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Report on Autecological Studies for Priority Species

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In accordance with Resolution 4.12, the current work being carried out on autecological studies of the Priority List of species (*Rhinolophus euryale*, *Myotis capaccinii* and *Miniopterus schreibersii*) should be updated by the Advisory Committee and should be made public.

References of papers and reports dealing with autecological studies

Rhinolophus euryale

Barataud M., Jemin J., Grugier Y. & Mazaud S., 2009. Étude sur les territoires de chasse du Rhinolophe euryale, *Rhinolophus euryale*, en Corrèze, site Natura 2000 des Abîmes de la Fage. *Le Naturaliste. Vendéen*, 9 : 43-55.

The cave of la Fage (Noailles, Département of Corrèze) is a major site for the Mediterranean horseshoe bat, *Rhinolophus euryale* Blasius 1853. However, contrary to the tendency to increase noted over the last 20 years in various other birth sites in France, numbers at la Fage have shown no change. One of the suspected causes links this to the presence of the A20 motorway, less than a kilometre away, where corpses have been collected. This article presents the results of a radio-tracking study of the space occupied by the colony, during the summers of 2006 and 2007.

Voigt C.C., Schuller B.M., Greif S. & Siemers B.M., 2010. Perch-hunting in insectivorous *Rhinolophus* bats is related to the high energy costs of manoeuvring in flight. *Journal of Comparative Physiology Biochemical Systemic and Environmental Physiology*, 180(7): 1079-1088

Foraging behaviour of bats is supposedly largely influenced by the high costs of flapping flight. Yet our understanding of flight energetics focuses mostly on continuous horizontal forward flight at intermediate speeds. Many bats, however, perform manoeuvring flights at suboptimal speeds when foraging. For example, members of the genus *Rhinolophus* hunt insects during short sallying flights from a perch. Such flights include many descents and ascents below minimum power speed and are therefore considered energetically more expensive than flying at intermediate speed. To test this idea, we quantified the energy costs of short manoeuvring flights (< 2 min) using the Na-bicarbonate technique in two *Rhinolophus* species that differ in body mass but have similar wing shapes. First, we hypothesized that, similar to birds, energy costs of short flights should be higher than predicted by an equation derived for bats at intermediate speeds. Second, we predicted that *R. mehelyi* encounters higher flight costs than *R. euryale*, because of its higher wing loading. Although wing loading of *R. mehelyi* was only 20% larger than that of *R. euryale*, its flight costs (2.61 +/- A 0.75 W; mean +/- A 1 SD) exceeded that of *R. euryale* (1.71 +/- A 0.37 W) by 50%. Measured flight costs were higher than predicted for *R. mehelyi*, but not for *R. euryale*. We conclude that *R. mehelyi* face elevated energy costs during short manoeuvring flights due to high wing loading and thus may optimize foraging efficiency by energy-conserving perch-hunting.

Dubourg-Savage M.J., Némoz M. & Groupe Chiroptères Aquitaine, 2010. Activity and foraging habitats of *Rhinolophus euryale* in southern France: implications for species conservation. *Bat Research News*, 51(1): 20.

Effective conservation of bats implies the need for biologists to focus attention on foraging ecology. A four-year European program (LIFE-Nature "Conservation of three cave-dwelling bats in southern France") gave us the

opportunity to study the autecology of *Rhinolophus euryale* in France, filling in the gaps in knowledge for this species (Eurobats Resolution 4.12). In three colonies of 200, 300, and 1400 adults, a total of 29 pregnant females and 35 lactating females were radio-tracked in 2005 and 2006. Foraging activity peaked at the beginning and the end of the night. Distances travelled by females to reach their feeding habitats were noteworthy-up to 13 km. A female was located in transit at 27 km from the roost. Home ranges for the colonies were: 14,660 ha, 8,015 ha, and 24,643 ha, respectively. Females select interface habitats between wood land and open areas (meadows, pastures, dry grasslands), a complex horizontal structure with highly connected microhabitats. Conservation of colonies of *Rhinolophus uryale* implies large scale land management-up to 15 km from the roost. Priorities are to conserve complex and connected woodland habitats and to encourage nature-friendly agricultural practices.

Salsamendi E., Garin I., Arostegui I., Goiti U. & Aihartza J., 2012. What mechanism of niche segregation allows the coexistence of sympatric sibling rhinolophid bats? *Frontiers in Zoology*, 9 : 30.

Our purpose was to assess how pairs of sibling horseshoe bats coexist when their morphology and echolocation are almost identical. We collected data on echolocation, wing morphology, diet, and habitat use of sympatric *Rhinolophus mehelyi* and *R. uryale*. We compared our results with literature data collected in allopatry with similar protocols and at the same time of the year (breeding season). Echolocation frequencies recorded in sympatry for *R. Mehelyi* (mean = 106.8 kHz) and *R. uryale* (105.1 kHz) were similar to those reported in allopatry (*R. Mehelyi* 105-111 kHz; *R. uryale* 101-109 kHz). Wing parameters were larger in *R. Mehelyi* than *R. uryale* for both sympatric and allopatric conditions. Moths constitute the bulk of the diet of both species in sympatry and allopatry, with minor variation in the amounts of other prey. There were no inter-specific differences in the use of foraging habitats in allopatry in terms of structural complexity; however we found inter-specific differences between sympatric populations: *R. Mehelyi* foraged in less complex habitats. The subtle inter-specific differences in echolocation frequency seems to be unlikely to facilitate dietary niche partitioning; overall divergences observed in diet may be explained as a consequence of differential prey availability among foraging habitats. Inter-specific differences in the use of foraging habitats in sympatry seems to be the main dimension for niche partitioning between *R. Mehelyi* and *R. uryale*, probably due to letter differences in wing morphology. Coexistence between sympatric sibling horseshoe bats is likely allowed by a displacement in spatial niche dimension, presumably due to the wing morphology of each species, and shifts the niche domains that minimise competition. Effective measures for conservation of sibling/similar horseshoe bats should guarantee structural diversity of foraging habitats.

Mikova E., Varcholova K., Boldogh S. & Uhrin M., 2013. Winter diet analysis in *Rhinolophus uryale* (Chiroptera). *Central European Journal of Biology*, 8(9): 848-853.

We investigated the winter food of Mediterranean horseshoe bats (*Rhinolophus uryale*) in four winter cave roosts in southern Slovakia and northern Hungary and investigated the relationship between food and ambient temperature. The bats were active during the whole winter period and they produced excrement throughout the entire hibernation period, even when outside temperatures dropped below zero. The guano was in two forms, containing (1) prey items and (2) non-prey items. The identifiable items belonged to lepidopteran species, but only one was identified, on the basis of the genital fragments, the moth *Colotois pennaria*, which was the main prey species in autumn and early winter. Our results shed light on the extraordinarily high level of activity in this bat species during winter hibernation, which in temperate regions is a strategy that enables bats to survive when prey is reduced or absent. In *R. uryale*, the torpor in the course of hibernation is not continuous and our results help to explain how energy losses caused by bat movements are covered.

Ahmim M. & Moali A., 2013. The diet of four species of horseshoe bat (Chiroptera: Rhinolophidae) in a mountainous region of Algeria: evidence for gleaning. *Hystrix, Italian Journal of Mammalogy*, 24(2): 174:176.

We analyzed the diet of four rhinolophids (*Rhinolophus ferrumequinum*, *R. Hipposideros*, *R. uryale* and *R. Blasii*) in the region of Kabylia Babors, in northern Algeria. Between March 2007 and January 2008 we sampled droppings at ten sites and carried out a morphological identification of prey remains. Three main groups of Arthropoda (Insecta, Chilopoda and Araneida) were preyed upon but frequencies varied across species. The insect prey most frequently preyed upon by *R. Ferrumequinum* are Diptera (34.56%), mainly including Culicidae (10.40%), Chironomidae/Ceratopogonidae (10.94%) and Tipulidae (4.28%), and also Lepidoptera (24.13%). In *R. Hipposideros* droppings we found Diptera (41.58%), Chironomidae/Ceratopogonidae (9.68%) and Tipulidae (6.45%). Also common were Lepidoptera (moths; 21.14%) and Hemiptera (11.68%). *R.euryale* ate mainly Diptera (29.00%), Chironomidae/Ceratopogonidae (7.14%) and Tipulidae (5.71%). The order Lepidoptera (moths) was also well represented (19.08%). *R. Blasii* preyed on two groups of Arthropoda: Insecta (96.87%) and Chilopoda (4.34%). The most consumed insect prey was Diptera (37.50%), mainly Chironomidae/Ceratopogonidae (9.38%), Culicidae, Anisopodidae and Sphaeroceridae (6.25%). The order Trichoptera was also well represented in its diet (15.63%) and Lepidoptera accounted for 12.50%. The most interesting aspect of this study was that Chilopoda

appeared in the diet of all species and that, albeit rarely, *R. Ferrumequinum* also ate spiders. This result suggests that all species could glean prey from substrate, most probably as a strategy to better exploit the open habitats typical of the study area.

Myotis capaccinii

Almenar D., Aihartza J., Goiti U., Salsamendi E. & Garin I., 2009. Foraging behaviour of the long-fingered bat *Myotis capaccinii*: implications for conservation and management. *Endangered Species Research*, 8: 69-78.

The main factors threatening *Myotis capaccinii* (Bonaparte, 1837) are considered to be foraging habitat degradation and roost loss. Conservation strategies that focus on the protection of roosts are feasible as long as direct threats by human activities are correctly identified. However, before protection of foraging habitat can be implemented more accurate information is required. We review the available information of relevance to foraging habitat management for the species. Three main topics are considered based on the results of a radiotelemetry study on 45 ind. In 3 seasons: habitat dependence, features of foraging habitat, and spatial range. *M. capaccinii* foraged almost completely over aquatic habitats as in other telemetry studies. We discuss the importance of terrestrial habitats and the dependence of the species on aquatic habitats. It has been proposed that several factors affect habitat selection in this species. The presence of smooth, clutter-free water surfaces seems to be the most important structural factor, but we found that prey richness also affected habitat selection. Effects of features related to riparian vegetation and water quality are thought to vary according to local conditions. Preference for wide water bodies is probably linked to preference for smooth surfaces, where detection and trawling of prey is favoured. As highlighted by recent telemetry studies, we observed *M. capaccinii* foraging at long distances from the roost. Therefore, the area of application for conservation measures should be large: we suggest a protection radius of 20 km around roosts.

Rist D., Beuneux G. & Courtois J.Y., 2010. Recherche des territoires de chasse du Murin de Capaccini (*Myotis capaccinii*) en Corse ; premiers résultats. *Symbioses*, 25 : 28-31.

In 2006 and 2007 foraging areas of *Myotis capaccinii* were studied in Corsica. Eleven females from Saint-Florent cave (Oletta) and 14 females from Piana mines (Castifau) were radio-tracked during gestation and lactation periods. Eighteen foraging areas in 11 geographical areas were recorded, these are mainly large water bodies and smooth surface rivers. Commuting distances can be very long, up to 108 km during the night following the riverbed, but *M. capaccinii* can also fly straight over hills up to 660m. A new colony will be studied in 2008 to identify the conservation priorities for this species.

Némoz M., Peyrard Y. & Quekenborn D., 2010. Activity and foraging habitats of *Myotis capaccinii* in Southern France: Implications for species conservation. *Bat Research News*, 51(1): 41.

Effective conservation of bats needs biologists to focus attention on foraging ecology. A four-year European program (LIFE-Nature "Conservation of three cave-dwelling bats in southern France") has enabled the study of *Myotis capaccinii* autoecology in France to fill in the gaps in knowledge (Eurobats Resolution). In two colonies of 600 and 1000 adults, a total of 33 females were radio-tracked in 2005 and 2006 during gestation and/or lactation periods. These studies and diet analyses enabled the confirmation that *M. capaccinii* feeding areas are aquatic (rivers, lakes, natural or artificial ponds). *M. capaccinii* feeds on Diptera (55%), Trichoptera (25%) and Lepidoptera (10-15%). Females frequently use several feeding areas per night (up to five), which can be more than 25 km (max: 34 km) distant from the roost. Each feeding area can be used by several *M. capaccinii* or other bat species (up to 50 individuals observed). Females select aquatic habitats with a smooth water surface, bordered by well-developed riparian vegetation with a wealth of insects. Habitat use by *M. capaccinii* probably depends on seasonal insect availability. Conservation of colonies of *M. capaccinii* requires that land managers work on the scale of the catchment area in order to preserve or improve water quality and abundance, and consequently the diversity and wealth of insects. Conservation of the associated riparian vegetation is also a priority.

Lison F. & Calvo J.F., 2011. The significance of water infrastructures for the conservation of bats in a semiarid Mediterranean landscape. *Animal Conservation*, 14(5): 533-541.

The semiarid Mediterranean areas of south-eastern Spain have undergone great economic growth in recent years following the disproportionate expansion of intensive agriculture and housing developments. Such growth can only be supported by the development of large-scale hydraulic engineering works to compensate for the restrictions imposed by the scarcity of autochthonous water resources. We have studied the role of this type of infrastructure in the habitat use of several bat species in a protected forest area and its surroundings, a mixed landscape of traditional and intensive agricultural landscape crossed by the Tagus-Segura water transfer channel and endowed with frequent irrigation ponds. Our results showed that water infrastructures have a positive effect

on bat activity (as measured as bat passes and feeding buzzes per unit time) and species richness. The regression models indicate that bat activity is notably higher in the Tagus-Segura channel than in the other habitat types studied. However, this higher activity appears to be mainly due to the presence of the two most common species, *Pipistrellus pipistrellus* and *Pipistrellus pygmaeus*, while others, such as the trawling bats *Myotis daubentonii* and *Myotis capaccinii*, specialist hunters in this kind of habitat and under greater threat in the study area are much less frequent. The absence of vegetation along the canal and the speed of the current do not seem to favour the presence of these last two species, whose conservation value is much greater than that of the pipistrelles.

Almenar A., Aihartza J., Goiti U., Salsamendi E. & Garin I., 2011. Reproductive and age classes do not change spatial dynamics of foraging long-fingered bats (*Myotis capaccinii*). *European Journal of Wildlife Research*, 57(4): 929-937.

Spatial dynamics of foraging long-fingered bats (*Myotis capaccinii*) were studied in the Eastern Iberian Peninsula. We analysed the locations of 45 radio-tracked individuals during three discrete periods through the breeding season and measured the spatial parameters related to their foraging behaviour in order to test whether variations in spatial use occur. Colony range, measured as the minimum convex polygon through all the radiolocations, was 345 km², but the area used during each period was smaller. During pre-breeding, foraging bats gathered at two stretches of different tributary rivers; during lactation, they scattered throughout the river system; and during weaning, they aggregated at a stretch of the main river. Individuals on average flew 5.7 km from roosts to foraging areas, with a maximum absolute distance of 22.7 km. Individual foraging ranges were measured linearly, because the bats foraged mostly along rivers; their values averaged 1.3 km/night and overlapped extensively between neighbouring bats (>65% on average). The sampling period, rather than the bats' reproductive status, age, or sex, explained the observed variability in spatial distribution and size of hunting sites. We did not find differences in spatial parameters between lactating females and non-lactating bats, nor between juveniles and adults. This is the first study to split the independent effects of season and population class in order to enable unconfounded interpretations of the spatial dynamics of foraging reproductive females and juveniles. We speculate that the relationship between colony size and prey availability ruled the observed changes in foraging area through seasons. The considerable overlap in individual foraging ranges may be a necessary adaptation to large colonies forced by the specific roost requirements of the long-fingered bat and the narrow foraging niche they appear to occupy.

Clarín T.M.A., Ruczyński I., Page R.A. & Siemers B.M., 2013. Foraging ecology predicts learning performance in insectivorous bats. *Plos One*, 8(6): e64823.

Bats are unusual among mammals in showing great ecological diversity even among closely related species and are thus well suited for studies of adaptation to the ecological background. Here we investigate whether behavioral flexibility and simple- and complex-rule learning performance can be predicted by foraging ecology. We predict faster learning and higher flexibility in animals hunting in more complex, variable environments than in animals hunting in more simple, stable environments. To test this hypothesis, we studied three closely related insectivorous European bat species of the genus *Myotis* that belong to three different functional groups based on foraging habitats: *M. capaccinii*, an open water forager, *M. myotis*, a passive listening gleaner, and *M. emarginatus*, a clutter specialist. We predicted that *M. capaccinii* would show the least flexibility and slowest learning reflecting its relatively unstructured foraging habitat and the stereotypy of its natural foraging behavior, while the other two species would show greater flexibility and more rapid learning reflecting the complexity of their natural foraging tasks. We used a purposefully unnatural and thus species-fair crawling maze to test simple- and complex-rule learning, flexibility and re-learning performance. We found that *M. capaccinii* learned a simple rule as fast as the other species, but was slower in complex rule learning and was less flexible in response to changes in reward location. We found no differences in re-learning ability among species. Our results corroborate the hypothesis that animals' cognitive skills reflect the demands of their ecological niche.

Almenar D., Aihartza J., Goiti U., Salsamendi E. & Garin I., 2013. Hierarchical patch choice by an insectivorous bat through prey availability components. *Behavioral Ecology and Sociobiology*, 67(2): 311-320.

Food availability does not only refer to the abundance of edible items; accessibility and detectability of food are also essential components of the availability concept. Constraints imposed by a habitat's physical structure on the accessibility and detectability of food have been seldom treated simultaneously to the abundance of prey at the foraging patch level in observational studies. We designed a research that allowed decoupling the effects of microhabitat structure and prey abundance on foraging patch selection of the trawling insectivorous long-fingered bat (*Myotis capaccinii*). The use of different patches of river was surveyed by radiotelemetry during three periods of the bat's annual cycle, and prey abundance was accordingly measured in and out of the hunting grounds of the tracked bats by insect traps emulating the species' foraging. Bats preferentially used river stretches characterised

by an open course and smooth water surfaces, i.e. they used the most suitable patches in terms of prey accessibility and detectability, respectively. In addition, prey abundance in the selected river stretches was higher than in others where bat activity was not recorded, although the latter also offered good access and prey detection possibilities. Bats also shifted foraging stretches seasonally, likely following the spatiotemporal dynamics of prey production over the watershed. We suggest that the decisions of bats during the patch choice process fitted a hierarchical sequence driven first by the species' morphological specialisations and ability to hunt in unobstructed spaces, then by the detectability of prey on water surfaces and, finally, by the relative abundance of prey.

Aizpurua O., Garin I., Alberdi A., Salsamendi E., Baagoe H. & Aihartza J., 2013. Fishing long-fingered bats (*Myotis capaccinii*) prey regularly upon exotic fish. *Public Library Science*, 8(11).

The long-fingered bat *Myotis capaccinii* is a European trawling bat reported to feed on fish in several Mediterranean locations, but the ecological circumstances of this behaviour have not yet been studied. To elucidate the importance of fishing in this bat's diet, we evaluated the frequency and seasonal variation of fish remains in 3,000 fecal pellets collected from *M. capaccinii* at a nursery roost in Denia (Eastern Iberian Peninsula) in 2008, 2009, and 2010. Fish consumption occurred evenly throughout the year. All otoliths found in feces were identified as belonging to the surface-feeding fish *Gambusia holbrooki*. Measuring otoliths, we estimated that the mean size of consumed fish was significantly smaller than the mean measured for available fish, suggesting that the long-fingered bat's relatively small body may constrain its handling of larger prey. Of note, one bat had eaten 15 fish, showing that fish may be a locally or seasonally important trophic resource for this species. By capturing 15 bats and radio-tracking the four with the most fish remains in their droppings, we also identified fishing areas, including a single fishing ground comprising several ponds within a golf course. Ponds hold a high density of *G. holbrooki*, suggesting that the amount of fish at the water surface may be the principal factor triggering fishing. The observed six-fold increase in percentage of consumed fish across the study period may be related to recent pond-building in the area. We discuss whether this quick behavioral response is a novel feature of *M. capaccinii* or an intrinsic feature that has erupted and faded locally along the species' history.

Miniopterus schreibersii

Garin I., Aihartza J., Agirre-Mendi P.T., Alcalde J.T., De Lucas J., Paz O. de, Goiti U. & Artazcoz A., 2009. Seasonal movements of the Schreibers' bat, *Miniopterus schreibersii*, in the northern Iberian Peninsula. *Italian Journal of Zoology*, 75(3): 263-270.

The movements of the Schreibers' bat, *Miniopterus schreibersii*, in the regions of Navarre, La Rioja, and the western Basque Country were studied on a seasonal basis by means of ringing and recapture data. A total of 3014 bats were ringed in the study area, with recaptures accounting for 198. We found only three breeding colonies and no hibernacula in the study area. Distances between capture sites averaged 77 km (range 0-258 km) and varied seasonally. Distances between spring colonies and between autumn colonies were the shortest, whereas distances between spring and breeding colonies and between breeding and autumn colonies were the longest, as many bats moved to and from nursery roosts located outside of and far from the study area. The bats in the study area are part of a larger population that, at a minimum, extends over the central northern half of the Iberian Peninsula. Presumably individuals from different subpopulations mixed in the nursery roosts, returning to their respective quarters from autumn to spring. Both males and females joined the common breeding colonies, although a high proportion of males remained sedentary.

Némoz M., Vincent S. & Aulagnier S., 2010. Activity and foraging habitats of *Miniopterus schreibersii* in southern France: implications for species conservation. *Bat Research News*, 51(1): 41.

Comprehensive knowledge of roosting and foraging ecology is essential for conserving bats. A four-year programme funded by the European Community (LIFE Nature "Conservation of three cave-dwelling bats in Southern France") included an autoecological study of *Miniopterus schreibersii* to fill in some gaps in knowledge. *Miniopterus schreibersii* is a gregarious species which uses different cave roosts along the year, and females switch roosts even during the breeding season. This behaviour enhances the necessity to monitor simultaneously all roosts of an area, to obtain a realistic estimation of populations. In a colony of 4000 adults, 21 females were radio-tracked during gestation and lactation periods. Every night, for about 6 hours, each bat moved between several small feeding areas, as far as 40 km from the roost. Mean individual home-range estimation averaged 10,800 ha for pregnant females, 22,300 ha for lactating females. Urban areas lighted by white street lamps were used extensively. Some bats foraged also in deciduous Mediterranean woods and in orchards. Preying on Lepidoptera (95% of the diet) *Miniopterus schreibersii* used, as a priority, areas where food was abundant and adapted their foraging behaviour in response to changes in food dispersal and possibly physiological requirements. Conservation of *Miniopterus schreibersii* must be planned at a very large scale. The priority is to

protect a network of roosts. Efforts should also focus on maintaining deciduous forests and traditional orchards, and promoting nature-friendly agricultural practices.

Moeschler P., Roué S. & Zbinden K., 2010. Protection of colonies of *Miniopterus* (bats) by closure of caves: an inadequate measure? *Rhinolophe*, 18: 113-128.

The closure of caves as a way of protecting colonies of the cave-dwelling *Miniopterus schreibersii* (Schreibers' bat) has been studied in two caves in the French Jura. Trials of short-term (one week) and medium-term (one year) closures using barriers with horizontal bars (15-17 cm apart) were made at Carroussel cave (Haute Saone). Closure of this cave entrance caused a considerable drop in the number of bats present. A study of the consequences of the closure of three other caves in the south of France confirms these results. Visual and acoustic observations, using a video camera and an automatic counter of acoustic signals made by the bats, have shown that Schreibers' bats have great difficulty getting past the horizontal bars. Temporary closure of one of the two entrances to a cave in Franche-Comte (St. Catherine, Doubs) has also shown the effect of barriers on the choice of access route by three species of bats; they showed a clear preference for the entrance without a protection barrier. Three recommendations emerge: 1) Plans to close caves that serve as summer roosting places for colonies of *Miniopterus* should be re-examined, and studies should be carried out before implementing any plans to close caves that are occupied in summer by colonies of other species of bats. 2) Plans to close caves of prehistoric or tourist interest occupied by colonies of bats should first be subject to studies of the bat populations. 3) A global strategy for the protection of Schreibers' bat in caves in France and southern Europe needs to be defined.

Vincent S., Némoz M. & Aulagnier S., 2011. Activity and foraging habitats of *Miniopterus schreibersii* (Chiroptera, Miniopteridae) in southern France: implications for its conservation. *Hystrix*, 22(1) : 57-72.

Comprehensive knowledge of roosting and foraging ecology is essential for conserving bats. Therefore, the four-year LIFE Nature programme "Conservation of three cave-dwelling bats in Southern France" included an autoecological study of *Miniopterus schreibersii*, a highly gregarious cave-dwelling species. In a colony of 3-5,000 adults, 21 females were radio-tracked during pregnancy and lactating periods, when some of them switched roosts within a 30 km radius around the maternity colony. Every night, for about 6 hours, each bat flew far from the roost (4.1 to 29.2 km) to forage on several small feeding areas (1 to 9 over a few nights). Mean individual home-range estimation averaged 10837 ha for pregnant females, 22318 ha for lactating females. Urban areas lighted by white street lamps were used extensively. Some bats also foraged selectively in deciduous or mixed woodlands and in orchards and parks. The importance of hedgerows was confirmed. Conservation of *M. schreibersii* must be planned at a large scale, protecting a network of roosts and promoting nature-friendly agricultural practices.

Rainho A. & Palmeirim J.M., 2011. The importance of distance to resources in the spatial modelling of bat foraging habitat. *Plos One*, 6(4): 1-10.

Many bats are threatened by habitat loss, but opportunities to manage their habitats are now increasing. Success of management depends greatly on the capacity to determine where and how interventions should take place, so models predicting how animals use landscapes are important to plan them. Bats are quite distinctive in the way they use space for foraging because (i) most are colonial central-place foragers and (ii) exploit scattered and distant resources, although this increases flying costs. To evaluate how important distances to resources are in modelling foraging bat habitat suitability, we radio-tracked two cave-dwelling species of conservation concern (*Rhinolophus mehelyi* and *Miniopterus schreibersii*) in a Mediterranean landscape. Habitat and distance variables were evaluated using logistic regression modelling. Distance variables greatly increased the performance of models, and distance to roost and to drinking water could alone explain 86 and 73% of the use of space by *M. schreibersii* and *R. mehelyi*, respectively. Land-cover and soil productivity also provided a significant contribution to the final models. Habitat suitability maps generated by models with and without distance variables differed substantially, confirming the shortcomings of maps generated without distance variables. Indeed, areas shown as highly suitable in maps generated without distance variables proved poorly suitable when distance variables were also considered. We concluded that distances to resources are determinant in the way bats forage across the landscape, and that using distance variables substantially improves the accuracy of suitability maps generated with spatially explicit models. Consequently, modelling with these variables is important to guide habitat management in bats and similarly mobile animals, particularly if they are central-place foragers or depend on spatially scarce resources.

Fourasté S., 2011. Recherche de routes de vol, gîtes complémentaires et terrains de chasse des minioptères de Schreibers de la grotte du Castellás. Master Gestion de la Biodiversité Aquatique et Terrestre, Université Paul Sabatier, Toulouse, 52p.

This study aimed to investigate the commuting routes and the foraging areas of *Miniopterus schreibersii* from the breeding colony of the Castellans cave (Tarn, southern France) using radio-tracking. During our study, only non breeding individuals were caught. However we were able to locate a new roost, which does not seem to be a nursery. Foraging behaviour was similar for adults of both sexes. The main foraging areas were the same as previous studies on other breeding colonies, i.e. urban areas. However, we were unable to establish a link between areas with mercury steam lighting and higher hunting activity. Moreover, males do not hunt in deciduous woodlands contrary to females. A major commuting route was identified to the North-West of Dourgne. Management guidelines were drafted for preserving the new roost and regarding the species' habitat use.

Rainho A. & Palmeirim J.M., 2013. Prioritizing conservation areas around multispecies bat colonies using spatial modeling. *Animal Conservation*, 16(4): 438-448.

Bats and other vertebrates form large colonies concentrating key populations of multiple endangered species. Their foraging ranges are of critical importance for the colony but can be too vast to preserve in full extent. We evaluated an approach to prioritize areas within this range that conciliates the distinct needs of various species. Our model colony was a large cave-bat nursery harbouring *Rhinolophus mehelyi*, *Myotis myotis* and *Miniopterus schreibersii* located in Southern Portugal. With radio-tracking data of foraging bats and spatially explicit modelling, we generated habitat suitability maps for each species. Models incorporated both habitat variables and distance to the roost. The resulting maps were then used separately or in combinations to identify the areas with greatest multispecies conservation value. The best results were obtained by combining individual suitabilities in a single value, weighting each species by its threat risk. Although the overall range of the colony was very extensive, this approach identified the areas that had most multispecies value; more than half of the foraging sites are included in the best 13% of the range, and adding the next best 12% includes almost all sites of the most threatened study species, *R. mehelyi*. The efficiency of the prioritization can be evaluated not only for the species ensemble, but also for individual species. The concentration of most multispecies conservation value in a small area is partly due to the importance of distance to roost as a determinant of foraging habitat selection in all species, so this factor is essential in suitability models used for prioritization. This prioritization process successfully minimizes the amount of land required for protection, while maximizing the quality of the habitat to protect. Such prioritizations should spur the preservation of foraging areas of large multispecies colonies, thus improving the chances of survival of populations of great conservation value.

Presetnik P. & Aulagnier S., 2013. The diet of Schreiber's bent-winged bat, *Miniopterus schreibersii* (Chiroptera: Miniopteridae), in northeastern Slovenia (Central Europe). *Mammalia*, 77(3): 297-305.

The diet of *Miniopterus schreibersii* was investigated by morphological analysis of prey remains in droppings from the spring to the autumn of 2000 from a bat roost in north-eastern Slovenia (Central Europe). Lepidoptera dominated, having an average percent volume (APV) of 79% and constituting the bulk of the diet throughout the year. By decreasing importance in the diet, the insects identified were Neuroptera - mostly Chrysopidae (APV 9.2%), Diptera (APV 7.4%), Trichoptera (APV 2.2%) and Coleoptera (APV 1.4%). The diet was most diverse in late October. It seems that *M. schreibersii* is an aerial hawk that specialises in eating moths, but can opportunistically switch to other seasonably abundant prey. It hunts small-to medium-sized winged prey (wing length: 2-18 mm), of which most are tympanate insects.

In preparation of Resolution 7.12, some work was already carried out on autecological studies of the new Priority List of species is listed below.

Rhinolophus blasii

Ahmim M. & Moali A., 2013. The diet of four species of horseshoe bat (Chiroptera: Rhinolophidae) in a mountainous region of Algeria: evidence for gleaning. *Hystrix Italian Journal of Mammalogy*, 24(2): 174-176.

We analyzed the diet of four rhinolophids (*Rhinolophus ferrumequinum*, *R. hipposideros*, *R. euryale* and *R. blasii*) in the region of Kabylia Babors, in northern Algeria. Between March 2007 and January 2008 we sampled droppings at ten sites and carried out a morphological identification of prey remains. Three main groups of Arthropoda (Insecta, Chilopoda and Araneida) were preyed upon but frequencies varied across species. The insect prey most frequently preyed upon by *R. ferrumequinum* are Diptera (34.56%), mainly including Culicidae (10.40%), Chironomidae/Ceratopogonidae (10.94%) and Tipulidae (4.28%), and also Lepidoptera (24.13%). In *R. hipposideros* droppings we found Diptera (41.58%), Chironomidae/Ceratopogonidae (9.68%) and Tipulidae (6.45%). Also common were Lepidoptera (moths; 21.14%) and Hemiptera (11.68%). *R. euryale* ate mainly Diptera (29.00%), Chironomidae/Ceratopogonidae (7.14%) and Tipulidae (5.71%). The order Lepidoptera (moths) was also well represented (19.08%). *R. blasii* preyed on two groups of Arthropoda: Insecta (96.87%) and Chilopoda

(4.34%). The most consumed insect prey was Diptera (37.50%), mainly Chironomidae/Ceratopogonidae (9.38%), Culicidae, Anisopodidae and Sphaeroceridae (6.25%). The order Trichoptera was also well represented in its diet (15.63%) and Lepidoptera accounted for 12.50%. The most interesting aspect of this study was that Chilopoda appeared in the diet of all species and that, albeit rarely, *R. ferrumequinum* also ate spiders. This result suggests that all species could glean prey from substrate, most probably as a strategy to better exploit the open habitats typical of the study area

Siemers B.M. & Ivanova T., 2004. Ground gleaning in horseshoe bats: comparative evidence from *Rhinolophus blasii*, *R. euryale* and *R. mehelyi*. *Behavioral Ecology and Sociobiology*, 56(5): 464-471.

The 71 species of horseshoe bat (genus *Rhinolophus*) use echolocation calls with long constant-frequency (CF) components to detect and localize fluttering insects which they seize in aerial captures or glean from foliage. Here we describe ground-gleaning as an additional prey-capture strategy for horseshoe bats. This study presents the first record and experimental evidence for ground-gleaning in the little-studied Blasius' horseshoe bat (*Rhinolophus blasii*). The gleaning bouts in a flight tent included landing, quadrupedal walking and take-off from the ground. The bats emitted echolocation calls continuously during all phases of prey capture. Both spontaneously and in a choice experiment, all six individuals attacked only fluttering insects and never motionless prey. These data suggest that *R. blasii* performs ground-gleaning largely by relying on the same prey-detection strategy and echolocation behaviour that it and other horseshoe bats use for aerial hawking. We also studied the Mediterranean horseshoe bat (*R. euryale*) in the flight tent. All four individuals never gleaned prey from the ground, though they appeared to be well able to detect fluttering moths on the ground. It is not known yet whether ground-gleaning plays a role in Mehely's horseshoe bat (*R. mehelyi*). In a performance test, we measured the ability of these three European species of "middle-sized" horseshoe bats (*R. euryale*, *R. mehelyi* and *R. blasii*) to take-off from the ground. All were able to take flight even in a confined space; i.e. the willingness to ground-glean in *R. blasii* is not related to a superior take-off performance. In contrast to ground-gleaning bats of other phylogenetic lineages, *R. blasii* appears not to be a specialist, but rather shows a remarkable behavioural flexibility in prey-capture strategies and abilities. We suggest that the key innovation of CF echolocation paired with behavioural flexibility in foraging strategies might explain the evolutionary success of *Rhinolophus* as the second largest genus of bat.

Eptesicus isabellinus

Lisón F., Haz A. & Calvo J.F., 2014. Preferencia de hábitat del murciélago hortelano meridional *Eptesicus isabellinus* (Temminck, 1840) en ambientes mediterráneos semiáridos. *Animal Biodiversity and Conservation*, 37(1): 59-67.

Currently several molecular studies have showed the presence of two species of genus *Eptesicus* in the Iberian Peninsula. This second species has been named meridional serotine bat *Eptesicus isabellinus*. This species is present in the south of Iberia and it seems to show an allopatric distribution with its twin species *Eptesicus serotinus*. It is necessary to make ecological studies to understand the biology of this species. In this study, we used only-presence data of *E. isabellinus* in the southeast of Spain to perform an Ecological Niche Factorial Analysis (ENFA) and its corresponding Habitat Suitability Map (HSM). Our results evidence that the species has a low marginality index which suggests a good adaptation to the semiarid environmental conditions in the study area. The main habitats used for *E. isabellinus* are water courses, scrubs, and zones with a high productive primary. The specie avoids the rainfed crops and do not have preferences by human activities or irrigated crops. This study provides information about the ecology of *E. isabellinus* allowing us to discussing relevant aspects for its conservation.

Santos H., Juste J., Ibáñez C., Palmeirim J.M., Godinho R., Amorim F., Alves P., Costa H., Paz O. de, Pérez-Suarez G., Martínez-Alos, S., Jones G. & Rebelo H., 2014. Influences of ecology and biogeography on shaping the distributions of cryptic species: three bat tales in Iberia. *Biological Journal of the Linnean Society*, 112(1): 150-162.

To determine what shapes the distributions of cryptic species, we aimed to unravel ecological niches and geographical distributions of three cryptic bat species complexes in Iberia, *Plecotus auritus/begognae*, *Myotis mystacinus/alcaethoe* and *Eptesicus serotinus/isabellinus* (with 44, 69, 66, 27, 121 and 216 records, respectively), considering ecological interactions and biogeographical patterns. Species distribution models (SDMs) were built using a presence-only technique (Maxent), incorporating genetically identified species records with environmental variables (climate, habitat, topography). The most relevant variables for each species' distribution and respective response curves were then determined. SDMs for each species were overlapped to assess the contact zones within each complex. Niche analyses were performed using niche metrics and spatial principal component analyses to study niche overlap and breadth. The *Plecotus* complex showed a parapatric distribution, although having similar biogeographical affinities (Eurosiberian), possibly explained by competitive exclusion. The *Myotis*

complex also showed Eurosiberian affinities, with high overlap between niches and distribution, suggesting resource partitioning between species. Finally, *E. serotinus* was associated with Eurosiberian areas, while *E. isabellinus* occurred in Mediterranean areas, suggesting possible competition in their restricted contact zone. This study highlights the relevance of considering potential ecological interactions between similarly ecological species when assessing species distributions.

Papadatou E., Ibáñez C., Pradel R., Juste J. & Gimenez O., 2011. Assessing survival in a multi-population system: a case study on bat populations. *Oecologia*, 165(4): 925-933.

In long-lived animals, adult survival is among the most important determinants of population dynamics. Although it may show considerable variation both in time and among populations and sites, a single survival estimate per species is often used in comparative evolutionary studies or in conservation management to identify threatened populations. We estimated adult survival of the isabelline serotine bat *Eptesicus isabellinus* using capture-recapture data collected on six maternity colonies scattered over a large area (distance 8-103 km) during periods varying from 8 to 26 years. We modelled temporal and inter-colony variations as random effects in a Bayesian framework and estimated mean annual adult survival of females on two scales and a single survival value across all colonies. On a coarse scale, we grouped colonies according to two different habitat types and investigated the effect on survival. A difference in adult survival was detected between the two habitat types [posterior mean of annual survival probability 0.71; 95% credible interval (CI) 0.51-0.86 vs. 0.60; 0.28-0.89], but it was not statistically supported. On a fine scale, survival of the six colonies ranged between 0.58 (95% CI 0.23-0.92) and 0.81 (0.73-0.88), with variation between only two colonies being statistically supported. Overall survival was 0.72 (95% CI 0.57-0.93) with important inter-colony variability (on a logit scale 0.98; 95% CI 0.00-8.16). Survival varied temporally in a random fashion across colonies. Our results show that inference based solely on single colonies should be treated with caution and that a representative unbiased estimate of survival for any species should ideally be based on multiple populations.

Plecotus kolombatovici

Whitaker J.O. & Karataş A., 2009. Food and feeding habits of some bats from Turkey. *Acta Chiropterologica*, 11(2): 393-403.

Food habits data were obtained from 26 species of bats from Turkey. *Barbastella barbastellus*, *Myotis capaccinii*, *M. mystacinus*, *Plecotus auritus*, *P. austriacus*, *P. kolombatovici*, *P. macrotullaris* and *Rhinolophus euryale* were primarily moth feeders. *Eptesicus bottae*, *E. serotinus*, *Myotis myotis* and *Taphozous nudiventris* fed heavily on beetles. *Myotis aurascens* and *M. brandtii* fed heavily on Diptera, *M. blythii* and *Tadarida teniotis* were tentatively classified as cricket feeders at least in Turkey. *Hypsugo savii*, *Miniopterus schreibersii*, *Myotis emarginatus*, *M. nattereri*, *Pipistrellus kuhlii*, *P. pipistrellus*, *P. pygmaeus*, *R. ferrumequinum*, *R. hipposideros* and *R. mehelyi* preyed on a variety of insects and may be treated as generalists. In 17 species, the foods found paralleled those previously reported in the literature, but in nine (some with notably small samples) they did not. These are apparently the first data on the food of *Plecotus macrotullaris*, *P. kolombatovici*, *M. schreibersii* and *M. aurascens*.

Pavlinić I. & Tvrtković N., 2004. Altitudinal distribution of four *Plecotus* species (Mammalia, Vespertilionidae) occurring in Croatia. *Natura Croatica*, 13(4): 395-401.

The altitudinal distribution of bats of four *Plecotus* species in Croatia was analysed. *P. austriacus* and *P. kolombatovici* are restricted to lower altitudes, under 800 m a.s.l. *P. auritus* inhabits continental forest habitats, preferably beech forests, with the exception of Pannonian lowland riparian forests of common oak which also lie under 100 m a.s.l. As distinct from the other three *Plecotus* species, Croatian specimens of *P. macrotullaris* have an extremely wide altitudinal distribution, ranging from sea level to mountain tops, but with most localities under 800 m.

Plecotus sardus

The IUCN Red List of Threatened Species. Version 2014.2

It occurs in the most wooded areas parts of Sardinia, and roosts in natural caves. Two of the three known localities are situated in karstic areas, one locality lies near the sea coast (Mucedda *et al.* 2002). Artificial habitats are not used. It is a sedentary species.

Plecotus teneriffae

The IUCN Red List of Threatened Species. Version 2014.2

It is highly associated with woodland habitats (coniferous and mixed), although it occasionally forages in more open and arid areas. Its diet consists primarily of moths. Recorded roost sites include volcanic tubes, caves, and crevices in abandoned buildings (Palomo & Gisbert 2002). Tree holes and bat or bird boxes are never used (Benzal & Fajardo 1999). The La Palma maternity colony is located in a natural cave..

Nyctalus azoreum

Leonardo M. & Medeiros F.M., 2011. Preliminary data about the breeding cycle and diurnal activity of the Azorean bat (*Nyctalus azoreum*). *Açoreana*, 7: 139-148.

The main aim of this study is to get information about the breeding habits of the Azorean bat that can be crucial for its conservation. Of the 22 roosts detected, 17 were located on trees, 3 on houses and 2 on rocks. Most of the adult females (103) were captured at maternity colonies. By contrast only one adult male was captured. As expected, the males of the Azorean bat seem to be solitary. The maternity colonies are formed from April until September/October. Before that period the individual appear to be alone or in small groups as it is established for the closest related species, *Nyctalus leisleri*. Most of the juveniles are born from mid June to July, as with *N. leisleri*. The annual cycle of *N. azoreum* probably is monoesteric with delayed fertilization as it is usual for the bats of temperate zones. The emergence from the roosts occurs before sunset, although the other species of this genus tend to emerge later. This seems to be a peculiarity of this endemic species, probably related to the scarcity of diurnal predators in the Azores allowing this species to forage during the insect abundance peak period.

Salgueiro P., Palmeirim J.M., Ruedi M. & Coelho M.M., 2008. Gene flow and population structure of the endemic Azorean bat (*Nyctalus azoreum*) based on microsatellites: implications for conservation. *Conservation Genetics*, 9(5): 1163-1171.

The Azorean bat (*Nyctalus azoreum*) is endemic to the Azores archipelago and is listed as endangered due to its reduced and fragmented distribution range. We assessed genetic diversity at eight microsatellite loci in 280 individuals from 14 locations throughout six islands. Overall, we found that the Azorean bat populations are not genetically impoverished. Indeed, the number of alleles per locus ranged from 8 to 10 and the observed heterozygosity ranged from 0.77 in Terceira to 0.83 in Faial. The highest genetic diversity and level of private alleles was observed in S. Miguel, the largest island, and the closest to the mainland. Private alleles occurred at all islands except in Graciosa. Global and pairwise FST among islands were all statistically significant, suggesting restricted gene flow. These results, together with those of factorial correspondence analysis, Bayesian clustering method, and individual assignment tests, corroborate the conclusions of a previous mtDNA based study, providing strong support for the existence of two major subpopulations: one includes all islands of the Central Group and the other corresponds to S. Miguel. Gene flow between them is very limited, suggesting that management plans should avoid translocations between these subpopulations.

Salgueiro P., Coelho M.M., Palmeirim J.M. & Ruedi M., 2004. Mitochondrial DNA variation and population structure of the island endemic Azorean bat (*Nyctalus azoreum*). *Molecular Ecology*, 13(11): 3357-3366.

The Azorean bat *Nyctalus azoreum* is the only endemic mammal native to the remote archipelago of the Azores. It evolved from a continental ancestor related to the Leisler's bat *Nyctalus leisleri* and is considered threatened because of its restricted and highly fragmented distribution. We studied the genetic variability in 159 individuals from 14 colonies sampled throughout the archipelago. Sequences of the D-loop region revealed moderate but highly structured genetic variability. Half of the 15 distinct haplotypes were restricted to a single island, but the most common was found throughout the archipelago, suggesting a single colonization event followed by limited interisland female gene flow. All *N. azoreum* haplotypes were closely related and formed a star-like structure typical of expanded populations. The inferred age of demographic expansions was consistent with the arrival of founder animals during the Holocene, well before the first humans inhabited the Azores. Comparisons with a population of *N. leisleri* from continental Portugal confirmed not only that all *N. azoreum* lineages were unique to the archipelago, but also that the current levels of genetic diversity were surprisingly high

for an insular species. Our data imply that the Azorean bat has a high conservation value. We argue that geographical patterns of genetic structuring indicate the existence of two management units.

Irwin N.R. & Speakman J.R., 2003. Azorean bats *Nyctalus azoreum*, cluster as they emerge from roosts, despite the lack of avian predators. *Acta Chiropterologica*, 5(2): 185-192.

We tested the hypothesis that clustering in the behaviour of emerging bats is a response to the risk of avian predation. We hypothesised that if avian predation was the cause of clustering, bats in the prolonged absence of avian predators, would not cluster or would cluster less during their emergences. We studied the Azorean bat (*Nyctalus azoreum*) in the Azores Archipelago. The Azores have a depauperate fauna with no raptorial birds likely to predate bats. The Azorean bat is an endemic mammal to the archipelago, which has an unusually extensive degree of diurnal activity that has been hypothesised to reflect release from the risk of diurnal predation by raptors. Contrary to our prediction Azorean bats clustered during emergence to the same extent as bat species which occur where there are raptors. Two interpretations of these data are possible. First, the hypothesis that the behaviour is anti-predatory may be incorrect. Most of the variation in clustering was explained by variation in ambient temperature possibly suggesting the bats emerged in groups to aid exploitation of sparsely distributed food. Alternatively, the behaviour may be anti-predatory, but the key factor precipitating clustering may not be the risk from aerial predators, but terrestrial predators, such as rats (*Rattus norvegicus*) and cats (*Felis catus*), both of which were common around the roost sites.

Speakman J.R. & Webb P.I., 1993. Taxonomy, status and distribution of the Azorean bat (*Nyctalus azoreum*). *Journal of Zoology*, 231: 27-38.

The taxonomic status of the Azorean bat (*Nyctalus azoreum* Thomas, 1901) was assessed, by a principal components analysis of measurements of the external morphology of the bat, together with specimens of the closest related *Nyctalus* species from mainland Europe (*Nyctalus leisleri*). This analysis confirms the recent suggestion, based on a similar analysis of skull morphology, that the Azorean bat represents a good species, distinguished from *N. leisleri* by its smaller size-forearm lengths for *N. azoreum* in range 35.7-42.0 mm (n = 14), compared with 42.0-45.8 mm (n = 8) for *N. leisleri*. The status and distribution of the Azorean bat was assessed by a survey conducted in the islands in September and October 1988. We assessed the presence or absence of bats, in 62 (1' latitude x 1' longitude) plots at the west end of the island of Sao Miguel. The study area covered 6% of the total land area of the archipelago and contained representative areas of all the major island habitat types. A less intensive survey throughout four other islands, literature review and information from other sources revealed that the bat is probably distributed throughout the entire archipelago, with the possible exception of Flores and Corvo. Bats were active both in the day and at night. At night, bats were mostly active in coastal villages where they were closely associated with street lighting. During the day, most bats were active in the inland areas near to Caldeira lakes. The maximum number of bats observed simultaneously active in the day was six whilst at dusk swarms of up to 55 (+/- 5) bats were observed together. At night, bats were also active over approximately 1.5 x the area they occupied in the day. By assuming the bat is found throughout the archipelago, and that our study area was representative, we estimated the maximum population to be between 1750 (from daylight activity) and 23,650 (from nocturnal activity). This latter estimate implies a population density throughout the archipelago of around 0.1 bats per hectare.

Nyctalus lasiopterus

Dubourg-Savage M.J., Bec J. & Gaches L., 2014. Deuxième année de suivi des grandes noctules dans le Lévezou (Aveyron) : bref bilan 2013. *L'Envol des Chiros*, 16: 6.

Smirnov D.G. & Vekhnik V.P., 2014. Ecology of nutrition and differentiation of the trophic niches of bats (Chiroptera: Vespertilionidae) in floodplain ecosystems of the Samara Bend. *Biology Bulletin*, 41(1): 60-70.

A complex analysis of the food range of 15 bat species inhabiting floodplain ecosystems of the Samara Bend has been performed. It is shown that, in bats, an important component of the structuring of their communities is the division of food resources. The guild structure and position of species in the trophic space are described. Seven food guilds consisting of nonspecialized and specialized species are distinguished. It is noted that most species are characterized by a wide overlapping of their trophic niches, which may be a consequence of their weak competition in an environment that is rich in food resources.

Smirnov D.G. & Vekhnik V.P., 2013. Trophic ecology and predation of the greater noctule bat (*Nyctalus lasiopterus*) in Russia. *Biology Bulletin*, 40(2): 206-212.

The trophic ecology of *Nyctalus lasiopterus* in the Samara Bend during July 2008-2010 has been studied. It has been revealed that the main feeding stations for this species are old ecotonal black poplar stands and willow groves. *N. lasiopterus* keeps to opportunistic foraging by using easily accessible and properly sized food objects. Having analyzed 129 fecal samples, we singled out 10 categories of food objects belonging to six orders of insects. The representatives of Lepidoptera constitute the major part of the ration. Their abundance rates undergo asynchronous changes relative to each other. Homoptera and Neuroptera are found more rarely in the feces. Orthoptera and Diptera are extremely rare. Besides insects, bird feathers were found in 14 faecal samples of *N. lasiopterus*. They made up from 60 to 90% of the total fecal mass.

Dubourg-Savage M.J., Bec J. & Gaches L., 2013. First roosts of *Nyctalus lasiopterus* breeding females in France. *Barbastella*, 6(1): 44-50.

The studies on tree-dwelling bats were very scarce until recently, due to the difficulty of finding their roosts in forests. The giant noctule (*Nyctalus lasiopterus*, Schreber 1780) is one of those difficult forest species and probably the European rarest and least studied of them. However the development of bat detectors and of radio-tracking techniques have allowed increasing the knowledge on this elusive species.

Dupuy, H., 2013. Etude de trois espèces de Chiroptères forestiers dans le Lézérou : *Myotis bechsteinii*, *Plecotus auritus* et *Nyctalus lasiopterus*. Master 1 Ecologie, Université Paul Sabatier, Toulouse, 22p.

Dubourg-Savage M.J., Bec J. & Gaches L., 2012. Premières données de reproduction pour la Grande noctule (*Nyctalus lasiopterus*) en France. *Arvicola*, 20(2): 37-40.

The greater noctule (*Nyctalus lasiopterus*) is one of the least known bat species in Europe and has been evaluated as Near Threatened by the IUCN in 2008 due to deforestation and fragmentation of its habitat. In France it is considered as Data Deficient (2011) but the number of contacts with the species is increasing since 2005 and the first breeding colony has been discovered in 2012 in the Aveyron department in south-western France. Fifteen individuals were mist-netted from June 20th to August 28th, mainly females (9 adult females, 1 adult male, 4 juvenile females, 1 juvenile male). Radiotracking of three post-lactating females has allowed identifying two roosts. Mortality of greater noctule by wind turbines is reported from the area

Paksuz S. & Ozkan B., 2011. New distributional records and some notes for greater noctule, *Nyctalus lasiopterus* (Mammalia: Chiroptera) from Turkey. *Acta Zoologica Bulgarica*, 63(2): 213-216.

The greater noctule *Nyctalus lasiopterus* is one of the least known vespertilionid bats in Turkey, and more information is needed to evaluate its presence in Turkey. In this study, we report the species from Anatolia and the European part of Turkey. This is the first record from the European part of Turkey with an unusual roosting site. The recent records of *N. lasiopterus* from Turkey indicate that the species has a wide range in Turkey as a resident species, and its roosting habitats are represented by mainly mountainous and coniferous forests in Turkey.

Bec J., Haquart A. & Julien J.F., 2010. La grande noctule, *Nyctalus lasiopterus*, en France: synthèse de sa répartition et hypothèse pour ses préférences d'habitats. *Symbioses*, N.S. 25: 66-69.

The recent acoustic studies revealed an unexpected wide distribution of the greater noctule *Nyctalus lasiopterus* in southern France. This distribution overlaps with the large coniferous forest of pine-trees (Landes, southern Central Massif), fir-trees (northern Alps). Further investigations on roosts and diet are needed to explain this pattern.

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. *Symbioses*, N.S. 25: 1-8.

The study of the greater noctule *Nyctalus lasiopterus* in Corsica aimed to identify tree-roosts, foraging habitats and diet. The 21 radiotracked males occupied 49 tree-roosts, mainly in large dead trees and woodpecker hollows. Additional results on activity rhythm and duration of roost occupancy were obtained. Five main foraging areas were identified in mountain woodlands, particularly in laricio pines. Diet included mainly Coleoptera, Scarabaeidae in June-July, Cerambycidae and Chrysomelidae in the other months. Suggested conservation measures include guidelines for forestry practices.

Vlaschenko A., Gashchak S., Gukasova A. & Naglov A., 2010. New record and current status of *Nyctalus lasiopterus* in Ukraine (Chiroptera: Vespertilionidae). *Lynx*, n.s. 41: 209–216.

An immature male of the greater noctule, Europe's largest bat species, was netted on the Ilya River (51° 24' N, 29° 37' E) in the Chernobyl Exclusion Zone (northern Ukraine) during the night of 29–30 July 2009. This is the first record of the species in Ukraine in the last 50 years. All available data on the greater noctule obtained within the present borders of Ukraine since 1898 are also analyzed in the paper. Together with the latest finding, the total number of records of the greater noctule in Ukraine is 35 (64 specimens) at 19 localities. The total area used by the species in the breeding season was nearly 200,000 km² in the middle of the 20th century and only one specimen has been found there since that. On one hand our review suggests that the population of the greater noctule is in critical state, and needs higher conservation status than it has now, on the other hand it demonstrates a low level of bat research activities in Ukraine.

Fortuna M.A., Popa-Lisseanu G., Ibáñez C. & Bascompte J., 2009. The roosting spatial network of a bird-predator bat. *Ecology*, 90(4): 934-944.

The use of roosting sites by animal societies is important in conservation biology, animal behavior, and epidemiology. The giant noctule bat (*Nyctalus lasiopterus*) constitutes fission-fusion societies whose members spread every day in multiple trees for shelter. To assess how the pattern of roosting use determines the potential for information exchange or disease spreading, we applied the framework of complex networks. We found a social and spatial segregation of the population in well-defined modules or compartments, formed by groups of bats sharing the same trees. Inside each module, we revealed an asymmetric use of trees by bats representative of a nested pattern. By applying a simple epidemiological model, we show that there is a strong correlation between network structure and the rate and shape of infection dynamics. This modular structure slows down the spread of diseases and the exchange of information through the entire network. The implication for management is complex, affecting differently the cohesion inside and among colonies and the transmission of parasites and diseases. Network analysis can hence be applied to quantifying the conservation status of individual trees used by species depending on hollows for shelter.

Ibáñez C., Guillen A., Agirre-Mendi P.T. Juste J., Schreur G., Cordero A.I. & Popa-Lisseanu A.G., 2009. Sexual segregation in Iberian noctule bats. *Journal of Mammalogy*, 90(1): 235-243.

Sexual segregation during the breeding season is common in many temperate bat species, and may be related to sex-specific thermoregulatory, microclimatic, or energetic requirements. We compiled capture data for 3 species of *Nyctalus* (noctule bats) obtained over > 20 years to study reproductive and migratory strategies of these species in southwestern Europe. Within the Iberian Peninsula, several different strategies regarding sex distribution and migratory behaviour were observed within each of the three *Nyctalus* species. In the northern part of Iberia there are populations of the 3 species composed of males all year-round with females appearing only during the mating season. Reproduction by females in this area has not been confirmed. In central and Southern Iberia there are breeding populations in which sexual segregation occurs only at file roosts or at a regional scale, possibly with females located at lower elevations during the breeding season. Female-biased, long-distance migration is likely to be the cause of sexual segregation in populations of *N. noctula* and *N. leisleri* in northern and central Iberia, but not of *N. lasiopterus*, absent in central Europe. For this latter species, segregation by elevation also could occur in northern Iberia. The Iberian Peninsula is a good example of how breeding strategies and migratory behaviour in bats can be very flexible and vary across relatively small geographical scales.

Popa-Lisseanu A.G., Bontadina F. & Ibáñez C., 2009. Giant noctule bats face conflicting constraints between roosting and foraging in a fragmented and heterogeneous landscape. *Journal of Zoology*, 278(2): 126-133.

The tree-dwelling giant noctule *Nyctalus lasiopterus*, a partially carnivorous aerial-hawking bat, is one of the least known European bats, and more information is needed to evaluate its conservation status. Using radiotracking, we obtained the first data on spatial requirements and habitat preferences for the species in an area critically affected by deforestation. Two breeding populations separated by 60 km, one roosting in a city and the other in a nature reserve encircling a vast coastal marshland, showed marked differences in the size of their home ranges, but both used selectively the marshlands for foraging. Urban bats remained in the city for foraging during pregnancy in spring, but increased largely their home ranges towards the marshland during lactation in early summer. The nature reserve, with few roosting opportunities, was only a marginal roosting site for a population which switched between roosts located up to 90 km apart. Giant noctules had to travel long distances (up to 130 km recorded) to meet both foraging and roosting requirements within the fragmented landscape, exhibiting among the largest home ranges ever reported in Microchiroptera. To promote the protection of this threatened species, a network of artificial roosting options should be provided in good foraging habitats until long-term forest restoration is achieved.

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

In some group-living animals, societies are far from being static but are instead dynamic entities encompassing multiple scales of organization. We found that maternity colonies of giant noctule bats, *Nyctalus lasiopterus*, form fission-fusion societies, where group composition in single tree roosts changes on a daily basis but social cohesion in the larger group is preserved. The population inside a small city park was comprised of three distinct but cryptic social groups coexisting in close proximity. Each social group used a distinct roosting area, but some overlap existed in the boundaries between them. Social groups were stable at least in the midterm because adult females were loyal to roosting areas and young females returned to their natal social groups in successive years. Our results suggest that distinct social groups with separate roosting areas may have existed for at least 14 years. The findings described support the hypothesis that roost-switching behaviour in forest bats permits the maintenance of social bonds between colony members and enhances knowledge about a colony's roosting resources. Fission-fusion societies in forest bats might have evolved as a mechanism to cope with changing conditions in the environment by restructuring subgroups or adjusting subgroup size, to maximize the amount of information that can be transferred between colony members or as a consequence of territory inheritance by philopatric female offspring. Other factors such as resource competition or kin selection could limit the size and composition of fission-fusion societies and promote strong social structuring within populations.

Sané F., 2008. La Grande noctule *Nyctalus lasiopterus* (Schreber, 1780) en Lozère : résultats d'une semaine de suivi radio-téléométrique. *Le Vespère*, 1: 21-35.

Five greater noctules (4 males and 1 female) have been radiotracked between July 8 to 14, 2007 in la Biourière valley (Aubrac mountain, southern Central Massif). During 7 nights only 73 fixes were obtained and three roosts were located in a beech forest between 1100 and 1200 m a.s.l., two in *Populus tremula*, one in *Quercus* sp. Despite the small number of fixes most activity of bats was recorded in the valley at the beginning of the night. The most distant fixes for one male were 6.1 km away. The local population was estimated to reach 15 individuals.

Estók P., Gombkötö P. & Cserkész, T., 2007. Roosting behaviour of the greater noctule *Nyctalus lasiopterus* Schreber, 1780 (Chiroptera, Vespertilionidae) in Hungary as revealed by radio-tracking. *Mammalia*, 71(1-2): 86-88.

In 2004 and 2005 eleven greater noctules (8 females, 3 males) were fitted with VHF emitters to find their roosts. Nine roosts were located in beeches; their circumference varied from 106 to 216 cm, the height of the roost entrances between 6.1 and 15.5 m, their exposure were mainly south-west. In 2004 one female used five different cavities over five days. In some cases the greater noctules shared their roost with Leisler's bats (*N. leisleri*).

Estók P., 2007. Seasonal changes in the sex ratio of *Nyctalus* species in north-east Hungary. *Acta Zoologica Academiae Scientiarum Hungaricae*, 53(1): 89-95.

The sex ratios of *Nyctalus noctula*, *N. leisleri* and *N. lasiopterus* were studied in North-East Hungary between 1994 and 2006. Significant seasonal changes were found in the sex ratios of *N. noctula* and *N. leisleri*. *N. noctula* females were not present during nursing time, which means that the species do not form maternity colonies in the region. Females were observed in the spring and autumn which suggests considerable migration. In the cases of *N. leisleri* and *N. lasiopterus* females were dominant during nursing time.

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

Popa-Lisseanu A.G., Delgado-Huertas A., Forero M.G., Rodriguez A., Arlettaz R. & Ibáñez C., 2007. Bats' conquest of a formidable foraging niche: The myriads of nocturnally migrating songbirds. *PLoS One*, 2(2): e205.

Along food chains, i.e. at different trophic levels, the most abundant taxa often represent exceptional food reservoirs, and are hence the main target of consumers and predators. The capacity of an individual consumer to opportunistically switch towards an abundant food source, for instance, a prey that suddenly becomes available in its environment, may offer such strong selective advantages that ecological innovations may appear and spread rapidly. New predator-prey relationships are likely to evolve even faster when a diet switch involves the exploitation of an unsaturated resource for which few or no other species compete. Using stable isotopes of carbon and nitrogen as dietary tracers, we provide here strong support to the controversial hypothesis that the giant noctule bat *Nyctalus lasiopterus* feeds on the wing upon the multitude of flying passerines during their nocturnal migratory journeys, a resource which, while showing a predictable distribution in space and time, is only

seasonally available. So far, no predator had been reported to exploit this extraordinarily diverse and abundant food reservoir represented by nocturnally migrating passerines

Uhrin M., Kanuch P., Benda P., Hapl E., Verbeek H.D.J., Kristin A., Kristofik J., Masan P. & Andreas M., 2006. On the greater noctule (*Nyctalus lasiopterus*) in central Slovakia. *Vespertilio*, 9-10: 183-192.

Recent records of *Nyctalus lasiopterus* in central Slovakia are presented. Altogether, seven individuals were mist-netted in three sites there in 2005 and 2006. Data on the food composition and ectoparasites are added and the population status of the species in Slovakia is discussed.

Ibáñez C., Migens E. & Popa-Lisseanu A.G., 2004. Las Cotorras asilvestradas y los nóctulos gigantes en los parques urbanos de Sevilla. in: *Especies exóticas invasoras en Andalucía*. Junta de Andalucía, Consejería de Medio Ambiente, Sevilla, 185-187.

The giant noctule bat, although exhibiting a broad distribution, is a rare bat species outside the Iberian Peninsula. However, it can be locally abundant in Spain, where the population of the city of Seville is very likely to be the most important of the world. The occurrence of colonies of this bat inside an urban habitat is probably due to the presence of large trees with cavities, as these are used as day roosts. In the monitored populations, each familiar group uses several roosts simultaneously (up to 20 different tree roosts during the breeding season). For the persistence of a population, it is necessary to preserve a high number of potential tree roosts. The greatest threat for this species is the removal of old trees and the competition with *Psittacula* for suitable cavities for roosting. As availability of roosts tends to decline whereas the *Psittacula* population is increasing, urgent measures must be implemented, like installation of bat boxes in urban parks, monitoring programs of the breeding population of *Psittacula* and design of eradication campaigns.

Dondini G. & Vergari S., 2004. Bats: Bird-eaters or feather-eaters? A contribution to debate on great noctula carnivory. *Hystrix, Italian Journal of Mammalogy*, 15(2): 86-88.

Bontadina F. & Arlettaz R. 2003. A heap of feathers does not make a bat's diet. *Functional Ecology*, 17(1): 141-142

Ibáñez C., Juste J., García-Mudarra J.L. & Agirre-Mendi P.T. 2003. Feathers as indicator of a bat's diet: a reply to Bontadina & Arlettaz. *Functional Ecology*, 17(1): 143-145

Ibáñez C., Juste J., García-Mudarra J.L. & Agirre-Mendi P.T., 2001. Bat predation on nocturnally migrating birds. *Proceedings of the National Academy of Sciences of the United States of America*, 98(17): 9700-9702.

Bat predation on birds is a very rare phenomenon in nature. Most documented reports of bird-eating bats refer to tropical bats that occasionally capture resting birds. Millions of small birds concentrate and cross over the world's temperate regions during migration, mainly at night, but no nocturnal predators are known to benefit from this enormous food resource. An analysis of 14,000 fecal pellets of the greater noctule bat (*Nyctalus lasiopterus*) reveals that this species captures and eats large numbers of migrating passerines, making it the only bat species so far known that regularly preys on birds. The echolocation characteristics and wing morphology of this species strongly suggest that it captures birds in flight.

Dondini G. & Vergari S., 2000. Carnivory in the greater noctule bat (*Nyctalus lasiopterus*) in Italy. *Journal of Zoology*, 251: 233-236.

An analysis of 59 droppings of the greater noctule *Nyctalus lasiopterus*, collected either during direct handling of the bat or from the bat-boxes used as shelters in the plan di Novello Natural Reserve (Tuscany, Italy), has shown that it is a partial carnivore. The content of the samples, collected in October and November of 1995 and in September and October of 1996 and 1997, consisted mainly of bird feathers identified as those of the robin *Erithacus rubecula* and the blue tit *Parus caeruleus*. The presence of feathers during the 3 consecutive years of the study period confirms that the diet of the greater noctule in this area is not based exclusively on arthropods as was previously suggested.

Pipistrellus hanaki

Georgiakakis P., 2009. Geographical and elevational distribution, acoustic identification and ecology of Cretan bats [Geografiki kai ypsometriki katanomi, akoustikos prosdiorismos kai oikologia ton chiropteron tis Kritis]. Unpublished PhD Thesis, University of Crete, Biology Department. 275p.

Pipistrellus maderensis

Jesus J., Teixeira S., Freitas T., Teixeira D. & Brehm A., 2013. Genetic identity of *Pipistrellus maderensis* from the Madeira archipelago: a first assessment, and implications for conservation. *Hystrix, Italian Journal of Mammalogy*, 24(2): 177-180.

According to the IUCN global Red List, *Pipistrellus maderensis* is among the most endangered bat species in Europe. Its populations are scattered across some islands of the Atlantic Ocean, particularly Madeira and the Canary archipelagos. This geographical pattern is likely to result in significant genetic differences between populations which would have important implications to set conservation priorities. To test this hypothesis, we analyze cytochrome b sequences and compared populations from Madeira and the Canary islands. Five sequences from Madeiran individuals were analysed and compared to 30 sequences extracted from GenBank from *Pipistrellus maderensis* from the Canary Islands and *Pipistrellus kuhli*. Our results indicate a significant divergence between the two groups, smaller than between true species, but higher than intra-group divergence. However, further research on the Madeiran population is needed, including the use of sequences of other mitochondrial markers and nuclear marker and microsatellites.

Myotis escalerae

Hermida R.J. & Arzúa M., 2013. Utilización de refugios antrópicos por agrupaciones estivales de *Myotis escalerae* en Galicia. *Barbastella*, 6(1): 100-101.

Myotis escalerae es una especie de reciente reconocimiento mediante técnicas moleculares, perteneciente al complejo *Myotis cf. nattereri*. En Galicia la primera información sobre su distribución basada en ejemplares identificados mediante ADN se publicó en el Atlas de Morcegos de Galicia en 2008 (www.morcegosdegalicia.org). Desde entonces, *M. escalerae* ha sido identificado en una gran variedad de ambientes en 21 cuadrículas UTM 10x10 km de Galicia. Se ha descrito como una especie fundamentalmente cavernícola y fisurícola, que utiliza cavidades subterráneas y construcciones como refugio. En Galicia se han encontrado ejemplares aislados en cavidades subterráneas en distintas épocas del año, pero los 7 refugios estivales conocidos utilizados por agrupaciones de ejemplares, se hallan en construcciones humanas: obras de casas paralizadas (3), iglesias (2), viaductos (1), nave de ganado (1). Cuatro de ellas (2 obras, 1 iglesia y 1 nave de ganado) corresponden a agrupaciones de cría; una (iglesia) a una agrupación de machos y de las otras dos se desconoce el carácter de la agrupación. Una hembra radiomarcada al principio de la época de cría utilizó dos refugios en días consecutivos, una iglesia y un puente. Se muestran imágenes de los refugios conocidos y el tipo de oquedad utilizada por la agrupación y se realizan algunas consideraciones sobre su conservación.

Salicini I., Ibáñez C. & Juste J., 2012 El complejo *Myotis nattereri* en Iberia: una larga historia. *Barbastella*, 5(1): 3-7.

More than a century after the description of *Myotis escalerae* by Ángel Cabrera, modern genetic tools now shed new light on the enigma of the *Myotis nattereri* species complex. Using different genetic markers (mitochondrial and nuclear) and different approaches in the analysis, we reveal the presence of four different clades corresponding to phylogenetic species. Two new species of *Myotis* besides *M. nattereri* and *M. escalerae* are identified for the Western Palearctic. Nevertheless, taxonomic and morphologic descriptions are necessary if these new species are to be officially recognized. Two of these four species are present in the Iberian Peninsula; their taxonomic situation, distribution and the presence of diagnostic characters are discussed.

Agirre-Mendi P.T. & Ibáñez C., 2012. Primeros datos sobre la distribución de *Myotis cf. nattereri* y *Myotis escalerae* Cabrera, 1904 (Chiroptera: Vespertilionidae) en la Comunidad Autónoma de La Rioja. *Barbastella*, 5(1): 8-11.

This paper consists of a preliminary discussion of the chorology in the Autonomous Community of La Rioja (central northern Spain) of *Myotis cf. nattereri* and *Myotis escalerae* Cabrera, 1904, two recently segregated cryptic bat species. In all, 49 specimens from 11 localities in the northern sector of the mountains of the Sistema Ibérico and the Ebro river valley were identified by sequencing a fragment of approximately 700 bp of the mitochondrial cytochrome b. The preliminary distribution of *M. cf. nattereri* in La Rioja is restricted to high- and mid-altitude areas of these mountains (altitudinal range: 850–1984 m a.s.l.), whereas *M. escalerae* is found in low- and mid-altitude areas of the region in an altitudinal range of 336–1150 m a.s.l. The morphological differences between the two species are presented.