

INTRODUCTION

Bat forest species are considered among the most poorly known bat species in the Iberian Peninsula¹. The Iberian distribution range of these bat forest species is mostly drawn from isolated records, thus precluding a robust knowledge of their habitat preferences and current distribution. However, several recent studies have provided novel and extensive data for the Iberian northern populations²⁻²⁰, whereas the status of these species remains unknown in the southern half of the Iberian Peninsula and only some records have been reported^{3,6,21-24}. This study provides new locations of *Barbastella barbastellus*, *Myotis mystacinus*, *M. bechsteinii* and *Nyctalus leisleri* in the Iberian south-eastern, thus notably expanding the distribution range of these forest-specialist bat species in mainland Spain.

STUDY AREA

Bat surveys were conducted in mountain and riparian forests from north-western Murcia, south Albacete province (Castilla-La Mancha) and north Almería province (Andalucía; Fig. 1e). Landscape is dominated by mountainous areas (altitude range: 600-2050 m. a.s.l.) with scattered habitat patches devoted to rainfed agriculture and extensive cattle farming. Forests are mostly composed by pine (*Pinus nigra*, *P. pinaster*, *P. halepensis*) and some dominant Mediterranean scrubland species (i.e. *Quercus rotundifolia* and *Juniperus thurifera*), with a lower contribution of other broadleaf trees (i.e. *Q. faginea*, *Q. pyrenaica*, *Acer granatense* and *Corylus avellana*). In addition to these mountain forests, mature riparian forests also occur in the close vicinity of two main rivers (Mundo and Segura) and some small streams (Tus and other tributaries), and are mostly composed by *Populus sp.*, *Salix sp.*, *Fraxinus angustifolia* and *Ulmus minor*²⁵⁻²⁷. Furthermore, drinking troughs, artificial pools and other types of traditional small waterbodies are still abundant in the study area and they are managed by local people for farming or cattle-raising purposes.

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Between 2019 and 2021, a total of 66 sites were surveyed over the study area (Fig. 1e) in the framework of two ongoing bat research projects. These sites were surveyed through passive acoustic surveys ($n=75$, SM4BAT FS and Audiomoth), mist netting or harp trapping in small waterbodies ($n=50$), visual inspection of potential roosting sites ($n=21$) and infrared video cameras used at dusk in roosting sites ($n=3$, SONY FDR-AX700 connected to a Pettersson D230 detector).

FIG 2. Representative pictures of the main types of surveyed habitats in the Iberian southeast. Mist nets were usually placed over traditional small waterbodies (a), as well as along bat crossing areas in riparian forests (b).

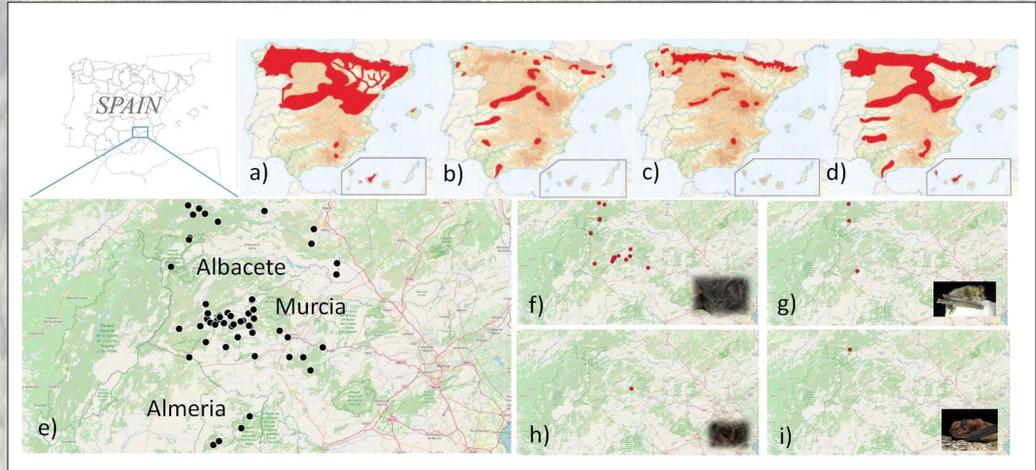
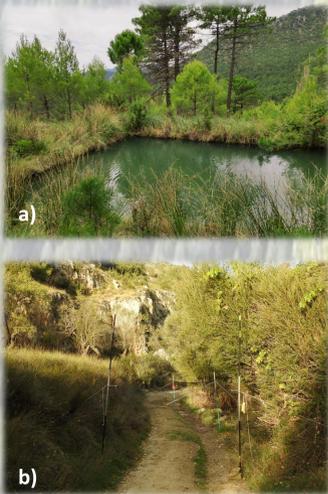


FIG 1. Map of the study area in the Iberian southeast and location of the surveyed sites. Above maps show the most recent distribution, previous to this study, for the four forest bat species (a: *B. barbastellus*; b: *M. bechsteinii*; c: *M. mystacinus*; d: *N. leisleri*); extracted from Guixé & Camprodon, 2018). Below maps show the location of the surveyed sites (e) and the new reported records for the four bat species (f: *B. barbastellus*, g: *M. bechsteinii*, h: *M. mystacinus*, i: *N. leisleri*).

RESULTS

We confirmed the presence of these four rare forest bat species in 20 locations from the Iberian south-eastern: 18 for *B. barbastellus*, three for *M. bechsteinii* and one for *M. mystacinus* and *N. leisleri* respectively (Table 1, Fig. 1f-i). During mist netting, we trapped 23 *B. barbastellus* belonging to both sexes and age classes (adult and juvenile), including seven lactating and post-lactating females, three *M. bechsteinii* (two adult males and a post-lactating female), two *M. mystacinus* (adult males) and one *N. leisleri* (adult male). The remaining reported records were provided through passive acoustic surveys for *B. barbastellus*, but also through direct observation of at least two bats belonging to that species.

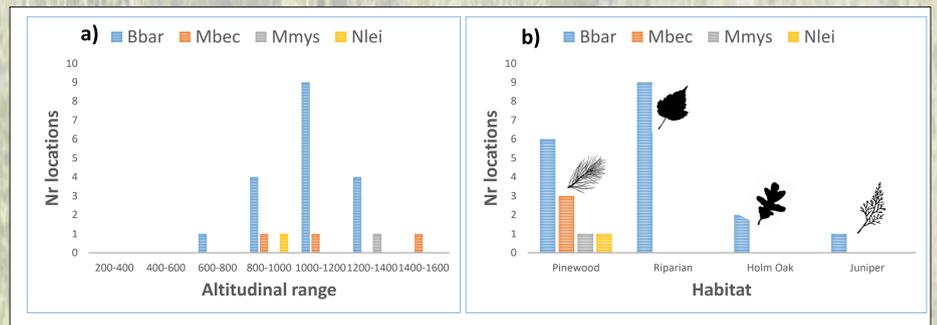


FIG 3. Distribution of the new records for *B. barbastellus* (Bbar), *M. bechsteinii* (Mbec), *M. mystacinus* (Mmys) and *N. leisleri* (Nlei) over an altitudinal range (a) and at different habitat types in the Iberian southeast.

Location	UTM Coordinates (30 S)	Altitude m.a.s.l.	Province	Habitat	Date	<i>Barbastella barbastellus</i>		<i>Nyctalus leisleri</i>		<i>Myotis bechsteinii</i>		<i>Myotis mystacinus</i>	
						Mist netting	Passive acoustic survey	Mist netting	Visual inspection	Mist netting	Mist netting	Mist netting	Mist netting
Vado del Tus	548983 4247108	820	Albacete	<i>Pinus pinaster</i>	29/11/2019- 17/5/2019		X						
Arroyo Tercero 1	569606 4226531	1.081	Murcia	<i>Populus nigra italica</i>	09/08/2019 14/08/2019		X						
Fuente de los Almeceas	567733 4222789	1.084	Murcia	<i>Celtis australis</i> <i>Juglans regia</i> <i>Quercus rotundifolia</i>	07/09/2019		X						
Rincón de los Huertos	583201 4233553	1.260	Murcia	<i>Quercus rotundifolia</i>	08/09/2019		X						
Cerro del Castellar	569682 4225932	1.165	Murcia	<i>Pinus halepensis</i> <i>Pinus nigra</i>	09/09/2019		X						
Arroyo Tercero 2	568731 4225997	1.079	Murcia	<i>Salix purpurea</i> <i>Salix eleagnos</i> <i>Juglans regia</i>	10/09/2019		X						
Molino de los Tormos	582816 4227596	1.037	Murcia	<i>Populus canescens</i>	10/09/2019		X		1				
Rambal de la Rogativa 1	568429 4224645	1.026	Murcia	<i>Populus nigra italica</i> <i>Juglans regia</i>	13/10/2019	1 male	X						
Rambal de la Rogativa 2	568544 4224505	1.044	Murcia	<i>Populus nigra italica</i> <i>Juglans regia</i>	10/09/2019		X						
Río Taibilla 1	552569 4220881	1.240	Albacete	<i>Populus sp.</i> <i>Quercus rotundifolia</i>	24/07/2020		X						
Río Taibilla 2	552555 4220816	1.240	Albacete	<i>Populus sp.</i> <i>Quercus rotundifolia</i>	24/07/2020	1 male	X						
Balsa de la Guitarra	556429 4258616	986	Albacete	<i>Pinus nigra</i> <i>Acer sp.</i> <i>Quercus rotundifolia</i>	27/07/2020 7 female 3 indet. 14/08/2021	5 male 7 female 3 indet. 1 male 2 female	X				1 male	1 male	
Arroyo de la Celadilla	556732 4259384	926	Albacete	<i>Pinus nigra</i> <i>Acer sp.</i> <i>Quercus rotundifolia</i>	27/07/2020		X						
Calar de la Santa	572975 4227775	1.218	Murcia	<i>Juniperus thurifera</i>	28/07/2020		X						
Cortijo de Quirante	584073 4225458	1.273	Murcia	<i>Pinus pinaster</i> <i>Quercus rotundifolia</i>	28/07/2020								2 male
Fuente Mellinas	579485 4224511	1.195	Murcia	<i>Populus nigra</i> <i>Populus alba</i> <i>Pinus pinaster</i>	30/07/2020 3/08/2021	2 female							
El Estanque	555975 4273057	1.126	Albacete	<i>Pinus pinaster</i>	01/08/2020	1 male						1 female	
Puerto Hondo	563876 4215296	1.427	Murcia	<i>Pinus nigra</i> <i>Populus sp.</i>	15/08/2020							1 male	
Río Madera	560595 4271765	987	Albacete	<i>Populus sp.</i> <i>Fraxinus sp.</i>	23/08/2020		X						
Fuentes del Marqués	598392 4217680	640	Murcia	<i>Platanus sp.</i> <i>Populus sp.</i>	05/04/2021				1				

TABLE 1. List of the new locations for the four study bat species in the Iberian southeast. Coordinates, altitude, province and main habitat types are provided for each record, as well as the sampling method through which the bat species were detected. For direct sampling methods (mist netting and visual inspection) bat counts and sex-ratio are provided.

DISCUSSION

These four bats are forest species particularly scarce and understudied in the Iberian Peninsula. Their current distribution is restricted to mature forests of mountainous areas from the Iberian northern half (Fig. 1a-1d), though isolated populations are also known for the southern regions⁶. In our case, an increased survey effort in non-prospect potential areas and the application of combined sampling methods allowed us to eventually detect these rare forest bat species (Fig. 2a-b). To our knowledge, these records comprise the first data of these species for the Region of Murcia and among the first for Albacete province, and they contribute to expand northward and eastward the distribution range from the Andalusian populations in Cazorla, Segura and Castril (spatially connected with the study area²⁹). Moreover, *B. barbastellus* recently cited in Fuentes del Marqués (Table 1), is now the distribution range eastern limit of its Iberian southern populations. Captures of post-lactating females and juveniles from mist netting suggest the breeding status of *B. barbastellus* and *M. bechsteinii* in the study area.

The altitudinal range of these new records (Fig. 3a) is similar to the observed pattern in other regions of the Iberian Peninsula. *M. mystacinus* occurs at altitudes higher than 900 m in Mediterranean areas³⁰ and our records for *M. bechsteinii* are close to the higher altitude limit reported for that species^{24,31-34}. Additional inferences in relation to *N. leisleri*, detected elsewhere between sea level and 2150, are precluded by the limited data. According to previous studies³⁵, *B. barbastellus* was detected in a wide altitudinal range. Our observations meet also the habitat preferences described for these bat species in other regions of the Iberian Peninsula^{30,32,35,36}, occurring in mature forests dominated by broadleaf tree -but also pine- species from mountainous areas. Pine forests comprised the habitat type with higher values of frequency of occurrence for the study bat species (Fig. 3b), which is probably due to the great landscape surface occupied by this habitat type over the study area. Because of riparian forests are naturally scarce in the study area, old poplar plantations (*Populus sp.*) could provide suitable roosting sites for these forest-specialist bat species in the study area^{36,37}. Furthermore, our results suggest that small waterbodies act as key landscape elements for bat communities in semiarid regions, as well as bat surveys over these isolated habitats could be used to improve bat inventories and increase species detectability.

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BIBLIOGRAPHY 1. Guixé, D. & Roca, E. 2018. Quilómetros arborícolas o espejismos forestales. Pg. 41-85. En: Guixé, D. y Camprodon, J. (Eds.). Manual de conservación y seguimiento de los quilómetros forestales. Organismo Autónomo Parques Nacionales, Ministerio para la Transición Ecológica. Madrid, 2. Benav, J., Aguiló, S. & García, C. 2001. El patrón de distribución del morfológico de los bosques (Barbastella barbastellus) en España y la posible influencia de la diversidad alimentaria. Ecología, 13: 383-372. 3. Castro, J. A. & Rodríguez, J. 2002. Nueva cita para Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en el Sureste Ibérico. Biogeografía, 19: 24-24. 4. Castro, J. A., Barja, M., Chaves, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia cita de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en Sierra Nevada (Granada, España). Acta Oecologica, 47: 57-61. 5. Aguirre-Merino, T. & Balboa, C. 2002. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 6. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 7. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 8. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 9. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 10. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 11. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 12. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 13. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 14. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 15. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 16. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 17. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 18. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 19. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 20. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 21. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 22. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 23. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 24. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 25. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 26. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 27. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 28. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 29. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 30. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 31. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 32. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 33. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 34. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 35. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 36. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24. 37. Benav, J., Aguiló, S., Ferreras, E., Vázquez, O., López-Sánchez, E., Serrano, V. & Acosta, J. 2006. Presencia de Barbastella barbastellus (Schreber, 1774) (Chiroptera, Vespertilionidae) en la Comunidad Autónoma de la Región de Murcia. Biogeografía, 19: 24-24.