

19th Meeting of the Standing Committee
26th Meeting of the Advisory Committee

Online Meeting, 9 – 12 May 2022

Report of the Intersessional Working Group on Priority
Species for Autecological Studies



Eight years after the 7th Session of the Meeting of the Parties (MoP7), the list of priority species, that proved to be useful for fund raising to carry on autecological studies, will be revised. This list has not been updated despite the successive additions of new species to the Annex of the Agreement. As previously, it will include species of the IUCN red list as well as species with status 'data deficient'.

The revised list will be discussed at the 26th meeting of the Advisory Committee to EUROBATS from the prepared table in Annex A, that you are invited to fill in the four right columns summarising the most important knowledge on bat autecology for conservation.

Could you please evaluate the present knowledge (through bibliography) on these four components of the life cycle of bats as follows (for the whole list or only for species that you can evaluate):

0: no information

+: poor knowledge

++: defective knowledge

+++ : good knowledge

In order to show the recent advances on autecological studies of priority species for the last period (2014-2022) a list of references (with abstract when available) is given in Annex B. This list was prepared from Web of Science and Google Scholar and should be completed by references from regional journals and reports.

A draft resolution is provided in Doc.EUROBATS.StC19-AC26.13.

Annex A

	Global 2008	Redlists		Global 2022	Habitat Dir. Annex II	Roosts		Migra- tion	Foraging	
		Europe				Winter	Summer		Habitats	Diet
<i>Rousettus aegyptiacus</i>	LC	LC	LC	LC	x					
<i>Taphozous nudiventris</i>	LC	LC	LC	LC						
<i>Rhinolophus blasii</i>	LC	VU	LC	LC	x					
<i>Rhinolophus euryale</i>	NT	VU	NT	NT	x					
<i>Rhinolophus ferrumequinum</i>	LC	NT	LC	LC	x					
<i>Rhinolophus hipposideros</i>	LC	NT	LC	LC	x					
<i>Rhinolophus mehelyi</i>	VU	VU	VU	VU	x					
<i>Tadarida teniotis</i>	LC	LC	LC	LC						
<i>Miniopterus pallidus</i>	-	-	NT	NT						
<i>Miniopterus schreibersii</i>	NT	-	VU	VU	x					
<i>Eptesicus anatolicus</i>	-	-	LC	LC						
<i>Eptesicus isabellinus</i>	-	-	LC	LC						
<i>Eptesicus nilssonii</i>	LC	LC	LC	LC						
<i>Eptesicus ognevi</i>	LC	-	LC	LC						
<i>Eptesicus serotinus</i>	LC	LC	LC	LC						
<i>Otonycteris hemprichii</i>	LC	-	LC	LC						
<i>Barbastella barbastellus</i>	NT	VU	NT	NT	x					
<i>Barbastella caspica</i>	-	-	-	-						
<i>Plecotus auritus</i>	LC	-	LC	LC						
<i>Plecotus austriacus</i>	LC	NT	NT	NT						
<i>Plecotus gaisleri</i>	-	-	-	-						
<i>Plecotus kolombatovici</i>	LC	NT	LC	LC						
<i>Plecotus macrobullaris</i>	LC	NT	LC	LC						
<i>Plecotus sardus</i>	VU	VU	VU	VU						
<i>Plecotus teneriffae</i>	EN	VU	VU	VU						
<i>Nyctalus azoreum</i>	EN	VU	VU	VU						
<i>Nyctalus lasiopterus</i>	NT	DD	VU	VU						
<i>Nyctalus leisleri</i>	LC	LC	LC	LC						
<i>Nyctalus noctula</i>	LC	LC	LC	LC						
<i>Pipistrellus hanaki</i>	DD	-	VU	VU						
<i>Pipistrellus kuhlii</i>	LC	LC	LC	LC						
<i>Pipistrellus maderensis</i>	EN	VU	VU	VU						
<i>Pipistrellus nathusii</i>	LC	LC	LC	LC						
<i>Pipistrellus pipistrellus</i>	LC	-	LC	LC						
<i>Pipistrellus pygmaeus</i>	LC	LC	LC	LC						
<i>Vespertilio murinus</i>	LC	LC	LC	LC						
<i>Hypsugo savii</i>	LC	LC	LC	LC						
<i>Myotis blythii</i>	LC	NT	LC	LC	x					
<i>Myotis myotis</i>	LC	LC	LC	LC	x					
<i>Myotis punicus</i>	NT	NT	DD	DD						
<i>Myotis alcaethoe</i>	DD	DD	DD	DD						
<i>Myotis bechsteinii</i>	NT	VU	NT	NT	x					

<i>Myotis brandtii</i>	LC	-	LC						
<i>Myotis capaccinii</i>	VU	VU	VU	x					
<i>Myotis crypticus</i>	-	-	-						
<i>Myotis dasycneme</i>	NT	NT	NT	x					
<i>Myotis daubentonii</i>	LC	LC	LC						
<i>Myotis davidii</i>	-	-	LC						
<i>Myotis emarginatus</i>	LC	LC	LC	x					
<i>Myotis escaleraei</i>	-	-	LC						
<i>Myotis hovei</i>	-	-	-						
<i>Myotis mystacinus</i>	LC	LC	LC						
<i>Myotis nattereri</i>	LC	-	LC						
<i>Myotis schaubi</i>	DD	-	DD						
<i>Myotis tschuliensis</i>	-	-	-						

Autecological Research on Priority Species – 2014-2022***Rhinolophus blasii***

Dalhoumi, R., Hedfi, A., Aissa, P., & Aulagnier, S. (2014). Bats of Jebel Mghilla National Park (central Tunisia): first survey and habitat-related activity. *Tropical Zoology*, 27(2), 53-62. We surveyed the bat fauna of the Jebel Mghilla National Park (central Tunisia) in the five main habitats from the lowland to the summit: cultivated area, open juniper (*Juniperus* spp.) forest, *Stipa tenacissima* steppe, open and dense forest of *Pinus halepensis*, with a special emphasis on water bodies. We mist-netted three bat species: *Eptesicus isabellinus*, *Myotis emarginatus* and *Myotis punicus*. We also identified echolocation calls of *Rhinolophus blasii*, *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Tadarida teniotis*, *Miniopterus schreibersii*, *Pipistrellus kuhlii*, *Plecotus gaisleri* and *Hypsugo savii*. *Pipistrellus kuhlii* and *E. isabellinus* were the most active and widely distributed species. The bat fauna was richer in the dense and open pine forest than in cultivated area and open juniper forest, but water bodies are also very attractive for bats.

Farfar, A., Bendjedou, M.L., Bouslama, Z., Metallaoui, W., Korba, R.A., Amr, Z., & Baker, M.A.A. (2017). Bats of the El Kala Biosphere Reserve, northeastern Algeria (Chiroptera). *Lynx, ns (Praha)*, 48, 79-92. Twelve bat species representing four families (Rhinolophidae, Miniopteridae, Vespertilionidae, and Molossidae) were recorded in sites representing nine different habitats of the El Kala Biosphere Reserve and its vicinity in northeastern Algeria. *Myotis emarginatus* showed the highest frequency, it was found at five sites, *Rhinolophus hipposideros*, *Eptesicus isabellinus* and *Miniopterus schreibersii* at four sites, while *Rhinolophus euryale*, *R. blasii*, *Myotis punicus*, *Pipistrellus kuhlii* and *Tadarida teniotis* in three localities each. Species richness (total number of species within a site) ranged between 1 and 8 (mean 4.33). The annual activity pattern of all species was recorded by one netting session per month per locality in the course of two years.

Jére, C., Bücs, S., Csősz, I., Szodoray-Parádi, F., & Barti, L. (2017). The northernmost *Rhinolophus blasii* colony in Europe: permanent presence in the Pădurea Craiului Mountains, Romania. *North-Western Journal of Zoology*, 13(1), 163-168. The status and distribution of Blasius's horseshoe bat *Rhinolophus blasii* in Romania is largely unknown. Historical records suggest the presence of the species mainly in the south-western part of the country, and also in the lower Mureș Valley, Metaliferi and Trascău Mountains. However, old faunistic data are questionable, due to

the difficult identification of medium-sized horseshoe bats and also due to the sympatric presence of the Mediterranean horseshoe bat *Rhinolophus euryale*. Recent and regular monitoring in North-Western Romania confirms the presence of the species in the Gălășeni Cave, Pădurea Craiului Mountains, in the northern part of the Apuseni mountains range. Formerly considered to be a 100% *R. euryale* colony, it is actually a colony where there are indications of seasonal *R. blasii* dominance. With this data, we provide the northernmost distribution point of *R. blasii* in Europe.

Petrov, B., Alexandrova, I., Karadakov, V., Georgieva, T., Toshkova, N., & Zhelyazkova, V. (2014). Bats (Mammalia: Chiroptera) in Ponor special protection area (Natura 2000), Western Bulgaria: species diversity and distribution. Acta Zoologica Bulgarica, 65(Suppl 5), 117-128. High diversity of bats was recorded in Ponor Special Protection Area (Ponor SPA). Thirty-five roosts (29 caves, 4 buildings, 1 gallery and 1 tunnel) were surveyed between 1913 and 2013. Twenty-three species (*Rhinolophus blasii*, *R. euryale*, *R. ferrumequinum*, *R. hipposideros*, *Myotis alcathoe*, *M. bechsteinii*, *M. blythii*, *M. brandtii*, *M. capaccinii*, *M. daubentonii*, *M. emarginatus*, *M. myotis*, *M. mystacinus*, *M. nattereri*, *Nyctalus noctula*, *Pipistrellus pipistrellus*, *Plecotus austriacus*, *P. auritus*, *Barbastella barbastellus*, *Eptesicus serotinus*, *Hypsugo savii*, *Miniopterus schreibersii* and *Vespertilio murinus*) were recorded in Ponor SPA. Habitat heterogeneity, variety of karstic landforms and availability of numerous underground roosts are considered as key reasons for this high diversity. Cave-dwelling species such as *R. ferrumequinum*, *R. hipposideros*, *M. myotis* and *M. blythii* are the most commonly found in the mountain. Maternity colonies were found only for *R. hipposideros*. Breeding of other species was not confirmed in any of the studied roosts in 2011 and 2012. Hibernating individuals of nine species were found in 28 caves. The highest diversity of bats was found during the autumn swarming in Dinevata Peshtera Cave (17 species), Dushnika Cave (14 species), Svinskata Dupka Cave (12 species), Golyamata Balabanova Dupka Cave (11 species) and Travninata Cave (10 species). The richest region is Iskrets - Dobravitsa with 18 species occurring in it.

Presetnik, P., Mulaomerovic, J., & Dervovic, T. (2014). First confirmation of *Rhinolophus blasii* in Bosnia and Herzegovina and its possible maternity roost. in: XIIIth European Bat Research Symposium, 1-5 September 2014, Šibenik, Croatia. Book of abstracts. Croatian Biospeleological Society, Zagreb, 136. *Rhinolophus blasii* is the rarest horseshoe bat in the western Balkans and, as such, the most endangered. Its range has shrunk in the past, since the species died out in northern Italy and Slovenia. It is still found in a few caves of the Croatian inland

Mediterranean area and some islands where some winter and summer colony roosts are known. For Montenegro, the situation is not so clear, and in Albania the species is considered widespread, but apparently declining. In Bosnia and Herzegovina only one location was known up to now, in the vicinity of Sarajevo, and originating from the year 1891. This record is considered dubious, since it falls outside the expected range of the species. Therefore, the 2013 observation of a colony of *R. blasii* in the vicinity of Mostar is considered the first reliable data for this species in the country. A colony of approximately 50–70 *R. blasii* was found in the entrance part of the cave Prosječnica, on 16 August, during a survey of caves in the framework of the project Bats in the Neretva River Catchment Area. The group of *R. blasii* dwelt together with a few individuals of *R. euryale*. During evening mistnetting in front of the cave entrance 5 adult, 2 sub-adult and 7 juvenile females and 16 juvenile males of *R. blasii* were captured, together with 1 sub-adult female, 1 adult and one juvenile male of *R. euryale*. With ultrasound detector also *R. hipposideros* was recorded in the cave. Additionally, 7 *Myotis oxygnathus*, 3 *M. nattereri*, 1 *M. emarginatus*, 1 *Hypsugo savii* and 2 *Miniopterus schreibersii* were caught but most probably did not roost in the cave. The presence of *R. blasii* juveniles indicates that the cave is serving as a maternity roost, however, since our first visit on 29 June 2013 there were no bats in the cave, this colony possibly has an additional maternity roost somewhere in the vicinity. Currently bats are disturbed by occasional tourist visits, which are also not safe for tourists themselves, since unexploded bombs are scattered in the cave entrance. Conservation management for this cave habitat is of utmost importance for the conservation of *R. blasii* in the area.

Théou, P., & Loce, E. (2017). First data on bats (Chiroptera) for Vlora Bay and Sazan Island, Albania. *Barbastella*, 10(1), 1-7. With 32 species recorded so far, Albania is one of the most important European countries in terms of bat diversity. However available data concerning the repartition of these species within the country is still very limited. For the first time, researches on bats were conducted in a key area of the country for biodiversity: Vlora Bay. During 5 years (2012-2016), at least 16 species (*Rhinolophus ferrumequinum*, *R. hipposideros*, *R. blasii*, *R. euryale*, *Myotis oxygnathus*, *M. capaccinii*, *M. emarginatus*, *Nyctalus leisleri*, *N. noctula*, *Pipistrellus kuhlii*, *P. pipistrellus*, *P. pygmaeus*, *Hypsugo savii*, *Plecotus kolombatovici*, *Miniopterus schreibersii*, *Tadarida teniotis*) were recorded in diverse habitats, including the main island of the country: Sazan Island. With this study we are providing new data for rarely recorded species such as *P. kolombatovici* and *N. leisleri* and enriching available data on bats in the South-West Balkans. This study aims to support the implementation of

conservation plans in Albania and to consolidate national monitoring of these protected species.

Eptesicus isabellinus

Cruz, J., Sarmiento, P., Rydevik, G., Rebelo, H., & White, P.C.L. (2016). Bats like vintage: managing exotic eucalypt plantations for bat conservation in a Mediterranean landscape. *Animal Conservation*, 19(1), 53-64. The transformation of native habitats into forest plantations for industrial purposes frequently has negative consequences for biodiversity. We evaluated the impact of eucalypt plantations on native bats in a Mediterranean area, taking Portugal as a case study. We compared the overall bat activity, species richness and Kuhl's bat *Pipistrellus kuhlii* (the most abundant bat species in the area) activity between eucalypt plantations and native montado habitat, and examined the influence of stand, landscape and survey variables within plantations on the response variables. A set of 11 plantation stands, three landscape and two survey variables were employed as predictor variables using a zero-inflated Poisson generalized linear mixed model. Hawking and generalist bats of the genus *Pipistrellus* were the most frequently detected species. Bat activity, species richness and *P. kuhlii* activity were higher in native montado than in any of the eucalypt stands. Mature eucalypt plantations showed the highest bat activity, while clear-cut areas showed the lowest. Generally, within eucalypt stands, complex high-level vegetation structure, from the ground level up to 3 m high, and proximity to water points were associated with higher levels of bat and *P. kuhlii* activity and species richness. The results suggest that in order to promote bat diversity and activity in exotic eucalypt plantations in the Mediterranean region, it is important to provide a high density of water points, maintain plots of mature plantations and promote understorey clutter.

Dalhouni, R., Aissa, P., & Aulagnier, S. (2016). Bat species richness and activity in Bou Hedma National Park (central Tunisia). *Turkish Journal of Zoology*, 40(6), 864-875. In order to investigate the likely contact of the Mediterranean and Saharan faunas, we surveyed bats in six different habitats of Bou Hedma National Park for 1 year. We sampled bats monthly by mist-netting and echolocation call detection at two basins, Bordj and Nouh, the Bou Hedma wadi, and open and dense acacia forest and steppe. We identified 13 species, among which *Pipistrellus kuhlii*, *Eptesicus isabellinus*, and *Miniopterus schreibersii* were the most abundant and frequent, followed by *Tadarida teniotis*, *Plecotus gaisleri*, and two Saharan species, *Rhinopoma cystops* and *Otonycteris hemprichii*. We also rarely recorded four rhinolophids: *Rhinolophus euryale*, *R. ferrumequinum*, *R. hipposideros*, and *R. mehelyi*. Bat activity was recorded

throughout the year in the six habitats, water bodies being more attractive than dry habitats for both Mediterranean and Saharan taxa. The wadi was the preferred habitat of *R. cystops*, *T. teniotis*, and *O. hemprichii*. The open acacia forest was attractive only during the flowering season. Species richness and bat activity peaked in late spring and reached the lowest values, but was still present, during winter.

Dalhousmi, R., Aissa, P., Beyrem, H., & Aulagnier, S. (2020). Bat species richness and activity in Dghoumes National Park (Southwest Tunisia): a preliminary survey. *Arxius de Miscellània Zoològica*, 18, 89-100. Bat species richness and activity in Dghoumes National Park (Southwest Tunisia): a preliminary survey. Bat fauna in eight of the main habitat types of Dghoumes National Park was inventoried using mist-netting, acoustic detection and roost search. Bats were active at night and recorded near water bodies and street lamps. We recorded the echolocation calls of six bat species: *Eptesicus isabellinus*, *Pipistrellus kuhlii*, *Vansonia rueppellii*, *Asellia tridens*, *Tadarida teniotis* and *Rhinopoma cystops*. Two bat colonies containing 111 individuals of *R. cystops* were found roosting in Jebel Morra cave and 54 individuals of *A. tridens* were found roosting in the ceiling of the Ecomuseum. Due to potential disturbance by visitors to the museum, we suggest strengthening management practices to ensure the usage of this roosting site in order to promote the conservation of *A. tridens*.

Dalhousmi, R., Hedfi, A., Aissa, P., & Aulagnier, S. (2014). Bats of Jebel Mghilla National Park (central Tunisia): first survey and habitat-related activity. *Tropical Zoology*, 27(2), 53-62. We surveyed the bat fauna of the Jebel Mghilla National Park (central Tunisia) in the five main habitats from the lowland to the summit: cultivated area, open juniper (*Juniperus* spp.) forest, *Stipa tenacissima* steppe, open and dense forest of *Pinus halepensis*, with a special emphasis on water bodies. We mist-netted three bat species: *Eptesicus isabellinus*, *Myotis emarginatus* and *Myotis punicus*. We also identified echolocation calls of *Rhinolophus blasii*, *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Tadarida teniotis*, *Miniopterus schreibersii*, *Pipistrellus kuhlii*, *Plecotus gaisleri* and *Hypsugo savii*. *Pipistrellus kuhlii* and *E. isabellinus* were the most active and widely distributed species. The bat fauna was richer in the dense and open pine forest than in cultivated area and open juniper forest, but water bodies are also very attractive for bats.

Dalhousmi, R., Morellet, N., Aissa, P., & Aulagnier, S. (2017). Seasonal activity pattern and habitat use by the Isabelline serotine bat (*Eptesicus isabellinus*) in an arid environment of Tunisia. *Acta Chiropterologica*, 19(1), 141-153. The seasonal activity of the Isabelline serotine bat *Eptesicus isabellinus* was studied in eight habitats

of the Bou Hedma National Park, central Tunisia. From June 2010 to June 2011 two techniques, mist-netting and echolocation call recording, were implemented. This bat species was captured throughout the year but only at water bodies and particularly at Nouh basin. Captures peaked in late spring - early summer, and declined in winter. Pregnant females were captured from April to June, and lactating females in May and June. Echolocation calls were recorded throughout the year, but not every month in all habitats. Most activity was reported at water bodies and street lamps. Activity peaked in late spring and early autumn, and declined during winter period. Terminal buzzes were mainly detected at basins, peaking in late spring - early summer and early autumn. Our study provided further insights on the importance of water bodies which should draw particular attention in the management plan of the national park and in the whole country.

Dalhouni, R., Nefla, A., Bedoui, W., Ouni, R., Aissa, P., & Aulagnier, S. (2019). Preliminary study of habitat-related bat fauna of Mastouta-Bishshouk region (northwest Tunisia). Vestnik Zoologii, 53(1), 23-30. In order to define appropriate conservation measures in northern Tunisia we surveyed the bat fauna of Mastouta-Bishshouk region in both roosting sites and foraging areas. A total of 11 species was recorded. We found only three occupied roosts including a maternity colony of *Rhinolophus ferrumequinum*, *Miniopterus schreibersii* and *Myotis cappacinii* in a train abandoned tunnel. A tunnel of water channel hosted *Rhinolophus mehelyi*, *M. schreibersii* and *M. punicus*. Echolocation calls were recorded at a bridge over Beja Wadi, at an artificial basin, and in crop fields. Bat activity was the highest at the bridge in late March, and null in the harvested crop fields in late August. *Pipistrellus kuhlii* was the most active bat species in the three sites, *Pipistrellus pipistrellus* was the second most active species, followed by *Eptesicus isabellinus*. *Plecotus gaisleri* and *Myotis punicus* were detected only once at the bridge and the basin respectively. This bat assemblage is representative of the bat fauna of northern Tunisia. Roost and foraging area surveys strongly benefit acoustic recording, even in winter when some bats remain active. The rare local underground roosts should be protected from human disturbance and the water quality of Majerda Wadi should be improved.

Lisón, F., & Calvo, J.F. (2014). Bat activity over small ponds in dry Mediterranean forests: implications for conservation. Acta Chiropterologica, 16(1), 95-101. In dry Mediterranean forests, ponds constitute essential water resources for animals, especially during summer months. In south-eastern Spain, land use changes and the human abandonment of mountainous zones have led to the loss of many ponds. These

ponds are scarce landscape elements, and, despite their usually small size (1,000 m²), they support a considerable amount of biodiversity. We studied the patterns of use of these ponds by bats during the activity season in dry forest landscapes of a Mediterranean region using acoustic monitoring. Our hypothesis was that these ponds are valuable landscape elements for bats, and bat activity and richness species will be high over them. Bat activity and species richness were compared between ponds and adjacent sampling points in the forest matrix. We recorded 14 bat species and our results show that both general bat activity (all species grouped together) and species richness were higher in the ponds than in the forest areas. Bat activity was higher in June, however it decreased during drier months (July–August), while activity in the forest increased. The number of species was constant in the areas surrounding the ponds through the study period, but in the forest, we observed an increase in July and a gradual decrease in August–September. Similar results were obtained for most individual species, although in some species activity was also influenced by temporal variables. Our study shows that the maintenance of small ponds may have important consequences for bat conservation, as they support high bat diversity, including some species of conservation concern like horseshoe bats (*Rhinolophus* spp.) or *Myotis* spp.

Lisón, F., Espinosa, J.A.L., Calvo, J.F., & Jones, G. (2015). Diet of the Meridional serotine *Eptesicus isabellinus* in an urban semiarid Mediterranean landscape. *Acta Chiropterologica*, 17(2), 371-378. The Meridional serotine *Eptesicus isabellinus* (Temminck, 1840) has recently been identified as a cryptic species that occurs in the south of the Iberian Peninsula. Little is known about its ecology. We used morphological analysis of droppings from an urban semiarid Mediterranean landscape to determine seasonal differences in diet. We identified 15 insect prey types and found significant seasonal differences in the consumption of seven prey types. The diet of *E. isabellinus* was dominated by Scarabaeidae (Coleoptera) and Diptera, and there were seasonal changes in the consumption of Carabidae (Coleoptera), Lepidoptera and Cercopidae (Hemiptera). Shannon-Wiener and Levins' indices showed that the diet was more diverse during the post-hibernation and pregnancy periods. Pianka's index showed that there was relatively low dietary overlap between periods. The seasonal changes recorded between different physiological periods could be related to changes in the energetic needs of the individual or to variation in prey availability. Although *E. isabellinus* mainly eats Scarabaeidae and Diptera, it can show flexibility for example by hunting insects that fly around blossoms such as chafers *Melolontha* spp.

Lisón, F., Haz, Á., & 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. Diversos estudios moleculares han revelado recientemente la existencia de una segunda especie del género *Eptesicus* en la península ibérica: el murciélago hortelano meridional *E. isabellinus*. Dicha especie se encuentra en el sur de la península y parece tener una distribución alopátrica con su especie gemela *E. serotinus*. Debido a la reciente separación entre ambas, es necesario realizar estudios que amplíen el conocimiento sobre la ecología de *E. isabellinus*. En este trabajo se han empleado datos sobre la presencia de la especie en la Región de Murcia (SE de España) para elaborar modelos de nicho ecológico (MNE) y el correspondiente mapa de idoneidad de hábitat. Los resultados revelan que la especie tiene un índice de marginalidad bajo, lo que sugiere una buena adaptación a las condiciones ambientales semiáridas de la zona de estudio. El principal hábitat utilizado por la especie son los cursos de agua, las zonas de matorral y, en general, los ecosistemas con una elevada productividad. Por el contrario, la especie parece evitar las zonas agrícolas de secano y no muestra especial preferencia por las zonas más humanizadas ni los cultivos de regadío. La información proporcionada por este estudio contribuye al conocimiento de la ecología de *E. isabellinus* y los resultados del modelo de distribución permiten discutir sobre los aspectos importantes para su conservación.

Loumassine, H.E., Bonnot, N., Allegrini, B., Bendjeddou, M.L., Bounaceur, F., & Aulagnier, S. (2020). How arid environments affect spatial and temporal activity of bats. *Journal of arid environments*, 180, 104206. Arid environments are characterized by resource fluctuations that lead to spatial and temporal variability in species abundance, resulting in low species diversity. This study aimed to determine the activity patterns and habitat use by bats in an arid environment in western Algeria (Bechar region). In 2016, six sites were studied using acoustic bat detection. A total of 10 species were reported: *Asellia tridens*, *Rhinopoma cystops*, *R. microphyllum*, *Tadarida teniotis*, *Miniopterus schreibersii*, *Eptesicus isabellinus*, *Hypsugo savii*, *Otonycteris hemprichii*, *Pipistrellus kuhlii* (including *P. kuhlii kuhlii* and *P. kuhlii deserti*) and *Vansonia rueppellii*. Activity varied considerably from month to month and from site to site. Bats were particularly active in the spring and autumn. The first activity peak coincides with pregnancy (late April), followed by relatively low activity in August, probably due to summer torpor induced by high temperatures. The second peak in October coincides with mating and storage reserves before winter. Water bodies, oasis and urban lights concentrate bat activity. These results confirm the previously reported

major role of water bodies in arid environments for bats. Further surveys should be carried out in the region and conservation measures should be taken to protect known roosts.

Mendes, E.S., Pereira, M.J.R., Marques, S.F., & Fonseca, C. (2014). A mosaic of opportunities? Spatio-temporal patterns of bat diversity and activity in a strongly humanized Mediterranean wetland. *European Journal of Wildlife Research*, 60(4), 651-664. The Baixo Vouga Lagunar (BVL) landscape, in the Portuguese central-west coast, harbours a mosaic of wetland habitat types, interspersed by intensive and extensive agricultural fields, pastures, production forests and urban areas. In this study, we aimed to determine the species composition and the structure of the bat assemblages of the different habitats that constitute this heterogeneous landscape and to investigate seasonal changes in the patterns of bat diversity and activity across habitats. We acoustically sampled bats across 24 sampling sites representative of the eight main habitat types that shape the landscape—Bocage, forests, maize fields, marshlands, reed beds, rice fields, sea rushes and urban settlements. We compared bat richness, diversity and evenness across habitat types and seasons. We analysed habitat-specific and season-specific overall bat activity, and because habitat selection by bats is known to reflect morphological characters, foraging strategies and echolocation call structures, we also analysed the activity of individual species and of eco-morphological guilds. From 1,544 bat-passes recorded, we identified 12 species. *Pipistrellus pygmaeus*, *Pipistrellus pipistrellus* and *Eptesicus serotinus/Eptesicus isabellinus* were the most frequently recorded. Species composition and activity were similar across habitats, whilst exhibiting strong seasonal dynamics within habitats. Our results suggest that the mosaicism of the landscape provides several opportunities for bats, enabling them to explore different resources in distinct habitat patches. However, it may also reflect a forced exploitation of less optimal habitats and resources by bats, due to the scarcity of opportunities provided by fragmented landscapes.

Plecotus kolombatovici

Đaković, M. (2017). Modeli rasprostranjenosti i ekološke značajke dugoušana (rod *Plecotus*; Chiroptera, Mammalia) u Hrvatskoj (Distribution models and ecological features of long-eared bats (genus *Plecotus*; Chiroptera, Mammalia) in Croatia). Doctoral Dissertation, University of Zagreb. Faculty of Science. Department of Biology, 97p + annexes. The main aim of this study was to model the potential distribution of four *Plecotus* species in Croatia, examine the differences in their ecological niches and determine their conservation status in Croatia. The predictive

models were built using the Ecological Niche Factor Analysis (ENFA) and the maximum entropy modelling method (Maxent), while the studied species' ecological niches were compared by using the ENMTools software. The species *P. auritus* prefers forest habitats at higher altitudes and a lower summer temperature. *P. austriacus* is tied to anthropogenic habitats and avoids forest habitats. *P. kolombatovici* prefers forest habitats and high summer temperature. *P. macrobullaris* prefers cooler and humid habitats at higher altitudes. *P. macrobullaris* occupies the widest ecological niche, while by far the narrowest niche of all four studied species belongs to *P. kolombatovici*. The largest overlap of ecological niches is between *P. macrobullaris* and *P. auritus*, while the smallest niche overlap can be found between *P. auritus* and *P. kolombatovici*. New conservation statuses were suggested for all four species.

Grubač, B. (2017). Record of kolombatovic's long-eared bat *Plecotus kolombatovici* Đulić, 1980 (Chiroptera, Mammalia) at the Hilandar monastery estate: Athos Peninsula, Greece. *Zaštita Prirode*, 67(1-2), 63-70. In this paper the author presents data on the record of Kolombatovic's long-eared bat *Plecotus kolombatovici* Đulić, 1980 at the estate of Hilandar Monastery (Athos Peninsula, Greece) collected during research conducted from 2015 to 2017. A small group consisting of no more than 8 individuals was recorded in a summer shelter at the Saint Sava's Tower on August 23, 25 and 26, 2015, and only one individual on September 17, 2016. Furthermore, one individual probably belonging to the same species was recorded at the Tower of King Milutin on September 28, 2017. The author provides detailed description of the site of the record – summer roost, and the immediate surroundings that represent their habitat - hunting ground, as well as other details related to the record.

Schofield, H., Damant, C., Hamidović, D., Žvorc, P., Crnčević, M., Rnjak, D., Zrncic, V., Glover, A., Krstinić, B., Krstinić, D., & Hysom, I. (2019). Report on the bats of Lokrum. Surveys, monitoring, radio-telemetry, buildings assessment and a mitigation- compensation plan for the benedictine monastrey and Maximillian tower. Vincent Wildlife Trust, 45p. No abstract.

Schofield, H., Hamidović, D., Glover, A., Krstinić, B., & Krstinić, D., Rnjak Kovac, D., Crnčević, M., (2018). Radio-tracking reveals the roosting and foraging behaviour of *Plecotus kolombatovici* on Lokrum Island, Dubrovnik. in: Regional Symposium "Conservation Status of Bats in The Central Europe and Western Balkan" Sarajevo, 31.5 - 1.6.2018. Program and book of abstract. *Plecotus kolombatovici* is restricted to islands and the coastal strip along the western Adriatic

from northern Croatia down to Greece. It was identified as a separate species in 2001, consequently, little is known of its roosting and foraging ecology; information that is critical to the conservation of this species. The presence of *P. kolombatovici* on Lokrum Island was confirmed by HBSD in the summer 2016 during surveys of the island to inform a management plan for the conservation of bats around the historical buildings on the island. This discovery led to a radio-telemetry study of the species to determine the roosting areas in the buildings and provide wider advice on protecting this species on the island. Seven females were caught in mist-nets on Lokrum in June 2017 and fitted with 0.38 g radio-transmitters. The bats were radio-tracked for six nights, and data were collected on their foraging locations, activity patterns and the roosts. The bats foraged in the native woodlands on the island as well as in non-native woodland in the Botanical gardens. There was considerable overlap in the core foraging areas of the tagged bats and the location of their principal foraging areas was strongly associated with the location of their day roosts. Day roosting was recorded in the historical buildings on the island but also in sea caves and trees.

Plecotus sardus

Bosso, L., Mucedda, M., Fichera, G., Kiefer, A., & Russo, D. (2016). A gap analysis for threatened bat populations on Sardinia. *Hystrix, the Italian Journal of Mammalogy*, 27(2), 212-214. A gap analysis for threatened bat populations on Sardinia Sardinia is home to three bat species of chief conservation importance, the endemic *Plecotus sardus* as well as *Myotis punicus* and *Rhinolophus mehelyi*, for which the island constitutes the Italian stronghold. We carried out two gap analyses by overlapping the network of protected areas present on Sardinia respectively with 1) the occurrence records of all species and 2) the binarized maps obtained from maximum entropy models. Unlike the other two species, *P. sardus* known records are confined to the central sector of the island and its suitable habitat partly overlaps with that of *M. punicus* but not with *R. mehelyi*. Due to its uniqueness and restricted range *P. sardus* requires a very specific management strategy for its protection to be successful. Both analyses led to the conclusion that all species considered require more extensive protection than is currently granted so that urgent measures should be taken to improve the current situation.

Plecotus teneriffae

Nyctalus azoreum

Rainho, A. (2021). Positive interactions drive bat distribution in a remote Oceanic archipelago (Azores, Portugal). *Diversity*, 14(1), 17. One of the fundamental interests

in ecology is understanding which factors drive species' distribution. We aimed to understand the drivers of bat distribution and co-occurrence patterns in a remote, insular system. The two bat species known to occur in the Azores archipelago were used as a model. Echolocation calls were recorded at 414 point-locations haphazardly distributed across the archipelago. Calls were analysed and assigned to each species. Binominal generalised linear models were adjusted using different descriptors at two scales: archipelago and island. The presence of the co-occurring species was included at both scales. The results show that island isolation, habitat and climate play an essential role on the archipelago and island scales, respectively. However, the positive interaction between bat species was the most critical driver of species' distribution at the island scale. This high co-occurrence pattern at the island scale may result from both species' maximising foraging profit in a region where prey abundance may be highly variable. However, further research is necessary to clarify the mechanisms behind this positive interaction. Both species are threatened and lack specific management and protection measures. Maintaining this positive interaction between the two species may prove to be fundamental for their conservation.

Nyctalus lasiopterus

Bartonička, T., Miketová, N., & Hulva, P. (2019). High throughput bioacoustic monitoring and phenology of the greater noctule bat (*Nyctalus lasiopterus*) compared to other migratory species. *Acta Chiropterologica*, 21(1), 75-85.

Conventional monitoring tools are seldom effective for studying the ecology of rare and elusive mammals. In the present study, we use automated ultrasound detectors to provide information about seasonal activity of the Greater noctule bat (*Nyctalus lasiopterus*), the largest and one of least known European bats. We selected localities within Central Europe with diverse geomorphological contexts, including rivers of different sizes and mountain passes. The study demonstrates the capability of the automatic recording approach to achieve bioacoustic discrimination of this species, but also pointed to the persistent need of integrating results from automatic classification software applications with the feedback from manual approaches. The high throughput capacity of the assay proved to be efficient, and the regular occurrence of the species was identified at two localities. These locations are associated with two known and intensely used migratory corridors of winged animals going through Vltava River valley and Červenohorské Saddle in Jeseníky mountains, as illustrated also by the activity patterns of other migratory species. Together with the occurrence of spring and autumn peaks in activity, these findings are in concordance with the plesiomorphic condition in

pipistrelloid bats, showing also migratory behaviour, and represent further indirect evidence of migration of the Greater noctule. This pattern could be facilitated by the trophic niche of the species, involving predation of migrating songbirds. Differences in phenology of migratory species observed at particular sites likely mirror position of the locality in relation to migration flyways, seasonal and geographic variation in prey availability and energy demands etc. Further application of bioacoustic monitoring and other tools is necessary to obtain detailed information about the range and movement ecology of the species in higher latitudes.

Beucher, Y., Darnis, T., & Parmin, V. (2022). Utilisation de balises GPS pour étudier l'écologie de la Grande noctule (*Nyctalus lasiopterus*) : retours d'expériences. Symbioses, 39-40 : 37-48. L'écologie de vol de la Grande noctule et globalement l'ensemble des comportements de son activité nocturne sont largement méconnus en France. Ces lacunes sont un enjeu de conservation majeur pour une espèce considérée comme sensible à certaines menaces parfois fortes localement (exploitation forestière, éolien...). Depuis 2017, pour compenser ces lacunes, les chiroptérologues d'EXEN et de l'ONF testent et adaptent l'utilisation de la technologie GPS sur différentes populations connues de grandes noctules. Le type de balise et leur mode de mise en œuvre pour cette espèce ont déjà évolué et permettent aujourd'hui le recueil de données précieuses pour préciser les sites de chasse, les hauteurs de vol, les domaines vitaux, le rythme d'activité.. Les premiers résultats permettent de percevoir l'extraordinaire aptitude de l'espèce à exploiter des zones de chasse parfois très éloignées des gîtes et parfois très hautes, ce qui remet en question la notion de ségrégation sexuelle en phase d'activité, de colonies pourtant distantes de plusieurs dizaines de kilomètres. Ils témoignent de plusieurs stratégies de recherche alimentaire chez les individus (prospections aléatoires ou prédictives). Ils traduisent d'étonnantes capacités de mémorisation spatiale et interrogent sur les raisons de longues séquences de vol à des niveaux de plateaux de haute altitude localisés dans l'espace. Ces résultats confirment l'intérêt évident de cette technologie pour compléter les connaissances à l'échelle de l'espèce mais aussi de façon plus appliquée à l'échelle d'une population. À terme, la miniaturisation des balises devrait ouvrir une nouvelle page des techniques de chiroptérologie.

Boisgontier, Q. (2014). Habitat de la Grande noctule (*Nyctalus lasiopterus*) dans le Lévézou, Aveyron (12). Master 1 Ecologie, Univ. Paul Sabatier, Toulouse, 13p. No abstract.

Cruz, J., Sarmiento, P., Rydevik, G., Rebelo, H., & White, P.C.L. (2016). Bats like vintage: managing exotic eucalypt plantations for bat conservation in a Mediterranean landscape. *Animal Conservation*, 19(1), 53-64. The transformation of native habitats into forest plantations for industrial purposes frequently has negative consequences for biodiversity. We evaluated the impact of eucalypt plantations on native bats in a Mediterranean area, taking Portugal as a case study. We compared the overall bat activity, species richness and Kuhl's bat *Pipistrellus kuhlii* (the most abundant bat species in the area) activity between eucalypt plantations and native montado habitat, and examined the influence of stand, landscape and survey variables within plantations on the response variables. A set of 11 plantation stands, three landscape and two survey variables were employed as predictor variables using a zero-inflated Poisson generalized linear mixed model. Hawking and generalist bats of the genus *Pipistrellus* were the most frequently detected species. Bat activity, species richness and *P. kuhlii* activity were higher in native montado than in any of the eucalypt stands. Mature eucalypt plantations showed the highest bat activity, while clear-cut areas showed the lowest. Generally, within eucalypt stands, complex high-level vegetation structure, from the ground level up to 3 m high, and proximity to water points were associated with higher levels of bat and *P. kuhlii* activity and species richness. The results suggest that in order to promote bat diversity and activity in exotic eucalypt plantations in the Mediterranean region, it is important to provide a high density of water points, maintain plots of mature plantations and promote understorey clutter.

Cuzin, F. (2017). Au sujet de quelques nouvelles données ultrasonores sur la Grande noctule (*Nyctalus lasiopterus* Schreber, 1774) au Maroc. *Bulletin de l'Institut Scientifique, Rabat, Section Sciences de la Vie*, 39, 27-35. The Greater noctule bat, *Nyctalus lasiopterus* Schreber, 1774, is a species considered rare in North Africa. However, ultrasound detection has allowed it to be detected in more regions of Morocco than previously known (Central Plateau, Central and Southern Middle Atlas). The parameters of calls are presented. The species is often present in various forest habitats with a high density of tall trees, notably mature cedar, holm oak, cork oak or cultivated olive trees. It has until now been detected most frequently in the holm oak forest of Bou Idmouma (Southern Middle Atlas).

De la Cruz Sánchez, A., Fuentes, M.M., & Fuentes, F.M. (2020). Nuevas citas e incidencias en parques eólicos de Nóctulo pequeño (*Nyctalus leisleri*, Khul 1817), Nóctulo mediano (*Nyctalus noctula*, Schreber 1774) y Nóctulo grande (*Nyctalus lasiopterus*, Schreber 1780) en la provincia de Soria (España). *Journal of Bat*

Research & Conservation, 13(1), 12-19. Forest chiropterans have in general, been little studied until the appearance of ultrasound detectors and vocalization recognition and identification programs, which has facilitated their detectability and study. In addition, at the peninsular level, the data and records of these bats are relatively scarce. With this note we expand the range of distribution of the noctules bats in the Iberian Peninsula and the information on incidents in wind turbines. The presence in the province of Soria of *Nyctalus leisleri* and *Nyctalus noctula* is at the moment anecdotal, while for the *Nyctalus lasiopterus* it is somewhat more frequent. Recently it has been described the presence of an agrupation of *Nyctalus noctula* in Almazán (Soria), has been described with sightings since 2016, as well as a *Nyctalus leisleri* and *Nyctalus lasiopterus* in the area known as Pinar Grande to the northwest of Soria. In this work we provide new citations from accident studies in wind farms in the province obtained from the database of the Junta de Castilla y León, where the presence of these species is verified between 2005 and 2019, as well as other citations collected in the last years through sampling using networks and ultrasound detectors. The specimens of *Nyctalus noctula* found during the studies in wind farms in the south of the province that could be sexed (26% of the total losses) were all males, probably males in the mating phase from the La Arboleda de Almazán park. In the case of the *Nyctalus lasiopterus*, the citations were scattered throughout the province, but recurring in recent years. In contrast, small nodule appointments were especially rare in wind turbines.

Dombrovski, V.C., Fenchuk, V.A., & Dietz, M. (2017). Unique colony of *Nyctalus lasiopterus* in Pripyat Polesie (Southern Belarus). “Stary Zhaden” nature reserve (51,9 N 27,6 E) hosts the only known maternity colony of the Greater noctule in Belarus. Since the discovery of the species at Stary Zadzien in 2015, 16 greater noctules have been caught and 11 (all females) marked and radotracked. All tracked bats belonged to one colony with a complicated territorial-temporal structure \pm 11 identified roosting tree holes located 0,05 to 4,6 km from each other, and the colony occupied an area of at least 5 km². All marked bats regularly changed tree holes, groups occupying tree holes were always mono-specific with usually 3-6 (1-18, n=18) animals in a hole. In two cases when bats were caught when leaving the hole, the groups consisted of one (non-breeding female) and four (two lactating females, one non-breeding female and one adult male) bats accordingly. The total colony size is at least 18 bats. Over half occupied roosting trees were standing dead pines, which confirms the significance of dead wood for biodiversity conservation.

Dubourg-Savage, M.J., Gaches, L., Bec, J., & Beucher, Y. (2014). The Greater noctule (*Nyctalus lasiopterus*) in France: distribution, ecology and conservation issues. in: XIIIth European Bat Research Symposium, 1-5 September 2014, Šibenik, Croatia. Book of abstracts. Croatian Biospeleological Society, Zagreb, 61. The first hint of possible breeding of the Greater noctule bat, *Nyctalus lasiopterus*, in France was in July 2006 when a dead lactating female was found on the Atlantic coast (Landes department). Since then, development of ultrasonic surveys for environmental impact assessments and mortality monitoring, at wind farms increased the number of contacts with the species all over southern France. However, it was not until the end of June 2012 that the first roosts were discovered, of breeding females in the Lévézou (Aveyron department, Midi-Pyrénées) and another colony (sex unknown) about 180 km to the north, in the Puy-de-Dôme department (Auvergne region). Both areas are part of the same geographical region, the Massif Central. We used different techniques for our studies: bat detector surveys, mist-netting and telemetry, with bat detectors at dawn to follow by car and foot a flying individual to its day roost, as well as afternoon listening for social calls in woods to locate roosts. Up to now the presence of 61 greater noctule bats has been assessed in the Lévézou district and other colonies are likely. In the Puy-de-Dôme, 29 individuals were counted leaving the roost, but several groups seem to cohabit in the same forest where more than 70 potential roosts are available. During the 2012-2013 study, 32 greater noctule bats were mist-netted in the Lévézou and nine females were radio-tracked. In the Puy-de-Dôme one non-breeding female was briefly followed by telemetry in 2013. We present here the first results of this dual study: the arrival of the species in spring (data from 2014), the parturition period that apparently starts at the end of May or beginning of June, the type of habitats and roosts, the results of the study on summer diet by comparing prey DNA from the faeces with GenBank database, and some behavioural notes. Finally, we also present new prospects for the study of the Greater noctule bat and its conservation

Dundarova, H., Michev, B., & Pandourski, I. (2022). Bats over the Western Black Sea open water area. Acta Zoolica Bulgarica, in press. Migration activity of bats of *Pipistrellus nathusii* across the European seas have been reported mainly for the North and Baltic Sea basins. Recently, we have recorded the species for first time within the Bulgarian Black Sea exclusive economic zone (100 km off the country's coast). In addition, six species, i.e., *Myotis daubentonii*, *Nyctalus leisleri*, *N. lasiopterus*, *Pipistrellus pipistrellus*, *P. nathusii* and *Eptesicus serotinus*, were identified over St. Anastasia Island in the Burgas Bay. These results suggest the necessity for organisation of a long-term acoustic monitoring for determination of bat migration

movements along the Bulgarian Black Sea coast and in open sea areas using ships and platforms.

Estok, P., Görföl, T., Szoke, K., & Barti, L. (2017). Records of Greater noctule bat (*Nyctalus lasiopterus*) from Romania-with new additions. *North. West. J. Zool*, 13, 375-376.

Gaches, L. (2020). La Grande noctule *Nyctalus lasiopterus* aveyronnaise (secteur du Lévezou). Bilan et synthèse des connaissances sur l'écologie de populations de femelles (de juin 2012 à juillet 2017). *Symbioses*, 38 : 63-66. L'article présente les résultats de six ans (juin 2012 à juillet 2017) de suivi de la colonie de mise bas de Grande noctule dans le Lévezou (Aveyron). Le suivi télémétrique de plusieurs femelles a permis la découverte de 35 arbres-gîtes dans 9 bois différents, l'ensemble étant réparti sur une surface de 23 km². La très grande majorité des gîtes est dans des hêtres de taille relativement grande et proches des lisières des boisements. Les comptages simultanés en sortie de gîtes ont permis d'estimer la taille minimale de cette population à plus de 243 individus. Bien que difficile, la télémétrie a permis d'identifier des prairies humides, des lisières de bois, le dessus de la canopée, des ripisylves ainsi que des plans d'eau dégagés utilisés comme terrains de chasse. La période de mise bas est entre fin mai et début juin et les premiers jeunes volants sont observés fin juillet.

Garin, I., Aihartza, J., Goiti, U., Arrizabalaga-Escudero, A., Noguerras, J., & Ibáñez, C. (2019). Bats from different foraging guilds prey upon the pine processionary moth. *PeerJ*, 7, e7169. Outbreaks of the processionary moth *Thaumetopoea pityocampa* (Denis & Schiffermüller, 1775), a forest pest from the Palearctic, are thought to induce a behavioural response of bats, but up to now the moth has been seldom identified as bats' prey. Studies on bat diets suggest moths with cyclical outbreaks attract a wide array of bat species from different foraging guilds. We test whether bats feed upon *T. pityocampa* in the Iberian Peninsula irrespective of the predator's ecological and morphological features. We found that seven out of ten bat species belonging to different foraging guilds contained *T. pityocampa* DNA in their faeces and no difference was found in the foraging frequency among foraging guilds. A different size of the typical prey or the lack of fondness for moths can explain the absence of the pest in some bat species. Moreover, the intraspecific foraging frequency of *T. pityocampa* also changed with the sampling site likely representing differential availability of the moth. Lack of information on flight and dispersal behaviour or the tympanate nature of the adult moth complicates understanding how different foraging guilds of bats prey upon the same prey. Our data suggests that *T. pityocampa* is a

remarkable food source for many thousands of individual bats in the study area and we anticipate that more bats besides the species studied here are consuming this moth.

Gual-Suárez, F., & Medellín, R.A. (2021). We eat meat: a review of carnivory in bats. *Mammal Review*, 51(4), 540-558. Some bat species in the families Phyllostomidae, Megadermatidae, and Nycteridae have long been known to consume terrestrial vertebrates and, more recently, reports of aerial-hawking vespertilionid carnivores have surfaced. We review the diets, hunting behaviour and roosting ecology of 17 bat species that are known to consume terrestrial vertebrates: *Vampyrum spectrum*, *Chrotopterus auritus*, *Trachops cirrhosus*, *Macroderma gigas*, *Megaderma (Lyroderma) lyra*, *Nycteris grandis*, *Nyctalus lasiopterus*, *Nyctalus aviator*, *Ia io*, *Antrozous pallidus*, *Cardioderma cor*, *Phyllostomus hastatus*, *Mimon (Gardnerycteris) crenulatum*, *Mimon cozumelae*, *Tonatia saurophila*, *Tonatia bidens*, and *Lophostoma silvicolium*. Data on their diet and roosts were obtained from 241 original works, with considerable differences in the amount of research and information available among species. Carnivorous bats were found to belong to an ecologically diverse group and share little but their diet. Therefore, we define a carnivorous bat as a bat that, either year-round or seasonally, uses terrestrial vertebrates as the main component of its diet, at least in part of its geographic range. We conclude from available data that *Mimon crenulatum*, *Lophostoma silvicolium*, *Mimon cozumelae*, *Phyllostomus hastatus*, *Tonatia bidens*, *Tonatia saurophila*, *Cardioderma cor*, and *Antrozous pallidus* use vertebrates as a minor part of their diet and should not be considered carnivorous. The nine other species we reviewed do fit into the definition of carnivorous bats, and can be further subdivided based on their ecology and the seasonality of their habits into three categories: year-round predominantly gleaning carnivores (*Chrotopterus auritus*, *Trachops cirrhosus*, and *Vampyrum spectrum*), seasonal predominantly gleaning carnivores (*Megaderma lyra*, *Macroderma gigas*, and *Nycteris grandis*) and seasonal aerial-hawking bird-eating carnivores (*Ia io*, *Nyctalus aviator*, and *Nyctalus lasiopterus*).

Guixé, D., Camprodon, J., Casbas, G., Roca, E., Lorente, L., Alcalde, J.T., Jato, R., & Popa, A. (2018). Novedades en las poblaciones de *Nyctalus lasiopterus* en el noreste ibérico. 7th SECEMU Conference. Programme & abstracts, 70. We provide new data on the populations of the Greater noctule bat (*Nyctalus lasiopterus*) in the Pyrenees (Catalonia, Aragon and Navarre). A total of 60 individuals were captured, and a further 24 were radio-tracked to enhance our current knowledge about their population and conservation status, deepen our understanding about their migratory movements and roost selection, and to develop technical guidelines for their conservation in relation

to forest management. We have identified 7 new zones and 2 breeding colonies in Aragon. In addition, habitat suitability models and isotope analysis have been used to obtain new data on migratory movements of European populations. Roost selection by *Nyctalus lasiopterus* was determined by comparing the characteristics of the occupied cavities with the closest potential roosts (50m range) in three different types of forests of the Iberian northeast. With a total of 57 occupied roosts and 35 potential roosts, the cavities, tree-shelters and surroundings were characterized. *Nyctalus lasiopterus* basically occupied woodpecker holes. However, they didn't discriminate on the type of cavity, but chose them because they were the most abundant in the surroundings. They also occupied cavities in decaying and ageing tree trunks and in stakes. The majority of the cavities are in areas of easy movements by the noctules, with less tree density in the proximity of the cavity. It is recommended that all potential cavities are preserved, especially those located near occupied ones. The availability of cavities could be reinforced with bat boxes and girdling trees to cause their decay. The models have helped to find new populations, for example, in Teruel and in the Puertos de Tortosa, and are seen as a tool of interest. Initial results using isotopes provide interesting data on the disparity in the origin and migration routes of the Greater noctule on a Pyrenean scale. Specifically, it is predicted that the females captured in autumn and winter in Fageda d'en Jordà (NE of Catalonia) are migrating and that they come from regions located further north than all the sampled populations, probably from the northern half of France or even further north.

Hernández Brito, D. (2018). El nóctulo gigante amenazado por una especie invasora: una competencia desigual por los nidos y el carisma de la sociedad. 7th SECEMU Conference. Programme & abstracts, 14-15. Biological invasions are one of the greatest threats facing global biodiversity, where certain negative interactions between invasive and native species, such as resource competition, can cause the extinction of native populations. The Ring-necked parakeet (*Psittacula krameri*) is one of the most successful invasive birds and can compete for nesting sites with the native fauna. In an urban park in the city of Seville, the largest population of this invasive species in Spain, coexists with the largest known population of Greater noctule bat (*Nyctalus lasiopterus*), the largest bat species in Europe and classified as Vulnerable. Both species nest in tree cavities and the decline of the network of roosts available to the Greater noctule bat, due to the tenacious competition of the Ring-necked parakeet, has been studied over a 15-year period. Using aggression, and even causing death, the Ring-necked parakeet has been evicting the Greater noctule bat from its historical roosts. Moreover, the constant population growth of the parakeets exacerbates this

scenario and endangers the continuity of a population crucial for this endangered species. Although urban areas can provide shelter for threatened species, unfortunately they do the same for invasive species. Given the lack of public awareness of the problems that biological invasions can bring and the incalculable value of native species, where the appeal of a certain species has more weight than its ecological importance, this can finally lead to the wrong actions being taken causing insurmountable problems further down the line. Therefore, immediate action is urgently needed from public authorities, under scientific supervision, for the joint implementation of effective measures to eradicate the Ring-necked parakeet and for the conservation of the Greater noctule bat.

Ibáñez, C. et al. (2021). Movements of ringed Greater noctule (*Nyctalus lasiopterus*) in Southwestern Europe: Conservation implications. VIII Jornadas SECEMU. Programme & abstracts, 56-58. From 1999 to 2021, more than 2600 greater noctules (*Nyctalus lasiopterus*) were ringed over a large part of the Iberian Peninsula (52% females). The 18% of these noctules were recaptured at least once. Most of the recaptures (97%) took place in the same location that the ringing (roost or mist-netting) or within 5 km of this point, were carried out by the ringing group itself, and maintains the sex ratio of the ringings (50% females). This is explained by the strong philopatry of this species together with the capture methods used. The rest of the recaptures happened after movements between 15 and 80 km, associated with changes of roost. These movements were due to daily foraging in very extensive roosting areas with sparse and fragmented forest cover along the Bajo Guadalquivir (87% females). In addition, there were three recaptures, all of them females, more than 150 km from the ringing place that could be related to seasonal migratory movements: Olot (Girona, Spain) to Vézins-de-Lévézou (Occitanie, France), 240 km; Seville (Spain) to Alegrete (Portalegre, Portugal), 237 km; Villoslada de Cameros (La Rioja, Spain) to Valsalobre (Cuenca, Spain), 167 km. The Greater noctule is considered as “Vulnerable” in both the IUCN Red List and the Spanish Catalogue of Threatened Species. Some of the movements of more than 25 km take place over deforested landscapes with wind farms where significant mortality of this species has been detected. It is urgent to increase the knowledge on the movement routes of greater noctules in order to reduce mortality and prevent the location of new wind farms. Recaptures also provide information on longevity, with one case of at least 14 years old and another eight cases over 10 years.

Ibáñez, C., Popa-Lisseanu, A.G., Pastor-Beviá, D., García-Mudarra, J.L., & Juste, J. (2016). Concealed by darkness: interactions between predatory bats and nocturnally migrating songbirds illuminated by DNA sequencing. *Molecular ecology*, 25(20), 5254-5263. Recently, several species of aerial-hawking bats have been found to prey on migrating songbirds, but details on this behaviour and its relevance for bird migration are still unclear. We sequenced avian DNA in feather-containing scats of the bird-feeding bat *Nyctalus lasiopterus* from Spain collected during bird migration seasons. We found very high prey diversity, with 31 bird species from eight families of Passeriformes, almost all of which were nocturnally flying sub-Saharan migrants. Moreover, species using tree hollows or nest boxes in the study area during migration periods were not present in the bats' diet, indicating that birds are solely captured on the wing during night-time passage. Additional to a generalist feeding strategy, we found that bats selected medium-sized bird species, thereby assumingly optimizing their energetic cost-benefit balance and injury risk. Surprisingly, bats preyed upon birds half their own body mass. This shows that the 5% prey to predator body mass ratio traditionally assumed for aerial hunting bats does not apply to this hunting strategy or even underestimates these animals' behavioural and mechanical abilities. Considering the bats' generalist feeding strategy and their large prey size range, we suggest that nocturnal bat predation may have influenced the evolution of bird migration strategies and behaviour.

Kovalov, V., Hukov, V., & Rodenko, O. (2019). New record of *Nyctalus lasiopterus* (Schreber, 1780) in Ukraine with a new confirmation of carnivory. *North-Western Journal of Zoology*, 15(1). The IUCN red list in 2016 classified *Nyctalus lasiopterus* (Schreber, 1780) as vulnerable. Consequently, *N. lasiopterus* appears to be the most threatened forest-dwelling bat species in Europe. Each record of *N. lasiopterus* is therefore important for the understanding of traits of species ecology, which need to be transformed into effective conservation strategies. Five immature *N. lasiopterus* individuals were mist-netted in the Kharkiv region (north-eastern Ukraine) at night time between the 30th and the 31st of July, 2016. This is the first record of *N. lasiopterus* in the Kharkiv region since 1955. Fecal analysis of caught individuals showed presence of feathers in the faecal pellets. Additionally, we reviewed the results of intensive mist-netting research on forest-dwelling bats in the Kharkiv region. More than 5200 specimens of 12 bat species were captured between 1999 and 2016 in main woodland areas of the Kharkiv region. Current records of *N. lasiopterus* complement information about bat community and could be explained both by migration and by the existence of a breeding colony in survey site.

Langheld, M. (2017). The impact of predation by the Tawny owl *Strix aluco* on the roost switching behavior of the Greater noctule bat *Nyctalus lasiopterus*. **Doctoral dissertation, Universität Hamburg.** No abstract.

Lehto, H.J., Kuitunen, K., & Vasko, V. (2021). Changes in the Finnish Bat fauna: long distance vagrancy of Greater noctule bat *Nyctalus lasiopterus* and first singing Parti-colored bat *Vespertilio murinus*. **EBRS 2021 Turku. Book of abstracts, 113.** We present here two single bat observations from Finland. A Greater noctule bat (*Nyctalus lasiopterus*) was flying high in Kaarina, SW Finland, on Sept 5, 2015, about five minutes before heavy rain from a line of thunderclouds begun. This is the first documented observation in Finland for the species. The following morning a large flux of Pallid harriers (*Circus macrourus*) noted in Finland. Both species originate in an overlapping zone in South-East Europe. The co-temporal arrival can be understood as caused by weather patterns. In a scheme for monitoring bats around water bodies in SW Finland, we detected echolocation sounds of two Parti-colored bats (*Vespertilio murinus*). After a couple of nights on Aug 28, 2019 one of the bats produced a display song. This is to our knowledge the first record of a singing Parti-colored bat in Finland. We will discuss the different vagrancy patterns of these records. We will also discuss shortly the implication of correct audio techniques and suitable spectrum analysis techniques used for these findings.

Michaux, J., André, A., & Dubourg-Savage, M.J. (2022). Etude du régime alimentaire de la Grande noctule (*Nyctalus lasiopterus*) par métabarcoding. **Symbioses, 39-40 : 33-36.** Le régime alimentaire de la Grande noctule a été étudié par une analyse de métabarcoding à partir de 33 fèces collectées dans différentes régions de France. Les résultats ont montré la présence de plusieurs espèces de vertébrés dans le régime alimentaire de la Grande noctule, comme plusieurs espèces d'oiseaux mais également des chauves-souris. De nombreuses espèces d'insectes et d'arachnides ont également été identifiées. Cette étude démontre que la Grande noctule présente un régime alimentaire riche et diversifié, de type assez opportuniste. Ces résultats doivent cependant être pris avec précaution et démontrent par ailleurs l'importance d'une grande prudence lors de l'échantillonnage afin d'éviter tout risque de contamination.

Nad'ò, L., Lóbbová, D., Hapl, E., Cel'uch, M., Uhrin, M., Šara, M., & Kaňuch, P. (2019). Highly selective roosting of the Giant noctule bat and its astonishing foraging activity by GPS tracking in a mountain environment. **Mammal Research, 64(4), 587-594.** The Giant noctule, *Nyctalus lasiopterus*, is the largest and one of the

least studied bat species in Europe with decreasing population trend. Due to its rarity, knowledge about its ecology and spatiotemporal activity is very fragmented. During two late-summer seasons, nine individuals were tracked using either radio-transmitters or GPS devices in an isolated population breeding in the Muránska planina Mts (Carpathians, Slovakia), which is an area characterized by distinct mountain landscape considerably different from the main species range. The bats roosted exclusively in mature aspen trees, *Populus tremula*, with decayed heartwood (n=20 cavities in 18 trees) and located in sparse unmanaged natural mixed forests. Using GPS tracking technology (15–23 nights for each of three females), we found that the bats have large foraging home ranges (on average a minimum convex polygon 430 km², average of 95% kernel density estimate of 361 km²) and had long foraging transits (up to ~130 km) with large distance from the roosting area (up to ~49 km). The bats foraged at altitudes from 1013 to 1308 m a.s.l. (max 2666 m a.s.l.), and from 124 to 367 m (max 1659 m) above ground. Novel information about roosting ecology and the spatiotemporal foraging patterns in a mountain environment is very important for conservation of this enigmatic bat in Central Europe.

Pastor Beviá, D. (2017). Ecología trófica del nóctulo grande (*Nyctalus lasiopterus*), un murciélago depredador de aves. Tesis doctoral, Universidad de Alicante, 91p. No abstract.

Pastor-Beviá, D., Ibáñez, C., García-Mudarra, J.L., & Juste, J. (2014). A molecular approach to the study of avian DNA in bat faeces. *Acta Chiropterologica*, 16(2), 451-460. The molecular identification of prey in faeces is an efficient non-invasive technique to study diet which requires both a satisfactory method of DNA extraction and the design of specific primers to selectively amplify prey's DNA. In this study we evaluated and compared the efficiency of two total DNA extraction methods and five primer pairs for the molecular identification of birds from scats, in particular from the Giant noctule bat (*Nyctalus lasiopterus*). A modified DNA stool Mini Kit of Qiagen was tested against a modified silica method with a guanidinium thiocyanate (GuSCN) applied after freezing and pulverizing the samples. We also checked two published vertebrate- and bird-generalist primer pairs and three bird-specific primer pairs designed by us (two pairs targeting the cytochrome *b* and one the cytochrome oxidase subunit I genes) that amplified shorter DNA fragments. The results show that pulverizing the scat remains before extraction was a very important step, presumably facilitating access to the well preserved DNA located inside the rachis of the feathers. The combination of our bird-specific designed primers showed a higher amplification rate than the generalist primers

and allowed successful bird identification from the feathers excreted by the Giant noctule bat in all the scat samples analyzed, independent of the preservation method used (dried and frozen). These methodological improvements will allow not only the study of the avian diet composition of the enigmatic giant noctule, but the extension of this methodology to other bird predators such as raptors.

Rigolot, C. (2018). Caractéristiques des gîtes arboricoles de la Grande noctule *Nyctalus lasiopterus* dans le Lézou (Aveyron). Master 1 Biodiversité Ecologie Evolution, Université Paul Sabatier, Toulouse, 13p + annexes. La Grande noctule étant la plus grande chauve-souris d'Europe, elle reste cependant très peu connue et étudiée. Malgré une large répartition elle est assez rare. Ce Chiroptère arboricole est aujourd'hui menacé par la sylviculture et le développement de l'énergie éolienne. La protection des gîtes qu'elle utilise est primordiale pour la conservation de l'espèce. En France, une population de femelles s'est installée pour mettre bas et allaiter dans le Lézou (Aveyron). Une population de mâles est également installée en Auvergne. Les gîtes arboricoles des grandes noctules présentent plusieurs caractéristiques : le nombre d'arbres gîtes et la diversité dans le bois sont importants pour ces chauves-souris, il y a une faible distance de l'arbre gîte à la lisière, ces gîtes se trouvent plutôt dans des forêts de moyens à gros bois, ils comprennent une hauteur du gîte de 9 à 10 m, un diamètre de l'arbre à hauteur du gîte de 41 à 45 cm et une ouverture de cavité préférentiellement orientée à l'est pour les femelles. Les arbres répondant à ces caractéristiques sont fortement susceptibles d'héberger des grandes noctules et doivent donc être protégés pour maintenir un nombre suffisant de gîtes afin de permettre aux populations présentes de se maintenir et si possible, d'augmenter leurs effectifs.

Sánchez-Navarro, S., Rydell, J., & Ibáñez, C. (2019). Bat fatalities at wind-farms in the lowland Mediterranean of southern Spain. *Acta Chiropterologica*, 21(2), 349-358. Wind energy is an important source of bat mortality worldwide. Extensive mortality data were gathered by a provincial surveillance program carried out at wind farms in lowland Mediterranean areas of the province of Cadiz, Andalusia (South Spain) between 2005 and 2016. As many as 2,371 bat fatalities were found. We determined the patterns of fatality in this sample and tested the quality of the surveillance program used. The data generally support previous observations regarding the seasonal timing, the species affected and the sex and age of fatalities. However, contrary to studies made at higher latitudes, fatalities mostly (95%) affected sedentary species and occurred on wind farms in flat landscape used for farming and livestock rearing. The current operational surveillance programme did not focus on bats initially, and,

consequently, we urge that an improvement should consider a standardized search methodology including bats, verification of species identity, precise data collection, and mandatory and regular scavenger-removal and search-efficiency trials, in order to obtain correctly adjusted fatality estimates that can be used for efficient mitigation or compensatory measures.

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 non-specialized 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.

Snit'ko, V.P., & Snit'ko, L.V. (2021). The first record of the Greater noctule bat (*Nyctalus lasiopterus*) in the Southern Urals. Biology Bulletin, 48(7), 1104-1106. The presence of the Greater noctule bat (*Nyctalus lasiopterus*), the largest and least studied species of bat in the western Palaearctic, was revealed for the first time in the southern Urals. In June–August 2018, three young females of *N. lasiopterus* were captured on the banks of the Nugush Reservoir between the Belaya and Nugush rivers, Meleuzovskii district, Bashkortostan. The nearest known locality of the species lies 300 km to the west, at Obshchiy Syrt Hill, Buzuluksky Bor. The present record of the Greater noctule allows for its eastern range limit to be clarified, also indicating the reproduction of this species in the southern Urals.

Thurrow, A., Beucher, Y. & Dubourg-Savage, M.J. (2018). Foraging flights of the Greater noctule (*Nyctalus lasiopterus*). 7th SECEMU Conference. Programme & abstracts, 58. The Giant noctule (*Nyctalus lasiopterus*) is a rare and vulnerable species. Considered as one of the least studied bats in Europe, there is an urgent need to increase knowledge on its ecology to better protect it. For this reason, the EXEN team is investing in research on the Giant noctule by developing new methods. Using GPS technology in autumn 2017 and summer 2018, we were able to trace few consecutive night trips made by several individuals from a male population roosting in the Lot Valley. These information on bats are part of the first ones gathered from GPS data. Our data confirm the high mobility of the species and its ability to fly very high: one

of the bats spent 50% of its time at more than 800 meters above ground level reaching a maximum of 1,390 meters. By analysing their movements and flight heights by statistical tests and graphs, we made new discoveries about their activity zones and rhythms associated with their nocturnal behaviour. We showed that one of the bats seems to adapt its flight height during transit and use hovering flight during its supposed foraging time. The return flight path to the roost is more direct and faster than its transit/foraging flights. Our first results bring a progress in the fundamental knowledge of the species ecology. They raise also new questions on the reasons of these high flights, and the type of potential preys available so high at this period. As the flight characteristics vary considerably between individuals and nights, we consider new GPS tracking sessions in 2019 in order to better understand the activity and nocturnal behaviour of this mysterious species.

Vasenkov, D.A., Vasiliev, N.S., Sidorchuk, N.V., & Rozhnov, V.V. (2020). Use of GPS–GSM trackers in studying the biology of the Greater noctule *Nyctalus lasiopterus* in Russia. *Biology Bulletin*, 47(6), 699-705. Twenty-five individuals of the Greater noctule *Nyctalus lasiopterus* were caught and marked with rings during an inventory of bat fauna (Chiroptera, Mammalia) of Meshchera National Park (Vladimir region) in 2019. Twelve animals were additionally tagged with miniature GPS–GSM trackers. For the first time for Russia, night time flight durations (1.3–3.3 h, average of 2.6 h) and flight activity characteristics (maximum speed 39–58 km/h) of this rare bat species were obtained. The flight activity characteristics and the condition of animals recaptured in summer indicate that there is no significant negative impact of trackers on the condition and movement of the Greater noctule.

Vivar, R., Kelm, D., Nogueras, J., & Ibáñez, C. (2018). Factores que influyen en la hora de emergencia del Nóctulo grande (*Nyctalus lasiopterus*) en la Reserva Biológica de Doñana. 7th SECEMU Conference. Programme & abstracts, 26-27. We study the factors that influence the emergence behaviour of the colony of Greater noctule bat (*Nyctalus lasiopterus*) found in artificial roosts at the Doñana Biological Reserve (Huelva, Spain). The initial hypothesis is that energy requirements will influence each sex differently between seasons and meteorological variables will do so on a day-to-day basis. The emergence data was obtained from automatic receivers that record the entries and exits of the transponders with which the bats are marked, with a total of 139 individuals marked. We use the data between 1st January 2014 and 31st July 2018 and differentiate 5 phases each year: winter, gestation, lactation, dispersion and mating. The environmental variables tested were precipitation, temperature and

wind speed measured during at sunset and the area of flooded marshland. Through generalized mixed models, the possible relationships between emergence and the environmental variables, sex, seasons, years and flooding of the marshland were tested. The influence of environmental variables are as expected except temperature during the warmer months (lactation and dispersion) when the noctules delay emergence with high temperatures probably related to problems of hyperthermia and dehydration. The differences between sexes and seasons do not match our expectations. There are only differences between sexes at the time of dispersion when males emerge earlier, possibly due to the high energy requirements prior to mating. During lactation emergence is related to the level of flooding of the marshland. Once the marshland is in a process of desiccation emergence is delayed indicating that the noctules have an abundance of food and do not need to emerge earlier and risk being predated upon. The inter-annual fluctuations in marshland flooding can explain emergence times between years.

Vlaschenko, A., Kravchenko, K., Prylutska, A., Ivancheva, E., Sitnikova, E., & Mishin, A. (2016). Structure of summer bat assemblages in forests in European Russia. *Turkish Journal of Zoology*, 40(6), 876-893. We used mist-netting to study summer bat assemblages in three state nature biosphere reserves in the European part of Russia from 26 June to 29 July 2013: Oksky, Ryazan region (54°44'N, 40°54'E); Voronezhsky, Voronezh region (51°55'N, 39°38'E); and "Bryansky Les", Bryansk region (52°27'N, 33°53'E). The main research efforts were in locations where *Nyctalus lasiopterus* had been captured in the past. In total, 1229 specimens of 12 bat species (*Myotis daubentonii*, *M. dasycneme*, *M. brandtii*, *M. mystacinus*, *Nyctalus noctula*, *N. lasiopterus*, *N. leisleri*, *Eptesicus serotinus*, *Pipistrellus nathusii*, *P. pygmaeus*, *Vespertilio murinus*, and *Plecotus auritus*) were caught. *N. lasiopterus* (a female subadult) was confirmed only in the Voronezhsky Reserve. The bat assemblages could be classified as forest-dwelling and dominated by long-distance migratory species (genera *Nyctalus*, *Pipistrellus*, and *Vespertilio*). Females also dominated and breeding was recorded for most of the species. The highest bat abundance (b/h index: 4.54) was in the Voronezhsky Reserve (the most south-easterly location) and the lowest (b/h index: 1.75) was in "Bryansky Les" (the most south-westerly location). The Shannon-Wiener index was higher in the Voronezhsky and Oksky Reserves but the evenness index was similar for all reserves. Bat assemblage structure in strictly protected forest areas (such as the Voronezhsky Reserve) has been stable for decades.

Pipistrellus hanaki

Georgiakakis, P., Poursanidis, D., Kantzaridou, M., Kontogeorgos, G., & Russo, D. (2018). The importance of forest conservation for the survival of the range-restricted *Pipistrellus hanaki*, an endemic bat from Crete and Cyrenaica. *Mammalian Biology*, 93(1), 109-117. Mediterranean forests have been exploited by humans for centuries, but their present area and condition have been shaped mostly during the recent decades. Overgrazing resulting from national and EU policies, increasing fires and touristic development have led to the shrinkage of forest, threatening forest species. In this study, we examine the relation of *Pipistrellus hanaki*, a bat species limited to Cyrenaica, Libya and Crete, with the relict forests of Crete. Radiotracking of males (in autumn) and lactating females (in early summer) showed that *P. hanaki* uses a range of roost types, but *Quercus* forest stands and old tree cultivations are largely preferred for foraging, while open areas, young *Cupressus* stands and Mediterranean maquis are avoided. To unveil larger-scale patterns of habitat suitability by the species, we used Maxent to model its potential distribution on Crete using Chelsa Climatology. The resulted model showed high distribution probability around the mountains of central and western Crete, where native *Cupressus*, *Pinus* and *Quercus* stands are still present, and the climatic conditions are favourable. The strong dependence of this strictly southeast Mediterranean bat on forests and old tree cultivations stresses the need for conservation of these habitat types. In situ forest protection and environmental friendly livestock and farming practices are necessary to ensure the long-term survival of the species in Crete.

Pipistrellus maderensis

Ferreira, D.F., Gibb, R., López-Baucells, A., Nunes, N.J., Jones, K.E., & Rocha, R. (2022). Species-specific responses to land-use change in island insectivorous bats. *Journal for Nature Conservation*, 126177. Due to their ability to disperse over water, over half of the extant bat species occur on islands and ca. 25% of these are island endemics. They are often the sole native island mammals and play key roles in the maintenance of insular ecosystems. Yet, due to increasing anthropogenic pressures, ca. 60% of island-restricted bats are now threatened. The sub-tropical island of Madeira is home to the Macaronesian endemic *Pipistrellus maderensis*, to *Nyctalus leisleri verrucosus* - an endemic subspecies to Madeira - and *Plecotus austriacus*. These species each represent the three main foraging guilds of insectivorous bats namely, edge space foragers, open space foragers and narrow space foragers. Despite the great conservation value and potential to provide pest suppression services, little is

known about the habitat associations of Macaronesian bats. We used low-cost autonomous sensors to conduct an island-wide bioacoustic survey to investigate how Madeiran bats are affected by human-induced land-use change and orography. Overall we obtained >63,000 bat passes across 216 sites and at each site, we quantified land-use cover and altitude within a radius of 250, 500 and 1000 m. *Pipistrellus maderensis* was the most widespread and commonly recorded species, whereas *Plecotus austriacus* had the most restricted distribution and lowest number of detected bat passes. We found species-specific and scale-dependent responses to land-use cover, with the activity of *Pipistrellus maderensis* being positively associated with landscape-scale shrubland, cropland and Laurisilva (primary forest) cover, whereas the activity of *Nyctalus leisleri verrucosus* and *Plecotus austriacus* were negatively influenced by Laurisilva and cropland cover, respectively. Furthermore, we found that altitude had a negative effect on the activity of *Nyctalus leisleri verrucosus* and *Plecotus austriacus*. This study provides the first insights into the effects of land-use type on Madeiran bats and showcases the great potential of low-cost bioacoustic detectors for island-wide bat surveys.

Rainho, A. (2021). Positive Interactions Drive Bat Distribution in a Remote Oceanic Archipelago (Azores, Portugal). Diversity, 14(1), 17. One of the fundamental interests in ecology is understanding which factors drive species' distribution. We aimed to understand the drivers of bat distribution and co-occurrence patterns in a remote, insular system. The two bat species known to occur in the Azores archipelago were used as a model. Echolocation calls were recorded at 414 point-locations haphazardly distributed across the archipelago. Calls were analysed and assigned to each species. Binominal generalised linear models were adjusted using different descriptors at two scales: archipelago and island. The presence of the co-occurring species was included at both scales. The results show that island isolation, habitat and climate play an essential role on the archipelago and island scales, respectively. However, the positive interaction between bat species was the most critical driver of species' distribution at the island scale. This high co-occurrence pattern at the island scale may result from both species' maximising foraging profit in a region where prey abundance may be highly variable. However, further research is necessary to clarify the mechanisms behind this positive interaction. Both species are threatened and lack specific management and protection measures. Maintaining this positive interaction between the two species may prove to be fundamental for their conservation.

Myotis escalerae

Cruz, J., Sarmiento, P., Rydevik, G., Rebelo, H., & White, P.C.L. (2016). Bats like vintage: managing exotic eucalypt plantations for bat conservation in a Mediterranean landscape. *Animal Conservation*, 19(1), 53-64. The transformation of native habitats into forest plantations for industrial purposes frequently has negative consequences for biodiversity. We evaluated the impact of eucalypt plantations on native bats in a Mediterranean area, taking Portugal as a case study. We compared the overall bat activity, species richness and Kuhl's bat *Pipistrellus kuhlii* (the most abundant bat species in the area) activity between eucalypt plantations and native montado habitat, and examined the influence of stand, landscape and survey variables within plantations on the response variables. A set of 11 plantation stands, three landscape and two survey variables were employed as predictor variables using a zero-inflated Poisson generalized linear mixed model. Hawking and generalist bats of the genus *Pipistrellus* were the most frequently detected species. Bat activity, species richness and *P. kuhlii* activity were higher in native montado than in any of the eucalypt stands. Mature eucalypt plantations showed the highest bat activity, while clear-cut areas showed the lowest. Generally, within eucalypt stands, complex high-level vegetation structure, from the ground level up to 3 m high, and proximity to water points were associated with higher levels of bat and *P. kuhlii* activity and species richness. The results suggest that in order to promote bat diversity and activity in exotic eucalypt plantations in the Mediterranean region, it is important to provide a high density of water points, maintain plots of mature plantations and promote understorey clutter.

García-Ruiz, I., Machado, M., Monsalve, M.Á., & Monrós, J.S. (2017). Phenology of emergence by Mediterranean sympatric cave-dwelling bats during their breeding period. *Acta Chiropterologica*, 19(2), 357-365. The emergence of cave-dwelling bats can be influenced by multiple variables, such as diurnal predator evasion, energetic requirements, and prey abundance. This work aimed to determine emergence patterns of cave-dwelling bat species from roosts over the April–July 2013 period in the Valencian Community (East Spain) by infrared camera and acoustic recordings. We observed that *Miniopterus schreibersii* left earliest followed by the *Myotis myotis/blythii* group and *Myotis capaccinii* and finally *Myotis escalerae*. This pattern of emergence was observed in four roosts with no significant differences. *Miniopterus schreibersii* tended to display quicker flight in open areas, compared to the *Myotis* genus. Moreover, the *M. myotis/blythii* group and *M. capaccinii* were larger in size and had a greater wing loading than *M. escalerae*. Therefore, variations in emergence times may be due to differences

in predation pressure by diurnal and crepuscular predators, which would enable large and fast bats like *M. schreibersii* to leave earlier, and thus, perhaps take advantage of insect abundance peaks. Another finding was that bats in general left earlier in relation to sunset in summer (particularly in June) than in spring. Differences between months could be attributed to the presence of lactating females in May and June in the genus *Myotis*, which have higher energetic demands than other reproductive classes and may need to forage for a longer time or travel to further distances. Different results were obtained for *M. schreibersii*, indicating different ecological pressures for this species.

Herrera, J.M., Costa, P., Medinas, D., Marques, J.T., & Mira, A. (2015). Community composition and activity of insectivorous bats in Mediterranean olive farms. *Animal Conservation*, 18(6), 557-566. Olive (*Olea europaea* L.) farming is one of the most widespread agricultural practice throughout the Mediterranean basin. Current trends even predict an increase in land area devoted to olive farms as well as the intensification of farming practices. However, knowledge of the effects of olive farming on animal species still remains elusive and conservation and management guidelines for the relevant stakeholders are therefore urgently needed. Here, we investigate community composition and activity patterns of insectivorous bats in Mediterranean olive monocultures in Southern Portugal. Bats surveys were carried out in three types of olive farms representing increasing levels of management intensity: (1) traditional olive farms, managed with few or no chemical inputs or manual labour; (2) semi-intensive olive farms, which share certain characteristics with traditional plantations, but are more intensively managed; (3) intensive olive farms, which are managed with high and frequent chemical inputs, and highly mechanized systems. We found differences in species richness and activity levels between farming practices. Both the number of species and foraging activity declined with increasing management intensity. However, olive groves as a whole showed a lower number of species compared with the regional species pool and extremely low activity levels, suggesting that large and homogeneous olive monocultures may serve more as commuting areas than true foraging habitats for bats. To our knowledge, this is the first study explicitly demonstrating the pervasive impact of olive farming on the community composition and activity levels of insectivorous bats. In the face of an even-increasing proportion of land surface devoted to olive farming in Mediterranean landscapes, our findings are therefore of great concern. We suggest that increasing habitat heterogeneity would contribute to preserve the community composition and ecological functionality of insectivorous bats in extensive olive monocultures.

Novella-Fernandez, R., Ibañez, C., Juste, J., Clare, E.L., Doncaster, C.P., & Razgour, O. (2020). Trophic resource partitioning drives fine-scale coexistence in cryptic bat species. *Ecology and Evolution*, 10(24), 14122-14136. Understanding the processes that enable species coexistence has important implications for assessing how ecological systems will respond to global change. Morphology and functional similarity increase the potential for competition, and therefore, co-occurring morphologically similar but genetically unique species are a good model system for testing coexistence mechanisms. We used DNA metabarcoding and high-throughput sequencing to characterize for the first time the trophic ecology of two recently described cryptic bat species with parapatric ranges, *Myotis escaleraei* and *Myotis crypticus*. We collected faecal samples from allopatric and sympatric regions and from syntopic and allotopic locations within the sympatric region to describe the diets both taxonomically and functionally and compare prey consumption with prey availability. The two bat species had highly similar diets characterized by high arthropod diversity, particularly Lepidoptera, Diptera and Araneae, and a high proportion of prey that is not volant at night, which points to extensive use of gleaning. Diet overlap at the prey item level was lower in syntopic populations, supporting trophic shift under fine-scale co-occurrence. Furthermore, the diet of *M. escaleraei* had a marginally lower proportion of not nocturnally volant prey in syntopic populations, suggesting that the shift in diet may be driven by a change in foraging mode. Our findings suggest that fine-scale coexistence mechanisms can have implications for maintaining broad-scale diversity patterns. This study highlights the importance of including both allopatric and sympatric populations and choosing meaningful spatial scales for detecting ecological patterns. We conclude that a combination of high taxonomic resolution with a functional approach helps identify patterns of niche shift.

Novella-Fernandez, R., Juste, J., Ibañez, C., Noguerras, J., Osborne, P.E., & Razgour, O. (2022). The role of forest structure and composition in driving the distribution of bats in Mediterranean regions. *Scientific Reports*, 12(1), 1-11. Forests are key native habitats in temperate environments. While their structure and composition contribute to shaping local-scale community assembly, their role in driving larger-scale species distributions is understudied. We used detailed forest inventory data, an extensive dataset of occurrence records, and species distribution models integrated with a functional approach, to disentangle mechanistically how species-forest dependency processes drive the regional-scale distributions of nine forest specialist bats in a Mediterranean region in the south of Spain. The regional distribution patterns of forest bats were driven primarily by forest composition and structure rather than by

climate. Bat roosting ecology was a key trait explaining the strength of the bat-forest dependency relationships. Tree roosting bats were strongly associated with mature and heterogeneous forest with large trees (diameters > 425 mm). Conversely, and contrary to what local- scale studies show, our results did not support that flight-related traits (wing loading and aspect ratio) drive species distributional patterns. Mediterranean forests are expected to be severely impacted by climate change. This study highlights the utility of disentangling species-environment relationships mechanistically and stresses the need to account for species-forest dependency relationships when assessing the vulnerability of forest specialists towards climate change.