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## Distribution of the Cabrera water shrew (*Neomys anomalus*) in Northeastern Spain

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### Abstract

This study deals with the range of the Cabrera water shrew (*Neomys anomalus*) in the northeast Iberian peninsula and the ecological factors that may determine its distribution. Information is provided on 26 new sites, including the first records of the species on the southern slope of the Pyrenees. In these mountains, where the water shrew (*Neomys fodians*) lives, the Cabrera water shrew (*N. anomalus*) was found at high altitudes and also below the range occupied by the former species. In the remainder of the study area its distribution seems to be conditioned by the hydrographic network characteristics, showing mediterranean preferences.

### Introduction

The geographical distribution of the Cabrera water shrew in the Iberian peninsula has not been thoroughly studied. Although a number of references suggest a widespread range (FAUS 1991), in the NE Iberian peninsula this species has been found only occasionally, perhaps due to its scarcity or low detectability through sampling methods (LÓPEZ-FUSTER et al. 1992). Its distribution and ecological requirements have been supposed on the basis of a small number of locations (GOSÁLBEZ 1987; JIMÉNEZ et al. 1989; FAUS 1991), or generalization from extensive data of this species over the entire range of its European distribution (SPITZENBERGER 1990). The aim of this study was to describe these aspects in greater detail, by analysing both information on new and previously known locations.

### Material and methods

The study was carried out in the autonomous regions of Aragón, Catalonia and in the province of Castellón. The altitude of the regions studied ranged from sea level to 3404 m above sea level. There are six bioclimatic zones belonging to the Eurosiberian and Mediterranean regions (RIVAS-MARTÍNEZ 1983). Therefore, almost all the climatic and ecological characteristics of the Iberian peninsula can be found in the study area. Figure 1 shows the principal geographic characteristics of the study area.

A review of the literature revealed 46 reports of the Cabrera water shrew from 24 locations (MILLER 1912; NADAL and PALAUS 1967; GARZÓN et al. 1971; SANS-COMA 1973; VERICAD and MEYLAN 1973; GONZÁLEZ 1975; PELAYO 1979; GOSÁLBEZ et al. 1985; RUBIO 1985; ARRIZABALAGA et al. 1986; GOSÁLBEZ 1987; JIMÉNEZ et al. 1989; SPITZENBERGER 1990; FAUS 1991; LÓPEZ-FUSTER et al. 1992; TORRE et al. 1992).

Our prospections were centred on wide areas where the presence of this species was unknown. The analysis of barn owl (*Tyto alba*) pellets collected from 1985 to 1992 provided 15,486 small-mammal preys from 33 different sites in the Ebro depression. Specimens were also captured at three different sites: Alt Aneu (Pyrenees), by placing 100 mouse traps for four days (December 1987) along the Noguera Pallaresa river and in alpine meadows; Híjar (Ebro depression), with the same number of mouse traps for three days (February 1988) along the Martín riverside and some irrigation channels; Ateca (on the Iberian range spurs), using 75 "pitfall" mouse traps at the Manubles riverside for 6 days (March 1990). We also obtained information about the species from two nature magazines and by interviewing some specialists working on small mammals in the study area.

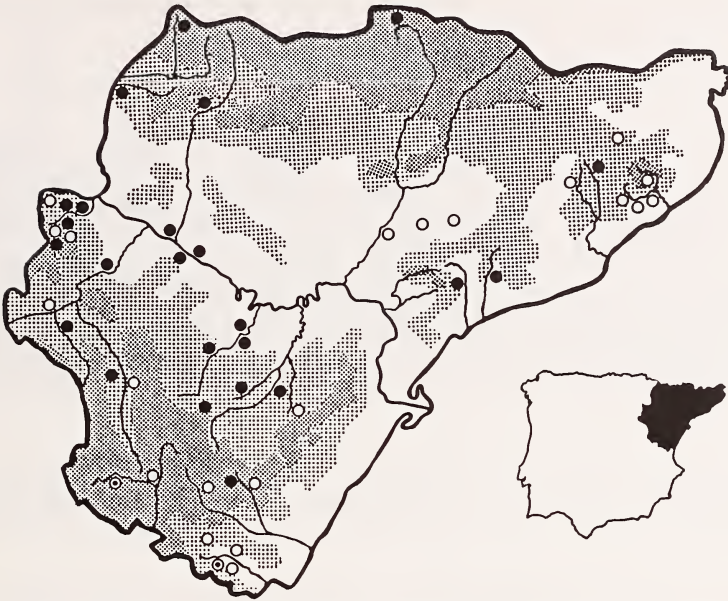


Fig. 1. Orography, hydrographic basins, location of the study area and sites where *Neomys anomalus* were recorded (Black circles = new localities; white circles = localities cited in literature; lightly dotted area = > 500 m.a.s.l.; densely dotted area = > 1000 m.a.s.l.)

Those Cabrera water shrews trapped or found dead were identified by morphological characteristics (CABRERA 1914; SPITZENBERGER 1990). The skulls found in the pellets were identified using the discriminant formula given by BÜHLER (1964). The skulls obtained by collaborators have also been determined by us. Reports of observations of live water shrews were only considered if the informant was an experienced person.

From each location we recorded the altitude above sea level, river flow, rainfall and annual average temperature (FORTEZA 1985; LEÓN et al. 1987; M.O.P.U. 1988; BOSQUE and VILA 1992). We have only treated the number of localities because there is a narrow relation between number of localities and number of *Neomys anomalus* for every variable considered: altitude ( $r = 0.94$ ,  $p < 0.001$ ), temperature ( $r = 0.97$ ,  $p < 0.001$ ), rainfall ( $r = 0.95$ ,  $p < 0.0001$ ), and water flow ( $r = 0.95$ ,  $p < 0.002$ ). Since every sampling method itself provides little information about the species (LÓPEZ-FUSTER et al. 1992) we treated all localities together. The results obtained may correspond to a biased sample, but could be considered as an approximation of the real ranges occupied by this species.

## Results and discussion

The presence of *Neomys anomalus* was recorded at 26 new sites and two previous ones. We found 45 animals, added to those already described in the literature, totals 91 Cabrera water shrews, belonging to 50 different sites in the NE of the Iberian peninsula. Figure 1 shows the situation of records of *Neomys anomalus* in the study area, and the table provides details on records sites, altitude, associated rivers, and number as well as origin of *Neomys anomalus*.

With regard to the altitude (Fig. 2A), the species was irregularly distributed between 180 and 1,850 m.a.s.l., but most of the records were made below 1,000 m (96%), in contrast with its preference for highlands in central Europe (FONS et al. 1980; VAN LAAR 1983; TABERLET 1984). The species was also found at variable river flows (Fig. 2B), from rivers with less than 2 m<sup>3</sup>/s to the Ebro river (261 m<sup>3</sup>/s), suggesting that its presence was

Sampling sites, altitude, associated river, number and origin of *Neomys anomalus*

Locality	U.T.M.	Altitude	Hydrographic basin	Nº <i>Neomys</i>	Source	Authors
Zorita del Maest. (CS)	30TYL3912	662	Bergantes	2	PE	FAUS (1991)
Villahermosa Río (CS)	30TYK1855	780	Villahermosa	1	OB	JIMÉNEZ et al. (1989)
Jérica (CS)	30TYK0919	420	Palancia	1	FD	JIMÉNEZ et al. (1989)
Teresa (CS)	30TYK0019	636	Palancia	1	OB	JIMÉNEZ et al. (1989)
Teresa (CS)	30TYK0019	636	Palancia	1	PE	JIMÉNEZ et al. (1989)
Bejis (CS)	30TXK9620	800	Palancia	1	OB	JIMÉNEZ et al. (1989)
Bejis (CS)	30TXK9620	800	Palancia	2	OB	J. VERDEJO (pers. com.)
Barracas (CS)	30TXK9632	981	—	2	TR	MILLER (1912)
Mora de Rubielos (TE)	30TXK9158	1030	Mora (Mijares)	1	TR	GARZÓN et al. (1971)
Mora de Rubielos (TE)	30TXK9158	1030	Mora (Mijares)	1	PE	GONZÁLEZ (1975)
Albarracín (TE)	30TXK3174	1100	Guadalaviar	2	TR	VERICAD and MEYLAN (1973)
Albarracín (TE)	30TXK3174	1140	Guadalaviar	1	OB	J. VERDEJO (pers. com.)
Turol (TE)	30TXK5968	870	Guadalaviar	1	OB	JIMÉNEZ et al. (1989)
Linares de Mora (TE)	30TYK0765	1220	Linares	1	OB	J. VERDEJO (pers. com.)
Linares de Mora (TE)	30TYK0764	1180	Linares	1	OB	J. VERDEJO (pers. com.)
Hijar (TE)	30TYL1663	230	Martin	4	PE	(this study)
Albalate del A. (TE)	30TYL0751	400	Martin	1	TR	J. I. PINO (pers. com.)
Albalate del A. (TE)	30TYL0448	400	Martin	1	PE	GOSÁLBEZ et al. (unpubl.)
Mas de las Matas (TE)	30TYL3224	494	Guadalope	1	PE	GOSÁLBEZ et al. (unpubl.)
Berge (TE)	30TYL1626	719	Guadalopillo	3	PE	GOSÁLBEZ et al. (unpubl.)
Cañizar del O. (TE)	30TXL9919	950	Estercuel	1	FD	L. BOLEA (pers. com.)
Sos del Rey C. (Z)	30TXN4606	654	Onsella	1	PE	J. M. SÁNCHEZ (pers. com.)
Ateca (Z)	30TXL0176	608	Jalón	7	PE	TORRE et al. (1992)
Ricla (Z)	30TXL0707	377	Jalón	1	PE	J. M. SÁNCHEZ (pers. com.)
Gallocanta (Z)	30TXL3042	1000	—	9	PE	BURGUETE and GUIRAL (unpubl.)
Gallocanta (Z)	30TXL3042	1000	—	1	PE	V. PEDROGCHI (pers. com.)
Calamocha (Z)	30TXL4333	880	Jiloca	1	OB	JIMÉNEZ et al. (1989)
Monasterio Piedra (Z)	30TXL0261	800	Piedra	1	OB	J. M. SÁNCHEZ (pers. com.)
Monasterio Piedra (Z)	30TXL0261	800	Piedra	1	OB	J. GUIRAL (pers. com.)
La Alfranca (Z)	30TXM8608	180	Ebro	1	OB	F. HERNÁNDEZ (pers. com.)
La Alfranca (Z)	30TXM8608	180	Ebro	1	OB	F. HERNÁNDEZ (pers. com.)
La Cartuja (Z)	30TXM8108	180	Ebro	1	OB	F. HERNÁNDEZ (pers. com.)
Juslibol (Z)	30TXM3042	180	Ebro	1	OB	F. HERNÁNDEZ (pers. com.)
Tarazona (Z)	30TXM0540	480	Queiles	1	TR	LÓPEZ-FUSTER et al. (1992)
Agón (Z)	30TXM2736	310	Huecha	1	FD	E. PELAYO (pers. com.)

Borja (Z)	30TXM2131	455	Huecha	1	OB	E. PELAYO (pers. com.)
Talamantes (Z)	30TXM0919	1000	Valdetriviño	1	OB	PELAYO (1979)
Talamantes (Z)	30TXM0920	880	Valdetriviño	1	OB	PELAYO (1979)
Añón (Z)	30TXM0225	1300	Morca (Huecha)	1	OB	J. M. SÁNCHEZ (pers. com.)
Añón (Z)	30TXM0626	836	Huecha	1	TR	LÓPEZ-FUSTER et al. (1992)
Alcalá de Moncayo (Z)	30TXM0827	766	Huecha	2	PE	ARRIZABALAGA and MONTAGUD (unpubl.)
Pard. Bataragüá (H)	30TXN9600	650	—	1	PE	J. GURRAL (pers. com.)
Ansó (H)	30TXM8350	1660	Alpine meadows	1	FD	J. L. RIVAS (pers. com.)
Leida (L)	32TCG0210	223	Segre	9	TR	MILLER (1912)
Mollerussa (L)	31TCG2410	246	Urgell channel (Segre)	2	PE	NADAL and PALAUS (1967)
E. de Montcortés (L)	31TCG1952	450	—	?	?	SPITZENBERGER (1990)
Alt Aneu (L)	31TCH4336	1850	Alpine meadows	1	FD	(this study)
La Riba-Vilavert (T)	31TCF4575	390	Francolí	1	OB	R. R. JARILLO (pers. com.)
Sa Perpetua de G. (T)	31TCF9066	500	Gaigà	1	TR	J. A. REGY (pers. com.)
S. M. Palautordera (B)	31TDG5214	260	Tordera	3	PE	ARRIZABALAGA et al. (1986)
Campins (B)	31TDG5418	260	Tordera	1	PE	ARRIZABALAGA et al. (1986)
Cànoves (B)	31TDG4616	344	Torrent Valformis	1	OB	RUBIO (1985)
Castellterçol (B)	31TDG2622	726	Tenes (Besós)	1	PE	SANS-COMA (1973)
Ayguafreda (B)	31TDG3724	406	Martinet (Congost)	1	TR	R. MARGALEF jr. (pers. com.)
S. Bartomeu del G. (B)	31TDG6321	900	—	1	PE	GOSÁLBEZ et al. (1985)
Arbúcies (G)	31TDG5929	295	Riera de Arbúcies	2	PE	SANS-COMA (1973)

Provinces: CS = Castellón; TE = Teruel; Z = Zaragoza; H = Huesca; L = Lleida; T = Tarragona; B = Barcelona; G = Girona. Source: PE = barn owl pellets; OB: observation; TR = trapped; FD = found dead.

not conditioned by water flow. As has been stated before (AMORES 1975; GOSÁLBEZ 1987; SPITZENBERGER 1990), the Cabrera water shrew lives distant from the streams, its distribution perhaps being favoured by the presence of irrigation channels (CORTES and GIL 1984). The Cabrera water shrew evidently has a wide climatic range (Fig. 2C, D), showing clear mediterranean trends: annual average temperatures were between 10 and 16°C for 90 % of the sites, and rainfall was lower than 800 mm in 92 % of the sites. The rainfall index does not constrain its distribution; these results are in contrast to those observed by TRIANO (1985) in SW Spain. Our results agree with those found by GONZÁLEZ and ROMÁN (1988) in the province of Burgos.

Concerning its geographical distribution, CABRERA (1914) pointed out its presence in the Spanish Pyrennes, but the lack of evidence available for this statement shed some doubts on its authenticity. Later researchers (e.g. VERICAD 1970; SANS-COMA and MARGALEF 1981; GIL et al. 1986; MORENO and BARBOSA 1992) did not find this species in these mountains, and a recent review (SPITZENBERGER 1990) did not consider the presence of the Cabrera water shrew in the Spanish Pyrenees. We provide the first confirmed records for their presence here. These may suggest a low density distribution along the axial Pyrenees, where the species may occupy alpine meadows far from streams over 1,600–1,800 m.a.s.l., and streams of the Prepyrenean foothills below 1,000 m.a.s.l. This distribution could be conditioned by the presence of the water shrew (*Neomys fodiens*), which lives in this area over 900–1,000 m.a.s.l. (GOSÁLBEZ 1987), as a result of the altitudinal and habitat

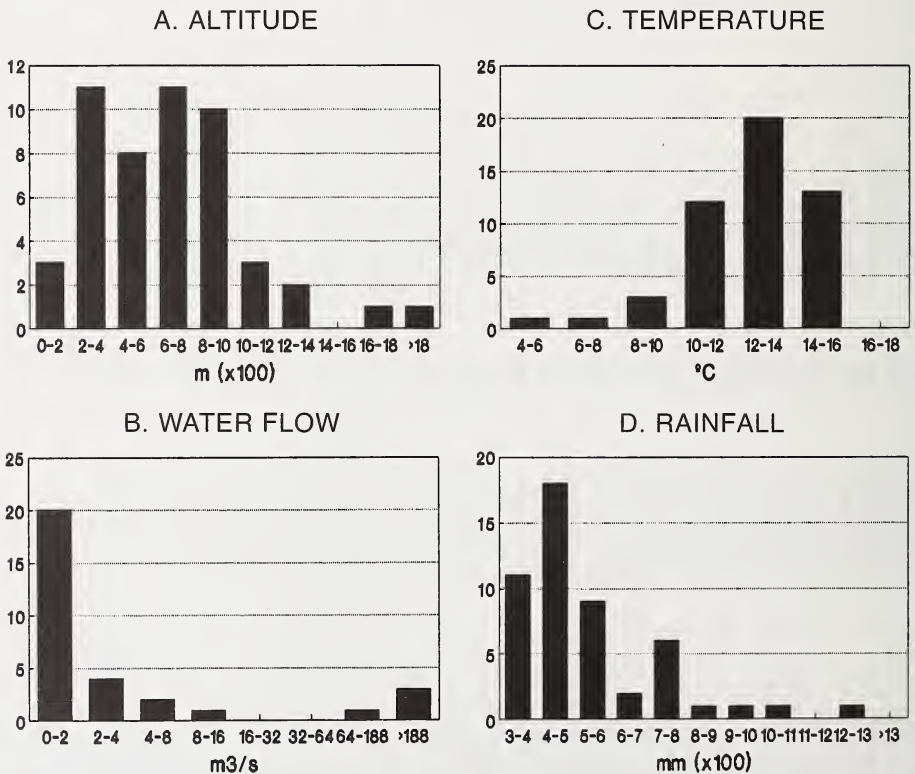


Fig. 2. Frequency of distribution of the localities where *Neomys anomalus* was found according to altitude (A), river water flow of the nearest station to the site of sampling (B), annual average temperature (C), and rainfall (D)

segregation sometimes reported between both species (SPITZENBERGER 1990). Otherwise, the information recorded is insufficient to confirm this hypothesis, more detailed studies being required about the species in the Pyrenees. In the remainder of the study area, where *N. fodiens* is absent, *N. anomalus* is widely distributed along the Iberian range, most probably reaching the arid regions of the Ebro depression through the river systems. The presence of the Cabrera water shrew in two separated centres of the Catalan range confirms its distribution along these mountains, discussed by JIMÉNEZ et al. (1989) and FAUS (1991), but we were unable to determine whether a continuity exists from the Iberian range to the Pyrenees through the Catalan range.

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### Zusammenfassung

#### *Verbreitung der Sumpfspitzmaus (Neomys anomalus) im Nordosten Spaniens*

Beschrieben werden die Verbreitung der Sumpfspitzmaus im Nordosten Spaniens sowie die ökologischen Faktoren, die ihr Verbreitungsgebiet bestimmen. Wir informieren über 26 neue Fundorte.

Auf der Südseite der Pyrenäen, wo die Sumpfspitzmaus zum ersten Male gefunden wurde, lebt die Art auf alpinem Grasland, wahrscheinlich aufgrund einer Kompetenzbeziehung zu *N. fodiens*. Im restlichen Studiengebiet, wo *Neomys fodiens* nicht auftritt, findet man die Sumpfspitzmaus in verschiedenen Klima- und Höhenlagen, obwohl mediterrane Umgebungen bevorzugt werden. Die Sumpfspitzmaus findet man in den axialen Pyrenäen, im Ebrotalkessel und der Umgebung der iberischen Gebirgskette. Noch ist nicht klar, ob *N. anomalus* vom Küstengebirge bis in die östlichen französischen Pyrenäen eine zusammenhängende Verbreitung aufweist. Die Anwesenheit der Sumpfspitzmaus wird andererseits von dem hydrographischen Netz bestimmt. Die Spitzmaus breitet sich über Ströme und Bewässerungskanäle aus und erreicht mitunter Trockenbiotope, die aber immer feuchte Mikrohabitate aufweisen.

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