuch der Fledermäuse Europas und Nordwestafrikas. Kosmos Verlag, Stuttgart, Germany, pp. 252-259.

Güttinger, R., Zahn, A., Krapp, F. & Schober, W., 2001. Myotis myotis. In Handbuch der Säugetiere Europas, Vol./I (Ed. J. Niethammer & F. Krapp), pp. 123-207. Aula Verlag, Wiesbaden, Germany.

Roué S. Y. & Barataud M. (1999). Habitats et activité nocturne des chiroptères menacés en Europe : synthèse des connaissances en vue d'une gestion conservatrice. Le Rhinolophe, N. Spec. 2: 99-104.

Whiskered bat (*Myotis mystacinus*)

Feeding habitats and areas

There is not much radio tracking data on whiskered bat available. The whiskered bat forages in forests, also woodland edges and river banks are suitable habitats. More open areas such as parks and hedges might be used as well. Not as tightly linked to forests and bodies of water as Brandt's bat (Schrober & Grimmberger 1997). Several feeding areas up to 2.8 kilometres from the roost can be used (Cordes 2004).

Recent studies have indicated that the species favored clearly grassland over builtup areas, woodland and arable land (Berge 2009).

Whiskered bats typically have few feeding areas (1,25) (Berge 2009). Maximun foraging distance is 200 to 2300 m while the average is 812 m (Berge 2009).

Critical feeding areas

Key foraging habitat is grassland (pastures etc) 8Berge 2009)

Commuting routes

In a study on echolocation behaviour it was observed that whiskered bats followed closely (distance under 7 meters) a hedgerow (Holderied *et al.* 2006) This suggests the importance of landscape elements that can provide acoustic "landmarks" to the species, such as hedgerows. Small forest islands in and agricultural landscape may not be suitable for the species (Lesinski *et al.* 2007) as the species needs acoustic cues for orientation during commuting.

Conservation and management of critical feeding areas

- management of grasslands
- save hedgerows, radius of 2,3 km around the roost

References

Berge, L. 2009 PhD thesis

Corders, B. 2004: Kleine Bartfledermaus – Myotis mystacinus. – In: A. Meschede & B.-U. Rudolph (eds.): Fledermäuse on Bayern: 155 – 165; Ulmer Verlag

Holderied, M.W., Jones, G. & von Helversen, O. 2006: Flight and echolocation behaviour of whiskered bats commuting along a hedgerow: range-dependent sonar signal design, Doppler tolerance and evidence for 'acoustic focussing. – J. Exp. Biol. 209: 1816 – 1826.

Schober, W. & Grimmberger, E. 1997: The bats of Europe and North America. T.F.H. Publications, USA. 240 p.

Taake ?

Natterer's bat (*Myotis nattereri)*

Feeding habitats and areas

Natterer's bats typically hunt in a variety of habitats across their European range ranging from meadows, orchards, broadleaf woods to open conifer forest and riparian habitats (Arlettaz, 1996; Siemers *et al.,* 1999; Siemers and Swift, 2006; Smith and Racey, 2008). Natterer's bat are likely to select foraging areas which are rich in horizontal and vertical edges (Siemers *et al.,* 1999). Foraging areas range between 128 ha – 580 ha (Fielder *et al*., 2004; Siemers *et al*., 1999; Smith and Racey, 2008). Multiple partial foraging areas are used within this area (Smith and Racey, 2008). The core of foraging grounds can be up to 4 km from roosts and individuals are faithful to core hunting areas, returning to these on consecutive nights (Siemers *et al.,* 1999). Connecting habitats between the roost d core area are also utilised for foraging (Siemers *et al.,* 1999).

Natterer's bats rely on a gleaning foraging strategy, preying on resting insects from the surface of vegetation using the tail membrane and/or feet to capture prey (Arlettaz, 1996; Swift and Racey, 2002). Diurnally active insects, insects which rarely fly, and non-flying arthropods are eaten (Gregor and Bauerova,1987; Shiel *et al.,*1991; Siemers and Swift, 2006).

Critical feeding areas:

Broadleaved riparian woodland, open conifer forest, orchards and grassland.

Commuting routes:

Hedgerows and riparian vegetation are important, particularly in areas where the foraging habitats are fragmented. Open areas tend to be avoided.

Conservation and management of critical feeding areas

- semi-natural broad-leaved woodland should be retained
- Clear felling of large blocks of woodland should be avoided
- Maintain diverse hedgerow structure in grassland areas for both roosting and commuting
- Tree cover along river banks should be encouraged and protected
- Minimum application of insecticides in orchards and grassland agricultural systems

References

Arlettaz, R. 1996. Foraging behaviour of gleaning bats Myotis nattereri (Chiroptera, Vespertilioniidae) in the Swiss Alps. Mammalia 60: 181–186

Fielder, W., Illi, A. & Alder-Eggli, H. 2004. Ramnutzung, Aktivität und Jagdhabitatwahl von Fransenfledermäusen (Myotis nattereri) im Hegau (Südwestdeutschland) und angrenzenden Schweizer Gebiet. Nyctalus 9: 215 - 235

Gregor, F. & Bauerova, Z. 1987. The role of Diptera in the diet of Natterer's bat, Myotis nattereri. Folia Zoologica 36: 13-19

Shiel, C.B., McAney, C.M. & Fairley, J.S. 1991. Analysis of diet of Natterer's bat Myotis nattereri and the common long-eared bat Plecotus auritus in the West of Ireland. Journal of Zoology 223: 299-305.

Siemers, B.M. & Swift, S.M. 2006. Differences in sensory ecology contribute to resource partitioning in the bats Myotis bechsteinii and Myotis nattereri (Chiroptera: Vespertilionidae). Behavioral Ecology and Sociobiology. 59: 373–380

Swift, S.M. & Racey P.A. 2002. Gleaning as a foraging strategy in Natterer's bat Myotis nattereri. Behavioral Ecology and Sociobiology. 52: 408 - 416

Smith, S.M. & Racey P.A. 2008. Natterer's bats prefer foraging in broad-leaved woodlands and river corridors. Journal of Zoology. 275: 314-322

Siemers, B.M., Kaipf, I. & Schnitzler, H.-U. 1999. The use of day roosts and foraging grounds by Natterer's bats (Myotis nattereri Kuhl, 1818) from a colony in southern Germany. Zeitschrift fur Säugetierkunde 64: 241–245.

Asiatic whiskered bat (*Myotis nipalensis)*

Maghrebian mouse-eared bat (*Myotis punicus*)

Feeding habitats and areas

Corsican studies in 1999 (Beuneux & Courtois 2002; Beuneux 2002), when the species was still considered as being *M. myotis,* already mentioned that its foraging habitat differed from foraging habitat of continental *M .myotis*, with a preference for pastures and grassland-wood ecotone and not forests.

Feeding grounds of *M. punicus* are therefore open habitats: pastures, freshly cut hay meadows, any kind of habitat with sparse vegetation (Beuneux 2004, Beuneux *com.pers*.). It captures its prey on the ground or in flight (Borg 1998 in Dietz et al. 2007). Size of feeding areas unknown yet.

Maximum distance of foraging areas from maternity roost: 15 km (Beuneux *com.pers*.).

Critical feeding areas

Open habitats with sparse vegetation

Commuting routes

In Corsica it crosses every day over a mountain pass at 1,450 m a.s.l.

Conservation and management of critical feeding areas

Radio-tracking studies are necessary near maternity roosts to determine preferred foraging habitats and home range of the colonies before giving any management recommendations. However, xeric grasslands turning into scrubland need management.

References

Beuneux, G. & Courtois, J-Y, 1999. Les Chiroptères en milieu forestier en Corse

Beuneux, G., 1999b. Les habitats de chasse du Grand Murin en Corse (Castifau, Haute-Corse). Poster VIIIe Rencontres Nationales « Chauves-souris » de la SFEPM, Bourges. In Symbioses 2002, n.s., 6: 54.

Beuneux, G., 1999a. Les habitats de chasse du Grand Murin Myotis myotis (Mammalia, Chiroptera) sur le site de Piana (Castifau, Haute-Corse). Université de Corte, mémoire de DESS, 30p.

Beuneux, G., 2004. Morphometrics and ecology of Myotis cf.punicus (Chiroptera, Vespertilionidae) in Corsica. Mammalia 68: 269-273.

Borg J.J., 1998. The lesser-mouse-eared bat Myotis blythii punicus in Malta. Notes on status, morphometrics, movements and diet (Chiroptera: Vespertilionidae). Natural.siciliano 22: 365-374.

Dietz C., Helversen O.von & Nill D., 2007. Handbuch der Fledermäuse Europas und Nordafrika. Franckh-Kosmos Verlag, Stuttgart, 400p.

Schaub's bat (*Myotis schaubi)*

Greater noctule (*Nyctalus lasiopterus*)

Feeding habitats and areas

Aerial hawking bat that frequently forages above riverine areas and marshlands in southern Spain (Popa-Lisseanu *et al* 2009). While in Corsica the foraging areas are mountain wooded areas, high ridges, coastal habitats destroyed by fire (previously woodlands), eucalyptus and citrus fruit plantations and vegetables fields (Beuneux *et al.* 2010). Population roosting in urban parks in southern Spain could also use urban areas for foraging. However there is no observation of city light attraction on the species. Woodlands and open areas are not frequent foraging habitats for the species in southern Spain (Popa-Lisseanu 2007).

As *Nyctalus lasiopterus* switches diet in spring and autumn (according to the availability of passerine preys), mountain passes could also have an important role in some areas.
Due to the lack of roosts in the best feeding habitats, bats (including lactating females) regularly forage in southern Spain up to 40 km from the roost. An extraordinary distance of 90 km from the roost has also been recorded and this bat covered over 130 km in one night. In Corsica the mean distance of the foraging areas to the roosts can reach 25 km (Beuneux *et al.* 2010*).*
In continental France, during a radio-tracking study aimed at locating the roosts of the species, some individuals have been watched foraging above pastures (Destre 2007).

Critical feeding areas

Water bodies, marshlands, large river valleys and mountain woodlands are the most important areas to conserve for the species.

Commuting routes

Along river valleys (Popa-Lisseanu 2007, Popa-Lisseanu *et al*. 2009) and possibly along bird migration routes.

Conservation and management of critical feeding areas

- No intensive logging in forests inhabited by the species;
- conservation of aging tree stands;
- reforestation (if necessary) and nest boxes in the meantime;
- no spraying of the foraging areas with insecticides.
- no installation of wind turbines in the critical feeding areas and on migration corridors of birds.

References

Alcalde, J. T., Trujillo, D., Artázcoz, A. & Agirre-Mendi, P. T., 2008. Distribución y estado de conservación de los quirópteros en Aragón. Graellsia, 64(1): 3-16.

Beuneux, G., Courtois, J-Y., & Rist, D., (2010). La Grande noctule (Nyctalus lasiopterus) en milieu forestier en Corse : bilan des connaissances sur les arbres-gîtes et les territoires de chasse fréquentés. Actes des XIIemes Rencontres nationales chauves-souris de la SFEPM, Bourges, mars 2008. Symbioses 25: 1-8

Destre, R., 2007. La Grande Noctule – Nyctalus lasiopterus (Schreber, 1780) dans le département de la Lozère. Electronic publication Le Vespère (2007-2009) 1 : 59-63 http://www.le-vespere.org

Dietz, C. , von Helversen, O. & Nill, D., 2007. Handbuch der Fledermäuse Europas und Nordwestafrikas. Kosmos Verlag, Stuttgart, Germany, p. 273-276.

Dondini, G. & Vergari, S., 2004. Bats: bird-eaters or feather-eaters? A contribution to debate on Great Noctule carnivory. Hystrix It. J. Mamm. (n.s.) 15(2): 86-88.

Estók, P., Gombkötő, P., Cserkész, T., (2007). Roosting behaviour of the greater noctule Nyctalus lasiopterus Schreber, 1780 (Chiroptera, Vespertilionidae) in Hungary as revealed by radio-tracking. Mammalia (2007), 86-88. DOI 10.1515/MAMM.2007.007

Estók, P., 2007. The year of Greater Noctule (Nyctalus lasiopterus [Schreber, 1780]) 2007 – review of Hungarian data and new results. Proceedings of the 5th and 6th Conference on the Bat Conservation in Hungary. Pp. 80-84.

Ibañez, C., Guillén, A. & Bogdanowicz, W., 2004. Nyctalus lasiopterus (Schreber, 1780). Riesenabendsegler. In: Handbuch der Säugetiere Europas, Vol./II (Ed. J. Niethammer & F. Krapp), pp. 695-716. Aula Verlag, Wiesbaden, Germany.

Ibañez, C., Guillén, A., Agirre-Mendi, P. T., Juste, J. & Popa-Lisseanu, A. G., in press . Sexual segregation in Iberian noctule bats. Journal of Mammalogy.

Ibañez, C., Guillén, A., Agirre-Mendi, P. T., Juste, J. & Popa-Lisseanu, A. G. Migratory and reproductive strategies in Iberian noctule bats. In revision by Mammal Review.

Popa-Lisseanu, A. G., 2007. Roosting behaviour, foraging ecology and enigmatic dietary habits of the aerial-hawking bat Nyctalus lasiopterus. PhD Thesis. Universidad de Sevilla, Sevilla, Spain.

Popa-Lisseanu A. G., Bontadina F., Mora O & Ibañez C., 2008. Highly structured fission-fusion societies in an aerial-hawking, carnivorous bat. Animal Behaviour, Vol. 75(2) : 471-482.

Popa-Lisseanu, A. G., Bontadina, F. & Ibañez, C. , 2009. Giant noctule bats face conflicting constraints between roosting and foraging in a fragmented and heterogeneous landscape. J. Zool. 278: 126-133.

Popa-Lisseanu, A. G., Delgado-Huertas, A., Forero, M., Rodriguez, A., Arlettaz, R. & Ibañez, C., 2007. Bats'conquest of a formidable foraging niche : the myriads of nocturnally migrating songbirds. PLoS ONE 2(2): e205. doi:10.1371/ journal.pone.0000205.

Leisler's bat (*Nyctalus leisleri*)

Feeding habitats and areas

Foraging behaviour depends on season, age, sex and geographical position of the site. In southern England Leisler's bats significantly preferred foraging in areas of woodland and along scrub-lined roads in Kent, but over pasture around Bristol. Urban and arable

areas were avoided at both sites. Bat-detector transects showed a significant preference for bats to forage along woodland margins (Waters et al. 1999).

In Ireland two-thirds of the recorded foraging time was over pasture or drainage canals. Foraging over other habitats, particularly lake and conifer forest, was greatest in preparturition. Other habitats foraged included lights, estuary, stream, beach and dunes. Lights are relatively the most favored foraging sites (Shiel& Fairley 1998; Shiel et al. 1999).

In eastern Germany forages both in large woodland areas without preference for any forest types, and also in different open lanscapes and at waters, as well as in settlements (Schorcht 2002).

In south-western Germany most foraging activity was recorded at lakes and rivers near forests, along forest roads and above clearings (Harbush et al. 2002).

In Italy foraging activity of *N. lesleri* was recorded by acoustic surveys in all habitat types except coniferous plantations and arable areas (Russo&Jones 2003), in England most activity was related with rivers, lakes and improved pasture (Vaughan et al. 1997)

Female and male home ranges in Germany were estimated at least in 6 and 1,5 km^2 correspondingly (Furmann et al. 2002), maximum distances of foraging flights could be over 17 km, but usually about 5 km from the roost (Shiel et al. 1999, Waters et al. 1999, Schorcht 2002).

Critical feeding areas
Water bodies, forest roads and clearings, pastures.

Commuting routes
In Ireland commuted directly to foraging sites at speeds often exceeding 40 kmh. (Shiel et al. 1999).

Conservation and management of critical feeding areas
No species-specific information is available (?).

References

Fuhrmann, M., Schreiber, C. & Tauchert, J. 2002. Telemetrische Untersuchungen an Bechsteinfledermäusen (Myotis bechsteinii) und Kleinen Abendseglern (Nyctalus leisleri) im Oberurseler Stadtwald und Umgebung (Hochtaunuskreis). – In: Meschede, A., Heller, K.-G. & Boye, P. (eds.): Ökologie, Wanderungen und Genetik von Fledermäusen in Wäldern – Untersuchungen als Grundlage für den Fledermausschutz. - Münster (Landwirtschaftsverlag) - Schriftenreihe für Landschaftspflege und Naturschutz 71: 131-140.

Harbusch, C., Meyer, M. & Summkeller, R. 2002. Untersuchungen zur Jagdhabitatwahl des Kleinabendseglers (Nyctalus leisleri Kuhl, 1817) im Saarland. – In: Meschede, A., Heller, K.-G. & Boye, P. (eds.): Ökologie, Wanderungen und Genetik von Fledermäusen in Wäldern – Untersuchungen als Grundlage für den Fledermausschutz. - Münster (Landwirtschaftsverlag) - Schriftenreihe für Landschaftspflege und Naturschutz 71.:163-175.

Russo, D. & Jones, G. 2003. Use of foraging habitats by bats (Mammalia: Chiroptera) in a Mediterranean area determined by acoustic surveys: conservation implications. Ecography 26: 197-209.

Schorcht, W. 2002. Zum nächtlichen Verhalten von Nyctalus leisleri (Kuhl, 1817). – In: Meschede, A., Heller, K.-G. & Boye, P. (eds.): Ökologie, Wanderungen und Genetik von Fledermäusen in Wäldern – Untersuchungen als Grundlage für den Fledermausschutz. – Münster (Landwirtschaftsverlag) - Schriftenreihe für Landschaftspflege und Naturschutz 71: 141-161.

Shiel, C. B. & Fairley, J. S. 1998. Activity of Leisler's bat Nyctalus leisleri (Kuhl) in the field in south-east County Wexford, as revealed by a bat detector. – Biol. Envir., Proc R. Ir. Acad. 98B: 105 – 112.

Shiel, C. B., Shiel, R. E., & Fairley, J. S. 1999. Seasonal changes in the foraging behaviour of Leisler's bats (Nyctalus leisleri) in Ireland as revealed by radio-telemetry. - Journal of Zoology, 249: 347-335.

Vaughan, N., Jones, G. & Harris, S. 1997. Habitat use by bats (Chiroptera) assessed by means of a broad-band acoustic method. J. Appl. Ecol. 34: 716-730.

Waters, D.A., Jones G., Furlong, M. 1999. Foraging ecology of Leisler's bat (Nyctalus leisleri) at two sites in southern Britain. – Journal of Zoology, 249: 173-180.

Noctule bat (*Nyctalus noctula*)

Feeding habitats and areas

Open water bodies, woodlands, wetlands and riparian habitats, valley pastures, harvested fields and enlighted places in towns (Austria: Spitzenberger 2001, Czech Republic: Gaisler et al. 1979, Bartonička & Zukal 2003, Denmark: Baagøe 2001, Germany: Kronwitter 1988, Meschede & Heller 2000, Greece: Hanak et al. 2001, Rottmann et al. 2003, Italy: Russo&Jones 2003, Latvia: Rydell & Petersons 1998, Luxembourg: Harbusch et al. 2002, Poland: Rachwald 1992, Spain and Portugal: Benzal et al. 1991, Russia: Strelkov&Ilyin 1990, Switzerland: Stutz & Haffner 1989, Gebhard & Zingg 1995, The Netherlands: Limpens & Kapteyn 1991. The UK: Vaughan et al. 1997).

At feeding sites bats flew at 6.0 ± 2.1 m/s (Jones 1995). Foraging flights can easily go more than 10 km away from the roost site (Meschede & Heller 2000), up to 20 km maximum (Limpens et al. 1997, Heise 1989), but the main activity of a maternity colony in Germany was within a radius of about 2 km from the colony's roost (Schmidt 1988).

The minimum convex polygon (MCP) used by the colony in the UK was 62.75 km2 and mean individual bat MCP was 8.2 km2 . A comparison of relative habitat use, between lactating and non-lactating bats, demonstrated state-dependent differences in use and identified habitats important for foraging in reproducing bats. Broadleaved woodland and pasture were the highest ranked foraging habitats consistently preferred by noctule bats across both levels. Although there was little difference in foraging activity (e.g. nightly duration, median 115 min) or maximum distances travelled to foraging grounds (mean 4.23 km), non-lactating bats used less preferred marginal habitats (arable land and moorland) significantly more than lactating bats (Mackie, Racey, 2007).

Critical feeding areas

Woodlands and nearby water bodies, pastures and other open habitats

Commuting routes

It seems that in most cases noctule bats fly directly from the roost to foraging areas.

Conservation and management of critical feeding areas

References

Bartonička T., Zukal J. (2003). Flight activity and habitat use of four bat species in a small town revealed by bat detectors. Folia Zool., 52(2): 155–166.

Baagoe, H. J. (2001). Danish bats (Mammalia: Chiroptera): Atlas and analysis of distribution, occurrence and abundance. Steenstrupia, 26: 1-117.

Benzal, J., Paz, O. de, Gisbert, J. (1991). Los murciélagos de la Península Ibérica y Baleares. Patrones biogeográficos de su distribución. Pp. 37-92 en: Benzal, J. et al. (eds.). Los murciélagos de España y Portugal. ICONA, Madrid.

Gaisler, J., Hanák, V., Dungel, J. (1979). A contribution to the population ecology of Nyctalus noctula (Mammalia: Chiroptera). Acta Sc. Nat. Brno, 13: 1-38.

Gebhard, J. & Zingg, P.E. (1995). Nyctalus noctula (Schreber, 1774). In: J. Hausser (Ed.): Mammifères de la Suisse. Birkhäuser Verlag, Basel: 133-138.

Hanak, V., Benda P., Ruedi M., Horaček I. & Sofianidou T. S. (2001). Bats (Mammalia: Chiroptera) in the Eastern Mediterranean. Part 2. New records and review of distribution of bats in Greece. Acta Societas Zoologica Bohemica, 65, 279-346.

Harbusch, C., E. Engel & J. B. Pir. (2002). Die Fledermäuse Luxemburgs (Mammalia: Chiroptera). Ferrantia 33: 1–156.

Heise G. (1989) Ergebnisse reproduktionsbiologischer Untersuchungen am Abendsegler (Nyctalus noctula) in der Umgebung von Prenzlau/Uckermark. Nyctalus (N.F.), 3: 17-32.

Jones, G. (1995). Flight performance, echolocation and foraging behaviour in noctule bats, Nyctalus noctula. J. Zool., Lond., 237: 303-312.

Kronwitter, F. (1988). Population structure, habitat use and activity patterns of the noctule bat, Nyctalus noctula Schreb., 1774 (Chiroptera, Vespertilionidae) revealed by radio-tracking. Myotis, 26: 23-85.

Limpens H., Kapteyn K. (1991) Bats, their behaviour and linear landscape elements. Myotis 29: 39-48.

Limpens, H., K. Mostert & W. Bongers (1997). Atlas van de Nederlandse vleermuizen: Onderzoek naar verspreiding en ecologie, KNNV Uitgeverij, Utrecht 260 pp.

Mackie I.J., Racey P. (2007) Habitat use varies with reproductive state in noctule bats (Nyctalus noctula): Implications for conservation. Biol. Conservation, 140 (1-2): 70-77.

Meschede, A. & Heller, K.-G. (2000): Ökologie und Schutz von Fledermäusen in Wäldern. Schriftenreihe für Landschaftspflege und Naturschutz 66, 374 pp.

Rachwald, A. (1992). Habitat preference and activity of the noctule bat Nyctalus noctula in the Bialowieza Primeval Forest . Acta Theriologica, 37: 413-422.

Rottmann, R., Boye, P. & Meinig, H. (2003). Die Säugetierfauna am Nestos-Delta in Nordost-Griechenland. Berichte aus dem Arbeitsgebiet Entwicklungsforschung 33. Münster (Westfälische Wilhelms-Universität, Institut für Geographie), 37 pp.

Rydell J., Petersons G. (1998). The diet of the Noctule bat Nyctalus noctula in Latvia. Z. Säugetierkunde, 63: 79-83.

Spitzenberger F. (2001). Die Säugetierfauna Österreichs. Bundesministerium für Land- und Forst- wirtschaft, Umwelt und Wasserwirtschaft, Graz, 894 pp.

Strelkov P.P. & V.Y. Ilyin (1990). Bats of South of Middle and Lower Volga provinces. Trudi Zoologicheskogo Instituta AN SSSR, 225: 42-167 (In Russian).

Stutz, H.-P., M. Haffner (1989): Verbreitung und Quartierwahl von Nyctalus noctula (Schreber, 1774) in der Süd-,Zentral- und Nordostschweiz. In.: Hanak I. , Horacek, I. , Gaisler, J. (eds.). European Bat Research 1987. Charles University Press, Praha: 452.

Vaughan, N., Jones, G. & Harris, S. 1997. Habitat use by bats (Chiroptera) assessed by means of a road-band acoustic method. J. Appl. Ecol. 34: 716-730.

Hemprich's long-eared bat (*Otonycteris hemprichii)*

Feeding habitats and areas

Hemprich's long-eared bats usually forage over rocky habitats with sparse herb vegetation (Horáček 1991), hovering close to the ground (Rybin *et al.* 1989, Arlettaz *et al.* 1995, Qumsiyeh 1996, Korine & Pinshow 2004), ca. 1 m on average in the early evening, or flying in large circles in height of 4-8 m later in the night (Horáček 1991). They also forage over small ponds in arid zones with many rock crevices (Harrison & Bates 1991, Bates & Harrison 1997), wadis and areas with springs vegetation, and even a garbage dump (Yom-Tov 1993, Fenton *et al.* 1999). When feeding areas are next to the roost (0.5-2 km) females have 3-4 bouts of foraging per night, and only one when the roost is 9 km far from these areas (Daniel *et al*. 2008).

Depending on the feeding areas, the diet could also vary seasonally (Fenton *et al.* 1999). Prey is taken from the ground (Arlettaz *et al.* 1995, Fenton *et al.* 1999) and also in flight (Horáček 1991). They include Tenebrionids, Blattoidea and Orthoptera (Horáček 1991), Scarabeidae (Whitaker *et al*. 1994), Solifugae, Acrididae, Scorpiones, Araneae, Carabidae, Gryllidae, Tettigoniidae, Lepidopteran imagos and larvae, Staphyllinidae (Arlettaz *et al.* 1995), and also Chilopoda, Heteroptera, Hymenoptera and Diptera (Fenton *et al.* 1999).

Critical feeding areas

In desert habitats the richest zones, mainly near water bodies, are the most favourable.

Commuting routes

Hemprich's long-eared bats seem to fly straight without fluttering or quick manœuvres over rocky habitats.

Conservation and management of critical feeding areas

- attention paid especially on maintenance of water bodies and herb vegetation.

References

Arlettaz, R., Dandliker, G., Kasyberov, E., Pillet, J.M., Rybin, S. & Zima, J., 1995. Feeding habits of the long-eared desert bat, Otonycteris hemprichii (Chiroptera: Vespertilionidae). J. Mammal., 76(3) : 873-876.

Bates, P.J.J. & Harrison, D.L., 1997.. Bats of the Indian Subcontinent. Harrison Zool. Mus., Sevenoaks, 258p.

Daniel, S., Korine, C. & Pinshow, B., 2008. Central-place foraging in nursing, arthropod-gleaning bats. Can. J. Zool., 86 : 623-626.

Horáček, I., 1991. Enigma of Otonycteris: ecology, relationshop, classification. Myotis, 29 : 17-30.

Fenton, M.B., Shalmon, B. & Makin, D., 1999. Roost switching, foraging behavior, and diet of the vespertilionid bat, Otonycteris hemprichii. Isr. J. Zool., 45(4) : 501-506.

Harrison, D.L. & Bates, P.J.J., 1991. The Mammals of Arabia. Harrison Zool. Mus., Sevenoaks, 354p.

Korine, C. & Pinshow, B., 2004. Guild structure, foraging space use, and distribution in a community of insectivorous bats in the Negev Desert. J. Zool., Lond., 262 : 187-196.

Qumsiyeh, M.B., 1996. Mammals of the Holy Land. Texas Tech Univ. Press, Lubbock, 389p.

Rybin, S.N., Horáček, I. & Červený, J., 1989. Bats of Southern Kirghizia: distribution and faunal status. in : V. Hanák, I. Horáček & J. Gaisler (eds). European bat research 1987. Charles Univ. Press, Praha, 421-441.

Whitaker, J.O. Jr, Shalmon, B. & Kunz, T.H., 1994. Food and feeding habits of insectivorous bats from Israel. Z. Säugetierk., 59 : 74-81.

Yom-Tov, Y., 1993. Character displacement among the insectivorous bats of teh Dead Sea area. J. Zool., Lond., 230 : 347-356.

Kuhl's pipistrelle bat (*Pipistrellus kuhlii*)

Feeding habitats and areas

A very flexible species, associated with a wide range of landscapes and also markedly synanthropic. In practice, may be observed foraging in virtually all habitats below 1000 m a.s.l., including riparian habitats, forests, farmland and urban settlements (Russo & Jones, 2003), whereas at higher elevations disappears (especially outside urban settlements) and may be replaced by other, less thermophilous pipistrelle species. Forages frequently around street lamps (Haffner & Stutz, 1985/6; Russo & Jones, 1999), especially those emitting white light which proves more attractive for insect prey.

Critical feeding areas

None in particular, albeit riparian habitats, traditionally managed farmland and "green areas" in urban settlements such as parks and gardens may be especially important.

Commuting routes

As other pipistrelle bats (Verboom & Huitema 1997) may follow hedgerows or commute along woodland edges, but frequently crosses open spaces.

Conservation and management of critical feeding areas

- Preservation of riparian habitats and low-intensity agriculture, promoting spatial and temporal heterogeneity
- Reduction of pesticide spreading
- Establishment and appropriate management of gardens and parks in built-up areas

References

Haffner, M. & Stutz, H. P. 1985/6: Abundance of Pipistrellus pipistrellus and Pipistrellus kuhlii foraging at street lamps. – Myotis 23-24: 167-168.

Russo, D. & Jones, G. 1999: The social calls of Kuhl's pipistrelles Pipistrellus kuhlii (Kuhl, 1819): structure and variation. – Journal of Zoology, London 249: 476-481.

Russo, D. & Jones, G. 2003: Use of foraging habitats by bats (Mammalia: Chiroptera) in a Mediterranean area determined by acoustic surveys: conservation implications. Ecography 26: 197-209.

Verboom, B. & Huitema, H. 1997: The importance of linear landscape elements for the pipistrelle Pipistrellus pipistrellus and the serotine bat Eptesicus serotinus. – Landscape Ecology 12: 117-125.

Nathusius's pipistrelle bat (*Pipistrellus nathusii)*

Feeding habitats and areas (based on Boye&Dietz, 2005):
Nathusius's pipistrelle bat prefers rather lowland region with water bodies (ponds, lakes, river, wetlands), if they are not available, they forage in rich structured biotopes, e.g. along forest edges, tree-lines, roads, old-growth woodlands, sometimes over reeds, pastures or around lamps (Austria: Bauer & Wirth 1979, Spitzenberger 2001, Denmark: Baagoe 2001, Fennoscandia: de Jong 1993, Germany: Heise 1982, Dense 1991, Schmidt 1997, Arnold & Braun 2002, Schorcht et al. 2002, Greece: Pieper 1978, von Helversen & Weid 1990, Hanak et al. 2001, Italy: Spagnesi et al. 2000, Luxembourg: Harbusch et al. 2002, Poland: Ruprecht 1977, 1990, Jarzembowski et al. 1998, Russia: Chistyakov 2001, Spain and Portugal: Benzal et al. 1991, Flaquer et al. 2009, Switzerland: Gebhard 1995, The Netherlands: Limpens & Kapteyn 1991). In the Transcaucasia forages also in semi-desert landscapes (Rakhmatulina 2005).

Pipistrellus nathusii has a home range of 10-22 km2 in summer (Schorcht et al. 2002). Certain foraging areas may be at a distance of 6.5 km from the roost site (Boye & Meyer-Cords 2004). The size of a foraging area is in eastern Germany 18 ha on average (Eichstadt 1995), in northern Germany four individual home ranges of femals from a maternity colony covered a total area of 5,8 km2 (Schorcht et al. 2002). The common home range of a colony is approximatly 80 km2 (Meschede & Heller 2000, Arnold & Braun 2002).

It is a typical aerial hawker, which hunt mainly Diptera in moderate distances from ground/water and vegetation (Kalko 1995), but can be also facultative gleaner (Pithartová 2007).

Critical feeding areas
The most important areas are natural wetlands and riparian habitats (Flaquer et al. 2009) and natural deciduous forest with established bat roosts.

Commuting routes
Nathusius's pipistrelle bat is a long distance migratory species in northeast-southwest direction (Petersons 2004, Hutterer et al. 2005). The importance of to guiding landscape structures, such as coastal lines, great rivers etc. is worth mentioned.
Depending on the habitat, the commuting flights from a roost to a foraging area are generally conected with linear landscape elements, e.g. streams, forest edges, hedges, tree-lines, roads or forest aisles, but they are also able to go across open fields (Arnold & Braun 2002).

References

Arnold, A., & Braun, M. 2002. Telemetrische Untersuchungen an Rauhhautfledermausen (Pipistrellus nathusii Keyserling & Blasius, 1839) in den nordbadischen Rheinauen. In: MESCHEDE, A., HELLER, K.-G., & BOYE, P., eds. Okologie, Wanderungen und Genetik von Fledermausen in Waldern – Untersuchungen als Grundlage fur den Fledermausschutz, 177-189. Munster (Landwirtschaftsverlag): Schriftenreihe fur Landschaftspflege und Naturschutz 71.

Baagøe, H. 2001. Danish bats (Mammalia: Chiroptera): Atlas and analysis of distribution, occurrence and abundance. Steenstrupia, 26, 1-117.

Bauer, K., & Wirth, J. 1979. Die Rauhhautfledermaus Pipistrellus nathusii Keyserling & Blasius, 1839 (Chiroptera, Vespertilionidae) in Osterreich (Mammalia Austriaca 2). Annalen des Naturhistorischen Museums in Wien, 82, 373-385.

Benzal, J., De Paz, O., & Gisbert, J. 1991. Los Murcielagos de la Peninsula Iberica y Baleares. Patrones Biogeograficos de su Distribucion. In : BENZAL, J., & DE PAZ, O. Los Murcielagos de Espana y Portugal, 37-92. Coleccion Tecnica, Madrid: ICONA.

Boye P. & Dietz M. 2005. Development of good practice guidelines for woodland management for bats. Report to English Nature № 661. 89 pp.

Chistyakov, D. V. 2001. Materials on distribution and ecology of Nathusius's pipistrelle (Pipistrellus nathusii) in the north-west of Russia. Plecotus et al., 4, 51-56.

Eichstadt, H. 1995. Ressourcennutzung und Nischengestaltung in einer Fledermausgemeinschaft im Nordosten Brandenburgs. Tecnical University of Dresden: PHD thesis.

Flaquer C., Puig-Montserrat X., Goiti U., Vidal F., Curcó A. & D. Russo. 2009 Habitat Selection in Nathusius' Pipistrelle (Pipistrellus nathusii): The Importance of Wetlands. Acta Chiropterologica 11(1):149-155.

Gebhard, J. 1995. Pipistrellus nathusii (Keyserling & Blasius, 1839). – In: HAUSSER, J. (Hrsg.) Saugetiere der Schweiz: Verbreitung, Biologie, Okologie, 152-156. Basel, Boston, Berlin: Birkhauser Verlag.

Hanak V., Benda P., Ruedi M., Horacek I. & Sofianidou T. S. 2001. Bats (Mammalia: Chiroptera) in the Eastern Mediterranean. Part 2. New records and review of distribution of bats in Greece. Acta Societas Zoologica Bohemica, 65, 279-346.

Harbusch, C., Engel, E. & Pir, J. B. 2002. Fledermause Luxemburgs (Mammalia: Chiroptera). Ferrantia 33, Luxemburg: Musee national d.histoire naturelle Luxembourg.153 pp.

Heise, G. 1982. Zur Vorkommen, Phänologie, Ökologie und Altersstruktur der Rauhhautfledermaus (Pipistrellus nathusii) in der Umgebung von Prenzlau (Uckermark), Bezirk Bezirk Neubranderburg. Nyctalus, 1: 281-300.

Helversen, O. Von & Weid, R. 1990. Die Verbreitung einiger Fledermausarten in Griechenland. Bonner zoologische Beitrage, 41, 9-22.

Hutterer, R., Ivanova,T., Meyer-Cords, CH., Rodrigues, L., 2005. Bat Migration in Europe. A Review of Banding Data and Literature. Federal Agency for Nature Conservation, Bonn, 162 pp.

Jarzembovski, T., Rymarzak, G. & Stepniewska, A. 1998. Forest habitat preferences of Pipistrellus nathusii (Chiroptera: Vespertilionidae) in Northern Poland. Myotis, 36, 177-182.

Jong, J. De 1995. Habitat use and species richness of bats in a patchy landscape. Acta Theriologica, 40, 237-248.

Kalko E.K.V., 1995: Insect pursuit, prey capture and echolocation in pipistrelle bats (Microchiroptera). Animal Behaviour, 50: 861-880.

Limpens H.& K. Kapteyn 1991. Bats, their behaviour and linear landscape elements. Myotis 29: 39-48.

Meschede, A. & Heller, K.-G. 2000. Ökologie und Schutz von Fledermäusen in Wäldern. Schriftenreihe für Landschaftspflege und Naturschutz 66, 374 pp.

Petersons, G. 2004. Seasonal migrations of north eastern populations of Nathusius bat, Pipistrellus nathusii (Chiroptera). Myotis 41-42:29-56.

Pieper, H. 1978. Pipistrellus nathusii (Keyserling und Blasius, 1839) in Griechenland und Bemerkungen zu einigen weiteren Arten. Zeitschrift fur Saugetierkunde, 43, 60-61.

Pithartová, T., 2007. Potravní ekologie syntopických populací čtyř druhů netopýrů (Myotis daubentonii, Myotis mystacinus, Pipistrellus nathusii a Pipistrellus pygmaeus): struktura potravy a její sezónní dynamika. Vespertilio, 11: 119-165

Rakhmatulina I. K. 2005. Bats of Azerbaijan (fauna, ecology, zoogeography). Baku. 480 pp.

Ruprecht, A. L. 1977. Uber die Verbreitung der Rauhhautfledermaus, Pipistrellus nathusii (Keyserling & Blasius, 1839) in Polen. Myotis, 14, 25-29.

Ruprecht, A. L. 1990. Weitere Fundorte der Rauhhautfledermaus, Pipistrellus nathusii (Keyserling et Blasius, 1839), in Polen. Nyctalus (N. F.), 3, 259-261.

Schmidt, A. 1984. Zu einigen Fragen der Populationsokologie der Rauhhautfledermaus,

Pipistrellus nathusii (Keyserling und Blasius, 1839). Nyctalus (N. F.), 2, 37-58.

Schorcht, W., and others. 2002. Zur Ressourcennutzung von Rauhhautfledermausen

(Pipistrellus nathusii) in Mecklenburg. In: MESCHEDE, A., HELLER, K.-G., & BOYE, P., eds. Okologie, Wanderungen und Genetik von Fledermausen in Waldern – Untersuchungen als Grundlage fur den Fledermausschutz, 191-212. Munster (Landwirtschaftsverlag): Schriftenreihe fur Landschaftspflege und Naturschutz 71.

Spagnesi, M., Toso, S. & De Marinis, A. M. 2000. Italian Mammals. Rome: Ministero dell.Ambiente, Servizio Conservazione della Natura and Instituto Nazionale per la Fauna Selvatica A. Ghigi. 203 pp.

Spitzenberger, F. 2001. Die Saugetierfauna Osterreichs. Grune Reihe 13, Vienna: Bundesministerium fur Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft.

Common pipistrelle bat (*Pipistrellus pipistrellus*)

Feeding habitats and areas

The common pipistrelle is a very flexible species that can be found hunting in a wide range of landscapes: from urban centres to arable land and woodland, but will hunt close to woodlands or riparian areas if available (Eichstat & Bassus, 1995; Taake & Vierhaus, 2004; Nichols & Racey, 2006a; Davidson-Watts et al., 2006; Dietz et al., 2007). As has its roosts in buildings, it will be mostly found close to human settlement. Poorer habitats, such as heather, pine wood, sand dune are poor habitats for the common pipistrelle (Kapteyn, 1996). In these habitats, it hunts in half open spaces, for example under the canopy of trees, or at water edges, usually no closer than 1 meter from vegetation. Frequently forages around street lamps (Haffner & Stutz, 1985; Russo & Jones, 1999), especially those emitting white light which proves more attractive for insect prey.

Critical feeding areas

None in particular, albeit riparian habitats, traditionally managed farmland and “green areas” in urban settlements such as parks and gardens are more important than others. Riparian areas and woodland edges are favoured (Taake & Vierhaus, 2004), but degraded riparian habitats (fewer trees, more uniform bank vegetation, etc.) have less bat activity than intact riparian habitats (Scott et al., 2009).

Distance between foraging areas and (maternity) roost can vary, but only females have been radio-tracked, and seem to forage round 1.5 km, and maximally 5 km, from the roost (Helmer, 1987; Racey & Swift, 1985; Simon et al., 2004; Davidson-Watts & Jones 2006; Nicholls & Racey, 2006b).

Commuting routes

Uses hedgerows, tree lines or woodland edges (Verboom & Huitema 1997), but frequently crosses open spaces of up to a few hundred meters (Helmer, 1987).

Conservation and management of critical feeding areas

- Preservation of riparian habitats and low-intensity agriculture, promoting spatial and temporal heterogeneity
- Reduction of pesticide spreading
- Establishment and appropriate management of gardens and parks in built-up areas

References

Davidson-Watts, I. & Jones, G. 2006. Differences in foraging behaviour between Pipistrellus pipistrellus (Schreber, 1774) and Pipistrellus pygmaeus (Leach, 1825). Journal of Zoology 268(1): 55–62.

Davidson-Watts, I., S. Wall, & G. Jones, 2006. Differential habitat selection by Pipistrellus pipistrellus and Pipistrellus pygmaeus identifies distinct conservation needs for cryptic species of echolocating bats. Biological Conservation 133: 118 – 127.

Dietz, C., O. Von Helversen & D. Nill, 2007. Handbuch der Fledermäuse Europas und Westafrikas. Kosmos, Stuttgart.

Eichstädt, H. & W. Bassus, 1995. Untersuchungen zur Nahrungsökologie der Zwergfledermaus (Pipistrellus pipistrellus). Nyctalus 5(6): 561-584.

Haffner, M. & Stutz, H. P., 1985. Abundance of Pipistrellus pipistrellus and Pipistrellus kuhlii foraging at street lamps. Myotis 23-24: 167-168.

Helmer, W., 1987. Vleermuizen in Mergelland-Oost. Studie ten behoeve van het NWC-advies voor de herinrichting Mergelland-Oost (Zuid-Limburg). Directie Natuur, Milieu en Faunabeheer, Maastricht.

Kapteyn, K., 1997. Gewone dwergvleermuis Pipistrellus pipistrellus. In: H. Limpens, K. Mostert & W. Bongers (eds.). Atlas van de Nederlandse vleermuizen. Onderzoek naar verspreiding en ecologie. KNNV-Uitgeverij, Zeist, the Netherlands.

Nicholls, B. & P.A. Racey, 2006a. Habitat selection as a mechanism of resource partitioning in two cryptic bat species Pipistrellus pipistrellus and Pipistrellus pygmaeus. – Ecography 29(5): 697–708.

Nicholls, B. & P.A. Racey, 2006b. Contrasting home-range size and spatial partitioning in cryptic and sympatric pipistrelle bats. Behavioural Ecology & Sociobiology 61:131–142.

Racey & Swift, 1985. Feeding ecology of Pipistrellus pipistrellus (Chiroptera: Vespertilionidae) during pregnancy and lactation. I Foraging behaviour. Journal of Animal Ecology 54: 205-215.

Russo, D. & Jones, G. 2003: Use of foraging habitats by bats (Mammalia: Chiroptera) in a Mediterranean area determined by acoustic surveys: conservation implications. Ecography 26: 197-209.

Scott, S. J., G. McLaren, G. Jones & S. Harris, 2009. The impact of riparian habitat quality on the foraging and activity of pipistrelle bats (Pipistrellus spp.). Journal of Zoology 280: 371–378.

Simon, M., Hüttenbügel, S. & Smit-Viergutz, J., 2004. Ecology and Conservation of Bats in Towns and Villages. Schriftenreihe für Landschaftspflege und Naturschutz 77. Federal Agency for Nature Conservation, Bonn.

Taake, K.-H. & H. Vierhaus, 2004. Pipistrellus pipistrellus (Schreber, 1774) – Zwergfledermaus. In: Niethammer & Krapp (eds.). Handbuch der Säugetiere Europas. Band 4, Teil II. Aula Verlag, Wiebelsheim.

Verboom, B. & Huitema, H. 1997: The importance of linear landscape elements for the pipistrelle Pipistrellus pipistrellus and the serotine bat Eptesicus serotinus. Landscape Ecology 12: 117-125.

Soprano pipistrelle bat (*Pipistrellus pygmaeus*)

Feeding habitats and areas

Ecological differences between common pipistrelle (*Pipistrellus pipistrellus*) and soprano pipistrelle (*Pipistrellus pygmaeus*) have been studied only in recent years, following the recognition in the late 1990s of the latter as a distinct species (see, e.g., Barrat *et al*. 1997, ICZN 2003). Nevertheless, before species recognition there were some useful studies of what was then perceived as two phonic types of *P. pipistrellus*, with the 45 kHz phonic type corresponding to *P. pipistrellus* (*sensu stricto*) and the 55 kHz phonic type corresponding to *P. pygmaeus*.

Several studies in the British Isles (Vaughan *et al*. 1997, Russ & Montgomery 2002, Nicholls & Racey 2006) and in Central Europe (Dietz *et al*. 2007) has concluded that soprano pipistrelle utilizes a more narrow feeding niche than its close congener, with feeding mainly taking place over or near wetlands (rivers, canals, lake/reservoir margins, riparian woodland). This was also suggested by studies of diet based on faecal analysis of the two phonic types (Barlow 1997). Glendell & Vaughan (2002), however, found that soprano pipistrelles selected tree lines and semi-natural woodlands over aquatic habitats in landscape parks in England, and Russ & Montgomery (2002) found that not only wetlands but also deciduous woodland was significantly selected in Northern Ireland. Bartonička & Řehák (2004) found a particularly high flight activity over water during spring, and an increase in foraging activity in ecotones and forest glades later in the season in their study area in Moravia, Czech Republic, and non-aquatic Brachycera has been found to be part of the diet particularly in the second half of the year (Arnold *et al*. 2002 #NOT SEEN#). In Scandinavia, where the soprano pipistrelle is by far the most widespread and numerous of the two species, *P. pygmaeus* does not show the same strong association with wetland habitats but are also found feeding in openings in woodlands, along tree lines and forest edge, and in parks and gardens with stands of deciduous trees (Ahlén 2004, Baagøe 2007). Wetlands, however, also constitute important hunting habitats, perhaps particularly in areas with otherwise low insect production (Ahlén 2004).

In general, bat hunting activity along stretches of rivers polluted by sewage outputs is less than along cleaner stretches of river in Southeast England, but soprano pipistrelle activity was found to be less affected than that of common pipistrelle (Vaughan *et al*. 1997). In accordance with this, Barlow (1997) found that the 55 kHz phonic type (=soprano pipistrelle) in Britain mainly feed on pollution-tolerant prey associated with wetland habitats. Russ & Montgomery (2002) found that water bodies with no vegetation edge generally were avoided by bats in Northern Ireland.

Critical feeding areas

Oakeley & Jones (1998) reported water (especially water edge habitat with woodland or hedgerow on the banks) and continuous hedgerow with emergent trees as habitats occurring significant more than expected around maternity roosts of the 55 kHz phonic type. They suggest that conservation of continuous hedgerows and watercourses close to maternity roosts may be particularly important for the soprano pipistrelle. It would seem, from this and the other studies listed above, that water bodies, deciduous forest near water and other areas with high insect abundance is likely to be important. The tendency of the soprano pipistrelle to establish rather large maternity colonies (e.g., Barrat *et al*. 1997, Dietz *et al*. 2007) implies that access to areas of high quality feeding habitat within reach of the colony is vital for the species. #Most foraging within 2 km of colonies?#

Commuting routes

Linear landscape elements are likely to be important for soprano pipistrelles, as it is for common pipistrelle, although relevant studies were done before recognition of the two as distinct species (e.g,, Verboom & Huitema 1997).

Conservation and management of critical feeding areas

- Attention need to be paid to management of
- wetlands and rich deciduous forest near maternity colonies (#within 2–3 km?#)
- linear landscape elements like hedgerows, tree lines and water courses near colonies
- bankside vegetation

References

Ahlén, I. 2004. The bat fauna of Sweden. Present knowledge of distribution and status. – Fauna och Flora 99(2): 2–11. [In Swedish with English summary].

Arnold, A., Häussler, U. & Braun, M. 2002 Comaprative study of the diets of two pipistrelle species (Pipistrellus pygmaeus/mediterraneus and P. pipistrellus) in Southwest Germany. – Bat. Res. News 43: 72. #NOT SEEN#

Baagøe, H. J. 2007. Dværgflagermus Pipistrellus pygmaeus (Leach, 1825). Pp. 70–73 in: Baagøe, H. J. & Jensen, T. S. (eds.). Dansk Pattedyratlas. – Gyldendal, København. [In Danish; English summary p. 346]

Barlow, K. E. 1997. The diets of two phonic types of the bat Pipistrellus pipistrellus in Britain. – J. Zool., Lond. 243(3): 597–609.

Barratt, E. M., Deaville, R., Burland, T. M., Bruford, M. W., Jones, G., Racey, P. A. & Wayne, R. K. 1997. DNA answers the call of pipistrelle bat species. – Nature 387(2): 138–139.

Bartonička, T. & Řehák, Z. 2004. Flight activity and habitat use of Pipistrellus pygmaeus in a floodplain forest. – Mammalia 68(4): 365–375.

Davidson-Watts, I. & Jones, G. 2006. Differences in foraging behaviour between Pipistrellus pipistrellus (Schreber, 1774) and Pipistrellus pygmaeus (Leach, 1825). – J. Zool., Lond. 268(1): 55–62.

Glendell, M. & Vaughan, N. 2002. Foraging activity of bats in historic landscape parks in relation to habitat composition and park management. – Anim. Conserv. 5(4): 309–316.

ICZN 2003. Opinion 2028 (Case 3073). Vespertilo pipistrellus Schreber, 1774 and V. pygmaeus Leach, 1825 (currently Pipistrellus pipistrellus and P. pygmaeus; Mammalia, Chiroptera): neotypes designated. – Bull. Zool. Nom. 60(1): 85–87.

Nicholls, B. & Racey, P. A. 2006. Habitat selection as a mechanism of resource partitioning in two cryptic bat species Pipistrellus pipistrellus and Pipistrellus pygmaeus. – Ecography 29(5): 697–708.

Oakeley, S. F. & Jones, G. 1998. Habitat around maternity roosts of the 55 kHz phonic type of pipistrelle bats (Pipistrellus pipistrellus). – J. Zool., Lond. 245(2): 222–228.

Russ, J. M. & Montgomery, W. I. 2002. Habitat associations of bats in Northern Ireland: implications for conservation. – Biological Conservation 108(1): 49–58.

Vaughan, N., Jones, G. & Harris, S. 1997. Habitat use by bats (Chiroptera) assessed by means of a broad-band acoustic method. – J. Appl. Ecol. 34(3): 716–730.

Verboom, B. & Huitema, H. 1997. The importance of linear landscape elements for the pipistrelle Pipistrellus pipistrellus and the serotine bat Eptesicus serotinus. – Landscape Ecol. 12(2): 117–125.

Brown long-eared bat (*Plecotus auritus)*

Feeding habitats and areas

The brown long-eared bat is a typical woodland bat. All over its range, its habitats are woody elements: deciduous forests with different ages of trees, less structured woodlands, forest edges, bushes and hedges, but also orchards, parks and gardens (Horácek 1975, Fuhrmann & Seitz 1992; Entwistle et al. 1996; Swift 1998, Woloszyn 2001; Kiefer & Boye 2004; Kyheröinen, 2009). It uses both coniferous and deciduous woods.

Diet studies and tracking studies show that the brown long-eared bat forages most on sitting prey, such as spiders, moths, earwigs, etc. gleaning it from leaves, branches, of walls, but it also catches prey in flight (Swift 1998, Rydell 1989; Meineke 1991). It can hunt on moths that are attracted to street lights (Swift 1998).

Critical feeding areas

Woodlands, or wooded more human-influenced habitats such as orchards, wooded parks and gardens. The species hunts in feeding areas that are close to its roost: usually within 100 meters; not further than 3 kilometres (Furhman & Seitz 1992; Entwisle et al. 1996; Swift 1998, Kyheröinen 2009). If feeding areas cannot be reached directly from the roost, commuting routes are used.

Commuting routes

P. auritus avoids crossing open spaces (Swift, 1998). Indeed, Ekman & De Jong (1996) found that the species does not forage in patches of isolated woodland in open agricultural areas.

Hedgerows, tree lines and fences and river edges can be used as commuting routes between roosts and feeding sites (Barataud 1990; Entwistle 1996; Swift 1998; Kyheröinen 2009) when it cannot be reached directly from the roost, or where woodland is fragmented.

Conservation and management of critical feeding areas

Attention need to be paid to management of

- woodlands, orchards and gardens within range of 1.5 km from roosts.
- structure linear landscape elements like hedgerows and tree lines in the case of areas with fragmented woodland.

References

Barataud, M., 1990. Eléments sur le comportement alimentaire des Oreillards brun et gris Plecotus auritus (Linnaeus, 1758) et Plecotus austriacus (Fischer, 1829). Le Rhinolophe 7: 3-10.

Ekman, M & J. de Jong, 1996. Local patterns of distribution and resource utilisation of four bat species (Myotis brandti, Eptesicus nilsonii, Plecotus auritus and Pipistrellus pipistrellus) in patchy and continuous environments. Journal of Zoology 238: 571-580.

Entwistle, A. C. , P. A. Racey, & J. R. Speakman , 1996. Habitat Exploitation by a Gleaning Bat, Plecotus auritus. Philosophical Transactions: Biological Sciences 351(1342): 921-931.

Fuhrman, M. & Seitz, A. 1992. Nocturnal activity of the brown long-eared bat (Plecotus auritus L., 1758): data from radio-tracking in the Lenneberg forest near Mainz (Germany). In: Priede, I. G. & Swift, M. S.,(eds). Wildlife telemetry, 538-548. New York, London: Ellis Horwood.

Horácek, I., 1975. Notes on the ecology of bats of the genus Plecotus (Geoffroy 1818) (Mammalia: Chiroptera). Vestestnik Cestkoslovenkse Spelecsnosti Zoologica 34: 195-210. Cs Spolia Zool 39 (3):195–210

Kiefer, A. & P Boye, 2004. Plecotus auritus. In: Petersen,B., Ellwanger, G., Bless, R., P. Boye, E. Schröder & A. Ssymank(eds). Das Europäische Schutzgebietssystem Natura 2000. Ökologie und Verbreitung von Arten der FFH-Richtlinie in Deutschland. Münster: Landwirtschaftsverlag. Schriftenreihe für Landschaftspflege und Naturschutz 69/2.

Kyheröinen, E.-M., 2009. Feeding habitats of brown long-eared bats (Plecotus auritus) in Southern Finland. Poster presentation, XIth European Bat Research Symposium, Cluj Napoca, Rumania.

Meineke, T., 1991 Auswertung von Fraßresten der beiden Langohrarten Plecotus auritus, L. und Plecotus austriacus, Fischer. - Naturschutz und Landschaftspflege in Niedersachsen 26: 37-46.

Rydell, J., 1989. Food habits of northern (Eptesicus nilssoni) and brown long-eared (Plecotus auritus) bats in Sweden. Holarctic Ecology 12:16-20.

Swift, S.,1998. Long-eared bats. T&AD Poyser, London.

Woloszyn, B. W. 2001. Nietoperze Polski, wystepowanie, srodowisko, status ochronny./Bats of Poland, distribution, habitat and conservation status. Polish Academy of Sciences, Krakow.

Grey long-eared bat *(Plecotus austriacus)*

Feeding habitats and areas

Plecotus auritus is a species of mosaics of (wooded and open) landscapes and of villages. It is known to hunt above extensively managed arable lands, meadows and uncultivated fields, in open forests (especially old beech forests) and forest edges, and more urbanised areas such as wooded gardens, parks and building and sheds (Horacek 1975; Flückinger & Beck 1995; Swift 1998; Kiefer & Veith 1998; Boeckx 2005; Johannes Regelink pers. commun.). In Southern Europe, the species is also reported from open mountain slopes with dry bush vegetation, mountain woodland, steppe areas and villages (Gaisler & Hanak, 1964; Rottmann et al. 2003).

The species hunts its prey in flight more than *Plecotus auritus*, but it also gleans prey from leaves, walls, or the ground; prey are predominantly moths but also beetles and flies (Bauerova, 1982; Barataud, 1990; Swift, 1998; Meineke, 1991).

Critical feeding areas

Critical feeding areas are meadows and arable fields, open woodland, wooded slopes, mountain steppes, orchard, parks and gardens and villages.

The species hunts in feeding areas that are maximally 5.5 kilometres, but usually not further than 1.5 kilometres from its roosts (Kiefer & Veith, 1998; Flückinger & Beck 1995; Boeckx 2005; Regelink pers. commun).

Commuting routes

Linear landscape elements such as hedges, treelines, fences, banks and streams or even railway lines are used as commuting routes (Barataud, 1990; Swift, 1998).

Conservation and management of critical feeding areas

- Attention need to be paid to management of
- - woodlands, orchards and agricultural lands within range of 1.5 km from roosts.
- - linear landscape elements like hedgerows, tree lines etc., especially in the case of areas with fragmented woodland.

References

Barataud, M., 1990. Eléments sur le comportement alimentaire des Oreillards brun et gris Plecotus auritus (Linnaeus, 1758) et Plecotus austriacus (Fischer, 1829). Le Rhinolophe 7: 3-10.

Boecks, 2005. De grijze grootoorvleermuis (Plecotus austriacus) (Fischer 1829) aan de noordgrens van zijn verspreidingsgebied. Deel 1: Terreingebruik in het landschap van Geel. Vleermuiswerkgroep Vlaanderen. (In Flemish).

Flückinger, F.P. & Beck, A., 1995. Observations on the habitat use for hunting by Plecotus austriacus (Fischer 1829). Myotis 32(33): 121–122.

Gaisler, J. & V. Hanak, 1964. Graues Langohr Plecotus austriacus (Fisher 1829) in Bulgarien. Zool. Listy 13: 31-38.

Horácek, I., 1975. Notes on the Ecology of Bats of the Genus Plecotus (Geoffroy 1818) (Mammalia: Chiroptera). Vestestnik Cestkoslovenkse Spelecsnosti Zoologica 34: 195-210.

Kiefer, A. & M. Veith, 1998. Untersuchungen zu Raumbedarf und Interaktionen von Populationen des Grauen Langohrs, Plecotus austriacus (Fischer 1829), im Nahegebiet. Nyctalus 6(5):531

Meineke, T.,1991. Auswertung von Fraßresten der beiden Langohrarten Plecotus auritus, L. und Plecotus austriacus, Fischer. - Naturschutz und Landschaftspflege in Niedersachsen 26: 37-46.

Rottman, R., Boye, P. & Meinig, H. 2003. Die Säugetierfauna am Nestos-Delta in Nordost-Griechenland. Berichte aus dem Arbeitsgebiet Entwicklungsforschung 33. Münster (Westfälische Wilhelms-Universität, Institut für Geographie.

Swift, S., 1998. Long-eared bats. T&AD Poyser, London.

Balkan long-eared bat (*Plecotus kolombatovici)*

Alpine long-eared bat *(Plecotus macrobullaris)*

Feeding habitats and areas
The feeding habitats of this newly discovered species have not been studied yet. But the Alpine long-eared bat has been mist-netted in the Pyrenees at 2,390 m a.s.l. and 2,807 m as it was flying above alpine pastures and bare ground (Garin 2003). The habitat below 1,900 m consists of mixed forests (*Fagus, Abies* and *Pinus*). In the French Alps it has been mist-netted mainly on forest tracks at the bottom of small valleys (Favre, pers. comm.), but there is no information whether the individuals were commuting or foraging.

Critical feeding areas
Probably alpine pastures

Commuting routes
No information as long as roosts and feeding areas have not been studied.

Conservation and management of critical feeding areas
No information as long as roosts and feeding areas have not been studied but at the altitude at which the species seems to forage, the habitat is not really endangered except in the areas where ski resorts are planned.

References

Garin, I., Garcia-Mudarra, J. L., Aihartza, J., R., Goiti, U., & Juste, J., 2003. Presence of Plecotus macrobullaris (Chiroptera : Vespertilionidae) in the Pyrenees. Acta Chiropterologica, 5(2) : 243-250.

Kiefer, A. & von Helversen, O., 2004. Plecotus macrobullaris (Kuzjakin, 1965). In Handbuch der Säugetiere Europas, Vol./II (Ed. J. Niethammer & F. Krapp), pp. 1051-1058. Aula Verlag, Wiesbaden, Germany.

Sardinian long-eared bat (*Plecotus sardus)*

Parti-colored bat (*Vespertilio murinus)*

Schreiber's bent-winged bat (*Miniopterus schreibersii)*

Feeding habitats and areas
Schreiber's bats forage mainly in deciduous woodlands and old-growth orchards (including olive groves), gardens, along hedgerows separating pastures and riverine forests and around street lamps (Barataud 1992, Lugon & Roué 1999, Russo & Jones 2003, Vincent 2007, Némoz & Brisorgueil 2008, Roué 2008). In the Mediterranean area, they can use grasslands (Barataud 1994), and avoid arable lands and maquis (Russo & Jones 2003). In some populations pregnant and lactating females forage over white street-lamps (Némoz *et al.* 2007, Vincent 2007, Némoz & Brisorgueil 2008, Roué 2008). Feeding areas are commonly located in a radius of 30 km around the main roost (Roué 2008); each female foraging over 18.5 ha in Franche Comté (Roué 2008), 7.5 ha in the Rhône Valley (Vincent 2007), moving among good quality feeding patches during the night (3 patches in a 500 m radius up to 6 patches 4 km apart, Vincent 2007, Némoz & Brisorgueil 2008). Females show fidelity to foraging areas over at least short periods, when juveniles change each night (Guillaume & Roué 2006, Némoz & Brisorgueil

2008). Lactating females forage farther than pregnant females, as their home range was 22318 ± 7141 ha vs 10837 ± 5399 ha in the Rhône Valley (Némoz *et al.* 2007). The foraging area of maternity colonies was ca. 200 000 ha (Némoz & Brisorgueil 2008, Roué 2008).
The diet relies on Lepidoptera in all seasons, varying among colonies from 76 to 95% of volume (Lugon & Roué 1999a, Prisetnik 2002, 2005, Lugon 2006), Diptera, mainly Tipulidae in late summer) being the second main preys in France (Lugon & Roué 1999b, Roué 2002) *versus* Neuroptera in Slovenia (Presetnik 2002, 2005). This diet includes larvae of Lepidoptera and Aranaeidea; as well as taxa flying close to vegetation (Mycetophilidae, Tipulidae and Cyclorraphae) (Lugon & Roué 1999a).

Critical feeding areas
Deciduous woodlands, old-growth orchards, riverine forests as well as hedgerows with high Lepidoptera production are the main feeding areas over the range.

Commuting routes
Schreiber's bats use tree lines, woodland borders, forest paths, hedgerows and riverine forests as commuting routes, flying usually at an altitude of 5-10 m and at 2 m from the vegetation, however they can cross open spaces up to 300m closer to the ground (Constant 1957, Barataud 1992, Lugon & Roué 2002). In spite of their quick flight (50-54 km/h, Constant & Cannonge 1957) they are able to easily jump over obstacles, including linear infrastructures, providing some landscape preparation (Lugon & Roué 2002). They preferably use rivers as landmarks (Serra-Cobo *et al.* 2000, Russo & Jones 2003), including when they are migrating (Serra-Cobo *et al.* 1998).

Conservation and management of critical feeding areas
- management of areas within at least a radius of 30 km around the nursing roosts;
- tree lines, mixed deciduous woodlands and riverine forests saved, and even replanted;
- varying forest logging, conserving borders;
- insecticides prohibited in forests.

References

Barataud, M., 1992. L'activité crépusculaire et nocturne de 18 espèces de Chiroptères, révélée par marquage luminescent et suivi acoustique. Rhinolophe, 9 : 33-57.

Barataud, M., 1994. Inventaire au détecteur d'ultrasons des Chiroptères fréquentant les zones d'altitude du centre-ouest de la Corse. Ronéo, Sauviat sur Vigé, 14p.

Constant, P., 1957. Etude systématique du Minioptère de Schreibers. Sous le Plancher (Bull. Spéléo Club Dijon), 2 : 30-34.

Constant, P. & Cannonge, B., 1957. Evaluation de la vitesse du vol des minioptères. Mammalia, 21(3) : 301-302.

Guillaume, C. & Roué, S.Y., 2006. Radio-pistage sur le Petit murin et le Minioptère de Schreibers : premiers résultats. Rev. sci. Bourgogne Nat., H.S. 1 : 113-115.

Lugon, A., 2006. Analyse du régime alimentaire de Miniopterus schreibersii. Site FR8201676 Sables du Tricastin, Suze-la-Rousse (Drôme). L'Azuré, Cernier, 10p.

Lugon, A. & Roué, S.Y., 1999a. Miniopterus schreibersii forages close to vegetation, results from faecal analysis from two eastern French maternity colonies. Bat Res. News, 40(3) : 126-127.

Lugon, A. & Roué, S.Y., 1999b. Minioptère de Schreibers Miniopterus schreibersii (Kuhl, 1817) in : S.Y. Roué & M. Barataud (coord.). Habitats et activité de chasse des Chiroptères menacés en Europe : synthèse des connaissances actuelles en vue d'une gestion conservatrice. Rhinolophe, Spéc. 2 : 119-123.

Lugon, A. & Roué, S.Y., 2002. Impacts d'une ligne TGV sur les routes de vol du Minioptère de Schreibers : de l'étude aux propositions d'aménagements. Symbioses, N.S. 6 : 39-40.

Némoz, M. & Brisorgueil, A., 2008. Connaissance et conservation des gîtes et habitats de chasse de 3 Chiroptères cavernicoles. S.F.E.P.M., Toulouse, 104p.

Némoz, M., Vincent, S. & Aulagnier, S., 2007. Conservation of the Schreibers' bat, Miniopterus schreibersii, in southern France : a LIFE-Nature program including an autecological study. Bat Res. News, 48(4) : 272-273.

Presetnik, P., 2002. Prehrana in biologija dolgokrilega netopirja (Miniopterus schreibersii Kuhl, 1817) na gradu Grad na Goričkem (SV Slovenija). Diplom. Delo, Univ. Ljubljani, 56p.

Presetnik, P., 2005. The diet of Schreiber's bat, Miniopterus schreibersii, in northeastern Slovenia. Bat Res. news, 46(3) : 118.

Roué, S.Y., 2002. Les Chiroptères de la Directive Habitats : le Minioptère de Schreibers Miniopterus schreibersii (Kuhl, 1817). Arvicola, 14(1) : 23-26.

Roué, S.Y., 2008. Stratégie de conservation du Minioptère de Schreibers, Miniopterus schreibersii, en Franche-Comté. Symbioses, 21 : 86-88.

Serra-Cobo, J., López-Roig, M., Marquès-Lopez, T. & Lahuerta, E., 2000. Rivers as possible landsmarks in the orientation flight of Miniopterus schreibersii. Acta Theriol., 45(3) : 347-352.

Serra-Cobo, J., Sanz-Trullén, V. & Martínez-Rica, J.P., 1998. Migratory movements of Miniopterus schreibersii in the north-east Spain. Acta Theriol., 43(3) : 271-283.

Vincent, S., 2007. Etude de l'activité et des terrains de chasse exploités par le Minioptère de Schreibers en vue de sa conservation, site Natura 2000 "Sables du Tricastin" FR8201676, Suze la Rousse (Drôme). C.O.R.A. Drôme - S.F.E.P.M., Romans - Toulouse, 66p.

European free-tailed bat (*Tadarida teniotis*)

Feeding habitats and areas

Tadarida teniotis forages generally high above forested areas or high mountain passes. Opportunistic forager it will hunt where it finds swarms of insects and exploits therefore various habitats: stone pine and/or cork oak woodlands, mountain forests, orchards and annual crops, scrublands, lakes, illuminated urban areas (Arlettaz 1990). In Italy the species shows no preference for a habitat or another (Russo & Jones 2003).

To find a suitable feeding habitat it can fly up to 36 km from the roost (Yavruyan & Safaryan, 1975) but the size of its feeding area is fairly small, about 102 ha (Tiago Marques *et al* 2004).

Critical feeding areas

All types of habitats providing that they are rich in insects.

Commuting routes

No evidence of clear commuting routes as the bats often change foraging areas, according to the abundance of insects.

Conservation and management of critical feeding areas

Prior to management recommendations, it is important to know the home range of the colonies and their habitat preferences as they may change according to geographical location, topography, and land-use types.

In the Mediterranean countries woodlands and scrublands are prone to forest fire and the use of land changes rapidly resulting in the disappearance of foraging habitats. Management of these areas is particularly important.

References

Arlettaz, R. 1990. Contribution à l'éco-éthologie du Molosse de Cestoni, Tadarida teniotis (Chiroptera), dans les Alpes valaisannes (sud-ouest de la Suisse). Zeitschrift für Säugetierkunde, 55 : 28-42.

Arlettaz, R. 1995. Tadarida teniotis. Pp. 198-202 in Säugetiere der Schweiz. Verbreitung, Biologie, Ökologie (J. Hausser, ed.). Birkhäuser Verlag, Basel, 501 pp.

Russo, D. & Jones, G., 2003. Use of foraging habitats by bats in a Mediterranean area determined by acoustic surveys: conservation implications. Ecography, 26: 197-209.

Tiago Marques, J., Rainho, A., Carapuço M., Oliveira, P. & Palmeirim, J. M., 2004. Foraging behaviour and habitat use by the European free-tailed bat Tadarida teniotis. Acta Chiropterologica, 6(1): 99-110.

Yavruyan, E., Safaryan, L., 1975. ??

6. Examples of successful habitat management cases

to be completed

7. Further reading

to be completed

8. References

All references will be moved to this section.